EPA-453/R-02-010
June 2002

# Technical Support Document: Printing, Coating, and Dyeing of Fabrics and Other Textiles Proposed NESHAP

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# MEMORANDUM

June 12, 2002

From: G. V. Hellwig

To: Printing, Coating and Dyeing of Fabrics and Other Textiles File

Subject: COATING AND PRINTING FLOOR

## SUMMARY

This memorandum describes the methodology and conclusions of the maximum achievable control technology (MACT) floor analysis for the Coating and Printing subcategory of the Printing, Coating, and Dyeing of Fabrics and other Textiles NESHAP. The analysis is based on overall control efficiency (OCE) data from coating lines at 22 major or synthetic minor fabric coating facilities that were obtained from survey data. The MACT floor for existing sources was determined to be a 97 percent facility-wide coating line application and curing OCE for hazardous air pollutants (HAP), which is achievable with add-on control technology. The MACT floor for new sources was determined to be a 98 percent facility-wide coating line application and curing OCE for hazardous air pollutants (HAP), which is achievable with add-on control technology.

## BACKGROUND [1, 2]

The Printing, Coating, and Dyeing of Fabrics industry was identified as a source category of HAP under section 112(c) of the Clean Air Act, as amended in 1990 (the Act), to be regulated by a National Emission Standard for HAP (NESHAP) under section 112(d) of the Act. Section 112(d) of the Act directs the EPA to develop standards that require the maximum degree of reduction in emissions of HAP that is achievable, which are commonly referred to as MACT standards. For existing major sources, the Act requires MACT to be no less stringent than the average emission limitation achieved by the best performing 12 percent of existing sources among the data available to the Administrator. For new major sources, the Act requires MACT to be no less stringent than the emission control that is achieved in practice by the best controlled similar source. These minimum stringency levels are often referred to as the “MACT floor.”

Coating and Printing was determined to be a subcategory of Printing, Coating and Dyeing of Fabrics. The manufacturing processes, HAP emissions, and types of controls in use set it apart from the other processes that are used in the manufacture of textile products. Coating is a web coating operation, and the physical operations and most facilities performing coating are separate and distinct from the other textile operations. Printing is a web process very similar to coating and uses some of the same equipment. This memo is to explain the basis for the MACT Floor for this subcategory.

Coating is a specialized chemical finishing technique designed to produce textiles to meet high performance requirements, e.g., for end products such as tents, roofing, soft baggage, marine fabric, drapery linings, flexible hoses, hot-air balloons, and awnings. Coatings generally impart elasticity to substrates, as well as resistance to one or more elements such as abrasion, water, chemicals, heat, fire, and oil. The substrate itself provides strength (such as tear strength) and can include wovens, nonwovens, knits, yarn, cord, and thread, although woven fabrics are most commonly used.

Printing is the application of color to a fabric in a design or pattern. In some cases the printing material is chemically the same as coating material only thinned to a lower viscosity. There are typically four types of printing used for mass production, rotary screen, engraved roller, flat-bed screen, and heat transfer. Rotary screen and engraved roller closely resemble coating and use principally the same type of equipment as fabric coating. Flat-bed screen is typically not a high production technique and does not emit large quantities of HAPs over a period of time given the limits of production. Heat transfer emits little or no HAPs in the transfer of the print to the fabric.

Both the substrates coated and printed as well as the coating itself vary. A number of different textile substrates can be coated including rayon, nylon, polyester, cotton, and blends. Coating chemicals used vary depending on end use of the coated fabric. Examples of coating chemicals include vinyl, urethane, silicone, and styrene-butadiene rubber. The polymer can be bought in various forms such as chunks, blocks, chips pellets or fine powder. However, beside the polymer resins, several other chemicals can also be included in the prepared coating. These include plasticizers to increase pliability (e.g., fatty acids, alcohols), solvents to disperse solids and adjust viscosity (e.g., toluene, xylene, dimethyl formamide, and MEK), pigments, curing agents, and fillers (e.g., carbon black and teflon). Rubber coating materials are frequently compounded in the facility performing the coating. Manmade fibers coated with epoxy or phenolic resins are often not immediately cured following application, but are first laid in a mold and then cured under pressure to form a composite structure.

The coating or printing process generally comprises the following unit operations: mixing the coating materials (including the solvents), conditioning the substrate, applying the coating to the substrate, evaporating the solvent in a drying oven, and sometimes curing or vulcanizing. The application and drying processes and emission controls used by facilities in the industry are similar and therefore lend themselves well to grouping into a subcategory. The application processes are similar in that they use continuous web coating techniques, but they include several types of coating and substrates. The coating industry treats coating as a surface applied coating in which a distinct layer of coating is applied to the substrate surface. Therefore, the mass of solids applied is a measure of coated or printed production. This leads to a production-weighted mass limit for HAP emissions, i.e., mass of HAP per mass of solids applied.

The MACT database for this subcategory consisted of a sample of seventeen facilities that EPA had complete non-CBI emissions and control information from responses to survey questionnaires. Although the MACT database contained information from 22 facilities, only seventeen of these are presented in this memo in order to maintain the confidential business information request. The coating and printing subcategory consists of more than thirty operating facilities; therefore, the MACT floor is based upon the best performing 12 percent of existing sources among the available data, in this case 3 facilities. The control option for all of the floor facilities in the coating and printing subcategory is capture and control by either thermal oxidation or carbon adsorption.

Printing is sometimes performed at the same facilities as other textile wet finishing operations such as dyeing, finishing, and coating. Printing was not a major contributor of HAPs in the surveys and plant visits EPA conducted. In the past this was a major source of HAP emissions and operations can emit large quantities of HAP if the formulations change from low HAP materials. The EPA has information on only one major source of HAP emissions from printing. The processes, application, and drying of printing are identical or nearly identical to coating, and therefore the control options and limits would be identical as well. For this reason printing operations were included in the fabric coating and printing subcategory. Wherever this memo discusses coating in the process description or control option, it also applies to printing.

## APPROACH TO ESTIMATING THE MACT FLOOR

The term "average," as it pertains to MACT floor determinations for existing sources, described in section 112(d)(3) of the Act, is not defined in the statute. In a Federal Register notice published on June 6, 1994 (59 FR 29196), the EPA announced its conclusion that Congress intended "average" as used in section 112(d)(3) to mean a measure of mean, median, mode, or some other measure of central tendency. The EPA concluded that it retains substantial discretion within the statutory framework to set MACT floors at appropriate levels, and that it construes the word "average" (as used in section 112(d)(3)) to authorize the EPA to use any reasonable method, in a particular factual context, of determining the central tendency of a data set.

In addition, in the June 6, 1994, Federal Register notice, the EPA stated that it has discretion to use "best engineering judgement" in collecting and analyzing data relevant to a MACT floor determination, and in assessing the data comprehensiveness, accuracy, and variability in order to determine which sources achieve the best emission reductions.

## DATA COLLECTION FOR THE MACT FLOOR

The American Textile Manufacturers Institute (ATMI) member companies represent about 80 percent of manufacturing capacity in the textile industry. In the Spring of 1997, ATMI mailed a MACT survey to member companies and to members of other Industry and State associations that agreed to collaborate on the survey effort. Responses were received from almost 400 facilities, including 4 facilities with solvent-based pigment printing, 17 facilities with water-based pigment printing, and 5 facilities with other printing [3]. Only one of the facilities with printing operations (solvent-based pigment printing) reported major source HAP potential to emit from printing. All but 3 of the facilities reported

HAP potential to emit less than 5 tons per year, with 7 facilities reporting less than 1 ton per year HAP potential to emit.

The ATMI database does not contain information about the materials used in printing. The EPA and ATMI agreed that it would not be reasonable to resurvey printing facilities for detailed process information, considering the low HAP emissions and potential to emit reported by facilities in the ATMI MACT survey. However, ATMI noted that coating might not be well represented in the survey [4]. Therefore, EPA undertook a survey effort to collect additional information from coating facilities. The EPA sent two different information collection requests to coaters, each to 9 companies: the first group of questionnaires was sent to companies that coat industrial fabrics [5]; and the second group of questionnaires was sent to companies that perform cord treating and surface coating operations for rubber-coated textiles [6].

To develop the two lists of companies to receive the questionnaires, the 1996 toxic release inventory (TRI) was used to identify facilities in the relevant SIC codes ( 2295 for industrial fabrics and 2296, 3052, and 3069 for cord treating and surface coating) that were major sources based on reported HAP releases to the air. Literature sources and stakeholders were consulted to obtain information about number of employees, products, and whether facilities had undertaken pollution prevention (P2) efforts. Companies were chosen for the mailing list to ensure representation of different sizes of companies and a range of products. To obtain a sample that is representative of the better performing facilities, preference was given to facilities that reported taking P2 actions; hence, the EPA believes that a larger sample would not result in a substantially different floor.

Responses were received from 22 facilities [7]. Five of the responses were classified largely as confidential business information, which limited the usefulness of these responses in characterizing the coating and printing subcategory. The results of the quantitative data collection efforts provided the technical database used for the MACT floor determination.

In addition to quantitative information obtained from the survey, the EPA made four site visits to coating facilities and two site visits to facilities with printing processes. The industry members that participated in the stakeholder process included members of the American Textile Manufacturer’s Institute (ATMI), the American Yarn Spinners Association (AYSA), the Industrial Fabrics Association International (IFAI), the Northern Textile Association (NTA) , and the Rubber Manufacturer’s Association (RMA), representatives of individual companies in the regulated industry, and representatives of companies that supply coatings to the industry. States that participated in the stakeholder process included Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia. The U.S. EPA was represented by the Office of Air Quality and Standards (OAQPS), the Office of Enforcement and Compliance Assurance (OECA), the Office of Pollution Prevention and Toxic Substances (OPPTS), the Office of Research and Development, and an EPA Small Business Ombudsman.

During stakeholder meetings, qualitative information from the Polymeric Coating of Supporting

Substrates - Background Information for Proposed Standards (EPA-450/3-85-022a, April 1987) was presented. Comments on the qualitative information presented as well as additional qualitative information were solicited from the stakeholders. The qualitative information reviewed and discussed with the stakeholders is contained in the following memoranda:

- Memorandum from Melissa Malkin and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. December 15, 1997 Final. Second PMACT Meeting for Fabric Printing, Coating, and Dyeing.
- Memorandum from Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. February 2, 1998 Final. Initial Regulatory Subgroup PMACT Meeting for Fabric Printing, Coating, and Dyeing.
- Memorandum from Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. March 2, 1998 Draft. Meeting with the American Yarn Spinners Association (AYSA) Environmental Services Committee to discuss the status of the Fabric Printing, Coating, and Dyeing MACT.
- Memorandum from Aarti Sharma and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. September 11, 1998 Draft. EPA and Rubber Manufacturers Association (RMA) meeting.
- Memorandum from Melissa Malkin and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. September 11, 1998 Draft. Summary of Northern Textile Association (NTA)/U.S. Environmental Protection Agency (EPA) meeting to review the MACT/PMACT status.

Qualitative information from these sources provided descriptions of coating and printing processes, HAP control technologies, and process and control technology concerns. These data verified that the coating processes and HAP emission sources are similar for all coating types and that similar HAP control technologies are used. Therefore, the qualitative data provide a representation of the coating industry and the control technology used by the industry. The database is reflective of the variety of products that contain coated fabrics and the facilities that will be subject to this rule.

Examples of the products manufactured from textiles coated by the facilities in the database include:

- rubber belts and hoses for automotive use
- coated fabrics for use as tarps, hot air balloons, awnings, and outer wear (raincoats)
- commercial aircraft evacuation slides
- geomembranes
- speaker diaphragm surrounds
- luggage
- hot air balloons
- tennis and racquet balls

The floor facilities comprised the following types of production facilities:

- Urethane fabric coating and fabric laminating
- PVC and polyurethane coating of nylon and polyester fabrics
- Rubber and vinyl coating of textile substrates

Coated fabrics produced by the floor facilities are used in manufacture of the following products: truck tarps, geomembranes, roofing, tents, pillow tanks, architectural structures, billboards, hot air balloons, inflatables, military fabric, air bag material for cars, and diaphragms for gas meters and fuel pumps.

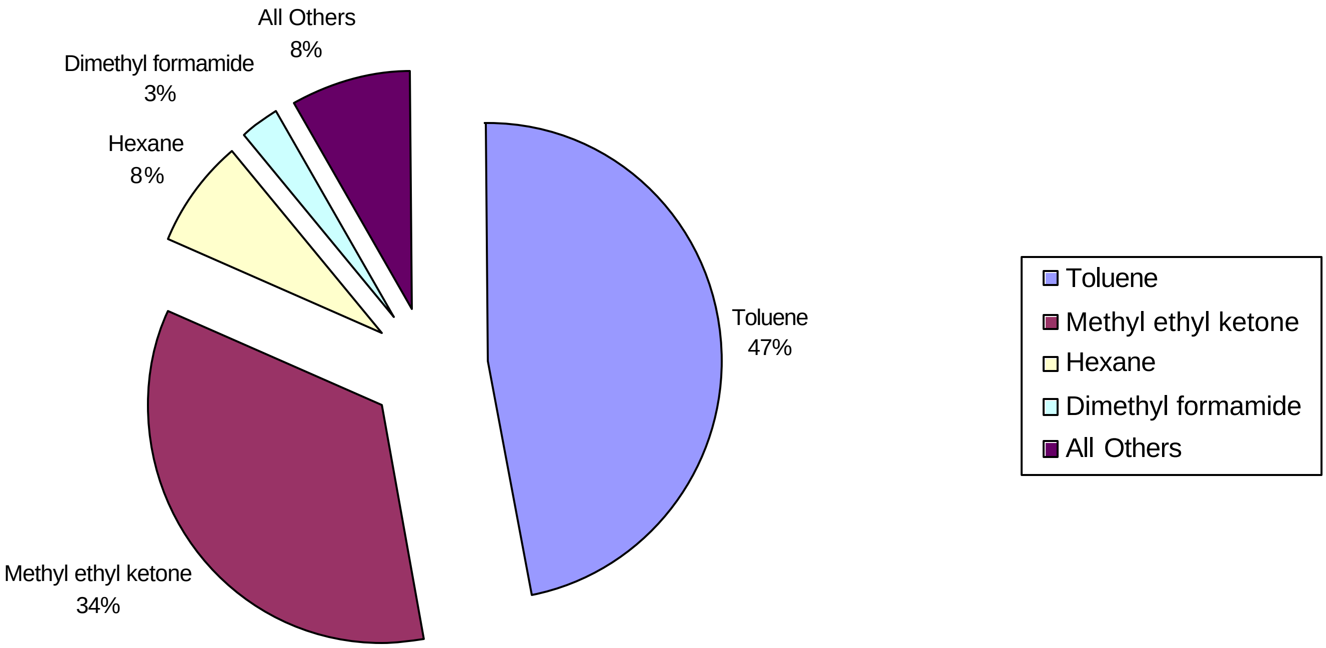
## RESULTS OF DATA COLLECTION AND THE COATING MACT DATABASE

The quantitative information collected from the coating industry [8] was entered into a database created to help determine MACT subcategory floor and to analyze impacts of regulatory options. The coating MACT subcategory database presented in this memo contains a total of 17 facilities, excluding 5 facilities that have classified most of the ICR response as confidential business information (CBI). Information from the 5 facilities claiming CBI (with the exception of emissions data, which were not claimed CBI) was not used in developing the summary data presented in this section. In performing the MACT floor analysis, the relevant information from the 5 facilities claiming CBI was examined to determine if any of the facilities qualified as MACT-floor facilities. None was determined to be a MACT-floor facility.

The surveyed facilities were asked to provide facility HAP emissions from coating operations as well as HAP emissions from the specific unit operations associated with coating. The total HAP emissions for the 21 facilities reporting facility HAP emissions in the ICR response (one facility did not report HAP emissions on the forms, but included sufficient HAP-containing materials information to calculate the HAP emissions) were calculated to be 1,242 tons in 1997. Chart 1-1 presents a breakdown of the facility emissions by HAP. Unit operations associated with coating for which HAP emissions estimates were requested including coating application, drying and curing; substrate preparation; storage tanks; mixing; parts and equipment cleaning; and waste and wastewater. Facilities in the MACT database reported only 4.3 percent of facility HAP emissions from unit operations other than coating application and drying/curing (ancillary operations), with mixing accounting for almost half of the emissions from ancillary operations. This is roughly in line with a previous estimate of the split of VOC emissions from coating operations made during development of the new source performance standards (NSPS) for polymeric coating of supporting substrates [9].

Of the 21 coating MACT-database facilities that provided detailed information including emissions and controls, thirteen facilities responded that they operate controls on their coating lines; seven facilities reported operating with no controls. There are 29 controlled coating lines in the MACT database. Of the 29 controlled lines, 16 lines are controlled with thermal oxidizers, 3 lines with catalytic oxidizers, 9 lines with carbon adsorbers, and one line with an electrostatic precipitator. The reported data on capture and control device destruction efficiency consisted of source test data, mass

**Chart 1-1. Nationwide Coating Industry Emissions by HAP**



balance comparisons, vendor guarantees, and engineering judgement.

## CRITERION FOR EVALUATING HAP EMISSION REDUCTIONS FROM COATING OPERATIONS

The MACT floor for coating and printing was evaluated on the basis of the collection of all operations at a facility associated with the surface coating of a textile; because, in general, the facilities in the coating source category floor capture and control emissions from their coating lines in this same manner. Surface coating and printing operations include preparation of a coating for application (e.g., mixing with thinners); substrate preparation; coating application and flash-off; drying and/or curing of applied coatings; cleaning of equipment used in surface coating; storage of coatings, thinners, and cleaning materials; and handling and conveyance of waste materials from the surface coating or printing operations. Coatings include such materials as adhesives and protective or decorative coatings.

From analysis of the coating survey responses, it was found that coating application and curing are the largest contributors of HAP emissions at coating facilities. On a nationwide basis, the portion of total facility HAP emissions attributed to coating application and curing by respondents to the coating MACT survey was approximately 95 percent. Other operations and activities that may create HAP emissions associated with coating include storage tanks, substrate preparation, coating mixing/thinning operations, parts and equipment cleaning, and waste and wastewater operations. In a facility with a permanent total enclosure (PTE) to capture fugitive HAP emissions, at least some of the associated coating operations and activities (e.g., substrate preparation, coating mixing/thinning operations, and parts and equipment cleaning) are performed in the PTE. Fugitive HAP emissions from operations in the PTE are controlled at the facility overall control efficiency (OCE).

The information concerning the level of HAP emissions from coating application and drying/curing collected in the coating MACT survey included the capture efficiency for each coating application area or for the entire coating line and the destruction efficiency of the control device receiving the HAP emissions. The OCE for the coating line application and drying/curing could be calculated from this information. Because this information was the value that was most common among all the data available, and because it was determined that the coating application and drying/curing OCE was the value that was most correlated with HAP emissions, coating application and drying/curing OCE was used as the basis for the MACT floor calculations for coating lines. The application and drying/curing OCE for the facilities in the MACT floor was calculated as a facility-wide average of all coating lines, to incorporate the effects of averaging across coating lines in facilities with more than one coating line.

## CONSIDERATION OF DATA QUALITY IN EVALUATING HAP EMISSION REDUCTIONS FROM COATING HAP SOURCES

There are a number of data quality issues that were considered in determining the MACT floor for the coating industry. These issues raised questions concerning the representativeness of the data in terms of what OCE the facilities can achieve in daily operations and over the entire year versus what facilities report and in terms of the quality of the coating capture efficiency data.

### Representativeness of the Control Device Performance Data in the Coating MACT Database

Representatives of two other web surface coating industries have noted that reported destruction efficiencies can differ from those actually achieved in daily operation. These industries are the metal coil surface coating and the paper and other web coating (POWC) industries, both of which use web coating lines consisting of one or more work stations that apply the coating to the web and subsequent drying stations, similarly to the coating industry. In fact, some coating lines are used to coat both POWC and textile substrates.

The metal coil coating industry reports that efficiencies determined by testing are generally measured during the initial compliance test, when the control device is new [10]. Destruction efficiency will gradually degrade with age (e.g., because of leaking heat exchangers or leaking isolation valves), so that the reported destruction efficiency may not be representative of the efficiency actually being achieved by control devices that have been in operation several years. Furthermore, the metal coil coating industry notes that when a facility reports an efficiency based on testing, it is usually based on test methods that call for averaging the results of three source tests of the inlet and outlet emissions from the control device. These tests are generally relatively short in duration (approximately one hour). Therefore, depending on the conditions of operation during these tests, e.g., inlet HAP loading to the control device, the control efficiency data acquired from the coating industry may not be representative of control device performance over the entire range of normal facility operation and over the entire year.

An important operating parameter at coating facilities that can cause control device test results to differ from control device performance during normal operation is the variation in loading rates. It is possible that during compliance tests, the inlet HAP loading (i.e., the amount of HAP volatilized from the surface and exhausted to the control device) is much higher than it is during normal operations. This situation may result in artificially high destruction efficiency rates achieved during testing. For example, thermal oxidizers are known to only achieve high levels of control, such as the greater than 99 percent destruction efficiencies reported by some facilities in the MACT database, when their inlet loadings are high [11]. Therefore, it is possible that differences in reported destruction efficiencies in the coating database may only be a result of variation in test conditions. The wide range of inlet loadings (from less than 100 ppmv to 8,500 ppmv) reported by coating facilities indicate that inlet loadings do fluctuate because of the batch nature of the coating process (i.e., different products with different coating specifications are often produced on the same line throughout the day). Therefore, inlet loadings will likely often be lower than the inlet loading when the facility undergoes source testing for compliance purposes.

As a step in the data validation process, available literature was reviewed and thermal oxidizer vendors were contacted to determine maximum destruction efficiencies that could be expected for thermal oxidizers [12]. The literature review on thermal oxidizers indicated that 99 percent destruction efficiency is achievable under ideal conditions, but that lower efficiencies are typically achieved under normal operating conditions. For example, the alternation between beds in a regenerative thermal oxidizer typically results in somewhat lower destruction efficiencies than are achieved in a conventional recuperative thermal incinerator, generally below 99 percent [13]. The lower destruction efficiency for regenerative thermal incinerators has been attributed in part to valve leaks within the system. In addition, a study conducted by EPA [14] concluded that 98 percent VOC reduction, or 20 ppmv by compound exit concentration is the highest control level achievable by all new incinerators. This level is expressed as both percent reduction and ppmw to account for the leveling off of exit concentrations as inlet concentrations drop below 2000 ppmw.

Telephone surveys of thermal oxidizer manufacturers indicated that 98 percent is the routine guarantee for regenerative or recuperative thermal oxidizers. Typically, this guarantee only covers the first year of operation due to potential destruction efficiency degradation caused by operational factors [15]. Vendors confirmed that long-term performance likely degrades because of leakage problems. Typically, vendors reported that untreated gas leaks into the treated gas stream through deterioration of heat exchange systems or leakage through isolation valves used on multiple chamber regenerative units.

Because of the practical limitations of the coating survey and other industry research, information on the specific test conditions for the control efficiency data collected was not available. For this reason and the various factors described above, the determination of the MACT floor for coating took into account the likelihood that the coating survey responses included only “best case” data, which do not reflect degradation in performance over time or normal variations in coating operations over an entire year.

### Quality of Coating Capture Efficiency Data

For a coating line controlling HAP emissions by capturing the emissions and venting to a solvent recovery device, coating line OCE is typically determined through liquid-liquid material balance by measuring the volatile matter being applied on the coating line and the volatile matter recovered and calculating the recovery efficiency. However, for a coating line controlling HAP emissions by capturing the emissions and venting to a thermal oxidizer, coating line OCE is calculated as the product of the capture and destruction efficiencies. A source can only report 100 percent capture if it meets the criteria of Method 24 of 40 CFR Part 51, Appendix M for total enclosures. If the criteria are met and all gases from the enclosure are vented to a control device, then capture efficiency is assumed to be 100 percent.

