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TOXICS RELEASE INVENTORY
Reporting Guidance for Food Manufacturers

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 source reduction (pollution prevention) activities and quantities recycled or treated for such chemicals, pursuant to Section 6607 of the Pollution Prevention Act (PPA), 42 U.S.C. 13106. EPCRA Section 313 established the Toxics Release Inventory (TRI) and the original EPCRA Section 313 list of chemicals. Hereafter, the list of EPCRA Section 313 chemicals will be referred to as the TRI chemical list.

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DISCLAIMER

This guidance document is intended to supplement the Toxics Release Inventory (TRI) Reporting Forms and Instructions (https://www.epa.gov/tri/rfi) and assist facilities in the food manufacturing sector with their statutory reporting requirements described under Section 313 of the Emergency Planning and Community-Right-to-Know Act (EPCRA) (42 U.S.C. 11023) and Section 6607 of the Pollution Prevention Act (PPA) (42 U.S.C. 13106). The recommendations provided in this guidance do not supersede or modify any statutory or regulatory requirements, are subject to change, and are not independently binding on either the EPA or covered facilities. Additionally, if a conflict appears to exist between the recommendations in this document and the statutory or regulatory requirements, the facility should proceed according to the statute or regulation.

Although EPA encourages facilities in the food manufacturing industry sector to consider these recommendations and other guidance put forth in this document as an aid for regulatory compliance, facilities should be aware that the recommendations and guidance were developed to address common circumstances at typical food manufacturing facilities. The circumstances at a specific food manufacturing facility may significantly differ from those contemplated in the development of this document. Moreover, as technology often changes, the day-to-day operations at many facilities will change accordingly. Recommendations and guidance mentioned in this document may have been written prior to development of technological advances used by the food manufacturing industry sector and, therefore, are not described in this document. Thus, individual facilities may find that the recommendations provided in this document are inapplicable to some or even all of their processes or circumstances, and that alternative approaches or information are more accurate and/or more appropriate for complying with the statutory requirements of EPCRA Section 313 and PPA Section 6607, and related EPA regulations. In such instances, facility-specific information and process knowledge should be used, where available, to comply with the regulatory requirements. EPCRA Section 313 also provides that, in the absence of such readily available data, a reporting facility may make reasonable estimates to meet the reporting requirements.[1]

Facilities are encouraged to contact the Agency with any additional or clarifying questions about the recommendations or other guidance in this document. Similarly, facilities are encouraged to provide updated information if they believe that EPA has incorrectly characterized a particular process or recommendation as well as to suggest revisions that they believe would increase the usefulness of this document.

Additional guidance documents, including other industry specific and chemical specific guidance documents, are also available on TRI's GuideME website: https://guideme.epa.gov/ords/guideme_ext/f?p=guideme:gd-list.

For general information on TRI reporting, please visit https://www.epa.gov/toxics-release-inventory-tri-program/reporting-tri-facilities.

Special thanks to staff from EPA's Safer Choice Program Branch as well as EPA Region 3 for their review and comments.

[1] EPCRA allows for the use of readily available data (including monitoring data) collected pursuant to other provisions of law, or, where such data are not readily available, reasonable estimates of the amounts involved. 42 USC 11023(g)(2).

SECTION 1.0 INTRODUCTION

This document contains guidance information and recommendations specific to Toxics Release Inventory (TRI)[2] reporting for facilities in the food manufacturing sector. EPA recognizes that not all food manufacturing facilities use every type of unit operation or process described in this document. However, each of the unit operations and processes discussed are used by many food manufacturing facilities subject to the EPCRA Section 313 and PPA Section 6607 reporting requirements. You should consult guidance for the operation, or combination of operations, that most closely fits the activities at your facility.

This document includes examples of activities that food manufacturers may conduct, illustrating how these activities should be considered for EPCRA Section 313 reporting purposes. This document also notes areas where potential errors in reporting might be encountered generally by food manufacturing facilities, which are based on information from written comments received from industry representatives, as well as from comments made by participants in EPA-sponsored EPCRA workshops.

This document supersedes the 1998 document entitled *Emergency Planning and Community Right-To-Know Act Section 313 Reporting Guidance for Food Processors (EPA 745-R-98-011: September 1998).* Changes reflected in this updated document include:

- Removed Overview section.
- Streamlined each section by referring the reader to the current version of the TRI Reporting Forms and Instructions for background information on the TRI Program, reporting requirements, and release estimations. This did not include information or examples unique to the food manufacturing industry (compared to other TRI sectors).
- Added references to other TRI reporting guidance documents (e.g., TRI Guidance for Reporting Aqueous Ammonia; TRI Guidance for Reporting and List of Toxic Chemicals within the Water Dissociable Nitrate Compounds Category) as appropriate throughout the document, replacing those chemical-specific descriptions found in other TRI guidance documents. This did not include information or examples unique to the food manufacturing industry (compared to other TRI sectors).
- Added information on the manufacture and releases of water dissociable nitrate compounds from wastewater treatment.
- Changed the previous facility process/operation categories by (1) dropping "Byproducts" as a category (since the manufacture of byproducts is not considered a food processing step or operation) and moving the byproduct manufacturing descriptions into other sections as appropriate (e.g., water treatment), and (2) adding "On-site Energy" to include those byproducts produced by fuel combustion on-site.
- Edited language throughout the document to reflect regulatory updates since 1998, including: updating the Standard Industrial Classification (SIC) codes to North American Industry Classification System (NAICS) codes; deleting mentions of chemicals delisted from the TRI list of chemicals (e.g., phosphoric acid); adding current electronic reporting requirements; and providing additional chemical activity subcategories on the Form R.
- Added Section 4, Reporting Pollution Prevention Activities.

[2] In this document, Toxics Release Inventory reporting refers to the information required to be disclosed under Section 313 of the Emergency Planning and Community Right-to Know Act (EPCRA), Section 6607 of the Pollution Prevention Act (PPA), and Section 7321 of the National Defense Authorization Act for Fiscal Year 2020.

