



# EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT - SECTION 313: Guidance for Reporting Toxic Chemicals: Polycyclic Aromatic Compounds Category

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires certain facilities manufacturing, processing, or otherwise using listed toxic chemicals to report the annual quantity of such chemicals entering each environmental medium. Such facilities must also report pollution prevention and recycling data for such chemicals, pursuant to section 6607 of the Pollution Prevention Act, 42 U.S.C. 13106. When enacted, EPCRA Section 313 established an initial list of toxic chemicals that was comprised of more than 300 chemicals and 20 chemical categories. EPCRA Section 313(d) authorizes EPA to add chemicals to or delete chemicals from the list, and sets forth criteria for these actions. EPCRA Section 313 currently requires reporting on over 600 chemicals and chemical categories.

## CONTENTS

|             |   |    |
|-------------|---|----|
| SECTION 1.0 | Introduction .....  | 1  |
|             | Section 1.1 Background .....  | 1  |
|             | Section 1.2 Who Must Report? .....  | 3  |
|             | Section 1.3 What are the Reporting Thresholds? .....  | 5  |
|             | Section 1.4 Polycyclic Aromatic Compounds - Their Structure and<br>Formation .....  | 7  |
|             | Section 1.5 What Other Changes to the EPCRA Section 313 Reporting<br>Requirements Apply to the Polycyclic Aromatic Compounds<br>Category? ..... | 10 |
|             | 1.5.1 <i>De Minimis</i> Exemption .....   | 10 |
|             | 1.5.2 Alternate Reporting Threshold (1 Million Lbs); Form A .....   | 10 |
|             | 1.5.3 Range Reporting .....   | 11 |
|             | 1.5.4 Data Precision .....  | 11 |
| SECTION 2.0 | Guidance on Reporting And Estimating Environmental Releases<br>Of PACs .....  | 13 |
|             | Section 2.1 Introduction .....  | 13 |
|             | Section 2.2 Threshold Determination .....   | 19 |

**CONTENTS (Continued)**

Section 2.3 Methods for Calculating Annual Releases and Other Waste Management Quantities of Chemicals in the PAC Chemical Category ..... 20

SECTION 3.0 REFERENCES ..... 25

APPENDIX A Definitions of Various Mixtures, with CAS Numbers, that may contain chemicals in the EPCRA Section 313 PAC category ..... A-1

## LIST OF TABLES

|     |   | <b>Page</b> |
|-----|---|-------------|
| 1-1 | Chemicals Included in the EPCRA Section 313 PAC Category . . . . .                      | 2           |
| 2-1 | Some Mixtures That Might Contain EPCRA Section 313 PACs . . . . .                       | 15          |
| 2-2 | Quantity of PACs Required to Meet the Reporting Threshold in Fuels and Asphalt .        | 17          |
| 2-3 | Emission Factors for PACs From Combustion Sources . . . . .                             | 18          |
| 2-4 | Potential Data Sources for Release and Other Waste Management<br>Calculations . . . . . | 23          |

## DISCLAIMER

This guidance document is intended to assist industry with EPCRA Section 313 reporting for the Polycyclic Aromatic Compounds category. In addition to providing an overview of aspects of the statutory and regulatory requirements of the EPCRA Section 313 program, this document also provides recommendations and emission factors to assist industry with EPCRA reporting. These recommendations do not supersede any statutory or regulatory requirements, are subject to change, and are not independently binding on either EPA or covered facilities. Additionally, if a conflict exists between guidance on this site and the statutory or regulatory requirements, the conflict must be resolved in favor of the statute or regulation. Although EPA encourages industry to consider these recommendations and emission factors, in reviewing this document, industry should be aware that these recommendations and emission factors were developed to address common circumstances at typical facilities. The circumstances at a specific facility may significantly differ from those contemplated in the development of this document. Thus individual facilities may find that the recommendations and emission factors provided in this document are inapplicable to their processes or circumstances, and that alternative approaches or information are more accurate and/or more appropriate for meeting the statutory and regulatory requirements of EPCRA Section 313. To that end, industry should use facility specific information and process knowledge, where available, to meet the requirements of EPCRA Section 313. Facilities are encouraged to contact the Agency with any additional or clarifying questions about the recommendations and emission factors in this document, or if the facility believes that EPA has incorrectly characterized a particular process or recommendation. Additional guidance documents, including industry specific and chemical specific guidance documents, are also available at the EPA TRI website: <<http://www.epa.gov/tri>>.

## SECTION 1.0 INTRODUCTION

### Section 1.1 Background

On October 29, 1999, EPA promulgated the Final Rule on Persistent, Bioaccumulative, and Toxic (PBT) chemicals (64 FR 58666). This rule added two chemicals to the existing polycyclic aromatic compounds (PAC) category on the list of toxic chemicals subject to the reporting requirements under Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). EPA also lowered the reporting threshold for the PAC category to 100 pounds. The two added PACs were benzo(j,k)fluorene and 3-methylcholanthrene. The 21 chemicals comprising the new PAC category, their Chemical Abstracts Service (CAS) Registry numbers, and common sources are listed in Table 1-1. The Persistent Bioaccumulative Toxic (PBT) chemical final rule also added benzo(g,h,i)perylene, a PBT chemical PAC, to the EPCRA Section 313 list of individual chemicals. Benzo(g,h,i)perylene has a reporting threshold of 10 lb/yr and is reported separately from the PAC category. Refer to the EPCRA Section 313 *Guidance for Reporting Toxic Chemicals: Pesticides and Other Persistent Bioaccumulative Toxic (PBT) Chemicals* for more information.

The purpose of this guidance document is to assist facilities in complying with the reporting requirements of EPCRA Section 313 for the polycyclic aromatic compounds category. Facilities that meet the EPCRA Section 313 employee threshold and SIC code requirements, and that exceed the reporting threshold for the PAC category are subject to the EPCRA Section 313 annual reporting requirements beginning with reporting year 2000, with the first reports due by July 1, 2001.

This document explains the EPCRA Section 313 reporting requirements, and provides guidance on how to estimate annual releases and other waste management quantities of PACs from certain industries and industrial activities. Because each facility is unique, the recommendations presented may have to be adjusted to the specific nature of operations at your facility or industrial activity.

**Table 1-1****Chemicals Included in the EPCRA Section 313 PAC Category<sup>a</sup>**

| Chemical Name                     | CAS Number | Sources <sup>(1)</sup>   |
|-----------------------------------|------------|--|
| Benzo(a)anthracene                | 56-55-3    | Product of incomplete combustion (PIC); fossil fuels (FF)                                      |
| Benzo(a)phenanthrene (chrysene)   | 218-01-9   | PIC; FF; coke plant exhaust  |
| Benzo(a)pyrene                    | 50-32-8    | PIC; FF; coal tar; municipal incinerator emissions   |
| Benzo(b)fluoranthene              | 205-99-2   | PIC; FF  |
| Benzo(j)fluoranthene              | 205-82-3   | PIC; FF; coal tar  |
| Benzo(k)fluoranthene              | 207-08-9   | PIC; FF; coal tar  |
| Benzo(j,k)fluorene (fluoranthene) | 206-44-0   | PIC; FF; coal tar  |
| Benzo(r,s,t)pentaphene            | 189-55-9   | PIC; FF; coal tar  |
| Dibenz(a,h)acridine               | 226-36-8   | PIC (particularly coal burning processes)  |
| Dibenz(a,j)acridine               | 224-42-0   | PIC (particularly coal burning processes)  |
| Dibenzo(a,h)anthracene            | 53-70-3    | PIC; FF; coal tar; gasoline engine exhaust tar   |
| Dibenzo(a,e)fluoranthene          | 5385-75-1  | PIC  |
| Dibenzo(a,e)pyrene                | 192-65-4   | PIC; FF  |
| Dibenzo(a,h)pyrene                | 189-64-0   | PIC; FF; coal tar  |
| Dibenzo(a,l)pyrene                | 191-30-0   | PIC; coal gasification   |
| 7H-Dibenzo(c,g)carbazole          | 194-59-2   | Coal burning processes; coal tar and coal distillates  |
| 7,12-Dimethylbenz(a)anthracene    | 57-97-6    | Produced in small quantities as a research chemical, not formed during combustion              |
| Indeno(1,2,3-cd)pyrene            | 193-39-5   | PIC; FF; coal tar  |
| 3-Methylcholanthrene              | 56-49-5    | Produced in small quantities as a research chemical, not formed during combustion              |
| 5-Methylchrysene                  | 3697-24-3  | PIC  |
| 1-Nitropyrene                     | 5522-43-0  | Diesel and gasoline engines; coal fired energy conversion plants; aluminum smelter stack gases |

<sup>1</sup> Reference: Aronson, D., and Howard, P.H. *Sources of Individual PAHs Listed in the PBT Chemical Pool*, January 2000.