With regard to the database information on capture of HAP emissions from coating application and drying/curing, it was clear that all the determinations of capture efficiencies were not performed in the same manner. In evaluating the data for 5 facilities claiming 100 percent capture, we found only one of these facilities reported the basis for the capture efficiency to be permanent total enclosure (PTE) as determined by Method 204. Three facilities cited testing as the basis for the 100 percent capture with the test method unspecified and one facility cited testing and engineering judgement. A sixth facility that reported capture by PTE claimed 99 percent capture based on source testing. Follow up phone contacts of the 3 facilities citing testing as the basis for 100 percent capture with the test method unspecified revealed that Method 204 criteria had been met by two of the facilities. Therefore, of the 6 facilities claiming PTE, only the data from the 3 facilities determining capture efficiency using Method 204 were used in the MACT floor data base [16].

## MACT FLOOR DETERMINATION

For this analysis, EPA determined that all 22 facilities in the coating MACT data base (including facilities claiming responses to the questionnaire CBI) were major or synthetic minor facilities with coating lines. Therefore, this set of 22 facilities was used to identify the top performing facilities for coating line control as the basis for the MACT floor determination.

The coating line overall control efficiency (OCE) was calculated for all of the facilities with sufficient information in the database as a facility-wide average, i.e., as an average of all of the coating lines at a facility (that accounts for the effect of averaging across coating lines.) The calculation procedure consisted of calculating an arithmetic average facility capture efficiency (arithmetic average for all lines), an arithmetic average facility destruction (for facilities with thermal oxidizers) or recovery (for facilities with carbon adsorbers) efficiency (arithmetic average for all control devices receiving emissions from coating lines in the facility), and an average facility OCE (product of average facility capture efficiency and average facility destruction or recovery efficiency.) Arithmetic average facility capture and destruction or recovery efficiencies were calculated because insufficient data were available to determine the quantities and characteristics of coatings being applied on specific coating lines or stations. Therefore, we don’t know the contribution of the different lines to the total facility emissions.

Table 1-1 presents a ranking based on the average facility OCE of all facilities in the MACT database with sufficient non-CBI information to calculate average facility OCE. For facilities listed in the tablewithout an average facility OCE, the reason the OCE was not calculated (no controls, information not available, or CBI) is noted.

## Table 1-1. Fabric Coating Average Facility OCE [a]

| Facility Rank | Facility SIC Code | Type of Add-on Control Device [b] | Facility OCE (%) [c] | Capture Efficiency (%) [d] | Control Device Efficiency (%) [d] |
|---|---|---|---|---|---|
| 1 | 2295 | RTO | 99.3 | 100.0 | 99.3 |
| 2 | 3052 | TO | 99.0 | 100.0 | 99.0 |
| 3 | NA | TO | 98.9 | 100.0 | 98.9 |
| 4 | 2295 | RTO | 97.2 | 100.0 | 97.2 |
| 5 | 2295, 3069 | CA | 96.0 | 100.0 | 96.0 |
| 6 | 2295 | TO | 95.3 | 99.0 | 96.3 |
| 7 | 3949 | CA | 93.1 | 98.0 | 95.0 |
| 8 | 2295 | TO | 91.9 | 93.8 | 98.0 |
| 9 | 3052 | CA | 90.8 | 99.8 | 91.0 |
| 10 | 2295, 3052 | CO | NA [e] | NA | 94.0 |
| 11 | 2295 | CO | NA | NA | 90.0 |
| 12 | 2295 | NC [f] | NC | NC | NC |
| 13 | 2295 | NC | NC | NC | NC |
| 14 | 2295 | NC | NC | NC | NC |
| 15 | 3052 | NC | NC | NC | NC |
| 16 | 3069 | NC | NC | NC | NC |
| 17 | 3052 | NC | NC | NC | NC |
| 18 | CBI | CBI [g] | CBI | CBI | CBI |
| 19 | CBI | CBI | CBI | CBI | CBI |
| 20 | CBI | CBI | CBI | CBI | CBI |
| 21 | CBI | CBI | CBI | CBI | CBI |
| 22 | CBI | CBI | CBI | CBI | CBI |

[a] Includes average facility OCE for all facilities in the MACT database with sufficient non-CBI information to calculate average facility OCE. For facilities without an average facility OCE, the reason the OCE was not calculated is noted.
[b] RTO = Regenerative Thermal Oxidizer; TO = Thermal Oxidizer; CA = Carbon Adsorber; CO = Catalytic Oxidizer.
[c] Product of average facility capture and control efficiencies as calculated from data reported by facility.
[d] Arithmetic average of data reported by facility if different efficiencies reported for different lines.
[e] NA = Not Available
[f] NC = No Control
[g] CBI = Confidential Business Information

NOTE: The 3 MACT floor facilities are **highlighted**.

## MACT Floor Determination for Existing Sources

As indicated previously in the **BACKGROUND** section of this memorandum, the MACT floor for existing sources is determined based on the average emission limitation achieved by the best performing twelve percent of existing sources. For the coating industry, OCE for the collection of all coating lines at a facility is the emission limitation that reflects the best controlled sources. The best performing 12 percent of the 22 facilities in the MACT database constitutes a set of 3 facilities.

As has been described previously, some facilities reported OCE's that could not be substantiated based on the data provided supporting reported capture efficiency. Facilities with unsubstantiated OCE's were not used in the MACT floor determination. Removing facilities with unsubstantiated OCE's from the MACT floor resulted in the removal of two facilities, which were replaced with the next best performing facilities with OCE's substantiated by Method 204 or Procedure T verification of capture efficiency. The resulting top performing 12 percent of the facilities are the 3 facilities identified in Table 1-1 as MACT-floor facilities.

All of the top performing facilities use capture systems and control devices including both thermal oxidizers and carbon adsorbers. The two facilities using thermal oxidizers are achieving 100 percent capture of application station emissions through the use of permanent total enclosures. Table 1-1 shows that the range of reported OCE for the top 12 percent was 93.1 to 99.3 percent.

The reported coating values show that controls on some specific coating operations may be capable of achieving greater than 99 percent HAP destruction based on 100 percent capture and thermal oxidizer destruction efficiency greater than 99 percent. The average OCE of the MACT floor facilities is 98.1 percent. However, to determine the level of emission control consistently achievable with thermal oxidation, it is important to consider not only the level of control reported, but also the previously cited data quality concerns and the control levels that EPA has generally found to be achievable for this type of control technology. This approach ensures that factors that affect control levels, such as variations in source operating conditions and inlet loadings to the control device, are accommodated in the selection of the MACT floor.

The study conducted by EPA [17] indicated that a 98-percent reduction is the control efficiency achievable by all new oxidizers. Information from vendor guarantees supports the determination of a destruction efficiency of 98 percent for thermal oxidizers. Adjusting the destruction efficiencies of the 2 facilities using thermal oxidizers in the MACT floor to 98 percent results in the calculation of an average 97 percent facility-wide coating line OCE for the 3 facilities that make up the best controlled twelve percent of the industry. Therefore, the MACT floor for existing sources is 97 percent reduction of organic HAP emissions from the coating lines.

An OCE of 97 percent is attainable by all of the facilities in the MACT floor considering available information regarding the capture and control technologies currently used at existing sources in the coating industry. A facility using carbon adsorption for control can achieve 97 percent by installing a PTE around the coating application station. A facility using a thermal incinerator for control can achieve 97 percent with less efficient capture efficiency, e.g., 99 percent capture efficiency and 98 percent destruction efficiency.

### MACT Floor Determination for New Sources

As indicated previously in the **BACKGROUND** section of this memorandum, the MACT floor for new sources must reflect the emission control achieved in practice by the best-controlled similar source. The OCE data in Table 1-1 show that the best-controlled source for which we have data is using a permanent total enclosure to achieve 100 percent capture and a thermal oxidizer to achieve a destruction efficiency greater than 99 percent.

As has been noted above in the description of the determination of the MACT floor for existing sources, it is important to consider not only the level of control reported by the single best-controlled coating facility (99+ percent facility-wide coating line OCE), but also the control levels that EPA has generally found to be achievable for this type of control technology. As described above, 98-percent reduction is the control efficiency achievable by all new oxidizers. Furthermore, new solvent recovery systems can also be designed to achieve 98 percent control efficiency [18]. Therefore, these types of control devices used to reduce organic HAP emissions at new coating facilities can be expected to achieve at least 98 percent emission reduction. Consequently, a 98-percent facility-wide coating line OCE was determined to be the MACT floor for new sources in the fabric coating industry.

### Calculation of Alternative Emission Rates for Existing and New Sources

Data from the coating MACT database were used to calculate alternative facility emission rate limits for existing and new sources. The alternative facility HAP emission rate for existing sources was calculated based on applying the 97 percent MACT floor OCE to a pre-controlled facility HAP emission rate representative for this industry. Similarly, the alternative facility HAP emission rate for new sources was calculated based on applying the 98 percent MACT floor OCE to a pre-controlled facility HAP emission rate representative for this industry. The rationale for this is that an alternative facility HAP emission rate limit should not be more stringent than the controlled HAP emission rate that can be attained by a coating facility using a representative coating formulation and applying MACT floor control.

The calculation procedure consisted of defining a representative coating for this industry by calculating the average pounds of HAP per pounds of solids for all of the facilities in the MACT database with sufficient coating information. Fourteen of the 22 facilities in the MACT database submitted detailed information about coating materials sufficient to calculate a facility average coating in terms of pounds of HAP per pounds of solids. The pounds of HAP used to define the representative coating included

HAP used in thinning and HAP used as a cleaning solvent.  All of the HAP is assumed to be emitted; therefore, the coating composition also represents the pre-controlled facility HAP emission rate.

As shown in Table 1-2, the pre-controlled facility HAP emission rate was calculated as 4.16 pounds of HAP emitted per pound of solids.  The pre-controlled facility HAP emission rate was then factored by the 97 percent facility OCE MACT floor for existing sources to derive the alternative facility HAP emission rate limit for existing sources of 0.12 pounds of HAP emitted per pound of solids.  The pre-controlled facility HAP emission rate was factored by the 98 percent facility OCE MACT floor for new sources to derive the alternative facility HAP emission rate limit for new sources of 0.08 pounds of HAP emitted per pound of solids.

This equivalent emission rates were established in order to afford the complying facilities with control options including low HAP coatings and a combination of low HAP coatings and add-on controls.  The units used in the equivalent emission limits are based on the units commonly used in the industry and the format submitted on replies to questionnaires for this rulemaking.

### Consideration of Beyond-the-Floor Technology for Existing and New Sources

The above the floor levels of control for coating and printing, to be considered, must be greater than an overall control efficiency of 97 percent for existing sources.  The floor for existing sources was based on the use of control equipment with a control efficiency of 97 percent and a capture efficiency of 100 percent.  In addition, the 97 percent MACT floor overall control efficiency was applied to a pre-controlled facility HAP emission rate representative for this industry to calculate an alternative facility emission rate limit.

Two regulatory alternatives were identified that are more stringent than the existing source MACT floor level of control for organic HAP and the alternative emission rate limit.  These alternatives were conversion to coating and printing materials that have a very low, or no, organic HAP content and use of add-on capture systems and add-on control devices to achieve an overall control efficiency of 98 percent.

Lower organic HAP liquid coatings fall into two primary categories.  The most common category is waterborne coatings, which allow the mixing of certain materials that would be incompatible in organic solvent borne coatings.  The second category is those higher solids coatings that result from alternate technologies such as ultraviolet (UV)-curable coatings and electron beam (EB)-curable coatings.  Some urethane coatings can be applied with a thermal process.  These coatings do not employ organic HAP or VOC to keep the pigment and other components of the coating in solution until curing.  Therefore, organic HAP emissions are very small.

These lower organic HAP coatings are currently in production use for some products in the coating industry, but their applicability is limited in that, for some products, these coatings are not able to achieve the desired final product characteristics.  Similarly, low organic HAP or waterborne printing

### Table 1-2. Coating Facility Average Emission Rate [1]

| Facility Number | Total Pounds of HAP in Coating Materials [2] | Total Pounds of Solids in Coating Materials [2] | Lbs of HAP/ Lbs of Solids [3] | Emission Rate at 97 % Facility OCE | Emission Rate at 98 % Facility OCE |
|---|---|---|---|---|---|
| 1 | 598,393 | 171,733 | 3.48 | 0.10 | 0.07 |
| 2 | 72,946 | 11,875 | 6.14 | 0.18 | 0.12 |
| 3 | 626,980 | 126,370 | 4.96 | 0.15 | 0.10 |
| 4 | 643,217 | 111,558 | 5.77 | 0.17 | 0.12 |
| 5 | 459,780 | 113,200 | 4.06 | 0.12 | 0.08 |
| 6 | 894,252 | 251,847 | 3.55 | 0.11 | 0.07 |
| 7 | 939,155 | 340,521 | 2.76 | 0.08 | 0.06 |
| 8 | 848,199 | 265,326 | 3.20 | 0.10 | 0.06 |
| 9 | 16,043 | 6,509 | 2.46 | 0.07 | 0.05 |
| 10 | 35,301 | 8,548 | 4.13 | 0.12 | 0.08 |
| 11 | CBI | CBI | CBI | CBI | CBI |
| 12 | CBI | CBI | CBI | CBI | CBI |
| 13 | CBI | CBI | CBI | CBI | CBI |
| 14 | CBI | CBI | CBI | CBI | CBI |
| | | | | | |
| AVG. | | | 4.16 | 0.12 | 0.08 |

[1] Lists all facilities in the MACT database with sufficient information to calculate average facility emission rate in terms of pounds of HAP emitted per pounds of solids applied.

[2] Calculated from coating/coating component, thinning solvent, and cleaning solvent materials reported by facility.

[3] Calculated by dividing total pounds of HAP (including thinning and cleaning solvents) in coating materials by total pounds of solids in coating materials.

materials are used for the majority of printed products, but these printing materials are not able to achieve the desired final product characteristics for certain products, such as designer and fashion apparel, requiring the use of higher organic HAP printing materials.  Given the limited applicability of waterborne, UV-curable, EB-curable, and thermal (“hot-melt”) coating and waterborne printing materials, it was determined not to be feasible to require the use of these coating and printing materials, therefore they were rejected as a beyond-the-floor option for organic HAP.

It is technically feasible to reduce emissions from existing facilities by at least 98 percent through the use of capture systems and add-on control devices.  Based on the model plants analysis used to estimate the impacts of the proposed rule, the incremental HAP reductions that could be achieved by using capture systems and add-on control devices to comply with a "beyond-the-floor" alternative of 98 percent reduction would range from about 0.09 Mg (0.1 tons) to about 3.8 Mg (4.2 tons) per facility. The effect of the alternative 98 percent reduction would result in an estimated reduction of an additional 32 tons of HAP per year.  To achieve this small incremental HAP emission reduction, existing affected facilities would have to upgrade or replace most existing add-on control systems.  The incremental emissions reductions that would be achieved at this time are not supported by the additional cost that many existing facilities would incur to upgrade or replace existing add-on control systems.  Therefore, requiring 98 percent overall control was rejected as a beyond-the-floor option for organic HAP at existing sources in the coating and printing subcategory.

The above the floor levels of control for coating and printing, to be considered, must be greater than an overall control efficiency of 98 percent for new or reconstructed affected sources.  The new source floor was based on the use of control equipment with a destruction efficiency of 98 percent and a capture efficiency of 100 percent.  Vendors could not guarantee greater than 98 percent destruction efficiency for the operating conditions experienced in coating and printing and over the life of the equipment.

The use of low HAP containing coating and printing materials was considered for an above the floor option for new or reconstructed sources.  However, as is explained above for existing sources, it was determined that some products in the coating and printing industry cannot meet certain performance characteristics with low-organic HAP coating and printing materials.

For these reasons it was determined that requiring above the floor emission limits for new or reconstructed sources is not practicable for this subcategory.

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# MEMORANDUM

January 11, 2002

To: Printing, Coating and Dyeing of Fabrics and Other Textiles File

From: Steve York and Alton Peters, RTI

Subject: MACT Floor for Dyeing and Finishing Compounds

## SUMMARY

This memorandum describes the methodology and conclusions of the maximum achievable control technology (MACT) floor analysis for the dyeing and finishing subcategory of the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP. The analysis is based on dyeing material information from dyeing operations at 30 major or synthetic minor fabric dyeing facilities and finishing material information from finishing operations at 12 major or synthetic minor fabric finishing facilities that were obtained from survey data. The dyeing MACT floor for existing and new sources was determined to be 1.58 weight percent organic HAP in dyeing materials as purchased. The finishing MACT floor for existing and new sources was determined to be 0.03 weight percent organic HAP in finishing materials as purchased. For the purpose of determining the mass fraction of organic HAP in a finishing material, each organic HAP that is not an OSHA-defined carcinogen as specified in 29 CFR 1910.1200(d)(4) that is measured to be present at less than 1 percent is counted as zero. Therefore, the floor for finishing is zero organic HAP. A facility with both dyeing and finishing operations is allowed to average between the floors, with the total mass of organic HAP in dyeing and finishing materials as purchased not to exceed the sum of the organic HAP allowed in dyeing materials and finishing materials as purchased.

## BACKGROUND [1]

The Coating, Printing, and Dyeing of Fabric industry was identified as a source category of HAP under section 112(c) of the Clean Air Act, as amended in 1990 (the Act), to be regulated by a National Emission Standard for HAP (NESHAP) under section 112(d) of the Act. Section 112(d) of the Act directs the EPA to develop standards that require the maximum degree of reduction in emissions of HAP that is achievable, which are commonly referred to as MACT standards. For existing major sources, the Act requires MACT to be no less stringent than the average emission limitation achieved by the best performing 12 percent of existing sources among the data available to the Administrator. For new major sources, the Act requires MACT to be no less stringent than the emission control that is achieved in practice by the best controlled similar source. These minimum stringency levels are often referred to as the “MACT floor.”

Dyeing and Finishing was determined to be a subcategory of Coating, Printing, and Dyeing of Fabric.

The manufacturing processes and materials and the HAP emissions set these processes apart from the other processes that are used in the manufacture of fabric products. Dyeing and finishing processes both use various types of aqueous materials, the choice of which depends on the type of substrate and the desired properties in the end product. Many facilities perform both dyeing and finishing and use some common equipment (e.g., tenter frames) for unit operations in both processes. In some cases the finishes are applied to fabric wet from the dyeing process and no drying is done until after the finish application. No add-on HAP emission controls are known to be in use on dyeing processes and very few on finishing processes. The few add-on emission controls used on finishing processes were installed to control opacity and are not effective at controlling HAP emissions. This memo is to explain the basis for the MACT Floor for this subcategory.

### Dyeing

Dyeing is the application of color to the whole body of a textile material with some degree of color fastness. Textiles are dyed using continuous and batch processes and dyeing may take place at any of several stages in the manufacturing process (i.e., prior to fiber extrusion, fiber in staple form, yarn, fabric, garment). Most of textile dyeing is done in finishing departments of basic textile manufacturing facilities, although there are also several commission dyehouses. From an environmental perspective, dyeing has typically been viewed as a wastewater issue due to large quantities of water, chemicals, and auxiliaries (such as salt) used. [1, 2, 3]

Dyeing is essentially a mass transfer process where the dye diffuses in solution, adsorbs onto the fiber surface, and finally, within the fiber. Dyeing is complicated by the fact that there are many sources of color variations, such as dyes, substrate, preparation of substrate, dyeing auxiliaries used, and water. Processing variables such as time, temperature, and dye liquor ratio (pounds of dyebath to pounds of cloth) also affect dyeing results. There are hundreds of dyes within several dye classes (see Table 2-1), each of which exhibits different results when applied to different types of fabric.

Various types of dyeing machines are used for both continuous and batch processes. Every dye system has different characteristics in terms of versatility, cost, tension of fabric, use of carriers, weight limitations, etc. Dyeing systems can be aqueous, non-aqueous (in organic solvents), or use sublimation (thermosal, heat transfer). Hydrophilic fibers such as cotton, rayon, wool, and silk, are typically easier to dye as compared with hydrophobic fibers such as acetate, polyesters, polyamides, and polyacrylonotriles. [2]

The four basic steps in the dyeing process are: dissolving or dispersing dye; diffusing dye onto the fiber surface; absorbing dye onto the fiber surface; and diffusing dye into the fiber. Batch dyeing involves moving the dye liquor through the goods or moving the goods through the dye liquor. The textile material is immersed in the dyebath during the entire period of dyeing. In batch dyeing, a certain amount of textile substrate, usually 220 to 2200 pounds, is loaded onto a dyeing machine and is brought to equilibrium or near equilibrium with a solution containing the dye. Once immersed in the dyebath, because the dyes have an affinity for the fibers, the dye molecules leave the dye solution and enter the fibers over a period of minutes to hours.

**Table 2-1 Major Dye Classes and Substrate Fibers**

| Class | Fibers |
|---:|---|
| Acid | Wool, silk, and nylon |
| Azoic | Cotton and cellulose |
| Basic | Acrylic, certain polyesters |
| Chrome | Wool, silk, nylon |
| Direct | Cotton, rayon, other cellulosic |
| Disperse | Polyester, acetate, other synthetic |
| Fiber Reactive | Cotton and other cellulosic, wool |
| Naphthol (azoic) | Cotton, rayon, other cellulosic |
| Pigment | All (requires binders) |
| Sulfur | Cotton and other cellulosic |
| Vat | Cotton and other cellulosic |

Reference 1.

Auxiliary chemicals and controlled dyebath conditions (mainly temperature) accelerate and optimize the action. The dye is fixed in the fiber using heat and/or chemicals after which the substrate is washed to remove unfixed dyes and chemicals. There is a trend to use of lower liquor ratios (pounds of dyebath to pounds of cloth) in batch dyeing, which lends benefits such as faster heating/cooling and less waste. Batch equipment can usually be purchased as atmospheric (operated below 212 °F) or pressurized (operated to about 280 °F) machines. [2, 3, 4] Most batch dyeing is being done using pressurized machines, although some facilities use atmospheric machines, especially for fabric dyeing. [5] Atmospheric dyeing might be required for fleeces and stretch fabrics, such as Lycra®, which typically cannot be dyed using jet equipment. [6] Dyeing processes in pressurized machines release no HAP emissions to the atmosphere since the process is totally enclosed and the pressure is released at the end of the dyeing process by cooling the dye bath which is subsequently drained before opening the dyeing machine. [7] However, in some cases, the drying of the pressure-dyed substrate releases HAP emissions.

Continuous processes typically consist of dye application, dye fixation with chemicals or heat, and washing. Almost all continuous dyeing is done at atmospheric pressure. [5] Continuous dyeing is usually used for long runs of polyester/cotton fabrics and involves immersing fabrics in a relatively concentrated dyebath for short periods. Textiles are fed continuously into a dye range at speeds usually between 540 and 2690 feet per minute and a concentrated solution of dyes and chemicals (held in pads) is moved evenly and uniformly to the goods with thorough penetration. A pad mangle helps apply pressure to squeeze dye solution into the fabric and the dye is usually diffused or fixed by heating in a steamer or oven. Dye fixation on fiber occurs much more rapidly in continuous dyeing as compared to batch dyeing. After fabrics are dyed, they are dried in ovens or tenter frames after washing to remove un-reacted chemical or loose dye. [1, 2, 3, 4, 6] Fabric that is processed through atmospheric batch dyeing is not dried at the dye range; it is sent to finishing and may be finished wet or dry. [6]

Various classes of dyes can be used, e.g, disperse for synthetics and direct for cellulosics (see Table 2-1). Dyes used in the textile industry are mostly synthetic and are derived from coal tar and petroleum-based derivatives. Dyes are sold as powders, granules, pastes, liquid dispersions, and solutions. Not only are dyes applied in different ways, they also impart color using different mechanisms. [2] Dyes can be classified according to chemical constitution or method of application. Dyestuffs can work on principles of electrostatic bonding, covalent bonding, or physical entrapment. For example, acid dyes work through the mechanism of electrostatic bonding, whereas disperse dyes work by physical entrapment. [4] Different dye classes exhibit different affinities depending on the type of fiber, although even dyes within the same classes can show wide affinity variations. They also exhibit different properties such as their fastness under end use conditions such as light, laundering, or dry cleaning.