For general instruction regarding compliance with TRI reporting requirements and form completion, please see the most recent version of the Toxic Chemical Release Inventory Reporting Forms and Instructions, available at: www.epa.gov/tri/rfi.

SECTION 2.0 REPORTING REQUIREMENTS AND THRESHOLD DETERMINATIONS

Section 2.1 NAICS Code Determination

Facilities engaged in the food manufacturing sector are typically classified under North American Industry Classification System (NAICS) Code 311, the Food Manufacturing sector. NAICS Code 311 consists of nine subsectors:

- Animal Food Manufacturing
- Grain and Oilseed Milling
- Sugar and Confectionery Product Manufacturing
- Fruit and Vegetable Preserving and Manufacturing
- Dairy Product Manufacturing
- Animal Slaughtering and Processing (Meats)
- Seafood Product Preparation and Packaging
- Bakeries and Tortilla Manufacturing
- Other Food Manufacturing

You should determine the NAICS Code(s) for your facility based on the activities conducted on site. For assistance in determining which NAICS Code(s) best represent(s) the activities performed at your facility, refer to the U.S. Census Bureau's website at https://www.census.gov/naics/. To determine if the NAICS Code for your facility is covered by TRI, see the most recent version of the TRI Reporting Forms and Instructions. Note that a facility may be covered by more than one NAICS code.

Section 2.2 TRI Chemicals in Food Manufacturing and Processing Operations

While every chemical and chemical category on the TRI chemical list must be considered, certain chemicals are more likely than others to be encountered at facilities that manufacture or process foods. As a guide, please refer to Table 2-1 for a list of TRI chemicals and chemical categories commonly encountered in food manufacturing and processing facilities based on reports submitted to TRI as of reporting year 2021 and relevant literature sources. Figure 2-1 provides examples of how certain activities occurring at facilities that manufacture or process foods may lead to waste management activities reportable to TRI.

Note that this table and figure are merely starting points for identifying chemicals for threshold determinations and may not be inclusive of all TRI chemicals and chemical categories at a specific food manufacturing facility.

Table 2-1: Examples of TRI Chemicals Reported by Food Manufacturing Facilities, Listed by Function

Function	Chemicals[1]
Water Treatment	Chlorine[2], chloroform[3], chlorine dioxide[2]
Refrigerant Uses	Ammonia[4], ethylene glycol[2,5], HCFC-22[33]
Food Ingredients	Various color additives (e.g., straight colors, lakes, mixtures[32]), various metals and metal compounds (e.g., zinc compounds[2], copper[6], copper compounds[6], manganese[2], manganese compounds[2], selenium[2])
Reactants	Ammonia[2], benzoyl peroxide[2,7], chlorine[7], chlorine dioxide[7], ethylene oxide[2,7], propylene oxide[2]
Catalysts	Nickel and nickel compounds[2]
Extraction/Carrier Solvents	*n*-Butyl alcohol[2], dichloromethane[7], *n*-hexane[7], cyclohexane[2], *tert*-butyl alcohol[7]
Cleaning/Disinfectant Uses	Chlorine[2,8], chlorine dioxide[2,8], formaldehyde[9], nitric acid[10], peracetic acid[2], 1,1,1-trichloroethane[11]
Fumigants	Ethylene oxide[2], propylene oxide[2], bromine[13], phosphine[13], sulfuryl fluoride[13]
Pesticides/Herbicides	Various pesticides and herbicides (e.g., ametryn[14], aldrin[15], captan[16], 2,4-D[17], lindane[18], maneb[19], pendimethalin[20], parathion[19], zineb[21], malathion[19], atrazine[22], diazinon bromine[23], and naphthalene[24])
Can Making/Coating	Various ink and coating solvents (e.g., certain glycol ethers[28], toluene[28], methyl isobutyl ketone[28], xylene[28]), various metals (e.g., manganese[31], nickel[29], chromium[30]) and metal compounds (e.g., many pigments contain copper[6], barium, chromium[30], zinc[30], or lead[6])
Wastewater Treatment	Ammonia[12], hydrochloric acid aerosols[7], sulfuric acid aerosols[2], chlorine[34,35], nitrates[35]
On-site Energy	Metal compounds (e.g., mercury compounds[25], lead compounds[26]), dioxin and dioxin-like compounds[19], hydrogen fluoride[27], acid aerosols (sulfuric acid[2] and hydrochloric acid[2])

