United States
Environmental Protection
Agency

Office of Pesticides
and Toxic Substances

EPA 560/4-88-004p
February 1988

EPA

Title III Section 313 Release Reporting Guidance

Estimating Chemical Releases From Wood Preserving Operations

Estimating Chemical Releases From Wood Preserving Operations

Facilities engaged in wood preserving operations may be required to report annually any releases to the environment of certain chemicals regulated under Section 313, Title III, of the Superfund Amendments and Reauthorization Act (SARA) of 1986. If your facility is classified under SIC codes 20 through 39 (wood preserving facilities generally fall under SIC code 2491) and has 10 or more full-time employees, for calendar year 1987 you must report all environmental releases of any Section 313-listed chemical or chemical category manufactured or processed by your facility in an amount exceeding 75,000 pounds per year or otherwise used in an amount exceeding 10,000 pounds per year. For calendar years 1988 and 1989 (and beyond), the threshold reporting quantity for manufactured or processed chemicals drops to 50,000 and 25,000 pounds per year, respectively.

This document has been developed to assist facilities engaged in wood preserving operations in the completion of Part III (Chemical Specific Information) of the Toxic Chemical Release Inventory Reporting Form. Included herein is general information on toxic chemicals used and process wastes generated, along with several examples to demonstrate the types of data needed and various methodologies available for estimating releases. If your facility performs other operations in addition to wood preserving, you must also include any releases of toxic chemicals from these operations.

Step One

Determine if your facility processes or uses any of the chemicals subject to reporting under Section 313.

A suggested approach for determination of the chemicals your facility uses that could be subject to reporting requirements is to, make a detailed review of the chemicals and materials you have purchased. If you do not know the specific ingredients of a chemical formulation, consult your suppliers for this information. If they will not provide this information, you must follow the steps outlined to handle this eventuality in the instructions provided with the Toxic Chemical Release Inventory Reporting Form.

The list presented here includes chemicals typically used in wood preserving operations that are subject to reporting under Section 313. This list does not necessarily include all of the chemicals your facility uses that are subject to reporting, and it may include many chemicals that you do not use. You should also determine whether any of the listed chemicals are created during processing at your facility.

Compounds found in wood preserving agents: Arsenic compounds, copper compounds, chromium compounds, zinc compounds, anthracene, benzene (in petroleum solvents), o-cresol, pentachlorophenol, dibenzofuran, naphthalene, quinoline

Vapor drying agents: Various solvents

Preserving carriers: Various solvents

Fire retardants: Zinc chloride, antimony trioxide, titanium dioxide, urea-melamine-formaldehyde resin

Step Two

Determine if your facility surpassed the threshold quantities established for reporting of listed chemicals last year.

You must submit a separate Toxic Chemical Release Inventory Reporting Form for each listed chemical that is "manufactured," "processed," or "otherwise used" at your facility in excess of the threshold quantities presented earlier. Manufacture includes materials produced as byproducts or impurities. Toxic compounds that are incorporated into your products (for example, wood preserving agents such as pentachlorophenol) would be considered "processed" because they become part of the marketed finished product. Degreasing solvents, cleaning agents, and other chemicals that do not become part of the finished product (for example, vapor drying agents and preserving carriers) would be considered "otherwise used."

The amount of a chemical processed or otherwise used at your facility represents the amount purchased during the year, adjusted for beginning and ending inventories. To ascertain the amount of chemical in a mixed formulation, multiply the amount of the mixture (in pounds) by the concentration of the chemical (weight percent) to obtain the amount of chemical processed.

Example: Determining whether chromium, copper, and arsenic were used in sufficient quantity to require reporting under Section 313.

