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Title III Section 313 Release Reporting Guidance

Estimating Chemical Releases From Monofilament Fiber Manufacturing

Estimating Chemical Releases From Monofilament Fiber Manufacturing

Manufacturers of monofilament fibers 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 (monofilament fiber manufacturers generally fall under SIC codes 2823 and 2824) 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 monofilament fiber manufacturers 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 monofilament fiber manufacturing, 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 monofilament fiber manufacture 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.

Polymer constituents: Propylene, ethylene glycol, terephthalic acid, acrylonitrile, carbon disulfide, methyl acrylate, p-phenyldiamine, ethylene, vinyl chloride, vinyl acetate

Solvents/precipitants: Acetone, toluene, sodium hydroxide, sulfuric acid, methyl ethyl ketone, aqueous $ZnCl_2$

Flame retardants: Decabromodiphenyl oxide, vinyl bromide, hexachloropentadiene

Promoters/activators: Hydrazine, hydroquinone

Pigments: Titanium dioxide

Lubricants: Ammonium salts

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, a flame retardant applied to a fiber) 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 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: Calculating annual use of sulfuric acid through purchases and inventory changes.

During 1987, a plant purchased and used 20,000 pounds of sulfuric acid at 40 percent by weight. From inventory it used 10,000 pounds of sulfuric acid at 40 percent by weight. The site also used 4,000 pounds of a formulation containing 15 percent sulfuric acid by weight.

Amount of sulfuric acid used =

(20,000 lb sulfuric acid x 0.40) +

(10,000 lb sulfuric acid x 0.40) +

(4,000 lb sulfuric acid x 0.15)

= 12,600 lb

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.

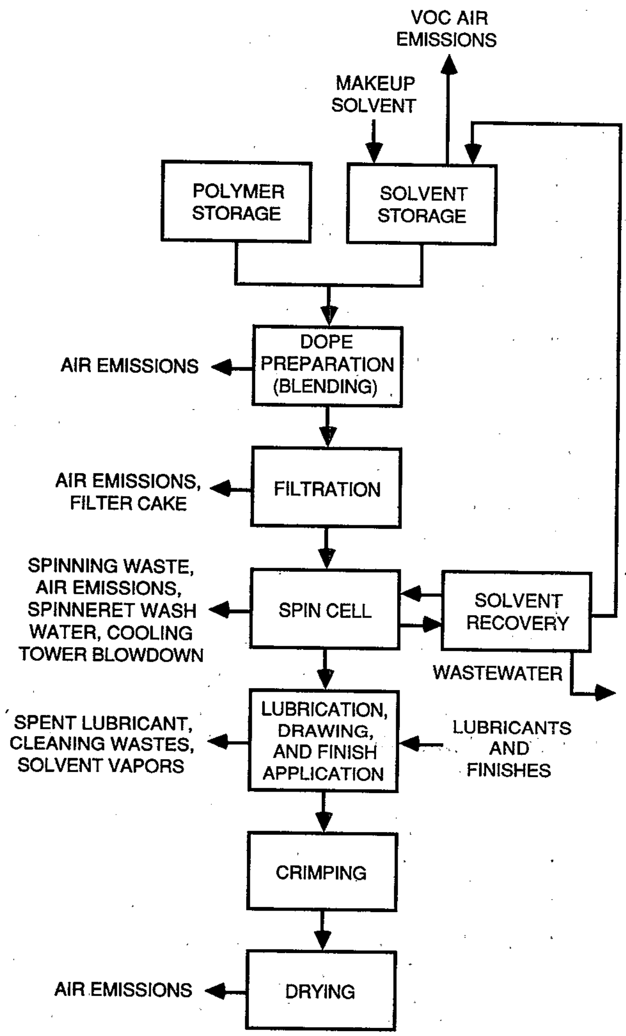
You must complete a report for each chemical for which a threshold is exceeded. The thresholds apply separately; therefore, if you both process and use a chemical and either threshold is exceeded, you must report for both activities. If neither threshold is exceeded, no report is needed.