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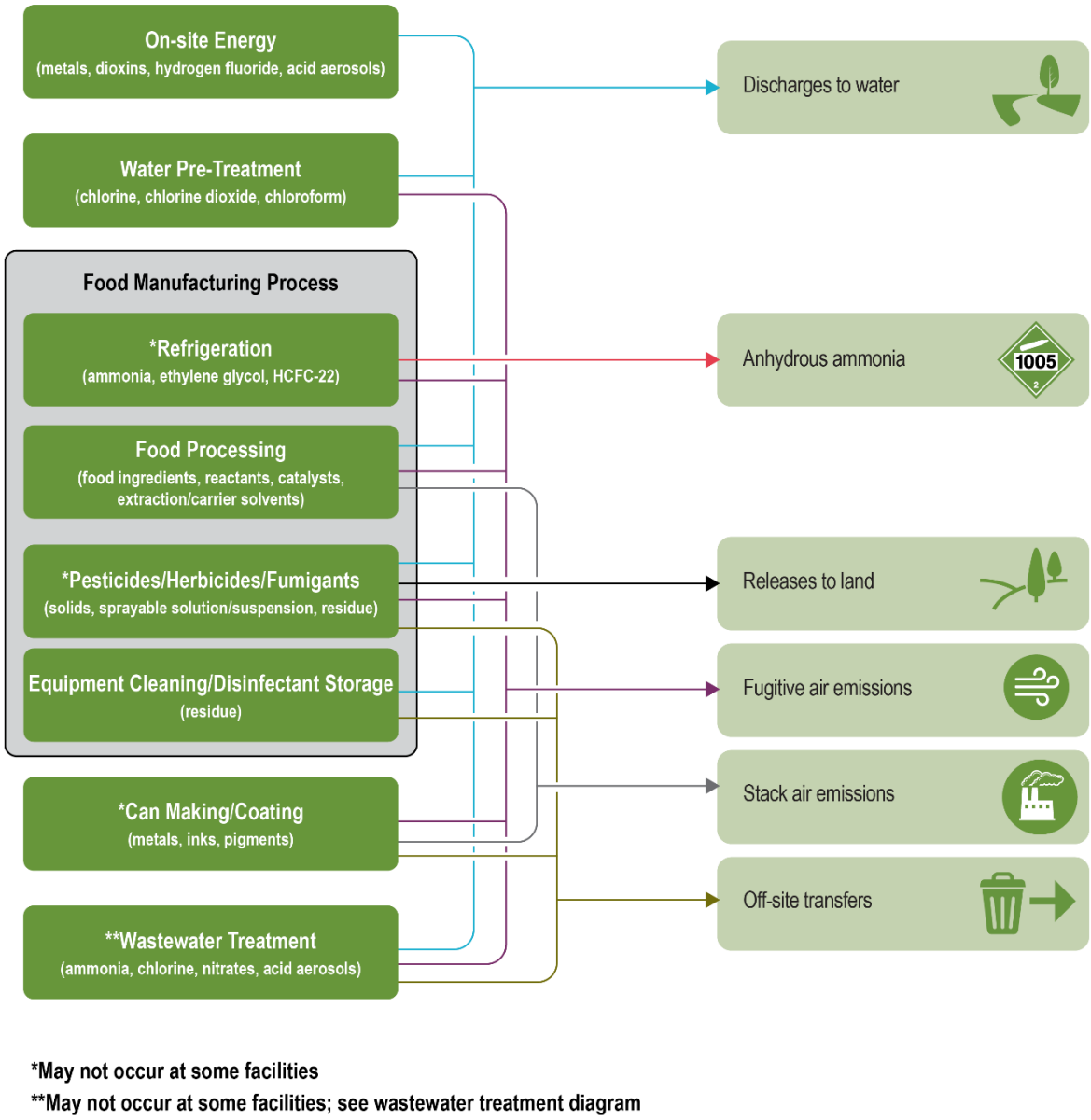

Figure 2-1: Process Flow Diagram – Food Manufacturing

More information on the TRI chemical list, including applicable qualifiers, are provided at 40 CFR 372.65 and can be found in the current TRI Chemical List; applicable qualifiers can also be found in the TRI Reporting Forms and Instructions.

Each of the three TRI activity categories (i.e., manufacture, process, or otherwise use) is divided into subcategories. As required by 40 CFR 372.85(b)(12) and as discussed in the TRI Reporting Forms and Instructions (Part II, Section 3), you are required on the Form R to designate each category and subcategory that applies to your facility. Detailed definitions, including descriptions of subcategories for each activity and examples of TRI chemicals and chemical categories potentially reported for each subcategory, are presented in Table 2-2, Table 2-3, and Table 2-4. The examples of TRI chemical reports received for each subcategory are as of Reporting Year 2021.

Table 2-2: Definitions and Examples of Manufactured Chemicals

Manufacturing Activity Subcategory	Definition	Examples in the Food Manufacturing Industry
Produced or imported for on-site use/processing	A chemical that is produced or imported and then further processed or otherwise used at the same facility.	Chlorine dioxide produced on-site for water treatment.
Produced or imported for sale/distribution	A chemical that is produced or imported specifically for sale or distribution outside the manufacturing facility.	Metal compounds for sale/distribution as nutrition supplements (e.g., zinc compounds, manganese compounds).
Produced as a byproduct	A chemical that is produced coincidentally during the manufacture, processing, or otherwise use of another chemical substance or a mixture and is separated from that substance or mixture. TRI-listed chemicals produced as a result of waste treatment or disposal are also considered byproducts.	Ammonia and nitrate compounds produced in a wastewater treatment system. Chloroform manufactured during water treatment processes. Combustion of fuel for production processes may result in byproducts including formaldehyde, hydrogen fluoride, sulfuric acid aerosols, and dioxins and dioxin-like compounds.
Produced as an impurity	A chemical that is produced coincidentally as a result of the manufacture, processing, or otherwise use of another chemical but is not separated and remains in the mixture or other trade name product with that other chemical.	Trace amounts of manufactured chemicals that remain with the commercial product (e.g., nitrate compounds or acetaldehyde)

Note: More complete discussions of the industry-specific examples can be found in Section 3.0 of this guidance document.

Table 2-3: Definitions and Examples of Processed Chemicals

Processing Activity Subcategory	Definition	Examples in the Food Manufacturing Industry
Reactant	A natural or synthetic chemical used in chemical reactions for the manufacture of another chemical substance or product. Examples include feedstocks, raw materials, intermediates, and initiators.	Ammonia used as a starter component in the batch process manufacture of cheese. Propylene oxide reacted with corn starch to produce hydroxyalkyl starches.
Formulation component[2]	A chemical that is added to a product or product mixture prior to further distribution of the product and acts as a performance enhancer during use of the product. Examples include additives[3], dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers.	Zinc compounds added to dog food. Food dyes (e.g., straight colors, lakes, mixtures) used as an ingredient.
Article component	A chemical that becomes an integral component of an article distributed for industrial, trade, or consumer use.	Pigments contained in inks and coatings that are applied to cans on-site (e.g., chromium-based pigments). Unless specifically listed separately, a chromium-based pigment is included on the TRI list in the chromium compounds category.
Repackaging only	A chemical that is processed or prepared for distribution in commerce in a different form, state, or quantity. May include, but is not limited to, the transfer of material from a bulk container, such as a tank truck, to smaller containers such as cans or bottles.	Metal compounds (e.g., manganese compounds, zinc compounds).
Processed as an impurity	A chemical that is included on the TRI chemical list individually or as a member of a chemical category that is processed but is not separated from and remains in the mixture or other trade name product with those chemicals.	Ammonia, lead compounds, nitrate compounds.
Recycling	A chemical that is included on the TRI chemical list individually or as a member of a chemical category that is prepared for commercial distribution in a different form, state, or quantity for recycling[1].	Cobalt compounds, copper compounds, manganese compounds, zinc compounds.

