United States Environmental Protection Agency
Office Of Air Quality Planning And Standards Research Triangle Park, NC 27711
EPA-454/R-00-030 April 2001

Air

HOT MIX ASPHALT PLANTS STAKEHOLDERS OPINIONS REPORT

This Page is intentionally left blank.

EPA-454/R-00-030

HOT MIX ASPHALT PLANTS

STAKEHOLDERS OPINIONS REPORT

This document was prepared by:

Emissions Monitoring and Analysis Division
Office of Air Quality Planning and Standards
United States Environmental Protection Agency
Research Triangle Park, NC

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

April 2001

DISCLAIMER

This report has been reviewed by the Emissions Monitoring and Analysis Division of the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, and has been approved for publication. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use.

PREFACE

This report was produced by the Source Measurement Technology Group of EPA's Emissions Measurement Center located in Research Triangle Park, NC. It is one of a series of twelve reports prepared to document an EPA program to characterize emissions to the air from hot mix asphalt plants. These twelve reports and their associated EPA document numbers and publication dates are:

Document Title	EPA Document Number	Publication Date
Hot Mix Asphalt Plants Emission Assessment Report	EPA 454/R-00-019	December 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Instrumental Methods Testing Asphalt Plant A, Cary, North Carolina	EPA 454/R-00-020	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Manual Methods Testing Asphalt Plant A, Cary, North Carolina		
Volume 1 of 2	EPA 454/R-00-021a	April 2000
Volume 2 of 2	EPA 454/R-00-021b	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Instrumental Methods Testing Asphalt Plant B, Clayton, North Carolina	EPA 454/R-00-022	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Manual Methods Testing Asphalt Plant B, Clayton, North Carolina		
Volume 1 of 2	EPA 454/R-00-023a	April 2000
Volume 2 of 2	EPA 454/R-00-023b	April 2000
Hot Mix Asphalt Plants Truck Loading and Silo Filling Instrumental Methods Testing Asphalt Plant C, Los Angeles, California	EPA 454/R-00-024	May 2000
Hot Mix Asphalt Plants Truck Loading and Silo Filling Manual Methods Testing Asphalt Plant C, Los Angeles, California		
Volume 1 of 8	EPA 454/R-00-025a	May 2000
Volume 2 of 8	EPA 454/R-00-025b	May 2000
Volume 3 of 8	EPA 454/R-00-025c	May 2000
Volume 4 of 8	EPA 454/R-00-025d	May 2000
Volume 5 of 8	EPA 454/R-00-025e	May 2000
Volume 6 of 8	EPA 454/R-00-025f	May 2000
Volume 7 of 8	EPA 454/R-00-025g	May 2000
Volume 8 of 8	EPA 454/R-00-025h	May 2000
Hot Mix Asphalt Plants Technical Systems Audit of Testing at Asphalt Plant C Asphalt Plant C, Los Angeles, California	EPA 454/R-00-026	May 2000

Document Title	EPA Document Number	Publication Date
Hot Mix Asphalt Plants Truck Loading Instrumental Methods Testing Asphalt Plant D, Barre, Massachusetts	EPA 454/R-00-027	May 2000
Hot Mix Asphalt Plants Truck Loading Manual Methods Testing Asphalt Plant D, Barre, Massachusetts	EPA 454/R-00-028	May 2000
Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D	EPA 454/R-00-029	May 2000
Hot Mix Asphalt Plants Stakeholders Opinions Report	EPA 454/R-00-030	April 2001

These documents, including this Stakeholders Opinions Report document, are available for downloading, on CD-ROM and in paper.

Downloads can be made from:

http//www.epa.gov/ttn/emc/asphalt.html

Copies of the CD ROM can be requested by mail at:

Emission Measurement Center, MD-19
US Environmental Protection Agency
Research Triangle Park, NC 27711

Paper copies of the reports can be obtained from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone orders 1-800-553-6847 or (703) 605-6000; FAX orders (703) 605-6900
http://www.ntis.gov/products/environment.htm

ACKNOWLEDGMENTS

Many individuals contributed to the development of this report. Ron Myers of the Emission Measurement Center's Source Measurement Technology Group of the Emissions Monitoring and Analysis Division, Roy Smith of the Risk and Exposure Assessment Group of the Emissions Standard Division and Gary Foureman of the National Center for Environmental Assessment of the Office of Research and Development are the primary authors of the report. Bob McConnell of EPA's Region I office, David Mobley, Acting Director of EPA's Emissions Monitoring and Analysis Division, Bill Lamason, Mike Toney, Gary McAlister, and Candace Sorrell of EPA's Emission Measurement Center, Ron Ryan and Dennis Beauregard of EPA's Emission Factor and Inventory Group, Laura Autry of EPA's Air Quality Trends Analysis Group, Jim Crowder and Mary Johnston of the Minerals and Inorganic Chemicals Group of the Emissions Standard Division participated in the review.

This Page is intentionally left blank.

Contents

This Page is intentionally left blank.

STAKEHOLDERS OPINIONS REPORT

Chapter 1

1.0 Project Background

This is the last in a series of EPA reports that document the development of methods to estimate emissions from hot mix asphalt plants. The primary purpose of this report is to publish the opinions of the stakeholders on the final "Hot Mix Asphalt Plants - Emissions Assessment Report." The stakeholders involved in the processes leading up to the publication of the Emissions Assessment Report include national and State legislators, State and local environmental and health agencies, national and regional industry associations, citizen public interest groups and industry technical consultants. As an adjunct to the opinions of the stakeholders on the final Emissions Assessment Report, this report includes EPA's responses to stakeholder issues that had not been documented previously or that EPA believes require additional clarification. Additionally, the stakeholder comments on the draft Emission Assessment Report and EPA's responses to these comments are included to round out the stakeholder opinions and EPA's assessment of the technical issues being raised.

The final "Hot Mix Asphalt Plants - Emissions Assessment Report" was published in December 2000. This report contains EPA's final emissions estimates from the two hypothetical facilities of average production using the two predominant US production methods. This report also includes the revised AP-42 section, the revised AP-42 background report and the July 1996 Emission Inventory Improvement Program (EIIP) report for hot mix asphalt plants. The AP-42 section contains the final emission estimation methods and the background report provides detailed information on the development of these emission estimation methods. Additionally, the background report contains summary information from all reference material (including more than 350 emission tests) used in the development of the emission estimation methods. The 1996 EIIP report describes preferred and alternative emission estimation techniques and provides concise example calculations to aid in the preparation of emission inventories.

The Emissions Assessment Report presents a comprehensive inventory with respect to the emission sources characterized and the pollutants addressed. The emission sources characterized include the kiln stack, hot mix asphalt (HMA) storage silo, truck load-out, hot asphalt storage tank, hot asphalt storage tank heater, aggregate handling, RAP crushing, diesel exhaust, and road dust. For each of these sources, the emissions data presented address the criteria pollutants (PM, VOC, CO, SO_2 and NO_x) and many of the Clean Air Act hazardous air pollutants (19 PAH compounds, 27 volatile HAP compounds and 10 HAP metals). While most of the emission estimates were based upon methodologies presented in the AP-42 section for hot mix asphalt plants, some emission estimates were based upon methodologies in other AP-42 sections (material handling, road dust and mobile sources) or journal articles (mobile source HAPs).

Emissions characterization data from three separate projects were utilized in drafting the Emissions Assessment Report. Although each of the projects involved characterizing air emissions from hot mix asphalt plants, each had a somewhat different goal. The goal of one project was to obtain and use existing emissions test data from State and local air pollution control agencies to improve AP-42 emission factors for hot mix asphalt plants. The second project was undertaken to determine whether there were any previously unidentified kiln stack HAP emissions and, if such were present, to quantify these emissions.

The third project was designed to characterize the fugitive emissions resulting from silo filling and transport truck loading operations.

Chapter 2

2.0 EPA Response to Stakeholder Opinions

This chapter presents EPA's responses to the stakeholder opinions presented in Chapter 3 of this report. For the purposes of brevity, a detailed response to all issues raised by stakeholders was not prepared. However, each major issue cited by a stakeholder has been thoroughly evaluated and a brief response is presented. For issues where there is previous documentation of the issue including EPA's evaluation and response, the reader is referred to the appropriate section(s) in the prior report(s).

2.1 Response to opinions of Wisconsin Department of Natural Resources

EPA agrees with Wisconsin's point that the development of the additional technical information that was presented in the Emissions Assessment Report was an ambitious project. Additionally, EPA reviewed the guidance for emission inventories for hot mix asphalt submitted with Wisconsin's opinion and will forward this document to the EIIP Point Source chair person for the committee's consideration.

2.2 Response to opinions of Connecticut Department of Environmental Protection

EPA recognizes that representatives of the Connecticut Department of Environmental Protection (DEP) were active participants in the development stages of the study, witnessed the emission test at Plant D, and participated in the review process of the test reports and subsequent technical analyses. EPA appreciates Connecticut DEP's recognition that the scope of the project was comprehensive, the collection and analysis protocols were appropriate, the objectives were well defined and the EPA staff were very capable.

2.3 Response to opinions of Coalition Against the Asphalt Plant et al

This section responds to the opinions of the citizen groups that were presented in the "Minority Report on Fugitive Emissions from Asphalt Plants" (Minority Report). We have organized and presented our responses based on the headings in the Minority Report.

2.3.1 Introduction (EPA interactions with citizens)

The citizens have provided a reasonable synopsis of the opportunities EPA afforded to all the stakeholder groups to assist in the development of emissions estimation methodologies for fugitive emission sources at hot mix asphalt plants. However, in the second half of the introduction and several other locations in the Minority Report, the citizens disparage EPA's interactions with the citizens. We believe the record shows that EPA provided an open and meaningful public participation process in the development and performance of the emission testing program as well as for the review of data generated from the testing. In doing so, EPA strived to balance its obligation to ensure responsible use of public monies with the numerous requests made by the citizens groups, many of which added to the cost of the testing program. A genuine effort was put forth, aided by facilitators brought in to assist the group discussions and to reach outcomes agreeable to all parties. We believe we succeeded in that regard to the greatest extent possible.

2.3.2 Why are many citizen groups concerned about asphalt plants?

2.3.2.1 Asphalt health effects, epidemiological studies, and sound science

In serving the public, the Agency has an obligation to use sound science in forming opinions on the toxicity of chemical compounds. One aspect of applying sound science is to utilize and/or consider all of the available credible scientific information on the toxicity of a given compound; credible scientific information includes reports published in peer-reviewed scientific journals, conference proceedings, or other similar peer-reviewed vehicles. Anecdotal information such as that referred to in the second paragraph of this section of the Minority Report is, by definition, information that does not originate from a scientifically peer-reviewed report and must be considered only with reservation. The recently published NIOSH hazard review on the health effects of occupational exposure to asphalt (http://www.cdc.gov/niosh/01-110pd.html) is a good example of an inclusive study of credible scientific information; in particular, it cites and evaluates about 40 studies in an effort to present an overall view of all of the credible scientific information on the acute and chronic health effects of asphalt emissions.[1] This report concludes that current data are not sufficient for quantifying the acute and chronic health risks of exposure to asphalt, asphalt-based paint, or asphalt fumes and vapors. The NIOSH report also cites specific limitations concerning the Hansen cohort, the one specifically cited in the Minority Report. The conclusions of the NIOSH report are of utility to EPA especially as NIOSH is concerned with worker populations (e.g., pavers and roofers) that are more heavily exposed to asphalt emissions than the general population, and in whom any adverse effects would be more likely to occur. Any future formal review of the health effects of asphalt emissions by EPA would closely approximate the sound science effort by NIOSH.

2.3.2.2 Differences in approach to assessing health impacts

The authors of the Minority Report express concern that the Agency is concerned solely with long-term average exposures and not "*… peak, short-term exposures for acute effects*." We acknowledge that the exposure guidelines issued by EPA for air pollutants concerning cancer and noncancer effects are concerned with long-term exposures and, although a methodology has been under development for several years, EPA has yet to institute methodologies for evaluating effects from short-term exposures. Additionally, as stated clearly in the introduction to AP-42, the emission factors in AP-42 are average values since its' primary purpose is to support the development of area wide emission inventories. However, the emission factors for fugitive emissions at hot mix asphalt plants provide adequate flexibility to estimate short term emission rates when combined with reasonable information on asphalt volatility and temperature. Furthermore, reasonable estimates of short term stack emissions associated with normal plant operations can be derived from the available supporting data. The authors of the Minority Report may wish to consider the conclusions of NIOSH in their recently promulgated Hazard Review on asphalt emissions. After considering the currently available information on workers under short-term exposure conditions, their recommendation for worker exposure over a 15 minute period was not altered from their original estimate determined in 1977, at the rather high level of 5 mg/m^3 for total particulate.

---

[1] *Hazard Review, Health Effects of Occupational Exposure to Asphalt*; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; DHHS (NIOSH) Publication No. 2001—110, December 2000.

2.3.2.3 Use of "best performance data" from sources

EPA does not agree with the citizens statement that "much of the data used for developing stack emission factors was collected just after initial plant startup often during a preoperating test period where the plant owner is demonstrating to the state regulatory authorities that the plant can operate for short periods of time at the design operating rate while staying within the permitted emission limits." While some of the data used were from tests performed within 60 days of the plants' initial start up (known as initial compliance tests) and may be representative of the most favorable operating conditions, most of data were from hot mix asphalt plant emission tests performed on facilities that had been in operation for many years. The data utilized were drawn from 278 tests reports for emission tests performed between 1987 and 1994. Given the slow production growth in the industry, it is unlikely that more than half of these tests were initial compliance tests. Generally, emissions tests are only conducted during periods of representative performance. EPA and most State and local agencies do not consider periods of startup, shutdown and malfunction to be representative conditions. As a result, testing is usually not conducted during these events. By definition, periods of non-representative operations are brief. Additionally, it is likely that a facility being forced to test because of compliance concerns would correct any significant problem prior to conducting the test. However, facilities that are compliance concerns are the exception. While it is recognized that these worst case conditions are not represented in the supporting data, the available supporting data is representative of the general range of facilities in operation. This is substantiated by the wide range of the data for those pollutants where there are more than about ten data points supporting the emission factor.

2.3.3 Unresolved issues

2.3.3.1 Volatility content and temperature issues

The citizens are concerned about the volatility content of asphalts and hot mix asphalt load-out temperature and present five specific issues as the following five questions. We address these concerns below specifically in regard to their impact on estimation of emissions using the emission estimation methodologies presented in Appendix A of the "Hot Mix Asphalt Plants - Emission Assessment Report," EPA 454/R-00-019, which is the text of Section 11.1 of AP-42, Hot Mix Asphalt Production.

a. Why did the industry change the specification for the maximum allowable volatile content of asphalt from 0.5% to 1.0%? What are the implications of this change?

b. How is this volatile content measured now and how was it measured in the past?

c. How is the volatile content affected by seasonal variations in oil refining practice?

d. How is the volatile content affected by the various classes of additives that are sold to improve the performance of asphalt?

e. Are the maximum operating temperatures recommended by industry groups actually followed by plant operators? If not, what are the variations in temperature and what is the consequence of these variations?

Response to questions a and b

As the citizens note, the industry has recently started using ASTM Method D2872-88, Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt - Rolling Thin-Film Oven Test -

RTFOT for assessing asphalt volatile content. In the past, the method commonly used was ASTM Method D1754-97, Standard Test Method for Effect of Heat and Air on Asphaltic Materials - Thin-Film Oven Test -TFOT). All information used to develop the emission estimation methodology for estimating load-out and silo filling emissions, used to establish the default values for asphalt volatility which may be used in estimating load-out and silo filling emissions when no volatility data are available, and specified for use in the emission equation rely on the volatile content as determined by the RTFOT method. Therefore, the industry's change in the specification for the maximum allowable volatile content of asphalt from 0.5% to 1.0% is not relevant to appropriate application of the emission estimation methodologies nor are the differences in the loss on heating obtained using the two methods of concern.

Response to questions c and d

The five State DOT laboratory directors contacted for this project have stated that the independent volatility assessments made by the states using the RTFOT method are conducted on samples of asphalt that are to be used without further blending or addition of additives. State DOT's routinely perform a variety of quality assurance tests including the RTFOT method on a representative sampling of asphalts to insure that materials used to construct State and Federal roadways in their State meet required specifications. There are potential legal ramifications to industry for changing the physical properties of asphalts after the State quality assurance samples have been obtained. Since State agencies obtain and independently determine the volatility of samples of asphalt which will be used without further modification, we conclude that there is no potential impacts of seasonal refining practices, crude stocks, and asphalt blending and additives in regard to the application of the emission estimation methodologies. This information available from State DOT's is superior to the use of assumed values and should be more than adequate in evaluating the variations in asphalt volatility over time.

Response to question e.

Since the emission estimation methodology for load-out and silo filling incorporates a variable for actual measured load-out temperatures, the effect on emissions of exceeding the industry recommended temperature guidelines as well as other load-out temperatures can be assessed (see, for example, Table 1 in the Minority Report). The use of measured load-out temperature data is superior to the use of theoretical extremes for load-out temperature. Facilities and/or their customers routinely monitor the hot mix asphalt temperatures loaded into the trucks before leaving the plant property. If measured load-out temperatures are not available, load-out temperatures for a given time can be approximated from other available temperature records. Hot mix asphalt plants, for example, routinely monitor the mix temperature of their heated aggregate and drum mix plants monitor the temperature of the product stored in silos. By correlating historical measured mix temperature or silo temperatures with historical measured load-out temperatures and combining this with plant records of mix temperature/silo temperature and RAP usage it is possible to obtain improved estimates of load-out temperatures.

General

We believe it may also be helpful to clarify the criteria for selecting appropriate values for asphalt volatility and load-out temperature. The values selected should not be arbitrary (e.g., based upon industry desired targets or industry or State maximum allowable specifications) but instead should be based upon legitimate verifiable data that is suitable for the health or environmental endpoint of interest. For example, health or environmental endpoints that are the result of long term exposures should rely on emissions estimations based upon a measure of central tendency (e.g., average, median, mode or other appropriate

statistical measure) of the asphalt volatility and load-out temperature. Conversely, if the health or environmental endpoint is the result of a short term exposure, a combination of reasonable upper bound values for volatility and load-out temperature should be used to estimate emissions. As stated in the last sentence of the first paragraph on page 105 of the "Response to Comment on Draft Emissions Assessment Report, AP-42 Section and AP-42 Background Report," the selection of these upper bound values should include an assessment of the probabilities of simultaneous events occurring. While the use of multiple worst case assumptions (as depicted in the two columns labeled "Citizens" in Table 1 of the Minority Report) may be a shortcut to evaluate maximum potential emissions, generally these emission estimates are an unlikely result.

Previous responses or relevant information on asphalt volatility and temperature issues are contained in Chapter 4 of this report (see Section 3.2 from page 54 through page 63, Section 3.5.34 on pages 88 and 89, Section 3.6.4 on pages 104 and 105, Section 3.6.6 on page 105 and Section 3.6.10 on page 106). In addition, the document EPA 454/R-00-029, "Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D" published in May 2000 also contains responses and relevant information on these volatility and temperature issues (Item 5 on pages 9 and 10 and Items 52 and 53 from page 61 through 68). Lastly, Appendix B of the "Hot Mix Asphalt Plants - Emission Assessment Report, EPA 454/R-00-019 which is the "Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Production," clearly presents the methodology used as the basis for the final emission factor equations recommended in the AP-42 section and the development of long term average default values for volatility and temperature (Section 4.4.1, 4.4.2, 4.4.3 and 4.4.4 from page 4-114 through 4-123 and Tables 4-27 through 4-44 from page 4-286 through 4-307).

2.3.3.2 Issues relating to collection and analysis of emissions data

Background correction and enclosure problems

The citizens identify three issues related to the collection and analysis of the fugitive emissions data. These issues include (1) the quality of the background emissions data obtained at Plant C, (2) the methodology used to correct for background emissions due to truck operation (diesel exhaust and road dust emissions), and (3) the effectiveness of the enclosure at Plant D to capture essentially all of the truck load-out emissions. The citizen groups have raised each of these issues during meetings held in Boston, in their written comments on the draft test reports for Plants C and D, and in their comments on the Draft Emissions Assessment Report. We understand the concerns of the citizens, the supporting arguments of the citizens, and their proposed methods to address these concerns. However, we remain unconvinced by the arguments that the collection and analyses of the fugitive emissions are flawed.

Previous responses and relevant information on the issues expressed in the Minority Report on the collection and analysis of emissions data are contained in Chapter 4 of this report (see Section 3.1 from page 43 through page 54, Section 3.3 from page 63 through 70 and Section 3.5.38 on pages 90 and 91). In addition, the EPA Report No. 454/R-00-029, "Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D" published in May 2000 also contains responses and relevant information on these collection and analysis issues (see in particular Item 11 on pages 17 and 18, Item 13 on page 19, Item 15 from page 21 to 26, Item 41 from page 41 through 50, Item 51 from page 56 through 61, Item 55 on pages 68 and 69, Item 57 on page 70 and Item 60 from page 72 through page 75).

"EPA's flat denial of errors in the report"

In one section of the Minority Report entitled "EPA's flat denial of errors in the report," the citizens express dissatisfaction with EPA's earlier response to their prior comments regarding errors in the draft reports distributed for review by the stakeholders. In particular, the citizens express dissatisfaction with "incorrect references, missing and incorrectly referenced appendices and numerical and logical errors in the analysis." We recognize that there were a few incorrect references and missing and incorrectly referenced appendices which we have acknowledged in the past and since corrected: nevertheless, we do not believe that these should have significantly affected the stakeholders reviews of the approximately 14 draft reports distributed. We appreciate the citizens identification of the two more significant errors they cite which we previously corrected. The first error was created when calculations to determine average emission concentrations for one of three test runs on a silo filling operation included time periods where no asphalt was being loaded into the storage silo; the second was an incorrect maximum concentration for the intermittent load-out test reported in an appendix of the report for Plant C which fortunately had no effect on data elsewhere in the report. We routinely distribute draft reports to all interested stakeholders for their review to integrate the various perspectives and ensure that we have not made inappropriate assumptions, overlooked relevant information, etc. Considering the large volume of data processed for this project and the tight time constraints on its generation, we do not find these few errors unreasonable.

"Unfounded leaps of faith"

The citizens believe the selection of docosane and tricosane as model compounds for asphalt emissions from storage tanks is an "unfounded leap of faith." They point out that docosane and tricosane are not the major measured constituents of asphalt emissions and that EPA chose these compounds because their Antoine's coefficients produce a working loss estimate of 32 pounds per million gallons of asphalt throughput for their approximate molecular weight. The use of docosane and tricosane as the model compounds in the development of Antoine's constants for asphalt for use in the TANKS program to estimate working losses from storage tanks is based on sound scientific principles. EPA recognizes that the specific compounds used are neither the major constituents of asphalt vapors nor major constituents of liquid asphalt. As the citizens imply, our selection of these compounds to derive Antoine's constants for asphalt is based in part on the fact that the Antoine's constants for the compounds produce working loss emission estimates consistent with the actual test data from Plant C. In other words, when using the Antoine's constants and the molecular weights developed, the TANKS program predicts the emissions calculated from the maximum vapor concentrations for asphalt measured during silo emission testing at Plant C. Each step of the development of the Antoine's constant is clearly described in Section 4.4.5 beginning on page 4-123 of Appendix B of the "Hot Mix Asphalt Plants - Emission Assessment Report," EPA 454/R-00-019 which is the "Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Production." Previous responses or relevant information on emissions estimations methods for asphalt storage tanks are contained in Chapter 4 of this report (Section 3.5.44 on page 93, Section 3.5.50 from page 96 through page 99, Section 3.7.2 on pages 115 and 116, Section 3.7.4 on page 116). While the calculational details are preliminary, this basic methodology is described in the response to item 17 from page 26 through 28 in the document EPA 454/R-00-029, "Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D" published in May 2000.

Problems with witnessing tests

The citizens raise a number of issues with regard to citizen observation of the emission tests at Plants C and D: (1) it was difficult for the single witness allowed at Plant C to simultaneously observe

operations at several places in the plant; (2) certain information was withheld from the citizen observer on-site under a claim of confidentiality, (3) citizens were forbidden to take photographs to document their observations, and (4) an EPA staff member commented during a dinner discussion that EPA had no intention of regulating fugitive emissions from the asphalt industry.

The citizens were allowed unprecedented access to both Plant C and D. All process and emissions sampling data were freely available to the observer for review during the test program. While EPA's Confidential Business Information (CBI) procedures precluded providing a hard copy of this information to the observer, hard copy was available later after it cleared CBI review. In addition, the citizen observer was considered an integral part of the test team during on site decision meetings to discuss issues that could potentially affect the test program. During both of the emission tests, the number of observers (citizen plus agency) greatly exceeded the number of operators at the plants. To minimize competing requests for the plant operators' attention, access to the plant operator was limited to the individual responsible for obtaining the process operation data who was responsible for keeping the remainder of the test team informed of plant operation changes. This limitation applied not only to the citizen observer but to the EPA observers, the three EPA contractor organizations, and the industry observers as well.

While no photographs were taken prior to correcting the two ventilation system problems that created the visible emissions condition observed by Dr. Nadkarni on the day before the first complete truck load-out emission test run at Plant C, documentation (capture efficiency measurements and photographs) have been supplied to the stakeholders that confirm that the capture of the emissions was not 100% and the capture efficiency measurements have been used to correct the data for the emissions testing at this emission point. Further responses to comments concerning the capture of emissions at both Plants C and D are included in items 11, 13 and 14 of the report "Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D" (EPA 454/R-00-029) and sections 3.1.2 and 3.1.4 in Chapter 4.

The citizens' assertion that EPA prejudged the final outcome of the project is incorrect. During the many teleconferences and meetings with the stakeholders (citizens, industry, and State agencies) prior to the emissions test, the EPA office responsible for regulatory decisions clearly identified the criteria established by the Clean Air Act Amendments of 1990 (CAAA) for developing emissions regulations. In particular, they explained that two major criteria that trigger development of a regulation are (1) a determination that one or more facilities in a source category are a "major source" of hazardous air pollutants (HAPs) and (2) that there is a demonstrated technology to control these HAP emissions. It was also explained to the stakeholders, that the CAAA defines a "major source" as any contiguous facility with emissions of more than 10 tons of any one HAP or 25 tons of any combination of HAPs. The objective of testing at both Plants C and D was to quantify the fugitive HAP emissions from hot mix asphalt plants and thereby determine whether any hot mix asphalt plants could be a "major source." Considering the substantial emission testing resources being expended to quantify emissions from hot mix asphalt plants in order to make the "major source" determination and that fact neither of the EPA staff present at the dinner is responsible for regulatory decisions, it is unlikely that they would have stated that EPA had no intention of regulating hot mix asphalt plant emissions.

2.3.4 Conclusions

2.3.4.1 Performance of epidemiological study by EPA

The Minority Report recommends that the government conduct community-based epidemiological studies to elucidate health effects from exposure to asphalt emissions. Justification for such a study would be helped by further definitive studies in worker populations in whom any adverse effects would be more likely to occur. Results from such a study among workers could then trigger and provide direction for studies at the community level. The authors of the Minority Report may want to refer to the work of Partanen, et al. (1995)[2] and Burstyn, et al. (2000)[3] which describe the feasibility of such studies among asphalt workers in more depth.

2.3.4.2 Include additional warnings in AP-42

The citizens recommend that EPA include the limitations regarding individual emission factors in each table in AP-42. As the citizens point out, EPA recognizes the great reliance on AP-42 emission factors by industry and state agencies in permitting and other processes. The introduction to AP-42 currently provides a detailed discussion regarding limitations for using the emission estimation methodologies contained in the numerous tables in the more than 200 sections of AP-42. We do not believe it is reasonable that every table include a statement that the emission estimation methods represent an average of available data and do not represent "worst case" impact scenarios. Such statements would introduce additional and unnecessary complexity into the tables that are already complex and such statements are not likely to eliminate or reduce any existing misuse of the available methodologies.

2.3.4.3 Get tough with industries on excessive claims of CBI

The citizens recommend that the government challenge industry regarding unsubstantiated demands for confidentiality of business information. We would again point out that all available information was provided to the stakeholders in sufficient time for evaluation and comment prior to the next decision point of the process. Prior to their observation of testing at Plant C, the citizens were provided with a copy of the OAQPS CAA Confidential Business Information (CBI) Security Manual. This manual includes the procedures followed by OAQPS to insure that CBI that is inadvertently received is protected. We recognize that much of the information collected during our plant visits and emission tests is unlikely to be claimed as CBI. However, we must still recognize the potential to collect some limited amount of CBI. The procedures used by OAQPS to protect and determine the CBI status of information collected during inspections and testing is described on page 19 of the manual. These procedures incorporate the requirements of Federal Rules established by Congress for insuring that information EPA needs from businesses do not infringe on businesses ability to keep selected information confidential. As indicated in third paragraph section "B. Original CBI," all information collected by EPA during data-gathering visits or

---

[2]Partanen, T.J., Boffetta, P., Heikkila, P.R., Frentzel-Beyme, R.R., Heederik, D., Hours, M., Jarvholm, B.G., Kauppinen, T.P., Kromhout, H. Langart, S. 1995. Cancer risk for European asphalt workers. Scand. J. Work Environ. Health 21(4): 252-258.

[3]Burstyn, I., Kromhout, H., Cruise, P.J. and Brennan, P. 2000. Designing an international industrial hygiene database of exposures among workers in the asphalt industry. Ann. Occup Hyg. 44(1): 57-66.

tests must be forwarded to the responsible industry official for review to preclude the inadvertent release of CBI. The sample letter on page 87 of the manual contains criteria for supporting a claim of confidentiality. EPA staff have no authority to presuppose what material obtained during a visit or test does not meet these criteria. Industries are usually provided 45 days to respond to EPA's requests to identify CBI. For all of the information obtained during the hot mix asphalt fugitive emissions study, industry made no claims of confidentiality. In addition, the information obtained by EPA was made available to all stakeholders less than 30 days after it was submitted to the industry for clearance.

2.4 Response to opinions of National Asphalt Paving Association

EPA agrees that the methodologies published in the Emissions Assessment Report have resolved the question of how best to estimate emissions from truck load-out and silo filling operations. Additionally, EPA agrees that with the completion of this report there are now reliable emission estimation methodologies for essentially all air emission sources at hot mix asphalt plants. EPA does not agree that the information in the Emissions Assessment Report proves that there are no hot mix asphalt plants that are "major sources." However, when combined with facility production information and the appropriate pollutant emissions evaluation criteria, the available methodologies in the report will allow State and local agencies to determine the major source status of a facility.

This Page is intentionally left blank.

Chapter 3

Stakeholder Opinions on

Hot Mix Asphalt Plants
Emission Assessment Report
EPA 454/R-00-019
December 2000

This Page is intentionally left blank.

Lloyd Eagan, Director
Bureau of Air Management
Wisconsin Department of Natural Resources
Madison, WI

This Page is intentionally left blank.

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Scott McCallum, Governor
Darrell Bazzell, Secretary

101 S. Webster St.
Box 7921
Madison, Wisconsin 53707-7921
Telephone 608-266-2621
FAX 608-267-3579
TTY 608-267-6897

February 28, 2001

Mr. Ron Myers
USEPA-OAQPS (MD-19)
Research Triangle Park, NC 27711

Subject: Asphalt Plant Emissions

Dear Mr. Myers:

We congratulate USEPA on its development of emission factors for hot mix asphalt plants. The Hot Mix Asphalt Plants - Emission Assessment Report (EPA 454/R-00-019), December 2000, was a very ambitious project that complements the Emission Inventory Improvement Program (EIIP) report *Preferred and Alternative Methods for Estimating Air Emissions from Hot Mix Asphalt Plants*, July 1996. Wisconsin was a major contributor to the EIIP report.

We would like to supply comments regarding the reporting of emissions from these asphalt plants that you may want to consider in your final document. The Wisconsin asphalt companies approached DNR in 1996 with a concern regarding the consistency of reporting air emissions across the state. Cooperatively we developed a document that met their concerns and we have included a copy of this document as an attachment to this letter.

The attached guidance document specifies equipment common (noted as base in the guidance document) to all asphalt plants. If a particular asphalt plant had not reported air emissions with that piece of equipment, that piece of equipment was added as an emission source and asphalt plant was expected to report air emissions for that piece of equipment. From this base, additional pieces of equipment (noted as optional in the guidance document) were added to complete the assessment of the asphalt plant. If a company did not have a base piece of equipment, it could notify WDNR and we would remove this piece of equipment from our database.

We have found this approach to be very successful in ensuring consistent reporting from asphalt plants across the state.

Thank you for allowing us to comment. If you should have any questions, please feel free to call Ralph Patterson of my staff at 608-267-7546.

Sincerely,

Lloyd Eagan

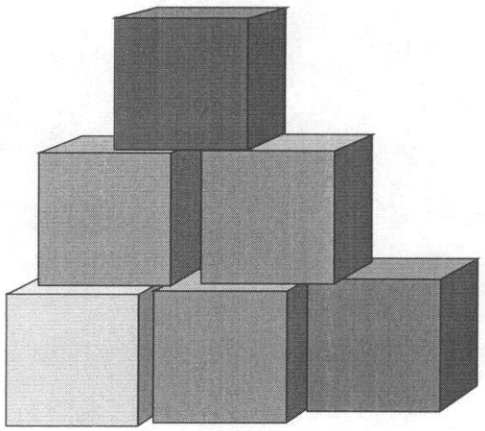
Lloyd Eagan, Director
Bureau of Air Management

This Page is intentionally left blank.

Hot Mix Asphalt Plant

Air Emission Inventory Guidance

20-Sep-99



DNR Disclaimer

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

Hot Mix Asphalt
Emission Inventory
Guidance

In the 1998 air emission inventory there were 133 asphalt plants reporting under SIC 2951 (Asphalt paving and mixtures) across all five DNR regions. It is air management's emission inventory goal to have air emissions reported consistently for Hot Mix Asphalt (HMAs) plants across the state. This document has been written so that air management can achieve this consistency by defining base level equipment and emission sources common to all HMAs.

This document is a revision of two previous documents. The HMA document was written in 1996 after discussions with the industry. This document was later updated in 1998. This document uses much of the same information of the prior documents but also includes summary tables for the HMA source and emission factor.

This guidance was developed by the Central Office and people that deal with hot mix asphalt plants from the South Central and Southeast Regions. This guidance is **only** applicable to the calculation of emissions for the air emission inventory. This guidance is not intended for use on asphalt plant permits because the focus of permits tends to be on potential to emit (PTE) and maximum total emissions (MTE) while the air emission inventory focuses on the calculation of actual emissions. This guidance furnishes information on the emission factors and information for calculating emissions from each hot mix asphalt plant.

DATABASE NEEDS

The Air Emissions Management System (AEMS) is the air management computer system used to calculate air emissions from all point sources. AEMS requires the identification of the device (i.e. the piece of equipment), the process (i.e., the type of fuel burned or material processed), and an eight digit source classification code (SCC) associated with the process. The database assigns a default emission factor unless some other data is placed into the database manually. The default emission factors are taken from four sections of AP-42, 1/95 version. These four sections are 11.1 Hot Mix Asphalt Plants, 1.3 Fuel Oil Combustion, 1.4 Natural Gas Combustion and 1.5 Liquefied Petroleum Gas Combustion.

USEPA HMA DESCRIPTIONS

[Note: This section taken from AP-42 Section 11.1 Hot Mix Asphalt Plants. Tables 1, 2, and 3 were developed from diagrams of the HMA plants in this section.]

There are different types of HMA set-ups. HMA paving materials can be manufactured by: (1) batch mix plants, (2) continuous mix (mix outside drum plants), (3) parallel flow drum plants and (4) counterflow drum mix plants. According to AP-42 Section 11.1 Hot

Mix Asphalt Plants of the total amount of asphalt plants in the United States, 64% are batch plants, 28% are parallel flow drum mix, and 8% are counterflow drum mix. Continuous mix plants are rare and were considered insignificant (and thus not considered) in Section 11.1. If a company has a continuous mix plant please notify the Central Office and we will determine the typical emission sources after discussions with the industry. Section 11.1 lists the emission sources for the three types of HMA plants.

1. Batch Mix HMA

Processing begins as the aggregate is hauled from the storage piles and is placed in the appropriate hoppers of the cold feed unit. The material is metered from the hoppers onto a conveyor belt and is transported into a rotary dryer (typically gas or oil fired). Dryers are equipped with flights designed to shower the aggregate inside the drum to promote drying efficiency.

As the hot aggregate leaves the dryer, it drops into a bucket elevator and is transferred to a set of vibrating screens where it is classified into as many as four different grades (sizes), and is dropped into individual "hot" bins according to size. To control aggregate size distribution in the final batch mix, the operator opens various hot bins over a weigh hopper until the desired mix and weight are obtained. Reclaimed asphalt pavement may be added at this point, also. Concurrent with the aggregate being weighed, liquid asphalt cement is pumped from a heated storage tank to an asphalt bucket, where it is weighed to achieve the desired aggregate-to-asphalt cement ratio in the final mix.

The aggregate from the weigh hopper is dropped into the mixer (pug mill) and dry-mixed for 6 to 10 seconds. The liquid asphalt is then dropped into the pug mill where it is mixed for an additional period of time. Total mixing time is less than 60 seconds. Then the hot mix is conveyed to a hot storage silo or is dropped directly into a truck and hauled to the job site.

As with most facilities in the mineral products industry, batch mix HMA plants have two major categories of emissions: ducted sources (those vented to the atmosphere through some type of stack, vent, or pipe), and fugitive sources (those not confined to ducts or vents but emitted directly into the ambient air). Ducted emissions are usually collected and transported by an industrial ventilation system having one or more fans or air movers, eventually to be emitted to the atmosphere through some type of stack. Fugitive emissions result from process and open sources and consist of a combination of gaseous pollutants and PM.

The most significant source of ducted emissions from batch mix HMA plants is the rotary drum dryer. Emissions from the dryer consist of water as steam evaporated from the aggregate, PM and small amounts of volatile organic compounds (VOC) of various species (including hazardous air pollutants [HAP] derived from combustion exhaust gases.

Other potential process sources include the hot-side conveying, classifying, and mixing equipment, which are vented to either the primary dust collector (along with the dryer gas) or to a separate dust collection system. The vents and enclosures that collect emissions from these sources are commonly called "fugitive air" or "scavenger" systems. The scavenger system may or may not have its own separate air mover device, depending on the particular facility. The emissions captured and transported by the scavenger system are mostly aggregate dust, but they may also contain gaseous VOCs and a fine aerosol of condensed liquid particles. This liquid aerosol is created by the condensation of gas into particles during cooling of organic vapors volatilized from the asphalt cement in the mixer (pug mill). The amount of liquid aerosol produced depends to a large extent on the temperature of the asphalt cement and aggregate entering the pub mill. Organic vapor and its associated aerosol are also emitted directly to the atmosphere as process fugitives during truck loadout, from the bed of the truck itself during transport to the job site, and from the asphalt storage tank. In addition to low molecular weight VOCs, these organic emission streams may contain small amounts of polycyclic compounds. Both the low molecular weight VOCs and the polycyclic organic compounds can include HAPS. The ducted emissions from the heated asphalt storage tanks may include VOCs and combustion products from the tank heater.

There are also a number of fugitive dust sources associated with batch mix HMA plants, including vehicular traffic generating fugitive dust on paved and unpaved roads, aggregate material handling and other aggregate processing operations. Fugitive dust may range from 0.1 μm to more than 300 μm in aerodynamic diameter. On average, 5 percent of cold aggregate feed is less than 74 μm (minus 200 mesh). Fugitive dust that may escape collection before primary control generally consists of PM with 50 to 70 percent of the total mass less than 74 μm.

Table 1
Batch Mix HMA
Emission Sources
AP-42, 1/95 Figure 11.1.1

Emission Source	Source Classification Code
Hot screens	3-05-002-02
Hot bins	3-05-002-02
Mixer	3-05-002-02
Elevator	3-05-002-02
Rotary Dryer	3-05-002-01
Cold Aggregate Bins	3-05-002-04
Asphalt Cement Storage Heater	3-05-002-06 3-05-002-07 3-05-002-08
Loader	3-05-002-04
Fine Aggregate Storage Pile	3-05-002-03
Coarse Aggregate Storage Pile	3-05-002-03
Conveyor from Rotary Dryer	3-05-020-06
Conveyor to Cold Aggregate Bins	3-05-020-06
RAP Bin Conveyor	3-05-020-06
Primary Collector	
Secondary Collector	
Unpaved Haul road Or Paved Haul Road	3-05-020-33 (proposed) 3-05-020-34 (proposed)

[Note: SCCs 3-05-020-33 and 3-05-020-34 have been proposed by DNR as additions to the USEPA SCC list.]

2. Parallel Flow Drum Mix Plants

This process is a continuous mixing type process, using proportioning cold feed controls for the process materials. The major difference between this process and the batch process is that the dryer is used not only to dry the material but also to mix the heated and dry aggregates with the liquid asphalt cement. Aggregate, which has been proportioned by size gradations, is introduced to the drum at the burner end. As the drum rotates, the aggregates, as well as the combustion products, move toward the other end of the drum in parallel. Liquid asphalt cement flow is controlled by a variable flow pump electronically linked to the new (virgin) aggregate and RAP weigh scales. The asphalt cement is introduced in the mixing zone midway down the drum in a lower temperature zone, along with any recycled asphalt (RAP) and particulate matter (PM) from collectors.

The mixture is discharged at the end of the drum and is conveyed to either a surge bin or HMA storage silos. The exhaust gases also exit the end of the drum and pass on to the collection system.

Parallel flow drum mixers have an advantage, in that mixing in the discharge end of the drum captures a substantial portion of the aggregate dust, therefore lowering the load on the downstream collection equipment. For this reason, most parallel flow drum mixers are followed only by primary collection equipment (usually a baghouse or venturi scrubber). However, because the mixing of aggregate and liquid asphalt cement occurs in the hot combustion product flow, organic emissions (gaseous and liquid aerosol) may be greater than in other processes.

The most significant ducted source of emissions is the rotary drum dryer. Emissions from the drum consist of water as steam evaporated from the aggregate, PM, and small amounts of VOCs of various species (including HAPs) derived from combustion exhaust gases, liquid asphalt cement, and RAP, if utilized. The VOCs result from the incomplete combustion and from the heating and mixing of liquid asphalt cement inside the drum. The processing of RAP materials may increase VOC emissions because of an increase in mixing zone temperature during processing.

Process fugitive emissions associated with batch plant hot screens, elevators, and the mixer (pug mill) are not present in the drum mix process. However, there may be slight fugitive VOC emissions from transport and handling of the hot mix from the drum mixer to the storage silo and also from the load-out operations to the delivery trucks. Since the drum process is continuous, these plants must have surge bins or storage silos. The fugitive dust sources associated with drum mix plants are similar to those of batch mix plants with regard to truck traffic and to aggregate material feed and handling operations.

Table 2 **Parallel Flow HMA** **Emission Sources** **AP-42, 1/95 Figure 11.1.2**	
Emission Source	Source Classification Code
Parallel Flow Drum Mixer	3-05-002-05
Cold Aggregate Bins	3-05-002-04
Asphalt Cement Storage Heater	3-05-002-06 3-05-002-07 3-05-002-08
Loader	3-05-002-04
Fine Aggregate Storage Pile	3-05-002-03
Coarse Aggregate Storage Pile	3-05-002-03
Conveyor from Parallel Flow Drum Mixer to scalping screen	3-05-020-06
Conveyor from scalping screen to Cold Aggregate Bins	3-05-020-06
Conveyor from RAP Bin to Parallel Flow Drum Mixer	3-05-020-06
Primary Collector	
Secondary Collector	
Unpaved Haul road Or Paved Haul Road	3-05-020-33 (proposed) 3-05-020-34 (proposed)

[Note: SCCs 3-05-020-33 and 3-05-020-34 have been proposed by DNR as additions to the USEPA SCC list.]

3. Counterflow Drum Mix Plant

In this type of plant, the material flow in the drum is opposite or counterflow to the direction of exhaust gases. In addition, the liquid asphalt cement mixing zone is located behind the burner flame so as to remove the materials from direct contact with hot exhaust gases.

Liquid asphalt cement flow is controlled by a variable flow pump which is electronically limited to the virgin aggregate and RAP weigh scales. It is injected into the mixing zone along with any RAP and particulate matter from primary and secondary collectors.

Because the liquid asphalt cement, virgin aggregate, and RAP are mixed in a zone removed from the exhaust gas stream, counterflow drum mix plants are will likely have organic emissions (gaseous and liquid aerosol) that are lower than parallel flow drum mix plants. A counterflow drum mix plant can normally process RAP at ratios up to 50 percent with little or no observed effect upon emissions.

The most significant ducted source of emissions is the rotary drum dryer in a counterflow drum mix plant. Emissions from the drum consist of water as steam evaporated from the aggregate, PM, and small amounts of VOCs of various species (including HAPs) derived from combustion exhaust gases, liquid asphalt cement, and RAP, if used.

Because liquid asphalt cement, aggregate, and sometimes RAP, are mixed in a zone not in contact with the hot exhaust gas stream, counterflow drum mix plants will likely have lower VOC emissions tan parallel flow drum mix plants. The organic compounds that

are emitted from counterflow drum mix plants are likely to be products of a slight inefficient combustion and can include HAP.

Process fugitive emissions associated with batch plant hot screens, elevators, and the mixer (pug mill) are not present in the drum mix process. However, there may be slight fugitive VOC emissions from transport and handling of the hot mix from the drum mixer to the storage silo and also from the load-out operations to the delivery trucks. Since the drum process is continuous, these plants must have surge bins or storage silos. The fugitive dust sources associated with drum mix plants are similar to those of batch mix plants with regard to truck traffic and to aggregate material feed and handling operations.

Table 3 **Counter Flow HMA** **Emission Sources** **AP-42, 1/95 Figure 11.1.3**	
Emission Source	Source Classification Code
Counter Flow Drum Mixer	3-05-002-05
Cold Aggregate Bins	3-05-002-04
Asphalt Cement Storage Heater	3-05-002-06 3-05-002-07 3-05-002-08
Loader	3-05-002-04
Fine Aggregate Storage Pile	3-05-002-03
Coarse Aggregate Storage Pile	3-05-002-03
Conveyor from Counter Flow Drum Mixer to scalping screen	3-05-020-06
Conveyor from scalping screen to Cold Aggregate Bins	3-05-020-06
Conveyor from RAP Bin to Counter Flow Drum Mixer	3-05-020-06
Primary Collector	
Secondary Collector	
Unpaved Haul road Or Paved Haul Road	3-05-020-33 (proposed) 3-05-020-34 (proposed)

[Note: SCCs 3-05-020-33 and 3-05-020-34 have been proposed by DNR as additions to the USEPA SCC list.]

DNR INFORMATION ON HMAs

DNR has experience with asphalt plants specific to their operations in Wisconsin. .The following is a list of DNR observations regarding HMAs.

1. **Emissions from processes**

   Processes are those sources ducted to a vent or to a piece of control equipment. For the most part emissions from these processes are assumed to be gaseous. Particulate matter emissions are assumed to be emitted from fugitive sources.

A. Particulate Matter Sources

The PM and PM10 emissions associated with ducted or vented processes at HMA plants are assumed to be negligible.

B. Sulfur dioxide (SO_2), nitrous oxides (NO_x), reactive organic gasses (ROG), lead (Pb), carbon monoxide (CO)

The discharge of theses criteria pollutants should be linked to the fuel burned at either the batch mix or drum mix asphalt plants. Information from AP-42 Sections 1.3 and 1.4 are used in calculating these emissions because these emission factors are supported through higher quality data (AP-42 gives them an A rating) as compared to the emissions for these pollutants in AP-42 Section 11.1 which have a D or E rating. [Note: USEPA assesses a quality rating of A (the best) to E (the worst) based on data compiled to support these emission factors.] These criteria emissions vary based on fuel burned.

1. Natural Gas

   Information from AP-42 Section 1.4 using SCC code 1-02-006-02 for small industrial boilers for burners with a heat input rating of less than100 MMBtu/hr are used in the calculation of criteria pollutant from natural gas burning. SCC code 1-02-006-01 is used for burners with a heat input rate greater than 100 MMBtu/hr.

2. Distillate Fuel Oil

   Information from AP-42 Section 1.3 using SCC code 1-03-005-02 for boilers using distillate fuel oil The criteria pollutant from distillate fuel oil burning should be calculated. Please note that distillate fuel oils are #1, #2 and #4 (if made up solely of heavy distillate fuel oil). #1 and #2 distillate fuel oils have a maximum sulfur content of 0.5% by weight.

3 Waste Fuel Oil

   Waste fuel oil is any oil refined from crude oil or synthetic oil that becomes contaminated during use. It includes engine oil, gear oil, lubricating oil, hydraulic oil, cutting oil, transformer fluids and tempering or quenching oils. Waste fuel oil is divided into three categories: specification, off-specification and hazardous waste. Waste fuel oil can then be mixed with either distillate or residual fuel oils to obtain a required viscosity.

As a default, DNR assumes that #3 waste oil emission factor(s) are the same as the distillate fuel oil emission factors, provided the #3 oil is made up of either distillate fuel oils or meets the specifications of #1 and #2 distillate fuel oils. Because of this assumption, we use the same SCC code of 1-02-005-02 for the #3 waste fuel oil meeting the above criteria.

4. Liquified Petroleum Gas Combustion

The criteria pollutant emissions from Liquified Petroleum Gas Combustion should be calculated using information from AP-42 Section 1.5 using SCC code 1-02-010-02 for industrial boilers. You will need to know the amount of Liquified Petroleum Gas burned at the HMA in 1000 gallons in order to calculate these emissions.

2. Fugitive Emissions

A. Asphalt Heaters

Asphalt heaters are used to heat the liquid asphalt cement. These units are typically fired with fuel oil. Again the combustion emissions factors from AP-42 Section 1.4 (natural gas fired) and 1.3 (fuel oil fired) could be applied to the heaters, as appropriate to fuel burned.

B. Fuel Oil Tank Heaters

Fuel oil tank heaters are used to heat the waste oil/residual fuel oil. These units are typically fired with fuel oil. Again the combustion emissions factors from AP-42 Section 1.4 (natural gas fired) and 1.3 (fuel oil fired) could be applied to the heaters, as appropriate to fuel burned. Generally, the emissions from fuel oil tank heaters are small or insignificant.

C. Roadways

Asphalt plants may have either paved or unpaved roadways, depending on their location and whether they are permanent or portable units. The same emissions factors and fugitive dust control efficiencies applied to roadways in quarries and sand and gravel operations under the current nonmetallic mining guidance document should be used to characterize these emissions.

D. Stockpiles

Asphalt plants will have several stockpiles of different types of stone, sand and ground recycled asphalt (RAP). The same emissions factors and

fugitive dust control efficiencies applied to roadways in quarries and sand and gravel operations under the current nonmetallic mining guidance document should be used to characterize these emissions.

E. Diesel/Gas Generators

Portable asphalt plants generally use diesel/gas generators in remote areas to supply power for the asphalt plant equipment. The same emissions factors applied to diesel/gas generators in crusher plants. The combustion emissions factors from AP-42 for Reciprocating engines (diesel fuel) 2-02-001-02 and (gas) 2-02-003-01 could be applied to the diesel/gas generators, as appropriate to fuel burned.

F. Hauling/Loading to Bins

Asphalt plants generally will have several bins that a loader operator is required to keep full by traveling between the storage piles and dumping into the bins. The same emissions factor and fugitive dust control efficiency applied to portable crusher operations can be applied to asphalt plants. The hauling emission factor (developed for crushers) is listed in the **Nonmetallic Air Emissions Guidance** document applicable to the calendar year the emission was reported. The SCC code applicable to this fugitive emission is 3-05-020-11.

G. Screening

Asphalt plants generally will have screen(s) that separate out over sized materials before it enters the mix. The same emissions factor and fugitive dust control efficiency applied to portable crusher operations can be applied to asphalt plants. The SCC Code applicable to screening is 3-05-020-04.

H. Soil Remediation

Asphalt plants that remediate soil discharge ROG and benzene emissions. These emissions are calculated and recorded according to their permit requirements and can be entered into AEMS under a separate process number. The SCC code associated with asphalt plants should be entered. The emission factor for ROG should reflect the units of reporting.

Typical HMA Plant

There are similarities and differences between (1) batch mix plants, (2) parallel flow drum and (3) counterflow drum mix plants. Each HMA plant in AEMS should begin with similar devices and proceses and have the specific HMA tailored using the devices and processes specific to the type of HMA. Table 4 lists the HMA sources identified by

DNR and USEPA. The table then lists whether these HMA sources should be part of the base emission configuration or can be added to make the HMA specific to the type of HMA.

Table 4 HMA Emission Sources Base or Optional			
Emission Source	SCC	Base or optional	Comment
Rotary Dryer or Parallel Flow, Counter Flow Drum Mixer	3-05-002-01 or 3-05-002-05	Base	Emission factors for SO2, NOx, ROG, and CO should be removed for asphalt mix process with SCC 3-05-002-05
Hot screens	3-05-002-02	Optional	
Hot bins	3-05-002-02	Optional	
Mixer	3-05-002-02	Optional	
Elevator	3-05-002-02	Optional	
Cold Aggregate Bins	3-05-002-04	Optional	SO2, NOx, ROG, and CO should be removed for asphalt mix process with SCC 3-05-002-04
Asphalt Cement Storage Heater	3-05-002-06 3-05-002-07 3-05-002-08	Base	
Loader	3-05-020-11 (unpaved) or 3-05-020-37 (paved)	Base	Assign 50%, 75%, or greater than 90% control efficiency
Fine aggregate storage pile	3-05-002-03	Optional	
Coarse aggregate storage pile	3-05-002-03	Optional	
Conveyor	3-05-020-06	Base	Assign 50%, 75%, or greater than 90% control efficiency
Primary collector		Base	Assume baghouse of 95% control
Secondary collector		Optional	
Unpaved Haul Road or Paved Haul Road	3-05-020-33 (proposed) 3-05-020-34 (proposed)	Base	Assign 50%, 75%, or greater than 90% control efficiency
Screen	3-05-020-04	Base	
Combustion tank heaters	1-03-005-02 oil 1-02-006-03 natural gas	Optional	Emission factors for PM and PM10 for natural gas should be switched off
Diesel/Gas Generators (Gensets)	2-02-001-02-diesel 2-02-003-01-gas	Base	
Soil Remediation	3-06-22-001 Underground Storage Remediation and Other Remediation	Optional	
	3-06-22-002 Underground Storage and Other Remediation: Soil: Residual Oil		
	30622003 Underground Storage and Other Remediation: Soil: Natural Gas		
	30622004 Underground Storage and Other Remediation: Soil: Distillate Oil		
	30622005 Underground Storage and Other Remediation: Soil: LPG		
	30622006 Underground Storage and Other Remediation: Soil: Waste Oil		

Summary

Air Management wants to consistently characterize HMA emissions. USEPA and DNR information were reviewed to determine what sources should be part of a base emission characterization and which sources could be optional.

Newt Rowe, Analytical Scientist
State of Connecticut
Department of Environmental Protection
Hartford, CT

This Page is intentionally left blank.

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

March 12, 2001

Mr. Ronald Meyers
USEPA
Mail Drop 19
Research Triangle Park, NC 27711

RE: Hot Mix Asphalt Plant Emissions Study

Dear Mr Meyers:

As a representative of the Connecticut DEP, I tracked the progress of the asphalt plant emissions study from the outset. As you know, I played an active role in the developmental stages of the study by attending meetings, participating in conference calls, providing written comments, and witnessing emissions testing. During the developmental stages of this project, I became very aware that the USEPA staff was conducting the project in an exemplary fashion. It was quite evident that the scope of the project was comprehensive, the collection and analysis protocols appropriate, the objectives well-defined, and the USEPA staff very capable.

Given this, it was decided that my time could be more efficiently and effectively spent on Title V and NSR permitting as well as other areas where technical support was needed within the DEP. As such, I started to track the progress of the asphalt study. It was important to track the progress of the study since a moratorium on the issuance of permits to asphalt batch and drum mix plants had been put into effect in Connecticut. This moratorium was established to assure that the results of the USEPA asphalt study could be considered in the NSR permit application review process. I believe that there are six applications in-house to which the results of the hot mix asphalt study will be applied.

To this end, the DEP has developed two sets of spreadsheets one for batch mix the other for drum mix plants. Each set contains eight individual tables, only natural gas and #2 fuel oil combustion are considered since the use of #4 or #6 fuel oil for a new or modified batch or drum mix plant in Connecticut would probably not be considered BACT. The eight tables are described briefly below:

1) Dryer/Hot Screens/Mixers (as applicable) – Criteria Pollutants
2) Dryer/Hot Screens/Mixers (as applicable) – HAPs (federal & CT)
3) Load & Silo Filling Operations – Criteria Pollutants
4) Load & Silo Filling Operations – Semivolatile HAPs (federal & CT)
5) Load & Silo Filling Operations – Volatile Organic HAPs (federal & CT)
6) Silo Filling & Storage Operations – Volatile Organic HAPs (federal & CT)
7) Asphalt Hot Oil Heaters – VOC, PAH & PCDD/PCDF
8) Premise-Wide Summary (Criteria Pollutant & federal HAP)

If you have any questions, please contact me at (860)-424-3465 or by E-mail at Newt.Rowe@po.state.ct.us.

Sincerely,

Newt Rowe
Analytical Scientist

cc: Robert McConnell, USEPA Region 1

This Page is intentionally left blank.

Lloyd Fillion
Citizens Against the Asphalt Plant
Boston, MA

Ravi Nadkarni
Wrentham Environmental Coalition
Wrentham, MA

Henry W. Nowick
Nowick Environmental Associates
Springfield MA

Hyla Napadensky
Napadensky Energetics
Lutsen MN

Janet &Lou Zeller
Blue Ridge Environmental Defense League
Glendale Springs, NC

Jeff Gearhart
Ecology Center
Ann Arbor MI

Stephen F. Lynch
Massachusetts State Senator
First Suffolk District
Boston, MA

This Page is intentionally left blank.

Minority Report on Fugitive Emissions from Asphalt Plants

Lloyd Fillion, Citizens Against the Asphalt Plant, Boston MA

Ravi Nadkarni, Wrentham Environmental Coalition, Wrentham MA

Henry W. Nowick, Nowick Environmental Associates, Springfield MA

Hyla Napadensky, Napadensky Energetics, Lutsen MN

Lou Zeller, Blue Ridge Environmental Defense League, Glendale Springs, NC

Janet Zeller, Blue Ridge Environmental Defense League, Glendale Springs, NC

Jeff Gearhart, Ecology Center, Ann Arbor MI

Stephen F. Lynch, Massachusetts State Senator, First Suffolk District, Boston MA

This Page is intentionally left blank.

Minority Report on Fugitive Emissions from Asphalt Plants

Introduction

In the mid-1990s, several groups of citizens and environmental organizations began petitioning the US EPA to quantify so-called "fugitive" emissions from bituminous concrete, or asphalt hot mix, plants. These requests were based on observations and subsequent theoretical analysis suggesting that such emissions could be significantly greater in their volume and concomitant impact on the local environment than the word "fugitive" implied. In late 1996, the EPA decided to move forward with its own testing after the asphalt industry failed to conduct their own testing in an open manner as they had promised the EPA, producing a test report[1] which was heavily criticized by academic and research scientists, public health officers, citizens, environmental activists and even from within the EPA itself. The citizen or public representatives who participated in this program ultimately included staff from public health departments in Chelsea, Massachusetts and Boston, Massachusetts, engineering/science consultants from several diverse disciplines including chemists, environmental, chemical and mechanical engineers, environmental organizations from Massachusetts, Connecticut, North Carolina and Michigan, and citizen activists from those states and from Minnesota, New York and Virginia. Additionally the Massachusetts Department of Public Health and one Massachusetts State Senator with experience in construction provided comments.

The EPA committed to providing an opportunity for citizens, along with industry and other stakeholders, i.e., other government agencies, to help frame the test protocols. This opportunity was provided through a series of conference calls and day long meetings and written communications. The interaction was hosted and coordinated by the EPA's New England Regional office, and continued through the testing, compilation of test data, analysis and production of reports. The commitment of the EPA was laudable; however, the several year long interactions were adversarial at best, with hostility or distrust between the multi-state citizen group with its technical consultants and the technical staff from EPA's Research Triangle Park (EPA-RTP). The barely contained rancor resulted in most of the conference calls and meetings being conducted with mediators from the EPA's New England Regional Alternative Dispute Resolution Program.

At the point of testing, the EPA provided opportunity (travel and lodging) for only one citizen technical advisor from the East Coast cluster of public commenters to witness the primary test which took place in California at a drum style facility, the same facility that had been previously selected by industry[1], code labeled by the EPA as "Plant C." At a secondary test in Massachusetts, at a batch style facility labeled "Plant D," three citizens were on site for the three days of testing. The primary test observer was severely handicapped because of an inability to be at more than one place simultaneously, a prohibition on citizen photography coupled with the EPA's reluctance and even refusal to take requested photographs as had been promised the citizens, and the exclusion of the citizen from certain meetings which occurred between plant personnel and EPA officers with their testing consultants who were responsible for the test. It is against this less-than-open venture in cooperation that the test and subsequent data are to be viewed.

---

1. "Emissions Testing: July 9 - 11, 1996" AIRx Testing, Ventura Ca - Job # 1030.

Why are many citizen groups concerned about asphalt plants?

Hot Mix Asphalt plants (HMA plants) and asphalt terminals have numerous characteristics that result in a large number of the general public being exposed to their hydrocarbon and particulate emissions. This is in contrast to the general experience where workers in industrial plants are frequently exposed to higher concentrations of pollutants for longer durations than the people who live near the plant. In the case of asphalt plants, this generalization is not correct because such plants, of which there are about 3,600 within the US, are often located in urban areas close to homes, schools and playgrounds with minimal setbacks. Further, the plants operate around the clock when fulfilling certain types of contracts so that while the workers might be exposed only eight hours per day, the neighbors breathe in the fumes day and night. While the operation of an asphalt plant might be seasonal, particularly in northern latitudes, the intensity of exposure during the peak production months is quite acute.

Anecdotal information collected by Boston Health Commission's Office of Environmental Health and by others shows that some individuals exposed to asphalt plant emissions have the same or similar symptoms: asthma, nausea, headaches, skin rash, etc. This information is not sufficient to indicate whether these physiological reactions were a result of hypersensitivity and allergies or whether this was a reaction of non-allergic people to levels of hydrocarbon and fine particulates high enough to elicit a response. Available epidemiological studies have shown statistically significant links between exposure to hydrocarbons and/or metal fume and childhood leukemia[2] and between exposure to asphalt fume and a variety of cancers. Dr. Eva Hansen[3] measured excess cancers in asphalt workers in Scandinavia. These included cancers of the mouth, esophagus, lung, and rectum. Dr. Hansen also found increases in non-pulmonary cancer, liver cirrhosis, bronchitis, emphysema and asthma in asphalt workers.

As a part of the interaction with the EPA, the multi-state citizen coalition held a conference call with EPA-RTP to discuss health effects of asphalt fume and to see if they could regulate emissions from HMA plants so that the exposure of the general population would be reduced. These discussions were unsatisfactory. EPA-RTP has acknowledged that their limited resources permit the consideration of only about 50 chemicals annually, out of a field of 50,000 chemicals not yet tested. Asphalt fume, a complex emission, is comprised of over 2,000 individual chemicals. Since EPA's current approach is based on considering each chemical by itself, knowledge about the health effects of each individual chemical will not be available for many decades. Further, even after this data has been compiled, the synergistic interactions between these chemicals in a complex mixture will not be available and would require further study. EPA-RTP suggested that the citizens undertake an epidemiological study to establish a statistical link between exposure to asphalt emissions and health

---

2. E.G. Knox & E.A. Gilman, "**Hazard proximities of childhood cancers in Great Britain from 1953 -80"**, *Journal of Epidemiology and Community Health*, 1997, **51**, 151-159.