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 on the right is a generalized flow diagram for monofilament fiber manufacturing. 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.

Air emissions of volatile chemicals will occur during fiber spinning and processing. Solvent recovery systems, vessel washings, and condensate may produce water releases. Potential sources of solid wastes include filter cakes, distillation fractions, spent catalysts, and vessel and tank residues. If a water treatment plant is located on site, releases also may occur from disposal of the sludge. Your reporting must account for all releases.



Example Flow Diagram of Monofilament Fiber Manufacturing

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.

Toxic Releases to Air

If you have not measured air emissions from your process, you can use one of the following approaches to estimate releases to air.

1) Volatile organic compounds

Releases of solvents and other volatile organic compounds used in your process will be primarily to air. Releases to air can be estimated as follows:

Amount of solvents released to air =

amount used –

amount accounted for by other wastes destroyed in treatment

In other words, rather than directly estimating air releases, you should estimate other releases first and then subtract them from the quantity known to be used.

Example: Estimating release of carbon disulfide used as a fiber constituent in fiber spinning.

Amount of carbon disulfide released to air =

100,000 lb used in 1987 –

10,000 lb accounted for in sludges incinerated on site –

1,000 lb discharged in wastewater –

5,000 lb in sludge shipped offsite –

50,000 lb accounted for in fiber product

= 34,000 lb

If you use acetone, dimethylformamide (DMF), or dimethylacetamide (DMAc) as the solvent in dry or wet spinning processes, you may be able to use the emission factors given in the table at the top of the following page.

Solvent Usage and Emission Factors for Several Types of Monofilament Fiber Manufacturing Processes

		Emission factors, kg/1000 kg of fiber produced			
Plant	Solvent	Makeup solvent	Solvent residual in fiber	Solvent losses to water	Emissions
Wet spin*	DMAc	70	5	25	40
Dry spin*	DMF	70	5	20	45
Dry spin	Acetone	155	5	10	140
Filter-tow dry spin	Acetone	130	Negligible	10	120
Filament yarn dry spin	Acetone	175	10	20	145

*These plants have a filament washing stage that extracts residual solvent and monomer from the fiber.

In the following example, these factors are used to calculate air releases.

Example: Using emission factors to estimate VOC releases

A plant produced 120,000 kilograms of modacrylic in 1987. Acetone was used as the solvent. Based on the VOC estimate for acetone from the preceding table,

Amount of acetone released to air =

120,000 kg fiber x

140 kg acetone/1,000 kg fiber x

2.2 lb/1 kg

= 36,960 lb

Using this approach, the plant in this example could report air emissions of 37,000 pounds of acetone.

2) Particulates

Two methods can be used to estimate the particulates released to air. The first entails the use of available emission factors for general monofilament, polypropylenes, or polyvinyl chloride manufacturing. The table shown at the bottom of this page presents selected air emission factors. In the following example, these factors are used to estimate the release of particulates to air during the manufacture of polypropylene.

Air Emission Factors for General Monofilament, Polyvinyl Chloride, and Polypropylene Manufacturing

	Particulate		Gases	
Type	lb/ton Pigment	kg/MT Pigment	lb/ton Product	kg/MT Product
General	5-10	2.5-5	–	–
Polyvinyl chloride	35	17.5	17	8.5
Polypropylene	3	1.5	0.7	0.35

Example: Using emission factors to estimate particulate emissions to air.

A plant produced 500,000 pounds of polypropylene in 1987. The pigment content of this fiber was 8 percent. Based on the emission factors provided in the preceding table, the particulate releases can be calculated as follows:

Amount of pigment released =

500,000 lb fiber x

0.08 lb pigment/1 lb fiber x

1 ton/2,000 lb x

3 lb particulate/1 ton pigment

= 60 lb

The second method entails back-calculating the particulate emissions from the weight of the particulate collected in the baghouse with design efficiencies provided by the baghouse manufacturer. If reported values are not available, an efficiency of 98 to 99 percent should be assumed.