<sup>a</sup> In addition to the PAC chemical category, the list of EPCRA Section 313 chemicals includes benzo (g,h,i) perylene (a polycyclic aromatic compound). The reporting threshold for the PAC category is 100 lb/yr and the reporting threshold for benzo (g,h,i) perylene is 10 lb/yr.

A primary goal of EPCRA is to increase the public's knowledge of, and access to, information on the presence and release and other waste management activities of EPCRA Section 313 toxic chemicals in their communities. Under EPCRA Section 313, certain facilities exceeding reporting thresholds are required to submit annual toxic chemical release forms.

These forms must be submitted to EPA and State or Tribal governments, on or before July 1, for activities in the previous calendar year. The owner/operator of the facility on July 1 of the reporting deadline is primarily responsible for the report, even if the owner/operator did not own the facility during the reporting year. EPCRA mandates that EPA establish and maintain a publicly available database consisting of the information reported under Section 313. This database, known as the Toxics Release Inventory (TRI), can be accessed through the following sources:

- C EPA's Internet site, [www.epa.gov/tri](http://www.epa.gov/tri);
- C TRI Explorer Internet site, [www.epa.gov/triexplorer](http://www.epa.gov/triexplorer);
- C Envirofacts Warehouse Internet site, [www.epa.gov/enviro/html/tris/tris\\_overview.html](http://www.epa.gov/enviro/html/tris/tris_overview.html); and
- C EPA's annual TRI data release materials (summary information).

This document supersedes the previous PACs guidance document (EPA 745-R-99-009). The objectives of this guidance document are to:

- C Provide explanation and assistance on EPCRA Section 313 reporting requirements for the polycyclic aromatic compounds category, since June 1999;
- C Promote consistency in the method of estimating annual releases and other waste management quantities of polycyclic aromatic compounds for certain industries and industrial classes; and
- C Reduce the level of effort expended by those facilities that prepare an EPCRA Section 313 report for the polycyclic aromatic compounds category.

## **Section 1.2 Who Must Report?**

To understand the following discussion you must first understand how EPCRA defines

a facility. The term “facility” is defined as, “all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, which is controlled by, or which is under common control with such person).” (EPCRA Section 328(4)). A facility may contain more than one “establishment” (40 CFR 372.3). An “establishment” is defined as, “an economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed” (40 CFR 372.3).

EPA recognizes that for business reasons it may be easier and more appropriate for establishments at one facility to report separately. However, the combined quantities of EPCRA Section 313 chemicals and chemical categories manufactured, processed, or otherwise used in all establishments making up that facility must be considered for threshold determinations. Also, the combined release and other waste management activities reported singly for each establishment must total those for the facility as a whole (40 CFR 372.30(c)).

Note that if a facility is comprised of more than one establishment, once an activity threshold is met by the facility, provided that the facility meets the SIC Code and employee threshold criteria, release and other waste management activities from all establishments at the facility must be reported (40 CFR 372.30(c)).

A facility is subject to the provisions of EPCRA Section 313, if it meets all three of the following criteria:

- C It is included in Standard Industrial Classification (SIC) codes 20 through 39; SIC code 10 (except SIC codes 1011, 1081, and 1094); SIC code 12 (except SIC code 1241); SIC code 4911 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), SIC code 4931 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), SIC code 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce); SIC code 4953 (limited to facilities regulated under the Resource Conservation and Recovery Act, subtitle C, 42 U.S.C. section



6921 *et seq.*); SIC code 5169; SIC code 5171; or SIC code 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); and

- C It has 10 or more full-time employees (or the equivalent of 20,000 hours per year); and
- C It manufactures (includes imports), processes, or otherwise uses any of the toxic chemicals listed on the EPCRA Section 313 list in amounts greater than the threshold quantities established in 40 CFR 372.25, 372.28. See Section 1.3.

These three reporting criteria alone, not a facility's release and other waste management quantities, determine whether your facility must prepare an EPCRA Section 313 report. A facility that meets these three criteria is required to prepare an EPCRA Section 313 report even if that facility has zero release or other waste management quantities of EPCRA Section 313 chemicals or chemical categories.

In addition, pursuant to Executive Order 13148 entitled "Greening the Government Through Leadership in Environmental Management," federal facilities are required to comply with the reporting requirements of EPCRA Section 313. This requirement is mandated regardless of the federal facility's SIC code.

### **Section 1.3 What are the Reporting Thresholds?**

Thresholds are specified amounts of toxic chemicals manufactured, processed, or otherwise used during the calendar year that trigger reporting requirements. EPCRA Section 313 establishes default reporting thresholds, but authorizes EPA to establish lower thresholds for particular chemicals, classes of chemicals, or categories of facilities, if a different threshold is warranted. EPA has used this authority to establish lower thresholds for PBT chemicals (40 CFR 370.28, 64 FR 58666). The EPCRA Section 313 PAC category consists of 21 specific compounds (see Section 1.1, Table 1-1) that are reported as a single chemical category. EPCRA Section 313 requires threshold determinations for chemical categories to be based on the total mass of all the chemicals in that

category. Therefore, provided that the facility meets the SIC code and employee threshold criteria, reporting is required for the PAC category:

- C If a facility *manufactures* more than 100 pounds of the PAC category during the calendar year.
- C If a facility *processes* more than 100 pounds of the PAC category during the calendar year.
- C If a facility *otherwise uses* more than 100 pounds of the PAC category during the calendar year.

The terms manufacture, process, and otherwise use are defined in 40 CFR 372.3 as:

*Manufacture* means to produce, prepare, import, or compound a toxic chemical. Manufacture also applies to a toxic chemical that is produced coincidentally during the manufacture, processing, otherwise use, or disposal of another chemical or mixture of chemicals, including a toxic chemical that is separated from that other chemical or mixture of chemicals as a byproduct, and a toxic chemical that remains in that other chemical or mixture of chemicals as an impurity.

*Process* means the preparation of a toxic chemical, after its manufacture, for distribution in commerce: (1) In the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance, or (2) As part of an article containing the toxic chemical. Process also applies to the processing of a toxic chemical contained in a mixture or trade name product.

*Otherwise use* means any use of a toxic chemical, including a toxic chemical contained in a mixture or other trade name product or waste, that is not covered by the terms manufacture or process. Otherwise use of a toxic chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:

(1) The toxic chemical that was disposed, stabilized, or treated for destruction was received from offsite for the purposes of further waste management; or

(2) The toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off site for the purposes of further waste management activities. Relabeling or redistributing of the toxic chemical in

which no repackaging of the toxic chemical occurs does not constitute otherwise use or processing of the toxic chemical.

The quantities of PACs included in threshold determinations are not limited to the amounts of these compounds released to the environment; they include all amounts of PACs manufactured, processed, or otherwise used at the facility. For example, some emission factors may include values for both before and after scrubbers, and while the after scrubber values would apply to release estimates, the before scrubber values would apply towards threshold calculations since this represents amounts that have been manufactured. If the only information that a facility has concerning the manufacturing, processing, or otherwise use of PACs at the facility comes from emission factors then those quantities can be used to determine threshold quantities. Quantities required to meet the threshold for some fuels and other raw materials may be found in Table 3-1.

If you perform threshold calculations for the PAC chemical category, you should also perform threshold calculations for benzo(g,h,i)perylene. Benzo(g,h,i)perylene (a polycyclic aromatic compound) is reported separately from the PAC chemical category. The reporting threshold for the PAC category is 100 lb/yr and the reporting threshold for benzo(g,h,i)perylene is 10 lb/yr. If you exceed a reporting threshold for both the PAC category and benzo(g,h,i)perylene, separate Form Rs must be submitted. For more information on benzo(g,h,i)perylene, refer to the EPCRA Section 313 *Guidance for Reporting Toxic Chemicals: Pesticides and Other Persistent Bioaccumulative Toxic (PBT) Chemicals*.