In 1987, a wood preserving facility purchased 600,000 pounds of a chromated copper arsenate solution containing 23.75 percent chromium oxide (CrO_2), 9.25 percent copper oxide (CuO), 17.0 percent arsenic pentoxide (As_2O_5), and 50.0 percent H_2O. At the beginning of the year, 36,000 pounds of this solution was held in storage; the amount in storage at the end of the year was 18,000 pounds. Therefore, the total amount of solution processed during the year would be:

36,000 lb (beginning inventory) +

600,000 lb (purchased) –

18,000 lb (ending inventory)

= 618,000 lb

The amount of chromium oxide processed would be equal to:

618,000 lb solution x

23.75 lb CrO_2/100 lb solution

= 146,775 lb

The amount of copper oxide processed would be equal to:

618,000 lb solution x

9.25 lb CuO/100 lb solution

= 57,165 lb

The amount of arsenic pentoxide processed would be equal to:

618,000 lb solution x

17 lb As_2O_5/100 lb solution

= 105,060 lb

In this example, only chromium and arsenic compounds were processed in sufficient quantity (that is, more than 75,000 pounds) to require reporting under Section 313 in calendar year 1987. In calendar year 1988, reports would be required for all three metal compounds.

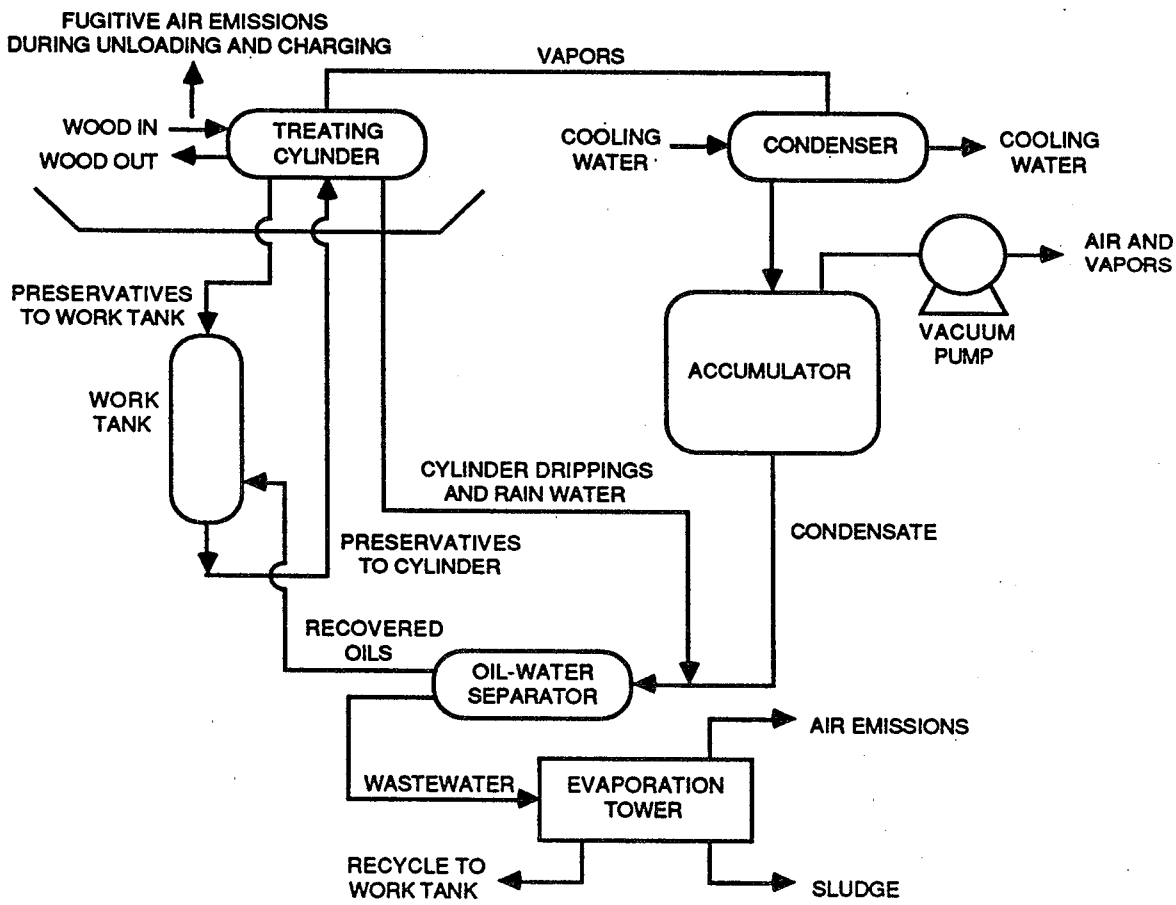
A listed chemical may be a component of several formulations you purchase, so you may need to ask your supplier for information on the concentration (percentage) of the chemical in each. For chemical categories (for example, chromium compounds), your reporting obligations are determined by the total amounts of all chemicals in the category.

