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Title III Section 313 Release Reporting Guidance

Estimating Chemical Releases From Roller, Knife, and Gravure Coating Operations

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Facilities performing coating 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 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 those using roller, knife, and gravure coating equipment 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 coating, 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 coating 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.

Solvents: Approximately 50 solvents are on the Section 313 list; these include 1,1,2-trichloroethane, n-butyl alcohol, ethylene glycol, methyl ethyl ketone, 2-ethoxyethanol, xylene, and toluene

Pigments: Primarily metal-containing compounds such as titanium dioxide, zinc oxide, white lead, barium sulfate, chromium oxide, nickel titanate, and cobalt chromite

Additives: Curing agents, surfactants, defoamers, thickeners, film control agents, and plasticizers such as dibutyl phthalate, dimethyl phthalate, dioctyl phthalate, ammonia, and diethanolamine

Polymer and resin precursors (residues/impurities): Ethyl acrylate, formaldehyde, vinyl chloride, vinyl acetate, methyl acrylate, acrylic acid, acrylonitrile, ethylene glycol, melamine, vinylidene chloride, styrene, 1,3-butadiene, and phenol

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, pigments, polymer and resin precursors) would be considered "processed" because they become part of the marketed finished product. Carrier solvents, degreasing solvents, cleaning agents, and other chemicals that do not become part of the finished product 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 toluene was used in sufficient quantity last year to require reporting under Section 313.

During 1987, a coil coating facility used two different coating formulas, one containing 38 percent toluene (by weight), and the other, 25 percent toluene (by weight). "Pure" (98 percent) toluene was also purchased for use as a coating thinner. Purchasing and inventory records indicate the following:

- *100,000 pounds of the 38 percent toluene coating was purchased in 1987; 2,000 pounds was in storage at the beginning of the year, and 7,000 pounds was in storage at the end of the year.*
- *50,000 pounds of the 25 percent toluene was purchased in 1987; 5,000 pounds was in storage at the beginning of the year, and none was in storage at the end of the year.*
- *25,000 pounds of the 98 percent toluene was purchased in 1987; none was in storage at either the beginning or the end of the year.*

The quantity of toluene used can be calculated as follows:

[(2,000 lb x 0.38) + (5,000 lb x 0.25)] (beginning inventory) +

[(100,000 lb x 0.38) + (50,000 lb x 0.25) + (25,000 lb x 0.98)] (purchased) –

(7,000 lb x 0.38) (ending inventory)

= 74,350 lb

Because this is in excess of the 10,000-pound reporting threshold for "otherwise used" chemicals, a Toxic Release Inventory

Reporting Form must be completed for toluene.

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, your reporting obligations are determined by the total amounts of all chemicals in the category. For example, if zinc oxide and zinc sulfate are used as pigments, the quantity of zinc compounds processed is the sum of the amounts of ZnO and $ZnSO_4$ present. For a substance such as cobalt chromite ($CoCr_2O_4$), the amount used must be considered in determining whether the threshold is met for both cobalt-containing and chromium-containing compounds.

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.

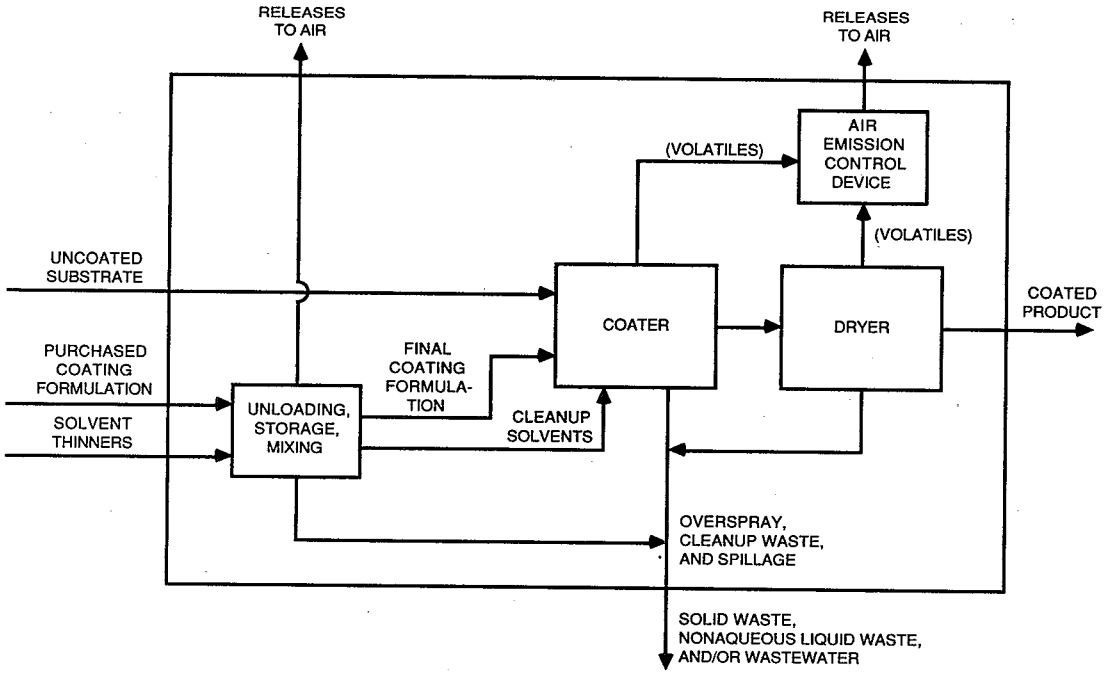
Step Three

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 for coating operations. 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.