#### **Section 1.4 Polycyclic Aromatic Compounds - Their Structure and Formation**

Polycyclic aromatic compounds (PACs) are a subset of a broad class of chemicals identified as polycyclic organic matter (POM). POM, a complex mixture containing thousands of organic compounds, is found in fossil fuels, oil, coal, wood, and natural gas. POM is also found as suspended particulate matter in the urban atmosphere, from the incomplete combustion/pyrolysis of fuels (coal, oil, natural gas, and wood).

PACs may also be referred to as polycyclic, or polynuclear, aromatic hydrocarbons (PAHs). The chemical structure is characterized by three or more aromatic (e.g., benzene) rings, usually fused together such that each pair of fused rings shares two carbons. The PAC structure can contain five-membered nonaromatic hydrocarbon rings fused to the six-membered rings, e.g., benzo(j)fluoranthene. PACs can also contain atoms other than carbon and hydrogen, such as nitrogen. Because of the high nitrogen content of coal, the coal burning process commonly produces EPCRA Section 313 PAC category chemicals containing nitrogen (such as dibenz(a,h)acridine).

Most of the 21 listed PACs are products of incomplete combustion; see Table 1-1. Two exceptions, 7,12-dimethylbenz(a)anthracene and 3-methylcholanthrene, are produced in small quantities as research chemicals and are not products of incomplete combustion (1). Twelve of the 21 are reported to be found in fossil fuels (1). EPCRA Section 313 PAC category chemicals are also found in coal tar and coal distillates.

Fossil fuel combustion for heat and power generation is the primary source of PACs; however, other industrial processes also contribute. EPCRA Section 313 PACs may be generated from the production of synthetic fuels from coal, petroleum, and other feedstocks as well as the manufacture of products other than fuels from coal and petroleum feedstocks. By-products of coal processing and petroleum refining such as heavy oils, crude tars, coal tars, coal distillates, and residues are likely to contain significant quantities of PACs.

These by-products are themselves often used in other industrial processes. Various liquid fractions distilled from tars and pitches can be used to produce chemicals such as benzene, toluene, xylene, phenols, creosols, and naphthalene. Pitches can be processed to make asphalt roofing and road surfacing material. Tars and pitches can be used in wood preservation and in the manufacture of carbon black, tar-epoxy coatings, and hydrocarbon resins. Coal tar pitch used at smelting facilities may also contain PACs.

Several factors influence the quantity and types of PACs generated: the combustion/pyrolysis method or industrial process; the method or process efficiency; the temperature range, and duration of combustion; and the material combusted/pyrolyzed or processed. Incomplete or inefficient combustion/pyrolysis processes tend to generate larger quantities of PACs. Higher temperature processes generate PACs that are higher in aromatic content.

EPA's publication, *Locating & Estimating Air Emissions from Sources of Polycyclic Organic Matter*, EPA-454/R-98-014, contains PAC emission factors for seven PAC chemicals in the PAC category (benz(a)anthracene, benzo(a)phenanthrene (chrysene), benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene) for the following sources potentially covered by EPCRA Section 313 reporting requirements (2):

- C Wood waste and bark fired industrial boilers;
- C Natural gas fired industrial boilers;
- C Coal fired industrial boilers;
- C Oil and waste oil fired industrial boilers;
- C Stationary diesel, natural gas, and gas turbine engines;
- C Waste combustion systems for facilities regulated under subtitle C of RCRA;
- C Primary aluminum producers – various processes;
- C Electric arc furnaces;
- C Iron foundries;
- C Secondary lead smelters;
- C Petroleum catalytic cracking;
- C Asphalt roofing manufacture;
- C Hot mix asphalt plants;
- C Coke ovens;
- C Portland cement kilns – wet and dry process; fired by various combinations of coal, coke, gas, and hazardous waste;
- C Pulp mills – Kraft recovery furnaces and lime kilns;
- C Carbon black manufacturing;
- C Creosote wood treatment; and
- C Rayon based carbon fiber manufacturing.

EPA's publication *Compilation of Air Pollutant Emission Factors*, commonly referred to as AP-42, is an additional reference for emission factors for many industries and industrial

processes (3). PAC emission factors are available for oil, coal, natural gas and wood combustion; for diesel engines; carbon black manufacturing; and hot mix asphalt plants.

## **Section 1.5 What Other Changes to the EPCRA Section 313 Reporting Requirements Apply to the Polycyclic Aromatic Compounds Category?**

EPA has also made modifications and/or clarifications to certain reporting exemptions and requirements for the PBT chemicals that are subject to the lower reporting thresholds; this includes the PAC category. Each of the changes as they apply to the PAC category is discussed in the following subsections.

### **1.5.1 *De Minimis* Exemption**

The *de minimis* exemption allows facilities to disregard certain minimal concentrations of toxic chemicals in mixtures or other trade name products they process or otherwise use when making thresholds determinations and release and other waste management calculations.

EPA eliminated the *de minimis* exemption for EPCRA Section 313 PBT chemicals, including the PAC category. This means that facilities are required to include all amounts of PACs in threshold determinations and release and other waste management calculations regardless of the concentration of the PACs in mixtures or trade name products (40 CFR 372.38(a)). However, the elimination of the *de minimis* exemption for PBT chemicals does not affect the applicability of the *de minimis* exemption to supplier notification requirements.

### **1.5.2 Alternate Reporting Threshold (One Million Pounds) and Form A**

The “Alternate Threshold for Facilities with Low Annual Reportable Amounts,” provides facilities otherwise meeting EPCRA Section 313 reporting thresholds the option of certifying on a Form A (a two-page certification statement) that they do not exceed 500 pounds for the total

annual reportable amount for that chemical, and that their amounts manufactured, processed, or otherwise used for that chemical do not exceed one million pounds.

EPA has excluded PBT chemicals, including the PAC category from eligibility for the “Alternate Threshold for Facilities with Low Annual Reportable Amounts” (40 CFR 372.27(e)). Therefore, the alternate threshold of one million pounds and the Form A certification statement are not options for the PAC category.

### **1.5.3 Range Reporting**

For facilities with total annual releases or off-site transfers of an EPCRA Section 313 chemical of less than 1,000 pounds, EPA generally allows the amounts to be reported on the Form R either as an estimate or by using ranges.

EPA has eliminated the range reporting option for releases and other waste management activities for PBT chemicals, including the PAC category. This means that for those sections of the Form R for which range reporting is an option, the option cannot be used when reporting on the PAC category (40 CFR 372.85(b)(15)(i)). Thus facilities are required to report an actual number rather than a selected range. However, the elimination of range reporting for PBT chemicals for releases and transfers does not affect the applicability of range reporting of the maximum amount on site as required by EPCRA Section 313(g).

### **1.5.4 Data Precision**

Facilities should report for the PAC category at a level of precision supported by the data and the estimation techniques on which the estimate is based. However, the smallest quantity that need be reported on the Form R for the PAC category is 0.1 pounds.

Example: If the total quantity for section 5.2 of the Form R (i.e., stack or point air emissions) is 0.05 pounds or less, then zero can be entered. If the total quantity is between 0.05 and 0.1 pounds, then 0.1 pounds or the actual number can be entered (e.g., 0.075 pounds).



## **SECTION 2.0 GUIDANCE ON REPORTING AND ESTIMATING ENVIRONMENTAL RELEASES OF PACS**

### **Section 2.1 Introduction**

You have determined that your facility is included in a covered SIC code, has 10 or more full-time employee equivalents, and manufactures, processes, or otherwise uses one or more of the chemicals included in the EPCRA Section 313 PAC category. The last step to establish if your facility must submit an EPCRA Section 313 report is to determine if your facility has exceeded the reporting threshold amount of 100 pounds for the chemicals in the PAC category.

This document includes concentration and emission factor data which may be used as default values in calculating activity thresholds, releases and other waste management quantities. EPA recommends that facilities complete these calculations using best readily available information applicable to their operations, even if it differs from the data provided herein. EPA also recommends that facilities maintain documentation of the basis for making these estimates. Facilities are not required to perform additional testing for EPCRA Section 313 reporting.

As discussed in Section 1.4 most of the 21 listed PACs are products of incomplete combustion; see Table 1-1. Table 2-1 presents a list of some mixtures, and their CAS numbers, that might contain EPCRA Section 313 PACs. It is suggested that you begin the threshold determination process by reviewing those two tables and compiling a list of all the fuels, mixtures, and other products, including but not limited to those listed in Table 2-1, used at your facility.

The concentration of an individual PAC in fuels and mixtures should always be based first on any specific information you have for the fuels, mixtures, or other products used at your facility. MSDSs are one source of information on the type and concentration of chemicals in mixtures. In the absence of such information, published data on the typical concentrations of the PACs found in those materials should be used.