Note: More complete discussions of the industry-specific examples can be found in Section 3.0 of this guidance document.

[1]For TRI reporting purposes, "recycling" is (1) the recovery for reuse of a toxic chemical from a gaseous, aerosol, aqueous, liquid, or solid stream; or (2) the reuse, or the recovery for reuse of a toxic chemical that is a RCRA hazardous waste or is a constituent of a RCRA hazardous waste as defined in 40 CFR 261. See the Interpretations of Waste Management Activities guidance for more information on this topic.

[2]The United States Food and Drug Administration (FDA) definition of "component," set forth at 21 CFR 314.3, is "any ingredient intended for use in the manufacture of a drug product, including those that may not appear in such drug product."

[3]A food additive is defined by section 201(s) of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. § 321(s), in part as "…any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food…." Some - but not all - ingredients are food additives. FDA specifies which ingredients are included in the definition of a food additive (**Understanding How the FDA Regulates Food Additives and GRAS Ingredients**).

Table 2-4: Definitions and Examples of Otherwise Used Chemicals

Otherwise Use Activity Subcategory	Definition	Examples in the Food Manufacturing Industry
Chemical processing aid	A chemical that is added to a reaction mixture to aid in the manufacture or synthesis of another chemical substance but is not intended to remain in or become part of the product or product mixture. Examples include process solvents, catalysts, inhibitors, initiators, reaction terminators, and solution buffers.	Nickel catalyst used in the hydrogenation of vegetable oil. *n*-Butyl alcohol used as a carrier solvent for spices. Chlorine used as a bleaching agent for flour. Chlorine used for water treatment. Solvents contained in inks and coatings that are applied on-site.
Manufacturing aid	A chemical that aids the manufacturing process but does not become part of the resulting product and is not added to the reaction mixture during the manufacture or synthesis of another chemical substance. Examples include process lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids.	Ammonia used as a refrigerant.
Ancillary or other use	A chemical that is used for purposes other than aiding chemical processing or manufacturing. Examples include cleaners, degreasers, lubricants, fuels (including waste fuels), and chemicals used for treating wastes.	Nitric acid used to clean process equipment. Fumigants used to treat grain products. Ethylene oxide used as a bactericide during processing of spices.

Note: More complete discussions of the industry-specific examples can be found in Section 3.0 of this guidance document.

SECTION 3.0 ESTIMATING RELEASES AND OTHER WASTE MANAGEMENT QUANTITIES

Section 3.1 Purpose

This section is intended to guide the user in developing a systematic approach for estimating quantities of TRI chemicals released from or otherwise managed as waste at food manufacturing facilities.

This section also includes common TRI reporting and compliance issues as they apply to the food manufacturing industry, and an overview of general production practices and the corresponding estimation of releases and other waste management quantities (Section 3.2).

Section 3.2 Determination of Release and Other Waste Management Quantities from Activities in Food Manufacturing Facilities

While there is significant variety among food manufacturing facilities in terms of products manufactured and chemical activities, EPA has identified 12 common chemical use activities that take place at food manufacturing facilities and that are relevant to TRI reporting. These chemical use activities or functions are listed in Table 2-1.

This section further describes the 12 chemical use activities described above in Table 2-1. Each subsection lists the commonly used TRI chemicals, gives an overview of the process involved, identifies the appropriate chemical activities and reporting thresholds, describes methods for estimating the quantities of chemicals released during the activities and/or otherwise managed as waste thereafter, and discusses common reporting errors.

To determine the quantities of TRI chemicals that are released or otherwise managed as waste, some facilities may find it helpful to prepare a process flow diagram. Not all food manufacturing facilities conduct each operation, and facilities may vary in the sequence of operations. You should consider analyzing the process flow in your facility and preparing a site-specific process flow diagram showing the individual operations present in your facility.

3.2.1 Water Treatment

Commonly Reported TRI Chemicals. Chlorine, chlorine dioxide, chloroform.

Process Description. Chlorine is used to disinfect process water at food manufacturing facilities. It is received as a compressed gas and added to process water as a disinfectant. The treated water uses include:

- Component of a food product;
- Wash or convey food products;
- Control odor in fish meal processing; and
- Cleaning purposes.

At a few plants, during water treatment, chlorine dioxide (a TRI chemical) is manufactured by reacting sodium chlorite, chlorine gas (a TRI chemical), and water. During this water treatment process other chemicals (e.g., chloroform, a TRI chemical) may be manufactured as byproducts.

Estimating Release and Other Waste Management Quantities. The TRI chemicals expected to be released in the above scenario are chlorine, chlorine dioxide, and chloroform. Since these chemicals are volatile, the releases are, for the most part, expected to be in the form of fugitive emissions to air, although some releases could also occur in the form of water discharges. These releases occur from sources such as leaks in valves and fittings and losses during cylinder changeovers. For the quantities of

chlorine typically used for water treatment purposes, engineering judgment can be used to estimate fugitive emissions (e.g., based on the volume of the connecting hose and the number of changeovers). If significant quantities of chlorine are handled, these fugitive emissions can be estimated using the Synthetic Organic Chemicals Manufacturing Industry (SOCMI) factors presented in *Protocol for Equipment Leak Emission Estimates* (EPA 453/R-95-017, November 1995).

While discharges of chlorine and chlorine dioxide to water are possible from the treatment scenario described above, releases of either of these chemicals to water would not be expected under the typical circumstance where the pH is above 4. Chlorine reacts very quickly with water to form hypochlorous acid (HOCl, a non-TRI chemical) and hydrochloric acid (as H^+ and Cl^-). Although this is an equilibrium reaction, at a pH above 4 the equilibrium shifts almost completely toward formation of these products. Therefore, if the pH is kept above 4, it is reasonable to assume that chlorine would not be released to water. Hydrochloric acid is a TRI chemical but is only reportable when in the form of an aerosol, fume, or mist. Releases of chlorine dioxide to water are also unlikely based on the chemical's strong oxidizing potential, its ability to react quickly with proteinaceous material and the constant supply of proteinaceous organic matter in waste streams in this scenario.