The principal potential sources of chemical release in typical coating operations are:

- Releases of volatile organic compounds from the coating application and dryer areas



Example Flow Diagram of Roll Coating

- Excess coating mix and solvent from the cleanup of the coating applicator, coating lines, and empty coating drums
- Transfer from rail cars or tank trucks to storage tanks and subsequent transfer to processing tanks
- Breathing losses from vents on storage tanks
- Agitation of mixing tanks that are vented to the atmosphere
- Evaporation of solvent from the coated substrate after it leaves the coating lines
- Wastes from control equipment used to reduce air emissions from the coating applicator and dryer

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 EPA 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 balance techniques and engineering assumptions and calculations can be used in a variety of situations to estimate toxic releases. These methods of estimation rely heavily on process operating parameters; thus, the techniques developed are very site-specific. Emission factors are available for some industries in publications referenced in the general Section 313 guidance document. Also, emission factors for your particular facility can be developed in-house by performing detailed measurements of wastes at different production levels.

The mass balance technique for estimating emissions is well suited for coating operations because of the numerous environmental release points involved and the ease with which the ultimate fate of waste chemicals can be determined (that is, process solvents and volatile components of the coatings are released to air, whereas nonvolatile components of the coating that do not become part of the product are released as solid waste or wastewater from clean operations). Direct measurement of waste sources is applicable in any situation; however, such measurements are not routinely performed for many of the coating chemicals subject to reporting.

To estimate toxic chemical releases by mass balance, one must know the quantity of chemical purchased (adjusted for changes in inventory) and the quantity retained in the coated product. The difference in these two

quantities yields the amount of chemical released as waste. An engineering assumption is then used to determine the method of release (air emission, wastewater, solid waste). For coating operations, the following assumptions can be used:

- All volatile organic compounds present in the applied coating formulation, such as solvent coating carriers and unpolymerized resin precursors, can be assumed to be released as air emissions.
- The portion of nonvolatile compounds in the coating formulation that is not retained on the coated substrate can be assumed to be released during cleaning as solid waste (including nonaqueous liquid waste) or wastewater, depending on the cleanup method.
- All solvents used during cleanup of coating equipment can be assumed to end up as solid waste (nonaqueous liquid waste) and/or air emissions, depending on the cleanup method.

Toxic Releases to Air

The mass balance approach is easily applied to solvent carriers of coating solids because they are purposely volatilized during coating and drying. Therefore, the quantity purchased (adjusted for inventory changes) is the quantity released to air. If a control device is used, the quantity of the solvent released should be adjusted for removal efficiency. If solvent is recovered from the control device and reused (as a carrier) in the process, the total quantity of solvent released to the air will still be equal to the quantity of solvent purchased, adjusted for inventory change (because the solvent recovery is an internal reuse, and the benefit of the control device manifests itself in a reduction in the quantity of solvent purchased). If the recovered solvent is shipped offsite instead of being reused, the quantity of solvent released to air would equal the difference between the quantity used (quantity purchased adjusted for inventory change) and the quantity recovered. In this case, the quantity recovered would be reported as "transferred to offsite locations."

In some coating processes, a small amount of solvent may be retained in the product. Although this is usually a negligible amount, if a rough value of the quantity retained is known, it can be subtracted from the quantity released to air.

Unpolymerized resin precursors are usually present in small quantities in organic coating formulations. Typically, these compounds are highly volatile and will be released to air during drying. The entire quantity present in the purchased coating (adjusted for inventory changes) can be assumed to be emitted to air. Amounts of chemicals in purchased formulations in concentrations below the 1% *de minimis* level (0.1% for carcinogens), however, do not have to be considered in threshold calculations. Again, if a control device is used for the dryer and coating area exhaust, its efficiency should be factored into the estimated releases of these compounds.

Example: Estimating releases of volatile toxic compounds from a coating formulation.

A direct roll coater is used to apply an alkyd-urea-formaldehyde resin top coat on plywood paneling. Urea-formaldehyde resin makes up 45 percent of the coating solids, and according to the manufacturer, this urea-formaldehyde resin contains 1.5 percent free formaldehyde. The density of the coating solids is 10 pounds per gallon of solids. As purchased, the coating containing xylene has 8 pounds of solids per gallon of coating. Before it is applied, the coating is thinned with xylene at the coating facility to yield 4 pounds of solids per gallon of coating.