3. Hansen ES, "**Cancer incidence in an occupational cohort exposed to bitumen fumes"**. Scand J Work Environ Health 1989;**15**:101-5. Hansen ES. **"Mortality of mastic asphalt workers"**. Scand J Work Environ Health 1991;**17**:20-4; Hansen ES, "**Author's reply**", **Scand. J. Work Environ. Health**,18: 135-41, (1992).

effects. EPA would not act to curb these emissions in the absence of such a study. For environmental pollutants like asphalt fume, neither exposure nor toxicity are acute enough to cause immediate death. The physiological response might take time (for example, cancer often takes several decades to develop even with exposure to known carcinogens like tobacco smoke) or the irritants will produce a variety of negative health responses in a general population which, while significant in terms of loss of productivity and "life, liberty and pursuit of happiness", don't cause immediate death but still have an effect on mortality and morbidity. To track asphalt plant neighbors on a national basis over a long period of time is a massive job that is totally outside the ability and resources of any citizen group[4].

The current work is the culmination of an almost 6-year effort to quantify fugitive emissions from HMA production/handling. On the one hand, EPA agreed to measure these emissions by collecting and analyzing data from two plants, labeled Plant C, a large drum plant and Plant D, a batch plant. For this we are grateful. On the other hand, the work has certain shortcomings and this Minority Report presents a discussion of these issues which have not been resolved to our satisfaction. Given the contentious and contradictory nature of the latest document "RESPONSE TO COMMENT ON DRAFT EMISSIONS ASSESSMENT REPORT, AP-42 SECTION AND AP-42 BACKGROUND REPORT"[5], a point by point rebuttal has not been attempted; instead a few select examples are presented to illustrate that these differences continue due to lack of valid response from EPA. The discussion focuses on the major questions that this work was expected to answer which unfortunately have not been answered.

It should be noted that there is a difference between the EPA and the citizens in the way they respectively approach the issue of asphalt fume emissions. The citizens approach the issue from a public health perspective. Thus their concern is with both average exposures for long term effects

---

4. There are probably political reasons for this reluctance. After all, the asphalt industry is at the confluence of several large, powerful and politically active industries with a long reach into Washington DC. These include the oil industry who produces the asphalt during the refining of petroleum, the sand and gravel business which produces aggregate, the other component of hot mix, the highway lobby and the State Departments of Transportation or Highways who have a symbiotic relationship with the hot mix asphalt industry as the major customer for the product. The article by Sarah Gibson ("How OSHA Dealt with Asphalt Fume", New Solutions, 5-1, 24 - 47, Fall 1994.) is essential reading for any one interested in learning how the industry dictated the final OSHA standards for occupational exposure to asphalt fume. The industry also conducted a vehement, coordinated attack on Dr. Hansen, the epidemiologist who has shown a significant relationship between exposure to asphalt fume and various cancers, at an ACGIH Satellite Meeting on "Developing Occupational Exposure Values from Toxicology and Epidemiology Studies" on March 6, 1998 in Seattle. Her use of statistics was vehemently challenged by a statistician as a part of an industry presentation by an employee of Ashland Oil. The industry also paid to bring other attackers to the meeting including an employee of a Scandinavian industry trade group and another Scandinavian researcher whose results are somewhat different from Dr. Hansen's.

5. "RESPONSE TO COMMENT ON DRAFT EMISSIONS ASSESSMENT REPORT, AP-42 SECTION AND AP-42 BACKGROUND REPORT" released December 20, 2000. This report and related information can be downloaded from: http://www.gov/ttn/emc/asphalt.html. Copies of CD ROM can be requested by mail from Emissions Measurement Center, MD-19, US EPA, Research Triangle Park, NC, 27711. Paper copies can be obtained from National Technical Information Service, 5285 Port Royal Road, Springfield VA 22161. 1-800-553-6847.

and also with peak, short-term exposures for acute effects; particularly since much of the anecdotal information deals with the latter. The EPA's approach, as stated in the latest response[5] is to collect data to primarily enable the estimation of emission inventories and for air quality planning, although EPA acknowledges that the information could be used in other contexts, for example, in applications to State authorities to build new plants. EPA's published data on emission factors is not just an average number for all plants when data from individual plants varies by orders of magnitude, as much of this data is collected under ideal operating conditions. For example, much of the data used for developing stack emission factors was collected just after initial plant startup often during a preoperating test period where the plant owner is demonstrating to the state regulatory authorities that the plant can operate for short periods of time at the design operating rate while staying within the permitted emission limits. In these situations, it is not unusual to have engineers from the equipment suppliers standing by to adjust and tune the equipment (as was the case at Plant C for EPA's test) to make sure that the equipment is operating optimally. Once the test is successfully completed, these engineers depart and the on-going emissions are dependent on the skills of the plant operators and their internal maintenance staff.

Of equal importance, and most critically, citizens and public health officers are inclined to consider worst case scenarios while the EPA almost consistently opted to publish data that reflects the best case scenario. Additionally, these numbers don't show measures of variability despite our request. Such measures are buried in the appendices.

Recently, the EPA has been criticized for the lack of science to back up their decision-making[6]. Specifically, National Research Council mentioned "weak scientific performance" and "weak scientific credibility". The problems uncovered by citizen reviewers in this case indicate that the current project also suffers from similar shortcomings.

Unresolved Issues

Rather than repeat the arguments, pro and con, under each topic, the highlights of the positions of the two sides will be presented in this discussion of unresolved issues with emphasis on issues that concern the citizens. Additional details, particularly of the EPA position, are in the most recent document[5]. Specific references are provided to the Section number in this "Response to Comments" report.

1. The issue of volatile content and operating temperature

If asphalt did not contain a volatile fraction, there would not be any emissions of hazardous organic chemicals from hot asphalt. Unfortunately, all asphalts contain a volatile fraction which evaporates at the operating temperature of between 275° and 375° F. Further, the emissions increase exponentially as temperature increases. The issues here are as follows:

---

6. "**Strengthening Science at the U.S. Environmental Protection Agency: Research Management and Peer Review Practices (2000)**", National Research Council, National Academy Press. http://www.nap.edu/openbook/030971275/html/

a. Why did the industry change the specification for the maximum allowable volatile content of asphalt from 0.5% to 1.0%? What are the implications of this change?
b. How is this volatile content measured now and how was it measured in the past?
c. How is the volatile content affected by seasonal variations in oil refining practice?
d. How is the volatile content affected by the various classes of additives that are sold to improve the performance of asphalt?
e. Are the maximum operating temperatures recommended by industry groups actually followed by plant operators? If not, what are the variations in temperature and what is the consequence of these variations?

The above issues are repeated below as captions for the discussion to follow which delineates the differing positions of the citizens and EPA in bold letters:

a. Why did the industry change the specification for the maximum allowable volatile content of asphalt from 0.5% to 1.0%? What are the implications of this change?

Traditional grades of asphalt use "proxy" properties such as viscosity at 140° F for specifying and differentiating between grades of asphalt. Under such specifications, the volatile content is a "not to exceed" value, typically 0.5% for the most common grade of asphalt AC-20. Certain users might allow a relaxation of these specifications. For example, in Massachusetts, the Mass Highway Department will allow their engineer in the field to relax the requirement for Loss on Heating from 0.5% to 1.0%. One of the problems with this type of specification is that the volatiles content of different batches of asphalt meeting the same viscosity specification will vary dramatically. For example, an article published by industry researchers[7] shows that the volatiles content of two different batches of AC-20 varied from 0.053% to 0.5%, a variation of one order of magnitude. This means that the emissions of asphalt fume would have also varied by an order of magnitude. Second, the "not to exceed" value for volatiles content is "based on original asphalt", i.e., before any blending. In other words, these specifications apply to the material that is shipped from a refinery, not necessarily to material that is shipped from a terminal to a hot mix plant. At a terminal, the terminal operator will add various diluents for altering viscosity. The potential effect of these diluents is discussed later in section d.

The old system of viscosity specification is being replaced by a new specification called "Superpave"which is based on measuring the properties of hot mix under simulated service conditions. This standard was jointly developed in concurrence with many parties including the government. However, the newer Superpave specification increases the permissible volatiles content to "not to exceed 1.0%".

Our concern is that the specification was changed by industry in order to make it easy and feasible for the industry to meet it under widely varying production conditions; otherwise, it

---

7. V.P. Puzinauskas & L.W. Corbett, of the Asphalt Institute, "**Report on Emissions from Asphalt Hot Mixes",** Paper presented at ACS Meeting, Chicago IL, August 1975.

would have remained at 0.5%. This means that the emissions from certain plants at certain times of the year, will be quite a bit higher than what is now shown in these reports. This increase is quantified in Table 1 later in this report. EPA's position is that this change is not relevant, and that anyone can use the volatility value they want in the equations presented. EPA also believes that the average volatility content of asphalts is less than 0.5% based on a set of samples analyzed in 1993 as a part of the SHRP program. (3.2.2) We strongly disagree that the range of volatility values measured in the SHRP program in 1993 is the relevant range for asphalts in use today after blending. Further, EPA arrives at conclusions about volatility of asphalts used around the country based on the SHRP data. This extrapolation would be correct only if equal quantities of each of the various asphalts in the database were sold each year in the US. There is absolutely no information to support that key assumption.

b. How is this volatile content measured now and how was it measured in the past?

The volatiles content of asphalt has traditionally been measured by the Thin Film Oven Test (TFOT), but the industry is moving to a slightly different test, the Rolling Thin Film Oven Test (RTFOT). We understand that a major reason for this change is because the results of the Rolling Thin Film Oven Test are more predictable, i.e., the method produces results with less systematic and random error.

There are two problems with either of these tests. First, both tests measure loss in weight on heating, which is not the same as measuring the volatiles content, particularly since some asphalt samples will gain weight as a result a pickup of oxygen and nitrogen. Nevertheless, because these tests are performed routinely, it is the only available data source for estimating the volatile content of original asphalt. Second, the loss of weight number obtained from the Thin Film Oven Test is lower than the loss of weight measured by the Rolling Thin Film Oven Test. However, the limited data, published by PES in the Plant C test report Appendix B.8, indicates that this difference is 0.16% at 325^{o} F. (For example, if the TFOT measured loss of weight as 0.3% and RTFOT measured the loss of weight as 0.46%, the difference would be 0.16%). When this difference was measured at two other temperatures, it was found to be less than 0.1%.

Thus, EPA's other explanation (3.2.2) that the volatiles specification was increased from 0.5% to 1% because of a change in the testing procedure from the Thin Film Oven Test to the Rolling Thin Film Oven Test is not supported by data. The citizens don't agree that a change of less than 0.16% should cause a relaxation of the specification by 0.5%, a value three times the measured change.

c. How is the volatile content affected by seasonal variations in oil refining practice?

Refinery operations change seasonally. For example, summer runs are designed to maximize gasoline production while winter runs decrease gasoline production and maximize fuel oil production. Seasonal variations in refining operations should affect the volatiles content of asphalt.

The citizens are concerned that no data is available on this subject. Similar concerns were raised by the Mass Department of Public Health. Such data might provide further insight why the specification was changed and might provide a better understanding of exposure suffered by neighbors of such plants.

d. *How is the volatile content affected by the various classes of additives that are sold to improve the performance of asphalt?*

In recent years, the industry has produced dozens of proprietary diluents and modifiers for the purpose of blending and for improving asphalt properties. These additives fall into different modifier families including the following: fibers, fillers, plastic/rubber, rejuvenating oils, antistripping agents, extenders and antioxidants. A partial list includes hydrolene (Sun Chemicals), Kraton polymers (Shell Chemicals), Elvaloy (Du Pont) and so on. The fibers and fillers are not expected to change the volatility but all others, which interact chemically with asphalt constituents, should alter the volatility of the asphalt, based on engineering principles. These substances are added in significant amounts: one or several percent by weight of the asphalt. In other words, the recommended amount of additive exceeds the percentage of the volatile component. Not only are these additives light compounds, but they can also alter the vapor pressure of the asphalt by increasing the volatility of some of the lighter components which otherwise might not have volatilized in the temperature range of 275 to 375^{o} F.

The citizens are concerned that the measurement of loss of heating of the original asphalt can bear little relation to the emissions from the asphalt that is actually used to prepare a hot mix. EPA's position is that this is not a significant issue. The two tests at Plant C and Plant D did not use any additives so there is no available data.

e. *Are the maximum operating temperatures recommended by industry groups actually followed by plant operators? If not, what are the variations in temperature and what is the consequence of these variations?*

The second factor that increases asphalt fume emissions is operating temperature. As such, emissions increase exponentially with temperature. State Highway Departments will specify a minimum and a maximum temperature for HMA when delivered to the job site where the pavement is being installed. In Massachusetts, this range is 275^{o} to 325^{o} F. Note that the actual temperature of the asphalt leaving the plant and being loaded into a truck is higher. The temperature has to be higher in order to compensate for cooling during transportation to the job site and this issue becomes critical when delivering to a distant job site. Also, note that there is no such restriction when delivering HMA for non-state supervised jobs. Also, according to an engineer who was the general manager of an asphalt plant and a plant designer internationally, who attended many of the planning meetings, many small private contractors who drive small trucks will demand a higher temperature at loadout since a smaller mass of HMA will cool faster.

There are also other factors that will increase emissions. For example, when a plant switches from one HMA mix formula to another, emissions will increase. The best example of this is

when a plant making hot mix with Recycled Asphalt Pavement (RAP) switches to a formula without RAP. In the first instance, the plant would have operated at a higher temperature to provide the extra heat to evaporate the water associated with RAP since the RAP is stored in the open and not dried. When the change occurs to a formulation without RAP, the plant loadout will emit a higher level of organics because of overheating. This is a frequent problem at batch plants though this type of problem is not restricted to only batch plants. (Examples of this type of excursion exist in the data collected at Plant C, a drum mix plant where emissions increased by a factor of two to three over a 40 minute period[8].) This again means that the episodes of high emissions caused by variations such as high temperatures are missed by the total reliance on averages of data collected under ideal conditions, even though the high emissions on the day of the test did affect the average.

The citizens, based on personal observations, believe that such periods of high emissions are frequent, especially at batch plants. Further, the public health impacts of these emissions are more significant since batch plants are more numerous than drum plants, located closer to homes and service the small independents who are more likely to demand hotter asphalt. The Table below, Table 1, is based on equations published by EPA relating volatiles content and production temperature to various emissions. (Please refer to the Emissions Assessment Report[9], Table 1 on page 6 and Table 11.1-14 on page 11.1-31 in appendix A.) Table 1 on page 9 of this report shows the differences between EPA's numbers and ours on the basis of assuming 1% volatile content and an operating/loadout temperature of 375^{o} F.

It can be seen that the emissions calculated by using EPA-derived equations, particularly emissions of noxious organic compounds, increase by more than 600% under conditions of higher operating temperature and volatility content. Both the EPA and the Citizen numbers would be increased by another 20 to 40% to compensate for the low bias introduced by the "background correction" and "Method 204", discussed later in this report. Finally, it should be noted that although the numbers in Table 1 are shown on an annual basis to help compare them to Table 1 in the Executive Summary of the Emission Assessment Report, the citizens are aware that actual annual emissions will be lower since a plant will not always operate with an asphalt with a high volatiles content at high temperatures. On the other hand, the table clearly shows the type of variation in emissions that is likely to occur under such conditions with its effects on nearby residents.

2. Issues relating to how the data was collected and analyzed

This process of planning, data collection and analysis has involved many discussions, agreements and disagreements.

---

8. Ravi Nadkarni, Comments on EPA Reports on Asphalt Fume Measurements, September 15, 1999.

9. "Hot Mix Asphalt Plants - Emissions Assessment Report" with Appendices A, B & C. EPA-454/R-00-019, December 2000.

The citizens are concerned that with time, EPA's responses have become more rigid, inconsistent and not based on data (or the lack thereof) in the reports. Only a few of the key issues are mentioned below. Others are found in the previous comments by the citizens to various draft reports by EPA[8, 10].

Table 1: Effect of Different Volatile Contents and Operating Temperatures on emissions

	<Batch plant data> EPA[a]	Citizens[b]	<Drum plant data> EPA[c]	Citizens[d]
Loadout emissions[e]				
- Total Particulate Matter	52	257	104	515
- Organic Particulate Matter	34	239	68	478
- Total Organic Compounds (Method 25A)	416	2,918	832	5,836
- Carbon Monoxide	135	947	270	1,893
Silo filling emissions[f]				
- Total Particulate Matter	59	211	117	423
- Organic Particulate Matter	25	178	51	356
- Total Organic Compounds (Method 25A)	1,219	8,550	2,437	17,100
- Carbon Monoxide	118	828	236	1,656

a. EPA estimates for batch plant in lb/100,000 tons of HMA. Volatility of 0.5%, 325° F.
b. Citizen estimates for batch plant in lb/100,000 tons of HMA. Volatility of 1.0%, 375° F.
c. EPA estimates for drum plant in lb/200,000 tons of HMA. Volatility of 0.5%, 325° F.
d. Citizen estimates for drum plant in lb/200,000 tons of HMA. Volatility of 1.0%, 375° F.
e. Loadout emissions for both batch and drum plants - See Table 11.1-14. AP-42.
f. Loadout emissions for plants with silo storage- mainly, but not exclusively, drum plants. See Table 11.1-14. AP-42.

a. *The issue of the "Background" correction*

Many of the methodological problems which occurred throughout this program are crystallized under EPA's topic of the "background correction". Background correction at Plant C refers to EPA's attempts to separately measure loadout emissions mixed with truck exhaust and just truck exhaust in order to subtract the truck exhaust values from the former to obtain a "pure" value for loadout emissions. But, the equipment for collecting the emissions in the tunnel at Plant C was not 100% efficient. Under such conditions of inefficient collection, the standard engineering practice is to use a tracer gas to measure the collection efficiency and then correct the raw emission data for this inefficiency of capture to arrive at a more appropriate estimate of the actual emissions. (Whether a single average

10. Ravi Nadkarni & Lloyd Fillion, Comments on EPA reports relating to AP-42 Section 11.1, August 31, 2000

collection efficiency factor should be used for adjusting all three runs or whether more time-specific collection efficiency factors should be used has been discussed extensively in previous comments[8] by the citizens. Also, the math works out such that if the truck exhaust value is high, the net value for the "pure" loadout emissions will be low.)

EPA conducted such a "background" run to measure just truck emissions. However, the data collected during the run had so many problems that EPA abandoned standard data reduction procedures to obtain an answer that they liked. There are three problems: First, the raw data shows a doubling in the background emissions from the first half to the second half of the run. What caused this doubling? Second, even if one uses the background data from the low first half of the run, the numbers are still too high. What is the cause of this result? Third, why did EPA abandon the standard engineering procedure for correcting measured emissions for capture efficiency? These various problems with this background run are discussed below:

i. Inconsistent raw data: The raw data, i.e., data as recorded, and not corrected for capture efficiency, shows two very distinct regimes in the run, with a break in between. The first regime is flat with little fluctuation and shows an average reading of 0.8 ppm of total hydrocarbons (THC). The second regime, which is also relatively flat, shows a value about twice this level. The first issue is what caused this doubling of measured emissions. EPA was unable to provide a credible explanation. The citizens believed that this increase was achieved by parking a second truck at the entrance to the tunnel so that the second regime was based on measuring emissions from two trucks. In the final RESPONSE TO COMMENTS report[5], EPA used only the first portion of the background run, hoping to avoid this inference that the background numbers were inflated. However, the second truck was at the entrance even in the first portion of the run, though for shorter time periods. Thus, as shown below, it is not clear that the lower values measured in the first regime represent exhaust from just one truck.

ii. Is the background reading from the first half of the run low enough?: By selecting only the data from the first half of the run and by not averaging the two regimes, it would appear that EPA has avoided problems with data reduction. Unfortunately, this is not the case.

iii. Problems with data corrected for capture efficiency: Standard protocol requires that when collection is not 100% efficient, the raw data has to be corrected for capture efficiency. Capture efficiency is measured with a tracer gas. Unfortunately, when correction is applied to the background data from the first half of the background run and subtracted from the combined loadout plus truck emissions to get "pure" loadout emissions, one gets negative values for several hazardous air pollutants. Since this is an impossible result, EPA decided to use the raw uncorrected background number rather than the capture-efficiency-corrected background number. Even after adopting this unusual procedure, some "pure" loadout emissions were still negative and they were assumed to be zero. There is a major problem with this procedure.

There is no technical/ scientific justification for ignoring capture efficiency. The only justification is that it produces numbers acceptable to EPA. The citizens suggested that the background "correction" be eliminated and the loadout emissions data reported as "truck plus loadout emissions". This suggestion was summarily rejected. We reproduce the first paragraph of EPA's summary rejection (3.2.2):

"The background adjustment was appropriate. There was no improper manipulation of the data from the background test at Plant C and EPA did not manipulate the placement of the trucks to obtain higher uncorrected emissions for the background run. Further, we do not agree that the background run demonstrates that data was manipulated to produce biased results and do not believe that concurrently measured truck exhaust and road dust emissions should be included in the emission factor for load-out emissions."

EPA states further that:

"The only additional instruction provided to the truck drivers during the background test was to reduce the time of their travel from the exit of the tunnel to the arrival at the tunnel entrance.....At about the time trucks began driving faster to reduce gaps between trucks, the wind speed increased. <u>This may have caused an increase in the diesel exhaust that entered the tunnel entrance</u> or increased the capture of the diesel exhaust of the truck that was inside the tunnel." (Emphasis added.)

The problem with these explanations is that the raw data clearly shows that the reading doubled in the second half of the run. This doubling needs to be explained. Above, EPA is admitting that there may have been an increase in diesel exhaust entering the tunnel entrance, i.e., exhaust from two trucks was being counted, but this possible explanation is two paragraphs after the original denial. Also, note the statement, *"Dr. Nadkarni* [the citizen observer at the Plant C tests] *observed the operation of the trucks during the background run. The issue of manipulating the placement of the trucks was not raised by him during the test to either of the EPA personnel present."* This statement is incorrect. On the day of the run, he left early to catch a plane and was not present when the second half of the data was collected. Further, problems of this type are visible only after the data has been collected and viewed. Such insights are impossible in the field. Dr. Nadkarni had objected originally to the background "correction" because it seemed to be an unnecessary manipulation of data and the results. In retrospect, his concerns were well founded.

The explanations of why the background reading was not corrected for capture efficiency, in 3.3.4, are mutually contradictory. The tracers used to measure capture efficiency showed that capture efficiency was high early in the morning and decreased as the day wore on during all the runs at Plant C. The most reasonable explanation was that as the land around the plant heated up, there was an on-shore breeze which blew through the tunnel and decreased the

capture efficiency. The capture efficiency data for the background run is consistent with this general statement. This also means that truck emissions captured in the second half of the background run, when corrected for capture efficiency, were three times those in the first half. This further confuses the issue. To the citizens, these problems raise serious questions about both the first and second half of the run. The general scientific procedure when data can't be explained is to reject it.

Finally, it should also be noted that the auditors from RTI were apparently not involved in a detailed analysis of this procedure of collecting "background" data.

This background correction introduces a low-bias in the published results for load out emissions. EPA's estimate of this bias introduced by not correcting for capture is about 20%. Both EPA and citizens' numbers in Table 1 would have to be increased by this amount to compensate for this unexplainable "background" factor. The citizens believe that the entire procedure is faulty and should be rejected.

b. Problems with enclosures

At Plant C, because the loadout enclosure did not meet the requirements of Method 204, an EPA protocol for constructing total enclosures for measuring pollutant emissions, a tracer gas was used to measure the capture efficiency. At Plant D, because the specially constructed loadout enclosure met the requirements of Method 204, it was assumed that all the emissions would be "captured". Method 204 gives precise design requirements which put limits on the size of Natural Draft Openings compared to the surface area of the walls, floor and ceiling of the enclosure with the desired ratio being less than 5%, the velocity at Natural Draft Openings to be at least 200 ft per minute and other limitations on the distance between the opening and the emission source. In essence, under Method 204, an induced draft fan collects the fumes from inside the enclosure and delivers them to the instrumentation at the sampling point. By controlling the openings (Natural Draft Openings) to a specific size, the intent is to force outside air into the enclosure, avoiding any loss of the material being sampled. As the data shows[8,10], complying with these requirements still does not result in proper sampling of fumes inside this enclosure. This point is illustrated by the following situation.

i. The loadout enclosure is empty. The instrumentation measuring hydrocarbons is showing zero hydrocarbons since the fan is pulling in just air from the empty enclosure. (See paragraph vi below.)
ii. A truck stops under the loadout point. Hot mix asphalt is dumped into the truck from a silo (a single dump) or from a batch mixer (several dumps with a waiting period in between). During this period, the air and asphalt fume in the enclosure are pulled past the hydrocarbon measuring instrumentation by a fan.
iii. The truck loadout is complete, but the instrumentation continues to indicate and record hydrocarbon emissions from the hot mix sitting in the truck
iv. The truck leaves the enclosure. One should expect the fan to evacuate all of the fume from inside the enclosure and for the hydrocarbon reading to go to

zero quickly. But this does not happen. As a matter of fact, the readings persist at a non-zero value for a long period of time showing that Method 204 does not do a good job of delivering hydrocarbons from inside the enclosure to the measuring point. In other words, since the emissions lingering in the enclosure are not delivered to the instrumentation for measurement, they are not "captured".

v. The truck will continue to emit hydrocarbons in the yard of the manufacturing plant. These are not captured by the sampling system attached to the enclosure. In the report, these have been estimated as the so-called "yard emissions".

vi. The next truck enters the enclosure. If the enclosure was doing the proper job, it would have shown an initial reading of zero, as mentioned above under i. However, this is rarely the case since these emissions linger in the enclosure.

Criticism of Method 204 was provided to the EPA before the Plant D tests but was ignored. One of the problems with Method 204 was illustrated during the first day of testing at Plant D. Method 204 requires that the inward velocity at any opening be maintained over 200 feet per minute (fpm) so that air is flowing into the enclosure and not out of the enclosure. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. At Plant D, the citizens observed that some of the fumes were escaping from the top or the bottom openings in the downwind door of the tunnel because of an ambient breeze. The contractors corrected this by decreasing the size of the openings by about half at the end of the first day of testing. Once this was done, this upset condition did not occur again. EPA's recollection of this event is quite different. (3.1.2).

In spite of these deficiencies, EPA position was:

"As the analysis is an extrapolation of only two data runs and the enclosure was designed to Method 204 criteria, EPA believed that the actual uncaptured emissions are most likely smaller than estimated by our analysis. Therefore, no further adjustments were made to the loadout emissions from Plant D." (3.1.2)

This is a confusing argument. The citizens position is that EPA again biased the results by this action. EPA's estimate of this bias is of the order of 10% and this adjustment would have to be used to adjust the EPA and citizen numbers in Table 1, but this adjustment could easily be double this value, i.e. 20%, in our opinion.

c. EPA's flat denial of errors in the report

In the Introductory Section of our last response[10], reproduced in the current report as 1.1.1, we commented that we were dissatisfied with the report review process because EPA released draft reports that were not sufficiently finalized. We specifically referred to the following problems; incorrect references, missing and incorrectly referenced appendices and numerical and logical errors in the analysis. We were referring to the entire review process, not just the

current cycle. Also, our point was that EPA should produce draft reports that are free from error and the review process should not become a search for a needle in a haystack if a large document is referred to without providing a page number. Further, once the responsibility for finding each mistake is entirely passed to the reviewers who are volunteering their time for the review, such mistakes will persist in the final report as such volunteer reviewers miss them. In their current response to comments[5], EPA responded on page 1:

> *"The comment with respect to numerical and calculational errors is unsubstantiated in that no instances of any numerical or calculational errors were provided by the commentors."*

This comment is not accurate. In the previous round of comments[8], such numerical and calculational errors were shown. These included averaging data over a period when there were no emissions because trucks were absent, and showing a wrong number as a maximum value. These mistakes were not caught by EPA'S auditor Research Triangle Institute (RTI). Although chances are that RTI's contract focused on data collection procedures and did not include an auditing of data reduction and data analysis, their role is being exaggerated in the final report. At industry's urging, EPA is including the following statement in the Final Report. "*For example, two scientific auditors from the Research Triangle Institute were employed to independently audit the test and reporting process."* (1.4.38). If RTI is to be given credit for the audit process, they should also be assigned blame for its failures.

EPA did admit to problems with references and appendices but stated that the missing appendices were provided on October 6 (1.1.2) or October 3 (1.4.54). They fail to mention that this was over a month after the end of the comment period.

At Plant D, two citizen observers noted what appeared to be errors in protocol for sampling. Specifically, when the sampling train was rinsed to recover condensed organic matter, the observers saw that the entire tube was not being rinsed. When this issue was mentioned, EPA's denial was immediate and strong, even before the citizens had explained their observations.

Numerous logical errors and examples of bias were pointed in comment letters[8, 10], To this, EPA's response is, *"The information presented in the reports as drafted are (sic) unbiased.*" (1.2.6). An example of an "unbiased" statement, we suppose, is the following from 2.4.6: *"The lack of data to substantiate the statement is not a reason to eliminate the statement"*.

d. <u>Unfounded Leaps of Faith</u>

In 3.7.2, while criticizing the use of model compounds by others at a time when no data on the composition of asphalt fume was available[11], EPA defends its own use of model

---

11. R. Nadkarni, written communication to Chief, Emission Factor and Methodologies Section, USEPA-RTP, November 7, 1994; R. Nadkarni, written communication to Mr. Ron

compounds when such data on composition of asphalt fume is available. Furthermore, this data clearly shows that the two substances selected by EPA as model compounds, docosane and tricosane, are not the major measured constituents of asphalt fume. Standard scientific practice would be to use the best information available for this purpose. When data is available on the major constituents of asphalt fume, EPA chose these two compounds purely for expediency when data shows otherwise. EPA states, *"The Antoine's coefficients for aliphatic hydrocarbons that come the closest to producing a working loss emission estimate of 32 pounds per million gallons of asphalt throughput for this approximate molecular weight are docosane and tricosane."* In other words, these compounds are chosen because they give the desired result.

A similar contradiction exists in 3.7.6. Here EPA admitted that reference 360 in Appendix B, a report of certain tests by Division of Air Quality, North Carolina Department of Environment and Natural Resources, 1998, was not evaluated critically but then EPA ignored the comments offered by the citizens. These comments had pointed out that the authors of the reference had selectively ignored high readings of ambient benzene concentrations and used only the low readings. Further, they had used questionable methodology to convert an ambient concentration to an emission rate. Nevertheless, EPA decided to retain this defective information in the final report stating: *"The reference was not read critically..... the results that were developed for truck load-out (*in this reference*) do provide limited support for the load-out emission estimates for benzene."* In other words, EPA will continue to use this faulty information because it, purely by accident, appears to provide limited support to an EPA-derived number.

e. Problems with witnessing tests

The citizens were permitted to witness the actual tests at Plant C and Plant D. One individual, Dr. Nadkarni, was allowed to be present at Plant C and up to 3 individuals, were allowed at Plant D. While there can be justifiable concerns about visitor safety and owner liability when visitors are allowed to wander unfettered around an operating industrial plant, the usefulness and limitations of allowing a single witness need to be discussed.

The first issue is what a single witness can see when data is being gathered using complex instruments or complex sampling trains in various places simultaneously. Second, when access is also prevented under the claim of confidentiality, much information is shielded from citizen observers and discrepancies are seen by the citizen observers only after the data has been published in a draft report. (See references 8 and 10 for details on the questions raised about the data.) In an industry where the manufacturing equipment is available from several competing firms who will provide all the necessary details in order to sell this equipment, and the product is produced to published customer specifications, our view is that there IS little proprietary content. If plant operating procedures are proprietary, they would be of interest

---

Ryan of EPA of October 26, 1995 and November 16, 1995; and R. Nadkarni, written communication to Mr. David Mobley of July 5, 1996.

only to another HMA manufacturer and access to these details would be obtained, as in other industries, by hiring away a plant operator. Yet, access to information was blocked on many occasions under the cloak of confidentiality. Following are specific incidents where there were differences between the observations by the citizen observer and the EPA.

i. Emissions from the downwind end of the tunnel: In the discussions leading up to the actual testing at Plant C, EPA asserted several times that they had not observed any fugitive emissions exiting the tunnel at Plant C. However, they agreed to use tracers to measure capture efficiency. When Dr. Nadkarni arrived at Plant C on the day before the first test, he was surprised to see visible emissions exiting from the tunnel. (Such emissions were seen during each day of the test, typically later in the day when the ambient breeze became stronger.) Several times when this phenomenon was pointed out to EPA staff, they ascribed these emissions to a plant malfunction. Since citizens could not take photographs but EPA could, he requested that this fume be photographed and several times his request to document this photographically was turned down because the fumes might not be visible in a photo. When the draft report was published, the capture efficiency numbers corroborated this observation that fume was escaping from the downwind side of the tunnel, contrary to EPA assertions during planning, but there is little photographic evidence. Yet, at Plant C, the EPA Project Director spent almost an entire day with a videographer hired by the industry association consulting him on what to videotape.

   In case of Plant D, no tracers were employed because the specially constructed enclosure was presumed to meet Method 204 requirements. The shortcomings of method 204 were obvious to the citizen observers on the first day of testing. Two citizen observers noted that the streamers at the Natural Draft Openings on the downwind side (above and below the door) were pointing towards the outside showing that a breeze was counteracting the draft induced by the fan. Again, there is no photographic evidence. While this problem was corrected for days 2 and 3 by installing plywood to reduce the size of the openings by half, EPA claims that this observation was not communicated to them until much later. (See 3.1.2) Similarly, the citizens observed that the fume lingered for a long time inside the enclosure at Plant D and was not transferred to the measurement point, as was discussed earlier in Section 1.b. Again, the citizens could not document this because of the restriction against photography.

ii. Lack of information sharing and access to instrumentation: At Plant C, the control room was cleared of all observers several times. Therefore it was not possible to take actual readings to double check the readings taken by EPA contractors. (This is not to cast any aspersions on the contractors who took these readings. Our point is that it was not possible to double check these readings). EPA had information on the volatile content of asphalt prior to and

during testing at both plants. This information was not shared until much later.

iii. Prejudging of final outcome: On the day before the start of testing at Plant C, the industry hosted a dinner attended by the senior EPA staff member and the citizen observer. The citizen observer was quite surprised when the industry was told by the EPA staff member that EPA had no intention of regulating fugitive emissions from their industry.

Conclusion

Citizens, industry and EPA-RTP have undergone a lengthy process during the last six years to examine fugitive emissions from asphalt plants. This process suggests that there are lessons to be learned regarding a number of aspects of this exercise.

1. An epidemiological study should be undertaken by the government to better understand the quantity and intensity of health problems caused by exposure to asphalt fume. In our very limited casual interaction with individuals across the country, we have had too many anecdotal histories come to our attention to ignore this public health problem. These histories include the deaths of otherwise healthy farm animals barned within several hundred yards of an asphalt plant in the northeast section of the country, rashes and difficulty breathing by humans all across the country, each living in close proximity to one of these facilities, and cancer clusters in proximity to asphalt storage tanks at terminals. It is hard to believe that each of these instances is due solely to uncaring plant operators lacking concern for the impact of their business on the surrounding neighborhood. Even if the cause is determined to be hypersensitivity by individuals to certain chemicals, this is an issue that should not be faced by each individual citizen as his or her "problem" but rather is a responsibility for society as a whole, as well as for the industry.

2. A number of the EPA's regional offices have extensive experience in working through environmental concerns in concert with citizens rather than in opposition to the public. Some of the citizens who are working with this problem of asphalt fume have heretofore had productive relations with their regional offices of EPA on other industrial concerns. It may be that EPA-RTP has not had reason to develop protocols for interaction with the public, possibly because more of its business is conducted with industrial representatives. Nevertheless, it may be appropriate that EPA-RTP review its approach to citizens to find ways of encouraging that dialogue with an emphasis on cooperation and mutual respect. It is important that the public understands that it IS no less a partner with government at every level than is industry.

3. Industry and state environmental departments place great reliance on AP-42 emissions factors during the process of local permitting. However, AP-42 contains averaged data collected under the best of circumstances and is a poor source to determine “worst case” environmental impact scenarios. Many of the factors representing these worst cases are not as clearly represented in that document as it could be. To avoid misuse, simple changes in the layout

could be accomplished such that where appropriate, the limitations of factors are made more evident, without recourse to the introductory language of this lengthy government publication. Even a standard "warning" or notice attached to each table could begin to highlight this complexity.

4. Industrial proprietary information varies from industry to industry. While some industries' competition may involve truly cutting edge technology, methodology and technique, other industries' competition is based on non-technical non-proprietary factors such as location and market power. Restrictions on oversight by the public during EPA financed tests as were conducted may be appropriate in one instance, and in other instances may more reflect an attempt by industry to hinder open and frank discourse. We believe that Government should aggressively challenge, where appropriate, unsubstantiated demands for secrecy by industry which ultimately reflect negatively on both that industry and on the government.

5. Henry Nowick, Nowick Environmental Associates, Springfield MA

Gary Fore, Vice President
Environment and Safety
National Asphalt Pavement Association
Lanham, MD

This Page is intentionally left blank.

NATIONAL ASPHALT PAVEMENT ASSOCIATION
NAPA Building • 5100 Forbes Boulevard . Lanham, Maryland, USA 20706-4413
Toll Free: l-888-468-6499 ▪ Tel: 301-731-4748 . Fax: 301-731-4621
Mike Acott, President

February 1,200 1

Mr. Bob McConnell
EPA Region'1
1 Congress Street/CAQ
Suite 1000
Boston, MA 02114

Reference: Draft Hot Mix Asphalt Plants – Emission Assessment Report; AP-42 Section 11.1; Emission Factor Documentation for AP-42 Section 11.1

Dear Mr. McConnell;

In 1996, the National Asphalt Pavement Association began working with government and citizen groups to determine the amount of emissions that are emitted during silo and truck load-out operations. In order to develop emission factors for the HMA industry, more than 390 emission test reports and other types of documentation were compiled and reviewed. The question of truck load-out and silo emissions has been answered. As a result, the Hot Mix Asphalt industry is now one of the most thoroughly studied industries in the United States. During testing, quality assurance scientists from Research Triangle Park, North Carolina were deployed on-site to independently audit the testing program and procedures. We have every reason to believe that the test data are representative of average emissions from HMA facilities.

This test data has proven conclusively that emissions from asphalt plants are low, well controlled and not "major sources" of emissions. The evidence is quite extensive, the industry and states need the data, and it is now time to bring finality to the process of testing.

We appreciate the diligence put forth in successfully completing a project of this magnitude.

Sincerely, ,

R Gary Fore

R. Gary Fore
Vice President –
Environment, Health & Safety

This Page is intentionally left blank.

Chapter 4

Hot Mix Asphalt Plants
Response to Comment on
Draft Emissions Assessment Report,
AP-42 Section and AP-42 Background Report

Released December 2000

This Page is intentionally left blank.

RESPONSE TO COMMENT ON DRAFT EMISSIONS ASSESSMENT REPORT, AP-42 SECTION AND AP-42 BACKGROUND REPORT

(Released December 20, 2000 and to be published in the Stakeholder Opinions Report)

This response to comments was prepared by:

Source Monitoring and Technology Group
Emissions Monitoring and Analysis Division
Office of Air Quality Planning and Standards
United States Environmental Protection Agency
Research Triangle Park, NC

December 2000

This Page is intentionally left blank.

Contents

This Page is intentionally left blank.

1.0 Process, Report Organization, Presentation and Bias

1.1 Process

1.1.1 CAAP Process Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Commentors Introduction, Section A*

Before discussing the results of our review, we want to comment on the review process and our general dissatisfaction with it. When complex, technical documents are sent to a wide audience for review, one assumes that both the EPA and their contractors did their best to produce as final a draft as possible. One would not only expect that most of the typos and numerical errors have been found and eliminated but that the authors wrote the report in a way that makes it easy for the reviewer to go back to the primary references and original sources (assuming that they are available) to check a particular point. On both these counts, the reports, just like the previous set of reports reviewed last year, fail resoundingly. Many key comments are not referenced at all; in some cases, the references are incorrect; in other cases, the reference is made to a large document without giving a page number, making it difficult and time-consuming to check. Appendix B refers to its Appendix B and Appendix C on page 4-137. But these appendices, which presumably contain the statistical results and the data sets, are not provided, making it impossible to even spot check the analysis. This, combined with the severe time constraints, makes it impossible to review the reports in any but a cursory fashion, using random spot checks, to make sure that the numbers are correct. Unfortunately, the reports also fail on that count since numerical or logical errors in the analysis have been found.

1.1.2 Response to CAAP Process Comment Number 1 - The commentors have identified a few areas where the report could benefit by more specificity in the wording of the statements. However, EPA believes that these reports present this large amount of highly technical information in a clear and organized fashion. Most respondents did not comment on the reports structure which appears to indicate most reviewers could understand the reports as drafted. The comment with respect to numerical or calculational errors is unsubstantiated in that no instances of any numerical or calculational errors were provided by the commentors. The primary references for this report are the almost 350 emission test reports used to develop the emission factors for the source category. All of the key comments in the report refer to the information contained within these test reports or were derived from compiled information contained in these test reports. While some ancillary information contained in the report was not referenced in the draft report, additional reference citations supporting this information were added to the final report. While we do not believe it is necessary to cite individual references in the main report, each of the test reports are cited in Appendix A and B. To assist the reader, in the main report we have included the location in Appendix A, B or C where more detailed reference citations are available. These test reports (which were summarized in Chapter 4 of Appendix B) are generally over 50 pages in length and some may be over one thousand pages (like the Plant C test report). EPA obtained most non-EPA test reports from State or local air pollution control agency files. Typically, copies of these reports are not routinely provided to reviewers. However, specific source

test reports can be provided upon request. While the detailed results of the statistical analysis were inadvertently excluded from the report, the data were presented in the tables in chapter 4 and the methodology and conclusion was presented in that chapter as well. The detailed results of the statistical analysis were provided to all of the commentors on October 6, 2000 and are included in the final report.

1.1.3 CAAP Process Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Commentors Introduction, Section A*

We also need to air another complaint regarding the process. For about 6 weeks before the report was finally issued, we received phone calls informing us that the release of the reports was imminent. While we appreciate receiving this advance warning, it also turns out that the actual release of the reports was much later than announced. One of us (Ravi Nadkarni) had cancelled attendance at the Annual Meeting of IPMI in mid-June in response to these calls. Because of weddings in the family, Ravi was going to be unavailable after July 17 and wanted to start the review process as soon as possible, hence the cancellation. Unfortunately, the reports were received only on June 28. This means that he missed an important Annual Meeting where he is on the Board of Directors. We appreciate getting the extra time until the end of August to complete this review.

Appendix C was prepared in 1996. Why was this 69-page document not provided earlier so that it could have been reviewed before this "crunch" period? Also, are comments on such a document, which has undergone a "final" review, relevant at this stage? Finally, why was this document not released to us when the citizen groups and the EPA were discussing sampling issues, when that document might have provided an additional viewpoint? For all these reasons, this third document has not been reviewed.

1.1.4 Response to CAAP Process Comment Number 2 - EPA reasonably accommodated reviewers by providing additional time and flexibility for the review of the Emissions Assessment Report. While the report was release later than originally anticipated, EPA provided notice of this delay and extended the review period for the report to provide flexibility to the reviewers schedules. Additionally, most of the information in the draft report had been available for over two years on the Emissions Factors and Inventory web site and both of the commentors had previously commented on at least two items in this earlier draft report. EPA postponed completing this 1998 draft AP-42 Section and background report pending completion of the load-out emissions testing. Almost all of the stack test data and analyses in the current draft were also contained in the previous draft. The information added since 1998 concerned the development of factors for the silo filling, load-out and yard emissions based largely on tests conducted at the request of the commentors and other stakeholders with similar interests. The data and EPA analyses for this information were clearly available to all of the stakeholders and were identified in the EPA report Response to Comments on Testing for Asphalt Plants C and D. There was a limited amount of information that was not available to the stakeholders until we circulated the draft. This information included the approximately thirty emission test reports submitted by the State of Wisconsin in response to the circulation of the first draft of the AP-42 Section and background report for Hot Mix Asphalt Plants. In addition, the

36 page main body of the Emissions Assessment Report was also new to reviewers. The review time provided was more than adequate to review information not previously made available for review.

With regard to Appendix C, the purpose of this appendix was to provide background information to reviewers on how the revised emission factors could be used with available techniques for preparing an emission inventory for hot mix asphalt plants. This type of information is not presented in AP-42 sections nor in the background reports for the AP-42 sections. As stated in the introduction to the EIIP document (Appendix C), "The purposes of the preferred methods guidelines are to describe emission estimation techniques for stationary point sources in a clear and unambiguous manner and to provide concise example calculations to aid in the preparation of emission inventories. While emissions estimates are not provided, this information may be used to select an emission estimation technique best suited to a particular application." It should be noted that the primary audience for the EIIP reports are engineers and environmental scientists that are assembling local or regional emissions inventories. Information on the availability of the draft of this EIIP document was provided in a letter from Ronald B. Ryan of EPA to Dr. Ravinda Nadkarni (with copy to Lloyd Fillion) dated September 5, 1995. The letter clearly states that the purpose of the EIIP document is to explain how to inventory emissions from hot mix plants. The letter further stated that additional information on fugitive emissions from truck loading was not included in the document. The draft document was available for comments on the EPA web from October 1995 to about March of 1996. The commentors did not request a paper copy of the draft EIIP document and did not provide any comment on this document at that time. As with most emission factor and inventory documents, the documents are revised from time to time. All of the commentors were advised that Appendix C was a final report in EPA's June 2000 cover letter transmitting the Emissions Assessment Report. Additionally, this cover letter stated "Comments on Appendix C of the EA Report will be forwarded to the EIIP Point Source Committee for their consideration in future revisions."

1.2 Organization

1.2.1 CAAP Organizational Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Commentors General Comments, Section B*

AP-42 is essentially a "cookbook" for engineers/contractors who need to produce emissions estimates for local regulatory authorities to obtain permits to construct and operate plants. In view of this, the overall organization of the three reports does not make sense. In the long run, Appendix A will be used most often for estimating emissions. When necessary, the background information in Appendix B will be reviewed. The "main" report will remain either as a political document used by lobbyists or fade away. As it now stands, the "main" volume repeats in a vague and biased way, the information in first two appendices. The same information is presented in a marginally better format and with slightly less "spin" in Appendix A. If the main document is supposed to be an Executive Summary to Appendix B, it is a poor summary and reads more like a political tract. This is particularly true since only emissions data on plants using natural gas is

given in the main report; i.e. there is a deliberate attempt to show only the lowest emissions. Most of the caveats associated with the summary information in the main report are well concealed in Appendix B. If EPA is serious about making the main document useful, it should use the main document to calculate the total emissions to the environment from a batch and a drum asphalt plant. This type of rewrite, where other emissions (for example from materials handling and storage piles, storage tanks, from traffic and truck exhaust, and so on) are also calculated and shown for typical plants, will result in a guidebook for industry contractors and help them by demonstrating how such calculations should be made. (In Massachusetts, specific plants will employ a wide range of pollution control technology and then argue that it is "state of the art" and is BACT (Best Available Control Technology)). Other emissions are currently only listed and cross-referenced in Section 2.3 on page 16. These include emissions from storage tanks (AP-42 Chapter 7), materials handling and storage piles (AP-42 Sections11.19.2 and13.2.4), vehicular traffic (AP-42 Sections 13.2.1 and13.2.2) and emissions from trucks bringing in the raw materials and taking away the hot mix asphalt (AP-42 Volume II).

1.2.2 Response to CAAP Organizational Comment Number 1 - The organization of the three reports was designed to meet the needs of a diverse audience. The "main" report presents a summary of the detailed technical information presented in Appendices and provides emission estimates for a typical facility. Because of limiting the volume of technical information, information representing HMA plants using fuel oil (an estimated 10 to 30% of the fuel used by the industry) were omitted from the "main" report. The presentation of technically factual information representing the two different production methods of average size, using fuel used by between 70 and 90% of the industry, is most representative of nationwide emissions from hot mix asphalt plants. While it is recognized that the use of fuel oil results in higher emissions of some pollutants, fuel oil is seldom used when natural gas is available and is primarily used as a backup fuel. However, it is recognized that the "main" report should include information that fuel oil is used to produce approximately 10 to 30% of the HMA, that the use of fuel oil creates higher emissions. The main body of the report will include a revised summary of emissions for both oil fired and gas fired facilities.

As stated above, the purpose of the "main" report is to provide a summary of more technical information. It is agreed that the "main" report may benefit by the addition of fugitive emissions calculated from emission factors contained in other AP-42 sections. These emissions include diesel exhaust, dust from truck traffic and dust from raw aggregate handling. The main body of the report is not a stand alone guidebook for contractors. Industry contractors and State agency permit and inventory specialists will use AP-42, the EIIP document (included as Appendix C) and other supplementary information to make the required calculations.

1.2.3 CAAP Organizational Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) -
Commentors General Comments, Section B
Finally, it is unclear whether this "main" report has a number or whether EPA-454/R-00-0XX is the final designation. The reason for asking this is because reference 1 of Appendix A has the same name and a designation of EPA-454/R-00-019, but this reference is dated May 2000. What is going on?

Commentors Summary Comments, Section C
Confusing Report Designations: The designation of the reports is confused. The main report is called EPA-454/R-00-0XX. But Reference 1 of Appendix A has the same name and a designation of EPA-454/R-00-019, and this reference is dated May 2000 while the main report is dated June 2000.

1.2.4 Response to CAAP Organizational Comment Number 2 - The EPA report number was requested for this report in advance so that all of the reports associated with the Hot Mix Asphalt projects would be numbered consecutively. The EPA report number on the title page of the report was changed to XX to avoid the draft report being considered a published EPA report. The actual date of publication of the report was used for the final report. The use of this report as the citation for the first reference in Appendix A is circuitous. Appendix A and Appendix B are being made available as separate independent reports through the various mechanisms used to distribute the AP-42 sections and their associated background reports. As a result, a more proper citation reflecting the Appendix B material was used.

1.2.5 CAAP Organizational Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) -
Commentors Summary Comments, Section C
Sloppy Report Preparation: The reports are full of minor errors, are poorly organized, repeat the same paragraphs in different documents, and have incorrect references. Many key comments are not referenced at all; in some cases, the references are incorrect; in other cases, the reference is made to a large document without giving a page number, making it difficult and time-consuming to check. The data sets used for statistical analysis are not provided, making it impossible to even spot check the analysis. All indications are that there was no complete internal review of the report within EPA before releasing it.

Commentors Summary Comments, Section C
Poor Organization: The overall organization of the three reports does not make sense. In the long run, Appendix A will be used most often for estimating emissions. When necessary, the background information in Appendix B will be reviewed. The "main" report will remain either as a political document used by lobbyists or fade away. The main report shows the industry's emissions in the best possible light with most of the caveats associated with information being well concealed in Appendix B. If EPA is serious about making the main document useful, it should use the main document to calculate the total emissions to the environment from a batch and a drum asphalt plant, rather than show the information from AP-42 with the decimal point moved to the right.

1.2.6 Response to CAAP Organizational Comment Number 3 - These reports present the large amount of highly technical information in a clear and organized fashion, and therefore it is reasonable to encounter some minor editorial errors in the final report review. While the document benefitted by some editorial corrections, the reports contained few errors and these errors were not substantive.

The organization of the three reports was designed to meet the needs of a diverse audience. In order to meet these needs, some information was repeated in all four parts of the report. As explained elsewhere, all three Appendices are available separately. Therefore, some background information is repeated so users do not have to obtain all three Appendices to understand any one Appendix. While future uses of the "main" report will be modest compared to Appendix A and B, it is unlikely to be used to support any air emissions permit for any new or existing facility. The information presented in the reports as drafted are unbiased.

1.2.7 CAAP Organizational Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

1. Page 1-1, final paragraph: The organization of the entire report is confusing. The last line refers to Section 5, which is the same as Appendix A. Which is the main report and which are the subsidiary appendices?

1.2.8 Response to CAAP Organizational Comment Number 4 - As stated previously, the report is organized such that each part of the report can stand by itself. The main body of the report provides summary information from the three Appendices. Appendix A is the AP-42 section for Hot Mix asphalt which is generally written for use by air pollution professionals. Appendix B is the background information for the AP-42 section and is typically used by researchers and the few air pollution professionals looking for more detailed information than is presented in the AP-42 section. Appendix C is an existing document describing emission inventory methodologies applicable to Hot Mix Asphalt Plants and was published for air pollution professionals specializing in emission inventories and air quality management.

As each of the Appendices is intended to be stand alone reports, the last line was revised to "The final AP-42 Section 11.1, Hot Mix Asphalt Production is presented elsewhere."

1.3 Perspective

1.3.1 CAAP Comment on Report Perspective (Ravi Nadkarni & Lloyd Fillion) - *Commentors General Comments, Section B*

The main report is a political document for the following reasons. The EPA's pro-industry bias shows on almost each page. Every attempt is made to minimize emissions, for example, by calculating emissions for plants burning natural gas only in the "main" report. The report also provides qualitative comments to indicate that emissions could be even lower in many cases; for example, "counterflow drum mix plants

will likely have lower organic compound emissions than parallel flow drum plants", page 11.1-9. Such comments are not substantiated in the detailed information provided in Appendix B. Yet, caveats regarding conditions under which the emissions might be higher are few and far between. This tilting is not surprising given the proindustry bias expressed many times by the Project Officer during the course of testing.

Commentors Summary Comments, Section C
Pro-industry Bias: The EPA's pro-industry bias shows on almost each page. Every attempt is made to minimize emissions shown. The report also provides qualitative comments to indicate that emissions could be even lower in many cases. We don't see why EPA makes such statements in the absence of data. Yet, caveats regarding conditions under which the emissions might be higher are few and far between.

1.3.2 Response to CAAP Comment on Report Perspective - The EPA has conducted a fair and balanced process to consider stakeholder's opinions during the development of emissions information for hot mix asphalt industry. Consistently, EPA ~~has~~ accommodated CAAP concerns at additional cost and delay in completing EPA's evaluation of hot mix asphalt plant emissions. In response to these latest comments, EPA has made additional changes to the Emissions Assessment Report. As stated elsewhere, the report was revised to suggest that the natural gas is used to manufacture HMA at approximately 70 and 90% of the HMA facilities in the US. Where appropriate, the report includes separate emission factors for oil-fired and gas-fired HMA plants.

The commentor quotes a statement in a part of the report that describes general process information. There are no statements in the "main" report or Appendix A which would provide support for using a lower emission factor in the report. It is not clear how the reporting of technically accurate information based on known engineering principles to generally characterize "typical" facilities of each, major production process, fired with the most commonly used fuel to fire most of the HMA plants in the U.S., shows a bias.

1.4 Presentation

1.4.1 Industry Presentation Comment Number 1 (Steve Zemba, Cambridge Environmental) -
General: A list of acronyms at the front of the document might e helpful to readers.

1.4.2 Response to Industry Presentation Comment Number 1 - A list of acronyms was added to the front of the document.

1.4.3 Industry Presentation Comment Number 2 -(Steve Zemba, Cambridge Environmental) -
Hot Mix Asphalt Plants Emissions Assessment Report
The last sentence third pgh. of pg 1 contains a typo: the 100,000 tons of production corresponds to a batch plant, not a drum plant.

1.4.4 Response to Industry Presentation Comment Number 2 - The word drum was changed to batch in this sentence.

1.4.5 Industry Presentation Comment Number 3 - (Steve Zemba, Cambridge Environmental) -

Hot Mix Asphalt Plants Emissions Assessment Report

1st pgh. of p. 10: Does the emission assessment report provide stack emission rates for a typical counterflow or parallel flow drum plant? If the estimates are for a parallel flow plant, it might make sense to mention in the text the approximate difference expected for emissions from a counterflow plant (e.g.. this could be mentioned in a footnote to Table 2).

1.4.6 Response to Industry Presentation Comment Number 3 - The emissions estimates provided in Table 2 are appropriate for both parallel flow and counter flow drum plants. While the statements in the AP-42 section and background reports concerning potential differences in organic emissions between these two dryer designs are based on valid engineering criteria, sufficient information is not available to quantify these differences. As a result, data from both types of facilities were combined to determine the volatile organic and organic particulate emission factors.

1.4.7 Industry Presentation Comment Number 4 - (Steve Zemba, Cambridge Environmental) -

Hot Mix Asphalt Plants Emissions Assessment Report

p. 3: EPA might want to provide the regulatory definition or a better explanation of criteria pollutants and HAPs.

1.4.8 Response to Industry Presentation Comment Number 4 - A brief regulatory definition of criteria pollutants and HAPs was included in the Glossary which be added to the document.

1.4.9. Industry Presentation Comment Number 5 - (Steve Zemba, Cambridge Environmental) -

Hot Mix Asphalt Plants Emissions Assessment Report

p. 2, 3rd pgh: Might want to mention the number of tests (> 300) that survived the screening process (i.e., were usable for the development of emission factors).

1.4.10 Response to Industry Presentation Comment Number 5 - We agree that more detailed information on the number of tests that were used to develop the resulting emissions factors is needed in this paragraph. In addition to stating that over 300 tests cleared the initial screening process, general information on the number of tests that support broad classes of pollutants was provided. Also, the reader was referred to Appendix A and B for more specific information on the number of supporting tests and quality ratings of individual pollutants. The paragraph was revised as follows: "To develop emission factors for the HMA industry, data from about 370 emission test reports and other documents on the industry were compiled and reviewed. Through a careful

screening process, about fifty of the reports were determined to be unusable for emission factor development and were excluded from further evaluation. About 310 reports remained and were compiled by plant type, emission source, pollutant, and emission control. For each emission test, emission factors were calculated by dividing the measured emission rates by the HMA production rate measured at the time of the emission test. These emission factors were then grouped by source, pollutant, and control device, and an average emission factor was calculated for each group. While particulate, CO_2, CO and TOC emission factors are based upon over one hundred tests, most of the remaining criteria pollutant emission factors are based on between five and ten tests. A few HAP emission factors are based upon more than five tests, although the majority are based upon between two and five tests. Information on the supporting data for specific emission factors and the quality rating assigned to the emission factor is included in the emission factor tables in Appendix A and B. Generally, the number of supporting data are typical of many AP-42 sections. However, the number of data supporting particulate, CO_2, CO and TOC emission factors is greater than most AP-42 sections."

1.4.11 Industry Presentation Comment Number 6 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 4: A. Add in (source classification code in parentheses) under Figure 1 Typical

Page 5: A. Add in (source classification code in parentheses) under Figure 2

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-3: A. Add in (source classification code in parentheses) under Figure 11.1-1 General ...

Page 11.1-4: A. Add to Figure 11.1-2. General process flow diagram for **parallel-flow** drum mix asphalt plants.

B. Add in (source classification code in parentheses) under Figure 11.1-2 General ...

Page 11.1-6: A. Add in (source classification code in parentheses) under Figure 11.1-3 General ...

1.4.12 Response to Industry Presentation Comment Number 6 - The titles of the figures were revised to include that the source classification codes are in parentheses within the figures and that Figure 11.1-2 is a parallel-flow drum mix plant..

1.4.13 Industry Presentation Comment 7 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 2: A. Paragraph 1, second line -please add the following: ...and PM-2.5 **and very small amounts of** hazardous air pollutant. ..

C. Second sentence - please add the following: ...VOC and **very small amounts of** volatile HAP organic compounds.

Page 10: B. 4th paragraph - Please correct as follows: ... CO; and **very** small amounts of organic compounds ...

Page 11: A. 1st paragraph - Please add the following: ... organic aerosol may contain **very** small amounts ...

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-7: A. In the fourth line, second paragraph under 11.1.2.1 - Batch Mix plants, please add the word *very* before the word small. The sentence will then read "and **very** small amounts of organic compounds"

Page 11.1-8: B. In the second line from the top of page - please add the word *very* before the word small. The sentence will then read "may contain **very** small amounts of HAP"

Page 11.1-9: A. I n the first paragraph under section 11.1.2.3 - please add the word *very* before the word small. The sentence will then read "and **very** small amounts of organic compounds of various species"

1.4.14 Response to Industry Presentation Comment Number 7 - The additional modifier "very" would not add any substantial information to the sentences and may be misinterpreted to be a relative indication that the emissions of these compounds or the relative proportion of these compounds from HMA plants are less than other similar type sources.

1.4.15 Industry Presentation Comment Number 8 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-10: A. 2nd paragraph -Suggest a more typical loss-on-heating of **0.25** not 0.41

a. To estimate total PM emissions from drum mix plant load-out operations using an asphalt loss-on-heating of 0.25 percent and temperature of 290°F, HMA mix, the following calculation is made:

$$
\begin{aligned}
EF = \; & 0.000181 + 0.00067\,(-v)e^{((0.0251)\,(290 + 460)\,-20.43)} \\
& 0.000181 + 0.00067\,(-(0.25))e^{((0.0251)(290 + 460)\,-20.43)} \\
& 0.000181 + 0.00067(0.25)e^{(-1.605)} \\
& 0.000181 + 0.00067(0.25)(0.2009) \\
& 0.000181 + 0.0000485 \\
& 0.000215 \text{ Ib/ton of asphalt loaded}
\end{aligned}
$$

NOTE: The correlation factor in the equation should be 0.00067 and not 0.00059.

This loss-on-heating value is a value that is seen on a daily basis within the Industry.

1.4.16 Response to Industry Presentation Comment Number 8 - As indicated in the sentence preceding the equations, this is an example to show the user how to calculate the emissions with the various equations presented in Table 11.1-14. A temperature and a loss-on-heating value was selected for this equation that would not be confused with the recommended default values in the footnote to Table 11.1-14. We agree that the constant for the MCEM portion of the equation should have been 0.00067. However, based upon other comments, the batch and drum mix equations were combined into one equation. As a result, the revised constant value of 0.00141 was used in the example equation.

1.4.17 Industry Presentation Comment Number 9 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-17 : A. In the title for Table 11.1-6, please delete the word formaldehyde from title

1.4.18 Response to Industry Presentation Comment Number 9 - The word formaldehyde was deleted since it is not included in the table.

1.4.19 Industry Presentation Comment Number 10 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
General comment - Tables tend to be confusing. For example, Place HAPs contiguously with HAPS and follow with Non-HAPs together. Also, suggest adding a set of batch table and drum tables with contiguous HAPs listing, non- HAPs listing and metals HAPs vs. non-metal HAPs listing.

General comment - Suggest following the same table order as found in the Emissions Assessment Report. Much less confusing.

Page 11.1-20 :
A. Sub title: Hazardous air pollutants under Pollutant Heading - For easier reader understanding, please change subtitle from Hazardous air pollutants to **non PAH/HAPs**

B. Please add a line totaling the non-PAHs hazardous air pollutants section. Currently very confusing.

C. Sub title PAHs - Please change from PAHs to **PAH/HAPs**

D. Please add row and sum the NO.6 fuel "organic HAPs"

E. Please change non-HAP subtitle to Non Organic HAPs

F. Sub title: Hazardous air pollutants -Please change to **PAH/HAPs**

G. Left side column under Dryer with fabric filter - Please add **natural gas, propane, fuel oil, or waste oil fired.** Confusing as is and fails to distinguish between these fuels and No.6 fuel oil.

G. Footnote b -Please change as follows: ~~Natural gas, propane, fuel oil, or waste oil fired dryer. For pollutants that are marked with a~~ "*", ~~separate emission factors are presented for No. 6 fuel oil fired dryers~~. Substitute these factors for above factors when burning No.6 oil.