3.2.2 Refrigerant Uses

Commonly Reported TRI Chemicals. Ammonia, ethylene glycol.

Process Description. Ammonia and (to a much lesser extent) ethylene glycol are used as heat exchange media in refrigeration processes. These chemicals are continuously reused in closed-loop units. The ammonia is handled as a gas, while the ethylene glycol is handled as a liquid. Both chemicals must be added to refrigeration systems to replace amounts lost through leaks or when purging a section of the system for maintenance.

Chlorodifluoromethane, or HCFC-22, is still reported by a small number of facilities in the food manufacturing sector. HCFC-22 has historically been used as a refrigerant in several applications such as unitary air conditioners, cold storage, retail food refrigeration equipment, chillers, and industrial process refrigeration. HCFC-22 is an ozone-depleting substance (ODS). As a Party to the Montreal Protocol, the United States must incrementally decrease HCFC consumption and production, culminating in a complete HCFC phaseout in 2030. Section 605 of the Clean Air Act establishes the U.S. phaseout targets for Class II substances. As of 2020, no production or import of HCFC-22 is allowed. However, existing equipment containing HCFC-22 may still be serviced. Certain exemptions to the ODS phaseout under the Montreal Protocol exist, including for recycled and reclaimed ODS. For additional information on HCFC-22, refer to the following: Phaseout of Class II Ozone-Depleting Substances, Exemptions to the Phaseout, Equipment Manufacturers, Importers, and Exporters: Frequent Questions.

Estimating Release and Other Waste Management Quantities. In its anhydrous form, ammonia is a volatile chemical and will be released to air through system filling operations, relief vents, and leaks from valves and fittings. All the anhydrous ammonia lost through these means should be reported as fugitive releases to air. If a system is vented to the air during system maintenance, this amount should also be reported as a fugitive release to air. The lines may be bled directly into water during system maintenance. In this situation, the anhydrous ammonia transferred to water should be estimated and reported as transfers to a publicly owned treatment works (POTW) or directly discharged to water. For additional information on threshold determinations and release calculations of different forms of ammonia for TRI reporting purposes, refer to the *Toxics Release Inventory Guidance for Reporting Aqueous Ammonia* (EPA-745-B-19-002).

Ethylene glycol is used in heat exchange applications and released as a result of other leaks in the system piping or drainage of the system for maintenance purposes. Releases and waste management types will be limited to wastewater and non-aqueous liquid waste streams.

Releases and other waste management activities in refrigeration applications are best estimated by mass balance. Total release and other waste management amounts are equivalent to the amounts of the chemicals that have been added to the system to replace losses. Ammonia is usually released to air, whereas ethylene glycol, a water-soluble substance that is liquid in its neat form, will usually be released to water. When ammonia is bled to water, an aqueous solution is formed that contains both ammonia (NH_3) and ammonium ion (NH_4^+). Estimates of the quantities of ammonia can be made from calculations using mass balance equations and are sufficient for reporting requirements if monitoring data are not available. The amount of ammonia released to air can then be estimated as the difference between total usage and the amount bled to water.

COMMON ERROR – Threshold Determination

A common error in refrigerant uses is basing the threshold determination on the total amount of the chemicals in the system. The throughput quantity to be used for a threshold determination is only the amount of the quantities of chemical(s) added to the system during the year (i.e., to charge a new system or to replace amounts of a chemical or chemicals lost through leaks and maintenance activities on an existing system). Thus, though a refrigeration system may contain more than 10,000 pounds of ammonia, a TRI report is not required unless more than 10,000 pounds of "new" ammonia are added to the system during the year. The quantities of the chemicals added during the year can best be determined from purchase and inventory records.

3.2.3 Food Ingredients

Commonly Reported TRI Chemicals. Various food dyes (e.g., straight colors, lakes, mixtures), and various metals and metal compounds (e.g., zinc compounds, copper, copper compounds, manganese, manganese compounds, selenium).

Process Description. Various TRI chemicals are present in food ingredients and become part of the final food product. Several metals and chemicals within certain metal compound categories on the TRI chemical list are used as formulation components in prepared feeds. Certain zinc compounds, for example, are added to dog food. Several food dyes are also on the TRI chemical list. Food ingredients, and any TRI chemicals contained therein, are handled as solids or liquids and may undergo various types of physical processing such as blending.

Estimating Release and Other Waste Management Quantities. Most TRI chemicals used as food ingredients, food formulation components, or food additives are not volatile. Since they become part of the final product, only small quantities are expected to be released or would otherwise need to be managed as waste from their processing. Engineering judgment can generally be used to estimate releases to air or water from handling or mixing operations. The largest source of release may be equipment cleanup (e.g., tank cleaning, clean-in-place systems). For storage tank losses (including loading and unloading) of chemicals handled as liquids, estimates of air emissions can be made using methods described in *Compilation of Air Pollutant Emissions Factors, AP-42*. Storage tank losses are considered point air emissions for TRI reporting (i.e., Part II, Section 5.2 of the Form R). Portions of spills of liquids could be reported as fugitive air emissions, discharges to wastewater, or off-site transfers depending upon the volatility of the chemical and the ultimate disposal of the material.

COMMON ERRORS – Reporting

One potential reporting error in food ingredient applications is incorrectly submitting a Form R for saccharin. Under TRI regulations, only persons who manufacture saccharin are subject to TRI reporting for saccharin; a Form R or Form A is only required for saccharin if the facility manufactures the chemical on-site. Processing of saccharin as a food ingredient is not subject to TRI reporting.