According to purchasing and inventory records, 10,000 gallons of the purchased coating formulation was processed during 1987. Assuming complete volatilization of

$$QSP = QSR + QSW$$

$$QSP = (d \times CT \times CA) + QSW$$

where QSP = total quantity of nonvolatile solids in coating processed

QSR = total quantity of nonvolatile solids retained in substrate

QSW = total quantity of nonvolatile solids wastes

d = density of solids

CT = coating thickness

CA = coated area

A relationship can be used to determine an overall coating transfer efficiency for an application/coating combination.

$$(QSR \div QSP) = te$$

$$QSP \times te = QSR$$

$$QSP \times (1 - te) = QSW$$

where te = overall transfer efficiency

For an individual toxic compound present as a nonvolatile solid, the overall transfer efficiency can be used to make a direct estimate of releases from the quantity of the chemical in the purchased coating (adjusted for inventory changes).

$$QCP \times (1 - te) = QCW$$

where QCP = quantity of nonvolatile solid chemical processed

QCW = quantity of nonvolatile solid chemical wasted

Example: Using a mass balance to estimate releases of nonvolatile toxic compounds from coating formulations.

A roll coater applies a water-based polyester resin paint to metal coil. The formulation contains titanium dioxide (TiO_2) and white lead ($PbCO_3$) for coloring. According to information provided by the manufacturer, the paint contains 14.5 pounds of nonvolatile solids per gallon of coating, and the density of the solids is 15.3 pounds per gallon. Also, the titanium dioxide and white lead represent 32 and 19 percent by weight of the nonvolatile solids. EPA has proposed to remove TiO_2 from the Section 313 list; however, this example is also representative of the use of a mass balance to estimate releases of other similar compounds.

Purchasing and inventory records indicate that 39,000 gallons of this formulation was processed during 1987. Production records indicate that 13,200,000 square feet of coil received a 3-mil coat of this formulation. The roll coater is cleaned with a water wash, and the resultant wastewater is discharged to the local sewers. The quantity of TiO_2 and Pb released via wastewater can be estimated by the following calculations:

Amount of nonvolatile solids processed =

39,000 gal coating x

10.5 lb solids/1 gal coating

= 409,500 lb

Volume of solids applied to coil =

13,200,000 ft^2 coil x

0.003 in. thickness ÷

12 in./1 ft x

7.48 gal/1 ft^3

= 24,684 gal

Amount of solids applied to coil =

24,684 gal solids x

15.3 lb solids/1 gal solids

= 377,665 lb

Coating solids transfer efficiency =

377,665 lb (applied) ÷

409,500 lb (processed)

= 0.933

Amount of TiO_2 processed =

409,500 lb (solids processed) x 0.32 (TiO_2 wt. percent)

= 131,040 lb

Amount of TiO_2 released =

131,040 lb processed x (1 – 0.933)

= 8,780 lb

Amount of $PbCO_3$ processed =

409,500 lb (solids processed) x 0.19 (Pb wt. percent)

= 77,805 lb

Amount of Pb released =

77,805 lb $PbCO_3$ processed x (1 – 0.933) x

1 mole $PbCO_3$/267 lb $PbCO_3$ x

207 lb Pb/1 mole $PbCO_3$

= 4,041 lb

Because the wash water leaves the facility through local sewers, 8,800 pounds of TiO_2 and 4,000 pounds of Pb would be reported as "discharged to POTW." If the roll coater was cleaned by a "dry" method and the cleanup wastes were drummed for shipment to a waste recovery or disposal facility, the same calculations would apply and the amounts would be reported as "transferred to an offsite location."

Toxic Releases Via Solid Waste

As mentioned in the preceding sections, solid and nonaqueous liquid wastes are generated in "dry" coating cleanup operations. These wastes contain cleanup solvents and nonvolatile coating solids that were not transferred to the substrate. The mass balance techniques demonstrated in the example concerning cleanup operations are also applicable to releases via solid and nonaqueous liquid wastes.

Toxic chemical releases via solid and nonaqueous liquid wastes may be measured directly by using data gathered for compliance with RCRA regulations. Many spent solvents are listed as hazardous waste under RCRA Waste Codes F002 through F005. These codes may apply to spent solvents used to clean up the coating applicator and surrounding area. Many spent cleanup solvents may also be considered hazardous under RCRA because of EP toxicity or ignition characteristics.

The RCRA manifesting procedure for hazardous waste shipped offsite requires documentation of quantities shipped. Treatment, storage, and disposal facilities must perform detailed chemical and physical analyses on the wastes. The waste also may be analyzed at your facility. Therefore, estimates of releases for several compounds can be made by direct measurement.

Other Toxic Releases

Coating operations produce other wastes from which toxic chemicals may be released. These include:

- **Residues from pollution control devices**
- **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.

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