Page 11.1-21,22,23: A. Use the same format and comments as suggested for above Table 11.1-9

Page 11.1-22 and 23: A. Please add Dioxins and Furans to above referenced Organics and HAPs

Page 11.1-24:B. Footnote b - Please change as follows: ~~Natural gas, propane, fuel oil, or waste oil fired dryer. For pollutants that are marked with a~~ "*", ~~separate emission factors are presented for No. 6 fuel oil fired dryers~~. Substitute these factors for above factors when burning No.6 oil.

Page 11.1-27:
A. Overall comment - Should create subtitles for Metal HAPs category and a Metal Non-HAPs categories. Also suggest moving to 11.1-9.

B. Adjust footnotes accordingly.

Page 11.1-28:
B. Use the same format and comments as suggested for above Table 11.1-9. Should be the same for both drum and batch.

C. Please delete Footnote b. unnecessary.

D. To make the table easier to read, suggest switch last two sections of the table. The section pertaining to lead and mercury should come last.

Page 11.1-30:
A. Place PAH/Organic PM (%) up above PAHs line in the left column. It should be a title, not a part of the data.

B. Change Subtitle from PAHs to **PAH/HAPs**

C. Total PAHs, subtitle -Change to **total PAH/HAPs**

Page 11.1-31:
A. Move subtitle -Compound TOC (%) up to be included in the titles for the columns.

B. Create Sub title - **non-VOC/non-HAP's**

C. Please a Percent sign (%) to every EF as in table 11.1-15. It is currently very confusing because the other tables in this document do not contain percents.

D. Total- add line **total volatile organic HAPs**

E. Please add to the example on page 11.1-10. It would be helpful to illustrate the use of Table 11.1-16.

1.4.20 Response to Industry Presentation Comment Number 10 - The reorganization of the emission factors tables for organic and metal HAPs address most of the issues identified by the commentor. Although the revised presentation causes repetition of most of the compound or element specific emission factors, this presentation makes this information less confusing. Within source category types, the compounds were segregated into broad classifications (non-HAP organic compounds, PAH HAP, non-PAH HAP, Dioxin and Furan) and the sums of these classifications were provided. These three changes should make it easier for the reader to use this information. The following suggested revisions of specific details in the tables were also accommodated. Specific comment for page 11.1-27 (A & B) - Rather than creating HAP and non-HAP categories of metals in this table, a separate footnote was created. To more clearly alert the reader of the HAP classification of the element, the footnote letter now follows the metal name in the pollutant column. Specific comment for page 11.1-30 (A, B & C) - The title was moved to the top of the column as a single heading for the load-out and yard column and the silo filling column. Also, the subtitles in the Pollutant column for PAH and Total PAH's were changed to PAH HAPs and Total PAH HAPs. Specific comment for page 11.1-31 (A) - The subtitle was moved to the top of the column as a single heading for the load-out and yard column and the silo filling column. Specific comment for page 11.1-31 (B) - The speciation profile for VOC was moved to the top of the column and a subtitle non-VOC/non-HAP was added between VOC and the other compounds. Specific comment for page 11.1-31 © - Percent signs were added to the values for each speciation profile percentage. Specific comment for page 11.1-31 (D) - A row was added to the bottom of the table to present Total Volatile Organic HAPs. Specific comment for page 11.1-31 (E) - An example to illustrate the use of speciation information in Tables 11.1.15 and 11.1.16 was added to page 11.1-10 between the paragraph describing the speciation profiles and the paragraph describing methods to estimate emissions from asphalt storage tanks.

1.4.21 Industry Presentation Comment Number 11 - (Gary Fore, Vice President National Asphalt Pavement Association) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

Page 11.1-29: A. Question[ing] why [the table] include[s] total PM when it includes organic PM? This is very confusing.

1.4.22 Response to Industry Presentation Comment Number 11 - Total PM does include organic PM. Organic PM is included as one of the known components of fine particulate matter as this information may be needed in air quality management analysis for PM fine. The speciation of the total PM (also PM-2.5) into the organic and inorganic components provides some information that will be needed to help prepare regional control strategies. EPA has established a network of air samplers that determine the constituents of fine particulate matter. The important major constituents include sulfates, nitrates, ammonium, organic carbon (a.k.a. organic PM), elemental carbon and a number of elements. Similar information is presented for the stack emissions although the nomenclature is slightly different. This difference in nomenclature recognizes that the organic constituents in stack gas are vapors and will condense after cooling to ambient temperatures. The users of AP-42 and FIRE should be aware that, for stack sources, total PM is the summation of Filterable PM, condensible inorganic PM and condensible organic PM.

1.4.23 Industry Presentation Comment Number 12 - (Gary Fore, Vice President National Asphalt Pavement Association) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

Page 11.1-29: B. Footnote a. -Please change the word asphalt to **HMA mix** to prevent confusion as to mix temperature or liquid temperature.

1.4.24 Response to Industry Presentation Comment Number 12 - The text in footnote a which defines the term T in the equation was changed to "T = HMA mix temperature in °F".

1.4.25 Industry Presentation Comment Number 13 - (Gary Fore, Vice President National Asphalt Pavement Association) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

Page 11.1-32: A. Please correct Reference No.2. Katherine is spelled Kathryn

1.4.26 Response to Industry Presentation Comment Number 13 - The correct spelling was used.

1.4.27 Industry Presentation Comment Number 14- (Gary Fore, Vice President National Asphalt Pavement Association) -

Hot Mix Asphalt Plants Emissions Assessment Report

Page 2: B. Second sentence - delete the "e" off of the end of with

1.4.28 Response to Industry Presentation Comment Number 14 - The spelling of with was corrected.

1.4.29 Industry Presentation Comment Number 15 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
D. paragraph 2 - please add the following: ...emissions for specific facilities **where source specific emissions is not available or where source testing is cost prohibitive.**

1.4.30 Response to Industry Presentation Comment Number 15 - The phrase "where source specific emissions are not available or where source testing is cost prohibitive" was added to the end of the last sentence in the second paragraph.

1.4.31 Industry Presentation Comment Number 16 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 10: A. 2nd paragraph - Please add the following: ... counterflow drum mix plants will likely have organic **stack** emissions ...

1.4.32 Response to Industry Presentation Comment Number 16 - The clarifying word "stack" was added to the sentence.

1.4.33 Industry Presentation Comment Number 17 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 11: B. Last paragraph - Please add the following: An initial screening ~~the~~ **of** these documents...

1.4.34 Response to Industry Presentation Comment Number 17 - The sentence was corrected to say "An initial screening of these documents…."

1.4.35 Industry Presentation Comment Number 18 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 12: A. 1st paragraph - Please add the following: ... truck prior to these departure for the job site"**)**". Missing end parentheses.

1.4.36 Response to Industry Presentation Comment 18 - The closing parenthesis was added to the end of the phrase.

1.4.37 Industry Presentation Comment Number 19 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page13: B. 4th paragraph - Prior to the last sentence please add the following sentence. ... developed from the data. **For example, two scientific auditors from the Research**

Triangle Institute were employed to independently audit the test and reporting process. These additional steps ...

1.4.38 Response to Industry Presentation Comment Number 19 - The additional sentence was added to the paragraph prior to the last sentence.

1.4.39 Industry Presentation Comment Number 20 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 20: A. Sub title PAH - Please change as follows: **PAH (semi volatile HAPs).**

1.4.40 Response to Industry Presentation Comment Number 20 - The parenthetical phrase was added to the sub title.

1.4.41 Industry Presentation Comment Number 21 - (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 20: B. Please delete line between methylene chloride and **MTBE**

1.4.42 Response Industry Presentation Comment Number 21 - The line was deleted.

1.4.43 CAAP Presentation Comment Number 1 - (Ravi Nadkarni & Lloyd Fillion) -
Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

12. Page 4-2 to page 4-117: On these pages, each reference is reviewed and commented upon. There are several problems with this section. Initially, section 4.2.1.1 discusses reference 1, section 4.2.1.2 discusses reference 2 and so on. By the time one reaches the end of this chapter, the numbering is no longer synchronized. Section 4.2.1.327 refers to reference 354. In between, some references are not discussed (42, 43, 115, 116, 120, 127, 131 and so on). In other cases, missing references are discussed, for example reference 258. In addition, the same reference numbers refer to different documents. For example, on page 4-6, during the discussion of reference 23, references 26 and 27 are discussed. One has to read the citations carefully to realize that these are references from the document called reference 23. But the exact citations for 26 and 27 are not given. A careful reading also shows many inconsistencies. In some cases, the data is downrated because some information is missing; in other cases, it is not. See for example reference 181 where the data is still rated A although information about RAP processing was not provided. On page 4-106, it appears that the cross references are incorrect.

1.4.44 Response to CAAP Presentation Comment Number 1 - Historical consistency of reference numbers with previous versions of this section was considered a more important criterion than synchronizing the paragraph numbering with the reference numbering. This consistency facilitates the understanding of some of the differences in national, regional and site specific emission inventories over time. In addition, this

consistency assists individuals reviewing or revising existing permits that include emission estimates made with emission factors from previous versions of AP-42.

The lack of synchronization beginning at paragraph 4.2.1.42 is the result of approximately 40 source tests excluded from emission factor derivation due to critical deficiencies. Rather than discussing the nature of the critical deficiencies for each test in the text, Table 4-1 provides the reasons the references cited are not considered further. Some of the critical deficiencies include "Flow rates provided; cannot calculate emission rates," "No production data provided," "Insufficient process description and production data," and "Test methods not comparable to EPA reference methods."

Reference 258 (described in paragraph 4.2-233) was not missing and was summarized on page 4-84 and listed in the references on page 4-365 of the draft Appendix B report. Reference 284 (described in paragraph 4.2.1.258) was also not missing and was summarized on page 4-91 and 4-92 of the draft Appendix B report and listed in the references on page 4-336.

Reference 23 is a document that provides information concerning the particulate size distribution of kiln stack emissions. As indicated in the discussion, the information is considered a secondary reference since the report provides limited detail on the contents of unavailable test reports. Also the discussion states that primary reference material is available for some information cited in the report. The discussion explains that because of a lack of the primary reference information, some emission factors were developed based on the secondary reference when no primary reference information was available.

It is recognized that a reader may misinterpret the reference numbering within the discussion of Reference 23 and that citations for references 26 and 27 of Reference 23 need to be provided. We have revised the way this information is presented and cited so that the reader can better discern that these citations are internal to reference 23.

Data are down rated because of the lack of critical information for quantifying the mass emissions or for quantifying the production rate in units of the emission factor developed. Data were not down rated due to the lack of information on normal operating parameters although this information might result in a slightly better understanding of the effects of these operating parameters on emissions. While it would have been helpful in evaluating the relationship between RAP usage and emissions, the lack of information on RAP usage does not affect the ability to assessing the quality of the measured emissions.

1.4.45 CAAP Presentation Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

12. Page 4-2 to page 4-117: The section ends with the review of reference 354 on page 4-117. This review resumes on page 4-167. This is poor formatting for a report.

1.4.46 Response CAAP Presentation Comment Number 2 - To facilitate the issuance of this report, including the addition of approximately 30 references, we have adopted the format summarizing all of the references in one section. As with the draft background report, we considered keeping the information related to the separate processes together to improve the users comprehension of the emission factor development for each emission point within a facility. However, this would have required renumbering the more recent references for load-out and silo filling to present unrelated processes separately. We believe that maintaining the numerical order of the references in the final report with the numbering in the draft is more important.

1.4.47 CAAP Presentation Comment Number 3 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

13. Pages 4-118 through 4-147: There are two sections in this report: 4.2.4 Results of Data Analysis and 4.3 Statistical Approach which more or less cover the same ground. They should be combined so that the exposition is complete and consistent.

    In many cases, common sense should tell us that the emissions to the atmosphere are either a result of the performance of a control device or the result of the presence of a pollutant in the feedstock. A good example of the former is the PM emission factor from dryers controlled with a fabric filter. Here, the emission factor for PM is not dependent on fuel type. An example of the latter, is the sulfur dioxide emission factor for dryers. Here, the emissions are dependent on fuel type since the control devices do not remove any substantial amount of this pollutant. Yet, these issues are never discussed.

1.4.48 Response to CAAP Presentation Comment Number 3 - We did not integrate the two analyses because we believed it would make it more difficult for users familiar with other AP-42 background reports to understand the basis upon which the emission factors for HMA were developed. Essentially all of the statistical analyses performed could not discern effects that many knowledgeable individuals, with good engineering judgement, would support. The inability of the statistical analyses to discern statistically significant effects are discussed elsewhere (see response 3.5.2 and 3.5.16). The HMA source category is one of few AP-42 sections that had sufficient data for us to consider a statistical analysis.

Generally, decisions on combining or separating data from different production methods or different control types are justified with good engineering judgement (e.g. common sense). Integrating the inconclusive statistical analyses, which provide no useable information, and the practical information typical users need, will obfuscate their understanding of the decisions we made to develop the emission factors. Additionally, we believe that some users would misinterpret the statements in the statistical analyses and perceive the quality of the factor is lower than the data indicate.

We have identified similar commentor misinterpretations concerning the criteria used for establishing the emission factor quality ratings. Specifically, in the comments presented in section 3.4.1, 3.4.3, 3.4.5 and 3.4.9, the commentor considered variation between sources (either range of data or standard deviation) as a primary criterion for assigning a low quality rating. Variations between sources is normally used as one of several secondary criteria to make minor adjustments to a rating. We believe that integrating the statistical analyses would further exacerbate misinterpretations of the established emission factor rating criteria. This is especially true when most statistical analyses were inconclusive even when there were hundreds of supporting data. Presenting the traditional emission factor derivation methods separate from the voluminous inconclusive statistical analyses will enable customary users of the background reports to better understand the derivations.

1.4.49 CAAP Presentation Comment Number 4 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

19. Page 4-137, paragraph 1: The description of the box plots is extremely short and incomplete. Obviously, the authors do not intend to make it easy for readers to understand these plots. Technically, what is shown is a "Box-and-Whisker" Plot, which is used to show characteristics of univariate data. The data is ordered and ranked and then divided into four equal parts. For example, a data set of 20 points would be divided into four portions, each containing five data points. The box encloses the middle 50% of the data. The text states that the whiskers "represent adjacent values". Our understanding is that the whiskers either enclose the entire data range, i.e. the upper whisker shows the range of values for the higher 25% of the data and the lower whisker encloses the range of values for the lower 25% of the data. Alternately, in modified Box plots, the upper whisker is drawn to the highest point within 1.5 times the interquartile range and the lower whisker is drawn to the lowest point within 1.5 times the interquartile range. The interquartile range is the difference between the 75^{th} and 25^{th} percentile values. Values outside the range bounded by the whiskers are plotted individually. None of this has been bought out in the terse description.

1.4.50 Response to CAAP Presentation Comment Number 4 - There are a number of common variants of box-plots or box-and-whisker plots. Although short, the description on page 4-137 is sufficient to explain the information presented in the plots. We agree that the statement "The horizontal lines above and below each box represent adjacent values," could easily be misunderstood by many readers and requires clarification. We have added the following definition "The upper adjacent value is defined as the largest data point less than or equal to the 75th percentile plus 1.5 times the interquartile range; the lower adjacent value is defined as the smallest data point greater than or equal to the 25th percentile minus 1.5 times the interquartile range."

1.4.51 CAAP Presentation Comment Number 5 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

20. Page 4-137, paragraph 3: The paragraph lists the statistical analyses performed. However, the box plots shown are for only a few of the analyses listed. Where are the remaining plots?

1.4.52 Response to CAAP Presentation Comment Number 5 - Box plots and scatter diagrams were not developed for small data sets because these statistical visualization tools provide little assistance in understanding the potential relationships that may exist between and among the individual data points. All of the box plots and scatter diagrams that were developed to facilitate understanding the distribution and relationships of the data are presented.

1.4.53 CAAP Presentation Comment Number 6 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

21. Page 4-137, paragraph 5: This paragraph refers to Appendices B & C. Where are they?

1.4.54 Response to CAAP Presentation Comment Number 6 - There were only two Appendices (A and B) that were developed for the 1997 draft of this background report. These Appendices were inadvertently left out of the revised draft provided to the commentors. The indication that there are three Appendices is a typographical error. Appendix A is the statistical analysis of batch mix driers and Appendix B is the statistical analysis of the drum mix driers. A copy of these two appendices were e-mailed to all of the commentors on October 3 and was included in the final report.

1.4.55 CAAP Presentation Comment Number 7 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

22. Page 4-138, paragraph 2: This paragraph refers to Appendix A. Where is it?

1.4.56 Response to CAAP Presentation Comment Number 7 - As stated above Appendix A was inadvertently left out of the revised draft.

1.4.57 CAAP Presentation Comment Number 8 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

23. Page 4-139, paragraph 1: This paragraph refers to Figure 4.2. Note that Figure 4.7 has an identical caption. The two figures should be labeled properly. One has to read the text very carefully to realize that Figure 4.2 refers to batch plants and 4.7 refers to drum plants.

1.4.58 Response to CAAP Presentation Comment Number 8 - The captions for Figures 4-1 through 4-6 were revised to include the term "batch plants" and the captions for Figures 4-7 through 4-11 were revised to include the term "drum mix plants." This should clarify which processes are presented in each set of figures.

1.4.59 CAAP Presentation Comment Number 9 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

26. Page 4-144, paragraph 2: The first sentence is incomplete.

1.4.60 Response to CAAP Presentation Comment Number 8 - We revised the first sentence to read , "The linear model analysis indicated that neither of the continuous variables modeled (RAP content, production rate) had a significant effect on filterable PM emissions. Furthermore, analysis of the scrubber data indicated that the effect of scrubber pressure drop on filterable PM emissions also was negligible."

1.4.61 CAAP Presentation Comment Number 10 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

29. Page 4-147, paragraph 4: This is the beginning of the review of the more recent data on load-out emissions. As noted earlier, there is a change in format of the report at this point in that the discussion of data sets is split into three separate parts.

1.4.62 Response to CAAP Presentation Comment Number 10 - Separate discussions of stack and fugitive emission sources were intended to keep the reference numbers the same as previous AP-42 sections and present unrelated emissions processes separately. However, approximately thirty additional emission test reports on HMA plants in Wisconsin were submitted for evaluation. These reports include tests supporting industry comments on the emission factors for SO_2 and benzene for stack emissions from drum mix plants. As a result, the summaries and evaluations of test reports for the stack emissions and fugitive production emissions were aggregated and presented in the approximate order that the references were reviewed and summarized for emission factor development.

1.4.63 CAAP Presentation Comment Number 11 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

34. Page 4-151, paragraph 4: The last line is ambiguous. Silo emissions were measured only at Plant C. They can't be "combined" with any other measurements.

1.4.64 Response to CAAP Presentation Comment Number 11 - The last sentence was revised to read "The following sections will describe the basis for performing these adjustments to arrive at load-out and silo filling emissions at a standardized temperature and asphalt volatility. This will allow the two load-out data sets to be compared and, where appropriate, combined."

1.4.65 Industry Presentation Comment Number 22 - (Norman Ostroff) -
Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft
On page 4-153 you present the following equation:

$$EF_{cor} = ((C_{prod}) - (C_{back}))*(EF_{prod}/C_{prod})$$

If this equation were written in "algebra" rather than "computerese," it might look like:

$$EF_{cor} = \left[\left(C_{prod}\right) - \left(C_{back}\right)\right] \times \frac{EF_{prod}}{C_{prod}}$$

This small change would make the equation more "readable" to me and perhaps others. I understand the physics of the equation, but recommend that the definition of the parameter C_{prod} be repeated here; it is not specifically stated. I assume that this equation is dimensionally correct, but recommend you include the units for the respective terms. In the numerical example that follows (in the text), I recommend that you indicate to the reader the exact source of the input data. I could not find the reference to Run 1 MCEM, but could have missed it while reading the report. Also, demonstrating the calculation of C_{prod} from raw data would have been helpful to me.

1.4.66 Response to Industry Presentation Comment Number 22 - The equation was placed in an equation format to make it more readable. In addition, the text that follows was revised to include units for the various terms and the table containing the source of the input data will included. The text will read as follows:

"

$$EF_{cor} = \left[\left(C_{prod}\right) - \left(C_{back}\right)\right] \times \frac{EF_{prod}}{C_{prod}}$$

Where:

EF_{cor} = Background corrected emission factor (lb/ton).
C_{prod} = Capture efficiency corrected production concentration (gr/dscf).
C_{back} = Measured background concentration (gr/dscf).
EF_{prod} = Capture efficiency corrected emission factor (lb/ton).

The following values were obtained from Table 4-22. REPORTED PARTICULATE-BASED LOAD-OUT EMISSIONS – PLANT C.

C_{prod} = 1.68×10^{-3} gr/dscf (from MCEM row, second column).
C_{back} = 3.78×10^{-4} gr/dscf (from MCEM row, eighth column).
EF_{prod} = 3.12×10^{-4} lb/ton (from MCEM row, third column).

EFcor = $((1.68 \times 10^{-3}) - (3.78 \times 10^{-4})) * (3.12 \times 10^{-4} / 1.68 \times 10^{-3})$
= $1.30 \times 10^{-3} * 1.86 \times 10^{-1}$
= 2.42×10^{-4} "

1.4.67 Industry Presentation Comment Number 23 - (Norman Ostroff) -
Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft
On the bottom of page 4-154 and the top of page 4-155, you present a short discussion of vapor pressure. I agree that the Clausius-Clapyron (CC) equation generates a linear relationship between (the logarithm of the) vapor pressure and (the reciprocal of the absolute) temperature. The Antoine equation is a refinement of the CC equation in which a third constant has been added. The CC equation is a special case of the Antoine equation in which the third constant is 273.16. Please double check your references, the (CRC) Handbook of Chemistry and Physics provides tabulated numerical vapor pressure (verses temperature) data for a large number of compounds and Lange's handbook provides Antoine equation constants.

1.4.68 Response to Industry Presentation Comment Number 23 - The commentor is correct that the Clausius-Clapyron equation uses two constant terms to predict vapor pressure and that Antoine's equation adds a third constant for improved accuracy under some conditions. The TANKS program can accept vapor pressure information in three ways. Two of the ways use vapor pressure curve equations. One of these ways uses the three terms as described by the commentor, this is described as "Constants for Antoine's equation (using C)". The other way uses two terms and is described as "Constants for Antoine's equation (using K)". In the TANKS documentation, Antoine's Equation (using K) has the form

$$\text{Log } P = (-0.05223\ A) / T) + B$$

where:

log (P) is the logarithm (base 10) of the vapor pressure (P).
P = vapor pressure in mmHg.
T = temperature for vapor pressure determination in °K.

The TANKS documentation describes the two parameters A and B as the constants in Antoine's equation. The constants A and B for the aliphatic hydrocarbons used to empirically develop the "Antoine's (using K) constants" were obtained from the Handbook of Chemistry and Physics; 45th Edition; CRC Press; June 1973 from the table titled Vapor Pressures, Critical Temperatures and Critical Pressures of Organic Compounds. The two term form of Antoine's equation as stated in the TANKS software program was used in the draft report since interpolation between constants for two compounds is simpler than when using the three constants version of Antoine's equation. Based on the commentors statements we considered deriving the more proper Antoine's constants using three terms. However, the highest molecular weight aliphatic hydrocarbon in Lange's handbook is eicosane. Since eicosane is more volatile than the compounds best representing asphalt, the more proper Antoine's constants are not available to predict vapor pressure. In addition, the improved accuracy is not required. While the proper terminology would refer to the Clausius-Clapyron equation, the

terminology used in the text is consistent with the terminology in the TANKS program. Therefore, to avoid confusing some readers, the terminology will not be revised.

1.4.69 Industry Presentation Comment Number 24 - (Norman Ostroff) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

In the second line of the next paragraph, I recommend that you remove the words "The industry indicates that higher temperatures are avoided…"

1.4.70 Response to Industry Presentation Comment Number 24 - The text was removed.

1.4.71 Industry Presentation Comment Number 25 - (Norman Ostroff) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

On the bottom of page 4-155, you cite equation numbers 4-11 and 4-12. Where are equations 4-1 through 4-10? Again, these equations, as presented, are somewhat difficult to follow. The equations can be simplified and perhaps the following sentence added: "Equation 4-11 can be rearrange to give:

$$EF_{Std} = EF_{Corr}\left(\frac{-0.5}{V}\right)e^{0.0231(325-T)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.13)$$

My Equation (4.13) is mathematically identical to your Equation (4.11). In addition, I have found (in my own writing) that the use of the dotted line, connecting the equation and the equation number, simplifies reading. Am I correct in my understanding that EF_{Std} is the emission factor to be used for prediction of future emissions? If so, then I believe this should be clearly stated.

1.4.72 Response to Industry Presentation Comment Number 25 - Equation 4-1 is on page 4-139 and Equation 4-10 is on page 4-145. It is recognized that the equations are somewhat difficult to follow since the standard condition values remain in the equation. These equations were not simplified to demonstrate the methodology EPA used to adjust the measured data to the standard condition. In order to use the report, the user is not required to use either of these equations. The equations that are to be used to predict future emissions are developed later in the background report and are presented on pages 4-160 through 4-162. The equations to be used for prediction of future emissions are reduced to the simple form suggested by the commentor.

1.4.73 Industry Presentation Comment Number 26 - (Norman Ostroff) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

Fifteen figures are referred to at various points. In their current location, reader must stop reading the document and look for the figures then return to the text. This is distracting, interrupts the smooth flow of information, and can be avoided if the figures were placed directly into the text (perhaps reduced in size).

1.4.74 Response to Industry Presentation Comment Number 26 - We agree that moving the figures so that they are closer to the text where they are referenced will help the reader locate them easier. However, we also believe that a significant size reduction will make some of details too difficult to see. Most of the figures are associated with the statistical analysis that was performed. We explored moving the figures for batch mix dryers to follow Section 4.3.1 and the figures for drum mix dryers to follow Section 4.3.2. This arrangement would also be distracting to some and interupt the smooth flow of information in the text. As a result, the location of the figures was not changed.

1.4.75 CAAP Presentation Comment Number 12 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

54. Table 4-15: When will this table be completed?

1.4.76 Response to CAAP Presentation Comment Number 12 - There is no table to be inserted at this location. The final document will have no blank tables and the table numbering was revised so that all tables are numbered consecutively.

1.4.77 CAAP Presentation Comment Number 13 - (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

55. Table 4-19: Footnote a is incorrect. R^2 is the correlation coefficient, not the "squared correlation coefficient." We believe the terminology calls R the coefficient of determination, so that R^2 could be called the "squared coefficient of determination". The more common usage is to stick with "correlation coefficient" or R^2.

1.4.78 Response to CAAP Presentation Comment Number 13 - The footnote is correct. The term R is the correlation coefficient. R^2 is called the coefficient of determination or the correlation index.

1.5 Reference Citations

1.5.1 CAAP Reference Citations Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Hot Mix Asphalt Plants Emissions Assessment Report*

3. Page 2, paragraph 3: This paragraph needs a cross reference, even if it is to the relevant sections in Appendix B. In general, we need page number references to information in Appendix B which is over 400 pages long.

1.5.2 Response to CAAP Reference Citations Comment Number 1 - To help locate the primary references for the key information presented in the main report, the reader is referred to specific tables or page numbers in the Appendices. However, to produce a report that is uncluttered with voluminous citations that would hinder the readability of the report, all of the primary references will not be used in the main body of the Emissions Assessment Report. Instead, a sentence was added to inform the reader that a comprehensive listing of references is contained in the Appendices. In addition, a table

has been added to the main body of the Emissions Assessment Report that provides a cross reference directing the reader to the specific section or table in the appendices where the more important information is located.

1.5.3 CAAP Reference Citations Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Hot Mix Asphalt Plants Emissions Assessment Report*

16. Page 15, paragraph 3: The first line refers to "emission tests described in previous paragraphs". Since the previous paragraphs refer to more than one plant test, it is preferable to have a proper reference; for example, the text can refer to the test at Plant C or Plant D.

1.5.4 Response to CAAP Reference Citations Comment Number 2 - Since there are a limited number of emission tests which were used to establish emission factors for hot oil heaters, load out, silo filling, asphalt storage tanks and yard emissions, the specific reference numbers used in Appendix B were cited to describe the test(s) used to establish these emission factors.

1.5.5 CAAP Reference Citations Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

16. Page 11, paragraph 2: What exactly is reference 1? Is it the main report with a different date and number? Also, the derivation of the factor is properly described, not in Reference 1 but in Appendix B.

1.5.6 Response to CAAP Reference Citations Comment Number 3 - Reference 1 for this part of the report should be Appendix B or the *Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Production*. This reference citation was revised.

1.5.7 CAAP Reference Citations Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

17. Table 1: There are many problems here. Footnotes k through p refer to Reference 1. That is incorrect. If you want to refer to Appendix B, provide specific page number and citation.

18. Table 3: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data and uncontrolled emissions equal controlled emissions.

19. Table 5: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data.

23. Table 14: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data.

1.5.8 Response to CAAP Reference Citations Comment Number 4 - Reference 1 for this part of the report should be Appendix B or the *Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Production*. This reference citation was revised.

We decided that citing each of the over 150 references used to derive these emission factors would add text that would confuse the typical user. Additionally, citing over 150 references would potentially hide information that adds value. As a result, we decided that we would reference only the background report. We agree that presenting a specific location in the footnote will assist a user find the information needed to better understand the basis for the emission factor. To provide this assistance, the table number in the background report was specified.

1.5.9 CAAP Reference Citations Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

20. Table 6: Unlike previous tables, descriptive statistics about the data sets are not presented.

22. Table 8: Unlike previous tables, descriptive statistics about the data sets are not presented.

1.5.10 Response to CAAP Reference Citations Comment Number 5 - Generally, we present descriptive statistics only when more than 20 supporting data are available.

1.5.11 CAAP Reference Citations Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

23. Table 14: This and many other tables, especially in appendix B, have footnote "a" obscured because it is superimposed over the last letter of the table heading

1.5.12 Response to CAAP Reference Citations Comment Number 6 - The print over of footnote "a" is not evident in the electronic file or page printed from the file. It is possible that the Adobe Acrobat software used by the commentor is not the version provided on the CD-ROM that the commentor is using. There also may be a problem with the printer or printer driver used by the commentor. However, all of the footnotes in the tables were evaluated for the situation the commentor describes.

1.5.13 CAAP Reference Citations Comment Number 7 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

2. Page 2-1, Section title: Reference 1 is to an earlier version of AP-42. Why is an obsolete version of the same document being used as the reference? Reference 3 is a personal communication from the head of an industry lobbying group. Is this information in the public domain? Can we get a copy?

1.5.14 Response to CAAP Reference Citations Comment Number 7 - Reference 1 was revised to indicate the original source of the information characterizing the industry. All of the information cited in this report is in the public domain. A copy of Reference 3 was provided to the commentor.

2.0 Industry Characterization and Structure

2.1 Capacity and Production Levels

2.1.1 CAAP Production Level Comment Number 1 - (Ravi Nadkarni & Lloyd Fillion) -

Commentors' General Comments, Section B

The report and its appendices contain little or no information about industry structure. For example, Appendix B asserts that drum plants are 90% larger than batch plants in terms of annual throughput. This really falls out of an assumption made by the authors. There is little or no backup for this conclusion. Similarly, there is no information on what proportion of plants use natural gas and what proportion use other fuels.

Commentors' Summary Section C

Undocumented Information on Industry Structure: The report and its appendices contain little or no documented information about industry structure. Yet such information is used to derive average plant sizes and share of annual production between batch and drum plants.

Commentors' Summary Section C

Industry Comments on Capacity Are Given More Weight than Data Collected by EPA or State Agencies: The report states that the hourly capacity data was averaged from the capacities of precisely 98 batch plants and 162 drum plants. Since most of the data was gathered during performance tests at full capacity and witnessed by State Agencies, it is unlikely that hourly production rate data is incorrect. It is interesting that "conversations with industry" are all that is needed to supercede this data. In the report, it is clear that the authors believe that batch plants generally operate fewer hours per year than drum plants. Reasons for this (not necessarily explained in the report) include the lack of silos for HMA storage, small customers using smaller trucks, and so on. The report keeps talking about hourly production rates when the discussion should focus on annual production, i.e. hourly rate times hours operated per year.

Comments on Hot Mix Asphalt Plants Emissions Assessment Report

1. Page 1, paragraph 3: In this paragraph, 1996 production statistics are presented along with an estimate of the number of plants in the country. There are no references to the source of these data. In Appendix B, page 2-1, the same paragraph is repeated. On page 2-2 and 2-3 of Appendix B, calculations are presented which derive average annual production rates for batch and drum plants. We will comment on the problems with these calculations in our page-by-page discussion of Appendix B. However, the entire discussion is aimed at showing that drum plants produce more HMA compared to batch plants without actual data.

5. Page 8, paragraph 4: More industry statistics are presented without a source or a measure of precision or accuracy.

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

1. Page 1, paragraph 3: This paragraph is repeated in the main volume, and in the first two appendices. It would be more useful to discuss the source of this data and comment on its reliability, rather than repeat it in three places.

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

3. Page 2-1, paragraph 3: The key information in this paragraph about the number of plants in the country and the type of plants being built is not referenced so the reader can't judge the reliability of the information.

4. Page 2-2, paragraph 1: The key information in this paragraph about 1996 production is not referenced so the reader can't judge the reliability of the information. Further, since road building tends to be a cyclical activity (at least locally), production or output over several years might be a more reliable way to establish these levels than the output in a single year. Dept of Commerce or USGS/Mineral Industry Surveys probably collect and publish this information.

5. Page 2-2, paragraph 2 and 3: If the hourly capacity data was averaged from the capacities of precisely 98 batch plants and 162 drum plants, the numbers are probably correct, unless these plants consistently misrepresented the capacity. Such misrepresentation is not likely to go unnoticed since most of the data was gathered during performance tests at full capacity in the presence of State agencies to make sure that emissions limits were being met. It is interesting that "conversations with industry" are all that is needed to supercede this data. Why are we not surprised!

   Overall, this paragraph is attempting to relate hourly capacity to annual production. That goal is not achieved. The discussion in paragraph 3 is totally confused and needs to be rewritten. Hourly production rates are easy to measure. If the data set referred to in the previous paragraph is for obtaining operating permits from the relevant State Air Pollution Control Agencies, as is the case in Massachusetts, the plant is supposed to be running at or close to the design hourly capacity when the emissions are sampled. Therefore, We believe that the hourly capacity measurements are correct because these numbers are measured during State compliance testing and should not be superceded by "industry comments".

   The discussion should be talking about the fact that batch plants, especially batch plants without silos for HMA storage, don't operate for as many hours a year as drum plants because they service customers using small trucks/small volume customers and because of the difficulties in matching hot mix production with truck arrivals. (Note that because batch plants store dried, hot stone, there is storage available, but the stored quantity is generally much smaller than that available with HMA storage silos.) In contrast, because of their large production contracts, drum plants operate for more hours each year and the ability to store HMA in silos also facilitates long production runs. The entire paragraph keeps talking about hourly

production rates when the discussion is really trying to focus on annual production, i.e. hourly rate times hours operated per year.

Also note that the key assumption is that drum plants produce 90% more HMA than batch plants ON AN ANNUAL BASIS. This assumption is not backed up with anything; no footnotes or anything. If this is EPA's assumption, say so. Interestingly, in the main report, this assumption transforms into a finding that drum plants produce 100% more than batch plants on an annual basis.

If one assumes that the empirical 80/20 rule applies, the average annual output from batch plants would be 108,000 tons per year and that from drum plants would be 194,000 tons per year. This means that the purported annual industry output of 500 million tons is shared almost equally between batch and drum plants.

It should also be noted that there is no information provided on distribution between small jobs and large jobs, which would also provide information on how the total production is split between batch and drum plants. Is it possible that this is because industry information was provided by a lobbying group supported mainly by the large producers? This means that the production information has a bias favoring large producers and making them appear more important.

2.1.2 Response to CAAP Production Level Comment Number 1 - Information presented in the Emissions Assessment Report (and the AP-42 Section and Background Report) includes references to the original source of information when it is relevant to the purpose of the document. The primary purpose of the document is not intended to provide a detailed information on the industry structure. The information considered most relevant to the purpose of the Emissions Assessment Report is the development of methodologies to estimate air emissions from available production and air pollution control device information. National production statistics, the number and type of production facilities and the average annual production at the different types of facilities are provided for the user to have a basic understanding of the source category when conducting an inventory of air emissions on a regional or national scale. Significant differences in the production level, the total number of plants and the number of plants by production method may exist between States and even within regions of States. Local emission inventories or individual facility permits should use locally developed information on the number, type, capacity and demonstrated or expected actual production levels to derive improved estimates of emissions.

Although it is believed that the national trade association for the HMA industry has a good assessment of the national production levels, EPA performed an independent assessment of HMA production. As suggested by the commentor, reviewed information in the USGS Mineral Yearbook[1] for production of aggregate by identified end uses. It

[1] Available by internet at URL http://minerals.usgs.gov/minerals/pubs/commodity/myb/

was determined that 1996 has the greatest reported use of bituminous aggregate. Information useful for estimating HMA production is divided between reports on Crushed Stone and Construction Sand and Gravel. Within these two categories the information is further divided.

For Crushed Stone, the following information is presented in Table 13:

Coarse aggregate, graded:	
Bituminous aggregate, coarse	88,900,000 Mt
Bituminous surface-treatment aggregate	22,900,000 Mt
Fine aggregate (-3/8 inch):	
Stone sand, bituminous mix or seal	25,500,000 Mt
Special:	
Asphalt fillers or extenders	1,280,000 Mt
Unspecified: 4/	
Actual	370,000,000 Mt
Estimated	182,000,000 Mt
Total	1,330,000,000 Mt
4/ Includes production reported without a breakdown by end use and estimates for nonrespondents.	

Figure 1. Excerpt from Table 13 of the 1996 USGS Minerals Yearbook.

In addition, Table 20 presents a Total of 1,350,000 Mt of Recycled asphalt for 1996.

For Construction Sand and Gravel, the following information is presented in Table 6:

Asphaltic concrete aggregates and other bituminous mixtures	70,800,000 Mt
Unspecified: 2/	
Actual	174,000,000 Mt
Estimated	203,000,000 Mt
Total	914,000,000 Mt
2/ Includes production reported without a breakdown by end use and estimates for nonrespondents.	

Figure 2. Excerpt from Table 6 of the USGS Minerals Yearbook.

In addition, Table 14 presents a Total of 3,740,000 Mt of Recycled asphalt for 1996.

Both chapters in the Minerals Yearbook recommend that the unspecified uses' categories be distributed as the specified uses categories. Adjusting the Total Crushed Stone production of 1,330,000,000 Mt to the ratio of reported total specified use totals for HMA usage verses the total specified uses of Crushed Stone yields 236,904,000 Mt (1,330,000,000 X (138,580,000 ÷ 778,000,000). Adjusting the Total Sand and Gravel

production of 914,000,000 Mt to the ratio of reported total specified use total for HMA usage verses the total specified uses for Sand and Gravel yields 120,505,000 Mt (914,000,000 X (70,800,000 ÷ 537,000,000). Asphalt is added to this newly quarried aggregate total of 357,409,000 Mt to produce HMA that is 6% asphalt (or 94% aggregate) to yield 380,222,000 Mt of HMA. In addition to newly quarried aggregate, the USGS reported that a total of 5,090,000 MT of recycled asphalt was used in HMA. Based on these reported values from USGS, the production of HMA for 1996 is estimated to be 385,312,000 Mt or 424,614,000 tons. However, given the emphasis on recycling in State paving contracts, a recycled asphalt to new HMA ratio of only 1.0% appears very low and is probably significantly under estimated by USGS.

In a 1993 joint Federal Highway Administration and EPA report (A Study of the Use of Recycled Paving Material - Report to Congress; FWHA-RD-93-147; EPA 600/R-93-095; June 1993), it was estimated that 73 million metric tons (80.4 million tons) of RAP were recycled annually. This report documents several methods of reprocessing RAP for reuse as pavement or other materials. However, the report does not provide estimates of reprocessing by each method. Based on this report, EPA concluded that the majority of RAP reprocessing is in HMA plants. Assuming all of the RAP is reprocessed in HMA plants, an early 1990's upper bound estimate of 16.1% recycled asphalt produced can be calculated [73,000,000 ÷ (380,222,000 Mt + 73,000,000 Mt) ×100% = 16.1%]. Recongizing this estimate includes reprocessing not in HMA plants, EPA examined an alternative method of estimating national RAP usage in HMA plants.

At Plants C and D between 80 and 90% of the asphalt produced included RAP. When RAP was used, Plants C and D included 30 percent and 10 percent RAP in their respective final asphalt mixes during EPA emission testing. Extrapolating this production information to an annual estimate, Plants C and D use between 8 and 27% RAP with a midpoint of 17.5 percent. While this number is larger than the FHA derived upper bound estimate of 16.1%, it may be more representative of RAP usage rates in the late 1990's. Using the midpoint (17.5%) of this range yields a revised RAP usage of 80,653,000 Mg (88,905,000 tons). Using the revised RAP usage yields a total estimated HMA production for 1996 of 469,102,000 Mg or 516,096,000 tons.

Since the industry has an economic interest in understanding the annual production of their industry, it is reasonable that this independently developed value is close to the value provided by the industry and used in the draft report. EPA's review of the USGS, FHA and EPA studies indicates the national RAP usage rate is likely between 15-20%. Accordingly, EPA used the above information and the mid-point of the estimated RAP usage range (17.5%) to estimate annual HMA production of 516,096,000 tons for the United States.

The commentor is correct that the paragraph including the explanation and comparison of estimated average drum mix plant annual production and average batch mix plant is confusing and is revised. However, based on statements in the fifth comment on Appendix B, it appears that the commentor understands the derivation and rationale in the

comparison of drum mix and batch mix asphalt plants; the development of annual production levels for typical batch mix and drum mix plants. In addition to presenting the development of the estimated annual production of HMA, we have revised Section 2.1 of the background report to read as follows:

"Information provided by the HMA industry indicates that HMA is produced by approximately 2,300 batch plants and 1,300 drum-mix plants. Using a national asphalt production estimate of 517 million tons of HMA, an estimate of the national annual production capacity at drum and batch mix plants was determined as follows:

Based on available production capacity data from emission compliance tests of 98 batch mix plants and 162 drum-mix plants, the average maximum production rates are:

Batch – 214 tons/hr
Drum – 272 tons/hr

Extrapolating these averages to the entire HMA industry yields an estimated, theoretical national production capacity of 7,409 million tons of HMA if all plants could operate 8760 hours in a year. The 2,300 batch mix plants would produce 4,311.7 million tons and the 1,300 drum mix plants would produce 3,097.5 million tons.

Based upon the above estimates of HMA production and available plant capacity, the estimated utilization rate of the industry is only about 7 percent (517 million ÷ 7,409 million). This significant under utilization is caused by limitations on when pavements can be laid that are created by weather conditions, contract specifications on times of the day when pavement construction can be performed, the local demands for paving construction and repair, the distance that HMA can be trucked to a paving site, the desire to be able to meet short term peak production demands and a variety of other factors. A number of differences between drum and batch mix asphalt plants suggest the estimated 7 percent utilization ratio is not likely to be equal distributed among batch mix and drum mix plants. These differences include:

1) production methods,
2) capability to make and store product ahead of the time,
3) ability for loading to occur significantly quicker at facilities with storage silos,
4) the general lack of storage capability at batch mix plants, and
5) the economic desire to shift higher production demands to the higher capacity and more cost efficient drum mix plants.

All drum mix plant require HMA storage silos to store product ahead of demand. It is estimated that for a maximum production day, a typical drum mix plants will begin production three hours prior to the first truck load-out in order to stay ahead of demand. For days with less than maximum production, a typical drum mix plants will maintain this relative production advantage, although it is not necessary to begin production three hours ahead of the first truck load-out. Since a typical batch mix plant does not have storage for a significant amount of aggregate, it cannot produce significantly ahead of demand. For an eight-hour load-out schedule and equal production capacity, the drum

mix plant would be able to produce 38% more product (11 ÷ 8 = 1.38). It is also estimated that for about 30 minutes over the eight hour day, a typical batch mix plant will need to stop production because there are no transport trucks to load. As a result, the batch mix plant will only be able to produce 94 percent of its hourly target production (7.5 ÷ 8 = 0.938). As a result the eight-hour load-out capability for drum mix plants would be 147% of the eight-hour production capacity for batch mix plants (1.38 ÷ 0.938 = 1.47). Since the average production capacity of drum mix plants is 27% greater than batch mix plants (272 ÷ 214 = 1.27), the overall eight-hour load-out advantage of the average drum mix plant (as compared to the average batch mix plant) would be 187 percent of the eight-hour production capacity (1.47 x 1.27 = 1.87). Using this estimate, if 517 million tons of HMA are produced per year by the 2,300 batch and 1,300 drum-mix plants then:

$$517 \times 10^6 = 2{,}300 \times B + 1{,}300 \times D$$

and

$$D = 1.87\ B$$

where:

B = average production of a batch mix plant (tons/yr)

and

D = average production of a drum-mix plant (tons/yr)

Solving the equations for B:

$$517 \times 10^6 = 2{,}300 \times B + 1{,}300\ (1.87 \times B)$$
$$517 \times 10^6 = 4{,}731 \times B$$
$$B = 109{,}000 \text{ tons/yr}$$
$$D = 204{,}000 \text{ tons/yr}$$

Using these average production rates, the total 1996 HMA production from batch and drum-mix plants is estimated at about 251 million tons and 265 million tons, respectively."

At the estimated annual production levels, the average batch plant would have a 5.5% utilization rate compared to an 8.1% utilization rate for drum mix plants. It is believed that using these estimates of annual production provides a reasonable differentiation in the utilization rates of batch mix plants and drum mix plants. Given the conditions stated above that would tend to influence the use of newer, higher production and more efficient plants, a 50% difference in utilization appears reasonable. In addition, the information that was obtained on the capacity and annual production of Plant C and Plant D (References 355 and 356 in the AP-42 section and background reports) supports these utilization rates. In the test report for Plant D, the hourly capacity is listed at 255 tons per hour and the typical annual production is about 100,000 tons per year. In addition to being very close to the average capacity and estimated annual production cited above, the

utilization rate is 4.5%. While this is slightly less than the estimated national average utilization rate, it is very close to the value estimated. In the test report for Plant C, the hourly capacity is listed as 650 tons per hour and the annual production is about 1,000,000 tons per year. While this facility has a much higher capacity than the estimate for the average plant, it is one of the newest plants in the nation and is likely one of the highest capacity plants in the nation. Based upon plant C production and capacity information, the utilization rate of this plant is 17.5%. This is significantly higher than the average utilization estimated above. However, the plant is located in southern California where the temperature is suitable for paving all year and where there are on average only 30 rain days a year to limit the laying of pavement. In addition, the facility was built to provide HMA for the construction of California Highway 241, which is a new 30 mile toll road west of Irvine, CA. It is unlikely that there are many other locations where the combination of weather and demand for major road construction would support the high utilization rate of Plant C. Weather conditions in the majority of the United States restricts paving operations to about nine months due to low temperatures. Further, for the eastern half of the United States, the average 100 days of precipitation further limits the number of paving days. Considering these situations, it is not unreasonable for plant C to have twice the utilization of the average HMA facility in the United States.

As indicated in the more detailed response provided later, information on the derivation of an estimated proportion of gas and fuel oil usage by the industry was presented in the revised industry description contained in Appendix B. In addition, statements were added to the "main" report and Appendix A that between 70% and 90% of the energy estimated to be used at HMA plants in 1998 was from natural gas. Further detail on the characteristics of the HMA industry such as the distribution between small jobs and large jobs are outside the scope of this report. This type of information would be highly specific to the location and type of the facility. It is not known whether this type of information is available outside the individual companies that own the 3600 plants and obtaining this information would require significant effort and time.

2.1.3 CAAP Production Level Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

10. Page 3-2, paragraph 1: The sentence states that emission data must be from a primary reference. In chapter 2, however, secondary references and anecdotal comments are used to supercede primary reference data on hourly capacity.

2.1.4 Response to CAAP Production Level Comment Number 2 - The information presented in chapter 2 which is derived from secondary references is not emission data and does not supercede primary reference data. As indicated in previous response, the discussion on the derivation of annual production from reported hourly capacity data was revised to more clearly indicate the basis for the derivation.

2.2 Type of Fuels Used by Typical Production Facility

2.2.1 State Fuel Usage Comment Number 1 (Massachusetts State Senator Stephen F. Lynch) -

In reading this report and its appendices, along with comments sent to my office by Ravi Nadkarni, it is my understanding that this report only shows emissions results from asphalt plants burning natural gas as a source of fuel.

The report also fails to provide information about what percentage of asphalt plants cited in the report used natural gas and what percentage of those plants used alternative fuels. Although I am not an environmental engineer, it is obvious to see that emissions result from asphalt plants burning only natural gas, as opposed to other fuels, will show considerably lower emissions result. This would clearly indicate to me that the results in this report are skewed. I would like to see more thorough testing of various data included in the final report, especially if this report is to be considered an emissions standard for all asphalt plants.

2.2.2 CAAP Fuel Usage Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) -

Hot Mix Asphalt Plants Emissions Assessment Report

18. Page 16, paragraph 3: The second line refers to Tables 4 through 11 which present more detailed information about "typical" plants. Unfortunately, this is the emission factor data of Appendix A multiplied by 100,000 for batch plants and by 200,000 for drum plants. The implication is that the reader can't move the decimal point to the right or multiply by 2. Further, in keeping with their bias for showing only low numbers, these tables are for natural gas only and not for oil-fired heaters. Why? Finally, what is the basis for assuming (third bullet on page 17) that PM emissions from load-out and silo filling are entirely PM-10? We would have thought that a better assumption was that these were PM-2.5.

2.2.3 Response to State and CAAP Fuel Usage Comments Number 1 - Presentation of emissions representative of an average gas fired HMA facility data in the draft Emissions Assessment report was reasonable. Over 95% of the fuels (by energy content) used in industrial sources is gas and fuel usage by HMA plants is likely similar. However, in response to commenters concerns we conducted a limited survey to obtain additional information on fuel useage and added emission factor tables for fuel oil fired HMA plants.

A very limited survey of available, but limited, fuel usage information from five State agencies suggests that approximate 70 - 90% of HMA plants are gas fired. Limitations on the available data from these five State agencies could not precisely discern fuel usage at HMA plants. However, we have revised the Emissions Assessment Report by adding text on page 3 characterizing this range of fuel usage in the industry.

We also recognize that there are local situations where a HMA plant may primarily use fuel oil and, as a result, may generate more emissions than the typical gas fired HMA

facility. We have revised the Emissions Assessment Report to indicate that many HMA plants have the capability to use fuel oil as an alternative to gas. The report was also revised to note that fuel oil fired HMA plants would have higher emissions of SO_2, NO_x and HAP compounds. In addition, Emissions Assessment Report Tables 1 and 2 were revised to include a column for fuel oil. The footnotes to these tables were revised to indicate that natural gas is used to produce between 70 and 90% of the HMA and fuel oil to produce between 10 and 30% of the HMA. Also, Tables 4 and 7 include columns presenting emissions for fuel oil. The footnotes to Tables 4 and 7 now indicate that between 70 and 90% of the HMA produced is with natural gas fuels and between 10 and 30% of the HMA is produced with fuel oil.

We have also documented the basis of the statements added to the main report in Appendix B. The following paragraph was added to Section 2.1 following the derivation of the estimates for the average annual production of batch and drum mix plants.

"The Department of Energy indicates that annual distillate fuel sales to industrial customers in the US for 1998 was 2,462,355,000 gallons[2] compared to natural gas sales of 8,686,147,000,000 cubic feet[3]. At a typical energy content of 140,000 Btu/gal for distillate oil and 1050 btu/ft^3 for natural gas, 96.3% of the energy used by industries was natural gas. We expect that many of the factors that promote the preferential use of gas fuels are common within many industries. Therefore, we expect fuel usage at Hot Mix Asphalt plants is very similar to other industrial sources. Some of these factors are fuel cost, delivery system requirements, and equipment maintenance requirements. The Energy Information Agency reported in the Manufacturing Consumption of Energy 1994 (Combined Consumption and Fuel Switching) report[4] that the national average cost industry paid for a million Btu of energy was $2.15 for natural gas, $4.84 for distillate oil and $4.71 for LPG. This report also separates these energy costs by four regions of the United States. Of the four regions, the differences in the costs of the various fuels are smallest in the northeast region. In this region, the average fuel costs were $3.39 for natural gas, $4.89 for distillate oil and $5.69 for LPG. In addition, the delivery of fuel oil and LPG must be scheduled and stored near the production unit. The storage tanks and supporting mechanical equipment require monitoring and maintenance that is not required when the plant is fueled with natural gas. Also, burners for firing fuel oil require a higher level of maintenance than natural gas burners. Lastly, it is recognized that the combustion of fuel oil produces more air emissions than natural gas combustion. Therefore, it is believed that, where it is available, natural gas is and will remain the predominant fuel used at HMA plants. However, many plants will maintain the

---

[2] Available by internet at URL http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/fuel_oil_and_kerosene_sales/current/pdf/table1.pdf

[3] Available by internet at URL http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/natural_gas_annual/current/pdf/table_014.pdf

[4] Available by internet at URL http://www.eia.doe.gov/emeu/mecs/mecs94/consumption/mecs4a.html

capability to use fuel oil as an alternate or supplementary fuel. A few plants will use only fuel oil due to the unavailability or high local cost of natural gas. As a spot check of the DOE information on industrial fuel usasge, an informal telephone survey of five States was conducted. The survey confirmed that HMA plants use natural gas when it is available. The fuel usage information in the States' emission inventories shows a range of about 50 percent to 99 percent gas usage. However, the fuel usage information reported by industry was incomplete. Also, for some States, energy usage per ton of product was over 50 percent higher than emission tests where fuel usage and production information was available. As a result, it is estimated that between 70 and 90 percent of HMA is produced with gas fuels."

While the main body of the Emissions Assessment report only presented estimated emissions for gas fired HMA plants, the appendices present emission factors for not only natural gas fired facilities but also coal, butane, propane, fuel oil and waste oil fired facilities. Most industrial facilities can fire both natural gas and fuel oil. Additionally, emissions performance tests with few exceptions are conducted under worst case conditions. This includes conducting emission tests while firing fuel oil in plants that almost always use natural gas. As a result, the use of test data presented in this report to estimate the percentage of facilities firing different fuels would provide a skewed estimate of the actual fuel usage by the industry.

The Emissions Assessment Report does not establish a national emission standard. The introduction to AP-42, EPA advises users that emission factors are not recommended as source-specific permit limits because emission factors are averages. Since emission standards are a "not to exceed" value, using the average emission factor without any engineering analysis would likely cause half the facilities to violate their permit limit. The background report compiles a significant amount of data that may not otherwise be available in one document. While not establishing emission standards or rules, this data can be part of the information used in rule or State Implementation Plan development.

EPA's primary purpose for AP-42 is for air quality planning purposes. This includes providing State and local agencies with reliable information to assist them to develop comprehensive emission inventories. The information presented in the report is based upon emission tests of many facilities. Although all facilities were not tested for all possible pollutants, the information available to characterize emissions from HMA plants is more than adequate to characterize emissions from these facilities for air quality planning purposes.

As the commentor states, the information presented in the tables is the emission factor data of Appendix A multiplied by 100,000 or 200,000. This information is presented in a simpler and more concise format to help non-technical readers understand the results. More technical information is included Appendicies A and B. The multipliers used in the main body of the Emissions Assessment Report are the approximate, average production levels for the typical batch mix plant and drum mix plant respectively. We have

explained how we determined the average production levels in Section 2.1.2. Response to CAAP Production Level Comment Number 1.

While it is reasonable to assume that organic emissions from load-out and silo filling are predominantly PM-2.5, the inorganic emissions are likely to be rock dust. The organic particulate emissions result from a condensation phenomenon which is expected to predominantly form particulate that is less than one micrometer in diameter. Therefore, all emissions from load-out and silo filling are PM-10 as well as PM-2.5. Footnote b in Table 11.1-14 in Appendix A of the draft report states "Total PM is assumed to be predominantly PM-2.5 since emissions consist of condensed vapors." While PM-2.5 has recently been designated by EPA as an additional particulate pollutant of concern for ambient air quality, the use of PM-10 was selected because it is the particulate pollutant with which most people are familiar.

2.3 Process Descriptions

2.3.1 CAAP Process Description Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Hot Mix Asphalt Plants Emissions Assessment Report*

2. Page 1, paragraph 4: The statement in line 1 is incorrect. The primary emission source is the dryer, not the mixer, as stated. This is the case because combustion of fuel for generating heat for drying generates large quantities of criteria pollutants. This error of confusing dryers and mixers is repeated several times, (for example in Table 1), and we have not bothered to find all instances of such misuse. The best way to clarify this issue is to substitute "dryer/mixer" for drum plants where the two units are connected. In the case of batch plants, the dryer and the mixer (pug mill) are typically uncoupled through hot storage bins. Emissions from both however are often captured by the same piece of air pollution control equipment.

2.3.2 Response to CAAP Process Description Comment Number 1 - Whether the dryer or the mixer is the primary emission source for batch plants depends on the pollutant that is being considered. As stated by the commentor, emissions from both sources are often captured by the same air pollution control device. Compared to other combustion sources, the majority of emissions of particulate, VOC and possibly CO are not due to fuel combustion. However, it is likely that most of the particulate emissions are generated in the dryer drum at batch mix plants. At batch mix plants, substantial particulate emissions may also be generated by the hot screens and the pug mill when the hot aggregate is transferred to these processes. However, to clarify the issue, the text was revised to clarify that the source of the batch mix emissions is the dryer, hot bins and mixer.

2.3.3 CAAP Process Description Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Hot Mix Asphalt Plants Emissions Assessment Report*

10. Page 9, paragraph 1: The sentence on line 6 is confusing. Do you mean RAP is added to the "hot" bins or is it added to the pug mill?

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

3. Page 2, paragraph 3: This paragraph repeats the ambiguity in the main report on page 9 paragraph 2. Is RAP added to the weigh hopper or to the hot bins?

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

6. Page 2-3, last paragraph: The writing should make clear whether the RAP is added to the hot storage bins or directly to the mixer/muller.

2.3.4 Response to CAAP Process Description Comment Number 2 - Although a few batch mix plants may mix RAP with the hot aggregate prior to the combined aggregate storage in the "hot" bins, it is more typical for the cold RAP to be combined with the hot aggregate in the pug mill. Some newer batch mix plants have a RAP silo with the "hot" bins to dry and partially heat the RAP before combining the RAP and the hot aggregate in the pug mill. The wording in the EA-Report, AP-42 Section and Background Report was revised to more clearly describe the more prevalent process.

2.3.5 Industry Process Description Comment Number 1 (Gary Fore, Vice President National Asphalt Pavement Association) -

Hot Mix Asphalt Plants Emissions Assessment Report

Page 8: A. 3rd paragraph - ...(2) continuous mix (mix outside **dryer** drum) plants, ... Please add the word dryer when using the "mix outside **dryer** drum" phrase. This will allow for both past and present types of plants.

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

Page 11.1-1: A. Hot mix asphalt paving materials can be manufactured by: ... (2) continuous mix (mix outside **dryer** drum) plants, ... Please add the word dryer when using the "mix outside **dryer** drum" phrase. This will allow for both past and present types of plants.

2.3.6 Response to Industry Process Description Comment Number 1 - The word dryer was added to the sentence to allow for both past and present types of plants.

2.4 Plant Characteristics

2.4.1 CAAP Plant Characteristics Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) -

Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

2. Page 2, paragraph 1: The statement that raw aggregate is stockpiled "near" the plant is ambiguous. Such aggregate is normally stockpiled within the plant site and is moved to the cold feed bins with a front-end loader.

2.4.2 Response to CAAP Plant Characteristics Comment Number 1 - The term plant in this statement is intended to designate the kiln, hot screens and pug mill and not the property site in general. The statement was revised to state that the raw aggregate is stockpiled near the production unit.

2.4.3 CAAP Plant Characteristics Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

4. Page 5, paragraph 2: In counterflow plants, the baghouse is preceded by a cyclone to reduce the load on the baghouse. This is a trade off issue where it is cheaper to use a cyclone than to increase bag house size and bag cleaning frequency to achieve the same result. Since the industry prefers counterflow plants to parallel flow plants(page 1 paragraph 3), the use of an additional particulate separation device in the former is obviously not a disadvantage, on an economic or a technical basis.

2.4.4 Response to CAAP Plant Characteristics Comment Number 2 - The decision on using a cyclone before the baghouse is more of a consideration of the baghouse manufacturer than the manufacturer of the HMA plant. The size of the baghouse depends on the gas flow, the bag cleaning method, and the type of fabric used for the bags and not a function of the inlet dust concentration. The statement only identifies one air pollution control advantage of a parallel flow plant. Other production tradeoffs may be considered by the plant manufacturer and operator in the selection of the final design of the plant. The statement as drafted provides information that is useful to individuals and the report will not be changed.

2.4.5 CAAP Plant Characteristics Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

4. Page 5, paragraph 2: If you have data to support the statement that organic emissions may be greater from this process, present it; otherwise eliminate the statement.

2.4.6 Response to CAAP Plant Characteristics Comment Number 3 - The lack of data to substantiate the statement is not a reason to eliminate the statement. As with many other emissions that were statistically evaluated, there is insufficient information about the relevant process variables, an insufficient number of data and relatively high variation in the emissions to properly evaluate the potential effect. However, the statement was revised to indicate that the available data is insufficient to discern any differences in emissions because the process.

2.4.7 CAAP Plant Characteristics Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

5. Page 5, paragraph 5: We believe the real issue is that with counterflow plants, the air from the mixing drum acts as secondary and tertiary air for the combustion process which eliminates many of the organic compounds through combustion. This point needs to be brought out. Further, is there data to support the statement that a counterflow plant can process RAP at ratios up to 50% with little or no observed effect on emissions? If not, the statement belongs in industry sales literature and not in an EPA document.

2.4.8 Response to CAAP Plant Characteristics Comment Number 4 - It is unlikely that a significant portion of the air from the mixing drum is used as combustion air for the

burners. Typically, the exit CO_2 concentration from HMA stacks is around 4% indicating that the combustion gases are only about 30% of the stack gas. The mixing of a significant portion of the air from the mixing drum in the combustion zone of the burner would quench the combustion and result in increased emissions of CO and uncombusted hydrocarbons (THC). As a result it is also unlikely that a significant reduction in the organic emissions results from the combustion process. With respect to the processing of high percentages of RAP, several emissions tests of facilities processing RAP at ratios of 50% are used in the development of the emission factors. The statistical analysis performed to evaluate the effect RAP percentage on emissions indicated that only the condensible organic particulate was affected by the RAP percentage. However, the squared correlation coefficient was only 0.11 (with a correlation of 1.0 being perfect) indicating that the RAP percentage explained very little of the variability in the data.

2.4.9 CAAP Plant Characteristics Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

5. Page 5, paragraph 5: Similarly, the comment about "improved thermal efficiencies" begs the question of what is being compared to what and what is the degree of improvement. The statement belongs in industry sales literature and not in an EPA document.

2.4.10 Response to CAAP Plant Characteristics Comment Number 5 - While it is clear that the report text on thermal efficiency compares currently designed plants to those of earlier designs, it does not add information needed to characterize the industry with respect to air emissions and was removed.

2.4.11 CAAP Plant Characteristics Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) -

Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

6. Page 7, paragraph 1: The statement that RAP with new aggregate and fresh asphalt is used to "produce a high quality grade of HMA" is another salesmanlike statement. The point is that the HMA industry produces products to meet a specification. If the specification requires the use of RAP, it is used; if not, RAP is not used. The point you want to make is that the use of RAP does not impair the ability to meet the specifications for certain grades of HMA since the specs might actually require that RAP is used. Or is EPA implying that the industry used RAP when specifications call for the use of only virgin materials?