Most of the particulate matter released to air will become airborne during the dope preparation or blending operation. Based on the weight percent of the chemical of interest that enters the blender, the amount of specific chemical released to air in the form of particulates can be estimated as follows:

Amount of chemical released to air =

amount of particulate released to air x

weight percent of chemical entering the blender

Example: Using baghouse efficiency to estimate particulate emissions to air.

A polyester textile fiber manufacturing plant collected 250,000 pounds of particulates in the baghouse filters from the blending operations in 1987. The baghouse manufacturer claims a 99.3 percent efficiency for these filters. If the weight percent of titanium dioxide (TiO_2) in the fiber is 8 percent, the amount of this chemical released to the air can be calculated as follows:

Amount of TiO_2 released =

250,000 lb particulate collected x

(0.007/0.993) x

0.08 lb TiO_2/1 lb particulate

= 140 lb

Toxic Releases Via Wastewater

The solvent recovery system, equipment cleaning effluent, condensate, and washing stage effluent are all potential sources for water release. If plant monitoring data for the water releases are available for the chemicals of interest, the water releases can be calculated directly.

Data on solvent emissions to water are available for some dry and wet spinning processes, as shown in the table of solvent usage and emission factors on page 5. The estimates in the table giving losses to water include losses from the solvent recovery system, any washing stage, and equipment cleaning. The following example shows the use of these factors to estimate water releases.

Example: Using emission factors to estimate water releases.

A plant produced 120,000 kilograms of modacrylic in 1987 by dry spinning. Acetone was used as the solvent. Emission factors can be used to calculate acetone losses as follows:

Amount of acetone released to water =

120,000 kg fiber x

10 kg acetone/1,000 kg fiber x

2.2 lb/1 kg

= 2,640 lb

Using this approach, the plant in this example could report water releases of 2,600 pounds of acetone.

If your facility uses a listed mineral acid or base but this acid or base is effectively neutralized in use or during wastewater treatment (to pH 6 to 9, as required by most effluent standards), no release quantities should be reported for these substances.

If wastewater treatment occurs on site, you should adjust the total losses to yield the release. If available, use plant operating data on removal efficiency for this purpose. Published data also may be used, if such data are available for the specific chemical treated by the method used at your plant (for example, biological wastewater treatment). The amount of chemical released to water after wastewater treatment can thus be calculated as:

Amount of chemical released to water =

amount lost in process water x

(1 – removal efficiency)

If no data are available, assume treatment does not remove the chemical.

Toxic Releases Via Solid Waste

The possible sources of nonaqueous waste to be landfilled or otherwise disposed of include filter cakes, distillation fractions, spent catalyst, vessel and tank residues, and drums. Assuming that the monomer weight percent in the dope is known, the loss in the filter cake will be:

Amount of monomer in filter cake =

amount of filter cake x

weight percent of monomer

When a wastewater treatment plant is located on site, some chemicals will also be transferred from the liquid to sludge and some will be chemically or biologically destroyed or neutralized. Loss to the sludge will be:

Amount of chemical in sludge =

amount lost from process –

amount lost in water

Alternatively, you may have data on the concentration of chemicals in the sludge.

For organic chemicals in general, some degradation may occur during treatment so that all of the chemical is not transferred to the sludge. The amount of organic compounds in the sludge may be estimated by using measured data or by subtracting the amount biodegraded from the total amount removed in treatment. Removal may be determined from operating data, and the extent of biodegradation may be obtained from published studies. If the biodegradability of the chemical cannot be measured or is not known, you should assume that all removal is due to adsorption of sludge.

Other Toxic Releases

Monofilament fiber manufacturing produces other wastes from which toxic chemicals may be released. These 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, Title III Section 313 Release Reporting Requirements (EPA 560/4-87-001) 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.

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