Various combinations of chemical auxiliaries and process conditions (temperature and pressure) may be used to better fix the dye on the fabric or impart specific characteristics. For example, a dye bath may contain the dyestuffs along with appropriate auxiliaries such as wetting agents and also specific chemicals such as acetic acid or sodium hydroxide. [4] The use of higher temperatures and superatmospheric pressures have reduced the need for dye carriers (chemical accelerants) that were required at lower temperatures for the use of disperse dyes on synthetic substrates, such as polyester. [1]

The sources of HAP emissions from dyeing are the HAP constituents that are contained in dyestuffs and auxiliary chemicals as purchased. The HAP constituents are needed to impart certain desirable characteristics to the dyed substrate (e.g., certain colors can only be attained through the use of HAP-containing dyestuffs or auxiliaries.) No HAP is known to be added by the users. The fraction of HAP contained in dye materials that is emitted to the atmosphere is generally estimated to range from zero to 10 percent or greater, depending on the characteristics of the specific HAP constituents and the pressures and temperatures that the HAP are exposed to in the dyeing process operations. One source test showed emissions of almost 19 percent of the incoming HAPs at one emission point. Although some of the HAPs from these operations remain in the waste water, there are no partition data, nor data on the atmospheric emissions from the waste water treatment aeration basins at the textile mills. The HAP content of the material usage is the best data available and the basis for the MACT floor is the input of HAPs in the dye materials.

Most HAP constituents are believed to be rinsed from the substrate before the substrate is dried, because drying a substrate with unattached dye would adversely affect the quality of the dyed product. Because users of the dye materials do not add HAP to the purchased materials, the amount of HAP in the dye formulations is generally much less than 1 percent, the point in the process where the HAP are emitted depends on the types and configurations of dye equipment and unit operations used, and no add-on emission controls are known to be used on dyeing processes, a mass limit on the amount of HAP contained in dyeing materials (i.e. weight percent) “as purchased” was chosen as the format of the standard.

The MACT database for dyeing consisted of a sample of 41 facilities for which EPA had complete dyeing materials usage data from responses to survey questionnaires. Since the dyeing and finishing subcategory consists of more than 30 operating facilities, the MACT floor is based upon the best performing 12 percent of existing sources among available data. All of the information in the MACT database is confidential business information (CBI), therefore, no individual facility data are presented in this memorandum. The control option for all of the floor facilities is to limit the HAP content "as purchased" of the dyestuffs and auxiliary chemicals used in dyeing.

### Finishing

Finishing refers to any process operation performed after bleaching, dyeing, or printing that improves the appearance and/or usefulness of a textile substrate. Finishing encompasses any of several mechanical (e.g., texturizing, napping) and chemical processes (e.g., optical finishes, softeners, urea-formaldehyde resins for crease resistance) performed on fiber, yarn, or fabric to improve its appearance, texture, or performance. [1, 2] Since the HAP emission sources from finishing are specific chemical compounds that may be applied and released during subsequent drying and curing operations, the MACT floor for finishing compounds is derived from available information on chemical finishing processes. Chemical finishing is also referred to as wet finishing. No chemicals are used in mechanical, or dry, finishing.

The fabric is usually dried prior to chemical finishing using either convective (hot air) or conductive (heated cans) methods. [3] Chemical finishing is commonly done on a continuous finishing range (pad and tenter frame). Fabric is passed through an aqueous solution containing the finishing chemical(s) and auxiliaries. After treatment, the fabric is typically passed through an oven to drive off water and activate/cure finishing chemicals. It is important to note that there is no set recipe for the chemical finishes or mechanical finishing processes applied to any given substrate. Finishing methods are used according to desired characteristics of the end product (which vary widely and are market driven) and the firms themselves have some amount of flexibility in the specific processes or chemicals they choose to use for a particular function.

The textile industry uses numerous categories of proprietary chemical speciality products that are used as chemical finishes. Some examples of chemical finish classes include [1, 4, 6] :

- Resin finishes (permanent press) are used on cotton or rayon to minimize the need to ironing by keeping the fabric smooth after washing and drying. Most resins contain formaldehyde; resins without formaldehyde are typically much costlier and adversely affect product quality.
- Softeners are used with resins to improve the way the fabric feels by breaking down hardness or stiffness.
- Stain resist finishes are used extensively on carpets and upholstery fabrics. Soil release finishes allow soils and stains to be removed by laundering

- Water repellants used to prevent fabrics from being wet out (breathable, unlike waterproofing agents) include but are not limited to wax, silicone compounds, and fluorine compounds.
- Flame retardant qualities can be achieved by using special fibers or phosphorus-based finishes.
- Antistatic agents decrease or eliminate static electricity in textiles.
- Stiffeners give the fabrics body or stiffness.

Other examples of types of chemical finishes include anticreasing agents, deodorants, moth resisting agents, oil repellants, rust preventatives, and shrinkage controllers. Some companies use more specialized finishes like electrical finishes and Teflon®. Because there are typically a wide variety of choices of chemical finishes that can be used within each finish class, it is often difficult to tag finishes used in certain classes as always toxic or nontoxic. In certain cases, as in the case of permanent press finishes, most of the resins used contain formaldehyde, although low or non-formaldehyde finishes are being developed to suit certain applications. [5]

There are also several different types of mechanical finishing techniques. For example, heatsetting can be done to improve dimensional stability in synthetic fabrics. Shearing involves using rotary blade(s) to trim raised surfaces and reduce pilling. Other examples include embossing, glazing, sueding, and polishing.

Many chemical and mechanical alternatives are available for every finishing operation, but the specific nature and applicability of these is unclear. Some mechanical finishes and design alternatives can avoid chemical processing. For example for softness, enzyme softening of cotton and other mechanical alternatives can be used. Proper use and application of N-methylol crosslinkers can minimize formaldehyde releases. Mechanical finishing (compacting) can also eliminate use of the crosslinker. Some crosslinkers that eliminate formaldehyde are available, but much more expensive. The industry has made a lot of efforts to reduce amount of free formaldehyde in resins, however good substitutes that do not adversely affect the quality of the product are difficult to find. [5] Formaldehyde contents can vary anywhere from less than one half of one percent for light weight fabrics to 4 percent for heavy fabrics (melamine-formaldehyde resins), and there is a lot of variability in types of resins. Formaldehyde itself does not affect the product, however it does affect the properties of the resin itself (manufacturing). Acrylic handbuilders and stiffeners can replace formaldehyde-based handbuilders.

The sources of HAP emissions from finishing are the HAP constituents that are contained in finishing materials as purchased. As is the case with dyeing, the HAP constituents are needed to impart certain desirable characteristics to the finished substrate (e.g., a resin finish containing HAP might be applied to a cotton/polyester blend for durable press and dimensional stability.) No HAP is known to be added by the users. In finishing, unlike in dyeing, the fraction of HAP contained in finishes that is emitted to the atmosphere is generally assumed to be 100 percent with the exception of HAP that cross-link to the fiber, such as formaldehyde. This is because finished fabric is generally dried and cured at relatively high temperatures over 300 °F. Because users of the finishing materials do not add HAP to the purchased materials, the amount of HAP in the finish formulations is generally much less than 1 percent, and very few add-on emission controls are known to be used on finishing processes, a mass limit on the amount of HAP contained in finishing materials (i.e. weight percent) “as purchased” was chosen as the format of the standard.

The MACT database for finishing consisted of a sample of 31 facilities for which EPA had complete finishing materials usage data from responses to survey questionnaires. Since the dyeing and finishing subcategory consists of more than 30 operating facilities, the MACT floor is based upon the best performing 12 percent of existing sources among available data. As is the case with dyeing, all of the information in the MACT database is confidential business information (CBI), therefore, no individual facility data are presented in this memorandum. The control option for all of the floor facilities is to limit the HAP content “as purchased” of the chemicals used in finishing.

## APPROACH TO ESTIMATING THE MACT FLOOR

The term “average,” as it pertains to MACT floor determinations for existing sources, described in section 112(d)(3) of the Act, is not defined in the statute. In a Federal Register notice published on June 6, 1994 (59 FR 29196), the EPA announced its conclusion that Congress intended “average” as used in section 112(d)(3) to mean a measure of mean, median, mode, or some other measure of central tendency. The EPA concluded that it retains substantial discretion within the statutory framework to set MACT floors at appropriate levels, and that it construes the word “average” (as used in section 112(d)(3)) to authorize the EPA to use any reasonable method, in a particular factual context, of determining the central tendency of a data set.

In addition, in the June 6, 1994, Federal Register notice, the EPA stated that it has discretion to use “best engineering judgement” in collecting and analyzing data relevant to a MACT floor determination, and in assessing the data comprehensiveness, accuracy, and variability in order to determine which sources achieve the best emission reductions.

## DATA COLLECTION FOR THE MACT FLOOR

The American Textile Manufacturers Institute (ATMI) member companies represent about 80 percent of manufacturing capacity in the textile industry. In the Spring of 1997, ATMI mailed a MACT survey to member companies and to members of other Industry and State associations that agreed to collaborate on the survey effort. Responses were received from almost 400 facilities, including 8 facilities that continuous dye fiber, 24 facilities that continuous dye yarn, 36 facilities that continuous dye fabric, 8 facilities that batch dye fiber, 31 facilities that batch dye yarn, 49 facilities that batch dye fabric and 81 facilities with wet finishing operations.

The ATMI MACT survey database [8] does not contain information about the materials used in dyeing and finishing. However, ATMI conducted dyeing and finishing surveys of member companies to collect information on the annual usage of dyeing and finishing materials by dye or finish class, average and maximum HAP contents as purchased and as formulated, and actual and potential annual HAP emissions. Responses to the ATMI dyeing survey [9] were received from 41 facilities; 31 facilities responded to the ATMI finishing survey [10]. Because of the production-related data collected in the surveys, the responses to both surveys were classified CBI by ATMI. Therefore, no specific facility data are presented in this memorandum; only general descriptions of the database and aggregated data related to the HAP content of materials “as purchased.” The results of the quantitative data collection efforts provided the technical database used for the MACT floor analysis.

In addition to quantitative information obtained from the surveys, the EPA made eight site visits to facilities with dyeing and finishing operations. The industry members that participated in the stakeholder process included members of the American Textile Manufacturer’s Institute (ATMI), the American Yarn Spinners Association (AYSA), and the Northern Textile Association (NTA), representatives of individual companies in the regulated industry, and representatives of companies that supply dyeing and finishing materials to the industry. States that participated in the stakeholder process included Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia. The U.S. EPA was represented by the Office of Air Quality and Standards (OAQPS), the Office of Enforcement and Compliance Assurance (OECA), the Office of Pollution Prevention and Toxic Substances (OPPTS), the Office of Research and Development, and an EPA Small Business Ombudsman.

During stakeholder meetings, qualitative information concerning dyeing and finishing process operations, associated HAP emissions, and control options including pollution prevention measures was presented. Comments on the qualitative information presented as well as additional qualitative information were solicited from the stakeholders. The qualitative information reviewed and discussed with the stakeholders is contained in the following memoranda:

- Memorandum from Melissa Malkin and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. December 15, 1997 Final. Second PMACT Meeting for Fabric Printing, Coating, and Dyeing.
- Memorandum from Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. February 2, 1998 Final. Initial Regulatory Subgroup PMACT Meeting for Fabric Printing, Coating, and Dyeing.
- Memorandum from Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. March 2, 1998 Draft. Meeting with the American Yarn Spinners Association (AYSA) Environmental Services Committee to discuss the status of the Fabric Printing, Coating, and Dyeing MACT.
- Memorandum from Melissa Malkin and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. September 11, 1998 Draft. Summary of Northern Textile Association (NTA)/U.S. Environmental Protection Agency (EPA) meeting to review the MACT/PMACT status.
- Memorandum from Steve York and Aarti Sharma, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. November 13, 1998 Final. Summary of meeting at which ATMI presented the results of the ATMI MACT survey to EPA.
- Memorandum from Melissa Malkin and Steve York, RTI to Paul Almodóvar, EPA/OAQPS/ESD/CCPG. November 13, 1998 Final. Summary of ATMI Task Force/EPA information gathering meeting.

Qualitative information from these sources provided descriptions of fabric dyeing and finishing processes, pollution prevention opportunities and verified that HAP control technologies are not used on dyeing and finishing HAP emission sources except in a few cases to control opacity from finishing processes. The qualitative data provide a representation of the fabric dyeing and finishing industry. The database is reflective of the variety of dyeing and finishing processes that are used by the facilities that will be subject to this rule.

## RESULTS OF DATA COLLECTION AND THE DYEING AND FINISHING MACT DATABASE

The quantitative information collected from the dyeing [9] and finishing [10] industry was entered into a database created to help determine MACT subcategory floor and to analyze impacts of regulatory options. The dyeing and finishing MACT subcategory database from which information was extracted and summarized in this memo contains a total of 30 facilities that are major or synthetic minor HAP emission sources with dyeing processes and 12 facilities that are major or synthetic minor HAP emission sources with finishing processes. See the "MACT FLOOR DETERMINATION" section of this memo for a description of the reasons eleven facilities with dyeing processes and 19 facilities with finishing processes could not be used in the MACT floor analysis.

The surveyed facilities were asked to provide annual facility HAP emissions from dyeing and finishing operations. The HAP contained in dyeing and finishing materials was speciated, but emissions were reported as total HAP. The organic HAP reported in dyeing materials (dyes and auxiliaries) at levels of at least 5 weight percent included ethylene glycol, glycol ethers, methanol, biphenyl, 1,2,4-trichlorobenzene, and dimethyl phthalate. The total HAP emissions from dyeing for the 30 facilities reporting facility HAP emissions were calculated to be 86 tons in 1999. The organic HAP reported in finishing materials at levels of at least 5 weight percent included methanol, ethylene glycol, and glycol ethers. The total HAP emissions from finishing for the 12 facilities reporting facility HAP emissions were calculated to be 120 tons in 1999. The HAP emissions estimates were based on the quantity of HAP in materials used in dyeing and finishing processes in 1999 and were not broken down by process operation (i.e., storage, mixing, substrate preparation, application, drying, curing, cleaning, waste and wastewater).

## CRITERION FOR EVALUATING HAP EMISSION REDUCTIONS FROM DYEING AND FINISHING OPERATIONS

The MACT floors for dyeing and finishing were evaluated on the basis of the HAP content of the purchased materials used in the dyes and finishes applied at a facility. There are currently no emission controls used to reduce HAP emissions from dyeing operations. The few emission controls used on finishing operations were installed to reduce opacity and most are not efficient at reducing HAP emissions. Furthermore, no emission factors have been developed for dyeing or finishing operations and the split of emissions, particularly from dyeing, are dependent on site specific conditions such as the unit operations the fabric passes through in the process range, the types of equipment used for the process, the dye or finish chemistry, and the process conditions, e.g., the points in the process where the fabric is subjected to heat. Finally, the available data include information on the HAP content of the dyeing or finishing materials used annually at a facility and HAP emission estimates based on the mass of HAP contained in the materials used in the process. Defining the MACT floor in terms of the mass of HAP per mass of purchased materials (weight percent HAP in the purchased materials) correlates directly to HAP emissions, serves to reduce the HAP emissions at the source, and is not dependent on the split of emissions between different unit operations in the process range or between media (air and water).

## MACT FLOOR DETERMINATION

For this analysis, EPA determined that a total of 30 of the 41 facilities in the ATMI dyeing MACT database [9] are major or synthetic minor HAP emission sources and 12 of the 29 facilities in the ATMI finishing MACT database [10] are major or synthetic minor HAP emission sources. Eleven facilities with dyeing processes could not be used in the MACT floor analysis for the following reasons: one facility has been shut down, 9 are area sources, and the Title V HAP status of one facility has not been determined. Similarly, 19 facilities with finishing process information could not be used in the MACT floor analysis for the following reasons: one facility has been shut down, one reported only coating processes, 15 are area sources of HAP emissions, and the Title V HAP status of 2 facilities has not been determined. Information from the facilities with indeterminate Title V HAP status was examined to determine if any of the facilities could potentially be MACT floor facilities. None was determined to be a MACT-floor facility. Separate MACT floor analyses were done for dyeing and finishing, as described in the following paragraphs.

### MACT Floor Determination for Dyeing

Two different approaches were taken to calculate the MACT floor weight percent organic HAP in purchased materials for dyeing. In the first approach, the weight percent organic HAP in purchased materials for dyeing was calculated for each facility in the ATMI dyeing MACT database [9]. The dyeing survey collected information on the organic HAP content of dyes and of auxiliary chemicals. To calculate the weight percent organic HAP, the mass of organic HAP in dyes as purchased and the mass of organic HAP in auxiliaries as purchased were calculated. Then the total mass of organic HAP in dye materials as purchased (mass of organic HAP in dyes plus mass of organic HAP in auxiliaries) was calculated and divided by the total mass of dye materials purchased (mass of dyes plus mass of auxiliaries) and multiplied by 100 to calculate the weight percent HAP in dye materials purchased by each facility. Four floor facilities were chosen (12 percent of 30), each of which reported zero organic HAP in dye materials as purchased, therefore, the calculated MACT floor was zero weight percent organic HAP. However, under this approach only 3 of the 11 dye classes reported in the dyeing survey were represented in the MACT floor.

Since the choice of a dye class depends on many factors including substrate, color (market driven), end use of the dyed fabric, and quality (e.g., dye fastness) and can not be made purely on the basis of organic HAP content of the materials, EPA chose a second approach to calculating the MACT floor that would represent all of the dye classes reported in the dyeing survey. Under this second approach, a MACT floor analysis was done for each dye class in the database. For each dye class used by each facility, the weight percent organic HAP in dye materials purchased was calculated by calculating the total mass of organic HAP in dye materials as purchased for the dye class (mass of organic HAP in dyes plus mass of organic HAP in auxiliaries) divided by the total mass of dye materials purchased for the dye class (mass of dyes plus mass of auxiliaries) multiplied by 100. The number of facilities reporting use of each dye class ranged from 2 to 14 facilities. Taking 12 percent of each of these groups resulted in choosing one or two floor facilities reporting the lowest weight percent organic HAP in dye materials for each dye class.

Table 2-2 presents the MACT floor organic HAP content calculated for each dye class in the database. To determine the MACT floor for dyeing, a weighted average organic HAP content of dye materials as purchased was calculated from the dye class MACT floors, using the total mass of dye materials used by the MACT floor facility or facilities for each dye class to weight the dye class MACT floor organic HAP contents. As shown in Table 2-2, the dyeing MACT floor organic HAP content in materials as purchased was determined to be 1.58 weight percent for existing sources. No technology has been identified that could achieve a lower organic HAP content in materials as purchased, therefore the dyeing MACT floor organic HAP average content in materials as purchased for new sources was also determined to be 1.58 weight percent.

### MACT Floor Determination for Finishing

Since the choice of a finish class depends on the desired characteristics of the finished substrate and can not be made solely on the basis of the HAP content of the finish, EPA chose the approach of calculating the MACT floor that would represent all of the finish classes reported in the ATMI finishing MACT database [10]. As was the case for dyeing, a MACT floor analysis was done for each finish class in the database. The finishing survey collected information on the organic HAP content of each finish class as purchased. In some cases, facilities reported different chemistry for finishes within the same finish class for use on different products. Therefore, for each finish class used by each facility, the weight percent organic HAP in finish materials purchased was calculated by determining the total mass of organic HAP in finish materials as purchased for the finish class (sum of the mass of organic HAP in different formulations within the finish class) divided by the total mass of finish materials purchased for the finish class (sum of mass of finish materials purchased within the finish class) multiplied by 100. The one facility (12 percent of the number of facilities reporting use of the finish class, which ranged from 1 to 8) reporting the lowest weight percent organic HAP in finish materials for each finish class was chosen as the floor facility.

**Table 2-2. Dyeing MACT Floor**

| Dye Class | Weighted Average % Organic HAP in Dye Class Floor |
|---|---|
| Acid | 0.0 |
| Basic | 0.0 |
| Develop | 0.0 |
| Direct | 0.51 |
| Disperse | 0.0 |
| Napthol | 0.0 |
| Neutral Premetalized | 0.01 |
| Pigment | 0.03 |
| Reactive | 0.0 |
| Sulfur | 5.02 |
| Vat | 0.0 |
| Dyeing MACT Floor [a] | 1.58 |

[a] Weighted average of dye class floors.

Table 2-3 presents the MACT floor organic HAP content calculated for each finish class in the database. To determine the MACT floor for finishing, a weighted average organic HAP content of finish materials as purchased was calculated from the finish class MACT floors, using the total mass of finish materials used by the MACT floor facility for each finish class to weight the finish class MACT floor organic HAP contents. As shown in Table 2-3, the finishing MACT floor organic HAP content in materials as purchased was determined to be 0.03 weight percent for existing sources. For the purpose of determining the mass fraction of organic HAP in a finishing material, each organic HAP that is not an OSHA-defined carcinogen as specified in 29 CFR 1910.1200(d)(4) that is measured to be present at less than 1 percent is counted as zero. Therefore, the floor for finishing is zero organic HAP. No technology has been identified that could achieve a lower organic HAP content in materials as purchased, therefore the finishing MACT floor organic HAP content in materials as purchased for new sources was also determined to be zero.

Table 2-3. Finishing MACT Floor

| Finish Class | Weighted Average % Organic HAP in Finish Class Floor |
|---|---|
| Melamine | 0.20 |
| Non-Melamine | 0.05 |
| Water Repellants | 0.0 |
| Soil/Stain Resistant | 0.12 |
| Hand Softening | 0.0 |
| Hand Building | 0.01 |
| Flame Retardant | 0.0 |
| Other [a] | 0.0 |
| Finishing MACT Floor [b] | 0.03 |

[a] Other finishes reported include lubricants, wetting agents, anti-stick, and dressing.

[b] Weighted average of finishing class floors.

### MACT Floor for Dyeing and Finishing Subcategory

The dyeing and finishing MACT floors represent planks in the MACT floor for the dyeing and finishing subcategory. In a textile finishing facility with both dyeing and finishing processes, averaging of organic HAP in materials as purchased for dyeing and finishing may be done within the total mass of HAP allowable under the MACT floors for dyeing and finishing. For example, if a facility uses dye materials with no organic HAP, the mass of organic HAP allowed by the MACT floor (1.58 weight percent of the dye materials purchased) may be contained in the finishing materials as purchased. Therefore, a facility with both dyeing and finishing operations can choose to meet the MACT floors for each process individually, or can limit the mass of organic HAP contained in dyeing and finishing materials as purchased to the sum of the allowable mass of HAP under the dyeing and finishing MACT floors.

It should be noted that the reportable quantity of HAPs in the dyeing and finishing material is limited to more than 0.1 percent by mass for carcinogenic compounds as specified in 29 CFR 1910.1200(d)(4) and more than 1.0 percent by mass for other HAP compounds. This is consistent with the data in the MACT database; several facilities reported no HAP in purchased materials on the basis of the HAP being less than reportable quantities in material safety data sheets (MSDS).