The EPCRA Section 313 listed toxic chemical creosote is an example of a mixture which may contain PACs. Creosote (CAS No. 8001-58-9) is a mixture that is often used as a wood preservative. The creosote mixture consists of hundreds of chemicals, and may include PACs listed at 40 CFR Section 372.28. In the October 29, 1999 Persistent, Bioaccumulative, Toxic Chemical final rule, EPA provided no exceptions to the reporting of PACs at the lower reporting threshold. Therefore, facilities must include PACs contained in creosote in their threshold calculations. If a facility exceeds the applicable threshold, a separate Form R for PACs, including any PACs in the creosote mixture, must be filed. Furthermore, when reporting PACs, the *de minimis* exemption is inapplicable, and neither range reporting options nor the Form A may be used. See 40 CFR Sections 372.38(a); 372.85(b); 372.27(e). In the event that a facility exceeds the reporting thresholds for both creosote and PACs, the facility must file a Form R for PACs, and either a Form R or, if applicable, a Form A for creosote.

**Table 2-1****Some Mixtures That Might Contain EPCRA Section 313 PACs<sup>a</sup>**

| <b>Mixture Name</b>  | <b>CAS Number<sup>b</sup></b> |
|--|-------------------------------|
| Aromatic hydrocarbons, polycyclic  | 130498-29-2                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed coal-tar pitch-polystyrene pyrolysis-derived                                    | 101794-76-7                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed coal-tar pitch-polyethylene pyrolysis-derived                                   | 101794-75-6                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed coal-tar pitch-polyethylene-polypropylene pyrolysis-derived                     | 101794-74-5                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic oil-polystyrene pyrolysis-derived                                      | 101794-73-4                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic oil-polyethylene pyrolysis-derived                                     | 101794-72-3                   |
| Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic oil-polyethylene-polypropylene pyrolysis-derived                       | 101794-71-2                   |
| Aromatic hydrocarbons, polycyclic, from decomposition of solvent extracted coal tar pitch-2,4,6-trinitrophenol-reaction products | 94113-85-6                    |
| Aromatic hydrocarbons, polycyclic, from decomposition of iodine-solvent extracted coal tar pitch charge-transfer complexes       | 94113-84-5                    |
| Aromatic hydrocarbons, polycyclic, toluene dealkylation distillation residues  | 93762-97-1                    |
| Aromatic hydrocarbons, polycyclic, cyclohexanone-extracted residue   | 68409-74-5                    |
| Aromatic hydrocarbons, polycyclic, alkyl-naphthalene-toluene thermal hydrodealkylation distillation residues                     | 68333-90-4                    |
| Petroleum  | 8002-05-9                     |
| Anthracene oil   | 90640-80-5                    |
| Coke (coal tar), low-temperature, low-temperature gasification pitch, calcined   | 150339-33-6                   |
| Tar bases, coal, low-temperature, crude  | 141785-66-2                   |
| Extracts (coal), coal tar pitch solvent  | 130576-63-5                   |
| Extracts (coal), coal tar pitch solvent, reaction products with 2,4,6-trinitrophenol   | 94113-98-1                    |
| Extracts (coal), coal tar pitch solvent, reaction products with iodine   | 94113-97-0                    |
| Extract residues (coal), liquefaction heavy acid, alkaline extracts  | 94113-96-9                    |
| Extract residues (coal), naphthalene oil acid, alkaline extracts   | 94113-95-8                    |
| Distillates (coal tar), low-temperature, pitch   | 140413-63-4                   |
| Distillates (coal tar), upper, fluorene-low  | 140203-27-6                   |
| Distillates (coal tar), high-temperature, heavy oils   | 140203-21-0                   |
| Distillates (coal tar), gasification, pitch, full range  | 140203-20-9                   |
| Distillates (coal tar), gasification, heavy oils, pyrene fraction  | 140203-19-6                   |
| Distillates (coal tar), pitch, pyrene fraction   | 91995-52-7                    |
| Distillates (coal tar), pitch, heavy oils  | 91995-51-6                    |

**Table 2-1 (Continued)**

| <b>Mixture Name</b>   | <b>CAS Number<sup>b</sup></b> |
|---|-------------------------------|
| Distillates (coal tar), pitch, pyrene fraction  | 91995-42-5                    |
| Distillates (coal), liquefaction, heavy   | 91995-25-4                    |
| Distillates (coal tar), heavy oils  | 90640-86-1                    |
| Distillates (coal tar), upper, fluorene-rich  | 84989-11-7                    |
| Distillates (coal tar), upper, fluorene-free  | 84989-10-6                    |
| Pitch, coal tar, high-temperature, heat-treated   | 12575-60-8                    |
| Pitch, mixed brown-coal tar-ethylene manufacturing pyrolysis oil distribution                         | 100403-59-6                   |
| Pitch, brown-coal tar   | 100403-58-5                   |
| Pitch, coal tar, high-temperature, secondary  | 94114-13-3                    |
| Pitch, coal gasification tar, low-temperature   | 94114-12-2                    |
| Residues, alkene-alkyne manufacturing pyrolysis oil byproduct distillation                            | 93686-02-3                    |
| Residues, olefin manufacturing pyrolysis oil distillation   | 92062-01-6                    |
| Residues (coal tar), pitch distillation   | 92061-94-4                    |
| Residues (coal tar), anthracene oil distillation  | 92061-92-2                    |
| Residues (coal), coke-oven gas-polycyclic aromatic hydrocarbons reaction products distillation        | 92061-88-6                    |
| Aromatic hydrocarbons, polycyclic, automobile scrap shredder waste pyrolysis products                 | 94581-00-7                    |
| Aromatic hydrocarbons, polycyclic, scrap cable pyrolysis  | 90989-45-0                    |
| Polyamides, polyester-, wastes, pyrolyzed, pyrolysis oil  | 100801-78-3                   |
| Polyamides, polyester-, wastes, pyrolyzed, pitch residue fraction                                     | 100801-77-2                   |
| Polyamides, polyester-, wastes, pyrolyzed, heavy oil fraction   | 100801-75-0                   |
| Hydrocarbon oils, aromatic, mixed with polyethylene, pyrolyzed, middle oil fraction                   | 101227-14-9                   |
| Hydrocarbon oils, aromatic, mixed with polystyrene, pyrolyzed, middle oil fraction                    | 101227-13-8                   |
| Hydrocarbon oils, aromatic, mixed with polyethylene and polypropylene, pyrolyzed, middle oil fraction | 100801-64-7                   |

<sup>a</sup>It cannot be determined from the mixture name if a chemical from the category is actually contained in the mixture.

<sup>b</sup>CAS definitions for most of the mixtures are provided in Appendix A.

Other important mixtures containing PACs are fuels. Table 2-2 provides concentrations of PACs in fuels. Be aware that these values only include a limited number of the specific PAC chemicals listed in the compound category. Analyses that include all of the chemicals are not available at this time.

EPA recognizes that the scientific literature shows that there is significant variability in the concentration of PACs in fuels. As always, facilities should use the best available information that is applicable to their operations. In the absence of better data, EPA recommends using the default values listed in Table 2-2 for these commonly used fuels.

Diesel fuel is also a likely source of PACs; EPA does not have a default value for sites to use at this time.

**Table 2-2**  
**Quantity of PACs Required to Meet the Reporting Threshold in Fuels and Asphalt**

| Fuel Type                   | Concentration | Reference | Quantity Needed to Meet Threshold (gallons) <sup>b</sup> |
|-----------------------------|---------------|-----------|--|
| No. 6 Fuel Oil (Bunker C)   | 2461 ppm      | 7         | $5.144 \times 10^3$                                      |
| No. 2 Fuel Oil              | 10.0 ppm      | 8         | $1.41 \times 10^6$                                       |
| Crude Oil                   | (a)           |           |  |
| Gasoline                    | 17 ppm        | 9         | $1.06 \times 10^6$                                       |
| Paving Asphalt <sup>c</sup> | 178 ppm       | 10        | $5.18 \times 10^4$                                       |

(a) PACs concentration in crude oil depends on the crude oil type. Additional PACs may be formed during petroleum refining operations.

(b) Assumes the following densities: No. 2 Fuel Oil = 7.1 lb/gallon; No. 6 Fuel Oil = 7.9 lb/gallon; gasoline = 5.6 lb/gallon; and paving asphalt = 10.84 lb/gallon.