2.4.12 Response to CAAP Plant Characteristics Comment Number 6 - The statement was revised to state "new asphalt cement is added to produce HMA that meets the required quality specifications".

3.0 Development and Evaluation of Available and Derived Information

3.1 Deficiencies in EPA Method 204

3.1.1 CAAP Capture Efficiency Comment Number 1 - (Ravi Nadkarni & Lloyd Fillion) - *Commentors Summary Section C*

Deficiencies in Method 204: Tracers were not used at Plant D because it met the requirements of Method 204. Unfortunately, Method 204 is inadequate to achieve the results it tries to achieve. Further, the contention that the estimate of unmeasured emissions is an "upper bound" is incorrect. At Plant D, a mild ambient breeze was sufficient to cause some of the fumes to escape from the top or the bottom openings in the downwind door of the tunnel. Therefore, the size of the openings was decreased further at the end of the first day of testing. This means that the Method 204 criterion of maintaining over 200 fpm at a natural draft opening is not adequate. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. Therefore it is not surprising that these criteria are inadequate to assure total containment within a TTE as contemplated by method 204.

Further, Method 204 has a more serious and fundamental problem. Although the size of natural draft openings is specified, the method does not contain any criteria to ensure that the emissions are pulled/sucked past the sampling point in a reasonable period of time. As is well-known, residence time calculations, based on enclosure volume and fan capacity, generally provide incorrect information by underestimating the time to evacuate the enclosure because of channeling. At Plant D, the tunnel was not evacuated in the approximately 15 second time gap between the final HMA drop and the opening of the doors. This can be clearly seen in the fact that THC readings did not drop to zero before the doors were opened. This fact was also observed visually inside the TTE enclosure since SVOCs are visible. Thus, the report contains compelling evidence that the collected sample had a low bias, not only because some emissions escaped through the natural draft openings but also because these emissions did not travel to the sampling point but were lost when the doors were opened.

Comments on Hot Mix Asphalt Plants Emissions Assessment Report

11. Page 13, paragraph 4: This paragraph is wrong in several ways. The capture efficiency was measured and calculated using tracers; it was not "estimated" as stated. To me, the word "estimation" denotes a weaker approach to quantification than calculations based on actual measurements. Equally, important, the EPA requirements for total enclosure were shown to be totally inadequate during the testing at Plant D in Massachusetts. A mild breeze was sufficient to cause visible emissions from the total enclosure even when a hand-held velometer showed that Method 204 criteria were being met. Why is this factor, which suggests that Method 204 criteria were inadequate and that the measured emissions have a low bias, not discussed in this paragraph?

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

45. Page 4-163, paragraph 3 - 5: We further find that the contention that the estimate of unmeasured emissions being an "upper bound" to be unpersuasive and incorrect. Our reasons for saying so result from the inadequacies of Method 204. These were outlined in Ravi Nadkarni's letter of September 15, 1999. They are:

    a. At Plant C, two precautions were taken to ensure that we could measure or estimate the amount of organic fugitive emissions that did not reach the primary sampling ports. The first was the use of sulfur hexafluoride tracer gas, and the second was the use of impingement/deposition plates in the ducts which collected organic particulates which would be deposited upstream of the sample port. Although all the emissions did not reach the sampling ports (some was deposited inside the tunnel and some was pumped out of the tunnel by ambient breeze or by truck movement), the tracer gas enabled an estimation the VOC portion of this loss. (As was pointed out during the planning, the tracer gas was a good proxy **only** for non-condensible emissions but not for condensible emissions.)

    At Plant D, a tracer gas was not used although requested by the citizens because the TTE was constructed to meet Method 204 criteria, yet visual observations and THC readings showed the following:

    b. An ambient breeze was sufficient to cause some of the fume to escape from the top or the bottom openings in the downwind door of the tunnel. Therefore the size of the openings was decreased further. This means that the Method 204 criterion of maintaining over 200 fpm at a natural draft opening is not adequate. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. Therefore it is not surprising that these criteria are inadequate to assure total containment within the TTE. We observed visible emissions of fume from the entrance, further emphasizing that the Method 204 criteria are inadequate.

    c. Further, Method 204 has a more serious and fundamental problem. Although the size of natural draft openings is specified, the method does not contain any criteria to ensure that the emissions are pulled/sucked past the sampling point in a reasonable period of time. As is well-known, residence time calculations, based on enclosure volume and fan capacity, generally provide incorrect information by underestimating the time to evacuate the enclosure because of channeling. Note that Method 204 does not require a specific location for the natural draft openings, a problem that was pointed out during the planning sessions. At Plant D, even after the size of the opening was decreased, and the little pieces of colored tape at the Natural Draft Openings were indicating airflow towards the inside of the TTE, the tunnel was not evacuated in the approximately 15 second time gap between the final drop and the opening of the doors. This can be clearly seen in the fact that THC readings did not drop to zero even when the sample averaging time is less than 1 minute. This fact was also observed visually inside the TTE enclosure

since SVOCs are visible. Thus, in the absence of a tracer gas, we have compelling evidence that the collected sample had a low bias. For example, the extended period test results in MRI-D-Table 4-4, show that final concentration did not drop to zero but stayed between 1 ppm and 2.1 ppm . Yet, this low bias is not mentioned anywhere in the report nor in Appendix B of the MRI Report which contains the original data. These emissions did not reach the instrumentation but were emitted to the environment causing a low bias.

3.1.2 Response to CAAP Capture Efficiency Comment Number 1 - There was no indication during the testing at Plant D that EPA Method 204 was inadequate for determining the ability of the enclosure to completely capture the emissions. The individuals that opened and closed the doors of the enclosure also periodically observed the tail tale streamers attached above the openings above and below the doors. At all times when both doors were closed they noticed that the tail tales showed that air was being drawn into the enclosure. Additionally, while it is stated that the citizen observers present at the test observed visible emissions leaving the natural draft openings to the enclosure, EPA was not advised of this until a meeting to discuss EPA's draft responses to comments on the test reports. Three EPA representatives were present at the test to address and resolve these type of issues. If EPA were advised of the presumed observations by the citizens, the cause could be investigated during the emission test. If it were determined that the complete capture of emissions was being compromised, corrective action would have been instituted.

The adequacy of EPA Method 204 criteria to assess whether the enclosure attained essentially complete capture was addressed in the draft of the "Response to Comments on Testing Program for Asphalt Plants C and D Report" submitted to commentors previously. Response number 15 "THC Emissions During Extended Period Tests" in the draft document was divided into two areas. The first area addressed the issue of the capture efficiency at Plant D. The second area addressed the issue of additional emissions following the load-out operation. In a meeting held in Boston on January 20, 2000, one point of discussion was EPA's interpretation of Ravi Nadkarni's comments. Based upon this discussion, EPA understood that the intention of Ravi Nadkarni's comments was not to question the capture effectiveness of the enclosure at Plant D since it met EPA Method 204 criteria. As a result, EPA proposed to delete the first area of the response. In the capture efficiency portion of the draft response, several evaluations were presented that provided various estimates of the capture efficiency obtained by the enclosure at Plant D. The text on the following six pages is reproduced from page 21 through 26 of the draft "Response to Comments on Testing Program for Asphalt Plants C and D Report" submitted to commentors.

* * *

Capture Efficiency and Post Loadout Emissions

15. THC Emissions During Extended Period Tests

COMMENT: Several commentors (Nadkarni, Fillion, Toxics Action Center, Yatzyshyn, Lynch) expressed concern over the determination of static emission rates (e.g., trucks sitting in the yard) based on the Plant D extended period tests. As a related issue, the same commentors were also concerned that holding the trucks for 15 sec following the final drop was not long enough, and that some fraction of the emission was missed. Additional clarification on both of these issues was requested.

RESPONSE: The commentors raise a valid concern that some portion of the emissions may have been missed due to opening and closing of the TTE doors. This represents a situation different from that in California, where tracer gases were used to determine capture. As discussed earlier in Response 11, MRI insured that the TTE design did meet all necessary criteria to assume 100% capture. However, the commentors are correct in that the TTE was intended to allow trucks to remain stationary until emission levels returned to baseline, which required 3 to 7 min as shown by the extended period tests. Since this is clearly longer than the 15 sec allowed most of the trucks, some accounting for the less than 100% capture efficiency was considered. Emissions due to trucks sitting in the yard are also related to these calculations and are discussed below.

Capture Efficiency

Commentor Nadkarni performs a mathematical analysis of the data set to arrive at a factor of 1.74, meaning that the measured emissions should be multiplied by 1.74 to arrive at the total (Total = sum of measured + unmeasured). The basic approach presented by the commentor is one of several of methods that seem reasonable. However, since the commentors calculations are

Figure 3. Excerpt from page 21 of the Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

not clearly presented, calculations based upon the commentors approach have been performed as part of this response, and a different value is presented.

Figures 2 and 3 show load-out data for two truck loadings during the Plant D testing. One of the loadings was during Test 2 and logged 10-sec data points prior to the extended period test from 1333 to 1338. The second loading was during Run 3 and logged 1-sec data points for an entire load-out cycle. These two data sets provide the only detailed data clearly showing both the load-out cycle and the extended tail-off to the baseline. Thus, these two data sets can be used to estimate the capture efficiency.

Measured emissions are represented by the area under the curve (integrated value) from the beginning of load-out until the doors are opened (i.e., 15 sec after the final drop). Figures 2 and 3 are marked with vertical lines at these times to provide clarity. It is believed that the commentor determined what he called "unmeasured" emissions by integrating from the 15-sec mark until the emissions return to baseline. The Extended Period column in Table 1 shows the results of this integration.

Table 1. Estimate of Capture Efficiency Adjustment

	Extended Period (>5 min)	Typical Period (30 sec)
Test 2 Data Set		
Measured	18.14 ppm-min	18.14 ppm-min
Unmeasured	7.66 ppm-min	1.80 ppm-min
Total	25.8 ppm-min	19.94 ppm-min
Capture Efficiency Adjustment Factor	1.42	1.10
Test 3 Data Set		
Measured	29.35 ppm-min	29.35 ppm-min
Unmeasured	9.75 ppm-min	1.67 ppm-min
Total	39.10 ppm-min	31.02 ppm-min
Capture Efficiency Adjustment Factor	1.33	1.06

Thus, using the Extended Period (as used by the commentor), the above calculations show that the estimated Capture Efficiency Adjustment Factor might be 1.33 to 1.42 (or a capture efficiency of between 70% and 75%), rather than the 1.74 (capture efficiency of 57%) calculated by the commentor. Furthermore, these calculations are overly conservative (i.e., high) for three reasons:

a. Integration of a greater than 5-min tail-off period is not representative of actual plant operations during the test. Under normal operating conditions, a truck left the load-out area no more than 30 sec after the final drop. In fact, as the commentors noted, a high volume of truck traffic forced MRI to shorten the waiting time to 15 sec during the actual

Figure 4. Page 22 from Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

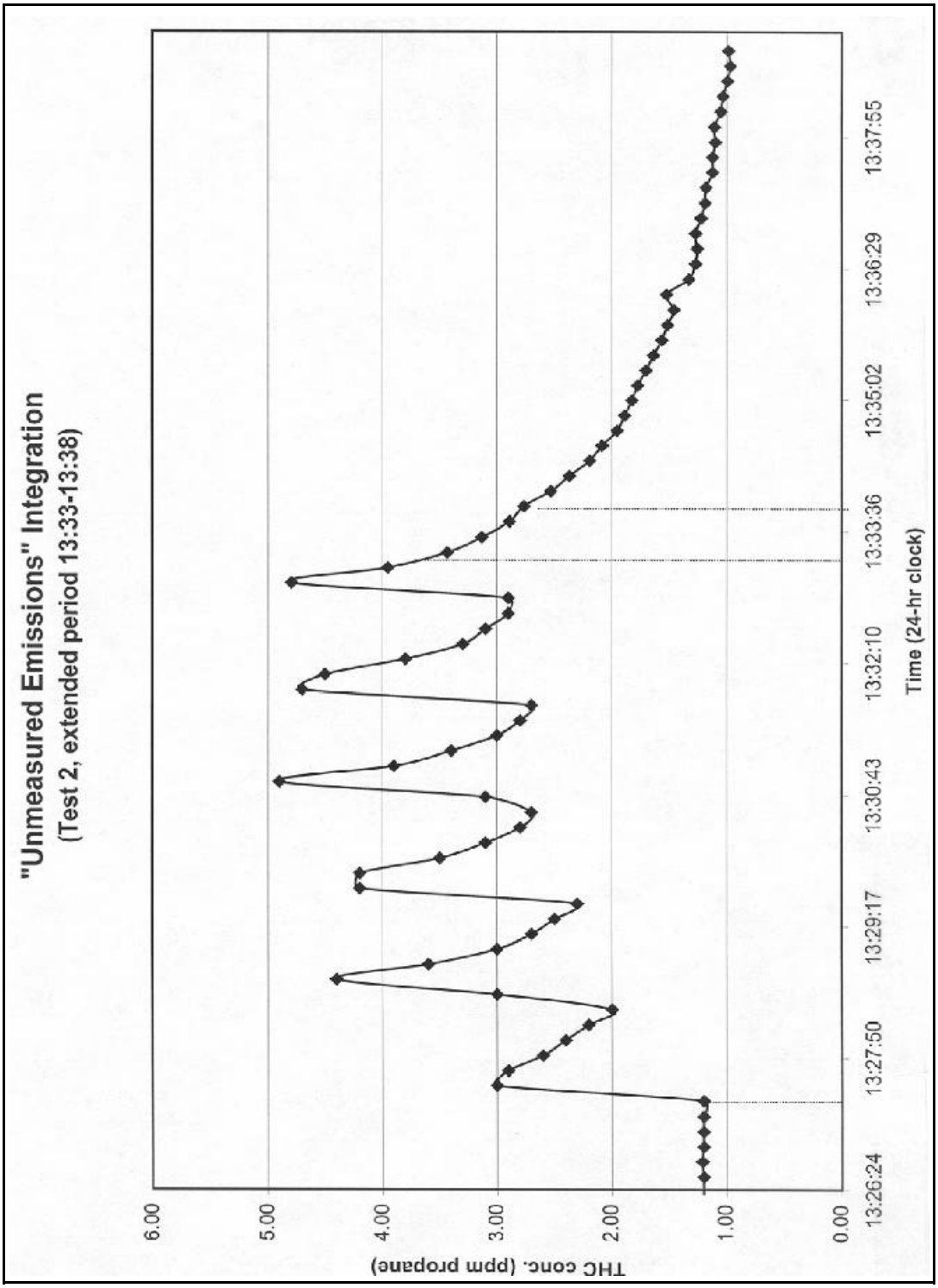


Figure 2. "Unmeasured Emissions" Integration (Test 2, period 13: 33 - 13: 38)

23

Figure 5. Page 23 from Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

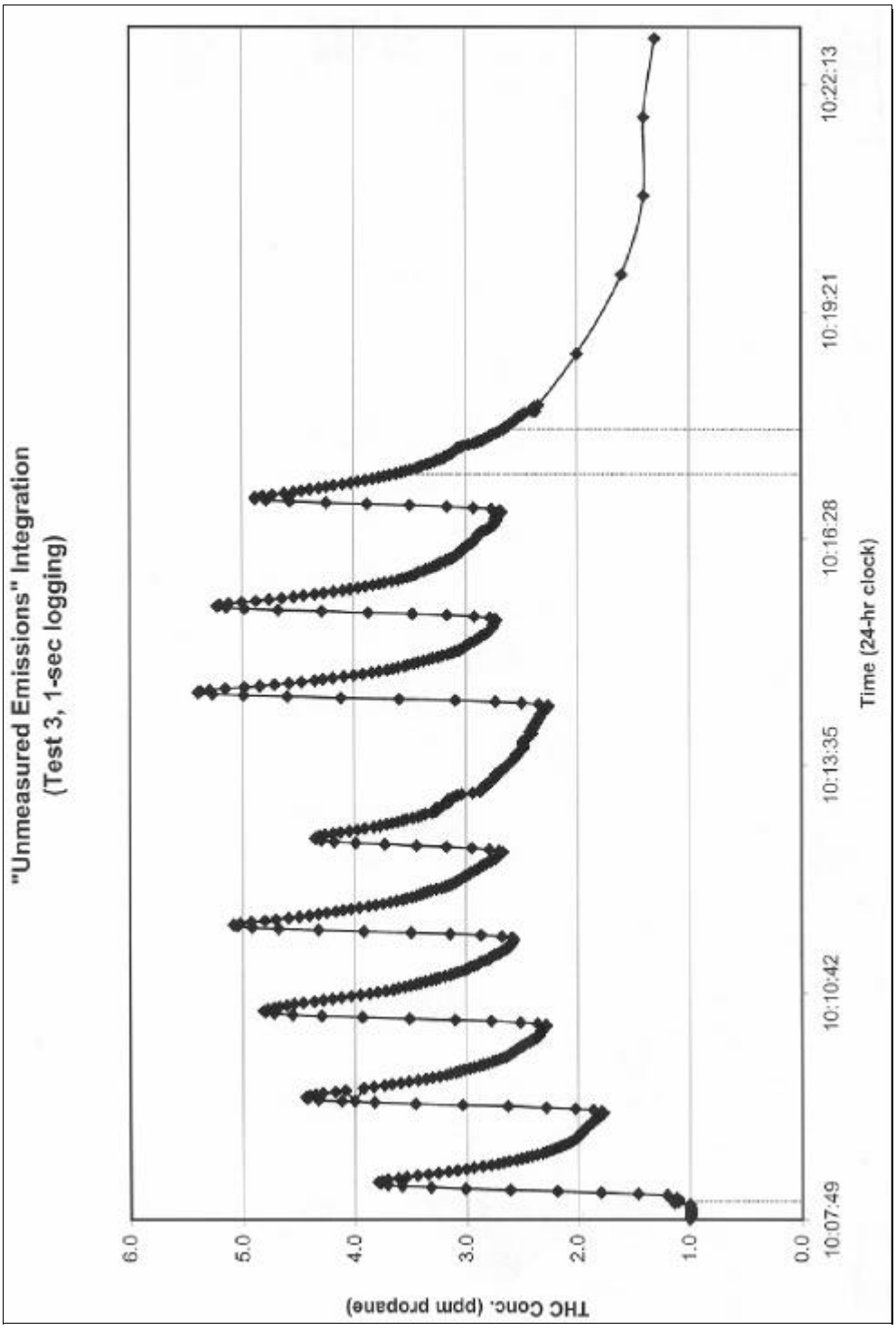


Figure 3. "Unmeasured Emissions" Integration (Test 3, 1 sec logging)

24

Figure 6. Page 24 from Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

tests. Thus, the greater than 5 min period integrated above clearly over estimates load out emissions. The greatest portion of what the commentors refer to as "unmeasured" emissions would be better termed "yard emissions," which are dealt with later in this section.

b. Almost all of the time periods between truck loadings were 2 min or less, and most were less than 1 min. Thus, not all of the emission went unmeasured when the doors were opened and closed around a new truck. In other words, not all of the lingering fumes were dissipated when a new truck entered the TTE in quick succession. Some of the "unmeasured" emission calculated above was actually measured as part of the next truck load-out and therefore was double counted.

c. As discussed in Response 11, both Plant C and Plant D enclosures were very similar except for the operating doors. The minimum measured capture efficiency for Plant C was 52% during the background run when only two trucks were available and 61% during production operations. One would expect that the addition of operable doors that significantly improved capture during about 80% of the time would improve capture efficiency to 90 to 95% rather than the 70 to 75% as estimated by the commentor.

Evidence of better capture than estimated by the commentor can be seen in the presentations of 1-min THC readings in Appendix B of the test report. Many times the drop in THC concentrations between loadings is less than 1 ppm from a value of about 3 to 5 ppm. Sometimes there is no perceptible drop in the THC concentrations between successive loading operations. The subsequent loadings begin from one to two minutes after the end of the previous loading. Based upon this information, one would expect the capture efficiency to be better than 90% {((6min*3ppm) + (2min*2ppm))/(8min*3ppm) = 0.92}. For loading times longer than 6 min, higher loading concentrations than 3 ppm, and shorter times between loadings than 2 min, the capture efficiency may be as high as 98% {((8min*5ppm) + (1min*4ppm))/(9min*5ppm) = 0.98}.

Additional evidence of better capture efficiency can be made based upon the assumption that the emissions from one complete drop out of seven is missed. This provides an estimated capture efficiency of 85%.

Note also that the two integrated data sets were from load-outs of 6 drops (Run 2) and 8 drops (Run 3). The lower factor (1.33) is from the 8-drop load-out. This makes sense since the measured emission is greater for 8 drops. Truck-loading operations for Plant D used both drop rates frequently, so an actual factor would fall somewhere between the two factors calculated.

A better method of estimating capture efficiency would be to select an interval more representative of actual plant operations than the greater than 5-min period used above. Under normal operations, a truck would not sit for more than 15 to 20 sec after the final drop before leaving the load-out area. Additionally, the doors were open an equally short period to allow an empty truck to replace the truck that was just loaded. Thus, an interval of 30 sec after the final drop can be used as a representative time period and will give a biased low estimate of the capture efficiency. Data presented in the table show that this method results in a biased high estimate for unmeasured emission of 6% to 10%, and that the scaling factor would be from 1.06

25

Figure 7. Page 25 from Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

to 1.10 (capture efficiency between 91% and 94%). As discussed in items b and c above, these estimates are also biased low due to multiple counting of emissions and comparison to the capture efficiency testing at Plant C.

Although biased low, Capture Efficiency Adjustment Factors in the range of 1.06 to 1.10 appear to be the more representative of actual plant operations and test conditions encountered than the commentors calculations. However, the analysis that follows for Yard emissions indicates that other factors appear to overestimate emissions, therefore we did not apply this adjustment to the data. Inclusion of the long tail-off period (emissions returning to baseline) is not appropriate since these emissions are more realistically included as yard emissions and will be described below.

* * *

Figure 8. Excerpt from Page 25 from Draft "Response to Comments on Testing Program for Asphalt Plants C and D Report."

This earlier, draft response indicates that, if commenters assertions are correct that opening doors 15 seconds after loadout did release some load out emissions from the enclosure before capture and measurement, the uncaptured and unmeasured release were small (less than 10%). As the analysis is an extrapolation of only two data runs and the enclosure was designed to Method 204 criteria, EPA believed that the actual uncaptured emissions are most likely smaller than estimated by our analysis. Therefore, no further adjustments were made to the loadout emissions from Plant D.

Although the capture efficiency for Plat C was based upon measurements and calculations using a tracer, these measurements still provide an estimate of the capture efficiency of the ventilation system during the emission testing. First, EPA Method 204 recommends that sources to use lower 90% confidence level of the measured data as a safety factor for demonstrating compliance with regulatory requirements. While the calculated lower 90% confidence level capture efficiency for Plant C averaged 61.3%, the actual measured capture efficiency averaged 67.9%. Second, as explained in item 60 on page 74 of the Response to Comments on Testing Program for Asphalt Plants C and D Report, many factors could contribute to variations in the correlation between what is measured from the release of process emissions and the tracer gas emissions. Quoting from this report, the first four items state:

> "1. The tracer gas was released outside the edge of the tallest truck bed, whereas actual emissions occurred generally from the entire bed area but primarily from the center. Therefore, the tracer gas was not thoroughly mixed with the gas containing the emissions.
>
> 2. The hot asphalt generated a buoyant stream that quickly rose to the ventilation system. This buoyant stream contained a concentrated mass of the emissions, whereas the tracer gas was injected toward the edge of this buoyant stream. Therefore, the gas containing the emissions would be captured better than the air containing the tracer gas.
>
> 3. The asphalt was loaded intermittently with emissions (both visible and measured) that peaked during the loading, decreased rapidly while the truck waited to be released, and then tailed off slowly after the truck left. This is significantly different than the constant continuous release of the tracer gas. Most of the visible emissions were released during a very short period when the truck was stopped in the tunnel. The truck being loaded (and the next truck waiting to enter the tunnel) blocked the movement of air through the tunnel, allowing for more effective capture of emissions and tracer gas. If a truck were not in the tunnel, wind effects would lower capture efficiency below the capture efficiency during actual load out. The tracer gas was also being injected during the time that trucks were moving in the tunnel and when there was no buoyant effect to help transport the tracer gas to the hood. The piston effect of truck movement would create air movement across the whole cross-section of the tunnel to draw the tracer gas away from the capture hood, thereby lowering the measured capture efficiency. Higher load-out rates (trucks per period) would

exacerbate this situation and increase the differences in the capture of the emissions and tracer gas.

4. Not only were the nozzles that injected the tracer gas at the edge of the gas stream of the emissions, but they were splayed to inject the tracer gas from 45° below horizontal to 45° above horizontal. For the majority of trucks, about 33% of the tracer gas was injected down from a point even with, and about two feet from, the upper edge of the truck bed. As a result, the capture of the tracer gas would be diminished."

While the design of the system to inject the tracer could not replicate exactly the release conditions of the emissions, it was as close as could be achieved given the dynamic nature of the load out process. The inability to replicate the release conditions results in situations that predominantly underestimate the actual capture efficiency. The magnitude of this underestimation cannot be determined and thus capture efficiency is considered an estimate. To avoid confusion created by using the non-qualified term "estimated," the term "quantitatively estimated " was used in the Emissions Assessment Report.

3.1.3 CAAP Capture Efficiency Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

32. Page 4-150, paragraph 3: There are several fundamental issues here that need to be explained. First, EPA argued for a long time that the tunnel at Plant C was adequate to capture all the emissions, based on visual observations by EPA - which were contradicted later by observations by the citizens. EPA reluctantly agreed to use tracers only because the tunnel did not meet Method 204 criteria. (In discussion of Plant D, We will discuss why Method 204 criteria are inadequate). Next, EPA averaged the efficiency over several runs and used a single capture efficiency correction. It was only after the citizens showed that capture efficiency varied during the day, typically declining as the on-shore wind picked up as the land around the plant heated up, that EPA agreed to correct data for the individual capture efficiencies. Finally, the so-called correction for truck emissions, discussed later, continues to be a sham. But that sham is not really discussed here when the quality of data is being considered. See our comments with reference to page 4-152 below. Also, note that there is a typographical error in EMD GD-035 " Guidelines for Determining Capture Efficiency". On page 9, in the formula for p in equation 7, x_{avg} value should be 100.8 not 110.8. The calculated value of p is correct, however.

3.1.4 Response to CAAP Capture Efficiency Comment Number 2 - It is not clear what information contained in the paragraph is incorrect and the commentor wants EPA to revise. The commentors statements concerning EPA's decision to use a tracer to characterize capture efficiency are inaccurate. We had previously concluded that, with doors open, Plant C enclosure did not meet EPA Method 204 criteria. We estimated that the capture efficiency was between 70% and 90%. EPA's decision to revise the calculation of capture efficiency was based on our established criteria in the guidance

document “Capture Efficiency Testing Guidance” (EMC GD-035). This guideline specifies that the lower 90% confidence level capture efficiency is to be used rather than the average measured capture efficiency. The variations in the capture efficiency were not germane in our decision to revise the calculation of the capture efficiency. The addition of this information to the current information describing capture efficiency adjustment is not needed. We agree that the intermediate value presented in equation 7 of the example calculation on page 10 of the guideline document is a typographical error. As the commentor notices, the value for p that results from the calculation is correct. In addition, the text preceding the equation presents the correct calculated value for term used in the equation.

3.2 Compensation for Asphalt Temperature and Volatility

3.2.1 CAAP Temperature and Volatility Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) -

Commentors Summary Section C

Incorrect Approach in Compensating for Volatiles Content of Asphalt: The methods used in these reports to correct for volatiles content of asphalt are contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss compared to the asphalt used in Plant C and Plant D tests. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The new Superpave specifications allow for a 1% loss on heating and therefore represent a relaxation of the previous AC grade standards. In view of this and the industry’s use of various additives and diluents (which would increase the vapor pressure), the citizens argued and the EPA agreed that maximum number of 0.5% should be used. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives, in spite of suggestions to the contrary, in some cases. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, is encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received, can then switch to an asphalt with a different RTFOT value with impunity.

As long as the specifications allow for up to 1% volatiles in asphalt (even before additives are used), it is misleading for EPA to state that their approach in Appendix B - Table 4-27 “encourages the use of site specific data”. The primary use of AP-42 is to prepare calculations to get permits to build and operate hot mix plants. Therefore, there is no site specific data that can be used other than fictional data. Unfortunately, the industry has a long history of providing low-ball estimates, designed to fool the public and get permits from agencies that are not particularly anxious to ask difficult questions.

Incorrect Substitution of Delivery Temperature for Loadout Temperature: The statement that “325^{o} F, which is the maximum load-out temperature recommended by industry” is

imprecise. Most specifications require this to be the maximum temperature **at a job site** where HMA is to be spread and compacted. (The minimum temperature is 275° F.) The maximum **load out** temperature is much more variable and can be higher if the plant is producing asphalt for a distant job or for a small job, where there can be considerable cooling of the HMA mass between loadout and delivery.

Hot Mix Asphalt Plants Emissions Assessment Report

13. Page 14, paragraph 2: The statement that "325° F, which is the maximum load-out temperature recommended by industry" is imprecise. Most specifications require this to be the maximum temperature **at a job site** where HMA is to be spread and compacted with rollers. (The minimum temperature is 275° F.) The maximum **load out** temperature is much more variable and can be higher if the plant is producing asphalt for a distant job or for a small job, where there can be considerable cooling of the HMA mass between loadout and delivery. This same error is repeated in the last sentence of the next paragraph and in many portions of Appendix B.

    This paragraph also states that -0.5% was selected as a default value for weight loss in a rolling thin film oven test. The methods used to apply the correction for volatility are contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The new Superpave specifications allow for a 1% loss on heating and therefore represent a relaxation of the previous AC grade standards. In view of this and the industry's use of various additives and diluents (which would increase the vapor pressure) which are often added after the asphalt has been sampled for the measurement of the weight loss, the citizens argued and the EPA agreed that maximum number of 0.5% should be used at all times. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, is encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received, can then switch to an asphalt with a different RTFOT value with impunity.

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

14. Page 10, paragraph 2, 3: The comments here are a major problem. The methods used to apply the correction for volatility are contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss than that suggested by limited sampling. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The new Superpave specifications allow for a 1% loss on heating. In view of this and the industry's use

of various additives and diluents which would increase the vapor pressure after sampling for the measurement of the weight loss, the citizens argued and the EPA agreed that maximum number of 0.5% should be used at all times. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, in encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received on the basis of a low RTFOT value, can then switch to an asphalt with a different RTFOT value. This entire paragraph has to be rewritten with -0.5% weight loss and 325° F or higher temperature.

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

39. Page 4-155, paragraph 2: The statement is that "The industry has stated that good paving practices dictate that load-out temperatures in excess of 325° F should be avoided." Who has stated this and in what context? The specification for highways is that hot mix temperature before the pavement is **laid down** should be between 325 and 275° F. Hot mix outside this temperature range can be rejected. The temperature at load out depends on the distance between the plant and the location where the new pavement is being laid and the size of the truck since smaller loads will cool faster than larger loads.

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

43. Page 4-159 - 162: As discussed earlier, the entire loss on heating discussion should be rewritten so that a RTFOT value of -0.5% is used in all cases. This way, the EPA will not be providing yet another opportunity for builders of new plants to misrepresent what might happen once the plant starts operating. The same applies for the formulae which promote the use of variable temperatures.

3.2.2 Response to CAAP Temperature and Volatility Comment Number 1 - EPA does not agree that we should present a single emission factor based upon the maximum allowable asphalt volatility and maximum load-out temperature. Both the volatility (as determined by the Rolling Thin Film Oven Test) and the HMA load-out temperature vary with a number of parameters. EPA has obtained data showing a regional variation in the volatility of asphalts used in road construction. EPA also has obtained information showing that the storage and mixing temperatures for different asphalt binder grades are different. Additionally, EPA recognizes that there are minimum delivery temperature requirements for paving operations. Therefore, manufacturers will vary the load-out temperature to accommodate transport times and ambient temperatures. EPA's equations provide a reasonable estimate of emissions when used with asphalt volatility and temperature information determined by valid measurements.

We recognize that the various citizens' groups requested EPA to require the tested facilities to use an asphalt with 1% loss on heating. Also, as we explained in the many meetings preceding the tests, it should be recognized that EPA could not require HMA plants to use 1% loss on heating asphalt during the emission tests. We also recognize that the various citizens' groups requested EPA to adjust the data to a 1% loss on heating as an alternative to using an asphalt with 1% loss on heating. EPA's analysis before the emissions tests revealed that the adjustment to a 1% loss on heating is clearly not supported by data collected by the Strategic Highway Research Program (SHRP)/National Academy of Sciences (NAS). Additional data collected by EPA from selected State Highway Departments, also does not support adjustment to a 1% loss on heating value. The limited data obtained from the State Highway Departments also supported a much lower loss on heating value. The State Highway Department data also indicates that the use of a single loss on heating value for all States or regions is not supported.

EPA's commitment is clearly stated in item 4 on page 3 and in the third paragraph on page 63 of the Response to Comments on Testing Program for Asphalt Plants C and D Report. This commitment is that while emissions presented in the EA-Report would be adjusted to 0.5% loss on heating for consistency, additional adjustments would be recommended to accommodate local and State specific conditions. In March 2000, EPA provided to all of the stakeholders 1) copies of all changed pages of the Plant C and D test reports and 2) copies of all changed pages of the Response to Comments on Testing Program for Asphalt Plants C and D report. EPA committed to change these pages as a result of written and verbal comments from stakeholders. Specifically, page 3 of the Response to Comments on Testing Program for Asphalt Plants C and D was included. EPA provided the stakeholders 30 days to review the changed pages to verify that EPA's commitments were properly reflected in the changed pages. There was no response from any stakeholder.

As stated in Item 52 on page 62 through 65 of the Response to Comments on Testing Program for Asphalt Plants C and D Report, less than 3% of the asphalts analyzed by the SHRP/NAS nationally have a loss on heating greater than 1%. As shown in the test reports for plants C and D, the earlier analysis method (used by SHRP/NAS) results in loss on heating values about half the presently recommended RTFOT analysis method for the same asphalt. The revised maximum loss on heating specifications is a recognition of the differences between the previous analysis method and the presently recommended RTFOT analysis method. The revised specification is not a relaxation of the standards for asphalt.

RTFOT data provided by State Departments of Transportation and presented in Table 10 on page 64 of the Response to Comments on Testing Program for Asphalt Plants C and D Report also show that adjustment to a 1% loss on heating using the presently recommended test method is not supported. For four of the five States less than 0.0004% of the asphalts analyzed would exceed the 1% loss on heating value. Only about 3% of the asphalts obtained and analyzed by one state (Minnesota) would exceed the 1% loss on heating value. As stated on page 63 of the Response to Comments on Testing Program

for Asphalt Plants C and D Report the value of 0.5% reflects the 99.99% upper confidence level for the average loss on heating value obtained from the State of Minnesota.

While EPA agreed to present data adjusted to 0.5% loss on heating for consistency, this would not be appropriate for the remainder of the States shown in Table 10. For the State of Massachusetts, only 1.5% of the 44 individual asphalts tested had a loss on heating greater than 0.5%. For most pollutants and most situations, the average loss on heating value is the most appropriate value to be used. However, some State Agencies may wish to use an alternate value for estimating emissions to address specific conditions of interest to them. This alternate approach could be based upon a statistical analysis of loss on heating data representative of the specific locality rather than a maximum value allowed by a product specification.

The commentors have made statements previously that diluents and additive are added at the distribution terminal after the State Transportation Department has obtained samples for analysis. However, as presented on page 64 of the Response to Comments on Testing Program for Asphalt Plants C and D Report each of the State Department of Transportation employees that provided the data on loss on heating indicated that the samples obtained were to be used without further blending. We recognize that asphalt distributors blend asphalts and include other additives so that the asphalt supplied to the HMA plant meets the required specifications. However, there is no evidence that indicates diluents are added following the collection of samples by the State Department of Transportation. Furthermore, the loss on heating analyses of samples collected during the pre-test survey and during the emission test of plant D compare very favorably with the loss on heating analyses performed by the State of Massachusetts Department of Transportation.

The equation presented in the report is not to be used with a hypothetical loss on heating value as implied by the commentor. The report specifically states that without regional or site-specific data for asphalt volatility, a default loss on heating value of -0.5% should be used. In addition, if State permitting authorities are concerned that a source may switch to asphalts that are significantly more volatile than what was stated in their application for the permit, the State could include enforceable limitations in the permit to preclude this switch. This enforceable limitation could be based upon a statistical analysis of loss on heating data representative of the specific locality rather than a maximum value allowed by a product specification.

We do not know of any specifications for maximum delivery temperature. However, as shown on Figures 1 and 2, the Asphalt Pavement Environmental Council's published "Best Practices" brochure published on 4/00 provides guidance for controlling fumes, emissions and odors from HMA plants and paving operations. The second side of the brochure (Figure 2) includes recommendations for the range and midpoint temperatures for both the storage of asphalt and the mixing of the HMA product. These temperatures vary by the asphalt binder grades. The numbers in the binder grade are indications of the

Asphalt Pavement Environmental Council Best Practices

Controlling Fumes, Emissions and Odors from HMA Plant and Paving Operations

AT THE PLANT

- Select plant mixing temperature by:
  - — Contacting your asphalt supplier.
  - — Using the chart on the back.
- Do not use laboratory mixing temperature as plant mixing temperature.
- Make sure RAP and aggregates are dry.
- Do not use RAP containing coal tar.
- Do not expose RAP to flame.
- Do not over-heat RAP.
- Look for other sources of fumes such as:
  - — Slag aggregate
  - — Shingles
  - — Crumb rubber mixtures
  - — Other products from construction and demolition waste.
- Read the Material Safety Data Sheet (MSDS) for all materials.
- Regularly calibrate thermocouples and other sensors.
- Tune up the burner.
- Contact the manufacturer and find out the limits on CO and O_2.
- When the stack is tested, compare the plant's thermocouple reading to the tester's thermocouple.
- Gather data on aggregate moisture content and fuel usage. If fuel usage goes up for the same or less moisture, find the reason.
- Have stack gases tested to see if they are in limits. If not, contact manufacturer to make adjustments.
- Compare mix temperatures with plant temperatures. Look for changes with time.
- Measure and record the pressure drop in the baghouse. Look for changes over time.
- Keep a record of fuel usage over time. Find the reason for any big changes.
- Keep track of this information and discuss it with co-workers and the manufacturer.
- Do not use diesel fuel and kerosene as release agents.

AT THE PAVING SITE

- Try increasing the mat lift thickness before calling for a higher plant temperature.
- Do not use diesel fuel and kerosene as release agents.
- Maintain engineering controls on paving equipment.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

APEC is comprised of the following organizations: **National Asphalt Pavement Association, Asphalt Institute, State Asphalt Pavement Associations**

Figure 9. Asphalt Pavement Environmental Council, Best Practices Brochure, Side 1. Reprinted with the permission of the National Asphalt Pavement Association.

Asphalt Pavement Environmental Council Best Practices

Typical Asphalt Binder Temperatures

Binder Grade	HMA Plant Asphalt Tank Storage Temperature (°F)		HMA Plant Mixing Temperature (°F)	
	Range	Midpoint	Range	Midpoint
PG 46 -28	260 – 290	275	240 – 295	264
PG 46 -34	260 – 290	275	240 – 295	264
PG 46 -40	260 – 290	275	240 – 295	264
PG 52 -28	260 – 295	278	240 – 300	270
PG 52 -34	260 – 295	278	240 – 300	270
PG 52 -40	260 – 295	278	240 – 300	270
PG 52 -46	260 – 295	278	240 – 300	270
PG 58 -22	280 – 305	292	260 – 310	285
PG 58 -28	280 – 305	292	260 – 310	285
PG 58 -34	280 – 305	292	260 – 310	285
PG 64 -22	285 – 315	300	265 – 320	292
PG 64 -28	285 – 315	300	265 – 320	292
PG 64 -34	285 – 315	300	265 – 320	292
PG 67 -22	295 – 320	308	275 – 325	300
PG 70 -22	300 – 325	312	280 – 330	305
PG 70 -28	295 – 320	308	275 – 325	300
PG 76 -22	315 – 330	322	285 – 335	310
PG 76 -28	310 – 325	318	280 – 330	305
PG 82 -22	315 – 335	325	290 – 340	315

Use mid-point temperature for test strip construction.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

APEC is comprised of the following organizations: **National Asphalt Pavement Association, Asphalt Institute, State Asphalt Pavement Associations**

Figure 10. Asphalt Pavement Environmental Council, Best Practices Brochure, Side 2. Reprinted with the permission of the National Asphalt Pavement Association.

project-specific temperature extremes (in degrees centigrade) for which the asphalt mixture is being designed. As such, a PG82-22 grade asphalt is intended for use when average 7-day maximum pavement design temperature is 82° C (179° F) and the minimum pavement design temperature is 22° C (-8° F). The midpoint HMA Plant Mixing temperatures range from 264° F to 315° F. As shown on in Figure 2, the highest HMA mixing temperature is associated with a binder used for the most severe temperature conditions.

In addition, in a letter dated September 14, 1999 commenting on the *Hot Mix Asphalt Emissions Tests and Report for "Plants C & D"* sent to Robert McConnell of EPA Region I by Massachusetts State Senator Stephen F. Lynch, a copy of the Massachusetts Highway Department 1995 Standard Specifications for Bituminous Materials was attached. The standard includes three separate maximum temperatures measured at the production facility. The maximum temperature standard for drum mix plants is 163° C (325° F) measured at the point where HMA is loaded onto the hot mix conveyor (see page III.25 Paragraph I). For batch mix plants there are two maximum temperature standards, one for HMA containing RAP and one for HMA without RAP. The maximum temperature for HMA containing RAP is 150° C (302° F). HMA that does not include RAP is allowed to have a maximum temperature of 190° C (374° F).

The 1995 standard specifications provide no explanation for why there are three different maximum production temperatures. However, process differences in batch mix and drum mix plants do provide a reasonable rationale for why there would be differences in achievable temperatures based upon the target temperature and RAP content of the predominant product. Drum mix plants make and store multiple loads ahead of their customers need for a given product. With relatively long production runs, they can change the new aggregate temperature to accommodate the temperature and percentage of RAP for that product. As a result, the production temperature can be the same despite the type of product or the ratio of RAP required. On the other hand, batch plants store sufficient preheated and screened aggregate for two to four truck loads of HMA. Therefore, any changes in aggregate temperature must be anticipated at least two transport trucks in advance and there is little capability to change aggregate temperatures for every product specification. As a result, it would be difficult for a batch plant to concurrently produce HMA with and without RAP and meet the same temperature requirements. It is believed that most batch mix facilities would heat the new aggregate to the temperature requirements of the predominant product but within a range that is also acceptable for production of the other products. As a result, for the more typical case where the predominant product includes RAP, products which do not contain RAP will be at a higher temperature. For example, a batch mix plant with a predominant product which contains 10% RAP at the maximum load-out temperature of 150° C (302° F) would heat the new aggregate to approximately 165° C (330° F). As a result, when a customer requests HMA without RAP, the load-out temperature will be 165° C (330° F). The statements with respect to the maximum recommended load out temperature are sufficiently accurate. Therefore, the use of a default temperature of 325° F is a reasonably high default value to accommodate all but the most extreme conditions.

3.2.3 CAAP Temperature and Volatility Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

23. Table 14: This table has to be redone so that an actual emission factor is given; not a formula for calculating low emissions based on fictitious values of asphalt volatility.

3.2.4 Response to CAAP Temperature and Volatility Comment Number 2 - Many other Sections of AP-42 employ equations to improve the precision of emission factors when there are documented characteristics which are readily available for use to develop a regionally or locally specific emission factor. Some examples are paved and unpaved roads, surface coal mines, wind erosion, and several emission factors for fuel combustion. The table presents formulas that allow emissions to be calculated based upon measured (not fictitious) parameters representative of the regional or site specific conditions. In the December 17, 1999 draft and the May 2000 final version of the Response to Comments on Testing Program for Asphalt Plants C and D Report, the adjustments for the volatility and load out temperature were specified. The basis of these adjustments is clearly documented in the text and tables in response numbers 52 and 53. While the equations are different in appearance from that presented in response numbers 52 and 53, the equations implement the tabular values for the adjustments presented.

3.2.5 CAAP Temperature and Volatility Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) -

Hot Mix Asphalt Plants Emissions Assessment Report

14. Page 14, paragraph 3: EPA again makes the same recommendation which is to assume that the load out temperature can never exceed 325^{o} F. This is incorrect. For example, Mr. Webster, the industry expert who has attended many of the EPA/citizen group/industry meetings has looked at the photographs that Ravi Nadkarni submitted to the EPA in 1994 and are in the EPA files. His comment was that the photos were typical of a plant loading out material at a high temperature when supplying small contractors. If this practice is common enough to be readily identified at a glance, EPA's comments about 325^{o} F being the maximum temperature under all conditions are wrong and need to be corrected.

3.2.6 Response to CAAP Temperature and Volatility Comment Number 3 - The statement is correct. At the time the citizens, EPA and industry agreed to request the facilities tested by EPA to target a load-out temperature of 325° F, the industry stated that this temperature was their best practices' recommendation. While a facility may target a specific load-out temperature, variations in storage time and some characteristics of the aggregate and RAP may cause small variations in the actual load out temperature. It is expected that temperature variations at batch mix plants would be greater than at drum mix plants. This is because batch mix plants generally do not store HMA product. However, they store aggregate heated to the desired temperature for their projected principal product. Using the previous example, if the principal product was HMA containing 10% RAP with a desired load-out temperature of 302° F, the new aggregate would be stored at about 330° F. If a single load of HMA with no RAP was required, the

load-out temperature for that load would be about 330° F. Based upon these two temperatures, for load-outs of equal amounts of these two materials, the HMA with no RAP would have emissions that are about twice the emissions of the HMA with RAP. Because of the difference in these emissions, the visual appearance of these two load-outs would be markedly different. It is believed that this is the type of situation described to Ravi Nadkarni by Mr. Webster. This type of situation occurred during emissions testing at Plant D about 10% of the time. It is expected that the situation described by the commentor would occur at about the same percentage of time. However, batch mix facilities that routinely produce significantly more than about 10% of their product without RAP should accommodate the emissions differences by adjusting the average load-out temperature used in the emission estimation equation.

3.3 Adjustment for Background Truck Operation Emissions

3.3.1 CAAP Background Emissions Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) -

Commentors Summary Section C

Improper Manipulation of Data from the "Background" Test, Run 4, at Plant C: The report states correctly: "The most reliable method to adjust for emissions measured during background operations would be to separately adjust each run for the measured capture efficiency and then subtract these adjusted background emissions from the adjusted emissions measured during production operations." However, because this "procedure produces negative values for both the PM and MCEM and many other HAP compounds", a new unsound procedure is adopted because it gives results that please EPA and industry by showing low but positive emissions. This new procedure is to use background emissions **uncorrected** for capture efficiency. If the actual emissions have to be corrected for capture efficiency because the enclosure does not capture all the emissions, there is no justification for ignoring the capture efficiency for the background run. Having used this incorrect analysis, the authors then have the temerity to advise us that this result might even have a "high bias" relative to the correct method mentioned above.

The report justifies this faulty procedure because this situation "cannot be accommodated retroactively." This statement is not correct. The best way to eliminate improper data manipulation is to discard the phony background adjustment and report the data as that from loadout **plus** truck exhaust. Since silos always dump hot mix into a truck, these combined emissions are present at each silo loadout point. Further, in the unlikely event that a local permitting authority requires inclusion of truck exhaust emissions (unlikely because we have not seen such calculations associated with any local permitting requirements), note that the truck spends about ½ minute under the silo but many more minutes, typically 3 to 8, on site. As a result, the truck emissions that are included under loadout correspond to the ½ minute portion. Therefore, the double counting of truck exhaust emissions would be minimal and can be adjusted for by subtracting the ½ minute from residence time of the truck on site.

Overall, the background run demonstrates how data collection was manipulated to produce biased results. The EPA Project Officer was interested in recording a high background and the original data showed that he was able to manipulate truck placement near the entrance of the tunnel in such a way that uncorrected emissions in the second half of the run were about twice the emissions in the first half. If these emissions are corrected for the lower capture efficiency in the second half of the run, the corrected emissions from the second half are almost three times the corrected emissions from the first half. In spite of using the emissions from the first portion of the background run, it appears that they were still too high when corrected for capture efficiency and resulted in negative or zero emissions to the environment.

Commentors Summary Section C

Unexplained Differences Between MCEM and TOC: The comparison of Plant C and Plant D results shows a wide variation between emission rates for MCEMs and TOC. MCEM PMs and TOC are generated the same way and from the same source. Therefore, if MCEM generation is a function of loadout time, TOC generation should also be a function of loadout time and TOC emissions should be higher for a batch plant in the same ratio. The report does not explain this discrepancy. Of course, the comparison is further complicated and made meaningless by the bogus "background" correction for drum plants discussed earlier. To eliminate the confusion, separate emission factors should be prepared for batch and drum plants in all cases.

Comments on Hot Mix Asphalt Plants Emissions Assessment Report

12. Page 13, paragraph 5: This paragraph discusses the subtraction of "background emissions", which reduced the calculated loadout emissions significantly. Our detailed comments are in our page-by-page discussion of Appendix B, which show that the method used is totally without foundation or theoretical support, and the only excuse for using it is that it gives non-negative results in several cases.

3.3.2 Response to CAAP Background Emissions Comment Number 1 - The background adjustment was appropriate. There was no improper manipulation of the data from the background test at Plant C and EPA did not manipulate the placement of the trucks to obtain higher uncorrected emissions for the background run. Further, we do not agree that the background run demonstrates that data was manipulated to produce biased results and do not believe that concurrently measured truck exhaust and road dust emissions should be included in the emission factor for load-out emissions.

As stated in Appendix B (AP-42 Background Report) and in item 51 on page 56 through 61 of the Response to Comments on Testing Program for Asphalt Plants C and D Report, the background adjustment was performed to accommodate the emissions from the operation of the trucks within and near the enclosure. The information presented on pages 56 through 61 of the Response to Comments on Testing Program for Asphalt Plants C and D Report shows that the emissions measured during the background run agree reasonably well with published data for diesel engine emissions. This is also explained in Section 3.3.6 of this response. As explained in Section 3.3.6, the truck drivers were

instructed to operate their trucks (including the placement prior to entering the tunnel and placement to simulate loading) as they did during normal operation. The only additional instruction provided to the truck drivers during the background test was to reduce the time of their travel from the exit of the tunnel to the arrival at the tunnel entrance. During the emission test at Plant C, Dr. Nadkarni observed the operation of the trucks during the background run. The issue of manipulating the placement of the trucks was not raised by him during the test to either of the EPA personnel present.

The differences in THC concentrations recorded for the first and second half of the background run do not indicate that either truck placement or data were manipulated. At about the time trucks began driving faster to reduce gaps between trucks, the wind speed increased. This may have caused an increase in the diesel exhaust that entered the tunnel entrance or increased the capture of the diesel exhaust of the truck that was inside the tunnel. Given that the THC concentrations during the background run were low, the differences in concentrations appear more significant.

Commentors raised concerns with the calculated average background THC concentrations at a stakeholders meeting to discuss EPA's draft document "Response to Comments on Testing Program for Asphalt Plants C and D." At the meeting, commentors raised concerns with the differences between the first and second half of the background test run suggesting the second half run measured emissions from two trucks; one in the tunnel and one waiting at the tunnel entrance. While EPA disagreed with the commentors assertions, we agreed to use only the first half run data (0.83 ppm) in lieu of the average of the entire run (1.2 ppm) to determine the background concentration to be used in adjusting for background concentrations that were attributed to truck engine emissions. This change of background concentration lowered the THC background adjustment from 9.7% to 6.7% of the capture efficiency adjusted THC emissions. If the background concentration of 0.83 ppm were adjusted for the 45% capture efficiency for Run 4, the background adjustment to the THC emission factor calculation would be 1.84 ppm. Adjusting for capture efficiency would have resulted in a 14.5% reduction of THC emissions compared to the 6.7% reduction used by EPA.

Publishing load-out emission factors, which includes diesel exhaust and road dust emissions as the commentor suggests does not address diesel exhaust or road dust emissions. These emissions were excluded since more comprehensive methods to calculate these emissions are available in other parts of AP-42. Specifically, mobile source factors are available for different engine type by milage and year of production and fugitive dust emission factors are available that accommodate the type and dustiness of the road surface. Excluding emissions not related to load-out operations isolates the emissions of concern, precludes future double counting emissions and precludes other improper manipulation of emissions data.

3.3.3 CAAP Background Emissions Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

35. Page 4-152, paragraph 3: This paragraph presents a major problem in this report. The second line states correctly: "The most reliable method to adjust for emissions measured during background operations would be to separately adjust each run for the measured capture efficiency and then subtract these adjusted background emissions from the adjusted emissions measured during production operations." However, because this "procedure produces negative values for both the PM and MCEM and many other HAP compounds", a new unsound procedure is adopted because it gives results that please EPA and industry by by showing low but positive emissions. This new procedure is to use background emissions uncorrected for capture efficiency. If the actual emissions have to be corrected for capture efficiency because the enclosure does not capture all the emissions, there is no justification for ignoring the capture efficiency for background.

    Having used this incorrect analysis, the authors then have the temerity to advise us that this result might even have a "high bias" relative to the most correct method mentioned above. In a very narrow sense, this comment might be correct, but in the current context, given the consistent efforts of the Project Officer to bias the results to favor industry, this comment is totally off base.

    Line 5 states that this situation "cannot be accommodated retroactively." This statement is not correct. The best way to eliminate improper data manipulation is to discard the phony background adjustment and report the data as that from loadout **plus** truck exhaust. Since silos always dump hot mix into a truck, these combined emissions are present at each silo loadout point. Further, if a local permit application requires the inclusion of an estimate for truck emissions on site (and we have yet to see a local permit that requires this), note that the truck spends about ½ minute under the silo but many more minutes, typically 3 to 8, on site. As a result, the truck emissions that are included under loadout correspond to the ½ minute portion. Therefore, the double counting of truck exhaust emissions would be minimal and can be adjusted for by subtracting the ½ minute from residence time of the truck on site. We strongly recommend that Tables 4-25 and 4-26 be revised to reflect this approach.

3.3.4 Response to CAAP Background Emissions Comment Number 2 - The goal of the test program and the document being commented on was to develop emission factors for publication in AP-42 for the various criteria and hazardous air pollutants resulting from truck loading and silo filling. Emission factors for specific process operations reduce the possibility of inappropriate and inconsistent manipulation of emissions to satisfy the differing State and local requirements for permit and inventories. Different methods are used by some states to evaluate and control fugitive, mobile source and point source emissions which occur within a facility.

Since emission factors for diesel truck tailpipe emissions and for paved and unpaved road emissions are available elsewhere, emissions sources may satisfy some States request to segregate these emissions. A known example of this occurs with unpaved and paved road emission factors. Both emission factors include the vehicle tailpipe emissions since they were not accommodated in the emission tests that provide the supporting data for the emission factors. EPA, and many State and local agencies subtract the estimated tailpipe emissions as calculated with the emission factors for the type of vehicle generating the fugitive emissions. This is reasonable for situations where the driving conditions of the vehicles are similar to the Federal Test Procedure for motor vehicles. However, in some situations (such as low load and mild acceleration conditions) this adjustment would over correct the emissions estimate. This latter situation is a distinct possibility for the combined load-out, diesel exhaust and fugitive dust emissions described in this comment.

Emissions for many pollutants measured during the background run agreed reasonably well with information published by EPA's Office of Transportation and Air Quality and in two journal articles for diesel emissions. It should be noted that additional information is being developed by EPA and others to better characterize diesel engine emissions for a wider variety of engines. Many AP-42 emission factors are revised from time to time to reflect improved information and changes that may occur due to improvements in emissions control. For diesel engine emissions, this is highly probable. Many diesel engine manufacturers are developing revised engine designs and exhaust controls. These revisions could potentially result in a significant reduction of diesel engine emissions.

The availability of separate emission factors for individual, distinctly different processes allow State and local agencies to more effectively meet the individual requirements of their programs. Additionally, separate emission factors eliminate the possibility for inconsistent and erroneous adjustments to the composite emission factor for truck load-out.

There are several justifications for not adjusting the background emissions for the measured capture efficiency as part of the process for isolating the load-out emissions from the composite emissions measured. First, it is evident that most of the visible particulate emissions were from the load-out operations and relatively little came from road dust and truck exhaust. Correcting the background emissions for the measured capture efficiency resulted in background particulate that exceeded the capture efficiency corrected emissions measured during the production tests. In addition, the capture efficiency corrected background organic particulate emissions (MCEM) were 99.5% of the capture efficiency corrected emissions measured during the production tests. This is clearly contrary to the observed situation. Since only two trucks were available during the background run, the entrance to the tunnel was obstructed less than half the time by a truck waiting to enter the tunnel. During the production tests, the tunnel entrance was obstructed over 90% of the time. The lack of obstruction allowed the prevailing winds to scavenge the tracer gas away from the capture hood and result in poorer capture of the tracer than would occur otherwise. Without the thermal lift created by the hot asphalt, the tracer was not drawn into the capture hood like during the production runs. And lastly,

excluding the capture efficiency adjustment would tend to understate the significance of the road dust and truck exhaust and provide a moderate and acceptable safety factor to the truck load-out emissions.

The adjustments to the data were reasonable. As stated above, the modification of the method used to adjust the composite emissions measured during the production periods provide at most a moderate safety factor to the truck load-out emissions while resulting in adjusted emissions that agree to the situations observed during the emissions tests. Further, published emission factors for diesel exhaust use the number of vehicle miles traveled and not on the time of operation. Adjusting road dust and diesel exhaust emissions for the time period or distance trucks' travel introduces additional complexities into calculating emissions for a facility and for an area. The availability of separate emission factors representing only truck load-out emissions will allow State and local agencies to meet multiple individual requirements with a minimum of inconsistent and potentially erroneous adjustments to the composite emission factor for truck load-out.

3.3.5 CAAP Background Emissions Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

36. Page 4-152, paragraph 4: This paragraph further demonstrates the problems with EPA's background run. The EPA project officer was interested in recording a high background and the original data showed that he was able to manipulate truck placement in such a way that uncorrected emissions in the second half of the run were about twice the emissions in the first half. If these emissions are corrected for the lower capture efficiency in the second half of the run, the corrected emissions from the second half are almost three times the corrected emissions from the first half. This further points out the problems with EPA's manipulation of and placement of trucks to maximize exhaust emissions inside the tunnel.

    We have to apologize for not taking this particular analysis far enough a year ago during a review of the Plant C draft. When the data for Run 4, the background run, was reviewed, it was clear that there was data manipulation going on since the raw data showed that emissions in the second half of the run were double those in the first half. When these emissions were adjusted for capture efficiency, the emissions from the second half almost tripled. We felt that the data from the first half of the run was more appropriate than that from the second half. We did not realize that this data, after correcting for capture efficiency, still overwhelmed and negated the load out emissions and was therefore also tainted.

3.3.6 Response to CAAP Background Emissions Comment Number 3 - Differences between the THC measured during the first and second half of the background run cannot be fully explained without some conjecture. However, there was neither manipulation of the truck placement nor manipulation of the data. As explained in response number 41 of the "Response to Comments on Testing Programs for Asphalt Plants C and D" document,

we instructed the two truck drivers used during the background run to replicate normal operations as much as possible. This included, the location where they stopped before entering the tunnel and the time and location within the enclosure to simulate loading. During normal production, there was almost always a truck parked about two to four feet from the tunnel entrance waiting for a signal to enter the tunnel for loading. Since only two trucks were available for the background run, the tunnel entrance was blocked between 20 and 70 percent of the time. The remainder of the time was required for a truck to exit the tunnel, circle the plant and return to the tunnel entrance. At about the midpoint of the background run, the truck drivers were asked to drive a little faster to return to the tunnel entrance quicker. As a result, the last half of the background run approximated normal operations more closely than the first half. In addition to increasing the time the tunnel entrance was blocked by a truck, the wind appeared to increase in velocity during the second half of the background run. During the tests during production, generally the emission testing was complete by the time the wind velocity increased.

While the commentors compare the differences in THC emissions between the first and second half of the background run, they fail to notice that the first and second half background emissions are only 10 and 20 percent of the emissions during production. In addition, by adjusting only the production runs for capture efficiency, the correction for background emissions for all pollutants is minimized. Contrary to the statement by the commentors, few background corrections overwhelmed or negated the emissions measured during the production runs. The above corrections of 10 to 20 percent for THC are comparable to the background corrections for most other pollutants. There are explanations for the few instances where there was a significant background correction for a pollutant. For example, the non-MCEM particulate matter is probably fugitive dust generated from the roadways approaching and within the tunnel. Additionally, emissions of chlorinated hydrocarbons (Methylene Chloride, Tetrachloroethene, 1,1,1 - Trichloroethane, Trichloroehtene etc.) would not be expected from asphalt.

In addition, the commentors ignore the comparison of mass emissions measured during the background run with the published emission rates from diesel trucks made in response number 51 of the “Response to Comments on Testing Programs for Asphalt Plants C and D” document and specifically in Tables 7 and 8 in this document. The last paragraph on page 57 and the first full paragraph on page 59 of this document summarizes the comparisons. The last sentences of the paragraph on page 57 states, “The uncorrected emissions measured during the background run was 0.66 g/min for THC, 1.2 g/min for CO, and 0.54 g/min for PM. Except for PM, these agree very well with the estimated emissions from AP-42. It should be noted that the fugitive PM emissions are not accounted for in the above comparison.” And the last sentences of the paragraph on page 59 states, “For all but four compounds, the emission rate during the background run was lower than presented in the articles. For these four compounds, the emission rate was within a factor of two of the rates presented in the articles. More background run compounds do not compare more favorably to the emission rates presented in the articles

because the Federal Test Procedure begins with a cold start and the acceleration requirements are greater than the truck accelerations used during the test."

3.3.7 CAAP Background Emissions Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

56. Table 4-23, 4-25: In view of the comments earlier about the background run, these tables need to be revised.

3.3.8 Response to CAAP Background Emissions Comment Number 4 - Based on EPA's response to comments in Section 3.3.6, the tables were not changed.

3.3.9 CAAP Background Emissions Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) -

Hot Mix Asphalt Plants Emissions Assessment Report

17. Page 16, paragraph 1: How do the truck exhaust emission factors published by EPA compare with the background measurement from Run 4 at Plant C? Why is such a comparison missing from the entire report?

3.3.10 Response to CAAP Background Emissions Comment Number 5 - A comparison of the background measurement from Run 4 at Plant C was compared to the truck exhaust emission factors published by EPA and others were presented on pages 57 to 59 and in Table 8 in item 51 of the Response to Comments on Testing Program for Asphalt Plants C and D Report. While the acceleration conditions for the trucks during Run 4 are less severe than during conditions use to develop EPA published truck exhaust emission factors, the emissions agreed reasonably well. A comparison is not made in this report since the validity of the test results is independent of other measures of diesel truck emissions by others.

3.3.11 CAAP Background Emissions Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

33. Page 4-151, paragraph 2: Note that Cambridge Environmental has calculated the cooling of a mass of HMA. Their results are not supported by any measurements.

3.3.12 Response to CAAP Background Emissions Comment Number 6 - It is not clear how the calculations made by Cambridge Environmental relate to this paragraph. In addition, the emission factor developed for the period following load-out account for only the first eight minutes following load-out and do not account for any cooling of the hot mix asphalt in the transport truck.