### Consideration of Beyond-the-Floor Technology for Existing and New Dyeing and Finishing Sources

The MACT floors for existing and new or reconstructed sources in the dyeing and finishing subcategory are based on the best information available. The floors represent pollution prevention options yielding the "best performing" and achievable emission rates for new or reconstructed and existing sources in each subcategory. No "above the floor" technology has been identified that could achieve a lower organic HAP content in materials as purchased and would be applicable to all products for dyeing operations and zero percent HAP is the lowest organic HAP content in materials as purchased for finishing operations that can be achieved.

**REFERENCES**:

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3. "Summary of Textile Manufacturing Operations". Submitted to the USEPA by the American Textile Manufacturers Institute. Prepared by the Institute of Textile Technology. July 1991.

4. Memorandum and 5 Attachments from Sharma, A. and S. York, RTI, to P. Almodóvar, EPA/OAQPS/ESD/CCPG. August 8, 1997 Final. Summary of Initial PMACT Meeting for Fabric Printing, Coating, and Dyeing.

5. Memorandum and Attachment from York, S. and A. Sharma, RTI to P. Almodóvar, EPA/OAQPS/ESD/CCPG. November 13, 1998 Final. Summary of meeting at which ATMI presented the results of the ATMI MACT survey to EPA.

6. Memorandum and 4 Attachments from Malkin, M. and S. York, RTI, to P. Almodóvar, EPA/OAQPS/ESD/CCPG. December 15, 1997 Final. Summary of Second PMACT Meeting for Fabric Printing, Coating, and Dyeing.

7. Memorandum and 2 Attachments from York, S. and A. Peters, RTI, to V. Hellwig and P. Almodóvar, EPA/OAQPS/ESD/CCPG. January 8, 2001 Final. Summary of American Textile Manufacturers Institute (ATMI)/US Environmental Protection Agency (EPA) MACT Development Meeting for Fabric Printing, Coating, and Dyeing.

8. U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

9. Letter, J. Fleming, ATMI, to G. V. Hellwig, EPA: OAQPS: CCPG, July 27, 2000. ATMI

MACT Development Support and Data Submission (textile dyeing).

10. Letter, J. Fleming, ATMI, to G. V. Hellwig, EPA: OAQPS: CCPG, November 2, 2000. ATMI MACT Development Support (textile finishing).

# MEMORANDUM

January 10, 2002

To: Printing, Coating and Dyeing of Fabrics and Other Textiles File

From: G. V. Hellwig

Subject: MACT Floor for Slashing

Slashing is a yarn preparation process performed on warp yarn prior to weaving. Warp yarns need to sustain their elongation and flexibility during the weaving process, which necessitates the slashing process. In the slashing process, large rolls (beams) of warp yarn are passed through a size box containing the aqueous sizing compound. Squeeze rolls remove excess solution and the yarn then passes through a drying unit that usually consists of steam filled dry cans (rollers) or an oven and then through a series of separator bars to prevent the ends from sticking together.[1] After the separation process, the warp is then wound onto the loom beam.[2] Some mills perform desizing. During the desizing step, at the end of the textile process, most of the sizing (slashing material) is removed from the textile by washing and the sizing is present in the wastewater.[3]

The objectives of slashing are to strengthen, smooth the outer surface, and lubricate the yarn. The chemical nature of the size applied is dependent on the yarn substrate and the type of weaving being used. The three main types of size currently used are natural products (starch), fully synthetic products [e.g., polyvinyl alcohol (PVA)], and semisynthetic blends (e.g., modified starches and carboxymethyl cellulose or CMC).[2] When starch or modified starch is the sizing compound there is water but no HAPs emitted from the slashing process. Starch is used principally on cotton, but does not work well on synthetic fabrics. Also, starch is not more widely used, and is not a good substitute for synthetic sizing, because of water pollution concerns. Starch greatly increases the BOD and cannot be partially recycled. The PVA and CMC are typically recycled when possible to reduce water treatment and water pollution. CMC is not as widely used as starch and PVA because of the cost of the material. CMC is not as effective in the slashing process on cotton and synthetic textiles as starch, modified

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[1] Cone, White Oak Plant, Cone Mills Corporation, Greensboro, NC, 1998

[2] A Dictionary of Textile Terms, Dan River, Inc. New York, New York, 1992

[3] The Basics of Textiles, NC State University College of Textiles, Raleigh, NC, May 1, 2000.

starches or PVA, respectively.[4]

The primary source of HAP emissions from slashing is methanol from  (PVA) size, typically applied to synthetics (although it adheres to and is used for natural fibers as well).  The methanol is present in the PVA size as a contaminant, and is not needed for the slashing process.  The methanol emissions can arise either from the size cooking operation and/or from the application or slashing process - the distribution is unclear, although it will depend upon the temperature at which the size is cooked, the cooking time, and how often mixing containers (cookers) are opened.[5]  These processes are not presently regulated by federal, state or local agencies, and there are no known HAP emission capture or control systems in use on size cooking or slashing processes. Slashing operations are not controlled with air pollution control equipment.  This was confirmed by state and federal agency representatives at a PMACT meeting.[6]  This fact was also confirmed by plant visits and information compiled by EPA and shared with stakeholders for review and comment during the PMACT process.

Based on information submitted by the American Textile Manufacturers Institute (ATMI) on September 17, 1999, it was demonstrated that the majority of the domestic textile market, in 1998, was using PVA for slashing with less than 1 percent by weight, methanol in the PVA "as purchased."   Methanol is a contaminant in the PVA that is a residual material from the manufacture of the PVA.  The typical PVA sizing compound previously contained from 4 to 10 percent methanol.  As a result of efforts by the suppliers, the amount of methanol contained in the PVA can be reduced from the four percent to ten percent in previous years to less than one percent.  Therefore, the methanol content of size "as applied" is below one percent.  The ATMI submittal included letters from suppliers representing approximately 74 percent of the domestic market for PVA.  These letters indicated that the "less than 1 percent methanol" is readily available and these suppliers are now changing their production to supply the lower HAP material. These letters provide detailed information from the PVA suppliers, and are located in the Confidential Business Information files at EPA.[7]  Information collected from the world wide web on two domestic suppliers of PVA confirms that PVA with "less than 1 per cent methanol" is available

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[4] Reference 3.

[5] Preliminary Industry Characterization: Fabric Printing, Coating, and Dyeing, Office of Air Quality Planning and Standards, U. S. EPA, September  1998.  Docket No. A-97-51.

[6] Memorandum from S. York to Paul Almodovar. Docket No. A-97-51.  Initial Regulatory Subgroup PMACT Meeting for Fabric Printing, Coating and Dyeing.  January 8, 1998.

[7] Confidential Business Information Files, OAQPS, U. S. EPA, RTP, North Carolina.

from suppliers.[8]

The basis for the MACT Floor for the slashing subcategory was demonstrated to be the use of low HAP PVA containing less than 1 percent HAP, by weight, "as purchased". Because this is the best information available and because of the availability of low HAP PVA and a large percentage of the operating facilities using the low HAP material in 1998, this establishes the floor for slashing at a PVA HAP content limit of less than 1 percent, by weight, "as purchased". For the purpose of determining the mass fraction of organic HAP in a slashing material, each organic HAP that is not an OSHA-defined carcinogen as specified in 29 CFR 1910.1200(d)(4) that is measured to be present at less than 1 percent, counted as zero. Therefore, the floor for slashing is zero organic HAP. Since the slashing is performed without the benefit of air pollution control equipment, and the distribution of emissions is between mixing, application, and drying is unknown, the pollution prevention option of zero HAP in the PVA "as purchased" is the preferred limit. Other synthetic organic sizing compounds in use also contain HAP, but the HAP content of these sizing compounds is well below 1 percent. Therefore, the emission rate limit based on the use of slashing materials with zero organic HAP for all organic HAP compounds is the average being achieved by all existing affected sources with slashing operations.

Because PVA sizing is available with zero organic HAP, and this represents the "best performing" and achievable emission rate for this subcategory, the new and reconstructed source MACT floor also is the pollution prevention option of zero organic HAP in the sizing material "as purchased".

The MACT floors for existing sources and new or reconstructed sources in the slashing subcategory are based on the best information available. The floors represent pollution prevention options yielding the "best performing" and achievable emission rates for existing and new or reconstructed sources in the slashing subcategory. There is no "above the floor" technology that could achieve a lower organic HAP content in materials "as purchased" than zero percent.

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[8] Memorandum from S. L. Turner to Docket No. A-97-51 regarding methanol content in slashing PVA compounds, September 27, 2000.

**MEMORANDUM**

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Alton Peters, Jim Turner, and Steve York, RTI
**DATE:** October 12, 2000
**SUBJECT:** Coating Model Plants

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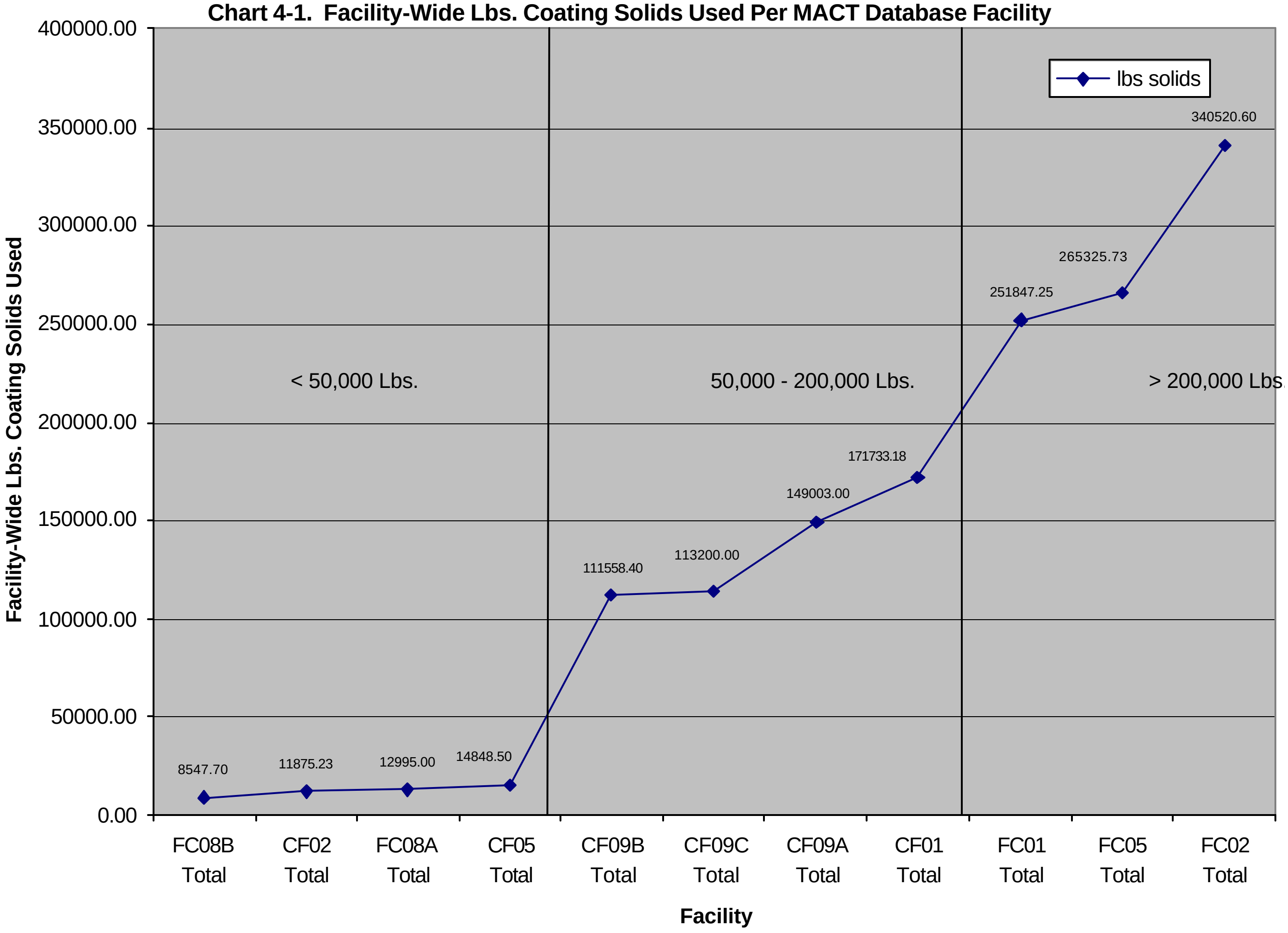
The purpose of this memorandum is to present coating model plants for the printing, coating, and dyeing of fabrics and other textiles source category. Each model plant is a representation of the drying/curing operations in a coating facility. The model plants will be used to estimate add-on control device control costs and resource requirements resulting from compliance with regulatory options. Emission control systems needed to comply with the proposed MACT standard also include coating rooms (permanent total enclosures) to capture fugitive HAP emissions from coating application stations. Coating room specifications are presented in the October 12, 2001 memorandum entitled Compliance Costs for Coating Model Plants.

The coating MACT database [1] consists of twenty-one facilities of which seventeen are non-CBI. Process, emissions, and control information is available from responses to survey questionnaires. There is sufficient process information available from eleven of the twenty-one facilities to provide a basis for the coating model plants.

The coatings applied by facilities in the coating MACT database can be classified as solvent-borne and water-borne, with the vast majority of the coatings applied being solvent borne. Most of the facilities in the MACT database apply solvent-borne coatings with either urethane or rubber polymer resins. Some facilities in the MACT database using mostly urethane coatings reported a small amount of vinyl coatings being used on the same lines as the urethane coatings. This vinyl coating use represents a very small proportion of the coatings used relative to urethane coatings; therefore, the model plants used for urethane coatings are sufficiently representative of the plants using vinyl coatings.

Mass of coating solids applied annually could be calculated from coating materials usage data and correlates well with the production of coated fabric. Therefore, mass of coatings solids applied annually was determined to be the best parameter in the data base to serve as the basis for the size of the coating facility. Chart 4-1 presents a plot of the mass of coatings solids applied per facility in the MACT database for which sufficient non-CBI coatings materials data were available. Interjection in this process of plants claiming coatings materials usage CBI was evaluated, but this did not significantly change the distribution of solids used per year. Therefore, only non-CBI data were used to specify model plants.

**Chart 4-1. Facility-Wide Lbs. Coating Solids Used Per MACT Database Facility**



The information in Chart 4-1 was used to define three different sizes of model plants as follow: plants applying less than 50,000 pounds of solids per year, plants applying between 50,000 and 200,000 pounds of solids per year, and plants applying greater than 200,000 pounds of solids per year.

The facilities applying less than 50,000 pounds of solids per year included facilities applying only urethane coatings and facilities applying only rubber coatings. Hence, two model plants were specified for this size category. Similarly, all of the facilities applying between 50,000 and 200,000 pounds of solids per year were using only rubber coatings and all of the facilities applying greater than 200,000 pounds per year were using only urethane coatings. Consequently, the following four model plants were specified:

- Model Plant No. 1, less than 50,000 pounds of solids applied per year in rubber coatings
- Model Plant No. 2, less than 50,000 pounds of solids applied per year in urethane coatings
- Model Plant No. 3, between 50,000 and 200,000 pounds of solids applied per year in rubber coatings
- Model Plant No. 4, more than 200,000 pounds of solids applied per year in urethane coatings.

Tables 4-1 through 4-4 present the model plant parameters. The basis for each model plant parameter is presented in the following paragraphs.

Since there was no information in the coating MACT database on operating time, two operating schedules were assumed; 2,000 hours per year (8 hours per day, 5 days per week, 50 weeks per year) for the small model plants and 4,000 hours per year (16 hours per day, 5 days per week, 50 weeks per year) for the medium and large model plants. These operating schedules were based on the operating schedules for model plants specified in the background information document [2] supporting the NSPS for polymeric coating of supporting substrates (hereafter referred to as the fabric coating NSPS). The annual coating time was also based on the model plants specified in development of the fabric coating NSPS.

As has already been described, the annual pounds of solids applied was calculated from information in the MACT database for each facility with sufficient non-CBI information. For each model plant, average values across the facilities in the MACT database in that size and coating category were calculated for the annual pounds of solids applied.

Similarly to the calculation of annual pounds of solids applied, for each facility in the MACT database with sufficient coatings materials information, the average coating composition was calculated in terms of weight percent HAP, solids, and non-HAP VOC. The HAP were speciated; only total VOC information for each coating material was collected. None of the facilities serving as the basis for the model plants reported water in coating materials.  Regarding the HAP speciation, toluene was the predominant organic solvent reported for solvent-borne

## Table 4-1. Model Plant Parameters for Model Plant No. 1

| | |
|---|---|
| Annual operating time: | 2000 hours |
| Annual coating time [a]: | 1000 hours |
| Annual pounds of solids applied: | 13,410 pounds |
| Coating: | Solvent-borne rubber coating, 87% HAP (toluene) by weight; 13% solids by weight |
| Ovens: | |

| | |
|---|---|
| Number of ovens | 1 |
| Maximum solvent concentration | 25% LEL |
| Quantity of toluene controlled | 89.7 lb/hr |
| Solvent capacity | 12.4 gallons/hr |
| Air flow | 2234 ACFM |
| Inlet temperature to control device [b] | 120 °F |

[a] Annual coating time is estimated to be 50% of annual operating hours.

[b] Estimated as 20 °F less than the average exhaust temperature from the oven of 140 °F that was calculated for facilities from the MACT database in this size and coating category.

## Table 4-2. Model Plant Parameters for Model Plant No. 2

| | |
|---|---|
| Annual operating time: | 2000 hours |
| Annual coating time [a]: | 1000 hours |
| Annual pounds of solids applied: | 10,775 pounds |
| Coating: | Solvent-borne urethane coating, 51% HAP (64/36 ratio of DMF/toluene) by weight; 29% solids by weight; 20% non-HAP VOC by weight |
| Ovens: | |
| Number of ovens | 1 |
| Maximum solvent concentration | 25% LEL |
| Quantity of toluene[b] controlled | 9.5 lb/hr |
| Quantity of DMF[b] controlled | 17 lb/hr |
| Solvent capacity | 3.4 gallons/hr |
| Air flow | 8570 ACFM |
| Inlet temperature to control device [c] | 300 °F |

[a] Annual coating time is estimated to be 50% of annual operating hours.

[b] Includes VOCs of unknown composition.

[c] Estimated as 20 °F less than the average exhaust temperature from the oven of 320 °F that was calculated for facilities from the MACT database in this size and coating category.

## Table 4-3. Model Plant Parameters for Model Plant No. 3

| | |
|---|---|
| Annual operating time: | 4000 hours |
| Annual coating time [a]: | 2000 hours |
| Annual pounds of solids applied: | 136,375 pounds |
| Coating: | Solvent-borne rubber coating, 81% HAP (toluene) by weight; 19% solids by weight |

Ovens:

| | |
|---|---|
| Number of ovens | 2 |
| Maximum solvent concentration | 25% LEL |
| Quantity of toluene controlled | 291 lb/hr |
| Solvent capacity | 40 gallons/hr |
| Air flow | 8465 ACFM |
| Inlet temperature to control device | 242 °F |

[a] Annual coating time is estimated to be 50% of annual operating hours.

## Table 4-4. Model Plant Parameters for Model Plant No. 4

| | |
|---|---|
| Annual operating time: | 4000 hours |
| Annual coating time [a]: | 2000 hours |
| Annual pounds of solids applied: | 285,900 pounds |
| Coating: | Solvent-borne urethane coating, 70% HAP (64/36 ratio of DMF/toluene) by weight; 24% solids by weight; 6% non-HAP VOC by weight |
| Ovens: | |

| | |
|---|---|
| Number of ovens | 4 |
| Maximum solvent concentration | 25% LEL |
| Quantity of toluene[b] controlled | 163 lb/hr |
| Quantity of DMF[b] controlled | 290 lb/hr |
| Solvent capacity | 59 gallons/hr |
| Air flow | 14,341 ACFM |
| Inlet temperature to control device | 228 °F |

[a] Annual coating time is estimated to be 50% of annual operating hours.

[b] Includes VOCs of unknown composition.

rubber coatings. Urethane coatings were reported to contain predominately toluene and N,N-dimethylformamide (DMF) with a small amount of non-HAP VOC. The model plant coating compositions represent average values across facilities in the MACT database in that size and coating category. It should be noted that the types of solvent-borne coatings and the coating compositions are consistent with the coatings specified for the model plants developed for the fabric coating NSPS.

The number of ovens per facility represents the average across facilities in the MACT database in that size and coating category.

Fire insurance regulations require that combustible gases in air not be at concentrations greater than 25 percent of the lower explosive limit (LEL) [3]. Exceptions can be made up to 50 percent LEL, but only with continuous monitoring of the combustible content. Gas flow rates for modeling are based on maintaining combustible concentration at or below 25 percent LEL. Dilution air is commonly added to the gas stream and was required for Models 1 and 3.

The LEL for toluene is 1.27 percent. Twenty-five percent of the LEL is 0.3175 percent, or 3175 ppmv. As an example of the calculation of the air flow needed to maintain combustible gas concentrations below 25 percent of the LEL, for Model 3, 6,000 acfm is the average air flow calculated from the MACT database for the facilities in the size and coating category represented by Model 3. The concentration of HAP, which represents all of the combustible material in the air stream, can be estimated from the quantity of solids applied annually, the concentration of solids in the coating mix, and the time over which the coating mix is applied. The parameters for Model Plant 3 are used in the equations below:

$$\begin{aligned} \textit{Quantity of HAP} &= \frac{136{,}375}{0.19}\ \frac{\textit{lb solids/y}}{\textit{fraction of solids}} \times \frac{0.81\ \textit{fraction as HAP}}{2{,}000\ \textit{coatinghours}} \\ &\times \frac{453.6\ g/lb}{92.13\ g/g-mol} = 1{,}431.2\ \textit{g mols HAP/h} \end{aligned} \tag{1}$$

The minimum quantity of gas for 25 percent of the LEL can be found by dividing the quantity of HAP by 0.3175.

$$\begin{aligned} \textit{Total gas flow, scfm} &= \frac{1{,}431.2\ \textit{g mols HAP}}{0.003175} \times \frac{1\ h}{60\ min} \times \frac{24.0\ L/g\ mol}{28.32\ L/ft^3} \\ &= 6{,}366.9\ \textit{scfm} \end{aligned} \tag{2}$$

Converted to acfm, the minimum gas flow rate becomes:

$$6366.9\ scfm\ x\ \frac{(460\ +\ 242)\ ^{\circ}F}{(460\ +\ 68)\ ^{\circ}F}\ =\ 8{,}465\ acfm \qquad (3)$$

This value was used for the gas flow for Model 3 in place of the gas flow calculated from the MACT database of 6,000 scfm. Similar methodology was used for the other model plants. Models 2 and 4 had sufficiently low concentrations based on MACT database values that no dilution air was required.

The average temperature entering the control device was calculated from data in the MACT database for Models 3 and 4. No such data were available for use with Models 1 and 2. However, the database did provide temperatures at the exhaust from the ovens. It was assumed that temperature losses of 20 °F occurred between the oven exhaust and the control device inlet. This value is consistent with model plants specified for the fabric coating NSPS.