(c) Paving asphalt is also known as bituminous concrete.

Also in the absence of site specific data, the coincidental manufacturing of PACs in the combustion of fuels can be estimated using published emission factors such as those found in EPA publications *Compilation of Air Pollutant Emission Factors*, AP-42 and *Locating & Estimating Air Emissions from Sources of Polycyclic Organic Matter*, see Table 2-3. Note that these values only include a limited number of PACs in the compound category.

The absence of information in Tables 2-2 and 2-3 on the other members of the EPCRA Section 313 PAC chemical category should not be interpreted to mean that those PACs are not

present in the fuel oil or in the combustion products. EPCRA Section 313 requires that you use the best, readily available information in preparing the report. Thus, if you have information on the presence and concentration of members of the EPCRA Section 313 PAC chemical category not included in the values provided in the tables you must use that data in your threshold determinations.

**Table 2-3**

**Emission Factors for PACs From Combustion Sources**

| Combustion Source                                    | Average Emission Factor         | Reference      |
|--|---------------------------------|----------------|
| Natural Gas-Fired Boilers                            | 8.69E-07 lb/MMCF                | 2 <sup>a</sup> |
| Natural Gas-Fired Boilers                            | 4.37E-07 lb/MMCF                | 2 <sup>b</sup> |
| Residual Oil Fired Boilers                           | 1.65E-05 lb/10 <sup>3</sup> gal | 3 <sup>c</sup> |
| Coal-Fired, Controlled                               | 1.12E-06 lb/ton                 | 3 <sup>d</sup> |
| Wood Waste Combustion,<br>Particulate Matter Control | 5.15E-05 lb/ton                 | 3 <sup>e</sup> |

<sup>a</sup> Source Classification Codes (SCC) Number 1-02-006-01, 02, 03; uncontrolled; based on 10 units tested: 2 firetube, 1 scotch, 7 watertube, rated capacity range: 7.2-178 MMBtu/hr.

<sup>b</sup> SCC Number 1-03-006-01, 02; uncontrolled; based on 5 packaged watertube boilers tested, rated capacity range: 17.4-126 MMBtu/hr. EPA recommends that facilities choose between this value and the one above by matching the type of boiler.

<sup>c</sup> Section 1.3, Fuel Oil Combustion, Table 1.3-9; SCC 1-01-004-01/04

<sup>d</sup> Section 1.1, Supplement E, Table 1.1-13; factors developed from emissions data from six sites firing bituminous coal, four sites firing subbituminous coal, and from one site firing lignite. Factors apply to boilers using both wet limestone scrubbers or spray dryers with an ESP or fabric filter. The factors also apply to boilers using only an ESP or fabric filter. Emission factor should be applied to coal feed, as fired, and are lb of pollutant per ton of coal combusted.

<sup>e</sup> Section 1.6, Supplement E, Table 1.6-4. Units are lb of pollutant/ton of wood waste burned. Emission factors based on wet, as fired wood waste with average properties of 50 weight % moisture and \$4500 Btu/lb heating value. PM controls include fabric filter, multi-cyclones, ESP, and wet scrubbers.

The concentration of an EPCRA Section 313 PAC category chemical may be known as a specific concentration, as an average, as a range, or as an upper or lower boundary. If you know the specific concentration of PACs in the stream, you must use that value (40 CFR 372.30 (b)(i)). If only an average concentration is provided (e.g., by the supplier), use that value in the threshold calculation. If only the upper bound concentration is known, you must use this value in the threshold calculation (40 CFR 372.30(b)(3)(ii)). If only the lower bound concentration is provided or the concentration is given as a range or an upper and lower boundary, EPA has developed the following guidance on the use of this type of information in threshold determinations.

- C If the concentration is given as a range or an upper and lower boundary, EPA recommends that you use the mid-point in your calculations.
- C If only the lower bound concentration of the PAC is given and the concentrations of the other components are given, EPA recommends that you subtract the other component's total from 100% to calculate the upper bound concentration. EPA then recommends that you determine the midpoint for use in your calculations.
- C If only the lower bound concentration of the PAC is given and the concentration of the other components is not given, EPA recommends that you assume the upper bound for the PAC is 100% and use the mid-point. Alternatively, product quality requirements or information available from the most similar process stream may be used to determine the upper bound of the range.

## **Section 2.2 Threshold Determination**

The following sample calculation will illustrate the use of published chemical specific concentration data and emission factors in the determination of threshold quantities.

### **Example – Threshold Determination Using Published Data**

Your facility has a primary SIC Code covered by EPCRA Section 313 reporting requirements and over 200 full-time employees. Your facility requires large quantities of steam in the manufacturing process and you use oil-fired boilers to generate the steam. The #6 fuel oil you purchase contains PACs included in the EPCRA Section 313 PAC chemical category. The combustion of the fuel oil generates EPCRA Section 313 PAC chemicals, in addition to other products (some of which, such as formaldehyde, may also be EPCRA Section 313 chemicals). You need to determine if your facility otherwise uses and/or coincidentally manufactures EPCRA Section 313 PAC category chemicals in an amount exceeding the annual reporting threshold of 100 pounds.

#### **Otherwise used**

Table 2-2 contains concentration information on the EPCRA Section 313 PAC category chemicals in #6 fuel oil. The total concentration for PACs is 2461 ppm. Using 7.9 lb/gal as the density of #6 fuel oil, you would exceed the otherwise used threshold of 100 lb/year with the consumption of 5,144 gallons of #6 fuel oil.

$$(5,144 \text{ gal/yr; oil consumed}) \times (2461 \text{ lb/1E+6 lb; PAC concentration}) \times (7.9 \text{ lb/gal; oil density}) > 100 \text{ pounds/year}$$

Your facility exceeds the reporting threshold, therefore a Form R must be prepared for the PAC chemical category.

### **Manufactured**

Table 2-3 contains an uncontrolled emission factor for PAC chemicals in #6 fuel oil. The emission factor is 1.65E-05 pounds/1,000 gallons of fuel oil burned. The uncontrolled emission factor can be equated to the quantity generated by the coincidental manufacturing.

If this was the only source of EPCRA Section 313 PAC category chemicals your facility would have to burn over 6.07 billion gallons of residual fuel oil during the reporting year to manufacture over 100 pounds of the PAC chemicals required to trigger the EPCRA Section 313 reporting threshold for the PAC chemicals category.

$$(6.07E+9 \text{ gal/yr; oil burned}) \times (1.65E-05 \text{ lb/1E+3 gal; PAC concentration}) > 100 \text{ pounds/year}$$

Your facility exceeds the reporting threshold, therefore a Form R must be prepared for the PAC chemical category.

Keep in mind that if there are other manufacturing, processing, or otherwise use activities at your facility of the PACs included in the EPCRA Section 313 PAC chemical category these must be included in your threshold determination.

### **Section 2.3 Methods for Calculating Annual Releases and Other Waste Management Quantities of Chemicals in the PAC Chemical Category**

You must estimate release and other waste management quantities if the reporting threshold for one of the manufacturing, processing, or otherwise use activities is exceeded. EPA recommends that you calculate PAC releases and other waste management activities by following these steps:

1. Identify the processes/operations where PACs may be manufactured, processed, or otherwise used.
2. Determine potential sources of releases and other waste management activities (e.g., emissions from incomplete combustion operations).
3. Identify the types of releases and other waste management activities. These types correspond to the Form R (e.g., stack emissions).
4. Determine the most appropriate estimation method(s) and calculate the estimates for release and other waste management quantities.



During threshold determinations, you identified the processes and operations in which PACs are found. Potential release and other waste management sources of PACs include the following:

- C Accidental releases;
- C Air pollution control devices (stack releases);
- C Combustion by-products;
- C Process discharge stream (e.g. scrubber wastewater);
- C Energy recovery by-products;
- C Tower stacks; and
- C Volatilization from processes.