3.4 Assignment of Quality Ratings

3.4.1 CAAP Quality Ratings Comment Number 1 - (Ravi Nadkarni & Lloyd Fillion) -
Commentors Summary Section C
Inconsistent Assignment of Ratings: In one portion of the report, the emission factor for sulfur dioxide was assigned an E rating because the data ranged over an order of magnitude. This might have been simply the result of the variation in sulfur content of the fuel. In the case of filterable PM, the range is over two orders of magnitude but the emission factor got an A rating

Comments on Hot Mix Asphalt Plants Emissions Assessment Report

7. Page 12, paragraph 2: Is the rating system applied consistently? The discussion in Appendix B indicates that it was not.

3.4.2 Response to CAAP Quality Ratings Comment Number 1 - The emission factor rating system was applied consistently. The discussion in Appendix B Section 3 includes a synopsis of the emission factor rating system. More detail is included in the reference cited at the end of Section 3. The commentor may be confusing the between source variations of the supporting data as the basis for the emission factor rating. While characteristics such as the variability of the supporting data may be used to adjust the emission factor rating, the primary criteria for assigning the emission factor rating are the quality of the supporting emission test data, the representativeness of the facilities tested to the source category and the number of facilities tested.

3.4.3 CAAP Quality Ratings Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) -
Comments on Hot Mix Asphalt Plants Emissions Assessment Report

9. Page 13, paragraph 1: The quality rating needs to be quantified so that one can get a numerical feel for the differences in ratings. If, as stated, the quality ratings are a "function primarily of the number of data points", these various quality ratings can be related to the standard error of estimate and using t-values, a range can be shown about the mean.

3.4.4 Response to CAAP Quality Ratings Comment Number 2 - As stated, the emission factor quality ratings are related to the number of data points used to develop the emission factor. As such, the rating is primarily an indicator of the robustness of the emission factor. For example, an emission factor that is likely to change significantly with the addition or deletion of data would be rated low. Whereas, an emission factor that is not likely to change significantly with the addition or deletion of data would be rated high. Information on the variability of the data supporting the emission factors are presented in an appropriate location when sufficient supporting data are available to provide a reasonable estimate of the variability.

3.4.5 CAAP Quality Ratings Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

11. Page 3-3, final paragraph: The comments here refer to variations or fluctuations in measured results which could not be explained readily. While we agree that such results might be given a lower rating, in many cases, variations are a normal part of the production process. For example, if a batch plant is producing a mix with a high RAP content, the crushed stone is heated to a high temperature to provide the heat for evaporation of the moisture associated with RAP stored in the open. If another customer comes in for a RAP-free mix at this stage, the hot mix will be loaded out at a much higher temperature and will emit more than the usual amount of fugitive organics. This is a normal transient.

3.4.6 Response to CAAP Quality Ratings Comment Number 3 - The point of the comment is not clear. The paragraph on page 3-3 is addressing the criteria used to evaluate source test reports for sound methodology and adequate detail. As stated in the paragraph if the test results have a high variation without process information that may explain the high variation, the source test is downrated. While one could assume that undocumented process variations were the cause of the variation in emissions, facilities generally monitor their process closely during emissions tests. While the information monitored may not be documented in the source test report, a source test run is not begun until the process is operating within the normal variation and source test runs are stopped when the process begins operating out on normal. It is recognized that variations are a normal part of the production process. It is also recognized that there will be a normal variation in the emissions of a facility. However, when the emission variation for one source test is significant compared to data from multiple facilities, it is likely that the variations are an indicator of the quality of the source test contractor. The example the commentor gives would result in short term variations in emissions. However, the emission tests cited in the background report for the batch mix facility were conducted over six or more hours. Although most of the HMA produced during the test included 10% RAP, approximately 15% of the HMA produced had no RAP. It is recognized that the short term variations that may occur with this situation are normal for this process and the source test was not downgraded because of the variations.

3.4.7 CAAP Quality Ratings Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

11. Page 3-3, final paragraph: There are many factors which contribute to the emissions which were not measured. For example, SO_2 emissions from combustion are dependent on sulfur in the fuel. The emission factors for different fuel types are a result of the maximum sulfur content allowed under the fuel specifications. No such analysis is presented. The same comments hold true for organic fugitive emissions being dependent on volatile content of the asphalt.

3.4.8 Response to CAAP Quality Ratings Comment Number 4 - It is agreed that there may be many factors which might contribute to differences in emissions which were not measured. However, if the information is not presented in the test report, an analysis cannot be performed. The vast majority of the emission tests used to develop the emission factors were obtained from the source test files of State and local air pollution control agencies. As a minimum, these source tests contain the information the State agency requires for determining compliance with applicable emission standards for the facility. As indicated in the summaries of the over 350 test reports reviewed for this section, additional information that would be helpful to evaluate a number of process variables were not available in most of the source test reports. Specifically for SO_2, there were very few source test reports for oil fired HMA plants. In addition, the fuel usage and fuel analysis for the fuel was not available for all of the oil fired tests. Therefore, a detailed analysis was not possible. However, the industry has supplied 14 source test reports for SO_2 which include fuel usage and sulfur analysis. These tests were evaluated to determine whether there was any relationship between the sulfur in the fuel and SO_2 emissions. Because of a variable reduction of the SO_2 emissions, no relationship between SO_2 emissions and the more typical parameters (fuel sulfur content, fuel usage, control device temperature) that affect SO_2 emissions could be found. With respect to the availability of the volatile content of the asphalt used during emissions testing, if this information were included in any of the over 350 kiln stack test reports it was not noticed during the review of the source test reports and generally State Agencies do not require this information to be collected during compliance tests.

3.4.9 CAAP Quality Ratings Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

15. Page 4-122, paragraph 4: This paragraph states that the emission factor for sulfur dioxide was assigned an E rating because the data ranged over an order of magnitude. This might have been simply the result of the variation in sulfur content of the fuel. In the case of filterable PM (page 4-118), the range is over two orders of magnitude but the emission factor got an A rating. A little consistency would help.

3.4.10 Response to CAAP Quality Ratings Comment Number 5 - The assignment of the emission factor ratings is consistent. The paragraph does not state that the sole reason for assigning an E rating to the emission factor for sulfur dioxide for #2 fuel oil fired drum mix dryers was the variability of the data. It should be noted that all of the sulfur dioxide emission factors for drum mix dryers are rated D or E. The primary reason for the low rating was the availability of only three to six source tests. An additional adjustment from a D rating to an E rating was made because of the low number of tests and the higher variability of the data. The rating of A was assigned to the emission factor for filterable PM for fabric filter-controlled drum-mix dryers because there were 145 tests. This is well in excess of the number of tests that would justify an A rating. While the data ranged over two orders of magnitude, the large number of data contributed to the magnitude or the range of the data. In addition, the relative standard deviation of this data is near one and is typical of many emission factors for PM.

3.4.11 CAAP Quality Ratings Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

16. Page 4-125, paragraph 4: This paragraph states that the emission factor for trace metals was assigned an E rating because the data ranged over two orders of magnitude. This might have been simply the result of the variation in trace metal content of the feed materials and fuel.

3.4.12 Response to CAAP Quality Ratings Comment Number 6 - The paragraph states "An emission factor rating of E was assigned to data sets with only one or two data points. An emission factor rating of D generally was assigned to data sets with three or more data points, and an emission factor rating of C generally was assigned to data sets with seven or more data points." The paragraph further states that a rating of E was assigned for silver because there were only three data points and the data ranged over two orders of magnitude. While it is likely that the variation of all of the metals emission factor are the result of variations in trace metal content of the feed materials, the metals content of the fuel and the effectiveness of the control device, the factor rating system would not accommodate these variations unless there was data to correlate the emissions with the process information.

3.4.13 CAAP Quality Ratings Comment Number 7 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

30. Page 4-148, paragraph 1: Reference 6 (fourth line) is incorrect. What is the proper reference? We are also amused that this report has been given an A rating for data because of the "few problems in the Technical systems Audit Report" etc. Unfortunately, this audit report missed all of the errors found by the citizens. Further, the citizens caught the errors through spot checking and there are no guarantees that they caught everything. If such errors can exist in a report that was guaranteed a high degree of scrutiny, how sure is the EPA that the other data is error free? We am particularly concerned about this point because the data, which is supposedly in appendices A, B and C, is not attached to the material sent to us for review. Also, it raises the question of whether EPA staff do any of their own reviews and spot checks before accepting a report from a contractor. It does not appear to be the case.

3.4.14 Response to CAAP Quality Ratings Comment Number 7 - We agree that citing Reference 6 is a typographical error. In addition, the "Response to Comments on Testing Programs for Asphalt Plants C and D" document cited is not included in the references at the end of the Chapter. This document was added to the list of references at the end of the chapter and the proper citation replaced the citation in this paragraph. The audit report was an independent evaluation of the sampling and analyses performed for the testing at Plant C. The citizens did not identify any additional errors that were not identified in the audit report. The citizens did comment on one statement in the audit report which was not accurate and is identified in response number 43 on page 50 and 51

of the Response to Comments on Testing Program for Asphalt Plants C and D. While the draft audit report stated that the "VOST and Modified Method 5 methods have not been validated for all chemical compounds of interest in asphalt plant emissions," response number 43 corrected this statement by providing information on why the test methods used provided a reasonable assessment of the emissions. Page 2 of the Response to Comments on Testing Programs for Asphalt Plants C and D reports provides summaries of changes made to the test reports. There were two changes that might be considered significant errors in the original test reports. The other seven identified changes in the test reports either result in a very minor difference in the emissions presented in the draft, added emissions of some pollutants that an instrument was capable of measuring but was not presented in the draft, make the presentation of some information more prominent, or provide some editorial changes in the text. The final reports are free of significant errors and have been reviewed multiple times by EPA staff and EPA contractors to produce a document which can withstand the most critical unbiased evaluation of the quality of the data presented. Because of the thorough documentation of the high quality emission testing activities, and the adherence to an established and approved quality assurance test plan, the source test exceeds the criteria for receiving an A rating.

3.4.15 Local Health Agency Quality Ratings Comment Number 1 (Elaine T. Krueger, Environmental Toxicology Program (BEHA) -

Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

As we have previously noted, it is important to understand the limitations of the emission testing at the Barre and Irvine plants, some of which were discussed in EPA: response to comments (i.e., "Emission Tests of Hot Mix Asphalt Plants, Response to Comments for Asphalt Plants C and D"). EPA noted that resources were not available to perform emission testing at different times of year or at different locations to determine whether there is a relationship between emissions and asphalt cooling or variability of emissions of specific chemical compounds. This information could be important in determining emissions of specific chemical compounds. This information could be important in determining emission from plants in different areas of the country. While we appreciate that limited resources may have prevented more comprehensive testing, unfortunately a number of uncertainties remain regarding opportunities for exposure and health concerns. In addition to those noted above, uncertainties also exist due to the variations in modes of operation, materials, and plant designs. Therefore emission data from previous asphalt studies may not be applicable to the Barre plant. We would recommend that these important limitations be outlined in the final document, rather than just in the response to comments.

3.4.15 Response to Local Health Agency Quality Ratings Comment Number 1 - It would not be reasonable to assess the limitations of the emissions information without knowing the intended final use and without comparing this information to other source categories. The most significant uncertainties and limitations of the emission factors for HMA plants is very similar to the uncertainties and limitations of emission factors for most source categories. The quality and quantity of chemical specific emissions information available for HMA plants is at least comparable to many source categories in AP-42 where this

information is available. In fact, many people familiar with chemically specific emissions information would consider the information for HMA plants to be superior to the information for most other source categories. First, chemically specific emissions information is not available for many source categories that may potentially create the greatest exposure to the individuals. Second, compound specific stack emission factors based on more than three to five emission tests is atypical of most source categories in AP-42. Third, the use of additional laboratory analyses was very successful and as a result allows site specific conditions with respect to asphalt volatility and load-out temperature to be used as parameters to more reliably estimate the load-out and silo filling emissions. Many of the uncertainties and limitations of emission factors are presented in the Introduction to AP-42, pages 3 through 5 (http://www.epa.gov/ttn/chief/ap42/c00s00.pdf). It is highly recommended that AP-42 emission factors users read this introduction to understand the development, use and limitations of these emission factors. When developing AP-42 emission factors, EPA assembles the best and most complete information available. As a result, the information that is presented in the AP-42 section and background report for HMA plants is the best data available and additional comments with respect to general uncertainties and limitations was not included in the final report.

3.5 Emission Factor Development Methods

3.5.1 CAAP Factor Development Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Hot Mix Asphalt Plants Emissions Assessment Report*

8. Page 12, paragraph 4: This paragraph presumably refers to the statistical analysis presented in Appendix B, but there is no direct link or reference. Our detailed comments regarding the statistical analysis are in our page-by-page discussion of Appendix B. However, the entire paragraph is wrong or inconsistent with information in other parts of the report. It states that the statistical analysis showed "no strong correlation" between parameters such as fuel type and emissions factors. When such correlation is absent, the approach has been to use the same emission factor in both cases. Yet, Table 11.1-5 in Appendix A shows different emission factors for NO_x and SO_2 for different fuel types. For NO_x, the emission factor is different for natural gas and oil fired dryers. For SO_2, there are three different emissions factors, one for gas, one for No. 2 oil and one for No. 6 oil. The backup analysis is not shown in Appendix B. But obviously, the analysis showed that fuel type did affect emissions, otherwise a single factor would have been used. Overall, the two sets of comments need to be made more explicit and explained more carefully and the inconsistencies removed.

3.5.2 Response to CAAP Factor Development Comment Number 1 - There is no error in what was stated and there is no inconsistency between what is stated in this paragraph and the remainder of the report. The information presented in this paragraph is based upon the detailed statistical analysis which attempted to discern a relationship between several operating characteristics and emissions. As stated in Appendix B, where the quantity of data should be sufficient to discern a relationship, no relationship could be documented.

As a result, the data were combined to arrive at a single emission factor for the differing characteristics. However, for some pollutants such as NO_x and SO_2, there were few supporting data and the reports lacked the necessary information that would help to discern the relationship. For example the NO_x and SO_2 emission factors for batch plants were based on less than six test reports. While there were less than 12 test reports supporting the NO_x and SO_2 factors for drum plants, this was still not sufficient to discern a statistical difference. In addition, few test reports include information on fuel usage and detailed fuel analysis that would provide the additional information needed to establish a correlation. Although there was insufficient data to establish a statistically based correlation, separate emission factors were developed for gas and oil fired HMA plants. An additional 30 Wisconsin test reports that were submitted which contain fuel usage and fuel analyses. However, a statistical evaluation of these data was unable to discern any strong statistical correlations between the available operating characteristics (fuel usage, fuel sulfur content, process type and control device temperature) and SO_2 emissions.

3.5.3 CAAP Factor Development Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Comments on Hot Mix Asphalt Plants Emissions Assessment Report*

10. Page 13, paragraph 2: This paragraph is confusing. It is stated that only a single test report was available for an oil-fired hot oil heater. Does this mean that only one hot oil heater was sampled out of 364 plants and test reports? Finally, why does EPA go out of their way Further, if most of such heaters are fired with natural gas, why was an oil-fired heater sampled? to here to point out that "emission factors developed from this data would not be representative of gas-fired heaters". While this comment is correct, since oil fired burners emit more pollutants than gas-fired burners, there is a consistent bias in such comments. The reports point out the possibility of a high-bias each time such possibility exists, inviting the user of AP-42 to discount the published number. But, when the reported emission factors have a low bias, there is no such comment. For example, see the issue of the phony correction for background emissions to truck loadout discussed later on the same page.

3.5.4 Response to CAAP Factor Development Comment Number 2 - As stated in the paragraph, only one emission test of a hot oil heater was available. As indicated on page 4-17 of Appendix B (Emission Factor Documentation for AP-42 Section 11.1 Hot Mix Asphalt Production), the hot oil heater test was conducted as part of a more comprehensive test program to quantify trace metals and trace organic pollutants from the combustion sources as required by California Air Resources Board (CARB) rules. The title of the test report (see reference 35 on page 4-350 of Appendix B) indicates that the CARB rule that the test was conducted to satisfy was the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588). The test report did not provide specific information on the rationale for testing the hot oil heater nor on the use of oil as the fuel for the unit when propane was the fuel for the dryer. However, two goals of the "Hot Spots" program were to collect emissions data and to identify facilities with localized impacts (see http://www.arb.ca.gov/ab2588/ab2588.htm). As this test was conducted for the California "Hot Spots" program, it likely that the oil fired tests were performed to obtain a reasonable "worst case" scenario for possible "hot spot" evaluation.

The comment with respect to the applicability of this emissions information to gas fired facilities was made to place the information into the proper perspective. The primary reason that there are no indications of low bias is that when information is not available to make a reasonable unbiased evaluation, an assumption is made that provides a bias that is protective of the public health. The objective is not to invite the user to discount the published number but to use the information as a screening tool and to collect additional data if the biased information results in concerns with respect to the potential environmental impacts.

The correction for the measured background conditions created by the emissions from diesel engines during the emissions test at plant C does not provide a positive bias to the resulting data. As explained in item 51 beginning on page 56 of the Response to Comments on Testing Program for Asphalt Plants C and D Report, the emissions measured during the background run are consistent with other measurements of diesel exhaust and a methodology was used that could be considered to provide a high bias for load-out emissions.

3.5.5 CAAP Factor Development Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

15. Page 11, paragraph 1: The industry's own MSDS sheets provide a molecular weight of asphalt as "over 2000" (a number we personally don't believe). It is refreshing to see EPA use a lower number of 345.69

3.5.6 Response to CAAP Factor Development Comment Number 3 - The molecular weight provided is not the molecular weight of the asphalt as specified in the MSDS's. Data presented in the document *SHRP Materials Reference Library: Asphalt Cements: A Concise Data Compilation* (SHRP-A-645; Strategic Highway Research Program; National Research Council; Washington, DC; May1993) indicates that the molecular weight of asphalts from single crude oil sources ranges from 700 to 1300. As indicated in Appendix C, the molecular weight of 345.69 is the average molecular weight of tetracosane and pentacosane. These two compounds were single compound surrogates that resulted in approximately the same vapor concentration at saturation as the complex mixture emitted from the storage silos. The molecular weight of 345.69 is also not the estimated average molecular weight of the emissions. The FTIR analysis of the silo vent indicated that most of the hydrocarbons emitted were similar in spectra (and therefore molecular structure) to hexane. Since the aliphatic hydrocarbons from about pentane to nonane have similar spectra, the molecular weight of the vaporous emissions are probably between 86 and 128. Therefore, to prevent additional misconceptions by users that the specified molecular weight is either the average molecular weight of the liquid asphalt or the head space vapors, the information presented on page 11 was revised to show the estimated molecular weights of the liquid and vapor. This required the TANKS program to be run to determine the appropriate surrogate compound to use to estimate the appropriate Antoine's coefficients. The Antoine's coefficients for aliphatic hydrocarbons that come the closest to producing a working loss emission estimate of 32 pounds per million gallons of asphalt throughput for this range of molecular weights were docosane

and tricosane. As a result, the background report was changed to describe this revised methodology. The revised Antoine's coefficients are "A = 75350.06" and "B = 9.00346" with a vapor molecular weight of 105 g/g-mole and are included in the background report and AP-42 section.

3.5.7 CAAP Factor Development Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft*

21. Table 7: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data. Furthermore, there is no discussion why a batch plant dryer using the same range of fuels e.g. natural gas, No. 2 fuel oil and other fuel oil and a drum dryer using the same fuel oil should have different emission factors for NO_x and SO_2.

3.5.8 Response to CAAP Factor Development Comment Number 4 - Reference 1 for this part of the report should be Appendix B or the *Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Production*. This reference citation was revised. However, it was decided that since citing each of the over 150 references used to derive these emission factors would add text that would confuse the typical user and potentially hide information that adds value, only the background report would be referenced. We agree that presenting a specific location in the footnote will assist a user find the information needed to better understand the basis for the emission factor. To provide this assistance, the table number in the background report was specified. A discussion on the reasons why two different technologies would have different emission factors is not germane for the development of emission factors. However, one of the primary reasons for industries migration from batch plants to parallel flow drum mix plants to counterflow drum mix plants is improved energy efficiency of the basic process. In addition, the higher production rates for drum mix plants makes fuel efficiency more critical. As a result of energy efficiency concerns, it seems reasonable that the CO_2, and SO_2 emission factors for batch mix plants are slightly higher than for drum mix plants. It is also realistic that the NO_x emissions may be slightly higher from attempts to improve combustion efficiency.

3.5.9 CAAP Factor Development Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

14. Page 4-119, paragraph 1: Was there any attempt to correlate capture efficiency in venturi scrubbers with the pressure drop?

3.5.10 Response to CAAP Factor Development Comment Number 5 - Information on the scrubber pressure drop was not available for many of the facilities where venturi scrubbers were used to control the particulate emissions. As a result, a statistical analysis was performed only for drum mix facilities. This analysis attempted to correlate the emission factor with the scrubber pressure drop. As stated on page 4-143 of Appendix B, only the type of control device significantly affected filterable PM emissions. On this

page it is explained that the lack of statistical power associated with small data sets and the large variability in the data is one reason for not finding a statistical association.

3.5.11 CAAP Factor Development Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

17. Page 4-126, paragraph 2:. This paragraph points out the inconsistencies in the approach taken in several places in the report. Because there was no analysis of the feed materials or of the fuel used, it is not clear whether the measured trace metals are present on the site or are a result of sample contamination in the lab or elsewhere or whether the detection of trace metals at the exhaust and non-detection at the entrance to the control device represents random error in the measurements. The approach of discarding inconvenient data is not acceptable.

3.5.12 Response to CAAP Factor Development Comment Number 6 - It is not clear how this paragraph points out any inconsistencies in sampling or analysis. The cited reference should be 340 rather than 356. Data were not discarded because they were inconvenient, the data were discarded because they provided no useful information. Sufficient information is provided to explain the reasons for discarding the data. Where the metal was not detected, other more useful data are available. In the one situation where the silver was higher at the outlet than was measured at the inlet of the control device, the outlet data was judged to be superior since the volume of flue gas sampled was greater. One would expect the control effectiveness to be greater than 90% as with other metals measured at both the inlet and outlet, and the potential for matrix effects is less for the inlet samples. An analysis of the feed material and the fuel used would not have altered this result or provided information to explain the inability to measure some metals. However, the differences in sample volumes and sample mass collected do provide an explanation of the differences in the mass of metal that were detectable. Because of the high particulate, loading at the inlet of the control device only about 50 cubic foot of flue gas was sampled. At the outlet of the control device where the particulate loading was significantly lower, approximately 200 cubic foot of flue gas was sampled. This difference in sample volumes is reasonable to detect metals at both the inlet and outlet. It is unlikely that the measured trace metals are the result of sample contamination. As provided in Chapter 6 (Quality Assurance/Quality Control Procedures and Results) in the test report (which was provided to the commentors), of the sixteen metals analyzed, the only metal that showed possible contamination was nickel.

3.5.13 CAAP Factor Development Comment Number 7 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

18. Page 4-135, last line: We are told that the statistical analysis is restricted to references up to number 338. Why? Several of the subsequent references, up to

reference 355, contain the same type of data as that being analyzed and should have been incorporated.

3.5.14 Response to CAAP Factor Development Comment Number 7 - The statistical analysis presented was performed in 1997 when the previous draft of the AP-42 section and background report were circulated for review. Only fifteen additional emissions tests of HMA kiln stacks were submitted in response to the draft section. Considering the over 300 source tests used in the statistical analysis, the lack of correlation that existed within these data, the resources required to reanalyze the data and the high probability that the results would be the same as for the earlier analysis, it was decided that the statistical analysis would not be repeated.

3.5.15 CAAP Factor Development Comment Number 8 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

24. Page 4-139, paragraph 2: There is a discussion of attempts to correlate wet scrubber performance with other parameters. Any engineering handbook will tell you that scrubber performance will correlate with pressure drop, yet this measurement was either not made or not used. As it now stands, this paragraph finds that although the emission factor for venturi scrubbers is less than half that for other, unspecified scrubbers, this result is not statistically significant.

3.5.16 Response to CAAP Factor Development Comment Number 8 - As stated elsewhere, the vast majority of emission tests were obtained from the files of State and local air pollution control agencies. It is recognized that with other parameters being equal, scrubber performance will correlate with pressure drop. However, there are many other design and operating parameters that can also affect the performance of wet scrubbers. Some more important parameters are scrubber geometry, scrubber water flow, mixing of scrubber water and flue gas, scrubber water solids content, flue gas cooling, mist eliminator performance, inlet particulate concentration and inlet particle size distribution. As explained in the paragraph, "the lack of statistical power associated with the small data sets is the likely explanation for this result." The lack of statistical power is caused primarily by the large variations in the data that may be attributable to parameters other than differences in the pressure drops. The inability to statistically differentiate the performance of these control devices can be seen on the box plots (figures 4-2 and 4-7) where the middle 50% of the data overlap. For emission factor development, statistical analyses provide additional support for engineering evaluations. Although no statistical support was found for segregating scrubber and fabric filter controls, the magnitude of the differences in the emission factors provides sufficient support to provide separate emission factors for these two control types.

3.5.17 CAAP Factor Development Comment Number 9 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

25. Page 4-141, paragraph 1: This entire paragraph is confusing. Figure 4.3 shows that there is a relationship between RAP content and condensible inorganic PM. The relationship appears to be non linear. Alternately, looking at just the 0% RAP data points, it is clear that there is great variability in the condensible inorganic PM emissions even without RAP. Without any analysis of feedstocks and fuels, the source of these condensible inorganic PM.s can't be isolated. To add further confusion, the last sentence jumps to a discussion of carbon dioxide emissions. The reference to Figure 4.3 in context of CO_2 emissions is incorrect.

3.5.18 Response to CAAP Factor Development Comment Number 9 - Although initially one may observe a relationship between RAP content and condensible inorganic PM, as the commentor points out that there is great variability in the condensible inorganic PM emissions without RAP. A similar variability would be expected if more than a single emission test were available for the higher RAP contents. As a result, when the data are evaluated with this additional information, it is evident that any correlation developed from this data would be highly speculative. In addition, when one considers that the primary components of condensible inorganic particulate would be formed from sulfur (in the fuel or in the asphalt) and nitrogen (from the fuel, air or asphalt), the possible relationship may be related more to fuel usage than RAP content. While there may be a correlation between RAP usage and fuel usage, other factors (such as moisture content of the new aggregate, final mixing temperature and fuel efficiency) may have a more dominant role in the fuel usage. The reference made to CO_2 is a typographical error and was changed from CO_2 to RAP.

3.5.19 CAAP Factor Development Comment Number 10 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

27. Page 4-145, paragraph 1: The invocation of engineering principles in the fifth line is interesting because they have been ignored in many instances up to this point; e.g. discussion of scrubber efficiencies without consideration of the pressure drops. VOCs, by definition, don't condense even when cooled to ambient temperatures. Therefore, if a control device has an effect on VOC emissions, this attenuation must be a result of a mechanism other than condensation, such as adsorption on solids. The data quoted show lower emission factors (by a factor of 4) for fabric filters compared to wet scrubbers, but the authors find this result surprising. Although they don't tell us which engineering principle they are referring to, one has to assume that they are referring to the ability of water to capture gases through dissolution. Unfortunately, the components of VOCs are only sparingly soluble in water and the pressure drops/retention times in such scrubbers are quite modest. Therefore, this is a bad place to invoke such engineering principles when they contradict the data.

3.5.20 Response to CAAP Factor Development Comment Number 10 - As stated elsewhere, in the development of emission factors are generally supported by a known engineering principle. Statistical analyses are used to characterize the significance of an observed effect. Although the engineering principles are not specifically cited in all of the summaries of the individual statistical analyses performed, they were the basis for many evaluations. While water-based scrubbers are not generally installed at HMA facilities to control VOC's, they may provide some incidental control. Air Pollution Technology Fact Sheets and Technical Bulletins[5] are available on the Clean Air Technology Center (CATC) web site that provides information on the ability of various scrubbers to control VOC's. Information on the ability of water-based scrubbers to control VOC's are specifically mentioned in the fact sheets for Impingement-Plate/ Tray-Tower Scrubbers[6], Packed-Bed/ Packed-Tower Wet Scrubbers[7], Spray-Chamber/ Spray-Tower Wet Scrubbers[8] and Venturi Scrubbers[9]. As indicated in the paragraph, one would generally expect that the fabric filter to provide little or no control of VOC. It is also stated in the paragraph that the data sets were small which would make any difference suspect. Therefore, the paragraph states that data were not segregated to develop the emission factors.

3.5.21 CAAP Factor Development Comment Number 11 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

28. Page 4-147, paragraph 2: The comment in the last line is that emissions are a function of RAP content and production rate. Yet, earlier on page 4-139, these same conclusions were rejected because of low correlation coefficients. Which conclusion is correct?

3.5.22 Response to CAAP Factor Development Comment Number 11 - Both of the statements cited by the commentor are correct. Statements on both pages indicate that filterable PM emissions show an association with production rate and RAP content. However, in the discussion on batch mix dryers on page 139, there is an additional qualifying statement. The qualifying statement is, "However, the squared correlation coefficient (R^2) value for the model is 0.22, which indicates that the model explains only a small percentage of the variability in the data."

---

[5] Available by internet at URL http://www.epa.gov/ttn/catc/products.html#aptecfacts

[6] Available by internet at URL http://www.epa.gov/ttn/catc/dir1/fimpinge.pdf

[7] Available by internet at URL http://www.epa.gov/ttn/catc/dir1/fpack.pdf

[8] Available by internet at URL http://www.epa.gov/ttn/catc/dir1/fsprytwr.pdf

[9] Available by internet at URL http://www.epa.gov/ttn/catc/dir1/fventuri.pdf

3.5.23 CAAP Factor Development Comment Number 12 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

31. Page 4-148, paragraph 2: The discussion should point out that Plant C is atypical of drum plants in the industry. Figure 4.6 shows CO_2 emissions factors for drum plants as a function of production. Although there is considerable scatter, it is interesting to note that all high emission points are associated with lower production and none are associated with high production. Does this behavior extend to the emission of other pollutants?

3.5.24 Response to CAAP Factor Development Comment Number 12 - As explained in many meetings during the planning phase for testing of Plant C, and in the "Response to Comments on Testing Programs for Asphalt Plants C and D" document, Plant C is typical of drum mix plants with respect to all characteristics affecting emissions generation from silo filling and truck loading operations. The method of loading hot mix asphalt into the storage silos is identical to other hot mix asphalt plants. Additionally, the method of loading hot mix asphalt into the transport trucks is identical to other hot mix plants. While there are characteristics that differentiate this plant from drum mix plants in other parts of the US, these characteristics relate more to the collection of emissions generated during silo filling and truck loading, the maximum production capacity of the plant and the ability of the plant to operate for a much larger percentage of the time than other facilities. It should be noted that to test the batch mix plant (Plant D) EPA constructed an enclosure and emissions collection system almost identical to Plant C.

With respect to the association between CO_2 emission factor and production rate noted by the commentors, the higher emission factors appear to be centered on about 180 tons per hour rather than the lower production rates. However, this observation may be misleading due to visual aspects of the data. The one or two high data points at 100 tons per hour production and the four high data points at about 200 tons per hour may be visually misleading since the remaining data do not show a strong relationship. The summary of the statistical analysis (page 4-142) states "The linear model analysis indicated that CO_2 emissions can be estimated as a function of RAP content ($p = 0.052$), production rate ($p = 0.0002$), and the RAP content-production rate cross-product ($p = 0.043$). However, the squared correlation coefficient (R^2) value for the model is 0.23, which indicates that the model explains only a small percentage of the variability in the data." For most combustion sources, CO_2 emissions are primarily a function of the fuel usage and the carbon content of the fuel used. Differences in fuel efficiency, moisture content of the aggregate and mixing temperature would also affect the CO_2 emissions. Other than the weak associations identified in the statistical analysis, no association between production rate and emission factor was evident.

3.5.25 Industry Factor Development Comment Number 1 (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-18 : B. Footnote D - There is a question that the range to 96 lb/ton is too high. Where is source for this number?

3.5.26 Response to Industry Factor Development Comment Number 1 - The results of individual source test analyses that were used to develop the CO2 emission factor are presented in Table 4-7 of the background report (Appendix B of the Emissions Assessment Report). In this table near the bottom of page 4-272 is summary information from Reference 347 which is a drain oil fueled facility that had measured CO2 emissions of 96 lb/ton.

3.5.27 Industry Factor Development Comment Number 2 (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-16: A. Footnote C -Suggest striking SO_2 or add 50% attenuation of SO_2. Please review attached stoechiometry and SO_2 attenuation data.

Page 11.1-18 : A. Footnote c -Suggest striking SO_2 or add 50% attenuation of SO_2. Please review attached stoechiometry and SO_2 attenuation data.

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft
The Hot Mix Asphalt Industry is providing additional data specifically relevant to SO_2 attenuation and benzene to EPA for possible inclusion into the Emissions Factors Document (AP-42). Attached are three binders containing stack test reports. All of the tests were consist of three 1-hour runs and were conducted for compliance purposes.

NOTE: NAPA is sending one copy of this material and one copy of the comments to Ron Myers. Only the comments document is being sent to EPA Region I.

SO_2

The Draft Emissions Assessment (EA) offers an EF for SO_2 of 0.078 lbs/ton hot mix from drum mix plants firing waste oil (Draft EA,, Table 11.1-7). The Draft EA also suggests via footnote (c.) of Table 11.1-7 that AP-42, Chapter 1 also be used to estimate SO_2. Chapter 1 Emission Factors (EF) incorporate fuel sulfur content to determine SO_2 emissions.

It is believed that a more accurate approach should be used to determine SO_2 emissions from plants firing oil, especially waste oil.

Several stack tests for SO_2 were conducted. Samples of each plant's burner fuel supply during each test were taken and analyzed for sulfur content. The amount of SO_2

produced during combustion of the burner fuel was calculated. There was an assumption that all of the sulfur in the fuel would be converted to SO_2. Then, using a mass balance approach, the actual stack emissions of SO_2 was compared with the calculated SO_2 as a product of combustion, and determined a control (i.e., emission reduction) factor for SO_2, from a hot mix asphalt plant, firing oil.

The proposed means of control would be the adsorption of SO_2 by dust particles suspended in the ductwork and captured on the bags in the baghouse. For a plant producing 250 tons/hour hot mix and firing 500 gallons/hour waste oil having a sulfur content of 0.046% by weight and a specific gravity of 0.89, the amount of SO_2 generated by combustion would be 500 gal/hr x 8.34 lbs/gal x 0.89 x 0.46/100 x 2 (lb SO_2/ lb S) = 34.14 lb SO_2/hr. At the same time, the uncontrolled particulate emissions from the plant would be 28 lbs PM/ton (Draft Table 11.1-3) x 250 tons/hour = 7000 lbs PM/hour. The available reaction surface area of the dust particulate provides significant acid gas capture opportunity by any alkaline solid material suspended in the exhaust stream or accumulated on the bag house bags.

The results from the 15 tests demonstrate SO_2 control ranging from 47% to 97%, with an average control of 62%. Test result averages show little variation in control among different plant types, aggregate types or recycle asphalt pavement (RAP) content in the mix. Please refer to the attached table: "Asphalt Plant SO_2 Emissions Summary"

The Wisconsin Department of Natural Resources (WDNR) has reviewed these stack tests and will adopt a conservative control factor of 50% for future permitting and emission inventory purposes. Please refer to the attached letter from Lloyd Eagan, Director of Bureau of Air Management from the State of Wisconsin - Department of Natural Resource.

3.5.28 Response to Industry Factor Development Comment Number 2 - The emission tests that were submitted were evaluated and added to the test information in the draft background report (Appendix B). The measured emissions were used to develop a revised SO_2 emission factor of 0.058 lb/ton for drain oil/waste oil/No. 6 fuel oil-fired dryers. The additional emission test data also included fuel usage and fuel sulfur content. This data was analyzed to discern a relationship between measured emissions, the results of sulfur mass balances (as SO_2) and several available operating parameters. Like the commentors, EPA could not find a correlation with the stated operating parameters. While EPA found no reasonable correlation, we did verify that control levels for SO_2 ranged from 47% to 92% and averaged 62%. Additionally, the available data indicate that a maximum of 0.1 lb/ton of SO_2 is retained in the product (which includes recycled baghouse dust). This analysis was described in more detail in the final background report. Based upon this analysis, we have added the following sentence to footnote c of Table 11.1-7: "50 percent of the fuel-bound sulfur, up to a maximum (as SO_2) of 0.05 kg/Mg (0.1 lb/ton) of product, is expected to be retained in the product, with the remainder emitted as SO_2."

3.5.29 Industry Factor Development Comment Number 3 (Gary Fore, Vice President National Asphalt Pavement Association) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

The Hot Mix Asphalt Industry is providing additional data specifically relevant to SO_2 attenuation and benzene to EPA for possible inclusion into the Emissions Factors Document (AP-42). Attached are three binders containing stack test reports. All of the tests were consist of three 1-hour runs and were conducted for compliance purposes.

NOTE: NAPA is sending one copy of this material and one copy of the comments to Ron Myers. Only the comments document is being sent to EPA Region I.

Benzene

Stack tests were also conducted for benzene from drum mix plants, firing either waste oil or natural gas. The reports from 17 tests are enclosed. These reports indicate average benzene emissions of approximately 0.0003 lbs benzene/ton hot mix asphalt, with no significant variation for fuel type. The draft EA lists a benzene EF of 0.00051 lbs/ton (Table 11.1-10).

3.5.30 Response to Industry Factor Development Comment Number 3 - The emission tests that were submitted were evaluated and added to the background report (Appendix B). As with the benzene data in the draft report, the fuel type did not appear to affect emissions. Therefore all 19 sets of data were averaged to produce a single emission factor for all fuel types. The background document section and table describing the development of benzene emission factors for drum mix plants were revised. The resulting benzene emission factor of 0.00040 lb/ton replaced the draft benzene emission factor in Table 11.1-10.

3.5.31 CAAP Factor Development Comment Number 13 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

37. Page 4-153, last paragraph: In the 10th line, there is an unnecessary caveat about the relationship being uncertain. The simplest assumption is one of proportionality. Unless lab scale data are collected that indicate otherwise, this is the best way to deal with the issue. Are you forgetting Occam's Razor?

3.5.32 Response to CAAP Factor Development Comment Number 13 - The simplest assumption that emissions are proportional to the results obtained from the RTFOT is being made. However, future laboratory and field data may reveal that the loss in mass obtained by the RTFOT analysis may not explain all the emissions from the asphalt. Specifically, there are some asphalts which lose very little weight or gain weight during this analysis. It is unlikely that these asphalts do not have any emissions or remove pollutants from the air. While the commentors may believe that this caveat is

unnecessary, it is provided because there have been only two emission tests of fairly similar asphalt (with respect to the RTFOT analysis) to verify the relationship.

3.5.33 CAAP Factor Development Comment Number 14 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

38. Page 4-154, paragraphs 1 - 2: These paragraphs repeat industry propaganda (along with that from State highway department laboratories who share the same road-building mind set). The specifications allow for measurements of unblended asphalt and the information represents the results of tests on unblended asphalt. In the Boston area, the terminal in Chelsea has a tank holding such additives for blending with the asphalt. After a meeting at EPA-Region 1, where the industry representatives had denied that any blending took place, Mr. Frank Singleton, the Board of Health Agent for Chelsea showed me this tank which is clearly labeled as containing an asphalt additive. The citizens submitted a list of many such additives from Roads and Bridges magazine to the EPA/citizen group which was ignored by the EPA Project Manager, who instead chooses to believe the asphalt industry's lobbyists who insist that such additives are not used. Also, we have examined the application from one of the terminals in Chelsea which said that they proposed to add these additives directly to the tanker truck whereby they would mix in the truck while being transported to the user. This would mean that a sample taken at the terminal would be a sample of unmixed asphalt.

    The third paragraph needs to be deleted. As long as the specifications allow for up to 1% volatiles in asphalt (even before additives are used), it is misleading for EPA to state that their approach in Table 4-27 "encourages the use of site specific data". The primary use of AP-42 is to prepare calculations to get permits to build and to operate hot mix plants. Therefore, there is no site specific data that can be used other than fictional data. Unfortunately, the industry has a long history of providing low-ball estimates, designed to fool the public and get permits from agencies that are not particularly anxious to ask difficult questions.

3.5.34 Response to CAAP Factor Development Comment Number 14 - The information in these paragraphs is not from industry but are results of preliminary laboratory analyses performed as part of a broader quality control program for State and Federal road construction. The State Departments of Transportation laboratories perform a quality control function to verify that the pavement being purchased (directly or indirectly through a contractor) meets the specifications for the road being constructed. The RTFOT analysis is only a preparatory step for the rheological analyses that determine the predicted performance of the asphalt. It is recognized that there are a variety of additives which are designed to be added to blended asphalt to improve the physical characteristics. It is also recognized that to meet some physical characteristics of some more recent performance graded asphalts, the use of additives is necessary. However, the contacts at the State Department of Transportation laboratories stated that they analyze samples of

asphalts that are to be used without further blending. If an asphalt distributor or a hot mix asphalt production plant adds a diluent or other additive that changes the physical characteristics, it is possible that they could be considered to be violating the State contract specifications.

In addition, no test information has been provided which would support the contention that asphalt distributors modify the asphalt provided to hot mix asphalt plants following the collection of samples for the State Department of Transportation analysis. In fact, the samples obtained during the pre-test survey and the emission test at Plant D in Massachusetts were within 2% of the average volatility for asphalts analyzed by the Massachusetts Department of Transportation laboratory. Also as stated previously, State and local departments of environment have the option of including enforceable requirements in the operating permits which limit the volatility of the asphalts used by the hot mix asphalt plants. If there are concerns that asphalt distribution terminals or hot mix asphalt plants are altering the asphalt, the collection and analysis of the final product by any authorized State or local transportation, environmental or health inspector seems in order.

The paragraph discussing the use of site specific information does not need to be deleted. There is ample information that the volatility of asphalts can vary both between and within States. The available information does not support the use of 1% as the only volatility value to use. There is also ample information that independent information on the volatility of asphalts used within States are readily available. It is not misleading to allow State and local agencies to use this readily available and independently collected data as a locally specific parameter for calculating emissions. The primary use of AP-42 is not to prepare calculations to get permits to build and operate plants. The primary use of AP-42 is to calculate unbiased actual emissions estimates for use in understanding and managing the combined emissions from all sources in a geographic area of interest. While AP-42 is used by industries and State agency reviewers to calculate emissions for various permits, these emissions are generally maximum limitations that are not to be exceeded by the facility. Although some facilities may provide low ball estimates in their permits for a variety of reasons, these values in permits are not estimates but are enforceable limitations. When the permit is issued, the facility must operate within this limitation and the company official signing the permit is held accountable.

3.5.35 CAAP Factor Development Comment Number 15 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

39. Page 4-155, paragraph 2: On the 13th line, the statement is that "this hypothesis has not been validated by emissions testing but provides an adjustment that is directionally correct." This comment is totally unnecessary and needs to be deleted. Is EPA saying that the Clausius-Clapeyron equation should be thrown out? Alternately, is EPA saying that the degree of precision and accuracy associated with emissions testing methodology is good enough to provide this type of data?

3.5.36 Response to CAAP Factor Development Comment Number 15 - The EPA is neither saying that the Clausius-Clapeyron equation nor that the precision and accuracy associated with emissions testing are in question. However, the relationship between temperature and emissions has been derived from a standard laboratory test that measures the loss of weight of the asphalt during heating and not on a measurement of emissions during this test. It is expected that there will be some differences in the mass emissions and loss of weight due to the uptake of oxygen or nitrogen by the asphalt and result in some small weight gain. It is believed that this phenomenon is at least one explanation for the few asphalts which have demonstrated a weight gain during the test. EPA obtained the temperature relationship for asphalts by performing three laboratory tests. While one of these tests was the standard laboratory test, the other two were at temperatures 25° F above and below the standard temperature. Asphalts that do not lose weight or that gain weight during the standard laboratory test, would have weight losses that are incompatible for developing the proper constants for the Clausius-Clapeyron equation.

3.5.37 CAAP Factor Development Comment Number 16 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

40. Page 4-157, paragraph 2: In this paragraph, the groundwork is being laid to explain why inorganic PMs were much higher at Plant D than Plant C. This is further elaborated on page 158. We strongly disagree with the conclusion that the additional dust was a result of truck movements. While Plant D was unpaved, water sprays were used to keep the dust down as noted in the report and as observed. At Plant C, because of the practice of cleaning the silos at the end of the day with crushed stone, there was considerable dust present in the tunnel. Furthermore, one ofthe silos had dumped hot mix on the floor and cleaning it up generated a lot of dust. Our recollection is that if anything, the tunnel at Plant C was dustier than the one at Plant D. We believe the explanation for the higher PM load at Plant D is the relatively short residence time in the mixer at any batch plant. Because of this, during mixing, there are small pockets of stone dust that are not coated with asphalt and these are the source of the high PM readings. In contrast, the vapors inside a silo have time to permeate through the mass of hot mix in the silo and coat any uncoated dust particles. Once coated, the fine dust coagulates and is no longer airborne particulate matter. This hypothesis is supported by the visual observation that dumps from the mixer at Plant D were dustier than those at Plant C when observed from inside the tunnel.

3.5.38 Response to CAAP Factor Development Comment Number 16 - The justification presented in paragraph 2 and supported by the presentation on page 158 are valid and the conclusion is reasonable. It is recognized that the unpaved road at Plant D was watered to minimize the dust created by truck movement. In first full paragraph on page 4-158 of the draft background report, an assumed surface moisture content of 15 percent was used to calculate the road dust emissions. This moisture content was used because it is

representative of a highly watered unpaved gravel road. At Plant C, emission testing was completed by the end of the day and the tests did not include the dust created by the silo cleaning with crushed stone. Additionally, emission testing was stopped temporarily during the clean up of the hot mix accidently dropped on the floor of the enclosure.

Although the suspended particulate within the Plant C enclosure appeared greater than within the Plant D enclosure, this increased suspended particulate was not due to suspended road dust as purported by the commentors. At Plant C, the load-out emission rate was much greater than at Plant D making the collection and removal by the ventilation system more difficult. First, at Plant C, the production rate averaged four times the production rate of Plant D with some periods of high production being six to seven times greater. Second, the volatility of the asphalt used at Plant C was about 40% greater than at Plant D. Third, the ventilation system at Plant C captured an estimated 60 to 70 percent of the emissions compared to essentially 100 percent capture at Plant D. In addition, the suspended particulate at Plant C was more visible since the enclosure was open on both ends thereby presenting a background more conducive to seeing the suspended particulate.

The hypothesis which the commentors contended explain the high inorganic PM measured at Plant D is remote. While there may be a small probability that small pockets of uncoated stone dust may periodically occur during batch mix operations, the one minute of vigorous agitation in the pug mill makes this highly unlikely. Additionally, the coating process for both batch and drum mix plants depends on the significance of this agitation and mixing not on additional coating in the silo due to the availability of vapors. Since the aggregate is also heated to approximately the same temperature as the asphalt, vapors inside the silo would not condense on any uncoated dust particles. Moreover, dust emissions even from highly watered unpaved roads have been measured and can account for a significant portion of the inorganic PM measured at Plant D.

3.5.39 CAAP Factor Development Comment Number 17 (Ravi Nadkarni & Lloyd Fillion) -
Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

41. Page 4-158, paragraph 2, 3: See the comments above. The adjustment is indeed "speculative" and should be eliminated. Separate emissions factors should be used for inorganic PM emissions from batch and drum plants.

3.5.40 Response to CAAP Factor Development Comment Number 17 - The equation used to adjust for background dust emissions from the unpaved road is not speculative but is based upon emissions measured at other sources. Since the basis of the unpaved roads emission factor equation is over 180 emissions tests we believe that it is a reasonably reliable indicator of unpaved road emissions.

3.5.41 CAAP Factor Development Comment Number 18 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

42. Page 4-159, paragraph 2, 3: There is a fundamental problem with the two paragraphs which has not been explained. MCEM PMs and TOC are generated the same way and from the same source. Therefore, if MCEM generation is a function of loadout time, TOC generation should also be a function of loadout time. Of course, the comparison is further complicated and made meaningless by the bogus "background" correction discussed earlier. To eliminate the confusion, separate emission factors should be prepared for batch and drum plants in all cases.

3.5.42 Response to CAAP Factor Development Comment Number 18 - The commentor is correct in that both MCEM PM and TOC emissions are generated as a result of organic material vaporizing from the asphalt binder. While the more volatile organic material remains a vapor and is measured as TOC, the less volatile material condenses to become a particulate and is measured as MCEM PM. The sum of the TOC and MCEM PM is the total organic emissions from the load-out operation and should be compared to determine whether drum mix and batch plants should have separate emission factors. Table 4-32 presents the emissions adjusted to a consistent asphalt volatility and temperature. The sum of the MCEM PM and the TOC load-out emissions presented in this table are 0.00421 (4.21 e-3) lb/ton for Plant C and 0.00477 (4.77 e-3) lb/ton for Plant D. The Plant D emissions are only 13% greater than Plant C. First, this agreement is better than most of the data supporting the kiln stack emission factors. Second, this level of agreement is remarkable given that the data have been adjusted to account for differences in measured load-out temperature and asphalt volatility. Given that the load-out times at Plant D were from six to eight times longer than at Plant C one would expect that differences in the total organic emissions would be close to this ratio. However, the emissions are very nearly the same and well within the uncertainties of the adjustments performed and the precision of the measurement methods. Therefore, there is insufficient data to conclude that emissions are a function of the load-out time. By presenting a single set of load-out equations for batch plants and drum mix plants, there should be no confusion on the applicability of the equation. As a result, the two paragraphs were revised as follows:

"The next most significant difference in emissions between Plant C and D is the MCEM PM. The MCEM PM from Plant D is slightly over four times the emissions from Plant C. This difference could be explained by the longer time required to complete the load-out operations at batch plants compared to drum-mix plants and other test-specific factors. However, the asphalt dependent mechanism that generates emissions of MCEM PM and TOC is the same for both pollutants. This volatilization should cause similar MCEM PM and TOC load-out emissions after adjustments for asphalt volatility and temperature. Both emissions are the result of vaporization of organic material from the asphalt binder. The more volatile organic material remains a vapor and is measured by Method 25A and is generally referred to as TOC. The less volatile organic material condenses into an aerosol and is measured by Method 315 and is referred to as MCEM

PM. When summed, the TOC and MCEM PM emissions from Plant D are only 13 percent higher than the TOC and MCEM PM emissions from Plant C. Given the variations in the run-by-run data, the low number of runs and the uncertainty in adjusting emissions to a consistent temperature and volatility, the difference is not significant. Therefore, for the purposes of developing emission factors for load-out operations, both the MCEM PM and TOC data from Plant C and Plant D were averaged and an equation that represents the averaged data was developed."

3.5.43 CAAP Factor Development Comment Number 19 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Hot Mix Asphalt Plants Emissions Assessment Report

15. Page 15, paragraph 2: It is ironic that EPA, after rejecting our repeated pleas for collecting some fundamental data on asphalts such as its vapor pressure, states "Although vapor pressure information on paving asphalt is not available.....". A more appropriate way to state what has happened would be to state that vapor pressure measurements are not available because of EPA's refusal to measure the vapor pressure.

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

44. Page 4-163, paragraph 1: The first line states that "vapor pressure information .... is not available". The report fails to state that this was only because of EPA's refusal to collect this information.

3.5.44 Response to CAAP Factor Development Comment Number 19 - Vapor pressure information is not available for paving asphalt because there is no established methodology to measure vapor pressures for this type of material. First, the collection of vapor pressure information would have required the development of a suitable test method to measure the vapor pressure of this material. While within the last year, the Lawrence Berkeley Laboratory has submitted a procedure for determining vapor pressures of heavy crude oils, this method was not available at the time the HMA project was started. To develop and validate their method required over a year of effort. This method requires quantification of almost all of the individual organic species in the vapor space. This method has not been attempted for hydrocarbons that are more volatile than the heavy California crude oils their method addresses. Although no acceptable standard methodology to measure the vapor pressure of asphalt is available, determining the maximum head space concentration of organic compounds above an organic substance is suitable for use in the TANKS equations. The use of this concentration provides an alternative to developing a laboratory method to determine vapor pressure for the complex mixtures of the compounds and mixtures requiring elevated storage temperatures.

3.5.45 CAAP Factor Development Comment Number 20 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

45. Page 4-163, paragraph 3 - 5: Please explain what you mean by "pegged TOC readings"? As it stands we can't understand this at all. Furthermore, Figures 4-9 through 4-13 are missing from our copy. Finally, it is not clear whether you are referring to Plant C or Plant D in this discussion, though the context suggests Plant C.

3.5.46 Response to CAAP Factor Development Comment Number 20 - The phrase "pegged" TOC readings means that the emissions being measured exceeded the maximum concentration of 1,000 ppm that the instrument was capable of measuring. The paragraphs explain how an estimate of the maximum TOC concentration was extrapolated from the measured data converging on 1,000 ppm. The paragraph and the figure cited describe how the lines of increasing and decreasing concentration on both sides of the plateau of 1,000 ppm were extended to determine the concentration where these lines crossed. In addition, the paragraphs explain by comparison to other similar situations which were within the instruments measurement capability why the actual maximum TOC concentration is likely to be less than was estimated by this extrapolation. The paragraph was edited to make the discussion more clear and to reinforce the source of the emission information.

All of the figures the commentors state were missing from their copy are included in the version available from the hot mix asphalt web page (www.epa.gov/ttn/emc/asphalt.html) and on the master use to produce the approximately 50 CD-ROMs that were mailed to individuals that requested the reports in this format (including the CD-ROM mailed to Ravi Nadkarni on July 24, 2000). If the commentors would have informed EPA of missing pages from the few paper versions mailed to stakeholders, we could have supplied the missing pages or informed the commentors on how to print them from the CD-ROM version.

3.5.47 CAAP Factor Development Comment Number 21 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

45. Page 4-163, paragraph 3 - 5: We further find that the contention that the estimate of unmeasured emissions being an "upper bound" to be unpersuasive and incorrect. Our reasons for saying so result from the inadequacies of Method 204. These were outlined in Ravi Nadkarni's letter of September 15, 1999. They are:

    a. At Plant C, two precautions were taken to ensure that we could measure or estimate the amount of organic fugitive emissions that did not reach the primary sampling ports. The first was the use of sulfur hexafluoride tracer gas, and the second was the use of impingement/deposition plates in the ducts which collected

organic particulates which would be deposited upstream of the sample port. Although all the emissions did not reach the sampling ports (some was deposited inside the tunnel and some was pumped out of the tunnel by ambient breeze or by truck movement), the tracer gas enabled an estimation the VOC portion of this loss. (As was pointed out during the planning, the tracer gas was a good proxy **only** for non-condensible emissions but not for condensible emissions.)

At Plant D, a tracer gas was not used although requested by the citizens because the TTE was constructed to meet Method 204 criteria, yet visual observations and THC readings showed the following:

b. An ambient breeze was sufficient to cause some of the fume to escape from the top or the bottom openings in the downwind door of the tunnel. Therefore the size of the openings was decreased further. This means that the Method 204 criterion of maintaining over 200 fpm at a natural draft opening is not adequate. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. Therefore it is not surprising that these criteria are inadequate to assure total containment within the TTE. We observed visible emissions of fume from the entrance, further emphasizing that the Method 204 criteria are inadequate.

c. Further, Method 204 has a more serious and fundamental problem. Although the size of natural draft openings is specified, the method does not contain any criteria to ensure that the emissions are pulled/sucked past the sampling point in a reasonable period of time. As is well-known, residence time calculations, based on enclosure volume and fan capacity, generally provide incorrect information by underestimating the time to evacuate the enclosure because of channeling. Note that Method 204 does not require a specific location for the natural draft openings, a problem that was pointed out during the planning sessions. At Plant D, even after the size of the opening was decreased, and the little pieces of colored tape at the Natural Draft Openings were indicating airflow towards the inside of the TTE, the tunnel was not evacuated in the approximately 15 second time gap between the final drop and the opening of the doors. This can be clearly seen in the fact that THC readings did not drop to zero even when the sample averaging time is less than 1 minute. This fact was also observed visually inside the TTE enclosure since SVOCs are visible. Thus, in the absence of a tracer gas, we have compelling evidence that the collected sample had a low bias. For example, the extended period test results in MRI-D-Table 4-4, show that final concentration did not drop to zero but stayed between 1 ppm and 2.1 ppm . Yet, this low bias is not mentioned anywhere in the report nor in Appendix B of the MRI Report which contains the original data. These emissions did not reach the instrumentation but were emitted to the environment causing a low bias.

3.5.48 Response to CAAP Factor Development Comment Number 21 - The paragraph three to five on page 4-163 pertains only to the methodology used to estimate a maximum TOC concentration from data collected during silo filling operations at Plant C and the

rationale why this methodology would lead to an "upper bound estimate of this concentration. It does not discuss any measurements at Plant D. However, since the commentor makes specific statements related to the ability of the enclosure constructed at Plant D to capture essentially all of the emissions, a response to the remainder of these statements is provided in Section 3.1.2.

3.5.49 CAAP Factor Development Comment Number 22 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

46. Page 4-164, paragraph 2: There is reason to believe that the numbers derived are low. We base this on several facts: Material Safety Data Sheets contain the following warning: "Studies have shown that low flash point substances, such as hydrogen sulfide and low-boiling hydrocarbons, may accumulate in the vapor space of hot asphalt tanks and bulk transport compartments. Such vapors may exhibit flammability characteristics of a significantly lower flash product than would be indicated by the open cup test." A review of light hydrocarbon compound properties in the Handbook of Chemistry and Physics indicates that the lower explosive limit is reached at vapor concentrations around 1%. Therefore, this warning makes sense only if the TOC concentration is around 10,000 ppm, not the 2000 ppm level used. Second, storage tank temperatures are generally higher than 325^{o} F and closer to 350^{o} F. Finally, the assumed vapor pressure is low in comparison to data from Nelson's Petroleum Refinery Engineering, which would indicate a vapor pressure over 10 mm Hg.

3.5.50 Response to CAAP Factor Development Comment Number 22 - It is assumed that the commentor is directing the statements to not only the paragraph stated but to all of section "4.4.2.5 Storage Tank Emissions." The warning cited by the commentor from an asphalt suppliers Material Safety Data Sheet (MSDS) could not be found in other MSDS's from other asphalt suppliers. However, neither this warning nor the concentration correlating with the lower explosive limit support using a vapor concentration of around 10,000 ppm. First, the open cup test method yields flash points that are from 10 to 25% higher than the closed cup test methods. For asphalts, this flash point difference could be more than 100 °F. While the flash point supplied in the MSDS should use the results obtained from the Pensky-Martens Closed Tester, the statement provides additional insurance that a user would not rely on other flash point information. For a closed liquid storage tank, the head space vapor would be at the lower explosive limit when the tank temperature is at the closed cup flash point. Measured flash points are available in a report that was previously provided to the commentors. The range of flash points for 86 asphalts analyzed by the Asphalt Institute (Properties of Asphalt Cements, V. P. Puzinauskas, Asphalt Institute Research Report No. 80-2, Asphalt Institute, November 1980) was from 450 °F to 685 °F.

The derivation of the information presented in this paragraph was explained on page 4-162 through 4-163 of the draft report. As explained on these pages the emissions for

storage tanks are derived from estimates of the maximum THC concentrations measured during the silo filling operations at Plant C. The validity of the derivation of these emissions depends mostly on the assumption that when operated at the same temperature, the estimated maximum THC concentration observed from the silo filling is the maximum THC concentration in the head space of asphalt storage tanks. At the meeting held in Boston on January 20, 2000, Dr. Nadkarni and others appeared to agree that it was reasonable to assume that the vapors in the exhaust from the silo were saturated. As stated by the commentor, we estimated that this maximum concentration was 2,000 ppm. At this concentration, emissions from an asphalt storage tank maintained at an average temperature of 325 °F would be 32 lb per million gallons of asphalt throughput.

If the average storage tank temperature was raised to 450 °F, the emissions would be increased to 570 lb per million gallons of asphalt throughput. Since these emissions are the result of the venting of the vapors due to the periodic displacement by liquid asphalt (working losses), the head space vapor concentration for the higher temperature tank can be calculated. The head space vapor concentration of the storage tank maintained at 450 °F would be 35,600 ppm. Given that the FTIR analysis of the silo exhaust indicated that most of the vapors were likely to be aliphatic hydrocarbons between pentane and nonane, the lower explosive limit concentration of 1% estimated appears reasonable. For the head space vapor concentration to be 10,000 ppm, the average temperature of the asphalt storage tank would need to be only 390 °F. As a result, the statement in the MSDS may also be a warning about the relative flammability of the head space vapors compared to the flash point. Therefore, the information derived in this section supports the statements in the MSDS.

Many safety and health related requirements are instituted at a percentage of the lower explosive limit rather than at the lower explosive limit. For example EPA safety requirements preclude entry into an environment that is above 10% of the lower explosive limit. As a result, the commentors inference that the vapor concentration in the asphalt storage tank is at or above the lower explosive limit is inappropriate. Therefore, the information presented in the paragraph does not contradict the information in the Material Safety Data Sheets cited by the commentors.

The information presented in the paragraph also does not contradict the information in Nelson's Petroleum Refinery Engineering. The commentors statement concerning the vapor pressure of 10 mm Hg neither specifies the boiling point for the hydrocarbon nor the temperature corresponding to the vapor pressure. To have a vapor pressure of 10mm Hg at a temperature of 325 °F, the boiling point of the hydrocarbon would have to be about 600 °F (See Point "A" on Figure R-1 which is adapted from Petroleum Refinery Engineering, Fourth Edition, Wilbur L. Nelson, McGraw-Hill, 1958). In a review of the physical properties of asphalts {CONCAWE: Bitumens and Bitumen Derivatives (92/104), CONCAWE, Brussels (December 1992)}, the range of boiling points for asphalts is from greater than 400 °C (752 °F) to greater than 550 °C (1,022 °F). Based upon the boiling point data presented in the CONCAWE review and the vapor pressure relationships presented in Petroleum Refinery Engineering, the vapor pressure for an

asphalt at 325 °F with a boiling point of 900 °F (about the midpoint of the range) would be less than 0.01 mm Hg. The range of vapor pressures at 325 °F corresponding to the extremes of the boiling points would be from about 0.0002 mm Hg to about 0.2 mm Hg. These vapor pressure extremes are shown as Points "B" and "C" on Figure R-1. The Asphalt Institute (http://www.asphaltinstitute.org/faq/acbfaqs.htm) states "It is estimated that at a typical inventory temperature of 325°C, the vapor pressure of petroleum asphalt is less than 0.01 psia (1.5e-3 kPa)." A vapor pressure of 0.01 psia is equal to 0.52 mm Hg. In addition, EPA confirmed with the Asphalt Institute that the stated temperature is a typographical error and should be 325°F. EPA does not know what type of asphalt the Asphalt Institutes estimate of vapor pressure is based upon nor what methodology was used to estimate the vapor pressure. However, the vapor pressure of 0.95 mm Hg estimated by the silo filling data is reasonably consistent with these other estimates of vapor pressure for asphalt.

The purpose of the commentors statement that the storage tank temperatures are generally greater than 325 °F and closer to 350 °F is unclear. There is nothing in the paragraph that indicates the typical storage tank temperature. The storage tank temperature used in the paragraph was the recorded temperature for the material being loaded into the silo on July 27, 1998 at 7:36 when the peak concentration was observed. The same temperature is used to provide consistency in the concentration of the vapors emitted for both emission sources to estimate the most appropriate Antoine's constants representing the asphalt. The use of a storage tank temperature of 350 °F at this point would generate Antoine's constants that represent a significantly less volatile substance than is indicated by the data. In addition, the commentors statement is in contrast to the industry recommendations for asphalt storage temperature (Asphalt Pavement Environmental Best Practices, Asphalt Pavement Environmental Council, April 2000) as previously shown in Figure 2. The industry guidance provide different recommended storage temperatures for different performance graded asphalts. The highest midpoint storage temperature recommended is 325 °F for PG82-22 asphalt. The numbers in the grade are indications of the project-specific temperature extremes (in degrees centigrade) for which the asphalt mixture is being designed. As such, a PG82-22 grade asphalt is intended for use when average 7-day maximum pavement design temperature is 82 °C (179 °F) and the minimum pavement design temperature is 22 °C (-8 °F). Of the asphalts included in the recommendations, this asphalt grade is for use in a severe application where the maximum design temperature is the highest.