The quantity of combustible material entering the control device (HAP and VOC) is estimated as in Equation 1. As shown there, 1,431.3 lb mols of HAP (toluene)/h (or 1,431.3 x 92.13 = 131,866 lb/h) enter the control device in Model 3. Model 1 is treated similarly. No VOCs are present in the gas stream for either Model 1 or Model 3. For Models 2 and 4, DMF quantities are also estimated from the quantity of HAP and the ratio of toluene to DMF suggested by the MACT database. Because the quantities of VOCs are relatively small and their constituents are not known, the VOCs are treated as additional quantities of HAPs in the same ratio as found for the toluene and DMF.

Solvent capacity is found from the quantity of HAP leaving the oven and the room temperature density of the liquid HAP. For example, in Model 3:

$$290.7\ \frac{lb}{h}\ x\ \frac{1\ gal}{7.26\ lb}\ =\ 40\ \frac{gal}{h} \qquad (4)$$

## References

1. U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

2. Polymeric Coating of Supporting Substrates – Background Information for Proposed Standards. Office of Air Quality Planning and Standards, U. S. EPA. EPA-450/3-85-022a, April 1987. pp. 6-5 thru 6-10.
3. U. S. Environmental Protection Agency. Control Technologies for Hazardous Air Pollutants

Handbook. EPA/625/6-91/014. Office of Research and Development. Washington, DC. June 1991. p. 4-3.

## MEMORANDUM

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Steve York and Alton Peters, RTI
**DATE:** January 7, 2002
**SUBJECT:** Summary of Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP Baseline Organic HAP Emissions and Emission Reductions

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Baseline organic HAP emissions data and calculations of emission reductions for coating and printing, dyeing, finishing, and slashing operations are presented in the following paragraphs. Though dyeing and finishing constitute a subcategory of the printing, coating, and dyeing of fabrics and other textiles source category, the detailed estimates of baseline HAP emissions and emission reductions are broken out in the text because the emission reductions are based on information from separate surveys of dyeing and finishing facilities. Also attached is a table summarizing the baseline organic HAP emissions and emission reductions by subcategory.

## Coating and Printing Baseline Organic HAP Emissions and Emission Reduction

The baseline organic HAP emissions for coating were derived from 1997 Toxics Release Inventory (TRI) data. The Standard Industrial Classification (SIC) codes used were as follows:

- 2262 - Finishing Plants, Synthetics
- 2269 - Finishing Plants, NEC
- 2284 - Thread Mills
- 2295 - Coated Fabrics, Not Rubberized
- 2298 - Cordage and Twine
- 3052 - Rubber and Plastics Hose and Belting
- 3069 - Fabricated Rubber Products, Not Elsewhere Classified

Baseline organic HAP emissions for printing were determined from data collected in the original ATMI MACT survey [1].

Baseline organic HAP emissions for coating were calculated to be 5537 tons per year and for printing were calculated to be 34 tons per year, yielding a total of 5571 tons of organic HAP emissions per year for the coating and printing subcategory. Of the 5571 tons of organic HAP emissions, 560 tons were determined to be emitted by area sources that would not be required to reduce organic HAP emissions to comply with the NESHAP. Of the 5,011 tons of organic HAP emissions from major sources, 214 tons were reported to be methylene chloride emissions.

Each facility in the coating MACT database [2] was examined to determine if it would be in compliance with the proposed OCE limit or the equivalent emission rate limit based on MACT database capture and control efficiency data and coatings use data reported in response to the coating ICR. Similarly, information collected as described in the memorandum at page 9-1 of this document regarding coating major facilities owned by small businesses was evaluated to determine which facilities owned by small businesses would be required to take measures to reduce HAP emissions to comply with the proposed emission limits. Emission reductions were calculated for each coating MACT database facility and each major facility owned by a small business that was determined to be required to take measures to reduce emissions to comply with either the OCE limit or the equivalent emission rate limit. The total emission reduction for the coating MACT database facilities and major facilities owned by small businesses was calculated to be 62 percent.

Methylene chloride emissions were assumed to be uncontrolled, since methylene chloride is not a VOC, and therefore, has not been required to be controlled under existing VOC regulations. Consequently, the emission reduction calculated for methylene chloride emissions would be 97 percent, i.e., the proposed OCE limit for existing sources of HAP emissions.

## Dyeing Baseline Organic HAP Emissions and Emission Reduction

The baseline organic HAP emissions for dyeing were determined from data collected in the original ATMI MACT survey [1]. Baseline organic HAP emissions were calculated to be 384 tons per year.

The emission reduction was calculated from the ATMI survey of dyeing facilities [3] as the reduction from the average HAP content in dyeing materials as purchased for the entire dyeing database of 12.37 percent to the HAP content in dyeing materials as purchased for the dyeing floor of 1.58 percent, yielding a reduction of 87 percent.

## Finishing Baseline Organic HAP Emissions and Emission Reduction

The baseline organic HAP emissions for finishing were determined from data collected in the original ATMI MACT survey [1]. Baseline organic HAP emissions were calculated to be 517 tons per year.

The emission reduction was calculated from the ATMI survey of finishing facilities [4] as the reduction from the average HAP content in finishing materials as purchased for the entire finishing database of 4.9 percent to the HAP content in finishing materials as purchased for the finishing floor of 0.03 percent. For the purpose of estimating the emission reduction, a floor of 1 percent was assumed, based on the Occupational Safety and Health Administration (OSHA) Material Safety Data Sheet (MSDS) minimum reportable quantity of ingredients. For a non-carcinogen, a mass fraction of less than 1 percent is not quantified further, but reported as < 1. Using the 1 percent floor yields a reduction of 80 percent.

## Slashing Baseline Organic HAP Emissions and Emission Reduction

The baseline organic HAP emissions for slashing were determined from data collected in the original ATMI MACT survey [1]. Baseline organic HAP emissions for slashing were calculated to be 348 tons per year.

The emission reduction was calculated to be 50 percent, representing a reduction in weight percent methanol content in PVA size from 2 percent to the slashing floor of 1 percent. The 2 percent baseline weight percent methanol content in PVA size is based on information provided by ATMI and presented for review and comment to stakeholders in a PMACT briefing package.

Table 5-1 summarizes the baseline organic HAP emissions and the emission reductions for the coating and printing, slashing, and dyeing and finishing subcategories and for the printing, coating, and dyeing of fabrics and other textiles source category.

## References

1. Memorandum, S. York and A. Sharma, RTI, to P. Almodóvar, EPA/OAQPS/ESD/CCPG. October 31, 1997. Summary of meeting at which ATMI presented the results of the ATMI MACT survey to EPA.

2. U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

3. Letter, J. Fleming, ATMI, to G. V. Hellwig, EPA: OAQPS: CCPG, July 27, 2000. ATMI MACT Development Support and Data Submission (textile dyeing).

4. Letter, J. Fleming, ATMI, to G. V. Hellwig, EPA: OAQPS: CCPG, November 2, 2000. ATMI MACT Development Support (textile finishing).

5. Memorandum and attachments, M. Malkin and S. York, RTI to P. Almodóvar, EPA/OAQPS/ESD/CCPG. December 15, 1997. Summary of September 4, 1997 P-MACT meeting, Attachment 3, p. 6 of 18.

**Table 5-1. Summary of Printing, Coating, and Dyeing of Fabrics and Other Textiles Source Category Baseline Organic HAP Emissions and Emission Reductions**

| Subcategory | Emissions Before NESHAP (tpy) | Emissions After NESHAP (tpy) | Emission Reduction (tpy) | Percent Reduction (%) |
|---|---|---|---|---|
| Coating and Printing | 5571[1] | 2389 | 3182 | 57[2] |
| Dyeing and Finishing | 901[3] | 153 | 748 | 83[4] |
| Slashing | 348[3] | 174 | 174 | 50[5] |
| Source Category Nationwide Total | 6820 | 2716 | 4104 | 60 |

[1] TRI data for 1997 and printing data from Reference 1.

[2] Based on estimated emission reduction of 62 percent required for major sources in the coating MACT database (Reference 2) and major sources owned by small businesses (see memorandum at page 9-1 of this document) to comply with the proposed emission limits applied to total organic HAP emissions from major sources (with the exception of 214 tons of methylene chloride emissions) calculated for the coating and printing subcategory. The methylene chloride emissions were assumed to be uncontrolled and would be reduced 97 percent by the proposed OCE limit.

[3] Reference 1.

[4] Based on detailed ATMI surveys of dyeing and finishing facilities (References 3 and 4).

[5] Reference 5.

## MEMORANDUM

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Steve York, Jim Turner and Jeff Coburn, RTI
**DATE:** January 7, 2002
**SUBJECT:** Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP Nationwide Energy and Secondary Environmental Impacts

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The purpose of this memorandum is to present estimates of the nationwide energy and secondary environmental impacts resulting from compliance with the proposed printing, coating, and dyeing of fabrics and other textiles NESHAP. The energy and secondary environmental impacts will result from the installation of new and upgrade of existing add-on controls by facilities in the coating and printing subcategory. Model plants and the criteria used to choose them are described in the October 12, 2000 memorandum entitled Coating Model Plants (see page 4-1 of this document). The assignment of model plants to facilities in the coating MACT database for the purpose of estimating impacts is described in the January 8, 2002 memorandum entitled Printing, Coating, and Dyeing of Fabrics and Other Textiles Nationwide Compliance Costs (see page 10-1 of this document). Similarly, the assignment of model plants to coating major facilities owned by small businesses is described in the December 20, 2001 memorandum entitled Summary of Evaluation of Estimated Compliance Costs Incurred by Coating Facilities Owned by Small Businesses (see page 9-1 of this document).

## Energy Impacts

Energy requirements for implementation of the compliance options for coating and printing facilities include electricity to collect and treat ventilation air, electricity to light permanent total enclosures and natural gas to provide supplemental fuel for stable operation of oxidizers and to generate the steam required for carbon regeneration. Table 6-1 presents a summary of increased coating and printing model plant and nationwide energy requirements associated with implementation of the compliance options. It should be noted that no incremental electricity usage is estimated for the upgrade of catalytic oxidizer model plants. This is because the air flow does not change. Similarly, no incremental energy usage is estimated for the upgrade of carbon adsorber Models 3 and Model 4. For each model plant, the increased efficiency comes from the addition of a carbon bed, reducing the cycle time between carbon bed regenerations, and therefore, reducing the HAP released to the atmosphere from breakthrough. There is no change in air flow or in the amount of steam used for regeneration, which is a function of the organic HAP load entering the carbon bed.

## Table 6-1. Summary of Coating and Printing Subcategory Model and Nationwide Energy Impacts

| Model | Number of plants [a] | Model incremental electricity usage, kWh/y | Nationwide total electricity usage, kWh/y | Model incremental natural gas usage, scf/y | Nationwide total natural gas usage, scf/y |
|---|---|---|---|---|---|
| **New Add-on Control Device** | | | | | |
| | | | | | |
| Model 1, carbon adsorber | 2 | 8,933 | 17,866 | 418,941 | 837,882 |
| Model 1, catalytic oxidizer | 1 | 11,293 | 11,293 | 2,360,755 | 2,360,755 |
| Model 2, thermal oxidizer | 2 | 28,857 | 57,714 | 36,332,289 | 72,664,578 |
| Model 3, carbon adsorber | 4 | 119,517 | 478,068 | 2,714,142 | 10,856,568 |
| **Upgrade of Add-on Control Device** | | | | | |
| | | | | | |
| Model 2, catalytic oxidizer | 1 | 0 | 0 | 691,592 | 691,592 |
| Model 3, catalytic oxidizer | 2 | 0 | 0 | 1,090,910 | 2,181,820 |
| Model 3, carbon adsorber | 3 | 0 | 0 | 0 | 0 |
| Model 4, catalytic oxidizer | 2 | 0 | 0 | 1,723,795 | 3,447,590 |
| Model 4, carbon adsorber | 1 | 0 | 0 | 0 | 0 |
| **New Coating Room (PTE)** | | | | | |
| | | | | | |
| Small | 14 | 11,200 | 156,800 | 0 | 0 |
| Medium | 13 | 12,250 | 159,250 | 0 | 0 |
| Large | 29 | 12,600 | 365,400 | 0 | 0 |
| **Total Energy Impacts for Model Plants Except Methylene Chloride Model Plants** | | | 1,246,391 | | 93,040,785 |
| | | | | | |
| **Nationwide Total Energy Impacts Except Methylene Chloride Energy Impacts [b]** | | | 2,567,565 | | 191,664,017 |
| | | | | | |
| **New Add-on Control System for Methylene Chloride Emissions [c]** | | | | | |
| | | | | | |
| Model 1, carbon adsorber | 1 | 15,742 | 15,742 | 418,941 | 418,941 |
| Model 3, carbon adsorber | 1 | 186,588 | 186,588 | 2,714,142 | 2,714,142 |
| | | | | | |
| **Total Methylene Chloride Control Energy Impacts** | | | 202,330 | | 3,133,083 |
| | | | | | |
| **Nationwide Total Energy Impacts with Methylene Chloride Energy Impacts [d]** | | | 2,769,895 | | 194,797,100 |

[a] Number of model plants assigned to 14 facilities in the coating MACT database and to 12 coating major facilities owned by small businesses to estimate the incremental energy requirement of achieving the proposed emission limits with add-on controls.

[b] Nationwide totals for all plants in the coating and printing industry, except plants with methylene chloride emissions, are based on factoring the total energy usage for model plants except methylene chloride model plants by the ratio of HAP emissions estimated for major HAP emission sources in the coating and printing subcategory (minus methylene chloride emissions) to the HAP emissions reported by facilities in the coating MACT database and major facilities owned by small businesses (the ratio is 2.06).

[c] Includes energy usage of add-on control system and coating room.

[d] Sum of nationwide total energy impacts except methylene chloride energy impacts and total methylene chloride control energy impacts.

## Water Impacts

Nationwide water impacts resulting from implementation of the compliance options are insignificant. Facilities adding carbon adsorber systems will require increased cooling water usage for the condenser used to recover organic HAP from the regenerated carbon and for the spray tower specified to cool the gas entering the Model 3 carbon adsorber used to recover methylene chloride. The cooling water for the condenser does not contact the HAP-laden stream and is assumed to be recycled. Similarly, only enough cooling water should be used in the spray tower to cool, but not saturate, the gas entering the Model 3 carbon adsorber, so the cooling water is assumed not to result in wastewater. Nationwide cooling water usage is estimated to be 70,292,992 gallons per year.

There is a small increase in water usage for steam to regenerate carbon. The steam used for regeneration will yield water requiring wastewater treatment. Nationwide total wastewater generation is estimated to be 3,766,369 gallons per year.

## Solid Waste Impacts

Facilities using existing catalytic oxidizers to comply with the emission limits probably will be required to install larger volumes of catalysts and to replace the catalysts more frequently than current replacement cycles to maintain high performance levels, resulting in a small increase in solid waste generation. Similarly, facilities that currently do not operate emission control systems and that install catalytic oxidizers to comply with the emission limits will result in an increase in solid waste generation. Sometimes the spent catalyst will be regenerated by the manufacturer for reuse. Activated carbon used in carbon adsorbers is returned to the manufacturer at the end of its useful life and converted to other salable products. Little solid waste impact is expected from this source.

## MEMORANDUM

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Steve York, RTI
**DATE:** October 12, 2001
**SUBJECT:** Compliance Costs for Coating Model Plants

The purpose of this memorandum is to present compliance costs for the coating model plants for the printing, coating, and dyeing of fabrics and other textiles source category. Model plant specifications used in estimating compliance costs are summarized in Table 7-1. Emission control systems needed to comply include coating rooms (permanent total enclosures) to capture fugitive HAP emissions from coating application stations and either oxidizers with 97 percent destruction efficiencies or carbon adsorbers with 97 percent recovery efficiencies.

## PERMANENT TOTAL ENCLOSURE COSTS

Table 7-2 presents a summary of permanent total enclosure (PTE) costs. As shown in Table 7-2, PTEs are costed in three sizes: 8,000 $ft^3$; 13,000 $ft^3$; and 18,000 $ft^3$. Floor areas for the three enclosures are taken as 800 $ft^2$, 875 $ft^2$, and 900 $ft^2$, respectively, based on typical coating application station sizes for the model plants. To estimate compliance costs for a coating line needing to upgrade capture efficiency, the costs of a small PTE are applied to Model Plants 1 and 2, the costs of a medium PTE to Model Plant 3, and the costs of a large PTE to Model Plant 4.

Each PTE is assumed to have two swing doors and four windows. Costing on a square-foot basis plus doors and windows, is taken from Reference 1. The structure is assumed to be constructed of steel. Auxiliary costs that contribute to the purchased equipment cost (PEC) are assumed to add 50 percent to the purchase price. Total capital investment (TCI) is taken as 1.6 times the PEC. Annual costs are charged for maintenance ($\$6/ft^2$ y) and electricity for lighting (14 $kWh/ft^2$ y). Indirect annual costs are based on typical values in the OAQPS Control Cost Manual[2] (Manual) , i.e., 60 percent labor and materials overhead, other indirect costs of 4 percent of TCI, and capital recovery based on 7 percent interest and a 15-year life for the enclosure.

In estimating the costs of a PTE, it has been assumed that existing process exhaust airflow will be adequate to satisfy the EPA Method 204 criteria and to provide for worker safety and comfort. This assumption is based on experience cited by several engineering contractors [3,4,5] that install PTEs. For example, Pacific Environmental Services reported that of more than 100 PTE designs completed, none has required an increase in the size of the air pollution control device in order to maintain worker comfort.

**Table 7-1. Model Plant Specifications Used for Compliance Costing**

| Model Plant | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Annual operating time (hr) | 2000 | 2000 | 4000 | 4000 |
| Annual coating time [a] (hr) | 1000 | 1000 | 2000 | 2000 |
| Solids applied annually (lbs) | 13,410 | 10,775 | 136,375 | 285,900 |
| Coating type | Rubber | Urethane | Rubber | Urethane |
| Coating formulation [b] : | | | | |
| Weight percent HAP | 87 | 51 | 81 | 70 |
| Weight percent solids | 13 | 29 | 19 | 24 |
| Weight percent non-HAP VOC | 0 | 20 | 0 | 6 |
| Ovens [c] : | | | | |
| Number | 1 | 1 | 2 | 4 |
| Maximum solvent concentration (% LEL) | 25 | 25 | 25 | 25 |
| Solvent capacity (gal/hr) | 12.4 | 3.4 | 40 | 59 |
| Air flow (ACFM) | 2234 | 8570 | 8465 | 14,341 |
| Inlet temperature to control device (°F) | 120 [d] | 300 [d] | 242 | 228 |

HAP = hazardous air pollutant, LEL = lower explosive limit.

[a] Annual coating time is estimated to be 50 percent of annual operating hours.

[b] Solvent-borne rubber coating contains toluene as the solvent: solvent-borne urethane coating contains dimethyl formamide and toluene in ratio of 35 to 20 by weight as the solvent.

[c] Parameters are given on a per facility basis; emissions from multiple ovens are routed to one add-on control device.

[d] Estimated as 20 °F less than the average exhaust temperature from the oven that was calculated for the facilities from the coating MACT database in the size and coating category.

## Table 7-2. Summary of Coating Room Costs

| Model | Small (8,000 ft $^3$) | Medium (13,000 ft$^3$) | Large (18,000 ft$^3$) |
|---|---:|---:|---:|
| Floor area, ft $^2$ | 800 | 875 | 900 |
| Cost/ft $^2$, $ | 15 | 18 | 20 |
| Cost, $ | 12,000 | 15,313 | 18,000 |
| Swing doors (2), $ | 5,000 | 5,000 | 5,000 |
| Windows (4), $ | 800 | 800 | 800 |
| Sum, $ | 17,800 | 21,113 | 23,800 |
| Auxiliaries (at 50 %), $ | 8,900 | 10,556 | 11,900 |
| Purchased equipment cost (PEC), $ | 26,700 | 31,669 | 35,700 |
| Total capital investment (TCI, 1.6 x PEC), $ | 42,720 | 50,670 | 57,120 |
| | | | |
| Maintenance (6$/ft $^2$ y), $/y | 4,800 | 5,250 | 5,400 |
| Maintenance supervision (15 % of maintenance), $/y | 720 | 788 | 810 |
| Materials (50 % of maintenance labor), $/y | 2,400 | 2,625 | 2,700 |
| Electricity (lighting, 14 kWh/ft $^2$ y and $.06/kWh), $/y | 672 | 735 | 756 |
| Direct costs, $/y | 8,592 | 9,398 | 9,666 |
| | | | |
| Labor/materials overhead (60 % of labor and materials), $/y | 4,752 | 5,198 | 5,346 |
| Other indirect costs (4 % of TCI), $/y | 1,709 | 2,027 | 2,285 |
| Capital recovery (7 % interest rate, 15-year life), $/y | 4,691 | 5,564 | 6,272 |
| Indirect costs, $/y | 11,151 | 12,788 | 13,903 |
| | | | |
| Total annual costs, TAC, $/y | 19,743 | 22,186 | 23,569 |

Note: Costs for enclosure, doors, and windows based on cost factors presented in Reference 1.

## OXIDIZER COSTS

For each model plant, costs are estimated for installing a 97-percent efficient thermal or catalytic oxidizer and for upgrading an existing catalytic oxidizer from 92 to 97 percent destruction efficiency. Every thermal incinerator in the coating MACT database [6] is reported to have a destruction efficiency of at least 96.3 percent (the average is greater that 98 percent), therefore, upgrade costs are not needed for thermal oxidizers. Table 7-3 presents a summary of the new oxidizer installation costs; Table 7-4 presents a summary of the catalytic oxidizer upgrade costs. The costs are estimated based on the Manual. Costs estimated from the Manual are expected to be within about 30 percent of the cost a buyer might pay for the equipment being costed. However, much larger deviations can be found if the input parameters for the model differ from values found in practice.

To estimate incremental costs of upgrading existing catalytic oxidizers, costs of baseline catalytic oxidizers are subtracted from the costs of upgraded units. The cost of a new oxidizer system includes the costs of ductwork, butterfly dampers, fans, motors, and stacks. Costs are estimated and are summarized in Tables 7-3 and 7-4 in three areas: TCI, total annual cost (TAC), and operation and maintenance costs (O&M). The TCI includes purchased equipment costs (incinerator and auxiliary equipment, instrumentation, sales tax, and freight), direct installation costs (foundation and supports, handling and erection, electrical, piping, insulation for duct work, and painting where not included in auxiliary costs), and indirect installation costs (engineering, construction or field expenses, contractor fees, start-up, performance test, and contingencies). The TAC includes indirect annual costs (overhead, administrative charges, property taxes, insurance, and capital recovery) and direct annual costs (O&M). The O&M costs are made up of electricity, natural gas, operating labor, and maintenance labor and materials.

The Manual is designed so that the user supplies information for a variety of model parameters. For oxidizers, some of these parameters are gas flow rate, gas temperatures at the inlet and outlet, HAP concentration, heats of combustion and heat capacities for the HAPs, and amount of heat recovery for oxidizers so equipped. Some of the model parameters come directly from the model plants, e.g., values for gas flow, temperature, annual hours of operation, and quantity of solvent are consistent with each of the model plants. For other model parameters, assumptions are required, as are explained in the following paragraphs.

Solvents assumed to be in the oxidizer inlet for Model Plants 2 and 4 are approximately 64 percent N,N-dimethylformamide (DMF) and 36 percent toluene. The solvent assumed to be in the oxidizer inlet for Model Plants 1 and 3 is toluene. Heats of combustion for the two compounds are taken as 2,161 Btu/scf for DMF and 4,522 Btu/scf for toluene. Auxiliary fuel is assumed to be natural gas with a heat of combustion of 21,502 Btu/lb. Temperature dependent chemical property data (e.g., vapor pressures and heat capacities) were estimated from correlations and data presented in Perry's Chemical Engineers' Handbook, 7th Edition.