A second potential error is failure to estimate releases and/or other waste management activities of food ingredient chemicals that occur during storage, transfer, and mixing operations. Total usage of the chemicals can be determined from purchasing records. Engineering judgment can be used to estimate the minor releases and/or subsequent waste management activities that may occur during these operations.

3.2.4 Reactants

Commonly Reported TRI Chemicals. Ammonia, benzoyl peroxide, chlorine, chlorine dioxide, ethylene oxide, propylene oxide.

Process Description. Various chemicals may be processed as reactants in the food industry. These chemicals are raw materials, feedstocks or starting materials for chemical reactions in the manufacturing of food products. For example, ethylene oxide is processed as a reactant with starch to improve the viscosity of the starch and, therewith, the food product. Chlorine, chlorine dioxide, and benzoyl peroxide may be used as bleaching agents for flour. Ammonia is used as a starter component in the batch process manufacture of cheese. To modify the viscosity of starches, propylene oxide is reacted with cornstarch to produce hydroxyalkyl starches (e.g., see Kirk-Othmer Encyclopedia of Chemical Technology: Starch, Treatment, and Modification; Carbohydrates; and Polysaccharides). These chemicals may be handled as gases under pressure, liquids, or aqueous solutions.

Estimating Release and Other Waste Management Quantities. Most of the throughput of these chemicals are expected to be consumed during the reaction. For TRI chemicals such as ethylene oxide, ammonia, and chlorine, relatively small quantities are expected to remain unreacted and released. For these and other TRI chemicals that are highly reactive or volatile, releases will occur from leaks in valves and fittings, and from losses during cylinder changeovers. If significant quantities of these chemicals are handled, these fugitive releases can be estimated using the Synthetic Organic Chemicals Manufacturing Industry (SOCMI) factors presented in *Protocol for Equipment Leak Emission Estimates* (EPA 453/R-95-017, November 1995). If only small quantities are handled, engineering judgment should be used to estimate fugitive releases (e.g., based on the volume of the connecting hose and the number of changeovers).

Estimates of releases to air from storage tank losses should be made as discussed in Section 3.2.3 (including loading and unloading of chemicals handled as liquids).

Spills or leaks are a common cause of releases of aqueous ammonia.

COMMON ERROR – Reporting

A common reporting error associated with use as a reactant is failure to account for minor fugitive air emissions during storage and transfer of volatile chemicals such as ethylene oxide, chlorine, or ammonia before their use as reactants.

3.2.5 Catalysts

Commonly Reported TRI Chemicals. Nickel and nickel compounds.

Process Description. Some TRI chemicals that are metals or metal compounds may be used as catalysts to help facilitate a desired reaction in food processing operations. For example, a nickel catalyst may be used to aid in the hydrogenation of vegetable oil. Such chemicals are not consumed in the reaction and do not become part of the product. The metal catalyst may be recycled or eventually become spent or contaminated and require disposal.

Estimating Release and Other Waste Management Quantities. Catalysts are typically not volatile and do not become part of the final product. Therefore, it is reasonable to assume the total amount of catalyst chemical added to the system during the year is, in theory, equal to the quantities released, such as in wastewater or as solid waste, with a small fraction being lost through handling and processing. Typically, the bulk of the spent catalyst is shipped off-site for regeneration (i.e., recycling). Releases or other waste management activity via wastewater would likely only occur from plant washdowns and should be minor.

3.2.6 Extraction/Carrier Solvents

Commonly Reported TRI Chemicals. *n*-butyl alcohol, dichloromethane, *n*-hexane, cyclohexane, *tert*-butyl alcohol.

Process Description. Certain TRI chemicals may be used as extraction or carrier solvents in the food manufacturing industry. For example, *n*-butyl alcohol may be used as a carrier solvent for spices. Dichloromethane may be used as an extraction solvent for hops and flavorings and to remove caffeine from coffee. *n*-Hexane is commonly used to extract the oil from soybeans. Both cyclohexane and *tert*-butyl alcohol may be used as an extraction solvent in the manufacture of food packaging materials.

Extraction and carrier solvents are normally handled as liquids and do not become part of the final food product.

Estimating Release and Other Waste Management Quantities. Releases of solvent chemicals that occur from their use or from other waste management activities may occur to air, land, or water, depending on the physical state of the chemical and the process in which it is used. Release and waste management amounts are often best estimated by a mass balance. It is often possible to use a mass balance in conjunction with monitoring data to estimate the release or other waste managed amount to one medium.

If volatile solvents such as dichloromethane are used, the quantity released to the air is approximately equal to the total quantity used for solvent purposes minus any amounts that are captured (such as by carbon absorbers) or destroyed (such as by thermal oxidizers). Mass balance calculations may be the best method for estimating these releases. If no control devices (e.g., carbon absorbers, thermal oxidizers) are employed, the entire quantity of TRI solvent chemical released should be assumed as released to air, as fugitive or point emissions, unless it is known that releases also occurred to water or land. If destructive controls are used (e.g., thermal oxidizers), the amount of solvent destroyed can be determined using engineering assumptions of the solvent quantity reaching the control device and its destruction efficiency. If nondestructive controls are used (e.g., absorbers), the amount of the captured solvent in wastes sent off-site for recycling, treatment, or disposal can be determined through analysis of these wastes. The quantity released to air is the difference between total usage and the amount captured and/or destroyed.

In aqueous extraction processes, the TRI chemical may be transferred to water. If this medium is the only one to which it is transferred, a mass balance may be the best method for estimating the quantity discharged or otherwise managed. Waste solvents are often shipped off-site for: disposal, combustion for energy recovery, treatment, or recycling. If releases and/or waste management activities involve several media, wastewater monitoring data or permit requirements along with waste manifests from off-site transfers can be used to estimate the release and other waste management quantities.

COMMON ERRORS – Reporting

A common reporting error for extraction or carrier solvents is failure to account for all the chemical usage through release and/or other waste management. Typically, none of the solvent should be assumed to remain with the food product. The total quantity of the solvent used should be accounted for through air emissions, amount captured or destroyed in control devices, and amounts sent off-site. The total usage is best determined from purchasing records for the solvent.