You must complete a report for each chemical for which a threshold is exceeded. The thresholds apply separately; therefore, if you both process and use a chemical and either threshold is exceeded, you must report for both activities. If neither threshold is exceeded, no report is needed.

Step Three

Identify points of release for the chemical(s) subject to reporting.

An effective means of evaluating points of release for listed toxic chemicals is to draw a process flow diagram identifying the operations performed at your facility. The figure below is an example flow diagram of a pressurized wood-treating process in which vapor is conditioned. Because each facility is unique, you are strongly urged to develop a flow diagram for your particular operations that details the input of materials and chemicals and the waste sources resulting from the operation of each unit.



Example Flow Diagram of a Wood Preserving Facility Using the Boulton Conditioning Process

Wood preserving facilities generate wastewater during the conditioning of the wood prior to its treatment and as a result of the condensation of vapors drawn off the treatment cylinder. Rainwater and spills collected from the area around the treatment cylinder also contribute to wastewater volume. Typically, the preservative chemicals and solvents (solvents are used during vapor conditioning) entrained in the wastewater are recycled to the extent possible. Solid waste in facilities using oil-borne preservatives is generated primarily as a result of treatment and/or evaporation of wastewater. Typical air emission sources are volatilization of organic chemicals during wastewater evaporation, vapors released from the treating cylinder during unloading and charging operations, and emissions from the vacuum vent during the treating cycle.

Your reporting must account for all releases.

Step Four

Estimate releases of toxic chemicals.

After all of the toxic chemicals and waste sources have been identified, you can estimate the releases of the individual chemicals. Section 313 requires that releases to air, water, and land and transfers to offsite facilities be reported for each toxic chemical meeting the threshold reporting values. The usual approach entails first estimating releases from waste sources at your facility (that is, wastewater, air release points, and solid waste) and then, based on the disposal method used, determining whether releases from a particular waste source are to air, water, land, or an offsite disposal facility.

In general, there are four types of release estimation techniques:

- **Direct measurement**
- **Mass balance**
- **Engineering calculations**
- **Emission factors**

Descriptions of these techniques are provided in the general Section 313 guidance document, Estimating Releases and Waste-Treatment Efficiencies for the Toxic Chemical Release Inventory Form.

Provisions of the Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, and other regulations require monitoring of certain waste streams. If available, data gathered for these purposes can be used to estimate releases. When only a small amount of direct measurement data is available, you must decide if another estimation technique would give a more accurate estimate.

Mass balances of the entire wood preserving process are of limited value in estimating emissions. Because recycling is practiced extensively, the quantities of waste produced are very small in relation to the quantities of chemicals processed. Any inaccuracies in the calculation of the quantity of chemical purchased or retained in the wood product would greatly affect the estimated quantity of chemical released as waste; therefore, the accuracy of the estimate would be questionable. The use of mass balances may be feasible for specific units, however, if sufficient input and output data are available. For example, if the quantity of a chemical entering a wastewater evaporator and the quantity exiting as a sludge are known, the quantity exiting as air emissions from the evaporator can be determined by mass balance.