After determining the release and other waste management activity sources of PACs, you are ready to determine the types of releases and other waste management activities. These final destinations of the PACs correspond to elements of the Form R. The potential types of releases and other waste management activities include:

- C Fugitive or nonpoint air emissions (Part II, Section 5.1 of Form R): PAC emissions are considered to be fugitive if not released through stacks, vents, ducts, pipes, or any other confined air stream. You must include (1) fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.; (2) evaporative losses from surface impoundments and spills; (3) releases from building ventilation systems; and (4) any other fugitive or non-point air emissions.
- C Stack or point air emissions (Part II, Section 5.2 of Form R): PAC emissions are considered to be stack if released through stacks, confined vents, ducts, pipes, or other confined air streams. You must include storage tank emissions. Air releases from air pollution control equipment would generally fall in this category. Using the control efficiency of an air pollution control device, you can determine the quantity of PACs released through the air device.
- C Discharges to receiving streams or water bodies (Part II, Section 5.3 of Form R): PACs may be present in scrubber wastewater. Monitoring is often performed at outfalls. This information can be used to determine the concentration of PACs leaving the facility.
- C Underground injection on site (Part II, Section 5.4 of Form R)

- C Disposal to land on site (Part II, Section 5.5 of Form R)
- C Discharges to Publicly Owned Treatment Works (POTW) (Part II, Section 6.1 of Form R): As with the receiving stream discharge, monitoring may be available to determine the PAC concentration in a wastewater stream.
- C Transfers to other off-site locations (Part II, Section 6.2 of Form R):
- C On-site waste treatment (Part II, Section 7A of Form R): You should report the amount of PACs treated by your facility; however this practice is not common for PACs.
- C On-site energy recovery (Part II, Section 7B of Form R): This waste management activity is not common for PACs.
- C On-site recycling (Part II, Section 7C of Form R). This waste management activity is not common for PACs.

After you have identified all of the potential sources for release and other waste management activity types, you must estimate the quantities of PACs released and otherwise managed as waste.

EPA has identified four basic methods that may be used to develop estimates (each method has been assigned a code that must be included when reporting). The methods and corresponding codes are:

- C Monitoring Data or Direct Measurement (M);
- C Mass Balance (C);
- C Emission Factors (E); and,
- C Engineering Calculations (O).

Descriptions of these techniques are provided in the U.S. EPA publication, *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Forms* (6).

Many data sources exist for these (and other) methods of developing estimates. Table 2-4 presents potential data sources and the estimation methodology in which each estimation source is most likely to prove useful. Based on site-specific knowledge and potential data sources available, you should be able to determine the best method for calculating each release and other waste management activity quantity.

**Table 2-4**

**Potential Data Sources for Release and Other Waste Management Calculations**

| DATA SOURCES   |   |
|--|---|
| <p><b><u>Monitoring Data</u></b></p> <ul style="list-style-type: none"> <li>C Air permits</li> <li>C Continuous emission monitoring</li> <li>C Effluent limitations</li> <li>C Hazardous waste analysis</li> <li>C Industrial hygiene monitoring data</li> <li>C NPDES<sup>1</sup> permits</li> <li>C Outfall monitoring data</li> <li>C POTW pretreatment standards</li> <li>C RCRA<sup>2</sup> permit (not common for PACs)</li> <li>C Stack monitoring data</li> <li>C New Source Performance Standards</li> <li>C Title V</li> <li>C MACT<sup>7</sup> Standards</li> </ul> <p><b><u>Emission Factors</u></b></p> <ul style="list-style-type: none"> <li>C AP-42<sup>3</sup> chemical specific emission factors</li> <li>C Facility or trade association derived <u>chemical-specific</u> emission factors</li> </ul> | <p><b><u>Mass Balance</u></b></p> <ul style="list-style-type: none"> <li>C Air emissions inventory</li> <li>C Hazardous material inventory</li> <li>C Hazardous waste manifests</li> <li>C MSDSs<sup>4</sup></li> <li>C Pollution prevention reports</li> <li>C Spill and accidental release event records</li> <li>C Supply and purchasing records (not common for PACs)</li> </ul> <p><b><u>Engineering Calculations</u></b></p> <ul style="list-style-type: none"> <li>C NTI<sup>6</sup> database</li> <li>C Facility <u>non chemical-specific</u> emission factors.</li> <li>C Henry's Law</li> <li>C Raoult's Law</li> <li>C SOCM<sup>5</sup> or trade association non-chemical specific emission factors</li> <li>C Solubilities</li> <li>C Volatilization rates</li> </ul> |

<sup>1</sup>National Pollutant Discharge Elimination System.

<sup>2</sup>Resource Conservation Recovery Act.

<sup>3</sup>Compilation of Emission Factors, U.S. EPA.

<sup>4</sup>Material Safety Data Sheets.

<sup>5</sup>Synthetic Organic Chemicals Manufacturing Industry.

<sup>6</sup>National Toxic Inventory.

<sup>7</sup>Maximum Achievable Control Technology.

The following sample calculation will illustrate how you might estimate the release and other waste management quantities for reporting on the Form R.

**Example - Release and Other Waste Management Estimation**

Let us assume that your threshold determination showed that in the combustion of fuel oil to generate steam for the manufacturing process, you coincidentally manufactured a total of 155 pounds of the PACs in the EPCRA Section 313 PAC chemical category. While you have not tested the efficiency of the air pollution control devices on your oil-fired burners (testing is not required for EPCRA Section 313 reporting purposes) the pollution control device manufacturer's data states that the devices will provide 85% control and removal.

Quantity released =  $155 \text{ lb/year} \times (1 - 0.85; \text{ control device efficiency}) = 23.25 \text{ pounds/year}$ .

This should be reported in Part II, Sections 5.2 and 8.1 of the 2000 Form R. The PACs captured by the control device also need to be reported.

### SECTION 3.0 REFERENCES

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4. U.S. EPA. *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313*. Office of Pollution Prevention and Toxics. April 1997.
5. American Petroleum Institute. *Transport and Fate of non-BTEX Petroleum Chemicals in Soil and Groundwater*. API Publication No. 4593. September 1994.
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**Appendix A**

**DEFINITIONS OF VARIOUS MIXTURES, WITH CAS NUMBERS, THAT MAY  
CONTAIN CHEMICALS IN THE EPCRA SECTION 313 PAC CATEGORY**

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
|------------------------------------|--|
| 101794-76-7                        | <p>Aromatic hydrocarbons, C-20-28, polycyclic, mixed coal-tar pitch-polystyrene pyrolysis-derived</p> <p>Definition: A complex combination of hydrocarbons obtained from mixed coal tar pitch-polystyrene pyrolysis. Composed primarily of polycyclic aromatic hydrocarbons having carbon numbers predominantly in the range of C20 through C28 and having a softening point of 100EC to 220EC (212EF to 428EF) according to DIN 52025.</p>  |
| 101794-75-6                        | <p>Aromatic hydrocarbons, C20-28, polycyclic, mixed coal-tar pitch-polyethylene pyrolysis-derived</p> <p>Definition: A complex combination of hydrocarbons obtained from mixed coal tar pitch-polyethylene pyrolysis. Combined primarily of polycyclic aromatic hydrocarbons having carbon numbers predominantly in the range of C20 through C28 and having a softening point of 100EC to 220EC (212EF to 428EF) according to DIN 52025.</p> |
| 101794-74-5                        | <p>Aromatic hydrocarbons, C20-28, polycyclic, mixed coal-tar pitch-polyethylene-polypropylene pyrolysis-derived</p> <p>Definition: A complex combination of hydrocarbons obtained from mixed coal tar pitch-polyethylene-polypropylene pyrolysis. Composed primarily of polycyclic aromatic hydrocarbons having a softening point of 100EC to 220EC (212EF to 428EF) according to DIN 52025.</p>   |
| 101794-73-4                        | <p>Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic Oil-polystyrene pyrolysis-derived</p> <p>Definition: A complex combination of hydrocarbons obtained from mixed aromatic oil-polystyrene pyrolysis. Composed primarily of polycyclic aromatic hydrocarbons having carbon numbers predominantly in the range of C20 through C28 and having a softening point of 30EC to 140EC (86EF to 284EF) according to DIN 52025.</p>         |
| 101794-72-3                        | <p>Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic oil-polyethylene pyrolysis-derived</p> <p>Definition: A complex combination of hydrocarbons obtained from mixed aromatic oil-polyethylene pyrolysis. Composed primarily of polycyclic aromatic hydrocarbons</p>   |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>  |
|------------------------------------|---|
|                                    | having carbon numbers predominantly in the range of C20 through C28 and having a softening point of 30EC to 140EC (86EF to 284EF) according to DIN 52025.   |
| 101794-71-2                        | Aromatic hydrocarbons, C20-28, polycyclic, mixed aromatic oil-polyethylene-polypropylene pyrolysis-derived<br><br>Definition: A complex combination of hydrocarbons obtained from mixed aromatic oil-polyethylene-propylene pyrolysis. Composed primarily of polycyclic aromatic hydrocarbons having carbon numbers predominantly in the range of C20 through C28 and having a softening point of 30EC to 140EC (86EF to 184EF) according to DIN 52025.     |
| 94113-85-6                         | Aromatic hydrocarbons, polycyclic, from decompn. of solvent extd. coal tar pitch-2,4,6-tricnitrophenol-reaction products<br><br>Definition: A complex combination of organic compounds obtained by addition of a picric acid solution to the solvent extract of a bituminous coal tar pitch and decomposition of the precipitated pitch-picric acid reaction product with bases. Composed primarily of high molecular weight polycyclic aromatic compounds. |
| 94113-84-5                         | Aromatic hydrocarbons, polycyclic, from decompn. of iodine-solvent extd. coal-tar pitch cargo-transfer complexes<br><br>Definition: A complex combination of organic compounds obtained by addition of iodine solution to the solvent extract of a bituminous coal tar pitch and decomposition of the precipitated pitch iodine reaction products. Composed primarily of high molecular weight polycyclic aromatic compounds.                               |
| 93762-97-1                         | Aromatic hydrocarbons, polycyclic, toluene dealkylation distillation residues<br><br>Definition: A complex combination of hydrocarbons obtained from the distillation of products from the thermal hydrodealkylation of toluene. It consists of predominantly bi- and polynuclear aromatic hydrocarbons such as diphenyl, methyldiphenyl, fluorene, and phenanthrene.   |



| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
|------------------------------------|--|
| 68409-74-5                         | <p>Aromatic hydrocarbons, polycyclic, cyclohexanone, ext. residues</p> <p>Definition: A complex residuum from the cyclohexanone extraction of anthracene salts. It consists predominantly of polynuclear aromatic hydrocarbons such as anthracene.</p>   |
| 68333-90-4                         | <p>Aromatic hydrocarbons, polycyclic, alkyl naphthalene-toluene thermal hydrodealkylation distillation residues</p> <p>Definition: The complex residuum from the distillation of products from the thermal hydrodealkylation of alkyl naphthalene and toluene. It consists predominantly of bi- and polynuclear aromatic hydrocarbons such as naphthalenes, biphenyl, fluorene, and phenanthrene.</p>  |
| 8002-05-9                          | <p>Petroleum</p> <p>Definition: A complex combination of hydrocarbons. It consists predominantly of aliphatic, alicyclic, and aromatic hydrocarbons. It may also contain small amounts of nitrogen, oxygen, and sulfur compounds. This category encompasses light, medium, and heavy petroleums, as well as the oils extracted from tar sands. Hydrocarbonaceous materials requiring major chemical changes for their recovery or conversion to petroleum refinery feedstocks such as crude shale oils, upgraded shale oils and liquid coal fuels are not included in this definition.</p> |
| 90640-80-5                         | <p>Anthracene oil</p> <p>Definition: A complex combination of polycyclic aromatic hydrocarbons obtained from coal tar having an approximate distillation range of 300EC to 400EC (572EF to 752EF). Composed primarily of phenanthrene, anthracene, and carbazole.</p>  |
| 141785-66-2                        | <p>Tar bases, coal, low-temperature, crude</p> <p>Definition: The reaction product obtained by neutralizing the acidic extract of alkali-washed low-temperature coal tar middle oil with an alkaline solution, such as aqueous sodium hydroxide, to obtain the free bases. Composed primarily of a complex mixture of aromatic nitrogen bases.</p>   |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>  |
|------------------------------------|---|
| 140203-34-5                        | <p>Tar bases, coal liquefaction, heavy oil fraction</p> <p>Definition: The heavy oil obtained by the high pressure hydrogenation of bituminous coal is subjected to acid extraction and then neutralized. The crude bases thus obtained contain polynuclear nitrogen aromatics such as quinoline, acridine, and phenanthridine.</p>   |
| 130576-63-5                        | <p>Extracts (coal), coal tar pitch solvent</p> <p>Definition: Solvent extract of bituminous coal tar pitch. Composed primarily of polycyclic aromatic hydrocarbons.</p>   |
| 94113-98-1                         | <p>Extracts (coal), coal tar pitch solvent, reaction products with 2,4,6-trinitrophenol</p> <p>Definition: Insoluble reaction product obtained by addition of a picric acid solution to the solvent extract of a bituminous coal tar pitch. Composed primarily of polycyclic aromatic hydrocarbons.</p>   |
| 94113-97-0                         | <p>Extracts (coal), coal tar pitch solvent, reaction products with iodine</p> <p>Definition: Extract obtained by adding an iodine solution to the solvent extract of a bituminous coal tar pitch. Composed primarily of polycyclic aromatic hydrocarbons.</p>   |
| 94113-96-9                         | <p>Extract residues (coal), liquefaction heavy acid, alkaline extracts</p> <p>Definition: The neutral oil obtained by debasing and dephenolating the heavy oil from the high pressure hydrogenation of bituminous coal. Composed primarily of unsubstituted and alkyl-substituted aromatic polynuclear hydrocarbons that are partially hydrogenated and may contain heteroatoms.</p>                          |
| 94113-95-8                         | <p>Extract residues (coal), naphthalene oil acid, alkaline extracts</p> <p>Definition: The neutral oil obtained by debasing and dephenolating the middle oil from the low temperature carbonization of bituminous coal. Composed primarily of a mixture of mono- and polynuclear, substituted and unsubstituted aromatic and naphthenic hydrocarbons and heterocycles as well as paraffinic hydrocarbons.</p> |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
|------------------------------------|--|
| 140413-63-4                        | <p>Distillates (coal tar), low-temperature, pitch</p> <p>Definition: The distillate obtained during the heat treatment of low temperature coal tar pitch having an approximate distillation range of 100EC to 400EC (212EF to 752EF). Composed primarily of a complex mixture of aromatic compounds.</p>   |
| 140203-27-6                        | <p>Distillates (coal tar), upper, fluorene-low</p> <p>Definition: A complex combination of hydrocarbons obtained by the crystallization of the fractional distillates from tar oil. It consists of aromatic polycyclic hydrocarbons, primarily diphenyl, dibenzofuran, and acenaphthene.</p>   |
| 140203-21-0                        | <p>Distillates (coal tar), gasification, pitch, full range</p> <p>Definition: The distillate obtained during the heat treatment of pitch obtained from coal gasification tar having an approximate distillation range of 100EC to 400EC (212EF to 752EF). Composed primarily of aromatic and other hydrocarbons, phenolic compounds, and aromatic nitrogen compounds.</p>  |
| 140203-19-6                        | <p>Distillates (coal tar), gasification, heavy oils, pyrene fraction</p> <p>Definition: The distillate from the fractional distillation of coal gasification tar having an approximate boiling range of 350EC to 450EC (662EF to 842EF). Composed primarily of phenanthrene and anthracene homologs, tetranuclear aromatic hydrocarbons which may also contain heteroatoms, high-boiling aliphatic and naphthenic hydrocarbons, and polynuclear phenols.</p> |
| 91995-52-7                         | <p>Distillates (coal tar), pitch, pyrene fraction</p> <p>Definition: The redistillate obtained from the fractional distillation of pitch distillate and boiling in the range of approximately 380EC to 410EC (716EF to 770EF). Composed primarily of tri- and polynuclear aromatic hydrocarbons and heterocyclic compounds.</p>  |
| 91995-51-6                         | <p>Distillates (coal tar), pitch, heavy oils</p> <p>Definition: The distillate from the distillation of the pitch obtained from bituminous high temperature tar. Composed primarily of tri- and polynuclear aromatic hydrocarbons</p>  |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>  |
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|                                    | and boiling in the range of approximately 300EC to 470EC (572EF to 878EF). The product may also contain heteroatoms.  |
| 91995-42-5                         | Distillates (coal tar), heavy oils, pyrene fraction<br><br>Definition: The redistillate obtained from the fractional distillation of pitch distillate boiling in the range of approximately 350EC to 400EC (662EF to 752EF). Consists predominantly of tri- and polynuclear aromatics and heterocyclic hydrocarbons.  |
| 91995-25-4                         | Distillates (coal), liquefaction, heavy<br><br>Definition: the heavy oil obtained by distillation in the range of approximately 300EC to 550EC (572EF to 1022EF) of coal oil from the catalytic hydrogenation of coal and coal-derived products. Composed primarily of polynuclear aromatics and naphthenes. The product contains sulfur, oxygen, and nitrogen compounds. |
| 90640-86-1                         | Distillates (coal tar), heavy oils<br><br>Definition: The distillate from the fractional distillation of coal tar having an approximate distillation range of 300EC to 400EC (572EF to 752EF). Composed primarily of tri- and polynuclear aromatic hydrocarbons and heterocyclic compounds.   |
| 84989-11-7                         | Distillates (coal tar), upper, fluorene-rich<br><br>Definition: A complex combination of hydrocarbons obtained by the crystallization of the fractional distillates from coal tar. It consists of aromatic and polycyclic hydrocarbons, primarily fluorene and acenaphthene.  |