Another common reporting error is overestimation of the amount of solvent in waste sent off-site. This quantity should be based on analysis of the waste. Most likely, the waste is not 100% solvent, and the total amount of waste shipped off-site must be adjusted for the solvent concentration. Many facilities that receive waste solvents will provide information on the quantity of solvents present. This information is a key component of a mass balance for estimating solvent release and/or other waste management quantities.

Yet another common reporting error is classification of a solvent that is being recirculated within a system. If a recovery step occurs then the solvent will be reported as recycled (e.g., distillation-type activities to recover *n*-hexane to extract oils from seeds constitutes recycling). Whereas, if there is no recovery step occurring and the solvent is being directly reused, then the solvent will not be reported as recycled.

3.2.7 Cleaning/Disinfectant Uses

Commonly Reported TRI Chemicals. Chlorine, chlorine dioxide, formaldehyde, nitric acid, 1,1,1-trichloroethane, peracetic acid.

Process Description. Nitric acid is used extensively by facilities in the Dairy and Meats subsectors, and to less of an extent by other subsectors in the food manufacturing industry, to clean and sanitize process equipment. Chlorine can also be used for cleaning purposes by reacting it with sodium hydroxide to form a sodium hypochlorite solution. Peracetic acid is used as a disinfectant in food manufacturing facilities. Many poultry processors have switched from using chlorine disinfectants to peracetic acid in response to concerns about the level of chlorine residuals in poultry—between reporting years 2012 and 2021, the number of forms submitted for peracetic acid in the Animal Slaughtering and Processing Industry (NAICS Code 3116) increased by 184% (74 forms submitted for 2012; 210 forms submitted for 2021). Chlorine dioxide is used as a germicidal disinfectant or sanitizer. Formaldehyde is used as a sterilant to limit microbial action in beet sugar processing equipment.

Estimating Release and Other Waste Management Quantities. When used in cleaning applications nitric acid (a TRI chemical) is usually treated (neutralized) with alkali in water prior to discharge in the form of wastewater. The products resulting from the neutralization of nitric acid are water dissociable nitrate compounds, a TRI chemical category. Nitric acid, while water dissociable, is listed separately from the nitrate compounds category on the TRI chemical list. If the pH is maintained above 6, the nitric acid is considered completely neutralized and, if you exceeded a reporting threshold for nitric acid you should report zero releases or transfers of nitric acid to water. But you would have to file a Form R report for nitrate compounds manufactured as a result of the neutralization of nitric acid and disclose the quantities of nitrate compounds released to the environment or otherwise managed as waste. For nitrate compounds, the largest contributors of waste managed quantities specific to the food manufacturing sector are facilities in the Dairy and Meats subsectors. See Section 3.2.8 for additional discussion of nitric acid, nitrate compounds, and other TRI chemicals released or treated during wastewater treatment operations at food manufacturing facilities.

Chlorine is consumed during the reaction with sodium hydroxide to produce sodium hypochlorite. Therefore, the only quantities of chlorine released or otherwise managed would be fugitive air emissions from such sources as leaks in valves and fittings and losses during cylinder changeovers. Chlorine releases and other waste managed quantities should be estimated as discussed in Section 3.2.1.

Estimates of air emissions from storage tank losses (including loading and unloading operations) should be made using methods described in *AP-42* as discussed in Section 3.2.3.

COMMON ERRORS – Reporting for Mineral Acids and Chlorine

A common reporting error for cleaning uses of acids is overestimation of release quantities or other waste management quantities. If the pH of the wastewater discharge is maintained between 6 and 9, which is required by many permits, the acid is neutralized and zero releases to water or transfers off-site of the acid should be reported. Additionally, if the neutralization of an acid (e.g., nitric acid) results in the manufacture of other TRI listed chemicals (e.g., nitrate compounds), the quantities of those chemicals manufactured must be considered towards the manufacturing thresholds for those chemicals.

Another common error is the overestimation of discharges or transfers to water for chlorine and chlorine dioxide (see Section 3.2.1).

Another type of reporting error in this application involves confusing cleaning chemicals with chlorine. Chemicals called "chlorine bleach" are often used for cleaning purposes. These cleaners normally contain chemicals such as sodium hypochlorite or calcium hypochlorite, and very little free chlorine (Cl_2). They are not subject to TRI reporting requirements.