Engineering assumptions and calculations can be used to estimate toxic releases in a variety of situations. Information such as the water solubility and vapor pressure of a chemical can be used in conjunction with process parameters such as treatment cylinder size, vacuum exhaust rate, and wastewater evaporation temperature to develop engineering calculations of releases. This method of estimation relies heavily on process operating parameters; thus, the techniques developed are very site-specific.

Emission factors are usually not available for wood preserving operations; however, the reference sources presented at the end of this document contain considerable information on wood preserving wastes. You may be able to use this information to develop emission factors or waste characteristics applicable to your facility to serve as a basis for release estimates. You may also be able to develop emission factors for your particular facility in-house by performing detailed measurements of wastes at different production levels.

Toxic Releases Via Wastewater

Most wood preserving facilities do not discharge wastewater. Instead, the wastewater is either completely recycled or evaporated. Some facilities, however, discharge wastewater to publicly owned treatment works (POTWs) or dispose of it by land application, and a few facilities discharge wastewater directly into navigable waters. If you dispose of wastewater by landspreading, the toxic chemicals contained in the wastewater are considered "released to land." The same is true for those facilities who discharge to onsite lagoons that have no discharge; however, the quantities of chemicals that evaporate into the air or are removed as sludge from these lagoons must be accounted for.

Facilities that use steam conditioning or the Boulton process must monitor wastewater discharged to POTWs for copper, chromium, and arsenic to comply with pretreatment standards set for this portion of the industry. These monitoring data can be used to estimate releases of these toxic chemicals via wastewater. Release amounts should be estimated for the parent metal, even though the facility is processing and reporting for the metal compound. For other toxic chemicals, in-house monitoring data can be used. If such data are unavailable, a different release estimation technique must be used.

Although wastewater is not discharged at most wood preserving facilities, estimates of the toxic chemical content in wastewater streams within a facility can be useful for estimating releases as air emissions or solid waste. Most process pollutants can be found in the wastewater generated within the facility, and they are released as solid waste or air emissions during recycling, treatment, or evaporation. The following example demonstrates the use of an engineering calculation to estimate toxic releases via wastewater.

Example: Using an engineering calculation to estimate releases of pentachlorophenol via wastewater.

A wood preserving facility uses open steaming to condition wood before it undergoes pressure treatment with a pentachlorophenol (PCP) preservative. The condensed steam used during this conditioning generates wastewater containing excess preservative. This preservative is recycled to the work tank after the wastewater flows through an oil/water separator. The wastewater exiting the oil/water separator is discharged to a POTW.

No direct measurement data for PCP are generated at this facility. The quantity of PCP discharged can be estimated by use of an engineering calculation that assumes the PCP concentration in the wastewater exiting the oil/water separator is equal to the PCP's solubility in water (0.002 percent

or 20 mg/liter). Based on a known wastewater flow rate of 3,250 gallons per day from a plant that operates 250 days per year, the quantity of PCP released via wastewater to the POTW can be estimated as follows:

Amount of PCP released into wastewater =

20 mg/liter PCP x

3.78 liter/1 gal x

1 lb/453,000 mg x

3,250 gal/day x

250 days/year

= 136 lb

Using this approach, the plant in this example could report releases of 140 pounds of PCP to wastewater. If direct measurement data were available for PCP in the wastewater, using these data would be the preferred method of estimating releases.

The assumption used in the preceding example (that the concentration of PCP in the wastewater exiting the oil/water separator is equal to the water solubility of the PCP) may not be valid at your facility because of wastewater flow rates and emulsion formations. If monitoring data are not available or in-house emission factors cannot be developed, however, this is probably the best approach to estimating releases via wastewater.