| 84989-10-6                         | Distillates (coal tar), upper, fluorene-free<br><br>Definition: A complex combination of hydrocarbons obtained by the crystallization of tar oil. It consists of aromatic polycyclic hydrocarbons, primarily diphenyl, dibenzofuran, and acenaphthene.  |
| 121575-60-8                        | Pitch, coal tar, high-temperature, heat-treated<br><br>Definition: The heat treated residue from the distillation of high temperature coal tar. A black solid with an approximate softening point from 80EC to 180EC (176EF to  |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>  |
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|                                    | 356EF). Composed primarily of a complex mixture of three or more membered condensed ring aromatic hydrocarbons.   |
| 100403-59-6                        | Pitch, mixed brown-coal tar-ethylene manufacturing pyrolysis oil distillation<br><br>Definition: The residue from the joint distillation of brown coal tar and pyrolysis residual oil from ethylene plants. Composed primarily of polynuclear aromatic and naphthenic hydrocarbons which can be alkyl- and vinyl-substituted and can contain heteroatoms, paraffin hydrocarbons, and high-boiling mono- and dinuclear phenols. It is a black solid with a softening point of 60EC (140EF) according to DIN 52025. |
| 100403-58-5                        | Pitch, brown-coal tar<br><br>Definition: The residue from the distillation of brown coal tar formed by carbonization up to 1250EC (2282EF). Composed primarily of polynuclear aromatic and naphthenic hydrocarbons and heterocycles, paraffin hydrocarbons, and high-boiling mono- and dinuclear phenols. It is a black solid with a softening point of 50EC to 120EC (122EF to 248EF) according to DIN 52025.  |
| 94114-13-3                         | Pitch, coal tar, high-temperature, secondary<br><br>Definition: The residue obtained during the distillation of high boiling fractions from bituminous coal high temperature tar and/or pitch coke oil, with a softening point of 140EC to 170EC (284EF to 338EF) according to DIN 52025. Composed primarily of tri- and polynuclear aromatic compounds which also contain heteroatoms.   |
| 94114-12-2                         | Pitch, coal gasification tar, low-temperature<br><br>Definition: The residue from the distillation of bituminous coal pressure gasification tar. A black solid with a softening point of greater than 60EC (140EF) according to DIN 52025 and composed primarily of a complex mixture of polynuclear aromatic and naphthenic hydrocarbons that may be alkyl substituted and may contain heteroatoms, high boiling aliphatic hydrocarbons and polynuclear phenols.   |
| 93686-02-3                         | Residues, alkene-alkyne manufactured by pyrolysis oil byproduct distillation<br><br>Definition: A complex combination of hydrocarbons obtained as a residue from the distillation of residual oils that are obtained by the pyrolytic recovery of alkenes and   |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
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|                                    | alkynes from mineral oil products or natural gas. It consists predominantly of tri- and polynuclear aromatic and alkylaromatic hydrocarbons and has a softening point of approximately 60EC to 180EC (140EF to 356EF) according to DIN 52025.  |
| 92062-01-6                         | Residues, olefin manufacturing pyrolysis oil distillation<br><br>Definition: A complex combination of hydrocarbons obtained as a residue from the distillation of residual oils that are obtained by the pyrolytic recover of alkenes and alkynes from petroleum products or natural gas. It consists predominantly of tri- and polynuclear aromatic and alkylaromatic hydrocarbons having a softening point of 20EC to 60EC (68EF to 140EF) according to DIN 52025.   |
| 92061-94-4                         | Residues (coal tar), pitch distillation<br><br>Definition: Residue from the fractional distillation of pitch distillate boiling in the range of approximately 400EC to 470EC (752EF to 878EF). Composed primarily of polynuclear aromatic hydrocarbons, and heterocyclic compounds.  |
| 92061-92-2                         | Residues (coal tar), anthracene oil distillation<br><br>Definition: The residue from the fraction distillation of crude anthracene boiling in the approximate range of 340EC to 400EC (644EF to 752EF). It consists predominantly of tri- and polynuclear aromatic and heterocyclic hydrocarbons.  |
| 92061-88-6                         | Residues (coal), coke-oven gas-polycyclic aromatic hydrocarbons reaction products distillation<br><br>Definition: The residue from the distillation of a complex reaction product, obtained by reaction of gases obtained by the dry distillation of bituminous coal with a distillate, consisting of di- and trinuclear aromatic hydrocarbons and their alkyl derivatives, with a softening point of 30EC to 50EC (86EF to 122EF). The residue consists predominantly of substituted aromatic di- and polynuclear hydrocarbons and sulfur-containing compounds. |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
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| 94581-00-7                         | <p>Aromatic hydrocarbons, polycyclic, automobile scrap shredder waste pyrolysis products</p> <p>Definition: Pyrolysis product obtained from the thermal treatment of the organic portion of shredder waste arising from automobile scrap. Composed primarily of mono- to tetracyclic aromatic hydrocarbons and their alkyl derivatives.</p>  |
| 90989-45-0                         | <p>Aromatic hydrocarbons, polycyclic, scrap cable pyrolysis</p> <p>Definition: Fraction formed by the thermal treatment of scrap cables at about 700EC (1292EF) with extensive exclusion of air. Consists chiefly of mono- to tetranuclear aromatic hydrocarbons and their alkyl derivatives.</p>  |
| 100801-78-3                        | <p>Polyamides, polyester-, wastes, pyrolyzed, pyrolysis oil</p> <p>Definition: The oil obtained from the pyrolysis of textile wastes from a polyamide/ polyester fiber mixture at 600EC to 800EC (1112EF to 1472EF). It consists predominantly of benzene and naphthalene and their homologs, benzonitrile, and other di- and polynuclear aromatic hydrocarbons.</p>                       |
| 100801-77-2                        | <p>Polyamides, polyester-, wastes pyrolyzed, pitch residue fraction</p> <p>Definition: A residue from the distillation of textile waste pyrolysis oil. It consists predominantly of polynuclear aromatic hydrocarbons boiling in a range above 350EC (662EF).</p>  |
| 100801-75-0                        | <p>Polyamides, polyester-, wastes, pyrolyzed, heavy oil fraction</p> <p>Definition: A fraction from the distillation of textile waste pyrolysis oil. It consists predominantly of benzonitrile, naphthalene, and homologs and other di- and polynuclear aromatic hydrocarbons boiling in the range of 200EC and 350EC (392EF to 662EF).</p>  |
| 101227-14-9                        | <p>Hydrocarbon oils, aromatic, mixed with polyethylene, pyrolyzed, middle oil fraction</p> <p>Definition: The oil obtained from the heat treatment of polyethylene with aromatic oils. It consists predominantly of naphthalene and its homologs, 1,3-diphenylpropane and other polynuclear aromatic hydrocarbons boiling in a range of approximately 200EC to 400EC (392EF to 752EF).</p> |

| <b>CAS<br/>Registry<br/>Number</b> | <b><u>Definition</u></b>   |
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| 101227-13-8                        | <p>Hydrocarbon oils, aromatic, mixed with polystyrene, pyrolyzed, middle oil fraction</p> <p>Definition: The oil obtained from the heat treatment of polystyrene with aromatic oils. It consists predominantly of naphthalene and its homologs, 1,3-diphenylpropane, and other polynuclear aromatic hydrocarbons boiling in a range of approximately 200EC to 400EC (392EF to 752EF).</p>  |
| 100801-64-7                        | <p>Hydrocarbon oils, aromatic, mixed with polyethylene and polypropylene, pyrolyzed, middle oil fraction</p> <p>Definition: The oil obtained from the heat treatment of a polyethylene/polypropylene mixture with aromatic oils. It consists predominantly of naphthalene and its homologs, 1,3-diphenylpropane and other polynuclear aromatic hydrocarbons boiling in a range of approximately 200EC to 400EC (392EF to 752EF).</p> |