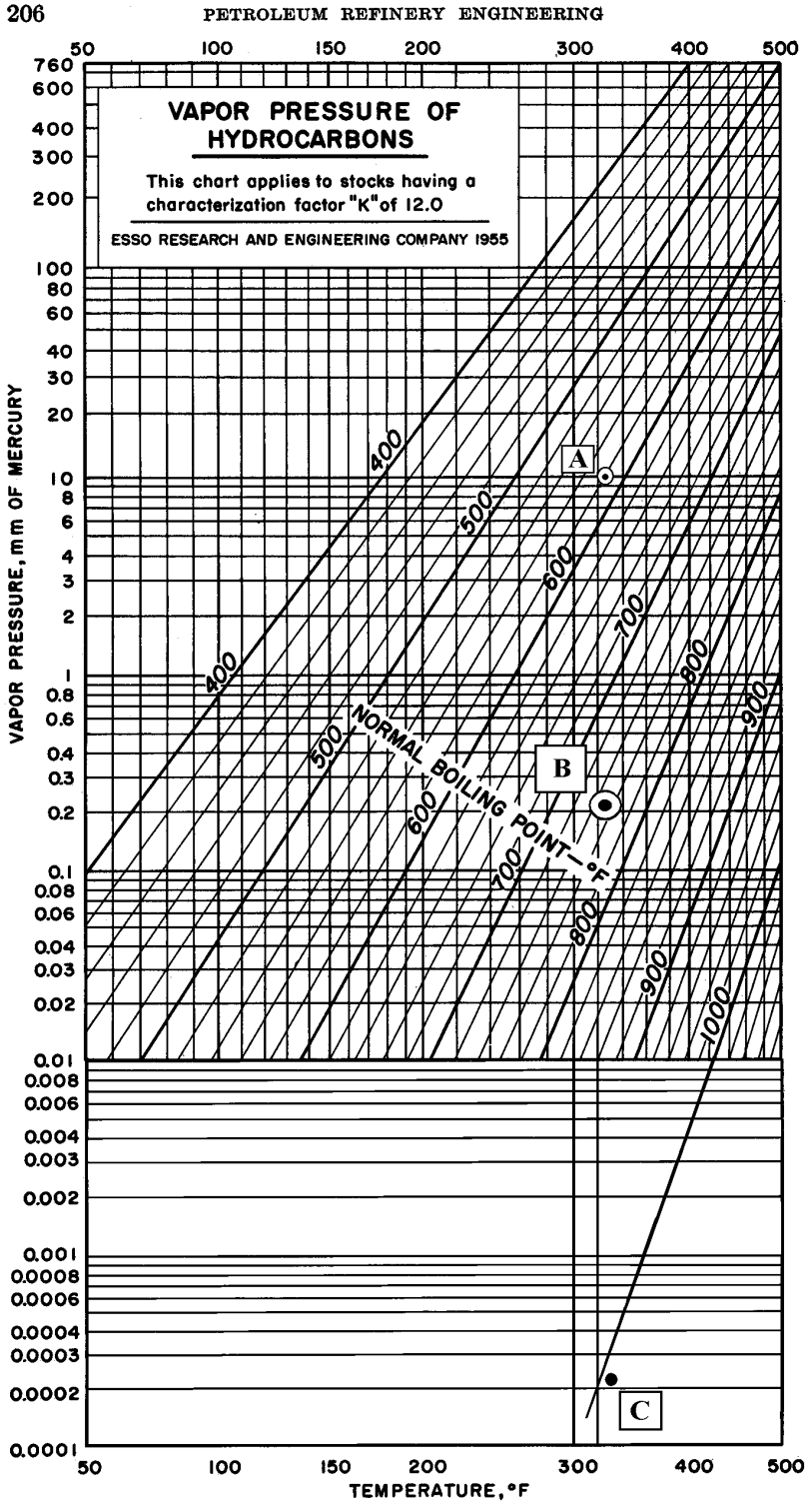


FIG. 5-25. Vapor pressure of hydrocarbon oils (low range). (*Esso Research and Eng. Co.*)

Figure 11. Vapor Pressure of Hydrocarbons. Adapted from Petroleum Refinery Engineering, W. L. Nelson, 1958.

3.5.51 CAAP Factor Development Comment Number 23 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

47. Page 4-166, paragraph 4: This needs to be rewritten. It is obvious that this paragraph is recycled from some other writeup. There is no relevant "response 53" in the present writeup. Further, emissions are not only dependent on temperature, they are also dependent on convective effects, i.e. evaporation rate increases in the presence of strong convection.

3.5.52 Response to CAAP Factor Development Comment Number 23 - We agree that there is no relevant "response 53". In addition, the document to which "Response 53" refers is missing from the reference list at the end of the chapter. The statement refers to Response number 53 in the EPA report "Response to Comments on Testing Program for Asphalt Plants C and D." The reference number of this report was added to the text. It is not clear that convective effects would have a significant impact on the emissions from asphalt in the bed of transport trucks. First, emissions of low molecular weight hydrocarbons are more likely a function of the rate at which volatile compounds can reach the asphalt surface, the rate that the high molecular weight asphalt molecules crack thereby creating the more volatile compounds within the asphalt and the rate at which these volatile compound can migrate from air spaces inside the asphalt pile to the surface of the pile. Second, near the surface of the asphalt pile in the transport truck without ambient air movement, the concentration of these volatile compounds was measured at about 10 ppm. This is much lower than the saturation concentration of these compounds. In order for convection effects to significantly influence the evaporation rate, the surface concentrations would need to approach saturation without air movement. Third, in many States, the asphalt in the transport truck bed is required to be covered. This cover limits the convective effects the asphalt is exposed to during transport.

3.5.53 CAAP Factor Development Comment Number 25 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

48. Page 4-166, final paragraph: This paragraph presents a single emissions factor for yard emissions. This is exactly what needs to be done with the RTFOT equations. They should be eliminated and only a single factor, based on RTFOT of 0.5% presented in AP-42.

3.5.54 Response to CAAP Factor Development Comment Number 25 - EPA believes that a single RTFOT value would overestimate emissions in the majority of locations in the US and also would underestimate the emissions in a few locations. The adjustment of measured emission to accommodate differences in emissions due to the effects of temperature and asphalt volatility was encouraged by the commentors. EPA believes that this adjustment has accommodated two parameters that would have otherwise been viewed as imprecision in the measurement of these emissions. Additionally, the use of

these two parameters improves the reliability of the final emissions estimates and the ability to adapt for different regional, regulatory and health impact situations and goals.

3.5.55 CAAP Factor Development Comment Number 26 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

53. Tables 4-4 to 4-14: There are numerous deletions of data shown in these tables where emission factors for each plant are presented. The reasons for the deletion are not explained in the text.

3.5.56 Response to CAAP Factor Development Comment Number 26 - There were 89 pieces of data presented in Tables 4-4 to 4-14 that were not used in developing emission factors. For 56 pieces of data the quality rating of the data is D. In Chapter Three of this appendix, the criteria for assigning the emission factor ratings are explained. As indicated, generally only lowest quality rated emission factors include D rated data and D rated data are generally not used when data of a higher quality rating are available. For 12 pieces of data, an explanation is provided in the text summarizing the specific reference or in the text describing the development of the emission factor. For the remaining 21 pieces of data, explanations were added to either the text summarizing the specific reference or the text describing the development of the emission factor. The following table provides information on the data that were not used and the 21 instances where explanations for the reason why the data was not used were added.

Emission Test Data Referenced and Not Used to Develop an Emission Factor

Table No.	Page No.	Reference No	Comment
4-6	4-263	22	D rated data.
4-6	4-266	56	Explanation in Table.
4-6	4-266	11	Report rating was revised from C to D.
4-7	4-267	209	D rated data.
4-7	4-274	350	Explanation was added.
4-7	4-275	236, 22	D rated data.
4-8	4-276	142	D rated data (three instances).
4-8	4-277	142	D rated data (two instances).
4-8	4-278	142	D rated data.
4-8	4-278	340	D rated data.
4-8	4-279	340	D rated data & explanation in text.

Emission Test Data Referenced and Not Used to Develop an Emission Factor

Table No.	Page No.	Reference No	Comment
4-9	4-281	40	Explained in text.
4-9	4-281	50	Explanation was added.
4-9	4-281	48	Explanation was added.
4-9	4-282	141	D rated data.
4-9	4-282	40	D rated data (six instances).
4-9	4-283	40	D rated data (eight instances).
4-9	4-283	146	D rated data.
4-9	4-284	48	Explanation was added.
4-9	4-285	50	Explained in text.
4-9	4-285	48	Explanation was added.
4-9	4-285	340	D rated data (eight instances).
4-9	4-286	340	D rated data (eight instances).
4-9	4-287	340	D rated data.
4-11	4-293	240, 46	Explanation was added.
4-11	4-293	331	Data was used for factor development.
4-11	4-296	1	Explained in text (three instances).
4-11	4-298	1	Explained in text (two instances).
4-11	4-298	76	Explanation was added.
4-11	4-298	15, 40	Explanations were added (five instances).
4-11	4-299	40	Explanations were added (two instances).
4-12	4-300	296	D rated data.
4-12	4-305	90	D rated data.
4-12	4-305	161	Explained in text.
4-13	4-306	317, 318, 319	Explanation was added.
4-14	4-308	47, 49	Explained in text.

Emission Test Data Referenced and Not Used to Develop an Emission Factor

Table No.	Page No.	Reference No	Comment
4-14	4-310	40	D rated data (nine instances).
4-14	4-310	143	D rated data.
4-14	4-311	49	Explained in text.

3.6 Characterization of Emissions

3.6.1 State Emissions Characterization Comment Number 1 - (Massachusetts State Senator Stephen F. Lynch) -
Additionally, as I mentioned in my last letter dated September 14, 199, it is my understanding that this report, again, neglects to specify the composition (ratio of bituminous cement to aggregate) of the asphalt used in the study. Due to various engineering standards/requirements associated with asphalt, it is very important that this information be provided so that test results can be adjusted accordingly.

3.6.2 Response to State Emissions Characterization Comment Number 1 - Information on the ratio of bituminous cement to aggregate was included in the draft and final reports of both load-out emission tests. As indicated in Section 2.1 Process Description of the EPA test report *Hot Mix Asphalt Plants, Truck Loading and Silo Filling Instrumental Methods Testing, Asphalt Plant C, Los Angeles, California, Final Report* (EPA/R-00-024, May 2000), "The percent by weight of liquid asphalt in the mix varies from 4.8% to 6.0% depending on the size of the aggregate (the smaller the aggregate, the higher the liquid asphalt content)." Additionally, as shown on the last four pages of Appendix B of the EPA test report *Final Report, Hot Mix Asphalt Plants, Truck Loading Manual Methods Testing, Asphalt Plant D, Bare, MA*, (EPA/R-00-028, May 2000), the percent weight of asphalt in the mix ranged from 4.4% to 7.2%. During the emissions test for plant C, the average asphalt used was 5.0% and for the five days of the test ranged from 4.9% to 5.2%. During the emission test for plant D, the average asphalt used was 5.2% and for the three days of the test ranged from 4.5% to 5.7%. Although the above information was added to the text reviewing the specific data sets in the AP-42 Background Report (Emissions Assessment Report Appendix B) EPA does not support adjusting the data further to accommodate the variations of the asphalt content of the HMA produced. While the range of asphalt content in any specific HMA formulation may vary significantly, as indicated by the two EPA tests, the range of asphalt content averaged over a days operation of a typical plant would be significantly less. Furthermore, the range asphalt content averaged over longer periods (months or entire year) would show very little variation. It is believed that the average asphalt content of 5.1% for the HMA produced during the EPA emissions tests are very close to the typical average asphalt content of most HMA plants. Additionally, differences between this value and measurement made at other plants are within the precision and accuracy of the

weigh scales used by the plants for measuring the materials. As a result, it would be unclear whether differences in the adjusted emissions are due to actual differences in the asphalt content in the HMA or differences due to measurement errors of the weigh scales.

3.6.3 Local Health Agency Emissions Characterization Comment Number 1 (Elaine T. Krueger, Environmental Toxicology Program (BEHA) -
Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
A final comment regards EPA reporting averages of data collected without presenting the range of numbers. This concern has also been raised by others. The use of average values may be appropriate for evaluating risks of long-term health effects e.g., cancer risk, but may underestimate the potential for health effects associated with other issues, e.g., short-term odors, that have been reported to be associated with these types of facilities. Clearly, some of the chemicals, e.g., naphthalene, contained in the asphalt have very low odor thresholds. For that reason, we recommend that EPA present the full range of predicted emissions data including upper-bound or maximum estimates of emissions as they relate to the potential for shorter term effects, such as odors. This is particularly important given that odors have been important issues at other facilities like this elsewhere in the U.S. (E.g., Michigan).

3.6.4 Response to Local Health Agency Emissions Characterization Comment Number 1 - There are a variety of reasons why AP-42 does not include additional emissions factors that would predict upper-bound or maximum values. First, AP-42 is primarily used for making source-specific emission estimates for area wide inventories. These inventories have many purposes including ambient dispersion modeling and analysis, control strategy development, and in screening sources for compliance investigations. Generally, long averaging times reduce the concern over short term variabilities and the over and under estimations (due to disparities between estimated emissions and actual emissions) tend to cancel each other. Second, not all emission factors are based upon the same amount of data nor the same quality of data. Emission factors based upon large data sets (like the HMA section) will have a greater difference between the average value and the maximum value. Conversely, emission factors based upon few data are likely to have a relatively small difference between the average value and the maximum value. Third, emission factors for source categories where emissions can be highly controlled, also have some supporting data from a few facilities with relatively high emissions. Their high emissions may be due to their location in a State without stringent emission limits or because they are an older facility that is grand fathered. Fourth, this type of information is rarely required and presenting this type of information in the AP-42 section would further complicate information that is already technically complex. Fifth, the range of possible time frames different individuals would want is great. For example, where one individual might want a 15 minute value while another would want a one hour value. And lastly, local situations may necessitate the use of either a value based on unique conditions or may require the collection of additional locally specific information that cannot be reflected in a “one size fits all” value. Additionally, different compounds may have health and nuisance thresholds that may have differing averaging times.

The HMA section has a background report which contains a significant amount of information which individuals can use to accommodate individual concerns related to a variety of uncertainties including estimating upper bound and short-term emissions. If required, copies of a few test reports could be obtained if more detailed information is required. In using this information, the user should develop an understanding for the conditions under which the data were collected. For example most tests are three run averages where each run was collected over one to six hour time frames. Estimating shorter term values from this data may involve significant uncertainties. In addition, the user should assess the probabilities (even if they can only be assumed) of simultaneous unlikely scenarios occurring since using multiple worst case type assumptions generally infers a highly improbable or almost impossible result.

3.6.5 Industry Emissions Characterization Comment Number 1 (Steve Zemba, Cambridge Environmental) -

Hot Mix Asphalt Plants Emissions Assessment Report

General: Tables 1 and 2 claim to present emissions for a "typical" plant. This is probably true for mixer emissions, but is not the case for the fugitive sources, as indicated by statements on p. 14. Specifically, the fugitive emission estimates assume a high-end volatility of asphalt cement, and also a maximum recommended load-out temperature. I would thus characterize the fugitive emission estimates as "high-end" for a typically-sized plant. EPA might want to clarify this matter somewhat, since the actual ratio of fugitive-to-stack emissions for a typical plant running at typical conditions will be lower than that implied in Tables 1 and 2.

3.6.6 Response to Industry Emissions Characterization Comment Number 1 - It is recognized that the loss on heating of 0.5% is likely an upper bound estimate of volatility of asphalt for a number of States based upon information that has been collected. It is also recognized that an average load-out temperature of 325° F is near the maximum target value for HMA plants. As a result of both of these conditions, it is estimated that the resulting emission estimate may be higher but as much as a factor of three over the operating conditions at the typical HMA plant. However, as currently drafted, the HAP emissions for load-out, storage, the eight minutes following load-out and HMA storage silo (for drum mix plants) are only 1.5% of the total of the HAP emissions for batch plants and only 5% of the total for drum mix plants. Since this is a relatively small percentage, it is not necessary to add text regarding the relative significance of these emission as this is readily apparent from the estimates derived.

3.6.7 Industry Emissions Characterization Comment Number 2 (Steve Zemba, Cambridge Environmental) -

Hot Mix Asphalt Plants Emissions Assessment Report

p. 13: Are emissions from hot oil heaters included in any of the categories in Tables 1 & 2 (e.g., the "mixer" category)? If not, does it make sense to mention the likely magnitude of these emissions relative to other sources (qualified, of course, by the large degree of uncertainty resulting from the dearth of test data)? Might it also be possible to use

emission factors from similar burners (used in other industries) to evaluate hot oil heater emissions?

3.6.8 Response to Industry Emissions Characterization Comment Number 2 - As stated elsewhere, emissions from other sources at HMA plants were added to Tables 1 and 2. In addition to adding an emissions estimate for hot oil heaters, road dust emissions, material handling emissions, and emissions from diesel truck exhaust were added.

3.6.9 CAAP Emissions Characterization Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) -

Hot Mix Asphalt Plants Emissions Assessment Report

4. Page 2, paragraph 4: In this and in other paragraphs and tables to follow, emissions and/or emission factors are given as averages. If this data was derived by averaging emissions from many plants, as indicated in Appendix B, measures of variability such as standard deviation should also be given. At present, this information is buried in the tables in the two appendices.

3.6.10 Response to CAAP Emissions Characterization Comment Number 1 - The presentation of information on the variability of the supporting data in the body of the Emissions Assessment Report would only complicate the already complex set of values presented. The two appendices provide increasingly technical discussions which support the information presented in the body of the report. As the commentor has stated in other comments, the appendices do include the standard deviation for some emission factors. Most emission factors do not include information on the variability of the supporting data. However, appendix B includes the individual data supporting all of the emissions factors that are provided. With the individual data, the user is not limited to one measure of variability and can develop statistical information that is tailored to the specific situation that they may be assessing.

3.6.11 CAAP Emissions Characterization Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

7. Page 7, paragraph 5: The fourth line from bottom uses the word “gas” when “ vapor of organic compounds” would be more correct.

3.6.12 Response to CAAP Emissions Characterization Comment Number 2 - The report has been revise to use the more proper term vapor in place of gas.

3.6.13 CAAP Emissions Characterization Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

8. Page 8, paragraph 1: The second line states that both the low and high molecular weight compounds “may” contain small amounts of HAP. We were under the impression that such asphalt-derived compounds always contain some HAPs. Is

EPA suggesting that certain asphalts don't contain any HAPs? Is there any data to support this statement?

3.6.14 Response to CAAP Emissions Characterization Comment Number 3 - The word "may" was deleted from the report.

3.6.15 CAAP Emissions Characterization Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

9. Page 8, paragraph 3: In the fourth line, a particle size analysis of cold feed is presented. We don't see the relevance of this sentence since the previous sentence and the subsequent sentence both talk about fugitive dust and cold feed is not a major contributor to fugitive dust.

3.6.16 Response to CAAP Emissions Characterization Comment Number 4 - The percentage of silt (less than 74 μm or minus 200 mesh) is used as a variable in calculating some fugitive particulate emissions. Although a silt content that is specific for the facility improves the predictive accuracy of the emission estimate, the presentation of a average estimate is useful when a facility specific value is unavailable.

3.6.17 CAAP Emissions Characterization Comment Number 5 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

10. Page 8, paragraph 4: If as you say in the last sentence that data are not available to support the hypothesis, EPA should not be repeating the hypothesis. Again, such a statement belongs in industry sales literature and not in an EPA document.

3.6.18 Response to CAAP Emissions Characterization Comment Number 5 - While the available data to support the hypothesis are very weak and other process parameters are probably responsible for the majority of the variations, the hypothesis is worthy of mention. The statement that data are not available to support the hypothesis was revised to "temperature during processing, data supporting this hypothesis is very weak. Specifically, although the data show a relationship only between RAP content and condensible organic particulate emissions, 89% of the variations in the data were the result of other unknown process variables."

3.6.19 CAAP Emissions Characterization Comment Number 6 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

11. Page 9, paragraph 1: Most of this paragraph is again a replay of industry assertions. The only relevant issue is whether or not these process modifications work to reduce "blue smoke". We notice that the industry favorite, the wet electrostatic precipitator or smog hog is conspicuous by its absence from this list.

3.6.20 Response to CAAP Emissions Characterization Comment Number 6 - The technologies mentioned have been demonstrated and are mentioned to provide individuals that encounter facilities with these problems to understand that solutions are available. It is unknown whether any wet electrostatic precipitator has been used to control PM and/or blue haze from the kiln exhaust. As a result, this control technology was not mentioned.

3.6.21 CAAP Emissions Characterization Comment Number 7 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

12. Page 9, paragraph 2: A repeat of the comment on page 5 about how such plants "will likely have lower ..... emissions". If you have the data, show it; if not, let the industry do its own PR.

3.6.22 Response to CAAP Emissions Characterization Comment Number 7 - The statements concerning the organic compound emissions address the location that organic material (from either RAP or asphalt cement) is added to the new aggregate and whether those emissions would be ducted to the kiln exhaust stack. Information, of this type is useful to State and local agencies that review permits. However, to clarify the statement, it was revised to "not in contact with the hot exhaust gas stream, counterflow drum mix plants will likely have lower organic compound emissions from the kiln stack than parallel flow drum mix plants. However, variations in the emissions due to other unknown process variables are more significant. As a result, emission factors for parallel flow and counter flow drum mix plants are the same."

3.6.23 Industry Emissions Characterization Comment Number 3 (Gary Fore, Vice President National Asphalt Pavement Association) -

Hot Mix Asphalt Plants Emissions Assessment Report

Page 15: A. Last paragraph - Please add the following sentence to the end of the paragraph. ...equation developed from the emission data. It should be noted that truck emissions would decrease rapidly with time as a result of surface cooling and crusting and industry practice of covering loads with tarps.

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

Page 11.1-8: A. In the first partial sentence on the page, please add **prior to tarping** after truck. The sentence will then read: Organic vapor ... bed of the truck **prior to tarping**, ..."

3.6.24 Response to Industry Emissions Characterization Comment Number 3 - Although the surface material of tarped or un-tarped HMA may cool rapidly during transport, it is believed that only the organic particulate emissions may be reduced due to condensation on the cooler surface material. The emission factor discussed in the paragraph is for the compounds that remain vapors after cooling to ambient conditions. It is believed that the emissions of these more volatile compounds would not be reduced as rapidly as the particulate or visible emissions. It is believed that the more volatile

emissions are reduced more slowly over time as a result of the more general cooling of the hot mix asphalt as a whole. This cooling is much slower than the cooling of the surface material. The addition of the phrase "prior to tarping" infers that the tarping of the HMA somehow inhibits the emissions of organic vapor from the bed of the truck. While tarping may limit to some extent the visible emissions from the truck bed, it is not believed that tarping inhibits the emissions of the volatile organic compounds that were measured during load-out. Even if there were information that supported a reduction in organic vapor emissions due to tarping, it is likely that these emissions would only be delayed until the tarp was removed. In addition, the presence of some covers may inhibit the loss of heat from the asphalt in the bed of the truck. The higher temperature retained by the HMA may in turn result in slightly higher emissions for a given load-out temperature. As a result the changes suggested by the commentor were not made.

3.6.25 Industry Emissions Characterization Comment Number 4 (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-17 : B. Note there is an error under VOC for natural gas-fired dryer and the No.2 fuel oil-fired dryer. They should be 0.0076 for both not ~~0.0082~~

3.6.26 Response to Industry Emissions Characterization Comment Number 4 - While there appears to be a mathematical error in the table, the differences in the VOC emission factor are due to the rounding of the formaldehyde, methane and THC emission factors. The arithmetic was reviewed. The emission factor is correct. A clarifying footnote was added to indicate that the values presented are different due to rounding.

3.6.27 Industry Emissions Characterization Comment Number 5 (Gary Fore, Vice President National Asphalt Pavement Association) -
Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft
Page 11.1-22 and 23: B. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

Page 11.1-24: A. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

Page 11.1-28: A. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

3.6.28 Response to Industry Emissions Characterization Comment Number 5 - When available, emission factors prior to air pollution control devices are provided in AP-42.

Information on uncontrolled emissions is used by some individuals to assess the regulatory status of some facilities, assess the potential impact due to air pollution control device by-pass during start up or shut down or to assess the potential impact of a temporary malfunction of the air pollution control device.

3.6.29 Industry Emissions Characterization Comment Number 6 (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page 3: A. At the end of the last paragraph -Please add an editors note: **"HAPs emissions are typical of emissions that result from fossil fuel combustion."**

3.6.30 Response to Industry Emissions Characterization Comment Number 6 - A limited comparison of the AP-42 emission factors for a drum mix HMA plant with a fuel oil fired boiler firing the same quantity of fuel oil (1.6 gal per ton of HMA) indicates that HMA plants generally have higher emissions than an industrial or commercial boiler. Therefore, the statement will not be added.

3.6.31 Industry Emissions Characterization Comment Number 7 (Gary Fore, Vice President National Asphalt Pavement Association) -
Hot Mix Asphalt Plants Emissions Assessment Report
Page13: A. 2"d paragraph -Please add to the end of the paragraph. ..."representative of gas-fired heaters. **As a practical matter theses units represent a very small combustion source when compared to the dryer.**

3.6.32 Response to Industry Emissions Characterization Comment Number 7 - At this location in the report, this statement is not believed to be appropriate. However, estimated emissions from the hot oil heater were added to Tables 1, 2, 6 and 10. In addition, the basis for the emissions estimates are included in Section 2.5. The following information was included in this basis. The typical HMA plant has two asphalt storage tanks that are 50 ft long by 8 ft diameter. It is estimated that these storage tanks require a total heating capacity of about 200,000 Btu/hr based on a heat loss of 60 Btu/ft^2 of tank surface area. The asphalt storage tanks are kept hot continuously for the five months the HMA plant operates. As a result 720 million Btu's are used to maintain the temperature of the asphalt in the storage tank. For a gas fired hot oil heater, 720,000 cubic feet of gas would be combusted. For an oil fired hot oil heater, 5,100 gallons of fuel oil would be combusted. It is estimated that this fuel usage is about 3% of the fuel used in a typical batch mix plant (100,000 tons HMA/year) and 1.6% of the fuel used in a typical drum mix plant (200,000 tons HMA/year).

3.6.33 CAAP Emissions Characterization Comment Number 8 (Ravi Nadkarni & Lloyd Fillion) -
Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

7. Page 2-4, last paragraph: This is a repeat comment in the last line. If you don't have the data about organic emissions, don't speculate about "potential".

3.6.34 Response to CAAP Emissions Characterization Comment Number 8 - The statements concerning the organic compound emissions address the location that organic material (from either RAP or asphalt cement) is added to the new aggregate and whether those emissions would be ducted to the kiln exhaust stack. Information, of this type is useful to State and local agencies that review permits. However, to clarify the statement it was revised to "asphalt cement occurs in the hot combustion product flow, there is a potential for kiln stack organic emissions (gaseous and liquid aerosols) to be greater than in counterflow plants and some batch plants. However, this increased emissions is not evident in the data due to variations in the emissions due to other unknown process variables are more significant."

3.6.35 CAAP Emissions Characterization Comment Number 9 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

8. Page 2-7, paragraph 3: Same comment as above under item ? regarding dataless conclusions. The last sentence belongs in an industry sales brochure, not in an EPA document.

3.6.36 Response to CAAP Emissions Characterization Comment Number 9 - The lack of data to substantiate the statement is not a reason to eliminate the statement. As with many other emissions that were statistically evaluated, there is insufficient information about the relevant process variables, an insufficient number of data and relatively high variation in the emissions to properly evaluate the potential effect. However, the statement was revised to indicate that the available data is insufficient to discern any differences in emissions because of the differences in the process. With respect to the processing of high percentages of RAP, a number of emissions tests of facilities processing RAP at ratios of 50% are used in the development of the emission factors. The statistical analysis performed to evaluate the effect RAP percentage on emissions indicated that only the condensible organic particulate was affected by the RAP percentage. However, the squared correlation coefficient was only 0.11 (with a correlation of 1.0 being perfect) indicating that the RAP percentage explained very little of the variability in the data.

3.6.37 CAAP Emissions Characterization Comment Number 10 (Ravi Nadkarni & Lloyd Fillion) -

Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

9. Page 2-10, paragraph 4: The last sentence belongs in an industry sales brochure, not in an EPA document.

3.6.38 Response to CAAP Emissions Characterization Comment Number 10 - The technologies mentioned have been demonstrated and are mentioned to provide individuals that encounter facilities with these problems to understand that solutions are available.

3.6.33 CAAP Emissions Characterization Comment Number 11 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

13. Page 9, paragraph 4: The last three lines appear to be a plug for one particular firm "Compliance Monitoring Service". Is it EPA's role to do this?

3.6.34 Response to CAAP Emissions Characterization Comment Number 11 - The only source test information available indicating the potential benefits of combustion monitoring was this report supplied by the State of New Jersey. While the report was produced by Compliance Monitoring Service, it is no more an endorsement of their services than any other test contractor referenced as performing any of the tests of Hot Mix Asphalt Plants. In addition, we would not think that this statement would provide a strong recommendation for this company since there was insufficient information in this report for EPA to quantify the emissions benefits of this monitoring and the contractor used a variety of assumptions rather than collecting the needed process information to allow the use of this test data.

3.6.35 Industry Emissions Characterization Comment Number 8 (Steve Zemba, Cambridge Environmental) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

General: Many HMA plants are now installing condensers on their asphalt storage tank vents and silo vents; some are enclosing or partially enclosing their loadout areas. The fugitive emissions discussed in this document are for uncontrolled sources. In fact, the estimates in Tables 1 and 2 implicitly assume controls on the mixer (dryer) stack but no controls for fugitive emissions. This assumption should be made explicit (perhaps in a footnote to the tables). EPA might also want to offer some opinion/conjecture on the efficacy of engineering controls for the various fugitive sources.

3.6.36 Response to Industry Emissions Characterization Comment Number 8 - The potential for controlling the emissions from asphalt storage tanks and HMA storage silos can be evaluated based upon the composition of these emissions. The composition of the organic emissions can be determined from the measured emissions from the silo vent during the emissions test at Plant C. The emissions measured were about 95% volatile organic compounds and about 5% particulate organic compounds. In addition, the FTIR analysis inferred that the majority of the volatile organic compounds were aliphatic hydrocarbons between about pentane and nonane. While it is likely that atmospheric condenser would provide some control of these organic compounds, the control efficiency would only be a conjecture. Normally, the control effectiveness of condensers is dependent on the temperature of the condenser and the concentration of the components in the vent stream. While atmospheric condensers should be highly effective at reducing the particulate components of the emissions and therefore the visible emissions, these are a small portion of the overall emissions from these sources. Atmospheric condensers would be significantly less effective in controlling relatively low concentrations (2,000 ppm) of low molecular weight compounds. The effectiveness of enclosing the load-out areas provides no control of emissions unless combined with an emissions control device.

In addition to having about the same situation as the asphalt storage tank and HMA storage tank emissions, these emissions would be more dilute because of the high air flow rates required to capture these emissions from load-out operations. Although the wet ESP at Plant C may not have been operating properly during the industry sponsored emissions test by AIRx Testing, this test showed essentially no control of either the particulate or vapor phase emissions. While there may be a cost effective control strategy that would be effective on these sources, it is premature to include such a statement in the AP-42 section since there is no basis at this time.

3.6.35 CAAP Emissions Characterization Comment Number 12 (Ravi Nadkarni & Lloyd Fillion) -

Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

17. Table 1: We are totally confused by the data on condensible inorganic and organic PM. These are defined in footnote b as being method-driven. It would have been helpful if additional details had been presented. In particular, we are curious about the chemical components of the condensible inorganic PM fraction. The table shows that uncontrolled emissions are numerically the same as controlled emissions. Footnote j states that "uncontrolled "values are assumed to be equal to the maximum controlled value measured". Since the controlled values of 0.013 and 0.0042 are averages (arithmetic means), and are the same as the uncontrolled values, is the table saying that the average is the same as the maximum value in the data set? Please explain. We recall that this problem has been in table 1 in previous versions of AP-42.

3.6.36 Response to CAAP Emissions Characterization Comment Number 12 - The commentor is correct that the components of particulate matter are method defined. The addition of details to explain the test method is beyond the scope of AP-42 and the background report for this section. The presentation of PM emission factors in this manner is common throughout AP-42 where information on the condensible fractions of particulate matter are available. More detail on pollutant terminology and conventions are contained in the Introduction to AP-42. Beyond the Introduction to AP-42, the introductions to the various EPA reference test methods may include additional detail on the constituents that are measured by the test methods. This information is presented for future assistance in reconciling ambient speciation information on fine particulate with the speciated information from the emission sources. While EPA Method 202 does not include determining the components in the inorganic or organic fractions, the inorganic fractions are generally sulfates and nitrates with lesser amounts of other inorganic substances. These inorganic substances are vapors at the filtration temperature used to avoid water condensation on the filter of EPA Method 5, EPA Method 201a or EPA Method 17. The values for the controlled and uncontrolled condensible (inorganic and organic portions) particulate are the same because fabric filter control devices (the most prevalent in use by HMA plants) are not expected to control vapors and there is no uncontrolled data for these components of particulate. While wet scrubbers may be expected to control these components of particulate, no test data was available to indicate

a suitable controlled emission factor with this type of control. The values are not maximums but are averages, the word maximum was removed from the footnote.

3.7 Evaluation of Unused Information

3.7.1 CAAP Unused Information Comment Number 1 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

49. Page 4-167, paragraph 2 - 4: This is a critique of Ravi Nadkarni's original submission in 1994. There are several problems here. If you are going to critique this work, you should refer to all of submissions to the EPA, not just the first one from 6 years ago. The complete list would include his response to Mr. Ryan of EPA of October 26, 1995 and November 16, 1995 and to Mr. Mobley of July 5, 1996. We find it particularly interesting that the estimate of vapor pressure of asphalt from 1994, based on several model compounds has been represented as one based on a single model compound. Second, "people who live in glass houses should not throw stones". In using the TANKS program, (see page 4-165) the authors used another set of model compounds whose presence at the required concentrations is also not supported by the same data that is used to attack this work. For example, if naphthalene and 2-methyl naphthalene are predominant species of PAH in emissions from asphalt DRYERS, why were tetracosane and pentacosane used as model compounds for TANKS? Can you please recalculate the TANK emissions using naphthalene and 2-methyl naphthalene?

    Next, why is the Cambridge Environmental letter not listed in the references? It should have been reference 358. Cambridge Environmental used another set of model compounds to come up with a different figure. That does not make their calculation any more valid since both estimates were done years ago in the absence of data on components of asphalt vapor. (This also begs the question of why DRYER emissions are used here when better data is now available from silo emissions.) Given Cambridge Environmental's track record as an extreme advocate for their industrial clients in the public health area, we would not characterize their work as "independent". (In one case, they compared emissions from a single plant versus emissions from all industrial plants of all types in a county and the state. Even the most polluting plant can appear to be a winner under that criterion.) There is more to the Cambridge Environmental story. In a public meeting in Uxbridge, Dr. Zemba, the principal author of the letter, reversed his position and stated that he now believed that the calculations are in the correct range, or only modestly overestimate the actual emissions. Specifically, he said, "When I originally looked at the calculations, I thought that these were grossly overestimated. I can see your point though and they might not be overestimated by as much as I originally thought." He also admitted that he had not studied Ravi Nadkarni's two 1995 letters to the EPA. A specific critique of the Cambridge Environmental work is in the 1996 letter to David Mobley.

We agree that calculations done in the absence of actual measurements should be discarded when actual measurements are available. But any critique should fairly represent the work and its shortcomings.

3.7.2 Response to CAAP Unused Information Comment Number 1 - We believe that the summary and the shortcomings identified are an accurate representation of the reference. The original submission is cited since it was submitted to EPA for use as the basis for emission factor for this source and has received wide distribution by the author. The reference cited is intended to include not only the submission by Dr. Nadkarni but also the various follow up submissions by Dr. Nadkarni and others. Data collected during the EPA emissions tests of Plant C and Plant D and analyzed by agreed upon procedures support the shortcomings that were identified in the analysis. The purpose of the discussion is to provide a brief summary of the information and describe its usefulness in developing the final emission factor. It is not intended to provide detailed critiques of all aspects of the methodology described nor the critiques by others.

With respect to EPA's selection of compounds to represent asphalt in the TANKS equations, this selection was based upon measured emissions and not assumptions about the minor constituents of the mixture and the physical processes that are occurring. It would not be appropriate to use molecular weight information from other compounds unless the Antoine's coefficients are changed to produce emission concentrations at 325 °F that are the same as the saturated vapor concentration measured at the HMA storage silos at Plant C. The TANKS software uses both the vapor pressure calculated with the Antoine's coefficients and the molecular weight to calculate mass emissions. While the molecular weights of naphthalene and 2-methyl naphthalene could be substituted, the Antoine's coefficients for these compounds would not be appropriate. Instead, a revised set of Antoine's coefficients would have to be selected so that the mass emissions are 32 pounds per million gallons of asphalt throughput. In addition, these two compounds comprise only 0.004% and 0.01% of the organic emissions (PM plus TOC) from silo filling and all PAH's are only 0.024% of the organic emissions. At these percentages, these compounds are not a significant portion of the vapor pressure of head space organic compounds. The test data strongly support the conclusions that the emissions are mostly aliphatic hydrocarbon vapors, a small component of aromatic hydrocarbon vapors, a small component of organic particulate and trace amounts of specific identified organic HAP compounds. The FTIR data also support the assumption that the molecular weight of the vapor is between pentane (72 g/g-mole) and nonane (128 g/g-mole). Since the presentation of the liquid and vapor molecular weight as well as the Antoine's coefficients for a model compound between tetracosane and pentacosane has been misinterpreted by the commentors and may be misinterpreted by others, the median molecular weight of 105 g/g-mole was used for tanks emissions. The Antoine's coefficients for aliphatic hydrocarbons that come the closest to producing a working loss emission estimate of 32 pounds per million gallons of asphalt throughput for this approximate molecular weight are docosane and tricosane. As a result, the background report was changed to describe this revised methodology. The revised Antoine's

coefficients “A = 75,350.06" and “B = 9.00346", vapor molecular weight of 105 g/g-mole and liquid molecular weight of 1,000 g/g-mole were included in the AP-42 section.

3.7.3 CAAP Unused Information Comment Number 2 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

50. Page 4-168, paragraph 2 - 4: The evaluation of reference 359 indicates that the reference was not read critically. Tables 4-42 and 4-43 are presented without any critical evaluation of the contents. The table shows about the same concentrations at an upwind site and a downwind site. How is this possible, unless the measurements represent background readings? There is no comment as to why higher concentrations were detected at a residential site and how the residential site compared to the upwind and downwind sites. If you are not going to evaluate the information, don’t present the tables.

3.7.4 Response to CAAP Unused Information Comment Number 2 - The reference was not read critically since it was impossible to derive an emission factor from the test. A more critical review would have been attempted should the samples from the railcar hatch and storage tank vent been within the calibration range of the GC/MS. However, it does offer limited support for the estimated concentration of THC for asphalt storage tank emissions that was used to develop Antoine’s constants for use with the TANKS equations. Assuming that the residential site was near the source, an insignificant difference between upwind and downwind concentrations provides information that indicates that emissions are low relative to the background concentrations. Finding significant increases in downwind concentrations requires at least four conditions to occur. The source strength (mass per unit of time) be significant relative to the other conditions. The downwind measurement must be close enough to the source so that the pollutant is not significantly diluted due to dispersion in the air. The test method should be capable of detecting the difference in concentrations. Last, the variations in the upwind and downwind concentrations should be insignificant when compared to the differences in upwind and downwind concentrations.

3.7.5 CAAP Unused Information Comment Number 3 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

51. Page 4-169, paragraph 2 - 6: Again, the comments indicate that reference 360 was not read critically. For example, the high outliers were rejected. Having read the original report, we know that the authors don’t plead that the instrument malfunctioned. Therefore, the high measurements must be explained. Or are they supposed to be background? It is likely that the wide variation in measured concentrations was a function of measuring technique? Low readings were obtained upwind of the emission source and high readings were obtained near the source and downwind from it. Under these conditions, when the instantaneous wind direction and sampling location with respect to the source were not recorded, there is no justification for rejecting the high data points. Note that the determination of the

high data points as outliers was based on a purely statistical argument (the "outliers" were many standard deviations away from the rest of the data; therefore they don't belong with the rest of the dataset); not one based on measurement errors or other relevant factors.

The final paragraph again uncritically quotes the process used by the authors to convert the measurement into a mass rate in g/sec. The concentration of benzene was measured in concentration units i.e. g/l which can be converted to g/m^3. This was then converted to an "emission factor" (actually a mass rate) by multiplying the concentration by wind velocity in m/sec and the vehicle area in m^2. This is data manipulation of the worst sort. If one is trying to measure the flux of benzene escaping from the truck, the flux would be expressed in units of mass flow per second per unit area or $g/sec\text{-}m^2$. The relevant area is that perpendicular to the direction of flow of the flux that you are trying to characterize. In this reference, concentration, wind velocity and truck area are combined in a way that might be dimensionally correct but make no physical sense. In particular, it is difficult to see how a measured wind velocity relates to the area of the truck. EPA does disservice to the reader when material of this type is presented in detail over 4 tables without critical evaluation.

3.7.6 Response to CAAP Unused Information Comment Number 3 - The reference was not read critically since the derivation of an emission factor from the test would require a number of additional unsubstantiated assumptions. For example, the amount of asphalt loaded during the one minute period, the temperature of the asphalt and the volatility of the asphalt. In addition, based upon the description of the sample collection, the air velocities and concentrations are probably biased high since the funnel was located within the bed of the truck near the falling HMA. While the authors excluded the high values due to statistical criteria, for emission factor development outlier evaluations are typically used to identify data requiring further evaluation. However, the test does provide a reasonable semi-quantitative estimate of emissions for use in a dispersion model used to determine the need for more sophisticated emissions testing. Within this context, the results that were developed for truck load-out do provide limited support for the load-out emission estimates for benzene.

3.7.7 CAAP Unused Information Comment Number 4 (Ravi Nadkarni & Lloyd Fillion) - *Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft*

52. Page 4-172, reference 364: This reference is the AIRx report of measurements at Plant C. We want to see exactly what procedure was used to estimate capture efficiency at 70 to 90%. Otherwise, this comment should be eliminated.

3.7.8 Response to CAAP Unused Information Comment Number 4 - The statement concerning the estimate of the capture efficiency of the enclosure should have indicated that the assessment was made during the evaluation of the test report done prior to capture efficiency testing. While the capture efficiency testing at Plant C supports the

estimates of capture efficiency that were made, this test report is not being used for developing the final emission factor. Therefore, no additional evaluations are necessary. The paragraph was revised to:

"Capture efficiency of the control system was not measured during the test. However, in an evaluation of the test report by an EPA contractor, an assessment of the capture efficiency was made. The assessment was made based upon the available information on the load-out area in this test report. The assessment indicates that an average face velocity of building air of about 42 feet per minute was estimated from data in the report. It was recognized that this velocity is outside the recommended range of 50 and 100 feet per minute specified in the Industrial Ventilation Manual. It also was recognized that the enclosure did not meet all of the criteria for a permanent total enclosure (PTE) specified in the EPA document The Measurement Solution: Using a Temporary Total Enclosure for Capture Efficiency Testing. Finally the assessment provides an estimated range of capture efficiency of the system at between 70 and 90 percent. While this capture efficiency assessment could be re evaluated using the measured capture efficiency and emissions documented in reference 355, this is unnecessary since this test was not used in developing the final emission factor."

Chapter 5

Stakeholder Comments on
Draft Emissions Assessment Report,
AP-42 Section and AP-42 Background Report

This Page is intentionally left blank.

Stephen F. Lynch
Massachusetts State Senator
First Suffolk District

This Page is intentionally left blank.

COMMONWEALTH OF MASSACHUSETTS
MASSACHUSETTS SENATE
STATE HOUSE, BOSTON 02133-1053

SENATOR STEPHEN F. LYNCH
FIRST SUFFOLK DISTRICT
STATE HOUSE, ROOM 424
TEL. (617) 722-1150
FAX (617) 722-2191

COMMITTEES:
COMMERCE AND LABOR
(CHAIRMAN)

WAYS AND MEANS
EDUCATION
PUBLIC SERVICE
COUNTIES
ETHICS

August 31, 2000

Mr. Robert McConnell
Environmental Engineer
Air Quality Planning Unit
U.S. Environmental Protection Agency
John F. Kennedy Federal Building
Boston, MA 02203-0001

RE: EPA-454/R-00-0XX Hot Mix Asphalt Plants Emission Assessment Report.

Dear Mr. McConnell:

This letter is in regard to the *EPA-454/R-00-0XX Hot Mix Asphalt Plants Emission Assessment Report.* As you may know, there have been various proposals to locate an asphalt plant in my district in the South Bay area of Boston. As the State Senator for the Dorchester, South Boston, South End and Roxbury neighborhoods which would be most impacted by this proposed plant, I appreciate the opportunity to comment on this report.

In reading this report and its appendices, along with comments sent to my office by Ravi Nadkarni, it is my understanding that this report only shows emissions results from asphalt plants burning natural gas as a source of fuel.

The report also fails to provide information about what percentage of asphalt plants cited in the report used natural gas and what percentage of those plants, used alternative fuels. Although I am not an environmental engineer, it is obvious to see that emission results from asphalt plants burning only

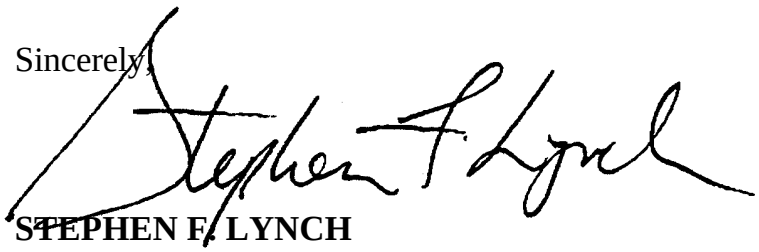
natural gas, as opposed to other fuels, will show a considerably lower emissions result. This would clearly indicate to me that the results in this report are skewed. I wol1ld like to see more thorough testing of various data included in the final report, especially if this report is to be considered an emissions standard for all asphalt plants.

Additionally, as I mentioned in my last letter dated September 14, 1999, it is my understanding that this report, again, neglects to specify the composition (ratio of bituminous cement to aggregate) of the asphalt used in the study. Due to the various engineering standards/requirements associated with asphalt, it is very important that this information be provided so that the test results can be adjusted accordingly.

As the elected Senator for this district, I would appreciate a response to these issues.

Thank you for the opportunity to comment on this important matter. I look forward to your response. If I can be of any further assistance, please do not hesitate to contact my office.

Sincerely,



STEPHEN F. LYNCH
State Senator

Lloyd Fillion - Boston, MA
Ravi Nadkarni - Wrentham, MA
Coalition Against the Asphalt Plant

This Page is intentionally left blank.

Comments on EPA reports relating to AP-42 Section 11.1

August 31, 2000

Table of Contents

A. Introduction

This letter is a review of the Draft of "Hot Mix Asphalt Plants Emissions Assessment Report" dated June 2000. The report is designated EPA-454/R-00-0XX. It comes with three appendices:

- Appendix A is Section 11.1 of AP-42 of June 2000
- Appendix B is "Emissions Factor Documentation" for the above
- Appendix C is on Preferred and Alternative Methods for Estimating Air Emissions from Hot Mix Asphalt Plants dated July 1996.

The overall package is 3" thick and contains over 500 pages.

Before discussing the results of our review, we want to comment on the review process and our general dissatisfaction with it. When complex, technical documents are sent to a wide audience for review, one assumes that both the EPA and their contractors did their best to produce as final a draft as possible. One would not only expect that most of the typos and numerical errors have been found and eliminated but that the authors wrote the report in a way that makes it easy for the reviewer to go back to the primary references and original sources (assuming that they are available) to check a particular point. On both these counts, the reports, just like the previous set of reports reviewed last year, fail resoundingly. Many key comments are not referenced at all; in some cases, the references are incorrect; in other cases, the reference is made to a large document without giving a page number, making it difficult and time-consuming to check. Appendix B refers to its Appendix B and Appendix

C on page 4-137. But these appendices, which presumably contain the statistical results and the data sets, are not provided, making it impossible to even spot check the analysis. This, combined with the severe time constraints, makes it impossible to review the reports in any but a cursory fashion, using random spot checks, to make sure that the numbers are correct. Unfortunately, the reports also fail on that count since numerical or logical errors in the analysis have been found.

We also need to air another complaint regarding the process. For about 6 weeks before the report was finally issued, we received phone calls informing us that the release of the reports was imminent. While we appreciate receiving this advance warning, it also turns out that the actual release of the reports was much later than announced. One of us (Ravi Nadkarni) had cancelled attendance at the Annual Meeting of IPMI in mid-June in response to these calls. Because of weddings in the family, Ravi was going to be unavailable after July 17 and wanted to start the review process as soon as possible, hence the cancellation. Unfortunately, the reports were received only on June 28. This means that he missed an important Annual Meeting where he is on the Board of Directors. We appreciate getting the extra time until the end of August to complete this review.

Appendix C was prepared in 1996. Why was this 69-page document not provided earlier so that it could have been reviewed before this "crunch" period? Also, are comments on such a document, which has undergone a "final" review, relevant at this stage? Finally, why was this document not released to us when the citizen groups and the EPA were discussing sampling issues, when that document might have provided an additional viewpoint? For all these reasons, this third document has not been reviewed.

In our review, we present general comments about the package and then a summary of major deficiencies. Finally, a page-by-page sets of comments are presented. The "major deficiencies" will repeat discussions in the page-by-page comments and readers might argue with our selection of certain areas to highlight as major deficiencies. However, because of the numerous problems with the reports, the page-by-page comments became very voluminous. Hence the decision was made to highlight some of the deficiencies in a separate section, even at the cost of some repetition, which mirrors the repetitions in various segments of the reports.

B. General Comments about the Package

AP-42 is essentially a "cookbook" for engineers/contractors who need to produce emissions estimates for local regulatory authorities to obtain permits to construct and operate plants. In view of this, the overall organization of the three reports does not make sense. In the long run, Appendix A will be used most often for estimating emissions. When necessary, the background information in Appendix B will be reviewed. The "main" report will remain either as a political document used by lobbyists or fade away. As it now stands, the "main" volume repeats in a vague and biased way, the information in first two appendices. The same information is presented in a marginally better format and with slightly less "spin" in Appendix A. If the main document is supposed to be an Executive Summary to Appendix B, it is a poor summary and reads more like a political tract. This is

particularly true since only emissions data on plants using natural gas is given in the main report; i.e. there is a deliberate attempt to show only the lowest emissions. Most of the caveats associated with the summary information in the main report are well concealed in Appendix B. If EPA is serious about making the main document useful, it should use the main document to calculate the total emissions to the environment from a batch and a drum asphalt plant. This type of rewrite, where other emissions (for example from materials handling and storage piles, storage tanks, from traffic and truck exhaust, and so on) are also calculated and shown for typical plants, will result in a guidebook for industry contractors and help them by demonstrating how such calculations should be made. (In Massachusetts, specific plants will employ a wide range of pollution control technology and then argue that it is "state of the art" and is BACT (Best Available Control Technology)). Other emissions are currently only listed and cross-referenced in Section 2.3 on page 16. These include emissions from storage tanks (AP-42 Chapter 7), materials handling and storage piles (AP-42 Sections11.19.2 and13.2.4), vehicular traffic (AP-42 Sections 13.2.1 and13.2.2) and emissions from trucks bringing in the raw materials and taking away the hot mix asphalt (AP-42 Volume II).

The main report is a political document for the following reasons. The EPA's pro-industry bias shows on almost each page. Every attempt is made to minimize emissions, for example, by calculating emissions for plants burning natural gas only in the "main" report. The report also provides qualitative comments to indicate that emissions could be even lower in many cases; for example, "counterflow drum mix plants will likely have lower organic compound emissions than parallel flow drum plants", page 11.1-9. Such comments are not substantiated in the detailed information provided in Appendix B. Yet, caveats regarding conditions under which the emissions might be higher are few and far between. This tilting is not surprising given the proindustry bias expressed many times by the Project Officer during the course of testing.

The report and its appendices contain little or no information about industry structure. For example, Appendix B asserts that drum plants are 90% larger than batch plants in terms of annual throughput. This really falls out of an assumption made by the authors. There is little or no backup for this conclusion. Similarly, there is no information on what proportion of plants use natural gas and what proportion use other fuels.

Finally, it is unclear whether this "main" report has a number or whether EPA-454/R-00-0XX is the final designation. The reason for asking this is because reference 1 of Appendix A has the same name and a designation of EPA-454/R-00-019, but this reference is dated May 2000. What is going on?

C. Summary of Major Deficiencies

This section will highlight our major concerns some of which have already been covered in the introduction or will be discussed in the page-by-page review in greater detail.

- Sloppy Report Preparation: The reports are full of minor errors, are poorly organized, repeat the same paragraphs in different documents, and have incorrect references. Many key

comments are not referenced at all; in some cases, the references are incorrect; in other cases, the reference is made to a large document without giving a page number, making it difficult and time-consuming to check. The data sets used for statistical analysis are not provided, making it impossible to even spot check the analysis. All indications are that there was no complete internal review of the report within EPA before releasing it.

- Poor Organization: The overall organization of the three reports does not make sense. In the long run, Appendix A will be used most often for estimating emissions. When necessary, the background information in Appendix B will be reviewed. The "main" report will remain either as a political document used by lobbyists or fade away. The main report shows the industry's emissions in the best possible light with most of the caveats associated with information being well concealed in Appendix B. If EPA is serious about making the main document useful, it should use the main document to calculate the total emissions to the environment from a batch and a drum asphalt plant, rather than show the information from AP-42 with the decimal point moved to the right.

- Pro-industry Bias: The EPA's pro-industry bias shows on almost each page. Every attempt is made to minimize emissions shown. The report also provides qualitative comments to indicate that emissions could be even lower in many cases. We don't see why EPA makes such statements in the absence of data. Yet, caveats regarding conditions under which the emissions might be higher are few and far between.

- Undocumented Information on Industry Structure: The report and its appendices contain little or no documented information about industry structure. Yet such information is used to derive average plant sizes and share of annual production between batch and drum plants.

- Confusing Report Designations: The designation of the reports is confused. The main report is called EPA-454/R-00-0XX. But Reference 1 of Appendix A has the same name and a designation of EPA-454/R-00-019, and this reference is dated May 2000 while the main report is dated June 2000.

- Deficiencies in Method 204: Tracers were not used at Plant D because it met the requirements of Method 204. Unfortunately, Method 204 is inadequate to achieve the results it tries to achieve. Further, the contention that the estimate of unmeasured emissions is an "upper bound" is incorrect. At Plant D, a mild ambient breeze was sufficient to cause some of the fumes to escape from the top or the bottom openings in the downwind door of the tunnel. Therefore, the size of the openings was decreased further at the end of the first day of testing. This means that the Method 204 criterion of maintaining over 200 fpm at a natural draft opening is not adequate. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. Therefore it is not surprising that these criteria are inadequate to assure total containment within a TTE as contemplated by method 204.

Further, Method 204 has a more serious and fundamental problem. Although the size of natural draft openings is specified, the method does not contain any criteria to ensure that the emissions are pulled/sucked past the sampling point in a reasonable period of time. As is well-known, residence time calculations, based on enclosure volume and fan capacity, generally provide incorrect information by underestimating the time to evacuate the enclosure because of channeling. At Plant D, the tunnel was not evacuated in the approximately 15 second time gap between the final HMA drop and the opening of the doors. This can be clearly seen in the fact that THC readings did not drop to zero before the doors were opened. This fact was also observed visually inside the TTE enclosure since SVOCs are visible. Thus, the report contains compelling evidence that the collected sample had a low bias, not only because some emissions escaped through the natural draft openings but also because these emissions did not travel to the sampling point but were lost when the doors were opened.

- Incorrect Approach in Compensating for Volatiles Content of Asphalt: The methods used in these reports to correct for volatiles content of asphalt are contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss compared to the asphalt used in Plant C and Plant D tests. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The new Superpave specifications allow for a 1% loss on heating and therefore represent a relaxation of the previous AC grade standards. In view of this and the industry's use of various additives and diluents (which would increase the vapor pressure), the citizens argued and the EPA agreed that maximum number of 0.5% should be used. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives, in spite of suggestions to the contrary, in some cases. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, is encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received, can then switch to an asphalt with a different RTFOT value with impunity.

  As long as the specifications allow for up to 1% volatiles in asphalt (even before additives are used), it is misleading for EPA to state that their approach in Appendix B - Table 4-27 "encourages the use of site specific data". The primary use of AP-42 is to prepare calculations to get permits to build and operate hot mix plants. Therefore, there is no site specific data that can be used other than fictional data. Unfortunately, the industry has a long history of providing low-ball estimates, designed to fool the public and get permits from agencies that are not particularly anxious to ask difficult questions.

- Incorrect Substitution of Delivery Temperature for Loadout Temperature: The statement that "325^{o}F, which is the maximum load-out temperature recommended by industry" is imprecise. Most specifications require this to be the maximum temperature **at a job site** where HMA

is to be spread and compacted. (The minimum temperature is 275°F.) The maximum **load out** temperature is much more variable and can be higher if the plant is producing asphalt for a distant job or for a small job, where there can be considerable cooling of the HMA mass between loadout and delivery.

- Improper Manipulation of Data from the "Background" Test, Run 4, at Plant C: The report states correctly: "The most reliable method to adjust for emissions measured during background operations would be to separately adjust each run for the measured capture efficiency and then subtract these adjusted background emissions from the adjusted emissions measured during production operations." However, because this "procedure produces negative values for both the PM and MCEM and many other HAP compounds", a new unsound procedure is adopted because it gives results that please EPA and industry by showing low but positive emissions. This new procedure is to use background emissions **uncorrected** for capture efficiency. If the actual emissions have to be corrected for capture efficiency because the enclosure does not capture all the emissions, there is no justification for ignoring the capture efficiency for the background run. Having used this incorrect analysis, the authors then have the temerity to advise us that this result might even have a "high bias" relative to the correct method mentioned above.

  The report justifies this faulty procedure because this situation "cannot be accommodated retroactively." This statement is not correct. The best way to eliminate improper data manipulation is to discard the phony background adjustment and report the data as that from loadout **plus** truck exhaust. Since silos always dump hot mix into a truck, these combined emissions are present at each silo loadout point. Further, in the unlikely event that a local permitting authority requires inclusion of truck exhaust emissions (unlikely because we have not seen such calculations associated with any local permitting requirements), note that the truck spends about ½ minute under the silo but many more minutes, typically 3 to 8, on site. As a result, the truck emissions that are included under loadout correspond to the ½ minute portion. Therefore, the double counting of truck exhaust emissions would be minimal and can be adjusted for by subtracting the ½ minute from residence time of the truck on site.

  Overall, the background run demonstrates how data collection was manipulated to produce biased results. The EPA Project Officer was interested in recording a high background and the original data showed that he was able to manipulate truck placement near the entrance of the tunnel in such a way that uncorrected emissions in the second half of the run were about twice the emissions in the first half. If these emissions are corrected for the lower capture efficiency in the second half of the run, the corrected emissions from the second half are almost three times the corrected emissions from the first half. In spite of using the emissions from the first portion of the background run, it appears that they were still too high when corrected for capture efficiency and resulted in negative or zero emissions to the environment.

- Industry Comments on Capacity Are Given More Weight than Data Collected by EPA or State Agencies: The report states that the hourly capacity data was averaged from the capacities of precisely 98 batch plants and 162 drum plants. Since most of the data was gathered during performance tests at full capacity and witnessed by State Agencies, it is unlikely that hourly production rate data is incorrect. It is interesting that "conversations with industry" are all that is needed to supercede this data. In the report, it is clear that the authors believe that batch plants generally operate fewer hours per year than drum plants. Reasons for this (not necessarily explained in the report) include the lack of silos for HMA storage, small customers using smaller trucks, and so on. The report keeps talking about hourly production rates when the discussion should focus on annual production, i.e. hourly rate times hours operated per year.

- Unexplained Differences Between MCEM and TOC: The comparison of Plant C and Plant D results shows a wide variation between emission rates for MCEMs and TOC. MCEM PMs and TOC are generated the same way and from the same source. Therefore, if MCEM generation is a function of loadout time, TOC generation should also be a function of loadout time and TOC emissions should be higher for a batch plant in the same ratio. The report does not explain this discrepancy. Of course, the comparison is further complicated and made meaningless by the bogus "background" correction for drum plants discussed earlier. To eliminate the confusion, separate emission factors should be prepared for batch and drum plants in all cases.

- Inconsistent Assignment of Ratings: In one portion of the report, the emission factor for sulfur dioxide was assigned an E rating because the data ranged over an order of magnitude. This might have been simply the result of the variation in sulfur content of the fuel. In the case of filterable PM, the range is over two orders of magnitude but the emission factor got an A rating.

D. Page-by page Comments on Hot Mix Asphalt Plants Emissions Assessment Report - EPA-454/R-00-0XX, June 2000

1. Page 1, paragraph 3: In this paragraph, 1996 production statistics are presented along with an estimate of the number of plants in the country. There are no references to the source of these data. In Appendix B, page 2-1, the same paragraph is repeated. On page 2-2 and 2-3 of Appendix B, calculations are presented which derive average annual production rates for batch and drum plants. We will comment on the problems with these calculations in our page-by-page discussion of Appendix B. However, the entire discussion is aimed at showing that drum plants produce more HMA compared to batch plants without actual data.

2. Page 1, paragraph 4: The statement in line 1 is incorrect. The primary emission source is the dryer, not the mixer, as stated. This is the case because combustion of fuel for generating heat for drying generates large quantities of criteria pollutants. This error of confusing dryers

and mixers is repeated several times, (for example in Table 1), and we have not bothered to find all instances of such misuse. The best way to clarify this issue is to substitute "dryer/mixer" for drum plants where the two units are connected. In the case of batch plants, the dryer and the mixer (pug mill) are typically uncoupled through hot storage bins. Emissions from both however are often captured by the same piece of air pollution control equipment.

3. Page 2, paragraph 3: This paragraph needs a cross reference, even if it is to the relevant sections in Appendix B. In general, we need page number references to information in Appendix B which is over 400 pages long.

4. Page 2, paragraph 4: In this and in other paragraphs and tables to follow, emissions and/or emission factors are given as averages. If this data was derived by averaging emissions from many plants, as indicated in Appendix B, measures of variability such as standard deviation should also be given. At present, this information is buried in the tables in the two appendices.

5. Page 8, paragraph 4: More industry statistics are presented without a source or a measure of precision or accuracy.

6. Page 9, paragraph 1: The sentence on line 6 is confusing. Do you mean RAP is added to the "hot" bins or is it added to the pug mill?

7. Page 12, paragraph 2: Is the rating system applied consistently? The discussion in Appendix B indicates that it was not.