## Table 7-3. Summary of New Oxidizer Costs for Coating Model Plants

| Model Plant | Total capital investment, $ | Total annual cost, $/y | O&M cost, $/y |
|---|---|---|---|
| | | | |
| Model 1, thermal | 434,562 | 130,972 | 58,469 |
| Model 1, catalytic | 300,140 | 90,888 | 23,361 |
| | | | |
| Model 2, thermal | 576,551 | 241,585 | 147,663 |
| Model 2, catalytic | 544,819 | 149,905 | 41,706 |
| | | | |
| Model 3, thermal | 588,505 | 303,215 | 199,946 |
| Model 3, catalytic | 569,135 | 204,066 | 84,371 |
| | | | |
| Model 4, thermal | 699,230 | 348,546 | 228,601 |
| Model 4, catalytic | 790,010 | 291,709 | 128,399 |

Assumptions: Units operate at 1,420 °F (thermal) or 1,200 °F (catalytic), have 70 % heat recovery and have a retrofit factor of 1.4.

Efficiency is 97 percent for all oxidizers, which requires 1.5 x operating labor cost and double the maintenance of existing units.

For all cases, costs include ductwork, dampers, fan, motor, and stack.

All costs are in 1997 $.

Total capital investment is annualized at 7 percent interest for 15 years.

## Table 7-4. Summary of Catalytic Oxidizer Upgrade Costs for Coating Model Plants

| Model | Total capital investment, $ | Total annual cost, $/y | O&M cost, $/y | Capital cost above baseline, $ | Annual cost above baseline, $/y | O&M cost above baseline, $/y |
|---|---|---|---|---|---|---|
| Baseline | | | | | | |
| Model 1, catalytic | 219,908 | 64,913 | 17682 | | | |
| Model 2, catalytic | 397,790 | 112,214 | 36,028 | | | |
| Model 3, catalytic | 413,629 | 152,020 | 69,175 | | | |
| Model 4, catalytic | 560,341 | 216,723 | 106,007 | | | |

Assumptions: Baseline units are catalytic oxidizers operating at 830 $^{o}$F.

Efficiency is 91 percent. Heat recovery is 50 % and retrofit factor is 1.2.

| | | | | | | |
|---|---|---|---|---|---|---|
| Upgrade of Baseline Unit | | | | | | |
| Model 1, catalytic | 293,755 | 90,136 | 23,600 | 73,847 | 25,222 | 5,918 |
| Model 2, catalytic | 528,757 | 148,516 | 43,233 | 130,967 | 36,302 | 7,205 |
| Model 3, catalytic | 549,665 | 199,933 | 84,045 | 136,036 | 47,914 | 14,870 |
| Model 4, catalytic | 742,659 | 275,369 | 128,399 | 182,319 | 58,646 | 22,392 |

Assumptions: Upgraded units operate at 1,200 °F, have 70 % heat recovery and have a retrofit factor of 1.4.

Efficiency is 97 percent for upgraded oxidizers, which requires 1.5 x operating labor cost and double the maintenance of existing units.

Baseline and Upgrade Assumptions: Costs exclude ductwork, dampers, fan, motor, and stack.

All costs are in 1997 $.

Total capital investment is annualized at 7 percent interest for 15 years.

For baseline catalytic oxidizers, oxidizer efficiency is assumed to be 91 percent and outlet temperature is assumed to be 830 °F, based on information in the coating MACT database reported by facilities with catalytic oxidizers. Heat recovery is assumed to be 50 percent. Retrofit costs are assumed to add 20 percent to the TCI.

Costs for upgraded and new oxidizers are based on an efficiency of 97 percent for all units. Outlet temperatures are assumed to be 1,420 °F and 1,200 °F for thermal and catalytic units, respectively. Heat recovery is assumed to be 70 percent. Retrofit costs are assumed to add 40 percent to the TCI, and the need for operating and maintaining the oxidizer system at constant high efficiency is assumed to require an additional 50 percent in operating labor and double the maintenance labor and maintenance materials of existing units.

For all cases representing the upgrade of an existing control system, costs exclude ductwork, butterfly dampers, fans, motors, and stacks. For all cases representing the installation of a control system in a facility with no existing controls, these auxiliaries are costed using Chapter 10 of the Manual for ductwork, dampers, and stack. Information in Chapter 4.12 of the Handbook - Control Technologies for Hazardous Air Pollutants [7] is used for costing fans and motors and also for sizing ductwork. Ductwork is assumed to be cold-rolled, spiral-wound steel with three inches of insulation. Labor costs are derived from tables provided by the Bureau of Labor Statistics at its Internet website (http://www.bls.gov/home.htm). All costs are in 1997 dollars.

The Manual provides equipment sizing equations based on simplifying assumptions. The equations can be altered if the underlying assumptions are changed. One such change is the assumed system heat loss. Because the waste-gas streams entering the oxidizers are at relatively high temperatures, heat losses are assumed to be from 35 to 55 percent, depending on inlet temperature assigned to the model plant being costed. For cases in which the model predicts auxiliary gas consumption to be less than five percent of total gas, additional auxiliary gas is provided for flame stabilization.

## CARBON ADSORBER COSTS

For each model plant, costs are estimated for installing a 97-percent efficient carbon adsorber and for upgrading an existing carbon adsorber from 93 to 97 percent destruction efficiency. Table 7-5 presents a summary of the new adsorber installation costs; Table 7-6 presents a summary of the adsorber upgrade costs. The costs are estimated based on the Manual [8].

The cost of a new carbon adsorber system includes the costs of carbon, adsorbers, condensers, fan, motor, stack, and 25 feet of ductwork and damper per carbon bed (1 bed for Model Plant No. 1, 2 beds for Model Plant No. 2 , and 3 beds for Model Plant Nos. 3 and 4). Adsorption systems were designed to accommodate 8 hours of exhaust at the average projected vent stream concentration over the operating time of the unit. This assumes relatively uniform application quantities for any given operating day.

**Table 7-5. Summary of New Carbon Adsorber Costs for Coating Model Plants**

| Model Plant No. | TCI, $ | TAC w/credits, $/yr | TAC w/o credits, $/yr | O&M w/credits, $/yr | O&M w/o credits, $/yr |
|---|---|---|---|---|---|
| 1 | 104,183 | 31,068 | 39,773 | 16,929 | 25,634 |
| 2 | 223,521 | 58,135 | 60,694 | 27,662 | 30,221 |
| 3 | 501,693 | 87,350 | 143,163 | 22,409 | 78,222 |
| 4 | 1,158,663 | 195,757 | 283,576 | 51,487 | 139,306 |

Assumptions: TCI includes a retrofit factor of 1.2, removal efficiency is 97 percent for all adsorbers, recovery credits assume a value of $ 0.10/lb of HAP recovered, all costs are in 1997 $, and TCI is annualized at 7 percent interest for 10 years.

**Table 7-6. Summary of Carbon Adsorber Upgrade Costs for Coating Model Plants**

| Model Plant No. | TCI, $ | TAC, $/yr | O&M, $/yr |
|---|---|---|---|
| 1 | 50,347 | 9,633 | 2,781 |
| 2 | 102,822 | 19,191 | 5,166 |
| 3 | 159,504 | 30,492 | 9,748 |
| 4 | 218,447 | 42,523 | 15,184 |

Assumptions: TCI includes a retrofit factor of 1.2, removal efficiency is 97 percent for all adsorbers, recovery credits are not calculated for the small amount of additional recovered HAP resulting from the increase in efficiency from 93 to 97 percent, all costs are in 1997 $,TCI is annualized at 7 percent interest for 10 years, and upgrade systems are based on adding one additional carbon bed to the adsorber system (one bed half the size of the original for Model Plant No. 1; one originally-sized bed for Model Plant Nos 2, 3, and 4).

The costs of the upgraded systems are based on the following assumptions. For Model Plant 1, a carbon bed one half the size of the original (approximately 90% efficient) bed was added in series to the system to estimate the upgrade costs of the small model plant. For all other model plants, one additional (originally sized) carbon bed was added to upgrade the system.

Costs are estimated and are summarized in Tables 7-5 and 7-6 in three areas: TCI, TAC, and operation and maintenance costs (O&M). The TCI includes purchased equipment costs (adsorber and auxiliary equipment, instrumentation, sales tax, and freight), direct installation costs (foundation and supports, handling and erection, electrical, piping, insulation for duct work, and painting where not included in auxiliary costs), and indirect installation costs (engineering, construction or field expenses, contractor fees, start-up, performance test, and contingencies). The TAC includes indirect annual costs (overhead, administrative charges, property taxes, insurance, and capital recovery) and direct annual costs (O&M). The O&M costs are made up of electricity, steam, cooling water, carbon replacement, operating labor, and maintenance labor and materials.

The Manual is designed so that the user supplies information for a variety of model parameters. For adsorbers, some of these parameters are gas flow rate, inlet gas temperatures, HAP concentration, and adsorption coefficients for the HAPs. Some of the model parameters come directly from the model plants, e.g., values for gas flow, temperature, annual hours of operation, and quantity of solvent are consistent with each of the model plants. For other model parameters, assumptions are required, as are explained in the following paragraphs.

Solvents assumed to be in the adsorber inlet for Model Plants 2 and 4 are approximately 64 percent DMF and 36 percent toluene. The solvent assumed to be in the adsorber inlet for Model Plants 1 and 3 is toluene. The equilibrium adsorptive capacity of carbon is dependent on the specific constituent and the operating temperature and concentrations. The Calgon fifth-order polynomial equation presented in the Manual was used to estimate the equilibrium adsorptive capacity of carbon for both toluene and DMF based on inlet conditions. The equilibrium adsorptive capacities were also calculated at the adsorber outlet concentration (based on 97 percent removal) to assess the phenomena of "tailing" and whether or not the working capacity assumption (i.e., being equal to 50 percent of the equilibrium adsorptive capacity) was sufficient to achieve the desired removal efficiency.

For Model Plant No. 2, the exhaust stream concentration is too high for effective carbon adsorption. Consequently, the exhaust stream was cooled to 212 °F prior to the carbon adsorption system. This cooling was assumed to be accomplished by radiant cooling. The cost of radiant cooling ductwork was estimated as 100 ft of normal duct work. An additional 1 inch of water pressure drop was added to the system's pressure drop to account for the energy required to pull the exhaust stream through the additional radiant cooling ductwork. The actual flow rate to model plant 1 at 212 °F is 7,575 acfm.

For the toluene only systems, the 50 percent working capacity appeared sufficient for Model Plant 1, but the calculated working capacity for Model Plant 3 was reduced by an additional factor of 1.2 based on the low equilibrium adsorptive capacity at the design outlet toluene concentration. The total carbon amounts required for the toluene/DMF systems (Model Plants 2 and 4) were calculated by assessing the amount of carbon needed for each chemical independently and adding the 2 quantities together. Because of the low equilibrium adsorptive capacities at the design outlet concentrations, adjustments to the 50 percent working capacity assumptions were made. The working capacity for assessing the amount of carbon required for toluene adsorption was reduced by an additional factor of 1.25 and the working capacity for assessing the amount of carbon required for DMF adsorption was reduced by a factor of 2 for both Model Plants 2 and 4.

Retrofit costs were assumed to add 20 percent to the TCI. For new carbon adsorbers, total annual costs were calculated with and without a recovery credit; to calculate the recovery credit a value of $ .10/lb was assumed for the recovered HAP. Recovery credits were not calculated for the upgrade costs because the additional amount of HAP recovered by increasing the recovery efficiency from 93 to 97 percent is a very small quantity.

## METHYLENE CHLORIDE CONTROL COSTS

During the MACT floor data collection effort, information was collected from two facilities that emit methylene chloride. Because the cost of controlling methylene chloride emissions will be greater than the cost of controlling other organic HAP emissions, additional cost analysis has been done for this specific case. The models with methylene chloride emissions assume the coating with methylene chloride is a single-solvent coating. Model Plants 1 and 3, with methylene chloride as the coating HAP rather than toluene, were used as the basis for estimating the costs of installing, operating and maintaining add-on control systems for methylene chloride emissions.

For each model plant, costs are estimated for installing a 97-percent efficient thermal or catalytic oxidizer and a 97-percent efficient carbon adsorber. Since methylene chloride has a higher LEL than the organic HAP specified for compliance costing, the air flow for Model Plant 1 was reduced to 250 acfm at 120 °F. No adjustment was needed to the Model Plant 3 flow rate. As has been described in previous sections of this memorandum, TCI, TAC, and O&M costs were estimated, using the Manual.

The costs for controlling methylene chloride emissions with oxidizers includes the costs of a post-oxidation scrubber system needed to remove the hydrogen chloride gas and neutralize the scrubber water and additional costs of the auxiliaries (ductwork, butterfly dampers, fans and stacks) which must be constructed of materials able to withstand the corrosive acid gas. Also, the heat of combustion of methylene chloride is only 662 BTU/scf, considerably lower than the heat of combustion of toluene or DMF, therefore, more auxiliary fuel will be required.

With respect to the carbon adsorber costs, carbon’s adsorptive capacity for methylene chloride at the 242 °F inlet temperature specified for Model 3 is very low, necessitating the installation of a spray tower to cool the gas. In addition, because of carbon's low adsorptive capacities at the target outlet concentration, a working capacity of one-third the working capacity of the inlet was used instead of the one-half that was used in costing carbon systems to control organic HAP emissions.

Table 7-7 presents the summary of oxidizer costs and Table 7-8 presents the summary of carbon adsorber costs for controlling methylene chloride emissions. For Model 1, the increase in TCI associated with controlling methylene chloride emissions ranges from around 21 percent for thermal oxidation up to 61 percent for carbon adsorption and the increase in TAC ranges from almost 20 percent for thermal oxidation up to almost 38 percent for carbon adsorption. For Model 3, the increase in TCI associated with controlling methylene chloride emissions ranges from approximately 30 percent for carbon adsorption up to 38 percent for catalytic oxidation and the increase in TAC ranges from over 20 percent for thermal oxidation to more than 59 percent for carbon adsorption.

**Table 7-7. Summary of New Oxidizer Costs for Control of Methylene Chloride Emissions**

| Model Plant | Total capital investment, $ | Total annual cost, $/y | O&M cost, $/y |
|---|---:|---:|---:|
| | | | |
| Model 1, thermal | 525,552 | 156,699 | 66,602 |
| Model 1, catalytic | 387,495 | 116,226 | 31,474 |
| | | | |
| Model 3, thermal | 805,600 | 365,223 | 221,135 |
| Model 3, catalytic | 785,529 | 265,985 | 105,448 |

Assumptions: Units operate at 1,420 °F (thermal) or 1,200 °F (catalytic), have 70 % heat recovery and have a retrofit factor of 1.4. Efficiency is 97 percent for all oxidizers, which requires 1.5 x operating labor cost and double the maintenance of existing units. For all cases, costs include ductwork, dampers, fan, motor, and stack. All costs are in 1997 $. Total capital investment is annualized at 7 percent interest for 15 years.

**Table 7-8. Summary of New Carbon Adsorber Costs for Control of Methylene Chloride Emissions**

| Model Plant No. | TCI, $ | TAC w/credits, $/yr | TAC w/o credits, $/yr | O&M w/credits, $/yr | O&M w/o credits, $/yr |
|---|---|---|---|---|---|
| 1 | 167,848 | 42,734 | 51,439 | 20,051 | 28,756 |
| 3 | 650,061 | 139,032 | 194,846 | 43,956 | 99,769 |

Assumptions: TCI includes a retrofit factor of 1.2, removal efficiency is 97 percent for all adsorbers, recovery credits assume a value of $ 0.10/lb of HAP recovered, all costs are in 1997 $, and TCI is annualized at 7 percent interest for 10 years.

## REFERENCES

1. Lukey, Michael E., P.E. Permanent Total Enclosures Needed in Response to Subpart KK and Changes in Test Procedures. Paper No. 97-TA4B.05, presented at the Air and Waste Management Association Annual Meeting & Exhibition. Toronto, Ontario, Canada. June 1997. Table 2.

2. U. S. Environmental Protection Agency. OAQPS Control Cost Manual, Fifth Edition. EPA-453/B-96-001. February 1996. Chapter 3.

3. Reference 1, page 3 of 4.

4. Turner, Thomas K. Local Capture or Total Enclosure? The Answer is Yes! Paper No. 94-RA111.01, presented at the Air and Waste Management Association Annual Meeting & Exhibition. Cincinnati, OH. June 1994.

5. Bemi, Dan. "Demonstrating VOC Capture Efficiency Using Permanent Total Enclosure Technology: Common Practices, Challenges and Rewards." Paper No. 97-TA4B.04, presented at the Air and Waste Management Association Annual Meeting & Exhibition. Toronto, Ontario, Canada. June 1997.

6. U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

7. U.S. Environmental Protection Agency. Control Technologies for Hazardous Air Pollutants. EPA/625/6-91/014. Office of Research and Development. Washington, DC. June 1991. Pages 4-98 thru 4-101.

8. Reference 2, Chapter 4.

## MEMORANDUM

**From:** Steve York, Research Triangle Institute

**To:** Printing, Coating, and Dyeing of Fabrics and Other Textiles File

**Subject**: Incremental Cost of Non-Formaldehyde Permanent Press Finish Versus Permanent Press Finish with Formaldehyde

**Date:** August 1, 2001

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Information was collected from three sources: (1) Cotton Incorporated, (2) BF Goodrich Textile Performance Chemicals, and (3) Vulcan Performance Chemicals. Cotton Incorporated is a research and marketing company representing cotton producers and importers. BF Goodrich Textile Performance Chemicals and Vulcan Performance Chemicals supply specialty chemicals to the textile industry, including non-formaldehyde or very low formaldehyde permanent press resins. Information used in estimating incremental costs is summarized in the following paragraphs and the contact summaries for each information source are attached to this memorandum.

Mr. John Turner of Cotton Incorporated stated that finishing with a formaldehyde-containing resin costs from 5 to 15 cents per pound of finished fabric. According to Bill Rarick of Cotton Incorporated and Mr. Turner, the cost of the cross-linking agent runs between 50 and 65 cents per pound and there is additional cost for chemical auxiliaries. Mr. Turner stated that BTCA is not commercially available, but he knows of a manufacturer that will supply BTCA for $2.50 per pound for a minimum order of 1 million pounds. For smaller quantities, the cost is $13 per pound. Mr. Turner also stated that resins without formaldehyde do not cross link as well as resins with formaldehyde.

Ms. Jennifer Grabowski of BF Goodrich Textile Performance Chemicals provided information about two permanent press resins, one that contains less than 1 percent formaldehyde and the second that contains less than 100 ppm formaldehyde (below MSDS reportable quantities). The cost of each depends on the quantity ordered and for the less than 1 percent formaldehyde resin ranges from $1.06 per pound for an order of 1 to 3 drums down to $0.79 per pound for an order of 50 to 80 drums. The less than 100 ppm formaldehyde resin costs 3 cents per pound more than the 1 percent formaldehyde resin at each size range.

Mr. Jerry Setzer of Vulcan Performance Chemicals provided information regarding the cost of a non-formaldehyde cross-link system Vulcan has developed and is marketing at a cost of $1.38 per pound for the resin and $0.78 per pound for the catalyst. Mr. Setzer claimed that the Vulcan Performance Chemicals non-formaldehyde cross-link system yields comparable results to a formaldehyde cross-link system, when cured at the proper temperature, and additionally has less adverse effect on the strength of the fabric than formaldehyde cross-link systems. Mr. Setzer has estimated the cost of one pair of twill pants would be about $0.40 to 0.45 more expensive than a pair of twill pants finished with a formaldehyde-containing permanent press resin.

The table below presents estimates of the increased cost (the cost increment above the baseline finishing cost of 10 cents per pound of finished fabric, the midpoint of the range of 5 to 15 cents per pound of finished fabric cited by Mr. Turner of Cotton Incorporated) of a pound of finished fabric resulting from using a non-formaldehyde or compliant resin instead of a common low-formaldehyde DMDHEU permanent press resin.

To estimate the increased cost, it was necessary to make certain assumptions. Information from Cotton Incorporated regarding the cost of finishing with a formaldehyde-containing resin (i.e., 10 cents per pound of finished fabric) was assumed to be the baseline cost for permanent press finishing. The increased cost of finishing with compliant materials was assumed to be only a function of the incremental cost in resins and catalysts; i.e., the cost of auxiliary chemicals was assumed to be the same for formaldehyde and non-formaldehyde systems. In addition, the baseline cost of formaldehyde-containing resin was assumed to be 57.5 cents, the midpoint of the range of 50 to 65 cents cited by Mr. Rarick and Mr. Turner for the formaldehyde-containing cross-linking agent.

| Information Source [a] | Cost of Formaldehyde-Containing Resin ($/lb of resin) | Cost of Non-Formaldehyde or Compliant Resin ($/lb of resin) | Increased Finishing Cost ($/lb of finished fabric) |
|---|---|---|---|
| Cotton Incorporated | 0.58 | 2.5 | 0.33 |
| Vulcan Performance Chemicals | NA | 1.38<br>+$ 0.26/lb catalyst | 0.18 |
| BF Goodrich Textile Performance Chemicals | NA | 0.82 | 0.04 |

[a] Attachment 1 is the Cotton Incorporated contact report, Attachment 2 is the Vulcan Performance Chemicals contact report, and Attachment 3 is the BF Goodrich Textile Performance Chemicals contact report.

NA = Not applicable.

As can be seen in the table, the incremental cost of finishing with a non-formaldehyde or compliant resin is estimated to range from 4 cents per pound of finished fabric up to 33 cents per pound of finished fabric.  Regarding the high end of this range, it should be noted that the BTCA non-formaldehyde finish that the non-formaldehyde resin costs from Cotton Incorporated is based on is not currently in commercial production.  The estimated incremental cost of 33 cents per pound that is presented is based on the price per pound of an order for at least one million pounds.  This is probably representative of the incremental cost that would be incurred if BTCA were in commercial production.

ATTACHMENT 1

## CONTACT REPORT

**From:** Steve York (919-990-8629 ), Research Triangle Institute project lead for the Printing, Coating,and Dyeing of Fabrics and Other Textiles NESHAP

**Date of Contact:** March 8, 2001

**Contact:** Bill Rarick and John Turner

**Company/Agency :** Cotton Incorporated
**Telephone Number:** (919) 678-2220, Bill Rarick 678-2416, John Turner 678-2455

**Location:** Raleigh, North Carolina

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## CONTACT SUMMARY:

Mr. Rarick was contacted by telephone to solicit information regarding the cost of permanent press resins containing formaldehyde versus the cost of permanent press resins without formaldehyde. Mr. Rarick offered that for a common low formaldehyde DMDHEU permanent press resin the cost runs about 60 to 65 cents per pound. This could be contrasted with BTCA, a non-formaldehyde finish that is currently not in commercial production and is of limited availability. Mr. Rarick stated that prices of BTCA range from possibly as low as $2 up to $6 per pound. Mr. Rarick also offered that as a rule of thumb, the chemical cost can be multiplied by a factor ranging from 7 to 20 to estimate the affect on the retail price of a product, such as a pair of pants, made from the finished fabric. Regarding trying to set general limits on HAP content in finish materials, Mr. Rarick commented that finish chemistry and the amount used is very complex, depending on the desired properties and the substrate being finished, e.g., a durable press finish might be used on a knit fabric to provide dimensional stability. Mr. Rarick transferred me to John Turner for more information on the costs of permanent press finishes.