Toxic Releases Via Solid Waste

The RCRA regulations specifically list solid wastes from wood preserving operations as hazardous. Therefore, the generation, transportation, and disposal of most of your solid wastes are regulated under this Act. The RCRA manifesting procedure for hazardous wastes shipped offsite requires documentation of waste quantities, and treatment, storage, and disposal facilities must perform detailed chemical and physical analyses on the wastes. Your facility may also analyze these wastes. Therefore, it should be possible to estimate solid waste releases for a number of compounds by direct measurement.

Example: Using direct measurement to estimate releases of toxic chemicals via solid waste.

Wastewater treatment sludge from a wood preserving operation was shipped monthly to an offsite secure chemical landfill for disposal. Shipping manifests for the past year contain detailed information on the quantity of sludge sent to the offsite facility. The landfill performed detailed chemical analysis for pentachlorophenol (PCP) on representative portions of each shipment before final disposal. The information from the manifests and landfill records can be combined to estimate the quantity of PCP shipped offsite each month in the wastewater treatment sludge by using the following equation.

Amount of PCP shipped offsite =

amount of sludge shipped x

PCP concentration

The results of this equation for each month are shown on the following table. These results are then totalled to yield the yearly amount of PCP shipped offsite in the sludge.

Month	Quantity of sludge shipped, lb	PCP conc., %	PCP in wastewater sludge, lb
January	2,000	5.06	101
February	2,400	5.19	73
March	700	4.88	34
April	1,500	3.70	56
May	2,100	3.00	63
June	2,800	7.50	210
July	3,200	8.40	269
August	2,400	5.55	134
September	2,900	5.00	95
October	500	10.55	53
November	1,200	6.90	83
December	1,300	2.00	26

Using this approach, the plant in this example could report that 1,200 pounds of PCP was transferred offsite in wastewater sludge.

This example addresses only PCP releases in wastewater sludge. The landfill would likely also have analytical data on other toxic chemicals in this sludge, which could be used to calculate releases for those compounds.

When no direct measurement data are available, another method of estimating releases is needed. A toxic chemical entering wastewater treatment or an evaporation device may be subject to numerous fates (for example, air emission, sludge residue, recycling to work tank). This makes it difficult to estimate releases of the chemical in sludge unless the content of the influent wastewater is known. In this case, a mass balance combined with an engineering assumption might be used.

Toxic Releases to Air

Your facility probably does not make direct measurements of fugitive air emission sources. In the absence of such measurements, a mass balance might be used to estimate releases of organic chemicals during wastewater evaporation if sufficient information is available on the content of wastewater entering and sludge exiting the evaporation device. A mass balance would be difficult to apply to releases from the treating cylinder during loading/unloading or from the vacuum vent during the treating cycle, however, and the results generated would be unreliable. Another possible approach to determining fugitive toxic releases would be to derive emission factors from the considerable information on air emissions from wood preserving operations contained in the material referenced at the end of this pamphlet. Engineering calculations can also be used to estimate releases from these sources.

To estimate air releases from wastewater treatment and evaporation devices, you must know the concentration of the toxic chemical of concern in the wastewater. As discussed earlier, this concentration can be determined by direct measurement or engineering calculation. Air releases can then be calculated by applying mass transfer principles to the process parameters of the wastewater treatment and/or evaporation devices. The EPA's Wood Preserving Industry Multimedia Emission Inventory and its Hazardous Waste Treatment, Storage and Disposal Facilities (TSDF)–Air Emission Models provide the theoretical background information you need to perform this engineering calculation. For some organic chemicals commonly found in creosote and pentachlorophenol preservative solutions, you can use the information in the following table for quick determination of the approximate fraction of chemical released to the atmosphere from evaporation devices.

Effect of Wastewater Treatment and/or Evaporation on Organic Constituents[a]

Preservative component	Percent emitted during evaporation at ambient temperature	Percent emitted during evaporation at elevated temperature (>60° C)
Penta		
Benzene	100	100
Ethylbenzene	100	100
Toluene	100	100
Phenol	100	100
Pentachlorophenol	0	0
Trichlorophenol	0	0
Creosote		
Naphthalene	0	95
Phenanthrene/ anthracene	0	40

[a] Data obtained from Wood Preserving Industry Multimedia Emission Inventory

Example: Using an emission factor to estimate air releases of naphthalene from a wastewater evaporator.