8. Page 12, paragraph 4: This paragraph presumably refers to the statistical analysis presented in Appendix B, but there is no direct link or reference. Our detailed comments regarding the statistical analysis are in our page-by-page discussion of Appendix B. However, the entire paragraph is wrong or inconsistent with information in other parts of the report. It states that the statistical analysis showed "no strong correlation" between parameters such as fuel type and emissions factors. When such correlation is absent, the approach has been to use the same emission factor in both cases. Yet, Table 11.1-5 in Appendix A shows different emission factors for NO_x and SO_2 for different fuel types. For NO_x, the emission factor is different for natural gas and oil fired dryers. For SO_2, there are three different emissions factors, one for gas, one for No. 2 oil and one for No. 6 oil. The backup analysis is not shown in Appendix B. But obviously, the analysis showed that fuel type did affect emissions, otherwise a single factor would have been used. Overall, the two sets of comments need to be made more explicit and explained more carefully and the inconsistencies removed.

9. Page 13, paragraph 1: The quality rating needs to be quantified so that one can get a numerical feel for the differences in ratings. If, as stated, the quality ratings are a "function

primarily of the number of data points", these various quality ratings can be related to the standard error of estimate and using t-values, a range can be shown about the mean.

10. Page 13, paragraph 2: This paragraph is confusing. It is stated that only a single test report was available for an oil-fired hot oil heater. Does this mean that only one hot oil heater was sampled out of 364 plants and test reports? Further, if most of such heaters are fired with natural gas, why was an oil-fired heater sampled? Finally, why does EPA go out of their way to here to point out that "emission factors developed from this data would not be representative of gas-fired heaters". While this comment is correct, since oil fired burners emit more pollutants than gas-fired burners, there is a consistent bias in such comments. The reports point out the possibility of a high-bias each time such possibility exists, inviting the user of AP-42 to discount the published number. But, when the reported emission factors have a low bias, there is no such comment. For example, see the issue of the phony correction for background emissions to truck loadout discussed later on the same page.

11. Page 13, paragraph 4: This paragraph is wrong in several ways. The capture efficiency was measured and calculated using tracers; it was not "estimated" as stated. To me, the word "estimation" denotes a weaker approach to quantification than calculations based on actual measurements. Equally, important, the EPA requirements for total enclosure were shown to be totally inadequate during the testing at Plant D in Massachusetts. A mild breeze was sufficient to cause visible emissions from the total enclosure even when a hand-held velometer showed that Method 204 criteria were being met. Why is this factor, which suggests that Method 204 criteria were inadequate and that the measured emissions have a low bias, not discussed in this paragraph?

12. Page 13, paragraph 5: This paragraph discusses the subtraction of "background emissions", which reduced the calculated loadout emissions significantly. Our detailed comments are in our page-by-page discussion of Appendix B, which show that the method used is totally without foundation or theoretical support, and the only excuse for using it is that it gives non-negative results in several cases.

13. Page 14, paragraph 2: The statement that "325^{o} F, which is the maximum load-out temperature recommended by industry" is imprecise. Most specifications require this to be the maximum temperature **at a job site** where HMA is to be spread and compacted with rollers. (The minimum temperature is 275^{o} F.) The maximum **load out** temperature is much more variable and can be higher if the plant is producing asphalt for a distant job or for a small job, where there can be considerable cooling of the HMA mass between loadout and delivery. This same error is repeated in the last sentence of the next paragraph and in many portions of Appendix B.

    This paragraph also states that -0.5% was selected as a default value for weight loss in a rolling thin film oven test. The methods used to apply the correction for volatility are

contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The new Superpave specifications allow for a 1% loss on heating and therefore represent a relaxation of the previous AC grade standards. In view of this and the industry's use of various additives and diluents (which would increase the vapor pressure) which are often added after the asphalt has been sampled for the measurement of the weight loss, the citizens argued and the EPA agreed that maximum number of 0.5% should be used at all times. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, is encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received, can then switch to an asphalt with a different RTFOT value with impunity.

14. Page 14, paragraph 3: EPA again makes the same recommendation which is to assume that the load out temperature can never exceed 325^{o} F. This is incorrect. For example, Mr. Webster, the industry expert who has attended many of the EPA/citizen group/industry meetings has looked at the photographs that Ravi Nadkarni submitted to the EPA in 1994 and are in the EPA files. His comment was that the photos were typical of a plant loading out material at a high temperature when supplying small contractors. If this practice is common enough to be readily identified at a glance, EPA's comments about 325^{o} F being the maximum temperature under all conditions are wrong and need to be corrected.

15. Page 15, paragraph 2: It is ironic that EPA, after rejecting our repeated pleas for collecting some fundamental data on asphalts such as its vapor pressure, states "Although vapor pressure information on paving asphalt is not available.....". A more appropriate way to state what has happened would be to state that vapor pressure measurements are not available because of EPA's refusal to measure the vapor pressure.

16. Page 15, paragraph 3: The first line refers to "emission tests described in previous paragraphs". Since the previous paragraphs refer to more than one plant test, it is preferable to have a proper reference; for example, the text can refer to the test at Plant C or Plant D.

17. Page 16, paragraph 1: How do the truck exhaust emission factors published by EPA compare with the background measurement from Run 4 at Plant C? Why is such a comparison missing from the entire report?

18. Page 16, paragraph 3: The second line refers to Tables 4 through 11 which present more detailed information about "typical" plants. Unfortunately, this is the emission factor data of

Appendix A multiplied by 100,000 for batch plants and by 200,000 for drum plants. The implication is that the reader can't move the decimal point to the right or multiply by 2. Further, in keeping with their bias for showing only low numbers, these tables are for natural gas only and not for oil-fired heaters. Why? Finally, what is the basis for assuming (third bullet on page 17) that PM emissions from load-out and silo filling are entirely PM-10? We would have thought that a better assumption was that these were PM-2.5.

E. Page-by page Comments on Appendix A: AP-42 Hot Mix Asphalt Plants June 2000 Draft

1. Page 1, paragraph 3: This paragraph is repeated in the main volume, and in the first two appendices. It would be more useful to discuss the source of this data and comment on its reliability, rather than repeat it in three places.

2. Page 2, paragraph 1: The statement that raw aggregate is stockpiled "near" the plant is ambiguous. Such aggregate is normally stockpiled within the plant site and is moved to the cold feed bins with a front-end loader.

3. Page 2, paragraph 3: This paragraph repeats the ambiguity in the main report on page 9 paragraph 2. Is RAP added to the weigh hopper or to the hot bins?

4. Page 5, paragraph 2: In counterflow plants, the baghouse is preceded by a cyclone to reduce the load on the baghouse. This is a trade off issue where it is cheaper to use a cyclone than to increase bag house size and bag cleaning frequency to achieve the same result. Since the industry prefers counterflow plants to parallel flow plants(page 1 paragraph 3), the use of an additional particulate separation device in the former is obviously not a disadvantage, on an economic or a technical basis.

   If you have data to support the statement that organic emissions may be greater from this process, present it; otherwise eliminate the statement.

5. Page 5, paragraph 5: We believe the real issue is that with counterflow plants, the air from the mixing drum acts as secondary and tertiary air for the combustion process which eliminates many of the organic compounds through combustion. This point needs to be brought out. Further, is there data to support the statement that a counterflow plant can process RAP at ratios up to 50% with little or no observed effect on emissions? If not, the statement belongs in industry sales literature and not in an EPA document.

   Similarly, the comment about "improved thermal efficiencies" begs the question of what is being compared to what and what is the degree of improvement. The statement belongs in industry sales literature and not in an EPA document.

6. Page 7, paragraph 1: The statement that RAP with new aggregate and fresh asphalt is used to "produce a high quality grade of HMA" is another salesmanlike statement. The point is that the HMA industry produces products to meet a specification. If the specification requires the use of RAP, it is used; if not, RAP is not used. The point you want to make is that the use of RAP does not impair the ability to meet the specifications for certain grades of HMA since the specs might actually require that RAP is used. Or is EPA implying that the industry used RAP when specifications call for the use of only virgin materials?

7. Page 7, paragraph 5: The fourth line from bottom uses the word "gas" when " vapor of organic compounds" would be more correct.

8. Page 8, paragraph 1: The second line states that both the low and high molecular weight compounds "may" contain small amounts of HAP. We were under the impression that such asphalt-derived compounds always contain some HAPs. Is EPA suggesting that certain asphalts don't contain any HAPs? Is there any data to support this statement?

9. Page 8, paragraph 3: In the fourth line, a particle size analysis of cold feed is presented. We don't see the relevance of this sentence since the previous sentence and the subsequent sentence both talk about fugitive dust and cold feed is not a major contributor to fugitive dust.

10. Page 8, paragraph 4: If as you say in the last sentence that data are not available to support the hypothesis, EPA should not be repeating the hypothesis. Again, such a statement belongs in industry sales literature and not in an EPA document.

11. Page 9, paragraph 1: Most of this paragraph is again a replay of industry assertions. The only relevant issue is whether or not these process modifications work to reduce "blue smoke". We notice that the industry favorite, the wet electrostatic precipitator or smog hog is conspicuous by its absence from this list.

12. Page 9, paragraph 2: A repeat of the comment on page 5 about how such plants "will likely have lower ..... emissions". If you have the data, show it; if not, let the industry do its own PR.

13. Page 9, paragraph 4: The last three lines appear to be a plug for one particular firm "Compliance Monitoring Service". Is it EPA's role to do this?

14. Page 10, paragraph 2, 3: The comments here are a major problem. The methods used to apply the correction for volatility are contrary to the agreement that was reached between the EPA and various citizen groups. The citizens had argued that the asphalt specifications allow the use of asphalt with a much higher weight loss than that suggested by limited sampling. The older AC specifications allow for a 0.5% loss on heating, which can be waived by an engineer on site who can then allow the use of an asphalt with up to 1% weight loss. The

new Superpave specifications allow for a 1% loss on heating. In view of this and the industry's use of various additives and diluents which would increase the vapor pressure after sampling for the measurement of the weight loss, the citizens argued and the EPA agreed that maximum number of 0.5% should be used at all times. Note that this was a compromise since the newer specification allows the use of asphalt with twice that amount of volatiles. This issue is particularly important since the measurements by State agencies quoted here appear to be for asphalt prior to blending with additives. The EPA, by providing an equation where a hypothetical RTFOT value can be plugged in, in encouraging misrepresentation by a proponent of any new asphalt plant, who, once the permit is received on the basis of a low RTFOT value, can then switch to an asphalt with a different RTFOT value. This entire paragraph has to be rewritten with -0.5% weight loss and 325^{o} F or higher temperature.

15. Page 11, paragraph 1: The industry's own MSDS sheets provide a molecular weight of asphalt as "over 2000" (a number we personally don't believe). It is refreshing to see EPA use a lower number of 345.69

16. Page 11, paragraph 2: What exactly is reference 1? Is it the main report with a different date and number? Also, the derivation of the factor is properly described, not in Reference 1 but in Appendix B.

17. Table 1: There are many problems here. Footnotes k through p refer to Reference 1. That is incorrect. If you want to refer to Appendix B, provide specific page number and citation.

    We are totally confused by the data on condensable inorganic and organic PM. These are defined in footnote b as being method-driven. It would have been helpful if additional details had been presented. In particular, we are curious about the chemical components of the condensable inorganic PM fraction. The table shows that uncontrolled emissions are numerically the same as controlled emissions. Footnote j states that "uncontrolled "values are assumed to be equal to the maximum controlled value measured". Since the controlled values of 0.013 and 0.0042 are averages (arithmetic means), and are the same as the uncontrolled values, is the table saying that the average is the same as the maximum value in the data set? Please explain. We recall that this problem has been in table 1 in previous versions of AP-42.

18. Table 3: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data and uncontrolled emissions equal controlled emissions.

19. Table 5: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data.

20. Table 6: Unlike previous tables, descriptive statistics about the data sets are not presented.

21. Table 7: Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data. Furthermore, there is no discussion why a batch plant dryer using the same range of fuels e.g. natural gas, No. 2 fuel oil and other fuel oil and a drum dryer using the same fuel oil should have different emission factors for NO_x and SO_2.

22. Table 8: Unlike previous tables, descriptive statistics about the data sets are not presented.

23. Table 14: This and many other tables, especially in appendix B, have footnote "a" obscured because it is superimposed over the last letter of the table heading. This table has to be redone so that an actual emission factor is given; not a formula for calculating low emissions based on fictitious values of asphalt volatility.

    Same problems as Table 1; i.e. use of Reference1 which does not really contain the primary data.

F. Page-by page Comments on Appendix B: Emission Factor Documentation for AP-42, Section 11.1, Hot Mix Asphalt Production, June 2000 Draft

1. Page 1-1, final paragraph: The organization of the entire report is confusing. The last line refers to Section 5, which is the same as Appendix A. Which is the main report and which are the subsidiary appendices?

2. Page 2-1, Section title: Reference 1 is to an earlier version of AP-42. Why is an obsolete version of the same document being used as the reference? Reference 3 is a personal communication from the head of an industry lobbying group. Is this information in the public domain? Can we get a copy?

3. Page 2-1, paragraph 3: The key information in this paragraph about the number of plants in the country and the type of plants being built is not referenced so the reader can't judge the reliability of the information.

4. Page 2-2, paragraph 1: The key information in this paragraph about 1996 production is not referenced so the reader can't judge the reliability of the information. Further, since road building tends to be a cyclical activity (at least locally), production or output over several years might be a more reliable way to establish these levels than the output in a single year. Dept of Commerce or USGS/Mineral Industry Surveys probably collect and publish this information.

5. Page 2-2, paragraph 2 and 3: If the hourly capacity data was averaged from the capacities of precisely 98 batch plants and 162 drum plants, the numbers are probably correct, unless these plants consistently misrepresented the capacity. Such misrepresentation is not likely to go unnoticed since most of the data was gathered during performance tests at full capacity in the

presence of State agencies to make sure that emissions limits were being met. It is interesting that "conversations with industry" are all that is needed to supercede this data. Why are we not surprised!

Overall, this paragraph is attempting to relate hourly capacity to annual production. That goal is not achieved. The discussion in paragraph 3 is totally confused and needs to be rewritten. Hourly production rates are easy to measure. If the data set referred to in the previous paragraph is for obtaining operating permits from the relevant State Air Pollution Control Agencies, as is the case in Massachusetts, the plant is supposed to be running at or close to the design hourly capacity when the emissions are sampled. Therefore, We believe that the hourly capacity measurements are correct because these numbers are measured during State compliance testing and should not be superceded by "industry comments".

The discussion should be talking about the fact that batch plants, especially batch plants without silos for HMA storage, don't operate for as many hours a year as drum plants because they service customers using small trucks/small volume customers and because of the difficulties in matching hot mix production with truck arrivals. (Note that because batch plants store dried, hot stone, there is storage available, but the stored quantity is generally much smaller than that available with HMA storage silos.) In contrast, because of their large production contracts, drum plants operate for more hours each year and the ability to store HMA in silos also facilitates long production runs. The entire paragraph keeps talking about hourly production rates when the discussion is really trying to focus on annual production, i.e. hourly rate times hours operated per year.

Also note that the key assumption is that drum plants produce 90% more HMA than batch plants ON AN ANNUAL BASIS. This assumption is not backed up with anything; no footnotes or anything. If this is EPA's assumption, say so. Interestingly, in the main report, this assumption transforms into a finding that drum plants produce 100% more than batch plants on an annual basis.

If one assumes that the empirical 80/20 rule applies, the average annual output from batch plants would be 108,000 tons per year and that from drum plants would be 194,000 tons per year. This means that the purported annual industry output of 500 million tons is shared almost equally between batch and drum plants.

It should also be noted that there is no information provided on distribution between small jobs and large jobs, which would also provide information on how the total production is split between batch and drum plants. Is it possible that this is because industry information was provided by a lobbying group supported mainly by the large producers? This means that the production information has a bias favoring large producers and making them appear more important.

6. Page 2-3, last paragraph: The writing should make clear whether the RAP is added to the hot storage bins or directly to the mixer/muller.

7. Page 2-4, last paragraph: This is a repeat comment in the last line. If you don't have the data about organic emissions, don't speculate about "potential".

8. Page 2-7, paragraph 3: Same comment as above under item 7regarding dataless conclusions. The last sentence belongs in an industry sales brochure, not in an EPA document.

9. Page 2-10, paragraph 4: The last sentence belongs in an industry sales brochure, not in an EPA document.

10. Page 3-2, paragraph 1: The sentence states that emission data must be from a primary reference. In chapter 2, however, secondary references and anecdotal comments are used to supercede primary reference data on hourly capacity.

11. Page 3-3, final paragraph: The comments here refer to variations or fluctuations in measured results which could not be explained readily. While we agree that such results might be given a lower rating, in many cases, variations are a normal part of the production process. For example, if a batch plant is producing a mix with a high RAP content, the crushed stone is heated to a high temperature to provide the heat for evaporation of the moisture associated with RAP stored in the open. If another customer comes in for a RAP-free mix at this stage, the hot mix will be loaded out at a much higher temperature and will emit more than the usual amount of fugitive organics. This is a normal transient.

    There are many factors which contribute to the emissions which were not measured. For example, SO_2 emissions from combustion are dependent on sulfur in the fuel. The emission factors for different fuel types are a result of the maximum sulfur content allowed under the fuel specifications. No such analysis is presented. The same comments hold true for organic fugitive emissions being dependent on volatile content of the asphalt.

12. Page 4-2 to page 4-117: On these pages, each reference is reviewed and commented upon. There are several problems with this section. Initially, section 4.2.1.1 discusses reference 1, section 4.2.1.2 discusses reference 2 and so on. By the time one reaches the end of this chapter, the numbering is no longer synchronized. Section 4.2.1.327 refers to reference 354. In between, some references are not discussed (42, 43, 115, 116, 120, 127, 131 and so on). In other cases, missing references are discussed, for example reference 258. In addition, the same reference numbers refer to different documents. For example, on page 4-6, during the discussion of reference 23, references 26 and 27 are discussed. One has to read the citations carefully to realize that these are references from the document called reference 23. But the exact citations for 26 and 27 are not given. A careful reading also shows many inconsistencies. In some cases, the data is downrated because some information is missing;

in other cases, it is not. See for example reference 181 where the data is still rated A although information about RAP processing was not provided. On page 4-106, it appears that the cross references are incorrect.

The section ends with the review of reference 354 on page 4-117. This review resumes on page 4-167. This is poor formatting for a report.

13. Pages 4-118 through 4-147: There are two sections in this report: 4.2.4 Results of Data Analysis and 4.3 Statistical Approach which more or less cover the same ground. They should be combined so that the exposition is complete and consistent.

    In many cases, common sense should tell us that the emissions to the atmosphere are either a result of the performance of a control device or the result of the presence of a pollutant in the feedstock. A good example of the former is the PM emission factor from dryers controlled with a fabric filter. Here, the emission factor for PM is not dependent on fuel type. An example of the latter, is the sulfur dioxide emission factor for dryers. Here, the emissions are dependent on fuel type since the control devices do not remove any substantial amount of this pollutant. Yet, these issues are never discussed.

14. Page 4-119, paragraph 1: Was there any attempt to correlate capture efficiency in venturi scrubbers with the pressure drop?

15. Page 4-122, paragraph 4: This paragraph states that the emission factor for sulfur dioxide was assigned an E rating because the data ranged over an order of magnitude. This might have been simply the result of the variation in sulfur content of the fuel. In the case of filterable PM (page 4-118), the range is over two orders of magnitude but the emission factor got an A rating. A little consistency would help.

16. Page 4-125, paragraph 4: This paragraph states that the emission factor for trace metals was assigned an E rating because the data ranged over two orders of magnitude. This might have been simply the result of the variation in trace metal content of the feed materials and fuel.

17. Page 4-126, paragraph 2:. This paragraph points out the inconsistencies in the approach taken in several places in the report. Because there was no analysis of the feed materials or of the fuel used, it is not clear whether the measured trace metals are present on the site or are a result of sample contamination in the lab or elsewhere or whether the detection of trace metals at the exhaust and non-detection at the entrance to the control device represents random error in the measurements. The approach of discarding inconvenient data is not acceptable.

18. Page 4-135, last line: We are told that the statistical analysis is restricted to references up to number 338. Why? Several of the subsequent references, up to reference 355, contain the same type of data as that being analyzed and should have been incorporated.

19. Page 4-137, paragraph 1: The description of the box plots is extremely short and incomplete. Obviously, the authors do not intend to make it easy for readers to understand these plots. Technically, what is shown is a "Box-and-Whisker" Plot, which is used to show characteristics of univariate data. The data is ordered and ranked and then divided into four equal parts. For example, a data set of 20 points would be divided into four portions, each containing five data points. The box encloses the middle 50% of the data. The text states that the whiskers "represent adjacent values". Our understanding is that the whiskers either enclose the entire data range, i.e. the upper whisker shows the range of values for the higher 25% of the data and the lower whisker encloses the range of values for the lower 25% of the data. Alternately, in modified Box plots, the upper whisker is drawn to the highest point within 1.5 times the interquartile range and the lower whisker is drawn to the lowest point within 1.5 times the interquartile range. The interquartile range is the difference between the 75^{th} and 25^{th} percentile values. Values outside the range bounded by the whiskers are plotted individually. None of this has been bought out in the terse description.

20. Page 4-137, paragraph 3: The paragraph lists the statistical analyses performed. However, the box plots shown are for only a few of the analyses listed. Where are the remaining plots?

21. Page 4-137, paragraph 5: This paragraph refers to Appendices B & C. Where are they?

22. Page 4-138, paragraph 2: This paragraph refers to Appendix A. Where is it?

23. Page 4-139, paragraph 1: This paragraph refers to Figure 4.2. Note that Figure 4.7 has an identical caption. The two figures should be labeled properly. One has to read the text very carefully to realize that Figure 4.2 refers to batch plants and 4.7 refers to drum plants.

24. Page 4-139, paragraph 2: There is a discussion of attempts to correlate wet scrubber performance with other parameters. Any engineering handbook will tell you that scrubber performance will correlate with pressure drop, yet this measurement was either not made or not used. As it now stands, this paragraph finds that although the emission factor for venturi scrubbers is less than half that for other, unspecified scrubbers, this result is not statistically significant.

25. Page 4-141, paragraph 1: This entire paragraph is confusing. Figure 4.3 shows that there is a relationship between RAP content and condensable inorganic PM. The relationship appears to be non linear. Alternately, looking at just the 0% RAP data points, it is clear that there is great variability in the condensable inorganic PM emissions even without RAP. Without any analysis of feedstocks and fuels, the source of these condensable inorganic PM.s

can't be isolated. To add further confusion, the last sentence jumps to a discussion of carbon dioxide emissions. The reference to Figure 4.3 in context of CO_2 emissions is incorrect.

26. Page 4-144, paragraph 2: The first sentence is incomplete.

27. Page 4-145, paragraph 1: The invocation of engineering principles in the fifth line is interesting because they have been ignored in many instances up to this point; e.g. discussion of scrubber efficiencies without consideration of the pressure drops. VOCs, by definition, don't condense even when cooled to ambient temperatures. Therefore, if a control device has an effect on VOC emissions, this attenuation must be a result of a mechanism other than condensation, such as adsorption on solids. The data quoted show lower emission factors (by a factor of 4) for fabric filters compared to wet scrubbers, but the authors find this result surprising. Although they don't tell us which engineering principle they are referring to, one has to assume that they are referring to the ability of water to capture gases through dissolution. Unfortunately, the components of VOCs are only sparingly soluble in water and the pressure drops/retention times in such scrubbers are quite modest. Therefore, this is a bad place to invoke such engineering principles when they contradict the data.

28. Page 4-147, paragraph 2: The comment in the last line is that emissions are a function of RAP content and production rate. Yet, earlier on page 4-139, these same conclusions were rejected because of low correlation coefficients. Which conclusion is correct?

29. Page 4-147, paragraph 4: This is the beginning of the review of the more recent data on load-out emissions. As noted earlier, there is a change in format of the report at this point in that the discussion of data sets is split into three separate parts.

30. Page 4-148, paragraph 1: Reference 6 (fourth line) is incorrect. What is the proper reference? We are also amused that this report has been given an A rating for data because of the "few problems in the Technical systems Audit Report" etc. Unfortunately, this audit report missed all of the errors found by the citizens. Further, the citizens caught the errors through spot checking and there are no guarantees that they caught everything. If such errors can exist in a report that was guaranteed a high degree of scrutiny, how sure is the EPA that the other data is error free? We am particularly concerned about this point because the data, which is supposedly in appendices A, B and C, is not attached to the material sent to us for review. Also, it raises the question of whether EPA staff do any of their own reviews and spot checks before accepting a report from a contractor. It does not appear to be the case.

31. Page 4-148, paragraph 2: The discussion should point out that Plant C is atypical of drum plants in the industry. Figure 4.6 shows CO_2 emissions factors for drum plants as a function of production. Although there is considerable scatter, it is interesting to note that all high emission points are associated with lower production and none are associated with high production. Does this behavior extend to the emission of other pollutants?

32. Page 4-150, paragraph 3: There are several fundamental issues here that need to be explained. First, EPA argued for a long time that the tunnel at Plant C was adequate to capture all the emissions, based on visual observations by EPA - which were contradicted later by observations by the citizens. EPA reluctantly agreed to use tracers only because the tunnel did not meet Method 204 criteria. (In discussion of Plant D, We will discuss why Method 204 criteria are inadequate). Next, EPA averaged the efficiency over several runs and used a single capture efficiency correction. It was only after the citizens showed that capture efficiency varied during the day, typically declining as the on-shore wind picked up as the land around the plant heated up, that EPA agreed to correct data for the individual capture efficiencies. Finally, the so-called correction for truck emissions, discussed later, continues to be a sham. But that sham is not really discussed here when the quality of data is being considered. See our comments with reference to page 4-152 below. Also, note that there is a typographical error in EMD GD-035 " Guidelines for Determining Capture Efficiency". On page 9, in the formula for p in equation 7, x_{avg} value should be 100.8 not 110.8. The calculated value of p is correct, however.

33. Page 4-151, paragraph 2: Note that Cambridge Environmental has calculated the cooling of a mass of HMA. Their results are not supported by any measurements.

34. Page 4-151, paragraph 4: The last line is ambiguous. Silo emissions were measured only at Plant C. They can't be "combined" with any other measurements.

35. Page 4-152, paragraph 3: This paragraph presents a major problem in this report. The second line states correctly: "The most reliable method to adjust for emissions measured during background operations would be to separately adjust each run for the measured capture efficiency and then subtract these adjusted background emissions from the adjusted emissions measured during production operations." However, because this "procedure produces negative values for both the PM and MCEM and many other HAP compounds", a new unsound procedure is adopted because it gives results that please EPA and industry by by showing low but positive emissions. This new procedure is to use background emissions uncorrected for capture efficiency. If the actual emissions have to be corrected for capture efficiency because the enclosure does not capture all the emissions, there is no justification for ignoring the capture efficiency for background.

    Having used this incorrect analysis, the authors then have the temerity to advise us that this result might even have a "high bias" relative to the most correct method mentioned above. In a very narrow sense, this comment might be correct, but in the current context, given the consistent efforts of the Project Officer to bias the results to favor industry, this comment is totally off base.

Line 5 states that this situation "cannot be accommodated retroactively." This statement is not correct. The best way to eliminate improper data manipulation is to discard the phony background adjustment and report the data as that from loadout **plus** truck exhaust. Since silos always dump hot mix into a truck, these combined emissions are present at each silo loadout point. Further, if a local permit application requires the inclusion of an estimate for truck emissions on site (and we have yet to see a local permit that requires this), note that the truck spends about ½ minute under the silo but many more minutes, typically 3 to 8, on site. As a result, the truck emissions that are included under loadout correspond to the ½ minute portion. Therefore, the double counting of truck exhaust emissions would be minimal and can be adjusted for by subtracting the ½ minute from residence time of the truck on site. We strongly recommend that Tables 4-25 and 4-26 be revised to reflect this approach.

36. Page 4-152, paragraph 4: This paragraph further demonstrates the problems with EPA's background run. The EPA project officer was interested in recording a high background and the original data showed that he was able to manipulate truck placement in such a way that uncorrected emissions in the second half of the run were about twice the emissions in the first half. If these emissions are corrected for the lower capture efficiency in the second half of the run, the corrected emissions from the second half are almost three times the corrected emissions from the first half. This further points out the problems with EPA's manipulation of and placement of trucks to maximize exhaust emissions inside the tunnel.

We have to apologize for not taking this particular analysis far enough a year ago during a review of the Plant C draft. When the data for Run 4, the background run, was reviewed, it was clear that there was data manipulation going on since the raw data showed that emissions in the second half of the run were double those in the first half. When these emissions were adjusted for capture efficiency, the emissions from the second half almost tripled. We felt that the data from the first half of the run was more appropriate than that from the second half. We did not realize that this data, after correcting for capture efficiency, still overwhelmed and negated the load out emissions and was therefore also tainted.

37. Page 4-153, last paragraph: In the 10th line, there is an unnecessary caveat about the relationship being uncertain. The simplest assumption is one of proportionality. Unless lab scale data are collected that indicate otherwise, this is the best way to deal with the issue. Are you forgetting Occam's Razor?

38. Page 4-154, paragraphs 1 - 2: These paragraphs repeat industry propaganda (along with that from State highway department laboratories who share the same road-building mind set). The specifications allow for measurements of unblended asphalt and the information represents the results of tests on unblended asphalt. In the Boston area, the terminal in Chelsea has a tank holding such additives for blending with the asphalt. After a meeting at EPA-Region 1, where the industry representatives had denied that any blending took place, Mr. Frank Singleton, the Board of Health Agent for Chelsea showed me this tank which is clearly labeled

as containing an asphalt additive. The citizens submitted a list of many such additives from Roads and Bridges magazine to the EPA/citizen group which was ignored by the EPA Project Manager, who instead chooses to believe the asphalt industry's lobbyists who insist that such additives are not used. Also, we have examined the application from one of the terminals in Chelsea which said that they proposed to add these additives directly to the tanker truck whereby they would mix in the truck while being transported to the user. This would mean that a sample taken at the terminal would be a sample of unmixed asphalt.

The third paragraph needs to be deleted. As long as the specifications allow for up to 1% volatiles in asphalt (even before additives are used), it is misleading for EPA to state that their approach in Table 4-27 "encourages the use of site specific data". The primary use of AP-42 is to prepare calculations to get permits to build and to operate hot mix plants. Therefore, there is no site specific data that can be used other than fictional data. Unfortunately, the industry has a long history of providing low-ball estimates, designed to fool the public and get permits from agencies that are not particularly anxious to ask difficult questions.

39. Page 4-155, paragraph 2: The statement is that "The industry has stated that good paving practices dictate that load-out temperatures in excess of 325^{o} F should be avoided." Who has stated this and in what context? The specification for highways is that hot mix temperature before the pavement is **laid down** should be between 325 and 275^{o} F. Hot mix outside this temperature range can be rejected. The temperature at load out depends on the distance between the plant and the location where the new pavement is being laid and the size of the truck since smaller loads will cool faster than larger loads.

On the 13th line, the statement is that "this hypothesis has not been validated by emissions testing but provides an adjustment that is directionally correct." This comment is totally unnecessary and needs to be deleted. Is EPA saying that the Clausius-Clayperon equation should be thrown out? Alternately, is EPA saying that the degree of precision and accuracy associated with emissions testing methodology is good enough to provide this type of data?

40. Page 4-157, paragraph 2: In this paragraph, the groundwork is being laid to explain why inorganic PMs were much higher at Plant D than Plant C. This is further elaborated on page 158. We strongly disagree with the conclusion that the additional dust was a result of truck movements. While Plant D was unpaved, water sprays were used to keep the dust down as noted in the report and as observed. At Plant C, because of the practice of cleaning the silos at the end of the day with crushed stone, there was considerable dust present in the tunnel. Furthermore, one ofthe silos had dumped hot mix on the floor and cleaning it up generated a lot of dust. Our recollection is that if anything, the tunnel at Plant C was dustier than the one at Plant D. We believe the explanation for the higher PM load at Plant D is the relatively short residence time in the mixer at any batch plant. Because of this, during mixing, there are small pockets of stone dust that are not coated with asphalt and these are the source of the high PM readings. In contrast, the vapors inside a silo have time to permeate through the

mass of hot mix in the silo and coat any uncoated dust particles. Once coated, the fine dust coagulates and is no longer airborne particulate matter. This hypothesis is supported by the visual observation that dumps from the mixer at Plant D were dustier than those at Plant C when observed from inside the tunnel.

41. Page 4-158, paragraph 2, 3: See the comments above. The adjustment is indeed "speculative" and should be eliminated. Separate emissions factors should be used for inorganic PM emissions from batch and drum plants.

42. Page 4-159, paragraph 2, 3: There is a fundamental problem with the two paragraphs which has not been explained. MCEM PMs and TOC are generated the same way and from the same source. Therefore, if MCEM generation is a function of loadout time, TOC generation should also be a function of loadout time. Of course, the comparison is further complicated and made meaningless by the bogus "background" correction discussed earlier. To eliminate the confusion, separate emission factors should be prepared for batch and drum plants in all cases.

43. Page 4-159 - 162: As discussed earlier, the entire loss on heating discussion should be rewritten so that a RTFOT value of -0.5% is used in all cases. This way, the EPA will not be providing yet another opportunity for builders of new plants to misrepresent what might happen once the plant starts operating. The same applies for the formulae which promote the use of variable temperatures.

44. Page 4-163, paragraph 1: The first line states that "vapor pressure information .... is not available". The report fails to state that this was only because of EPA's refusal to collect this information.

45. Page 4-163, paragraph 3 - 5: Please explain what you mean by "pegged TOC readings"? As it stands we can't understand this at all. Furthermore, Figures 4-9 through 4-13 are missing from our copy. Finally, it is not clear whether you are referring to Plant C or Plant D in this discussion, though the context suggests Plant C.

We further find that the contention that the estimate of unmeasured emissions being an "upper bound" to be unpersuasive and incorrect. Our reasons for saying so result from the inadequacies of Method 204. These were outlined in Ravi Nadkarni's letter of September 15, 1999. They are:

a. At Plant C, two precautions were taken to ensure that we could measure or estimate the amount of organic fugitive emissions that did not reach the primary sampling ports. The first was the use of sulfur hexafluoride tracer gas, and the second was the use of impingement/deposition plates in the ducts which collected organic particulates which would be deposited upstream of the sample port. Although all the emissions did

not reach the sampling ports (some was deposited inside the tunnel and some was pumped out of the tunnel by ambient breeze or by truck movement), the tracer gas enabled an estimation the VOC portion of this loss. (As was pointed out during the planning, the tracer gas was a good proxy **only** for non-condensible emissions but not for condensible emissions.)

At Plant D, a tracer gas was not used although requested by the citizens because the TTE was constructed to meet Method 204 criteria, yet visual observations and THC readings showed the following:

b. An ambient breeze was sufficient to cause some of the fume to escape from the top or the bottom openings in the downwind door of the tunnel. Therefore the size of the openings was decreased further. This means that the Method 204 criterion of maintaining over 200 fpm at a natural draft opening is not adequate. Note that 200 fpm is less than 2.3 miles per hour, which is not much of a breeze. Therefore it is not surprising that these criteria are inadequate to assure total containment within the TTE. We observed visible emissions of fume from the entrance, further emphasizing that the Method 204 criteria are inadequate.

c. Further, Method 204 has a more serious and fundamental problem. Although the size of natural draft openings is specified, the method does not contain any criteria to ensure that the emissions are pulled/sucked past the sampling point in a reasonable period of time. As is well-known, residence time calculations, based on enclosure volume and fan capacity, generally provide incorrect information by underestimating the time to evacuate the enclosure because of channeling. Note that Method 204 does not require a specific location for the natural draft openings, a problem that was pointed out during the planning sessions. At Plant D, even after the size of the opening was decreased, and the little pieces of colored tape at the Natural Draft Openings were indicating airflow towards the inside of the TTE, the tunnel was not evacuated in the approximately 15 second time gap between the final drop and the opening of the doors. This can be clearly seen in the fact that THC readings did not drop to zero even when the sample averaging time is less than 1 minute. This fact was also observed visually inside the TTE enclosure since SVOCs are visible. Thus, in the absence of a tracer gas, we have compelling evidence that the collected sample had a low bias. For example, the extended period test results in MRI-D-Table 4-4, show that final concentration did not drop to zero but stayed between 1 ppm and 2.1 ppm . Yet, this low bias is not mentioned anywhere in the report nor in Appendix B of the MRI Report which contains the original data. These emissions did not reach the instrumentation but were emitted to the environment causing a low bias.

46. <u>Page 4-164, paragraph 2:</u> There is reason to believe that the numbers derived are low. We base this on several facts: Material Safety Data Sheets contain the following warning:

"Studies have shown that low flash point substances, such as hydrogen sulfide and low-boiling hydrocarbons, may accumulate in the vapor space of hot asphalt tanks and bulk transport compartments. Such vapors may exhibit flammability characteristics of a significantly lower flash product than would be indicated by the open cup test." A review of light hydrocarbon compound properties in the Handbook of Chemistry and Physics indicates that the lower explosive limit is reached at vapor concentrations around 1%. Therefore, this warning makes sense only if the TOC concentration is around 10,000 ppm, not the 2000 ppm level used. Second, storage tank temperatures are generally higher than 325^{o} F and closer to 350^{o} F. Finally, the assumed vapor pressure is low in comparison to data from Nelson's Petroleum Refinery Engineering, which would indicate a vapor pressure over 10 mm Hg.

47. Page 4-166, paragraph 4: This needs to be rewritten. It is obvious that this paragraph is recycled from some other writeup. There is no relevant "response 53" in the present writeup. Further, emissions are not only dependent on temperature, they are also dependent on convective effects, i.e. evaporation rate increases in the presence of strong convection.

48. Page 4-166, final paragraph: This paragraph presents a single emissions factor for yard emissions. This is exactly what needs to be done with the RTFOT equations. They should be eliminated and only a single factor, based on RTFOT of 0.5% presented in AP-42.

49. Page 4-167, paragraph 2 - 4: This is a critique of Ravi Nadkarni's original submission in 1994. There are several problems here. If you are going to critique this work, you should refer to all of submissions to the EPA, not just the first one from 6 years ago. The complete list would include his response to Mr. Ryan of EPA of October 26, 1995 and November 16, 1995 and to Mr. Mobley of July 5, 1996. We find it particularly interesting that the estimate of vapor pressure of asphalt from 1994, based on several model compounds has been represented as one based on a single model compound. Second, "people who live in glass houses should not throw stones". In using the TANKS program, (see page 4-165) the authors used another set of model compounds whose presence at the required concentrations is also not supported by the same data that is used to attack this work. For example, if naphthalene and 2-methylnaphthalene are predominant species of PAH in emissions from asphalt DRYERS, why were tetracosane and pentacosane used as model compounds for TANKS? Can you please recalculate the TANK emissions using naphthalene and 2-methylnaphthalene?

Next, why is the Cambridge Environmental letter not listed in the references? It should have been reference 358. Cambridge Environmental used another set of model compounds to come up with a different figure. That does not make their calculation any more valid since both estimates were done years ago in the absence of data on components of asphalt vapor. (This also begs the question of why DRYER emissions are used here when better data is now available from silo emissions.) Given Cambridge Environmental's track record as an extreme advocate for their industrial clients in the public health area, we would not characterize their

work as "independent". (In one case, they compared emissions from a single plant versus emissions from all industrial plants of all types in a county and the state. Even the most polluting plant can appear to be a winner under that criterion.) There is more to the Cambridge Environmental story. In a public meeting in Uxbridge, Dr. Zemba, the principal author of the letter, reversed his position and stated that he now believed that the calculations are in the correct range, or only modestly overestimate the actual emissions. Specifically, he said, "When I originally looked at the calculations, I thought that these were grossly overestimated. I can see your point though and they might not be overestimated by as much as I originally thought." He also admitted that he had not studied Ravi Nadkarni's two 1995 letters to the EPA. A specific critique of the Cambridge Environmental work is in the 1996 letter to David Mobley.

We agree that calculations done in the absence of actual measurements should be discarded when actual measurements are available. But any critique should fairly represent the work and its shortcomings.

50. Page 4-168, paragraph 2 - 4: The evaluation of reference 359 indicates that the reference was not read critically. Tables 4-42 and 4-43 are presented without any critical evaluation of the contents. The table shows about the same concentrations at an upwind site and a downwind site. How is this possible, unless the measurements represent background readings? There is no comment as to why higher concentrations were detected at a residential site and how the residential site compared to the upwind and downwind sites. If you are not going to evaluate the information, don't present the tables.

51. Page 4-169, paragraph 2 - 6: Again, the comments indicate that reference 360 was not read critically. For example, the high outliers were rejected. Having read the original report, we know that the authors don't plead that the instrument malfunctioned. Therefore, the high measurements must be explained. Or are they supposed to be background? It is likely that the wide variation in measured concentrations was a function of measuring technique? Low readings were obtained upwind of the emission source and high readings were obtained near the source and downwind from it. Under these conditions, when the instantaneous wind direction and sampling location with respect to the source were not recorded, there is no justification for rejecting the high data points. Note that the determination of the high data points as outliers was based on a purely statistical argument (the "outliers" were many standard deviations away from the rest of the data; therefore they don't belong with the rest of the dataset); not one based on measurement errors or other relevant factors.

The final paragraph again uncritically quotes the process used by the authors to convert the measurement into a mass rate in g/sec. The concentration of benzene was measured in concentration units i.e. g/l which can be converted to g/m^3. This was then converted to an "emission factor" (actually a mass rate) by multiplying the concentration by wind velocity in m/sec and the vehicle area in m^2. This is data manipulation of the worst sort. If one is trying

to measure the flux of benzene escaping from the truck, the flux would be expressed in units of mass flow per second per unit area or g/sec-m^2. The relevant area is that perpendicular to the direction of flow of the flux that you are trying to characterize. In this reference, concentration, wind velocity and truck area are combined in a way that might be dimensionally correct but make no physical sense. In particular, it is difficult to see how a measured wind velocity relates to the area of the truck. EPA does disservice to the reader when material of this type is presented in detail over 4 tables without critical evaluation.

52. Page 4-172, reference 364: This reference is the AIRx report of measurements at Plant C. We want to see exactly what procedure was used to estimate capture efficiency at 70 to 90%. Otherwise, this comment should be eliminated.

53. Tables 4-4 to 4-14: There are numerous deletions of data shown in these tables where emission factors for each plant are presented. The reasons for the deletion are not explained in the text.

54. Table 4-15: When will this table be completed?

55. Table 4-19: Footnote a is incorrect. R^2 is the correlation coefficient, not the "squared correlation coefficient." We believe the terminology calls R the coefficient of determination, so that R^2 could be called the "squared coefficient of determination". The more common usage is to stick with "correlation coefficient" or R^2.

56. Table 4-23, 4-25: In view of the comments earlier about the background run, these tables need to be revised.

This Page is intentionally left blank.

Elane Kruger, Chief
Environmental Toxicology Unit
Bureau of Environmental Health Assessment
Massachusetts Department of Health
Boston, MA

This Page is intentionally left blank.

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
250 Washington Street, Boston, MA 02108-4619

ARGEO PAUL CELLUCCI
GOVERNOR

JANE SWIFT
LIEUTENANT GOVERNOR

WILLIAM D. O'LEARY
SECRETARY

HOWARD K. KOH, MD, MPH
COMMISSIONER

September 7, 2000

Robert F. McConnell
Environmental Engineer
Air Quality Planning Group
United States Environmental Protection Agency
Region I
John F. Kennedy Building
Boston, MA 02203-0001

Dear Mr. McConnell:

Thank you for extending the deadline for submitting our comments. The Massachusetts Department of Public Health (MDPH) Bureau of Environmental Health Assessment (BEHA) is "Writing this letter in response to the U.S. Environmental Protection Agency's (EPA) request for comments on the draft emissions assessment report and draft AP-42 section regarding emissions from hot-mix asphalt plants (i.e., “Hot Mix Asphalt Plants Emission Assessment Report” and "Hot Mix Asphalt Plants AP-42 Section 11.1”). These documents are the culmination of work done by EPA to characterize uncontrolled emissions during loading operations at hot mix asphalt plants. As well as reviewing asphalt plant test reports and related documents, EPA performed its own emission testing at asphalt plants in Irvine, California, and Barre, Massachusetts. Using these data, EP A produced emission factors which can be used to estimate area-wide emissions from many facilities as welt as emissions from specific facilities.

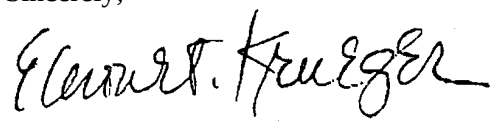
Previously, MDPH had submitted comments concerning the two-part protocol for emission testing at the hot mix asphalt plant in Barre, Massachusetts, and the 8-volume draft report on results for emission testing at the Barre and Irvine plants. MDPH comments focused primarily on whether speciated emissions data, which were gathered solely from the Cal1fornia facility, were applicable to the Barre facility due to differences in modes of operation and material between the two plants and whether dust particles collected at the elbow junctions of the Barre plant exhaust system were included in the study. In response, EPA explained that limited resources precluded conducting analyses at the Barre plant to better speciate emission data. However, EPA also stated that applicable specific emissions data for asphalt could be gathered from previous asphalt studies. In addition, EPA stated that those dust particles that were deposited at the elbow junctions were recovered and analyzed.

As we have previously noted, it is important to understand the limitations of the emission testing at the Barre and Irvine plants, some of which were discussed in EPA: response to comments (i.e., "Emission Tests of Hot Mix Asphalt Plants, Response to Comments for Asphalt Plants C and D"). EPA noted that resources were not available to perform emission testing at different times of year or at different locations to determine whether there is a relationship between emissions and asphalt cooling or variability of emissions of specific chemical compounds. This information could be important in determining emissions from plants in different areas of the country. While we appreciate that limited resources may have prevented more comprehensive testing, unfortunately a number of uncertainties remain regarding opportunities for exposure and health concerns. In addition to those noted above, uncertainties also exist due to the variations in modes of operation, materials, and plant designs. Therefore emission data from previous asphalt studies may not be applicable to the Barre plant. We would recommend that these important limitations; be outlined in the final document, rather than just in the response to comments.

A final comment regards EPA reporting averages of data collected without presenting the range of numbers. This concern has also been raised by others. The use of average values may be appropriate for evaluating risks of long-term health effects e.g., cancer risk, but may underestimate the potential for health effects associated with other issues, e.g., short-term odors, that have been reported to be associated with these types of facilities. Clearly, some of the chemicals, e.g., naphthalene, contained in the asphalt have very low odor thresholds. For that reason, we recommend that EPA present the full range of predicted emissions data including upper-bound or maximum estimates of emissions as they relate to the potential for shorter term effects, such as odors. This is particularly important given that odors have been important issues at other facilities like this elsewhere in the U.S. (e.g.) Michigan).

We appreciate the substantial amount of technical work that was undertaken by EPA and others in regard to this project and applaud EPA's efforts to freely discuss the results of this with a variety of concerned individuals and organizations. Thank you for your attention and consideration. If you have any questions, please do not hesitate to call me or Michael Celona at 617-624-5757.

Sincerely,



Elaine T. Krueger, Chief
Environmental Toxicology Program (BEHA)

cc: Suzanne K. Condon, Assistant Commissioner
Martha J Steele, Deputy Director, BEHA
Michael Celona, Environmental Analyst, BEHA

Gary Fore, Vice President
Environment and Safety
National Asphalt Pavement Association
Lanham, MD

This Page is intentionally left blank.

NATIONAL ASPHALT PAVEMENT ASSOCIATION
NAPA Building P 5100 Forbes Boulevard P Lanham, Maryland 20706-4413
Toll Free: 1-888-468-6499 P Tel: 301-731-4748 P Fax: 301-731-4621
Mike Acott, President

August 17, 2000

Bob McConnell
EPA Region I
Q Congress Street/CAQ
Suite 1000
Boston, MA 02114

Reference: Draft Hot Mix Asphalt Plants -Emission Assessment Report; Draft AP-42 Chapter 11.1; Background Report

Dear Mr. McConnell:

We have reviewed the above referenced draft reports and offer comments and suggestions for your consideration.

This letter will be broken into two sections. Section I will discuss the suggested corrections and comments per above referenced document. Section II will discuss additional stack test report data. This data offers significant additional information relative to Benzene and Sulfur Dioxide (SO2).

Section I

Chapter 11.1 Hot Mix Asphalt Plants (Draft 2000)

General comment - Tables tend to be confusing. For example, Place HAPs contiguously with HAPS and follow with Non-HAPs together. Also, suggest adding a set of batch table and drum tables with contiguous HAPs listing, non-HAPs listing and metals HAPs vs. non-metal HAPs listing.

General comment - Suggest following the same table order as found in the Emissions Assessment Report. Much less confusing.

- **Page 11.1-1**

  A. Hot mix asphalt paving materials can be manufactured by: ... (2) continuous mix (mix outside **dryer** drum) plants, ...

  Please add the word dryer when using the "mix outside **dryer** drum" phrase. This will allow for both past and present types of plants.

- **Page 11.1-3**

  A. Add in (source classification code in parentheses) under Figure 11.1-1 General ...

- **Page 11.1-4**

  A. Add to Figure 11.1-2. General process 11ow diagram for **parallel-flow** drum mix asphalt plants.

  B. Add in (source classification code in parentheses) under Figure 11.1-2 General ...

- **Page 11.1-6**

  A. Add in (source classification code in parentheses) under Figure 11.1-3 General ...

- **Page 11.1-7**

  A. In the fourth line, second paragraph under 11.1.2.1 - Batch Mix plants, please add the word *very* before the word small. The sentence will then read "and **very** small amounts of organic compounds"

- **Page 11.1-8**

  A. In the first partial sentence on the page, please add **prior to tarping** after truck. The sentence will then read: Organic vapor ... bed of the truck **prior to tarping**, ..."

  B. In the second line from the top of page - please add the word *very* before the word small. The sentence will then read "may contain **very** small amounts of HAP"

- **Page 11.1- 9**

  A. In the first paragraph under section 11.1.2.3 - please add the word *very* before the word small. The sentence will then read "and **very** small amounts of organic compounds of various species"

➢ **Page 11.1-10**

A. 2nd paragraph -Suggest a more typical loss-on-heating of **0.25** not 0.41

a. To estimate total PM emissions from drum mix plant load-out operations using an asphalt loss-on-heating of 0.25 percent and temperature of 290˚F, HMA mix, the following calculation is made:

$$
\begin{aligned}
EF &= 0.000181 + 0.00067\,(-v)e^{((0.0251)\,(290+460)\,-20.43)} \\
&= 0.000181 + 0.00067\,(-(0.25))e^{((0.0251)(290+460)\,-20.43)} \\
&= 0.000181 + 0.00067(0.25)e^{(-1.605)} \\
&= 0.000181 + 0.00067(0.25)(0.2009) \\
&= 0.000181 + 0.0000485 \\
&= 0.000215 \text{ lb/ton of asphalt loaded}
\end{aligned}
$$

NOTE: The correlation factor in the equation should be 0.00067 and not 0.00059.

This loss-on-heating value is a value that is seen on a daily basis within the Industry.

➢ **Page 11.1-16**

A. Footnote C -Suggest striking SO_2 or add 50% attenuation of SO_2. Please review attached stoechiometry and SO_2 attenuation data.

➢ **Page 11.1-17**

A. In the title for Table 11.1-6, please delete the word formaldehyde from title

B. Note there is an error under VOC for natural gas-fired dryer and the No.2 fuel oil-fired dryer. They should be 0.0076 for both not ~~0.0082~~

➢ **Page 11.1-18**

A. Footnote C – Suggest striking SO_2 or add 50% attenuation of SO_2. Please review attached stoechiometry and SO_2 attenuation data.

B. Footnote D – There is a question that the range to 96 lb/ton is too high. Where is source for this number?

➢ **Page 11.1-20**

A. Sub title: Hazardous air pollutants under Pollutant Heading – For easier reader understanding, please change subtitle from Hazardous air pollutants to **non PAH/HAPs**

B. Please add a line totaling the non-PAHs hazardous air pollutants section. Currently very confusing.

C. Sub title PAHs – Please change from PAHs to **PAH/HAPs**

D. Please add row and sum the NO. 6 fuel "organic HAPs"

E. Please change non-HAP subtitle to Non Organic HAPs

F. Sub title: Hazardous air pollutants – Please change to **PAH/HAPs**

G. Left side column under Dryer with fabric filter – Please add **natural gas, propane, fuel oil, or waste oil fired.** Confusing as is and fails to distinguish between these fuels and No.6 fuel oil.

G. Footnote b – Please change as follows: ~~Natural gas, propane, fuel oil, or waste oil fired dryer. For pollutants that are marked with a~~ "*", ~~separate emission factors are presented for No. 6 fuel oil fired dryers~~. Substitute these factors for above factors when burning No.6 oil.

➢ **Page 11.1-21,22,23**

A. Use the same format and comments as suggested for above Table 11.1-9

➢ **Page 11.1-22 and 23**

A. Please add Dioxins and Furans to above referenced Organics and HAPs

B. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

- **Page 11.1-24**
  A. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

  B. Footnote b – Please change as follows: ~~Natural gas, propane, fuel oil, or waste oil fired dryer. For pollutants that are marked with a~~ "*", ~~separate emission factors are presented for No. 6 fuel oil fired dryers~~. Substitute these factors for above factors when burning No.6 oil.

- **Page 11.1-27**
  A. Overall comment – Should create subtitles for Metal HAPs category and a Metal Non-HAPs categories. Also suggest moving to 11.1-9.

  B. Adjust footnotes accordingly.

- **Page 11.1-28**
  A. Delete uncontrolled from this table because to be consistent with other HAPs, we should use data collected after filtration in the stack. Please make a footnote reference that the uncontrolled numbers are in the Emission Factor documentation for AP-42 Section 11.1 Hot Mix Asphalt Production.

  B. Use the same format and comments as suggested for above Table 11.1-9. Should be the same for both drum and batch.

  C. Please delete Footnote b. unnecessary.

  D. To make the table easier to read, suggest switch last two sections of the table. The section pertaining to lead and mercury should come last.

- **Page 11.1-29**
  A. Question why include total PM when it includes organic PM? This is very confusing.

  B. Footnote a. – Please change the word asphalt to **HMA mix** to prevent confusion as to mix temperature or liquid temperature.

- **Page 11.1-30**
  A. Place PAH/Organic PM (%) up above PAHs line in the left column. It should be a title, not a part of the data.

  B. Change Subtitle from PAHs to **PAH/HAPs**

  C. Total PAHs, subtitle – Change to **total PAH/HAPs**

- **Page 11.1-31**
  A. Move subtitle – Compound/TOC(%) up to be included in the titles for the columns.

  B. Create Sub title – **non-VOC/non-HAPs**

  C. Please a Percent sign (%) to every EF as in table 11.1-15. It is currently very confusing because the other tables in this document do not contain percents.

  D. Total – add line **total volatile organic HAPs**

  E. Please add to the example on page 11.1-10. It would be helpful to illustrate the use of Table 11.1-16.

- **Page 11.1-32**
  A. Please correct Reference No.2. Katherine is spelled Kathryn.

Emission Assessrnent Report (Draft 2000)

- **Page 2**
  A. Paragraph 1, second line -please add the following: ...and PM-2.5 **and very small amounts of** hazardous air pollutant...

  B. Second sentence – delete the "e" off of the end of with.

  C. Second sentence – please add the following: ...VOC and **very small amounts of** volatile HAP organic compounds.

D. paragraph 2 - please add the following: ...emissions for specific facilities **where source specific emissions is not available or where source testing is cost prohibitive.**

- **Page 3**
  A. At the end of the last paragraph -Please add an editors note: **"HAPs emissions are typical of emissions that result from fossil fuel combustion."**

- **Page 4**
  A. Add in (source classification code in parentheses) under Figure 1 Typical

- **Page 5**
  A. Add in (source classification code in parentheses) under Figure 2

- **Page 8**
  A. 3rd paragraph – ...(2) continuous mix (mix outside **dryer** drum) plants, ... Please add the word dryer when using the "mix outside **dryer** drum" phrase. This will allow for both past and present types of plants.

- **Page 10**
  A. 2nd paragraph – Please add the following: ... counterflow drum mix plants will likely have organic **stack** emissions ...

  B. 4th paragraph – Please correct as follows: ... CO; and **very** small amounts of organic compounds ...

- **Page 11**
  A. 1st paragraph – Please add the following: ... organic aerosol may contain **very** small amounts ...

  B. Last paragraph – Please add the following: An initial screening ~~the~~ **of** these documents...

- **. Page 12**
  A. 1st paragraph – Please add the following: ... truck prior to these departure for the job site”**)**”. Missing end parentheses.

- **Page13**
  A. 2nd paragraph – Please add to the end of the paragraph. ...”representative of gas-fired heatlers. **As a practical matter theses units represent a very small combustion source when compared to the dryer.**

  B. 4th paragraph – Prior to the last sentence please add the following sentence. ... developed from the data. **For example, two scientific auditors from the Research Triangle Institute were employed to independently audit the test and reporting process.** These additional steps ...

- **Page 15**
  A. Last paragraph – Please add the following sentence to the end of the paragraph. ...equation developed from the emission data. **It should be noted that truck emissions would decrease rapidly with time as** a **result of surface cooling and crusting and industry practice of covering loads with tarps.**

- **Page 20**
  A. Sub title PAH – Please change as follows: **PAH (semi volatile HAPs).**

  B. Please delete line between methylene chloride and MTBE

Section II

The Hot Mix Asphalt Industry is providing additional data specifically relevant to $S0_2$ attenuation and benzene to EPA for possible inclusion into the Emissions Factors Document (AP-42). Attached are three binders containing stack test reports. All of the tests were consist of three 1-hour runs and were conducted for compliance purposes.

NOTE: NAPA is sending one copy of this material and one copy of the comments to Ron Myers. Only the comments document is being sent to EPA Region I.

$S0_2$

The Draft Emissions Assessment (EA) offers an EF for SO_2 of 0.078 lbs/ton hot mix from drum mix plants firing waste oil (Draft EA,, Table 11.1-7). The Draft EA also suggests via footnote (c.) of Table 11.1-7 that AP-42, Chapter 1 also be used to estimate SO_2. Chapter 1 Emission Factors (EF) incorporate fuel sulfur content to determine SO_2 emissions.

It is believed that a more accurate approach should be used to determine SO_2 emissions from plants firing oil, especially waste oil.

Several stack tests for SO_2 were conducted. Samples of each plant's burner fuel supply during each test were taken and analyzed for sulfur content. The amount of SO_2 produced during combustion of the burner fuel was calculated. There was an assumption that all of the sulfur in the fuel would be converted to SO_2. Then, using a mass balance approach, the actual stack emissions of SO_2 was compared with the calculated SO_2 as a product of combustion, and determined a control (i.e., emission reduction) factor for SO_2. from a hot mix asphalt plant, firing oil.

The proposed means of control would be the adsorption of SO_2 by dust particles suspended in the ductwork and captured on the bags in the baghouse. For a plant producing 250 tons/hour hot mix and firing 500 gallons/hour waste oil having a sulfur content of 0.046% by weight and a specific gravity of 0.89, the amount of SO2 generated by combustion would be 500 gal/hr x 8.34 lbs/gal x 0.89 x 0.46/100 x 2 (lb S02/ lb S) = 34.14 lb SO_2/hr. At the same time, the uncontrolled particulate emissions from the plant would be 28 lbs PM/ton (Draft Table 11.1-3) x 250 tons/hour = 7000 lbs PM/hour. The available reaction surface area of the dust particulate provides significant acid gas capture opportunity by any alkaline solid material suspended in the exhaust stream or accumulated on the bag house bags.

The results from the 15 tests demonstrate SO_2 control ranging from 47% to 97%, with an average control of 62%. Test result averages show little variation in control among different plant types, aggregate types or recycle asphalt pavement (RAP) content in the mix. Please refer to the attached table: “Asphalt Plant SO_2 Emissions Summary”

The Wisconsin Department of Natural Resources (WDNR) has reviewed these stack tests and wil adopt a conservative control factor of 50% for future permitting and emission inventory purposes. Please refer to the attached letter from Lloyd Eagan, Director of Bureau of Air Management from the State of Wisconsin – Department of Natural Resource.

Benzene

Stack tests were also conducted for benzene from drum mix plants, firing either waste oil or natural gas. The reports from 17 tests are enclosed. These reports indicate average benzene emissions of approximately 0.0003 lbs benzene/ton hot mix asphalt, with no significant variation for fuel type. The draft EA lists a benzene EF of 0.00051 Ibs/ton (Table 11.1-10).

Thank you for your attention to these matters. If you have any questions or comments, please feel free to call either Una Connolly or myself at 301-731-4748.