Mr. Turner stated that finishing with a formaldehyde-containing resin costs from 5 to 15 cents per pound of finished fabric. The cost of the cross-linking agent runs between 50 and 60 cents per pound and there is additional cost for chemical auxiliaries. In response to my question regarding BTCA, Mr. Turner responded that BTCA is not commercially available, but he knows of a manufacturer that will supply BTCA for $2.50 per pound for a minimum order of 1 million pounds. For smaller quantities, the cost is $13 per pound. Mr. Turner also stated that resins without formaldehyde do not cross link as well as formaldehyde. Mr. Turner mentioned there are a number of polycyclic acids without formaldehyde that can be used for durable press finishes, e.g., citric acid, though citric acid has a tendency to yellow and is not durable to home laundering. Mr. Turner suggested that I call David Shank of Vulcan Performance Chemicals in Columbus, GA for cost information about the company’s polycyclic acid polymer for durable press.

ATTACHMENT 2

## CONTACT REPORT

**From:** Steve York (919-990-8629 ), Research Triangle Institute project lead for the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP

**Date of Contact:** March 12, 2001

**Contact:** Jennifer Grabowski

**Company/Agency :** BF Goodrich Textile Performance Chemicals
**Telephone Number:** (704) 399-0216

**Location:** Charlotte, NC

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## CONTACT SUMMARY:

Ms.Grabowski was contacted by telephone to solicit information regarding the cost of permanent press resins containing formaldehyde versus the cost of permanent press resins without formaldehyde. Ms. Grabowski returned the call and provided information about two 40 percent glyoxal products, i.e., Freechem 40D and Freechem 40 DL. Freechem 40D contains less than 1 percent formaldehyde while Freechem 40DL is BF Goodrich's low-formaldehyde product and contains less than 100 ppm formaldehyde. The cost of each depends on the quantity ordered and for Freechem 40D ranges from \$1.06 per pound for an order of 1 to 3 drums down to \$0.79 per pound for an order of 50 to 80 drums. Freechem 40DL costs 3 cents per pound more than Freechem 40 D at each size range.

ATTACHMENT 3

## CONTACT REPORT

**From:** Steve York (919-990-8629 ), Research Triangle Institute project lead for the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP

**Date of Contact:** March 22, 2001

**Contact:** Jerry Setzer

**Company/Agency :** Vulcan Performance Chemicals
**Telephone Number:** (706) 576-6403

**Location:** Columbus, Georgia

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## CONTACT SUMMARY:

Mr. Setzer was contacted by telephone to solicit information regarding the cost of permanent press resins containing formaldehyde versus the cost of permanent press resins without formaldehyde. Mr. Setzer offered that for a non-formaldehyde cross-link system developed and marketed by Vulcan, the cost of the resin is $1.38 per pound and the cost of the catalyst is $.78 per pound. The resin and catalyst are added to a finishing formulation at a 3 to 1 ratio. A typical formulation also contains a silicone softener ($1.65/lb), a wetting agent ($.36/lb) and a lubricant ($.44/lb), but these would also probably be included in a formaldehyde cross-link system. Based on typical usage quantities, Mr. Setzer has estimated that the cost of one pair of twill pants finished with the non-formaldehyde cross-link system would be about $.40 - .45 more expensive than a pair of twill pants finished with a formaldehyde-containing permanent press finish.

Mr. Setzer claimed that the Vulcan Performance Chemicals non-formaldehyde cross-link system yields comparable results to a formaldehyde cross-link system, when cured at the proper temperature. The system was first tested by several textile companies in 1998 and seemed to be producing erratic results. Vulcan measured the cure temperatures and found that the fabric should reach a temperature of 170 °F in the curing process for optimal results. In addition to yielding comparable results to formaldehyde cross-link systems, the cross-link material used in Vulcan's system has less adverse affect on the strength of the finished fabric.

Mr. Setzer stated that, to date, no U.S. textile company is using the Vulcan non-formaldehyde cross-link system. The U.S. market is driven by large customers such as LL Beane and there is resistance to change for fear of losing a customer. The Vulcan non-formaldehyde cross-link system is being used successfully by one textile manufacturing company in Europe.

## MEMORANDUM

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Steve York and Alton Peters, RTI
**DATE:** December 20, 2001
**SUBJECT:** Summary of Evaluation of Estimated Compliance Costs Incurred by Coating Facilities Owned by Small Businesses

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The approach followed to estimate the compliance costs that will be incurred by coating facilities subject to the printing, coating, and dyeing of fabrics and other textiles NESHAP that are owned by small businesses is presented in the following paragraphs. The approach consisted of the following three steps: (1) identify the major facilities with coating operations that are owned by small businesses, (2) collect information needed to estimate compliance costs, and (3) estimate compliance costs.

### Identify Major Facilities with Coating Operations Owned by Small Businesses

A list of major facilities with coating operations was developed using information from the coating MACT database [1] and 1997 HAP emissions data from the Toxics Release Inventory (TRI) database. The year 1997 was chosen because it is the base year for the coating MACT database. The coating MACT database has information on the facility Title V classification for HAP (area/minor, synthetic minor, or major source). For facilities from the TRI database, we assumed that if reported emissions were less than 10 tons per year (TPY) of any one HAP or 25 TPY of total HAP, then the facility is an area source or synthetic minor and is not subject to the control requirements of the NESHAP. In order to verify major source status, years later than 1997 were checked, and the facility was considered a major source if emissions were 10/25 tons per year or greater for any of those years.

A list of coating facilities owned by small businesses (i.e, businesses with fewer than 1,000 employees) was provided by the Innovative Strategies and Economics Group (ISEG). This list was used to identify the major facilities with coating operations owned by small businesses. Table 9-1 presents the list of the 25 coating facilities owned by small businesses.

### Collect Information Needed to Estimate Compliance Costs

A key factor in estimating the compliance cost that will be incurred by a facility is whether the facility currently operates add-on emission controls. The first information we collected to help determine current compliance status was the VOC attainment status of the county in which each of the small facilities is located.

## Table 9-1. Coating Facilities Owned by Small Businesses

| Facility Name | City | State | County | Total HAP Emissions (TPY) | Sales ($million) |
|---|---|---|---|---|---|
| Amerbelle Corp. | Vernon | Connecticut | Tolland | 26.3 | 26 |
| Athol Corp. | Butner | North Carolina | Granville | 269.3 | 47 |
| Bando Mfg. of America Inc. | Bowling Green | Kentucky | Warren | 56.6 | 53 |
| Bradford Industries Inc. | Lowell | Massachusetts | Middlesex | 59.3 | 53 |
| Brownell & Co. Inc. | Moodus | Connecticut | Middlesex | 46.5 | 7.5 |
| Delatex Processing Corp. | Clifton | New Jersey | Passaic | 12.9 | 0.75 |
| Duraco, Inc. | Chicago | Illinois | Cook | 47.8 | 27.5 |
| Duro Industries Inc. | Fall River | Massachusetts | Bristol | 42 | 199 |
| Eddington Thread Mfg. Co. | Worcester | Massachusetts | Worcester | 19.2 | 5 |
| Excello Fabric Finishers Inc. | Coshocton | Ohio | Coshocton | 191.6 | 3.75 |
| Fil-Tec, Inc. | Cavetown | Maryland | Washington | 46.3 | 14 |
| General Clothing Co. Inc. | Smyrna | Delaware | Kent | 11.5 | 7.5 |
| Haartz Corp. | Acton | Massachusetts | Middlesex | 12.8 | 100 |
| Holliston Mills Inc. | Church Hill | Tennessee | Hawkins | 553 | 21.2 |
| Hub Fabric Leather Co. Inc. | Everett | Massachusetts | Middlesex | 84.7 | 4.7 |
| J. Charles Saunders Co. Inc. | Gastonia | North Carolina | Gaston | 17.6 | 15 |
| Kenyon Ind. Inc. | Kenyon | Rhode Island | Washington | 123 | 115.3 |
| Ouimet Corp. | Nashville | Tennessee | Davidson | 25.4 | 15 |
| Par Products | Wylie | Texas | Collin | 53.4 | 1.75 |
| Penn Racquet Sports | Phoenix | Arizona | Maricopa | 73 | 75 |
| Robin Industries Inc. | Cleveland | Ohio | Cayahoga | 11.6 | 15 |
| Seaman Corp. | Bristol | Tennessee | Sullivan | 17 | 68 |
| Schneller | Kent | Ohio | Portage | 28.9 | 28.3 |
| Textileather Corp. | Toledo | Ohio | Lucas | 396 | 12.9 |
| Textile Tapes Corp. | Gonic | New Hampshire | Strafford | 31.2 | 1.75 |

Most of the designations were taken from the website http://www.epa.gov/oar/oaqps/greenbk/oncs.html. Also, designations for counties in some states (e.g., Ohio) were taken from 40 CFR Part 81.

Three of the facilities owned by small businesses are located in severe non-attainment areas. These facilities are Delatex Processing Corporation, Duraco Incorporated, and General Clothing Company Incorporated. For each of these facilities, we assumed that the SIP RACT requirements would be imposed and efficient controls would be in place, and therefore, no upgrade of add-on controls will be required.

For the remaining facilities in Table 9-1, we used available data in the coating MACT database [1] or ATMI MACT database [2] and information obtained through telephone contacts of state and local permitting authorities and the facilities to determine applicability of the printing, coating, and dyeing of fabrics and other textiles NESHAP, current Title V permit status and level of HAP emission control. The following paragraphs summarize information collected for each facility that served as the basis for the estimates of compliance costs.

**Amerbelle Corporation**. Information in Reference 2 indicates that two coating lines are tied into a thermal oxidizer with less than 97 percent overall control efficiency (OCE). RACT compliant coatings are used.

**Athol Corporation**. Information in Reference 1 indicates that the HAP emissions reported by Athol are from finishing machines that are subject to the Printing and Publishing NESHAP. A control device was planned by 1999 to comply with the Printing and Publishing NESHAP.

**Bando Manufacturing of America, Inc.** Information in Reference 1 indicates that there are no emission control devices used by this facility. However, drying is not done in ovens, therefore, the coating operations do not meet the applicability criteria of the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP to be proposed.

**Bradford Industries, Inc.** Information in Reference 1 indicates HAP emissions are controlled by a regenerative thermal oxidizer with an OCE greater than 97 percent.

**Brownell & Company, Inc.** The information in this paragraph was collected in a telephone contact on December 6, 2001 between Steve York, RTI and Nicholas Vasile, Brownell & Co., telephone (860) 873-8625. Brownell was founded in 1846 and is currently the only mill of 10 to 12 that formerly operated that is still operating in Moodus, Connecticut. The facility operates 10 twine, net, and rope (cord) treating tables. The cord is fed from creels through dip tanks for coating (plasticizer-based formulations) and then is pulled vertically through a lighted attic where flash off takes place and is then rewound. There are no emission controls. The facility has a permit limit of 50 TPY VOC and a 5 lb/hr limit on highly photochemically reactive compounds and 40 lb/hr on other VOC. To comply with the 5 lb/hr limit, jobs with coatings with highly photochemically reactive components are run at a slow production rate, e.g., a job that would take 1 hour is run at a rate that will take 8 hours.

Since drying is not done in ovens, the coating operations do not meet the applicability criteria of the NESHAP to be proposed.

**Duro Industries, Inc.** The following information was collected in a telephone contact on December 6, 2001 between Vinson Hellwig, EPA/CCPG and Bill Bailey, Environmental Manager, Duro Industries, telephone (508) 675-0101, x1603. Mr. Bailey stated that the fabric coating operations that emit HAP are controlled by a thermal oxidizer and the OCE is 94 %. He further stated that they have aqueous coating lines with no HAPs (that can be averaged with the controlled lines). Mr. Baily also stated that they perform printing, the print past is high solids but low HAP, and the paste diluent is a non-HAP material. This would allow averaging of the print paste into the overall compliance determination. Mr. Bailey was very familiar with the MACT development process, he was a stakeholder on a prior MACT, and he was aware of the printing, coating, and dyeing of fabrics and other textiles NESHAP. He was not certain at this time that Duro could meet the 0.12 lb HAP/lb solids limit, but it is possible. On the issue of recordkeeping, he anticipated no increased costs over his Title V permit recordkeeping requirements to meet the NESHAP MRR requirements. Duro's Title V permit encompasses all the recordkeeping that will be in the NESHAP monitoring, reporting and recordkeeping requirements.

**Eddington Thread Manufacturing Company**. The following information was collected in a telephone contact on December 5, 2001 between Vinson Hellwig, EPA/CCPG and Dana Nickel, Massachusetts DEP, Central Region, telephone (508) 767-2772. Ms. Nickel stated that Edington has restricted emissions of methanol from thread coating/bonding. They operate and oxidizer with an OCE of 90 to 95 percent. They were subject to a State BACT that was more stringent than RACT.

**Excello Fabric Finishers, Inc.** The following information was collected in a telephone contact on December 4, 2001 between Steve York, RTI and Kay Gilmer, Ohio EPA, Southeast Region, Telephone (740) 380-5257. Excello uses VOC compliant coatings and has no add-on controls. The facility operates 1 coating line which coats canvas for tents. Excello has not been able to reformulate to reduce HAP and maintain product specifications. HAP emissions for the past 3 years **(RY2000 are preliminary data)** are as follow:

| | Total Air Release (lbs) | | |
|---|---|---|---|
| Chemical | RY1998 | RY1999 | RY2000 |
| MEK | 39,675 | 21,026 | 22,226 |
| Toluene | 222,709 | 190,962 | 176,634 |

**Fil-Tech, Inc.** The following information was collected in a December 5, 2001 fax transmittal from Laramie Daniel, Maryland Air Quality Compliance Program, Air and Radiation Management Administration (ARMA) to Alton Peters, RTI, in response to a telephone contact on December 4, 2001 between Alton Peters, RTI and Bill Reamy, Maryland Department of the Environment, telephone (410) 631-3504. Fil-Tec is Title V but does not have a Part 70 permit to operate. They will have to submit a Part 71 PTO application. Three bonder/coaters exhaust to a thermal oxidizer. Destruction efficiency = 98% @ 1150 °F per an 8/97 stack test. Capture efficiency = 98.2% (also 8/97 test). OCE = 96.2%. Products currently manufactured include polyester and nomex threads, glass insulation wrap, fiberglass wicks, and fiberglass yarn. Former products include climbing rope, rip cords, fiber optic lines, and dental floss.

**Haartz Corporation**. The following information was collected in a telephone contact on December 5, 2001 between Vinson Hellwig, EPA/CCPG and Dana Nickel, Massachusetts DEP, Central Region, telephone (508) 767-2772. Ms. Nickel stated that Haartz emits MEK and has two oxidizers that control emissions. The controls meet the state RACT requirements (a minimum of 85 percent OCE) and may be operating at a higher level of control.

**Holliston Mills, Inc.** The following information was collected in a telephone contact on December 6, 2001 between Steve York, RTI and Dan Cochran, Holliston Mills, Telephone (423) 357-6141. Mr. Cochran stated that he does not like giving out information over the phone, and asked that I submit a written questionnaire. I told him we were gathering information under a tight deadline and did not have time to send a letter. He confirmed that the plant is a coating facility subject to the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP and has no emission controls. Holliston is in debt, and was bought out about 3 and one half years ago. Mr. Cochran offered that the company has put a lot of effort in the last 3 years into converting to waterborne coatings and is in compliance with the State's 2.5 lb/gal VOC limit. I talked to Mr. Cochran about the proposed limits and some of the compliance requirements and gave him the address of the Air Toxics CCCR website.

**Hub Fabric Leather Company, Inc.** The following information was collected in a telephone contact on December 5, 2001 between Vinson Hellwig, EPA/CCPG and Mon Wong, Massachusetts DEP, Northeast Region, telephone (978) 661-7677. Hub Fabric has applied for and will shortly be issued a Synthetic Minor Title V permit with restrictions on production using HAP-emitting materials that will keep Hub below the major source threshold. Therefore, Hub will not be subject to the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP.

**J. Charles Saunders Company, Inc.** The following information was collected in a telephone contact on December 6, 2001 between Steve York, RTI and Mike Landis, NCDEHNR, Mooresville Office, Telephone (704) 663-1699. J. Charles Saunders Co. produces thread and has 5 thread bonding machines. There are no emission controls. The thread bonding process is basically the same as the process at A&E that is controlled by thermal oxidizer. In 2000, Saunders reported 25,000 pounds of VOC (methanol) emissions.

**Kenyon Industries, Inc.** Confidential business information in Reference 1 indicates that the coating operations at Kenyon are controlled, but the control systems will not comply with the MACT floor and will require upgrades.

**Ouimet Corporation**. The information in this paragraph was collected in a telephone contact on December

10, 2001 between Vinson Hellwig, EPA/CCPG and Don Greeson, Ouimet Corporation, telephone (615) 242-5478. Mr. Greeson confirmed that Ouimet manufactures synthetic leather products. They form the material on paper then release it from the paper. It is then laminated to fabric in a heat process with no HAPs or other solvents used. It is then printed on the synthetic side, not the fabric side, at a separate station.

The process would therefore not be subject to the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP. It is probably subject to the Paper and Other Web Coating NESHAP, and the facility is aware of that applicability.

**Par Products**. The following information was collected in a telephone contact on December 5, 2001 between Steve York, RTI and Craig Richardson; TNRCC, Air Permits, Coating Team, telephone (512) 239-1309. Par Products has installed a carbon adsorption system that is supposed to be 95 percent efficient. However, the facility has not been able to demonstrate the NSPS level of 90 percent OCE, probably because of poor capture efficiency. The plant is permitted at 22.6 T of VOC and is in violation. Par Products produces plugs for repairing tubeless tires. All of the emissions are n-hexane.

**Penn Racquet Sports**. Information in the Coating MACT database indicates that this facility operates a carbon adsorber system with three 13,000 pound carbon beds in parallel. Two beds are in service and one is regenerating at any one time. The system OCE is 93.1 percent (98 percent capture and 95 percent control).

**Robin Industries, Inc.** Steve York, RTI left messages December 6 and 10, 2001 requesting a return call from Mr. Mike Olderman, plant manager, telephone (216) 961-5810. No return call has been received. Steve York also left a message December 3, 2001, requesting a return call from Mr. David Hearne, Cuyahoga County Ohio EPA, Cleveland Air Pollution Control (Permits), telephone (216) 664-2178. No return call has been received. Steve York contacted Jenneta Adams of Cleveland Department of Health and Welfare, Division of the Environment, telephone (216) 664-2457 on December 18 and 19, 2001. Ms. Adams was able to pull the file for Robin Industries, but required a written request for information and several levels of signature approvals to release the information, which could not be accomplished until after January 1, 2002.

**Seaman Corporation**. The information in this paragraph was collected in a telephone contact on December 4, 2001 between Steve York, RTI and Andrew Shimko, Seaman Corporation, telephone (330) 262-1111. In response to a request for information on the Bristol, Tennessee plant, which reported no add-on controls in 1997 in an information collection request response, Mr. Shimko stated that the facility has 3 coating lines, only one (Line 3) with HAP emissions. Line 3 runs only a few days a month. Mr. Shimko has estimated the cost of installing PTE/RTO to be around $1 million. In addition, process modifications would be required costing around $200,000. The web loops around in the dryer on Line 3 so it enters and exits the same end. The company will evaluate closing the line. If a control system is installed, it would be used to control VOC emissions from Lines 1 and 2 as well as HAP emissions from Line 3. I asked Mr.

Shimko about annual sales, noting that he had reported $60 million in sales in 1997 and our estimate for 2000 is $22 million. He replied that their sales have increased and were $68 million last year. Seaman is currently doing a lot of fabric coating for military applications, which is not related to the conflict in Afghanistan.

In an ICR response that is in Reference 1, Seaman has provided information showing that less than one percent by mass of the coating materials used by the facility contain HAP. Therefore, the facility will be able to comply with the emission rate limit without add-on controls that will be in the proposed Printing, Coating and Dyeing of Fabrics and Other Textiles NESHAP by averaging the HAP content from the HAP-containing materials across the solids content of all coating materials applied by the facility.

**Schneller, Inc.** Confidential business information in Reference 1 indicates that the coating operations at Schneller are controlled and the control systems will comply with the MACT floor requirements.

**Textileather Corporation**. The following information was collected in a telephone contact on December 4, 2001 between Steve York, RTI and Bob Kossow; Toledo Environmental Services, telephone (419) 936-3015. Textileather has submitted a Title V permit application and the permit is in process. The engineer working on the permit is on leave through the end of this year; Mr. Kossow is not familiar with the facility but had access to the permit application. Textileather applies a textured coating to cloth, fabric and plastic substrates. The facility has 9 vinyl coating lines (print and finish), 3 calendering lines (high solids, restricted to 2.9 lb VOC per gallon of coating) and 2 plastisol lines. The vinyl coating lines are controlled by a 90 percent efficient carbon adsorption system, the calendering lines are uncontrolled, one plastisol line is controlled by ESP to remove condensate and the second vents to a thermal oxidizer that is permitted at 95 percent destruction, though Mr. Kossow is certain he has seen a performance test demonstrating 99 percent (combustion T is 1400 °F). Capture efficiency appears to be 75 percent.

The following additional information was collected in a telephone contact on December 10, 2001 between Steve York, RTI and Rick Scott, Textileather, Toledo, Ohio, telephone (419) 729-7557.
Mr. Scott confirmed that the vinyl coating lines and plastisol line controlled by thermal oxidizer are subject to the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP. A HAP-containing top finish is applied on the vinyl coating lines. He stated that the calendering lines are applying high solids materials with minimal HAP emissions. Mr. Scott stated that the carbon adsorption system has 90 percent capture and 95 percent control and confirmed the capture efficiency of 75 percent and destruction efficiency of 95 percent for the thermal oxidizer. Textileather is evaluating options for complying with the NESHAP. One option that is being considered is converting to a non-HAP finishing material with acetone substituted for the HAP. This is not an attractive option because the finish would have a VOC content very close to the State's organic limit of 4.8 lb/gal of coating. An adjustment in coating viscosity would result in a violation of the State limit. Textileather has estimated a cost of $1.5 million for installing PTE on all of the coating lines. This would include air conditioning needed in the summer and extra ventilation because of employee exposure concerns. Textileather has also evaluated replacing the carbon adsorption system with RTO; this would cost between $2 and $3 million. In response to my question of Textileather being an ESOP, Mr. Scott replied

that employees bought the company from Gencorp in 1990 and sold to Canadian General Tower in 1995.

**Textile Tapes Corporation**. The following information was collected in a telephone contact on December 6, 2001 between Steve York, RTI and Danuta Royes, New Hampshire DES, Air Resources Division, telephone (603) 271-1987. Textile Tapes is permitted as a Title V major source. The permit is being modified to add a thermal oxidizer. The oxidizer will be permitted with a minimum OCE of 95%. The plant has demonstrated PTE using Method 204. Two coating lines are operated, one with a dryer and one without a dryer. The plant produces shoe laces and fabric tape that is used to line the inside of leather shoes.

## Estimate Compliance Costs

Based on the information described in the previous section of this memorandum, we determined that six of the facilities listed in Table 9-1 will not incur compliance costs. The HAP emissions reported by Athol Corporation are from operations subject to the Printing and Publishing NESHAP and will be controlled accordingly. Similarly, the HAP-emitting operations at Ouimet Corporation are subject to control under the Paper and Other Web Coating NESHAP. Hub Fabric Leather Company, Inc. is being permitted as a synthetic minor and therefore will not be subject to the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP. Neither Bando Manufacturing of America, Inc. nor Brownell & Company, Inc. dries the coated textile substrate in an oven after coating application, therefore, the coating operations at these facilities do not meet the applicability criteria that will be proposed in the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP. Seaman Corporation's Bristol, Tennessee facility will be able to comply with the emission rate limit without add-on controls option that will be in the proposed NESHAP.