Wastewater entering a thermal (PAN) evaporator is sampled to characterize its toxic chemical content. The results of the sampling program show that the average naphthalene content of wastewater is 5 mg/liter. The wastewater flow rate

averages 15,300 gallons per day. The mass flow rate of naphthalene entering the evaporator would be:

5 mg/liter x

3.78 liter/gal x

1 lb/453,000 mg x

15,300 gal/day

= 0.64 lb/day

The PAN evaporator is operated at 80°C. Based on the preceding table, an estimated 95 percent of the naphthalene would be emitted to the atmosphere (the remaining 5 percent would be found in the sludge). Thus, the quantity of naphthalene released to the air from the evaporator would be 0.61 pound per day. If the plant operates 250 days a year, the total air emissions of naphthalene per year would be 150 pounds.

It is more likely, however, that the quantity of naphthalene disposed of as solid waste would be known by direct measurement and the content in the wastewater would be unknown. If direct measurement showed that 20 pounds of naphthalene per year was disposed of as solid waste from the evaporator (which would represent 5 percent of the total amount), the total amount of naphthalene per year in the influent wastewater would be:

$$20 \text{ lb} \div 0.05 = 400 \text{ lb}$$

Therefore, the total quantity of naphthalene released to air annually for this source would be:

$$400 \text{ lb} \times 0.95 = 380 \text{ lb}$$

Estimating air releases from the treating cylinder and vacuum vent can become a complicated task because of the number of variables involved, which include the amount of preservative solution in the treatment cell, the surface area of the liquid, the temperature of the process steam, the barometric pressure, the humidity, and the length of the treatment cycle. One approach is to estimate the volume of gas exhausted and the concentration of toxic chemicals in the exhaust gas. You can estimate the concentration in the exhaust air by assuming equilibrium between the preservative solution and the exhaust air. At equilibrium, the concentration in the exhaust air can be expressed as:

$$\frac{P_A}{P_T} = X_{AG} = \text{mole fraction of A in gas phase}$$

where P_A = *partial pressure of compound A*

P_T = *total pressure of system*

In this instance, P_T is equal to the barometric pressure, and P_A can be calculated as:

$$P_A = x_{AL} P^\circ$$

where P° = *vapor pressure of pure compound A*

x_{AL} = *mole fraction of compound A in solution*

Data on vapor pressures are readily available; however, be sure the vapor pressure used is appropriate for the operating temperature of the air exhaust.

Example: Using engineering calculations to estimate air releases of naphthalene from the vacuum exhaust.

The vacuum vent for a wood preserving operation in which creosote is used operates for a total of 4 hours per day at a flow rate of 400 cubic feet per minute. The preservative used in the treatment cycle contains 0.5 percent naphthalene by weight. Based on the molecular weights of the preservative components, the mole fraction of naphthalene in the preservative is 0.0076 (pounds ÷ molecular weight = moles). The liquid temperature in the accumulator is typically 90° C. The concentration of naphthalene in the air

exhausted through the vacuum vent can be estimated as follows:

Vapor pressure ($P°$) = 10 mm Hg at 85.8 °C

Partial pressure (P_A) = 0.0076 x 10 = 0.076 mm Hg

Total pressure (P_T) = 760 mm Hg (barometric pressure)

$$\frac{P_A}{P_T} = \frac{0.076}{760} = 0.0001 \text{ mole fraction of naphthalene in exhaust air}$$

Assuming 250 operating days per year, the amount of naphthalene released through the exhaust vent would be calculated as follows:

Amount of naphthalene released through vent =

0.0001 lb-mole naphthalene/lb-mole exhaust gas x

1 lb-mole exhaust gas/2387 cubic feet x

128 lb naphthalene/lb-mole naphthalene x

400 cubic feet/minute x

240 minutes/day x

250 days/year

= 129 lb

Using this approach, the facility in this example could report air emissions of 130 pounds of naphthalene.