Sincerely,

Gary Fore

Gary Fore
Vice President -
Environment & Safety

attachments

ASPHALT PLANT SO2 EMISSIONS SUMMARY

All Plants Fired Using Waste Oil

Plant I.D.	Test Locations	Plant Type*	%Sulfur in Fuel	HMA, TPH	% RAP	Aggregate Type, % Limestone	% SO2 Control
4	K&N Pit	CD	0.46	362	24	Gravel 73	50.5
8	Cedar Lake Pit	CD	0.37	287	25	Gravel 68	92.2
15	Saukville Pit	CD	0.63	358	25	Gravel 79	54.3
25	Michel's Pit SE of Markesan	PD	0.44	250	0	Quarry 100	77.5
26	Quarry Near Fish Creek	PD	0.53	303	10	Quarry 100	55.0
27	Quarry SE of Horicon	PD	0.39	300	20	Quarry 100	52.1
28	Pit NW of Wautoma	PD	0.43	270	0	Gravel 61	78.8
29	Vulcan Pit Near Dousman	PD	0.47	282	20	Gravel 81	62.3
34	Denmark	CD	0.43	273	15	Gravel 74	56.3
53	Newberry, MI	PD	0.64	227	0	Gravel 62	61.5
68	Cold Spring	PD	0.54	245	10	Quarry 100	47.6
10	NW Wisconsin	B	0.36	183	0	Gravel 30	97.1
25	NW Wisconsin	PD	0.5	127	0	Gravel 0	48.1
41	NW Wisconsin	PD	0.47	280	0	Gravel 0	47.2
46	NW Wisconsin	PD	0.36	272	0	Gravel 10	50.9

Average % SO2 Control
62.1

Standard Deviation
15.88

Statistical Analyses Based on Operational Variables
All values represent Average % SO2 Controlled

Plant Type		% RAP		Aggregate Type	
PD	57.9	0%~14% RAP	62.6	0%~50% Limestone	60.8
CD	63.3	10%~25% RAP	61.28	51%~100% Limestone	62.5
Batch	97.1				

* PD means parallel-flow drum
CD means counter-flow drum
B means batch plant

Comp\Pit\TestSumNAPASO2Sites

Comp\Ptt\TestSum-NAPA+MATHY

ASPHALT PLANT STACK TEST SUMMARY

August, 2000

Plant I.D.	Plant Type	Test Date	Fuel Used	HMA, TPH	% RAP	Lbs/Ton TSP	Lbs/Ton HCOH	Lbs/Ton CO	Lbs/Ton NOX	% SO2 Control	Lbs/Ton Benzene	% HCl Control	Lbs/Ton Cl-Benzenes
2	B	6/98	NG	350	15			0.04					
4	CD	10/97	WO	362	24	0.0099	0.0104			50.5			
5	CD	10/95	NG	300	20	0.0012	0.0048	0.2053	0.017		0.00044		
6	CD	7/95	NG	395	20	0.0023	0.0021	0.085	0.0228		0.000036		<0.00006
7	CD	7/95	NG	298	20	0.0038	0.00046	0.0282	0.0134		0.00038		<0.00008
8	CD	8/97	WO	287	25	0.005	0.0142			92.2			
15	CD	8/97	WO	358	25	0.0052	0.0015			54.3	0.0004		
24	PD	10/95	WO	290	24	0.0169	0.0009	0.058	0.0163		0.00012		
25	PD	Oct-98	WO	250	0	0.0202				77.5		95.06	
26	PD	5/97	WO	303	10	0.0054				55.0	0.00015		<0.00003
27	PD	10/97	WO	300	20	0.009	0.0023			52.0			
28	PD	9/95	WO	244	24	0.0077		0.0299	0.0166		0.00009		
28	PD	Oct-99	WO	270	0	0.031				78.8	0.00056	99.28	
29	PD	8/97	WO	282	20	0.0139				41.7	0.0001		
31	B	5/98	NG	175	0			0.11					
34	PD	Oct-99	WO	275	15					56.3		94.3	
52	PD	6/95	WO	155	0	0.0126	0.0026	0.1054	0.111		0.0003		
53	PD	9/98	WO	227	0	0.03				61.5		97.79	
55	B	5/98	NG	260	15			0.1					
55	CD	Sep-99	NG	450	20	0.027	0.0015				0.0004		
56	PD	9/97	NG	292	15	0.0023	0.0003				0.0002		<0.00003
59	PD	7/96	WO	240	0	0.0076	0.0006				0.0007		
63	CD	8/96	WO	420	20	0.0042	0.0007				0.00008		
65	PD	7/97	WO+NG	319	21	0.0103					0.0011		
65	CD	Jun-99	NG	450	25	0.004	0.0013				0.0003		
68	PD	7/97	WO	245	10	0.0214				47.6	0.00029		<0.00003
10	B	Sep-99	WO	183	0					97.1			
25	PD	Aug-99	WO	127	0					48.1			
41	PD	Jul-99	WO	280	0					47.2			
46	PD	Oct-99	WO	272	0					50.9			

Averages in Lbs/Ton

Plant Type	Fuel	EF Sources	TPH	% RAP	TSP	CH2O	CO	NOX	% SO2 Control	Benzene	% HCl Control	Chloro-Benzenes
Batch Plant	natural gas	Tests AP-42, Draft EA			0.041	0.00062	0.07 0.5	0.025		0.00025		<limit of detection
	waste oil	Tests AP-42, Draft EA			0.041	0.00062	0.5	0.120				<LOD
Drum Plant	natural gas	Tests AP-42, Draft EA	321	19	0.004 0.033	0.00192 0.0025	0.106 0.15	0.018 0.029		0.0003112 0.00051		<LOD
	waste oil	Tests AP-42, Draft EA	268	16	0.010 0.033	0.00415 0.0025	0.064 0.15	0.048 0.051	62.1	0.000277 0.00051	96.61	<LOD

B = Batch Plant, PD = Parallel-flow Drum Plant, CD = Counter-flow Drum Plant.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary

101 S. Webster St.
Box 7921
Madison, Wisconsin 53707-7921
Telephone 608-266-2621
FAX 608-267-3579
TDD 608-267-6897

August 8, 2000

Peter Tolsma
Construction Resources Management, Inc.
P.O. Box 1632
Waukesha, WI 53187

Subject: Determination of a Sulfur Dioxide emissions factor for hot mix asphalt plants

Dear Mr. Tolsma:

Members of my staff have met with the Wisconsin Asphalt Pavement Association Environmental Technology Transfer Team (WAPA ETTT). The meetings covered several topics including the one addressed in the subject heading of this letter.

The Wisconsin Department of Natural Resources (DNR) decision making process regarding environmental protection is always based on good engineering practices and sound engineering judgement. In the absence of commonly accepted scientific fact we will, on rare occasion, consider extrapolation if it is based on sound engineering principles.

It is my understanding, based on discussion with my staff; the Wisconsin hot mix asphalt (HMA) industry has provided DNR with a considerable number of SO_2 emissions test results. In addition, data from the Michigan Department of Natural Resources has been made available to the DNR. The Michigan data and the DNR data are consistent in showing that 50% of the sulfur in the fuel oil does not result in SO_2 emissions.

The consistency in data among these sources, in addition to other scientific information supports our conclusion that an emission factor of 0.5 pounds per pound is reasonable and appropriate. We also note that the data we have evaluated suggests a range that could possibly indicate 0.5 pounds per pound to result in a conservative estimate of SO_2 emissions from HMA sources.

The Wisconsin Department of Natural Resources reserves the right to alter its current position without notice if a review of existing or new relevant data dictates.

If you have questions or concerns regarding our position or this issue, feel free to contact either Mr. Patrick Kirsop or Mr. Keith Pierce of my staff.

Sincerely,

Lloyd L. Eagan, Director
Bureau of Air Management.

cc: P. Kirsop - AM/7, K. Pierce - AM/7

This Page is intentionally left blank.

Norman Ostroff, PhD, PE
Stamford, CT

This Page is intentionally left blank.

NORMAN OSTROFF, PhD, P.E.
87 **FISHING TRAIL**
STAMFORD, CONNECTICUT 06903
(203) 322-5559

2000.190

August **25, 2000**

Mr. Robert McConnell
Environmental Engineer
Air Quality Planning Group
USEPA - Region 1
1 Congress Street - Suite 1100
Boston. MA 02114-2023

Dear Bob:

I am writing to discuss several points in the recently issued draft report titled "Hot Mix Asphalt Plants, Emission Assessment Report" EPA-454/R-OO-OXX. Please extend my congratulations to all those who worked on its preparation for a job very well done. Please also accept the comments I make in this letter as purely constructive.

In general, I my comments will concern the readability of equations, rather than their derivation, which I took to be correct. My primary area of concern at this time involves VOC emissions during truck load-out operations; my comments will be mainly concerned with this section of the draft and will cite examples based upon Appendix B, pages 4-147 et seq.

I recommend you consider adding equation numbers wherever needed. When reviewing the document (especially Appendix B) I found it somewhat difficult to follow because of the lack of equation numbers.

On page 4.153 (Appendix B) you present the following equation:

$$EF_{cor} = ((C_{prod})-(C_{back}))*(EF_{prod}/C_{prod})$$

If this equation were written in "algebra" rather than "computerese," it might look like:

$$EF_{cor} = \left[\left(C_{prod}\right) - \left(C_{back}\right)\right] \times \frac{EF_{prod}}{C_{prod}}$$

This small change would make the equation more "readable" to me and perhaps to others. I understand the physics of the equation, but recommend that the definition of the parameter C_{prod} be repeated here; it is not specifically stated. I assume that this equation is dimensionally correct, but recommend you include the units for the respective terms. In the numerical

example that follows (in the text), I recommend that you indicate to the reader the exact source of the input data. I could not find the reference to Run 1 MCEM, but could have missed it while reading the report. Also, demonstrating the calculation of C_{prod} from raw data would have been helpful to me.

On the bottom of page 4-154 and the top of page 4-155, you present a short discussion of vapor pressure. I agree that the Clausius-Clapyron (CC) equation generates a linear relationship between (the logarithm of the) vapor pressure and (the reciprocal of the absolute) temperature. The Antoine equation is a refinement of the CC equation in which a third constant has been added. The CC equation is a special case of the Antoine equation in which the third constant is 273.16. Please double check your references, the (CRC) Handbook of Chemistry and Physics provides tabulated numerical vapor pressure (versus temperature) data for a large number of compounds and Lange's handbook provides Antoine equation constants.

I suggest that the form of the two equations at the top on page 4-155 are somewhat difficult to read. For example:

$$\text{Loss} = -e^{((t+460)*0.0231-19.28)}$$

would be easier to read if it were in the form:

$$\text{Loss} = -\text{EXP}\left[0.0231(t+460)-19.28\right]$$

I don't think the minus sign is necessary in these equations, but I understand it being placed there to re-enforce the fact that the asphalt is losing mass during heating.

Return to the CC equation for a moment. The linearized form of the equation is:

$$\ln(VP) = A + \frac{B}{0T}$$

Where A and B are compound-specific constants. If one would make the same transformation on the empirical equations (ignoring the minus sign) the form of the equations would be:

$$\ln(\text{Loss}) = AT + B$$

Please note the difference in form between the two equations.

In the second line of the next paragraph, I recommend that you remove the words "The industry indicates that higher temperatures are avoided ."

On the bottom of page 4-155, you cite equation numbers 4-11 and 4-12. Where are equations 4-1 through 4-10? Again, these equations, as presented, are somewhat difficult to follow, The equations can be simplified and perhaps the following sentence added:

"Equation 4-l 1 can be rearranged to give:

$$EF_{Std} = EF_{Corr}\left(\frac{-0.5}{V}\right)e^{0.0231(325-T)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.13)"$$

My Equation (4.13) is mathematically identical to your Equation (4.11). In addition, I have found (in my own writing) that the use of the dotted line, connecting the equation and the equation number, simplifies reading. Am I correct in my understanding that EF_{Std} is the emission factor to be used for prediction of future emissions? If so, then I believe this should be clearly stated.

Fifteen figures are referred to at various points. In their current location, reader must stop reading the document and look for the figures then return to the text. This is distracting, interrupts the smooth flow of information, and can be avoided if the figures were placed directly into the text (perhaps reduced in size).

Finally, I have been interested in the emissions from this phase of hot mix asphalt manufacture for some time and have developed a purely theoretical model to describe VOC emissions from freshly prepared asphalt starting the instant that it is discharged from a storage hopper or a pug mill. My model predicted temperature changes during discharge and during transfer to the paving site, and the VOC emissions accompanying the the transfer. My (theoretical) analysis of the period in the truck is extremely close to your measurements. Your measured emission factor was of 0.0011 pounds of VOC per ton of asphalt in 8 minutes, my value was 0.00046 pounds of VOC per ton of asphalt in 3.3 minutes. I am enclosing a copy of my report, you may find it interesting.

Please accept my congratulations for a job very well done. Thank you for the printed review-copy you provided, and for the opportunity to comment on it.

Very truly yours,

Norman Ostroff, PhD, P.E.
Consulting Engineer

enclosure

cc: Mr. Ron Myers, US EPA, RTPNC

This Page is intentionally left blank.

DEVELOPMENT OF EMISSION FACTORS FOR FUGITIVE EMISSIONS FROM HOT MIX ASPHALT PLANTS

A THEORETICAL EVALUATION

by

Norman Ostroff, Ph.D, P.E.
87 Fishing Trail
Stamford, CT 06903
(203) 322 5559

April 1998
(Revised January 2000)

This Page is intentionally left blank.

DEVELOPMENT OF EMISSION FACTORS FOR FUGITIVE EMISSIONS FROM HOT MIX ASPHALT PLANTS

A THEORETICAL EVALUATION

by

Norman Ostroff, PhD, P.E.
Consulting Engineer

1. INTRODUCTION AND THEORY

1.1 Introduction

There are no published emission factors to quantify the fugitive emissions at hot mix asphalt plants. The fugitive emissions in this study will be limited to VOCs. Fugitive particulate emissions from blended product are expected to be negligible because of the binding action of the asphalt.

The emission factors will be studied by following the temperature history of the product and relating it to the rate of evaporation of volatile compounds.

There are two points in the process during which fugitive emissions can occur. These are:

1. The period during which the blended material is being dropped from the pug mill into the transport truck, and

2. The period when the material is in the truck and is being transported to the paving site.

In the case of blended hot mix asphalt, there are three mechanisms by which heat can be lost from the mass. These are:

1. Radiation of heat from the hot particles to the atmosphere,

2. Convection from the surface of the mix to the atmosphere, and

3. Evaporative cooling accompanying evaporation of volatile components from the mass.

1.2 Radiation

The equation for heat transfers by radiation between a solid wall and a gas [1] is:

$$\frac{Q}{A} = 0.173\varepsilon\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right] \quad \text{(l-l)}$$

where ϵ is the emissivity of the gas which will be assumed to be 0.1 based on published data for water vapor and CO, [2]. Take 325°F (785°R) as the surface temperature of the asphalt mix and 60°F (520°R) as the air temperature. Substitute these quantities in Equation (1) to get:

$$\frac{Q}{A} = 0.173 \times 0.1 \times \left[7.85^4 - 5.20^4\right]_{\frac{hr}{ft^2}} = 50.3 \frac{BTU}{} \quad \text{(l-2)}$$

1.3 Convection

The equation for heat loss from the mass to the atmosphere by convection is given by:

$$\frac{Q}{A} = h\left(T_S - T_\infty\right) \quad \text{(1-3)}$$

Where T_S is the surface temperature and T_∞ is the air temperature. The heat transfer coefficient for heat loss from a flat plate to still air [3a] is:

$$h = 0.38\left(T_S - T_\infty\right)^{0.25} \quad \text{(l-4)}$$

Substitute in Equation (l-4) to get:

$$h = 0.38 \times (325 - 60)^{0.25} = 1.53 \frac{BTU}{ft^2\ hr\ ^\circ F} \quad \text{(l-5)}$$

and in Equation (l-3) to get:

$$\frac{Q}{A} = 1.53 \times (325 - 60) = 406.3 \frac{BTU}{ft^2\ hr} \quad \text{(1-6)}$$

The heat loss per unit area (assuming an average convective heat transfer coefficient approximately of 1.5 BTU/hr ft^2 °F) is approximately 400 BTU/hr ft^2.

1.4 Evaporative Cooling

The heat loss accompanying evaporative cooling of asphalt compounds from the surface of the mass is approximately 100 BTU/lb of asnhalt evaoorated. Since asphalt only comprises approximately 5 percent of the mass, and only a small amount of the asphalt will be evaporated, this quantity of heat will not be included in the heat balances that follow.

1.5 Particle Heat Loss Summary

Convective heat transfer (406 BTU/hrft^2) from the surface of the mixed mass is the primary mechanism for heat loss from the surface and radiative heat transfer (53 BTU/hrft^2) accounts for approximately ten percent of the convective loss. To simplify the calculations that follow, a combined convective-radiative heat transfer coefficient whose value is (1.1x1.5) 1.65 BTU/hr ft^2 °F will be used in this study.

1.6 Conduction

The mechanism of heat transfer within the mass is conduction. The equation describing the temperature profiles in a solid is the Laplace Equation [5a] of conduction which, in this case is:

$$\frac{\partial T}{\partial t} = \alpha(\nabla^2 T) \quad (1 - 7)$$

In this case, the asphalt mass will be modeled as a semi infinite solid, Equation (l-7) becomes:

$$\alpha \frac{\partial^2 T}{\partial X^2} = \frac{\partial T}{\partial t} \quad \ldots\ldots \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1\text{-}8)$$

In Equation (1-8), T is temperature, t is time, and α is a parameter called “thermal diffusivity” defined by:

$$\alpha = \frac{k}{\rho C_p} \quad \ldots\ldots\ldots\ldots\ldots \quad (1\text{-}9)$$

in which k is the thermal conductivity, ρ is the density of the solid, and C_p is its heat capacity. Equation (l-8) is made dimensionless by introducing the following parameter:

$$\Theta = \frac{T_0 - T}{T_0 - T_S} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (l\text{-}10)$$

Substitute Equation (l-10) in Equation (l-8) to get:

$$\alpha \frac{\partial^2 \Theta}{\partial X^2} = \frac{\partial \Theta}{\text{at}} \quad \ldots\ldots \quad \text{(l-11)}$$

The initial and boundary conditions used to solve Equation (l-11) are:

$\Theta = 0$ when $t = 0$ all X (1-12a)

$\Theta = 1$ when $t \rangle 0$ X = 0 (I-12b)

$\Theta = 0$ when $t \rangle 0$ $x \rightarrow \infty$ (l - 1 2 c)

The solution to Equation (l-l 1) is [5d]:

$$\frac{T_0 - T}{T_0 - T_S} = 1 - \text{erf}\left[\frac{X}{\sqrt{4 \alpha t}}\right] \quad \ldots\ldots \quad \text{(l-13)}$$

In which erf(Z) is defined by:

$$\text{erf}(Z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-u^2}\, du \quad \ldots\ldots \quad \text{(1-14)}$$

$$\text{erf}(0) = 0 \quad \ldots\ldots \quad \text{(1-15)}$$

$$\text{erf}(m) = 1 \quad \ldots\ldots \quad \text{(I-16)}$$

The heat flux is given by:

$$\frac{Q}{A} = -k\left(\frac{\partial T}{\partial X}\right)_{X=0} \quad \ldots\ldots \quad \text{(1-17)}$$

Differentiate Equation (1-13) with respect to X to get:

$$\frac{\partial}{\partial X}\left[\frac{T_0 - T}{T_0 - T_S}\right] = \frac{\partial}{\partial X}\left[1 - \text{erf}\left(\frac{X}{\sqrt{4 \alpha t}}\right)\right] \quad \ldots\ldots \quad \text{(l-18)}$$

Evaluate Equation (l-18) using the identity:

$$\frac{\partial}{\partial X}\left[\text{erf}(Z)\right] = -\left[\frac{2}{\sqrt{\pi}} e^{-Z^2}\right]\frac{\partial Z}{\partial X} \quad \text{(l-19)}$$

with:

$$z = \frac{X}{\sqrt{4\alpha t}} \qquad \text{(l-20)}$$

and:

$$\frac{\partial Z}{\partial X} = \frac{1}{\sqrt{4\alpha t}} \qquad \text{(l-21)}$$

Substitute Equations (1-19) and (l-20) in Equation (1-18), and rearrange slightly to get

$$\frac{\partial T}{\partial X} = -(T_0 - T_S)\left[\frac{2}{\sqrt{\pi}}\right]\left[\exp\left(-\frac{X}{\sqrt{4\alpha t}}\right)^2\right]\left[\frac{1}{\sqrt{4\alpha t}}\right] \quad \text{(l-22)}$$

The temperature gradient at the solid surface (X = 0) is:

$$\left(\frac{\partial T}{\partial X}\right)_{X=0} = \frac{Ts - To}{\sqrt{\pi \alpha t}} \qquad \text{(l-23)}$$

and the conductive heat flux is:

$$\frac{Q}{A} = -k\left(\frac{\partial T}{\partial X}\right)_{X=0} = k\left(\frac{T_0 - T_S}{\sqrt{4\alpha t}}\right) \qquad \text{(l-24)}$$

Heat transfer by convection (corrected for radiation) is the primary mechanism for removing heat from the surface of the mass of the asphalt; it will be assumed that it is the only mechanism, and the conductive heat flow in the mass will be equated with the convective heat flux. It will be necessary to adjust the surface temperature (T,) as time progresses.

2. PHYSICAL PROPERTIES

Asphalt is not a single compound, but a mixture of hundreds of individual compounds that are found in the residuum of petroleum refining. Asphalt is the material that remains after the more volatile components have been distilled away, often at high vacuum. The hydrocarbon components in asphalt are generally C_{25} and higher. Since it was impossible to find all required physical properties of asphalt in available literature, the compound hexacosane ($C_{26}H_{54}$) was used as a physical property model. Physical properties that were not available were estimated using standard methods. The following data were available [4]:

Molecular Weight	366.72	API gravity	50.3"
Specific Gravity	0.7783	UOP K factor	13.7
Boiling Point	262°C at 15 mmHg		

Vapor Pressure:

mmHg	1	10	40	100	760
T°C	204.0	257.4	295.2	323.2	399.8
T°F	399.2	495.3	563.4	614.1	751.6

The vapor pressure data were correlated by:

$$P^0 (\text{mm Hg}) = 9.695 \sim 10^9 \left[\text{erp} \quad \frac{}{} \quad \left(\frac{-19750}{T°R}\right)\right] \qquad (2\text{-}1)$$

The following properties were estimated using accepted methods:

Property	Method	Value
Critical Temperature	Nokay [6a]	543.2°C
Critical Pressure	Lyderson [6a]	9.412 atm
Critical Volume	Lyderson [6a]	1470 cm^3/mol
Heat of Vaporization	Othmer [3b]	103.7 BTU/lb at 325°F
Liquid Viscosity	Orick and Erbar [6b]:	

$$\mu (cp) = 1.16 \times 10^{-3} \left[\exp\left(\frac{2846}{T°K}\right)\right] \qquad (2\text{-}2)$$

Liquid Heat Capacity — Luria and Benson [6c]:

$$C_P (\text{molar}) = -16.724 + 1.69(T) - 5.063 \times 10^{-3}\left(T^2\right) + 5.79 \times 10^{-6}\left(T^3\right) \qquad (2\text{-}3)$$

Thermal Conductivity — Robbins and Kingrea [6d]:

$$k = 3.314 \times 10^{-4}\left(\frac{C_P}{T°R}\right) \qquad (2\text{-}4)$$

Note: C_P in molar units in this equation

3. TEMPERATURE PROFILES

3.1 Introduction

The system will be modeled in two stages. The first is the period during which a batch of asphalt product is dropped from the pug mill mixer into the truck. The second is the period when the batch is in the truck. The second period will be assumed to begin at the conclusion of the first.

3.2 First Period

During this period, the asphalt will be assumed to be in the form of 1/4 inch (2.08×10^{-3} ft) spheres at a uniform temperature of 325°F. Since the spheres are moving (they are falling into the truck), it is assumed that the heat transfer coefficient, between the spheres and the air, is (10x1.5) 15 $BTU/ft^2 hr°F$.

The Biot number [7] in the sphere is:

$$Bi = \frac{L\,k}{h} = \frac{2.08 \times 10^{-2} \times 0.132}{15} = 1.8 \times 10^{-4} \quad \cdots \quad (3\text{-}1)$$

Since the Biot number is very low, one can safely assume that the convective heat transfer (from the surface) is controlling and the internal temperature is relatively constant. Assume that the heat transfer coefficient will be approximately ten times as high as the value calculated using Equation 1-5, the rate of heat loss from the sphere is:

$$\frac{Q}{A} = h\left(T_S - T_\infty\right) = 15x(325 - 60) = 3980 \frac{BTU}{hr\,ft^2} \quad \cdots \quad (3\text{-}2)$$

In which T_∞ is the temperature of the air and T_S is the surface temperature of the particle. The area of the sphere is:

$$A = \pi D^2 = \pi\left(2.0810^{-2}\right)^2 1.36 \times \quad 10^{-3} \quad ft^2 \quad (3\text{-}3)$$

Assume that the particle must fall 10 feet from the mill outlet to the truck. The elapsed time is:

$$t = \sqrt{\frac{2 \times 10}{32.2}} = 0.788 \text{ sec} \quad \cdots \quad (3\text{-}4)$$

Which is equivalent to (0.78813600) 2.19×10^{-4} hours. The amount of heat lost from the particle is:

$$Q_{particle} = 3980 \times 1.36 \times 10^{-3} \times 2.19 \times 10^{-4} = 1.18 \times 10^{-3} \text{ BTU} \quad (3-5)$$

The mass of the particle is:

$$\text{Mass} = \frac{\pi D^3}{6}\rho = \frac{\pi \times \left(.08 \times 10^{-3}\right) \times (0.7885 \times 62.4)}{6} = 2.32 \times 10^{-4} \text{ lbs} \quad (3-6)$$

The temperature change in the particle (using the heat capacity of asphalt) is:

$$AT = \frac{1.18 \times 10^{-3}}{2.32 \times 10^{-4} \times 0.656} = 7\ 8\ ^\circ\ F \quad (3\text{-}7)$$

This estimate can be refined with several additional iterations, but for the purpose of this study, it is sufficiently accurate to take the temperature change as 7°F and the initial temperature of the asphalt in the truck to be (325 - 7) 318°F.

3.3 Temperature Changes in the Truck

This period will be evaluated using the equations developed in Sections 1.3 and 1.5. It will be assumed that the mass in the truck is homogeneous, and its physical properties are equal to those of asphalt (or hexacosane). In this case, the Biot number is very large and the internal temperature profiles must be considered. The development of the temperature profiles will be developed first using numerical methods; the emission rate from the mass will be computed using the results of the temperature calculation.

The conductive heat flux through the asphalt has been given by Equation (l-24):

$$\frac{Q}{A} = -k\left(\frac{\partial T}{\partial X}\right)_{X=0} = k\left(\frac{T_0 - T_S}{\sqrt{4\alpha t}}\right) \quad (1\text{-}24)$$

and the convective heat flux from the surface has been given by Equation (l-3):

$$\frac{Q}{A} = h\left(T_S - T_\infty\right) \quad (1\text{-}3)$$

Since the heat flux is the same in the solid and gas phases, equate Equations (l-23) and (l-5) to get:

$$\frac{Q}{A} = -k\left(\frac{T_0 - T_S}{\sqrt{4\alpha t}}\right) = h\left(T_S - T_\infty\right) \quad (3\text{-}8)$$

Now solve Equation (3-8) for the surface temperature T_S to get:

$$T_s = \frac{h T_\infty \sqrt{\pi \alpha t} + k T_0}{h \sqrt{\pi \alpha t} + k} \qquad \text{(3-9)}$$

Equation (3-9) is a relationship between the surface temperature of the mass, and the elapsed time since it was deposited in the truck.

The thermal boundary layer is that portion of the mass in which all of the temperature changes occur. Outside of this boundary layer, the temperature is constant at the temperature of the initial deposit (318°F). In order to evaluate the boundary layer thickness, a trial and error approach was used. The temperature profile, given in Equation (l-12) was solved for T:

$$T(x,t) = T_0 - (T_0 - T,)\left[1 - \operatorname{erf}\left(\frac{X}{\sqrt{4 \alpha t}}\right)\right] \qquad \text{(3-10)}$$

The time was assumed and values of X were found so that the temperature was within tolerance of the initial temperature. The boundary layer thickness was found to be approximately 1 inch at 3.3 minutes.

4. EMISSION RATES

The emission rates were determined based upon published AP-42 emission factors. These are:

TABLE 4-l
AP-42 Emission Factors for VOC
From Hot Mix Asphalt Plants
Entries in lb/ton

	Batch Mode	Drum Mode
Natural Gas	0.017	0.051
Fuel Oil	0.046	0.069

Of these, the factor for VOC emission using fuel oil in the drum mode was chosen for this study because it provided the most conservative (high) estimate.

The data in Table 4-l represents the amount of VOC that will be emitted during the production of a ton of hot mix asphalt. The amount of fuel required to produce a ton of hot mix asphalt has been reported to be 0.5 gallons of Number 2 fuel oil. This is equivalent to (05x140,000) 70,000 BTU or (70,000/1000) 70 standard cubic feet of natural gas.

The AP-42 factor for VOC emission during Number 2 fuel oil combustion is 0.20 lb/mgal; the AP-42 factor for VOC emission during natural gas combustion is 2.78 lb/mmSCF. The VOC emission associated with fuel combustion during hot mix asphalt production are $(0.5x10^{-3}x0.2)$ $1.0x10^{-4}$ lb/ton for fuel oil and $(70x10^{-6}x2.78)$
$1.95x10^{-4}$ lb/ton. These quantities are small and will not be considered here.

For the purposes of this investigation, the emission factors given in Table 4-l were interpreted as lb/ton per hour. That is, if one ton of hot mix asphalt could be maintained under manufacturing process conditions, it would emit the AP-42 factor.
When dealing with fugitive emissions, the process conditions are not maintained. If fact the mass cools quickly, and a thermal boundary layer is created. The emissions of VOC are dependent upon three parameters:

1. The rate at which liquid can flow to the surface,
2. The ease with which the liquid can be vaporized (volatility), and
3. The rate with which the volatilized asphalt components can be removed from the vicinity of the cooling mass (diffusion).

In order to develop a liquid flow factor, it will be assumed that the liquid flow to the surface of the mass occurs by capillary flow, which is a form of laminar flow. The equation for pressure drop in a fluid system is:

$$H_f = f\left(\frac{L}{D}\right)\left(\frac{v^2}{2g}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.1)$$

The (D'Arcy-Moody) friction factor in laminar flow is:

$$f = \frac{64}{N_{Re}} = \frac{64\,\mu}{D\,v\,\rho} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4\text{-}2)$$

substitute Equation (4.2) in Equation (4.1) and solve for v to get:

$$v = \frac{H_f D^2 \rho g}{32\,\mu L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4\text{-}3)$$

If it is assumed that the capillary pressure is constant, and the diameter of the passages arc constant, Equation (4-3) demonstrates that the liquid flow rate is inversely proportional to the viscosity of the liquid.

The volatility is simply expressed as the vapor pressure (of hexacosane) at the surface temperature of the mass.

The diffusion coefficient is more difficult to estimate. There are no published data describing diffusion of compounds of this type in air. The diffusion coefficient for asphalt vapor in air (at 25°C) was estimated by noting the a strong correlation between diffusion coefficient and geometric mean molecular weight shown in Figure 4-l. The data were correlated using the method of least squares; the resulting empirical equation is:

$$D_{AB} = 20.78(MW)^{-1.392} \quad (4\text{-}4)$$

The index of correlation (r^2) is 0.91, indicating a good fit to the data. Equation (4-4) was evaluated at the geometric mean molecular weight of air and hexacosane $[(29+366)^{0.5}]$ 103 to obtain an estimate of 0.0327 cm^2/sec at 25°C. Admittedly, this is a small extrapolation but represents the best available information.

The Chapman-Enskog [5b] kinetic theory was used to relate the diffusion coefficient to temperature. The Chapman-Enskog equation is rather complex, but for this discussion has been simplified as:

$$D_{AB} = \varsigma\left(\frac{T^{1.5}}{\Omega_D}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4\text{-}4)$$

in which ζ is a constant related to the system and Ω_D is a function of temperature that is usually presented in tabular form [5c]. For use in this investigation, Ω_D was plotted against the temperature function (which is the product of two system-specific constants and the absolute temperature). The graph is presented Figure 4-2.

FIGURE 4.1
Diffusion Coefficients of Various
Compounds in Air at 25°C [8]

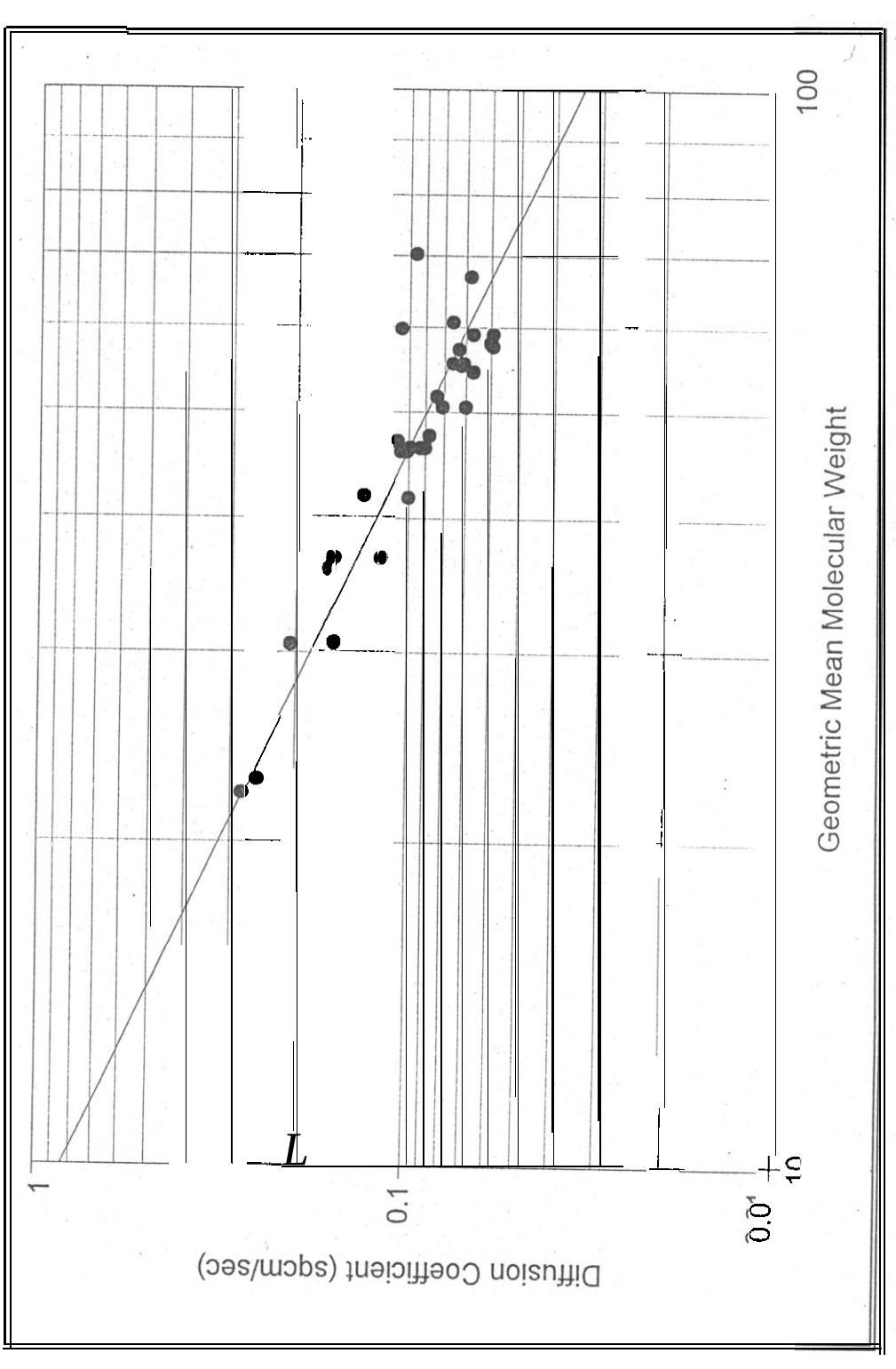
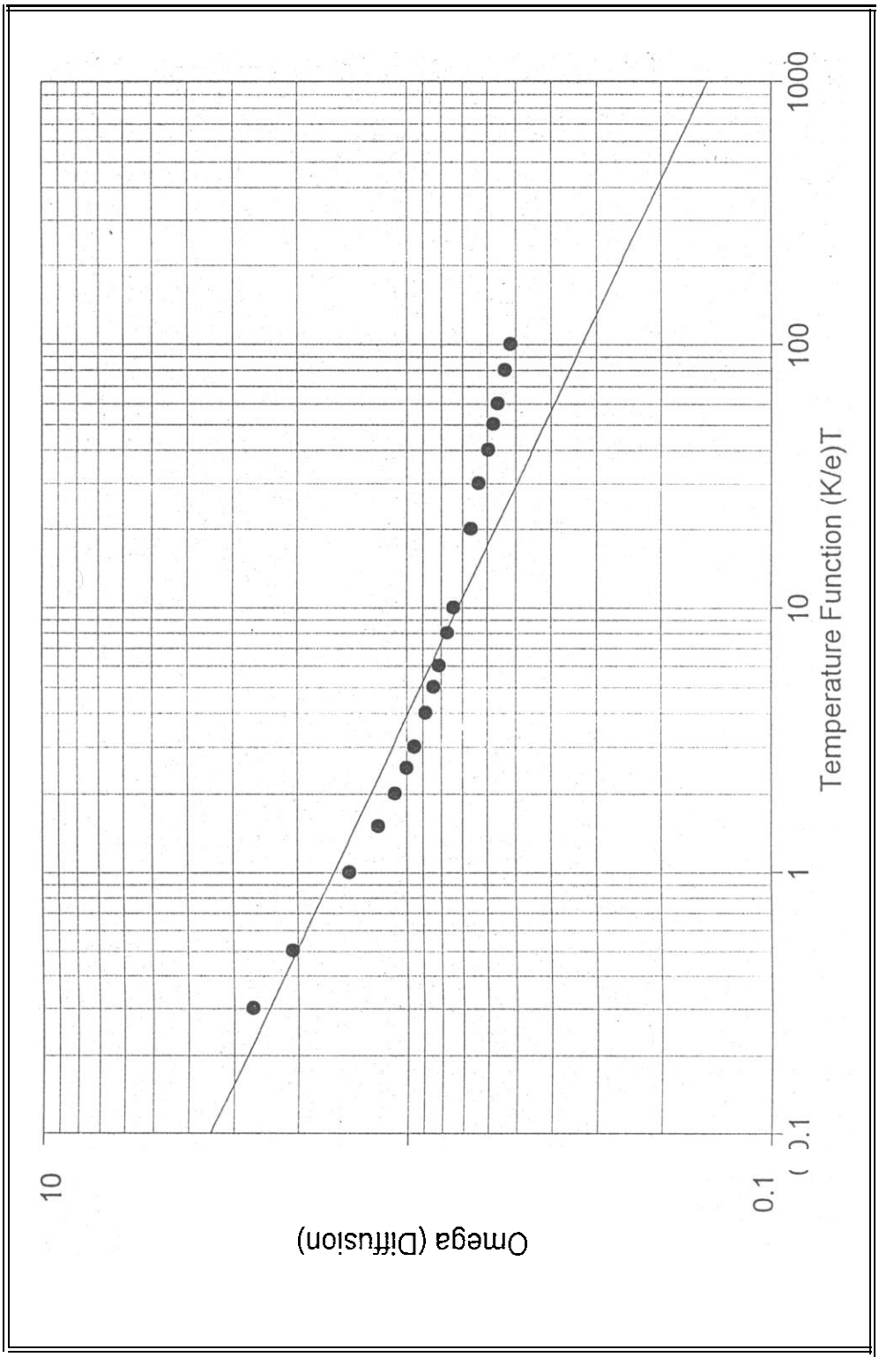


FIGURE 4-2
The Ω_D Function [5c]



c:\tcwin2\omegadif.prn

A power law equation (similar to Equation 4-3) was fit to the published data again using the method of least squares; the resulting empirical equation is:

$$\Omega_D = 1.583(KT / \varepsilon)^{-0.34} \quad (4\text{-}6)$$

The index of correlation (r^2) is 0.93, indicating another good fit. Equation (4-5) is a simple and relatively accurate relationship which is satisfactory for use here. Since both K and ϵ are compound-specific constants, Equation (4-6) indicates that the Ω_D function is proportional to the (absolute) temperature raised to the (-0.34) power. When this is substituted in Equation (4-5) it becomes:

$$D_{AB} = \varsigma\left(\frac{T^{1.5}}{T^{-0.34}}\right) = \varsigma\left(T^{1.84}\right) \quad \ldots\ldots\ldots\ldots \quad (4\text{-}7)$$

Equation (4-7) will be used to estimate the variation of diffusion coefficient with temperature,

In order to predict emission rates as the mass cools, it was assumed that the full value of the AP-42 factor was applicable when the mass was being prepared and was maintained at the mixer temperature of 325°F.

The AP-42 factor is adjusted using three "parameter correction factors" defined:

$$F_i = \frac{P_i\left(T_{SUR}\right)}{P_i(325°F)} \quad (4.8)$$

in which P is the parameter (vapor pressure, viscosity, diffusivity) and F_i is the respective correction factor defined as the ratio between the value of the parameter at the instantaneous surface temperature of the asphalt, divided by the value of the same parameter at 325°F. The overall correction factor is:

$$F_O = \frac{F_{VP} F_{Diff}}{F_{Visc}} \quad \ldots\ldots\ldots\ldots \quad (4\text{-}9)$$

The emission rate is computed as the product of the overall correction factor and the AP-42 factor. Recall that the oil/drum factor will be used here because it provides the most conservative (high) estimate:

$$\text{Emission Rate}\left(\frac{lb / hr}{ton}\right) = F_0 \times (AP42EmissionFactor) \quad (4\text{-}10)$$

5. CALCULATIONS

The calculations were in the following order:

5.1 A time was assumed.

5.2 The surface temperature was calculated using Equation (3-9).

5.3 The physical and transport properties of the mass were evaluated at the surface using the surface temperature computed in Step 5.2.

5.4 The thickness of the thermal boundary layer was computed using Equation (3-10) and a trial and error solution. The assumed thickness (X) was varied until the computed temperature [T(X,t)] was equal to the initial temperature (T,).

5.5 The vapor pressure, liquid viscosity, and diffusion coefficient, at the surface temperature were computed using Equations (2-1), (2-2), and (4-6), respectively.

5.6 The parameter correction factors for vapor pressure, liquid viscosity, and diffusion coefficient were computed using Equation (4-7), and the overall correction factor was computed using Equation (4-8).

5.7 The emission rate was computed using Equation (4-9). Recall that this rate is only valid for the period defined in Step 5.1.

5.8 The amount of VOC emitted during the period is equal to the product of the emission rate calculated in Step 5.7 and the duration of the time period. The emission is expressed in the units of lb/ton.

5.9 The total emission is calculated by adding the amount emitted (Step 5.7) to that computed in previous iterations.

5.10 Assume a new temperature and repeat Steps 5.2 through 5.9.

These calculations were performed by computer, the output is appended.

6. RESULTS

The results of this study are summarized in Figures 6-1, 6-2, and 6-3 which relate surface temperature, thermal boundary layer thickness, total emissions, and instantaneous emission rate; respectively; to elapsed time. The study was conducted over a time period of 3.3 minutes from the time that the pug mill is empties into a truck. The emission rate has decayed considerably and only adds a small increment to the total.

The "3.3 minute emission factor" is 4.21×10^{-4} pounds per ton, which will be increased by 10 percent to $(1.1 \times 4.21 \times 10^{-4})$ 4.63×10^{-4} pounds per ton to account for any emissions that might occur after the 3.3 minute period has elapsed.

This number is approximately two orders of magnitude smaller than the AP-42 factors (Table 4-1) because the asphalt is cooling and thereby severely restricting its ability to emit,

The stack emissions from a batch mix hot mix asphalt facility, operating in the batch mix mode, using natural gas fuel, and producing 300 tph of product are:

VOC emissions = 0.017 x 300 = 5.10 lb/hr (6-l)

The fugitive emission from the truck would be:

Fugitives = (4.63×10^{-4}) x 300 = 0.14 lb/hr (6-2)

Which is about 2.7 percent of the stack emissions.

The emission rate, defined as the rate at which VOC evaporates from the surface of the asphalt, is initially equal to the evaporation rate from the asphalt during the mixing, falls to approximately ten percent of the initial rate after approximately 3 minutes. This is shown in Figure 6.4.

FIGURE 6.1
Surface Temperature of Cooling Asphalt Mass

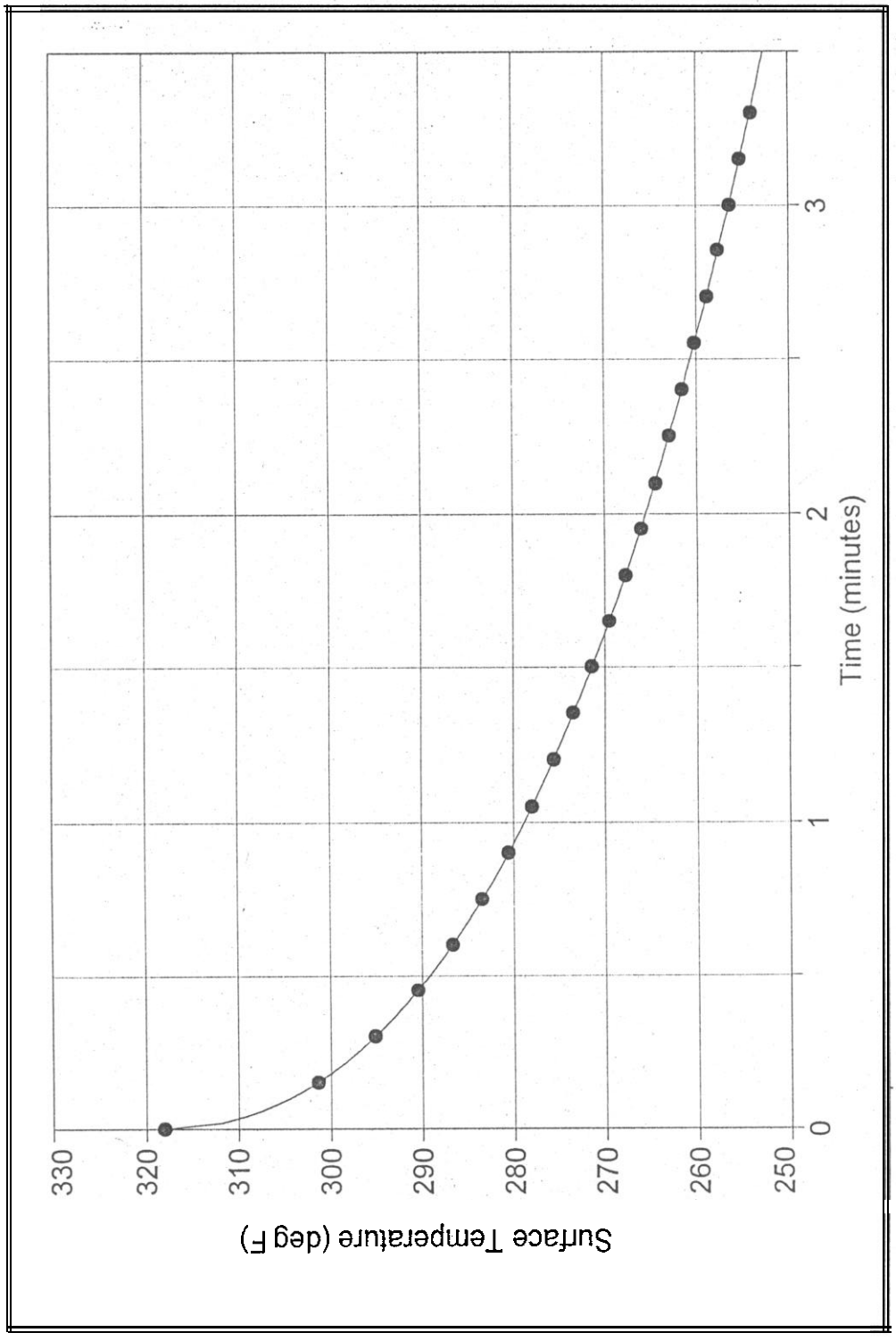


FIGURE 6.2
Development of the Thermal Boundary Layer
in Cooling Asphalt Mass

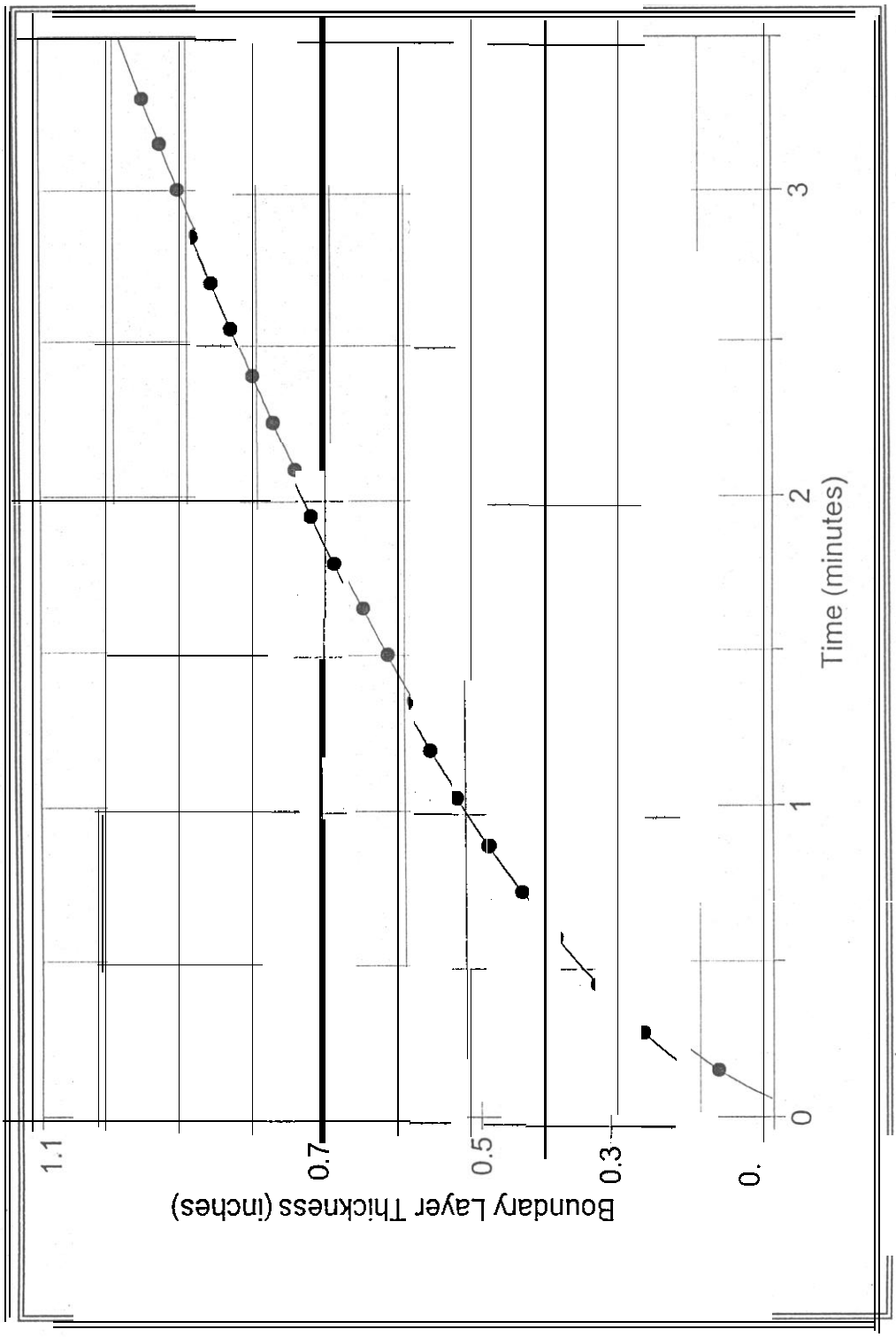


FIGURE 6.3
Fugitive VOC Emissions from Cooling Asphalt Mass
Development of the Emission Factor

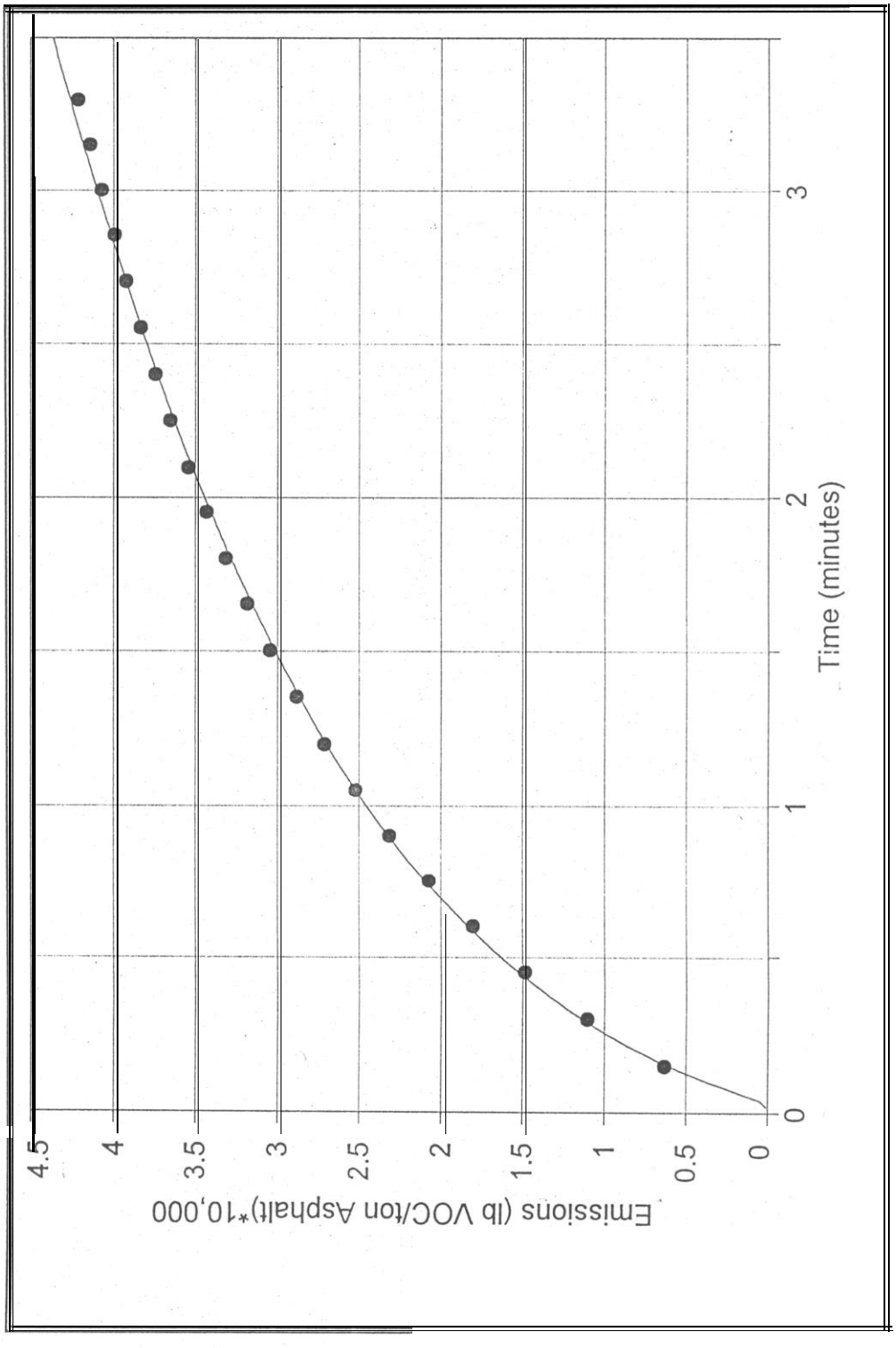
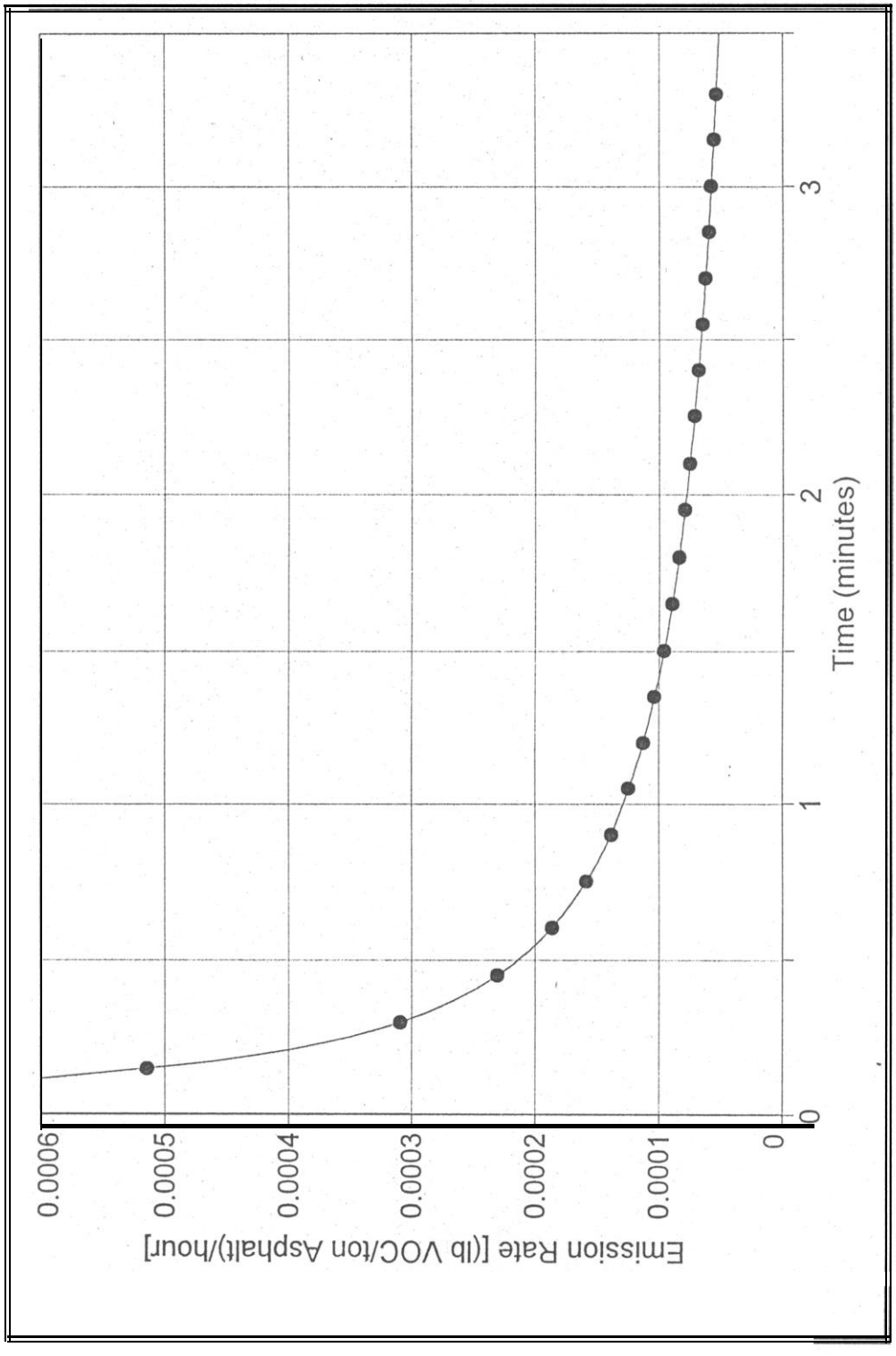


FIGURE 6.4
Fugitive Emission Rate from
Cooling Asphalt



c:\tcwin2\aspderiv.prn

Appendix 1: Computer Output Sheets

Appendix 2 Literature Cited

[1] 1989 Ashrae Handbook, Fundamentals, Page 3.11

[2] RH Perry, D Green "Perry's Chemical Engineers' Handbook, 6/ed" McGraw Hill (1984) pp 10.62, 10.63

[3] JH Perry, ed. "Chemical Engineers' Handbook, 3/ed" McGraw Hill (1950) p 474

[3b] Ibid, Page 300

141 RC Weast, ed. "Handbook of Chemistry and Physics, 49/ed" (1968) assorted pages

[5a] RB Bird, WE Stewart, EN Lightfoot "Transport Phenomena" Wiley (1960), Chapter 10

[5b] Ibid, Page 510

[5c] Ibid, Page 746

[5d] Ibid, Section 11.1

[6a] RC Reid, JM Prausnitz, TH Sherwood "The Properties of Gases and Liquids, 3/ed" McGraw Hill (1977), Page 12

[6b] Ibid, Page 439, 440

[6c] Ibid, Page 155, 156

[6d] Ibid, Page 519

[7] DQ Kern "Process Heat Transfer" McGraw Hill (1950) Page 37

[8] CO Bennett, JE Myers "Momentum, Heat, and Mass Transfer, 2/ed" McGraw Hill (1974) Page 787

Steven Zemba
Cambridge Environmental Inc.
Cambridge, MA

This Page is intentionally left blank.

zemba@cambridgeenvironmental.com

09/22/00 10:34 AM

To: Ron Myers/RTP/USEPA/US
cc:
Subject: Belated Comments on the Hot Mix Asphalt Emissions Assessment Report

---

Hi Ron:

I apologize for not geeting these comments to you within the official comment period, but since I did review the emission assessment report at a cursory level, I thought I would pass along my notes belatedly in the hope that they still might be useful to you. My notes/comments are contained in the attached file. Feel free to call/write with any questions on them. I hope that this represents the end of the process for you!

Take care,

Steve

--
Stephen Zemba (mailto:Zemba@CambridgeEnvironmental.com)
Cambridge Environmental Inc.
58 Charles St.
Cambridge, MA 02141
617-225-0810 (Voice)
617-225-0813 (FAX)
http://www.CambridgeEnvironmental.com

 - asphalt_comments.PDF

Comments and notes on "Hot Mix Asphalt Plants, Emission Assessment Report"

General: A list of acronyms at the front of the document might e helpful to readers.

General: Tables 1 and 2 claim to present emissions for a "typical" plant. This is probably true for mixer emissions, but is not the case for the fugitive sources, as indicated by statements on p. 14. Specifically, the fugitive emission estimates assume a high-end volatility of asphalt cement, and also a maximum recommended load-out temperature. I would thus characterize the fugitive emission estimates as "high-end" for a typically-sized plant. EPA might want to clarify this matter somewhat, since the actual ratio of fugitive-to-stack emissions for a typical plant running at typical conditions will be lower than that implied in Tables 1 and 2.

General: Many HMA plants are now installing condensers on their asphalt storage tank vents and silo vents; some are enclosing or partially enclosing their loadout areas. The fugitive emissions discussed in this document are for uncontrolled sources. In fact, the estimates in Tables 1 and 2 implicitly assume controls on the mixer (dryer) stack but no controls for fugitive emissions. This assumption should be made explicit (perhaps in a footnote to the tables). EPA might also want to offer some opinion/conjecture on the efficacy of engineering controls for the various fugitive sources.

Specific comments

The last sentence third pgh. of pg 1 contains a typo: the 100,000 tons of production corresponds to a *batch* plant, not a drum plant.

1st pgh. of p. 10: Does the emission assessment report provide stack emission rates for a typical counterflow or parallel flow drum plant? If the estimates are for a parallel flow plant, it might make sense to mention in the text the approximate difference expected for emissions from a counterflow plant (*e.g.*. this could be mentioned in a footnote to Table 2).

p. 3: EPA might want to provide the regulatory definition or a better explanation of criteria pollutants and HAPs.

p. 2, 3rd pgh: Might want to mention the number of tests (> 300) that survived the screening process (*i.e.*, were usable for the development of emission factors).

p. 13: Are emissions from hot oil heaters included in any of the categories in Tables 1 & 2 (*e.g.*, the "mixer" category)? If not, does it make sense to mention the likely magnitude of these emissions relative to other sources (qualified, of course, by the large degree of uncertainty resulting from the dearth of test data)? Might it also be possible to use emission factors from similar burners (used in other industries) to evaluate hot oil heater emissions?

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-454/R-00-030		

4. TITLE AND SUBTITLE	5. REPORT DATE
Hot Mix Asphalt Plants Stakeholders Opinions Report	April 2001
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Ron Myers (EPA)	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Research Triangle Park, NC 27711	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Air Quality Planning and Standards Office of Air and Radiation U.S. Environmental Protection Agency Research Triangle Park, NC 27711	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE EPA/200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The United States Environmental Protection Agency (EPA) Source Measurement Technology Group (SMTG) and Emission Factors and Inventory Group (EFIG) are investigating the Hot Mix Asphalt industry to identify and quantify criteria and hazardous air pollutants (HAP's) emitted from kiln stacks, transport truck loading and silo filling at hot mix asphalt plants. The EPA report titled "Hot Mix Asphalt Plants - Emissions Assessment Report" (EPA 454/R-00-019, December 2000) presented the findings from these investigations. As part of the investigation, EFIG obtained over 300 emission tests from kiln stacks that characterize emissions of criteria pollutants and hazardous air pollutants' emissions. Additionally, SMTG sponsored two kiln stack emission tests and two emission tests of the transport truck and silo filling operations. The primary objective of the testing program was to characterize uncontrolled emissions of the criteria pollutants particulate matter (PM) and total hydrocarbons (THC) and emissions of volatile and semi-volatile organic HAP's. The results of the four test reports and responses to comments on these test reports are covered in separate EPA reports (EPA 454/R-00-020, EPA 454/R-00-021, EPA 454/R-00-022, EPA 454/R-00-023, EPA 454/R-00-024, EPA 454/R-00-025 (a through h), EPA 454/R-00-026, EPA 454/R-00-027, EPA 454/R-00-028 and EPA 454/R-00-029). This document includes stakeholder comments on the draft version of the Emissions Assessment Report, EPA's response to these comments, stakeholder opinions on the final version of the Emissions Assessment Report and EPA responses on new issues raised by stakeholders.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Hot Mix Asphalt Silo Filling Truck Loading Particulate Matter Volatile Organic Compounds Total Hydrocarbons Hazardous Air Pollutants	Air Pollution control	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(Report)*	21. NO. OF PAGES
Release Unlimited	Unclassified	288
	20. SECURITY CLASS *(Page)*	22. PRICE
	Unclassified	

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

This Page is intentionally left blank.