Table 9-2 presents the estimated compliance costs for the remaining 19 coating facilities owned by small businesses. The costs were estimated by assigning the applicable model plant control costs (see the memorandum at page 7-1 of this document) and monitoring, recordkeeping and reporting (MRR) costs [3] based on the following assumptions:

- The most cost effective add-on control option that would bring a facility into compliance was costed, e.g., adding permanent total enclosures if 100 percent capture efficiency combined with the existing control device destruction or removal efficiency would result in 97 percent OCE, upgrading an existing control device rather than installing a new control device, or for an uncontrolled facility, assigning the cost of the most cost effective applicable control system;
- Sizes of Model Plants used to determine the costs to assign were chosen on the basis of uncontrolled facility HAP emissions;
- Facilities for which we did not know the number of coating lines were assumed to have 2 lines (the average number of coating lines per facility in the coating MACT database) for the purpose of assigning PTE costs with the exception of Holliston Mills, Inc. which was assumed to have 4 coating lines because of the magnitude of HAP emissions;
- With regard to MRR costs, facilities in serious and severe VOC non-attainment areas were assigned only the MRR costs associated with performance testing control devices and PTE since other

records are already maintained as part of their Title V requirements;

- Robin Industries was assumed to be uncontrolled and assigned the cost of a carbon adsorption system with 2 PTE; and
- Facilities in severe non-attainment areas were assumed to have SIP required emission controls, and therefore, be in compliance with the MACT floor requirements.

## References

1 U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

2. Memorandum and Attachment from York, S. and A. Sharma, RTI to P. Almodóvar, EPA/OAQPS/ESD/CCPG. November 13, 1998 Final. Summary of meeting at which ATMI presented the results of the ATMI MACT survey to EPA.

3. U.S. Environmental Protection Agency. Standard Form 83-I Supporting Statement for OMB Review of ICR No. Information Collection Request for the Fabric Printing, Coating, and Dyeing Source Category. Emission Standards Division. Research Triangle Park, NC. December 18, 2001.

## Table 9-2. Estimated Compliance Costs for Coating Facilities Owned by Small Businesses

| Facility Name | City | State | County | Total Emissions (TPY) | VOC Attainment Status | Sales ($million) | HAP Emission Controls [a] | TCCC [b] ($) | TACC [b] ($/yr) |
|---|---|---|---|---|---|---|---|---|---|
| Amerbelle Corp. | Vernon | Connecticut | Tolland | 26.3 | Serious | 26 | yes | 246,626 | 79,106 |
| Bradford Industries Inc. | Lowell | Massachusetts | Middlesex | 59.3 | Serious | 53 | yes | 30,219 | 3,318 |
| Delatex Processing Corp. | Clifton | New Jersey | Passaic | 12.9 | Severe-17 | 0.75 | yes | 30,219 | 3,318 |
| Duraco, Inc. | Chicago | Illinois | Cook | 47.8 | Severe-17 | 27.5 | yes | 30,219 | 3,318 |
| Duro Industries Inc. [c] | Fall River | Massachusetts | Bristol | 42 | Serious | 199 | yes | 144,459 | 50,456 |
| Eddington Thread Mfg. Co. [c] | Worcester | Massachusetts | Worcester | 19.2 | Serious | 5 | yes | 115,659 | 42,804 |
| Excello Fabric Finishers Inc. | Coshocton | Ohio | Coshocton | 191.6 | u/a | 3.75 | no | 593,534 | 119,994 |
| Fil-Tec, Inc. | Cavetown | Maryland | Washington | 46.3 | u/a | 14 | yes | 162,881 | 68,304 |
| General Clothing Co. Inc. | Smyrna | Delaware | Kent | 11.5 | Severe-15 | 7.5 | yes | 30,219 | 3,318 |
| Haartz Corp. [c] | Acton | Massachusetts | Middlesex | 12.8 | Serious | 100 | yes | 115,659 | 42,804 |
| Holliston Mills Inc. [d] | Church Hill | Tennessee | Hawkins | 553 | u/a | 21.2 | no | 1,266,587 | 278,051 |
| J. Charles Saunders Co. Inc. [e] | Gastonia | North Carolina | Gaston | 17.6 | Moderate | 15 | no | 224,344 | 79,629 |
| Kenyon Industries Inc. | Kenyon | Rhode Island | Washington | 123 | Serious | 115.3 | yes | 509,097 | 167,748 |
| Par Products | Wylie | Texas | Collin | 53.4 | Serious | 1.75 | yes | 80,889 | 25,504 |
| Penn Racquet Sports | Phoenix | Arizona | Maricopa | 73 | Serious(p) | 75 | yes | 240,290 | 55,996 |
| Robin Industries Inc. | Cleveland | Ohio | Cayahoga | 11.6 | Moderate | 15 | no | 224,344 | 79,629 |
| Seaman Corp. [f] | Bristol | Tennessee | Sullivan | 17 | u/a | 68 | no | 0 | 0 |
| Schneller | Kent | Ohio | Portage | 28.9 | Moderate | 28.3 | yes | 34,721 | 9,075 |
| Textileather Corp. | Toledo | Ohio | Lucas | 396 | Moderate | 12.9 | yes | 824,368 | 287,288 |
| Textile Tapes Corp. | Gonic | New Hampshire | Strafford | 31.2 | Serious | 1.75 | yes | 30,219 | 3,318 |

Table 9-2 Footnotes

[a] Facilities in severe non-attainment areas are assumed to have SIP required controls. Robin Industries is assumed to be uncontrolled and has been assigned the cost of a carbon adsorption system and two PTE.

[b] Total capital compliance costs (TCCC) and total annual compliance costs (TACC) include costs associated with upgrade or installation of engineering control systems, where applicable, and MRR costs.

[c] Two coating lines assumed.

[d] Four coating lines assumed.

[e] PTE on two coating lines assumed.

[f] Information in Reference 1 indicates this facility is in compliance with the emission rate without add-on controls option that will be proposed.

## MEMORANDUM

**TO:** Vinson Hellwig, EPA/OAQPS/ESD/CCPG
**FROM:** Steve York and Alton Peters, RTI
**DATE:** June 12, 2002
**SUBJECT:** Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP Nationwide Compliance Costs

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The purpose of this memorandum is to present estimates of the nationwide costs resulting from compliance with the proposed printing, coating, and dyeing of fabrics and other textiles NESHAP. The compliance costs consist of the costs of add-on controls for the coating and printing subcategory; compliant, low-formaldehyde permanent press finishes for the dyeing and finishing subcategory; and monitoring, reporting and recordkeeping (MRR) costs for all major sources in the printing, coating, and dyeing of fabrics and other textiles source category.

## Coating and Printing Control Costs

The coating MACT database [1] contains sufficient non-CBI information from 16 facilities that are major sources of HAP emissions to calculate a facility organic HAP overall control efficiency (OCE). Two of the facilities report OCE of greater than 97 percent determined using EPA test methods, and therefore, are in compliance with the proposed OCE limit. The remaining 14 facilities will be required to take measures to reduce organic HAP emissions either through coatings reformulation or through adding or upgrading emission control systems.

Information needed to estimate the compliance costs that would be incurred by coating facilities subject to the printing, coating, and dyeing of fabrics and other textiles NESHAP that are owned by small businesses (hereafter referred to as the small business database) has also been collected (see memorandum at page 9-1 of this document). The small business database includes information on 20 facilities (3 of which are also in the coating MACT database). Of the 17 small business database facilities that are not also in the coating MACT database, 5 have been determined to be in compliance with one of the proposed emission limits. The remaining 12 facilities owned by small businesses will be required to take measures to reduce HAP emissions.

Because 73 percent of the facilities in the coating MACT and small business databases (24 of the 33 facilities) already have controls in place, and because of the likelihood that organic HAP are required in certain coatings to achieve desired performance characteristics, we assume facilities needing to reduce HAP emissions to comply with one of the compliance options will do so either by upgrading existing controls or installing controls if emissions are currently uncontrolled.

We have examined the capture and control efficiencies reported by each facility with existing add-on control systems that do not achieve the emission limits to determine the most cost-effective measure needed to reach compliance, e.g., a facility with a 97 percent efficient control device but less than 100 percent capture efficiency will need to install coating rooms on application stations to meet a facility OCE of 97 percent. Similarly, for the 9 facilities that are currently uncontrolled, we have evaluated applicable controls (facilities in the MACT database applying various coatings to industrial fabrics report using thermal oxidizers; facilities in the MACT database applying coatings with only one or two solvents report using catalytic oxidizers or carbon adsorbers) to determine the most cost-effective add-on control device that could be installed to attain compliance.

Table 10-1 presents a summary of coating and printing model and nationwide control costs. The nationwide compliance costs for model plants are based on the total number of small, medium and large coating rooms needed to upgrade capture efficiency, the total number of control device upgrades needed for each model plant assigned to represent a facility, and the number of new emission control systems needed for facilities that are currently uncontrolled. In addition, two facilities with methylene chloride emissions that will incur additional control costs (see the October 12, 2001 memorandum at page 7-1 of this document regarding compliance costs for coating model plants) have been identified from ATMI MACT survey [2] and TRI database information. Based on the total methylene chloride emissions reported by each facility, one was assigned Model 1 carbon adsorber control costs and one was assigned Model 3 carbon adsorber control costs.

For the 26 facilities in the coating MACT and small business databases to which model plants are assigned, the total capital investment is $8,089,006 and the total annual cost is $2,617,336 per year in 1997 dollars. The total HAP emissions for these facilities in 1997 were 2,326 tons. The total nationwide organic HAP emissions in 1997 from coating and printing facilities were estimated to be 5571 tons (see January 7, 2002 memorandum at page 5-1 of this document summarizing printing, coating, and dyeing of fabrics and other textiles NESHAP baseline organic HAP emissions and emission reductions), of which 5,011 tons were from major sources of HAP that will be subject to the control requirements of the NESHAP and 214 tons were methylene chloride emissions from two coating facilities. To estimate the control costs for all coating and printing facilities, the control costs for the coating MACT and small business database facilities represented by the model plants were factored by the ratio of HAP emissions from major sources for the subcategory (minus methylene chloride emissions for which control costs were estimated separately) to HAP emissions reported by facilities represented by model plants (i.e., 4,797/2,326 = 2.06) and the control costs for methylene chloride emissions were added. Therefore, the estimated nationwide total capital investment is $17,574,651 and the nationwide total annual control cost is $5,615,407 per year in 1997 dollars.

# Table 10-1. Summary of Coating and Printing Subcategory Model and Nationwide Control Costs [a]

| Model | Number of plants [b] | Model total capital investment [c], $ | Nationwide total capital investment, $ | Model total annual cost [c], $/yr | Nationwide total annual cost, $/yr |
|---|---|---|---|---|---|
| **New Add-on Control Device [d]** | | | | | |
| | | | | | |
| Model 1, carbon adsorber | 2 | 104,183 | 208,366 | 31,068 | 62,136 |
| Model 1, catalytic oxidizer | 1 | 300,140 | 300,140 | 90,888 | 90,888 |
| Model 2, thermal oxidizer | 2 | 576,551 | 1,153,102 | 241,585 | 483,170 |
| Model 3, carbon adsorber | 4 | 501,693 | 2,006,772 | 87,350 | 349,400 |
| **Upgrade of Add-on Control Device** | | | | | |
| | | | | | |
| Model 2, catalytic oxidizer | 1 | 130,967 | 130,967 | 36,302 | 36,302 |
| Model 3, catalytic oxidizer | 2 | 136,036 | 272,072 | 47,914 | 95,828 |
| Model 3, carbon adsorber | 3 | 159,504 | 478,512 | 30,492 | 91,476 |
| Model 4, catalytic oxidizer | 2 | 182,319 | 364,638 | 58,646 | 117,292 |
| Model 4, carbon adsorber | 1 | 218,447 | 218,447 | 42,523 | 42,523 |
| **New Coating Room (PTE)** | | | | | |
| | | | | | |
| Small | 14 | 42,720 | 640,800 | 19,743 | 276,402 |
| Medium | 13 | 50,670 | 658,710 | 22,186 | 288,418 |
| Large | 29 | 57,120 | 1,656,480 | 23,569 | 683,501 |
| **Total Control Costs for Model Plants Except Methylene Chloride Model Plants** | | | 8,089,006 | | 2,617,336 |
| | | | | | |
| **Nationwide Total Control Costs Except Methylene Chloride Control Costs [e]** | | | 16,663,352 | | 5,391,712 |
| | | | | | |
| **New Add-on Control System for Methylene Chloride Emissions [f]** | | | | | |
| | | | | | |
| Model 1, carbon adsorber | 1 | 210,568 | 210,568 | 62,477 | 62,477 |
| Model 3, carbon adsorber | 1 | 700,731 | 700,731 | 161,218 | 161,218 |
| | | | | | |
| **Total Methylene Chloride Control Costs** | | | 911,299 | | 223,695 |
| | | | | | |
| **Nationwide Total Control Costs with Methylene Chloride Control Costs [g]** | | | 17,574,651 | | 5,615,407 |

## Table 10-1 Footnotes

[a] The nationwide costs were calculated using model plants to estimate the costs of bringing each of 14 coating MACT database facilities and 12 small business database facilities into compliance with the proposed emission limits, extrapolating this to a nationwide cost based on organic HAP emissions from major sources for the subcategory, and adding costs for controlling methylene chloride emissions from the 2 major facilities reporting methylene chloride emissions in the TRI database (neither of which is in the coating MACT database or is owned by a small business). For each of the 26 coating MACT and small business database facilities, the most cost-effective add-on control measure (e.g., upgrading capture efficiency by adding PTE to application stations, or if no add-on controls are in place, the installation of a complete system including PTE and add-on control device) was applied to bring the facility into compliance with one of the proposed emission limits. The model plant costs include costs of installing, upgrading, operating and maintaining add-on control systems. MRR costs are presented in Table 10-2. All costs are in 1997 $.

[b] Number of model plants assigned to the 26 facilities in the coating MACT and small business databases requiring organic HAP emission reductions to estimate the compliance cost of achieving the MACT floor compliance options with add-on controls.

[c] From October 12, 2001 memorandum regarding compliance costs for coating model plants. Note that the upgrade costs represent incremental costs above the costs of a baseline unit.

[d] Model plant costs represent the costs of a new add-on control device and auxiliaries, including ductwork, butterfly dampers, fans, motors, and stacks. Coating room costs are presented separately.

[e] Nationwide total control costs for all facilities in the coating and printing industry, except plants with methylene chloride emissions are based on factoring the total control costs for model plants except methylene chloride model plants by the ratio of HAP emissions estimated for major HAP emission sources in the coating and printing subcategory (minus methylene chloride emissions) to the HAP emissions reported by facilities for which control costs have been estimated (the ratio is 2.06)

[f] Includes cost of add-on control system and coating room.

[g] Nationwide total control costs for all affected facilities in the coating and printing industry are the sum of the nationwide total control costs except methylene chloride control costs and the total methylene chloride control costs.

## Dyeing and Finishing Compliance Costs

The dyeing and finishing compliance options are based on the use of low-HAP materials. During the data collection effort to support the MACT floor determination, EPA held numerous stakeholder meetings and made eight site visits to facilities with dyeing and finishing operations. Qualitative information concerning pollution prevention measures gathered from the stakeholder meetings and site visits indicated that there would be substantial costs incurred in reducing the formaldehyde content of permanent press resins. No concerns were expressed about the cost of reformulating other dyes and finishes. Therefore, we collected information from Cotton Incorporated, a research and marketing company, and two textile chemical suppliers regarding the incremental cost of non-formaldehyde permanent press finish versus permanent press finish with formaldehyde (see August 1, 2001 memorandum at page 8-1 of this document summarizing incremental cost information).

Information collected from Cotton Incorporated indicates that the cost of finishing with a formaldehyde-containing resin ranges from 5 to 15 cents per pound of finished fabric and the cost of the cross-linking agent runs between 50 and 65 cents per pound. According to Cotton Incorporated, BTCA, a non-formaldehyde finish that is not commercially available can be purchased for $2.50 per pound for a minimum order of 1 million pounds. However, through contacts with textile chemical suppliers we found a permanent press resin on the market that contains less than 100 ppm formaldehyde (below MSDS reportable quantities and in compliance with the proposed emission limit for finishing) for 82 cents per pound for an order of 50 to 80 drums. Thus the cost of the compliant cross-linking agent is about 43 percent higher than the cost of a formaldehyde cross-linking agent. Assuming that the cost of finishing is directly proportional to the cost of the cross-linking agent, the cost of finishing with the compliant resin would range from about 7 to 21 cents per pound of finished fabric, an average of approximately 4 cents per pound of finished fabric more than the cost of finishing with a formaldehyde resin.

The ATMI MACT survey database [2] contains information about facility Title V status for HAP, wet finishing operations with formaldehyde emissions, and the quantity (pounds) of fabric processed in each finishing operation. Facilities that are major sources for HAP in the ATMI MACT database reported finishing over 1.44 billion pounds of fabric per year in operations with associated formaldehyde emissions. Actual formaldehyde emissions reported by the facilities ranged from 0.01 to 13.9 tons, with most of the facility emissions less than 1 ton per year.

The ATMI MACT finishing database [3] contains information about facility Title V status for HAP, the HAP content of finishing materials used, and the annual production of finished fabric and provides a basis for estimating the quantity of fabric currently finished with compliant materials by facilities that are major sources of HAP emissions. Analysis of the database indicated that 87 percent of the fabric finished in operations at major sources using formaldehyde-containing materials was finished with compliant materials (in terms of formaldehyde content). Therefore, to estimate the nationwide cost of converting to compliant finishing materials, we assumed that 13 percent of the 1.44 billion pounds of fabric per year (i.e., 186 million pounds of fabric per year) reported to be finished at major facilities for HAP emissions in operations with associated formaldehyde emissions would incur the cost of reformulating to low-formaldehyde compliant finishing materials.

Applying the 4 cents incremental cost per pound of finished fabric to use a compliant resin versus a formaldehyde resin to the estimated 186 million pounds of fabric currently finished with non-compliant materials yields a nationwide annual cost of $7.5 million per year. The cost of working with chemical suppliers to reformulate the finish is accounted for in the estimate of the MRR burden described in the next section of this memorandum.

## Monitoring, Reporting and Recordkeeping Costs

Respondents subject to national emission standards for hazardous air pollutants (NESHAP) are required by law (40 CFR Part 63, Subpart A) to submit one-time notifications and one-time reports on compliance status and performance test results. Respondents also must develop and implement a Startup, Shutdown, and Malfunction Plan and make semiannual reports if an event is inconsistent with the plan. Semiannual reports are required for periods of operation during which measured emissions exceed an applicable limit or control device operating parameters are outside of the established ranges. General recordkeeping requirements applicable to all NESHAP require records of applicability determinations; test results; startup, shutdown, or malfunction events; exceedances; performance test reports, monitoring records, and all other information needed to determine compliance with the applicable standard.

Respondents are owners and operators of the 135 printing, coating and dyeing facilities subject to the requirements of this rule. We estimate that the public MRR burden associated with this proposed rule will average 213 hours per year per facility for each year after the date of promulgation of the rule. The total annualized costs associated with MRR have been estimated at $1,403,670; the total capital costs have been estimated at $1,156,442. Details of the cost estimates are presented in Reference 4.

## Nationwide Compliance Costs of the Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP

Table 10-2 presents a summary of the nationwide compliance costs of the printing, coating, and dyeing of fabrics and other textiles NESHAP, including the control costs for affected facilities in the coating and printing subcategory, the finishing reformulation costs for affected facilities in the dyeing and finishing subcategory, and the MRR costs for all affected facilities in the source category. We have estimated nationwide capital costs, in 1997 dollars, of approximately $18.8 million and annual costs of approximately $14.5 million.

**Table 10-2. Summary of Printing, Coating, and Dyeing of Fabrics and Other Textiles NESHAP Compliance Costs**

| Nationwide cost component | Nationwide total capital investment, $\$ \times 10^{-6}$ | Nationwide total annual cost, $\$ \times 10^{-6}$ |
|---|---|---|
| Coating and printing subcategory control costs | 17.6 | 5.6 |
| Dyeing and finishing subcategory reformulation costs | | 7.5 |
| Source category MRR costs | 1.2 | 1.4 |
| **Nationwide total compliance costs** | 18.8 | 14.5 |

## References

1. U.S. Environmental Protection Agency. Fabric Printing, Coating, and Dyeing NESHAP. ICR Responses. Office of Air Quality Planning and Standards. Research Triangle Park, NC. Responses received September 1998 - October 1998.

2. Memorandum and Attachment from York, S. and A. Sharma, RTI to P. Almodóvar, EPA/OAQPS/ESD/CCPG. November 13, 1998 Final. Summary of meeting at which ATMI presented the results of the ATMI MACT survey to EPA.

3. Letter, J. Fleming, ATMI, to G. V. Hellwig, EPA: OAQPS: CCPG, November 2, 2000. ATMI MACT Development Support (textile finishing).

4. U.S. Environmental Protection Agency. Standard Form 83-I Supporting Statement for OMB Review of ICR No. Information Collection Request for the Printing, Coating, and Dyeing of Fabrics and Other Textiles Source Category. Emission Standards Division. Research Triangle Park, NC. February 27, 2002.

# TECHNICAL REPORT DATA

*(Please read Instructions on reverse before completing)*

| | | |
|---|---|---|
| 1. REPORT NO.<br>EPA-453/R-02-010 | 2. | 3. RECIPIENT'S ACCESSION NO. |

| | |
|---|---|
| 4. TITLE AND SUBTITLE<br>Technical Support Document: Printing, Coating, and Dyeing of Fabrics and Other Textiles Proposed NESHAP | 5. REPORT DATE<br>June 2002 |
| | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S) | 8. PERFORMING ORGANIZATION REPORT NO. |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>U.S. Environmental Protection Agency<br>Office of Air Quality Planning and Standards<br>Coatings and Consumer Products Group (C539-03)<br>Research Triangle Park, NC  27711 | 10. PROGRAM ELEMENT NO. |
| | 11. CONTRACT/GRANT NO. |
| 12. SPONSORING AGENCY NAME AND ADDRESS<br>Director<br>Office of Air Quality Planning and Standards<br>Office of Air and Radiation<br>U.S. Environmental Protection Agency<br>Research Triangle Park, NC  27711 | 13. TYPE OF REPORT AND PERIOD COVERED<br>Proposed Regulation |
| | 14. SPONSORING AGENCY CODE<br>EPA/200/04 |

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Under Section 112(d) of the Clean Air Act (the Act), the U.S. Environmental Protection Agency (EPA) is developing national emission standards for hazardous air pollutants (NESHAP) for the printing, coating, and dyeing of fabrics and other textiles source category.  The purpose of this document is to summarize the technical background information that supports the proposed NESHAP for the printing, coating, and dyeing of fabrics and other textiles industry.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| Environmental Protection<br>Administrative Practices and Procedures<br>Intergovernmental Relations<br>Reporting and Recordkeeping Requirements | Air Pollution Control<br>Hazardous Air Pollutants<br>Printing, Coating, and Dyeing of Fabrics and Other Textiles<br>NESHAP | |

| | | |
|---|---|---|
| 18. DISTRIBUTION STATEMENT<br>Release Unlimited | 19. SECURITY CLASS *(Report)*<br>Unclassified | 21. NO. OF PAGES<br>96 |
| | 20. SECURITY CLASS *(Page)*<br>Unclassified | 22. PRICE |

**EPA Form 2220-1 (Rev. 4-77)** PREVIOUS EDITION IS OBSOLETE

United States
Environmental Protection
Agency

Office of Air Quality Planning and Standards
Air Quality Strategies and Standards Division
Research Triangle Park, NC

Publication No. EPA 453/R-02-010
June 2002