The assumption used in the preceding example (that the exhaust air from the vacuum vent is in equilibrium with the preservative liquid) is not entirely appropriate. A better assumption would be that the exhaust air is in equilibrium with the condensate liquid in the accumulator. It is highly unlikely, however, that the mole fraction of a particular chemical in the condensate liquid is known or could be estimated.

Other Toxic Releases

Other wastes in wood preserving operations from which toxic chemicals may be released include:

- **Residues from pollution control devices**
- **Wash water from equipment cleaning**
- **Product rejects**
- **Used equipment**
- **Empty chemical containers**

Releases from these sources may already have been accounted for, depending on the release estimation methods used. These items (and any other of a similar nature) should be included in your development of a process flow diagram.

The contribution of sources of wastes such as cleaning out vessels or discarding containers should be small compared with process losses. If you do not have data on such sources (or any monitoring data on overall water releases), assume up to 1 percent of vessel content may be lost during each cleaning occurrence. For example, if you discard (to landfill) "empty" drums that have not been cleaned, calculate the release as 1 percent of normal drum content. If the drums are washed before disposal, this may contribute 1 percent of the content to your wastewater loading.

Step Five

Complete the Toxic Chemical Release Inventory Reporting Form.

After estimating the quantity of each chemical released via wastewater, solid waste, and air emissions, you must determine the amount of each chemical released to water, land, or air or transferred to an offsite disposal facility. This determination will be based on the disposal method you use for each of your waste streams. Enter the release estimates for each chemical or chemical category in Part III of the Toxic Chemical Release Inventory Reporting Form. Also enter the code for each treatment method used, the weight percent by which the treatment reduces the chemical in the treated waste stream, and the concentration of the chemical in the influent to treatment (see instructions). Report treatment methods that do not affect the chemical by entering "0" for removal efficiency.

For More Information

Emergency Planning and Community Right-to-Know Hotline	(800) 535-0202 or (202) 479-2449 (in Washington, D.C. and Alaska)
Small Business Ombudsman Hotline	(800) 368-5888 or (703) 557-1938 (in Washington, D.C. and Virginia)

The EPA brochure, Emergency Planning and Community Right-to-Know Act, Section 313 Release Reporting Requirements (EPA 560/4-88-001) presents an overview of the new law. It identifies the types of facilities that come under the provisions of Section 313, the threshold chemical volumes that trigger reporting requirements, and what must be reported. It also contains a complete listing of the chemicals and chemical categories subject to Section 313 reporting. The EPA publication, Estimating Releases and Waste-Treatment Efficiencies for the Toxic Chemical Release Inventory Form (EPA 560/4-88-002), presents more detailed information on general release estimation techniques than is included in this document.

Additional Sources of Information on Releases From Wood Preserving Operations

U.S. Environmental Protection Agency. Wood Preserving Industry Multimedia Emission Inventory. EPA 600/2-81-066. NTIS PB81-205999. April 1981.

U.S. Environmental Protection Agency. Emission and Residue Values From Waste Disposal During Wood Preserving. EPA-600/2-82-062. NTIS PB82 234246. April 1982.

U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines, New Source Performance Standards for the Timber Products Processing Point Source Category. EPA 440/1-81/023. NTIS PB81-227282. January 1981.

U.S. Environmental Protection Agency. Multimedia Pollution Assessment of the Wood Products Industries. EPA-600/2-81-008. NTIS PB84-160366, February 1984.

U.S. Environmental Protection Agency. Hazardous Waste Treatment, Storage and Disposal Facilities (TSDF)–Air Emission Models. EPA Draft Report. April 1987.

☆U.S. Government Printing Office : 1988 - 516-002/80163