3.2.8 Wastewater Treatment

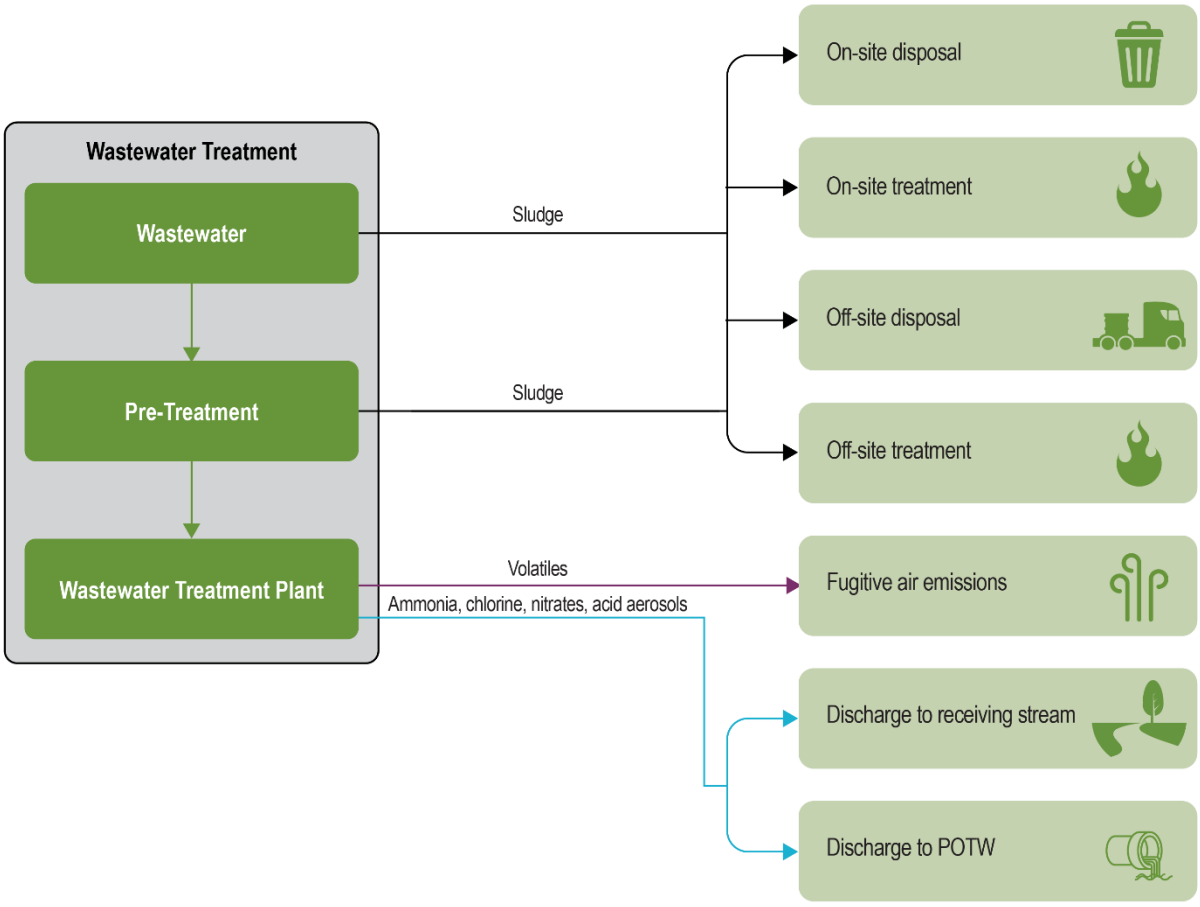

Figure 3.2.8-1: Process Flow Diagram – Wastewater Treatment

Commonly Reported TRI Chemicals. Ammonia, chlorine, hydrochloric acid (acid aerosols), sulfuric acid (acid aerosols), nitric acid, and nitrate compounds.

Process Description. Various TRI chemicals are used in wastewater treatment processes at some food manufacturing plants. Mineral acids (e.g., nitric acid) and alkali (e.g., sodium hydroxide) are often added for pH control, and ammonia may be added to provide a nitrogen source for biological treatment systems. Wastewater treatment operations at food manufacturing facilities (in particular, from the Dairy and Meats subsectors) result in releases of nitrate compounds.

Sulfuric acid is the most frequently used acid. However, TRI reporting threshold determinations and release estimates for sulfuric acid and hydrochloric acid only apply to aerosol forms of those chemicals. U.S. EPA considers the term "aerosol" to cover any airborne sulfuric (or hydrochloric) acid (including mists, vapors, gas, or fog) without regard to particle size. If vapors or other aerosols of sulfuric acid are generated from the process, the mass of the sulfuric acid aerosol that is produced must be applied toward the manufacturing threshold. If the aerosol is then processed or otherwise used, its mass should be applied to those thresholds as applicable. Releases should be reported as fugitive air emissions (assuming a threshold has been met). More guidance for reporting sulfuric acid aerosols can be found in *Toxics Release Inventory Guidance for Reporting Sulfuric Acid*, available on GuideME.

Ammonia is often added to the system as a metabolic nitrogen source for the microbes. In such instances, the ammonia is otherwise used. Ammonia can also be generated (manufactured) as a byproduct in biological treatment systems when proteins break down. Any other TRI chemicals which are manufactured as byproducts during waste treatment processes must also be considered towards the manufacturing threshold for TRI reporting. Water dissociable nitrate compounds are manufactured during wastewater treatment processes as a result of nitrification during aerobic biological treatment of ammonia in wastewater or when nitric acid in waste water is neutralized with alkali (e.g., sodium hydroxide) to meet standards under EPA's effluent guidelines. For more information on how to consider nitrate compounds manufactured during wastewater treatment, refer to *TRI Guidance for Reporting and List of Toxic Chemicals within the Water Dissociable Nitrate Compounds Category*, also on GuideME.

Estimating Release and Other Waste Management Quantities. Most of the ammonia found in wastewater treatment operations at food manufacturing facilities is released or otherwise managed as waste via water except for small quantities of ammonia that may be released to air from storage and transfer operations before its introduction into the wastewater treatment system.

Spills of such liquids could be reported as fugitive air emissions, discharges to wastewater, or off-site transfers depending upon the volatility of the chemical and the disposal of the cleanup material.

COMMON ERROR – Reporting

A common error is the failure to report ammonia that is manufactured as a byproduct during the wastewater treatment process. Other reportable chemicals also may be manufactured during such treatments depending upon the chemicals present.

3.2.9 Fumigants

Commonly Reported TRI Chemicals. Bromomethane (methyl bromide), ethylene oxide, propylene oxide, bromine.

Process Description. Various TRI chemicals are used as fumigants, either alone or in a mixture with carrier gases, during certain types of food processing operations. For example, ethylene oxide can be used as a bactericide during processing of spices. Bromomethane (methyl bromide) can be used as an insecticide in grain storage facilities. In such applications, these chemicals are handled and used as gases. The fumigant is usually released to air when fumigation is complete. If the process is conducted in a pressurized container, the fumigant may be vented to a treatment device such as a scrubber.

Estimating Release and Other Waste Management Quantities. If no control devices exist, you should assume the total quantities of these volatile chemicals are released to air. The quantities released to air should be delineated between fugitive air emissions from leaks in valves and fittings and losses during cylinder changeovers, and point air emissions, such as, for example, from fumigation operations when the building air is routed through a control device. Mass balance is the best approach for estimating releases or other waste management quantities, with an assumption of minor fugitive releases to air. The point air emission total (i.e., Part II, Section 5.2 of the Form R) must be adjusted based on the destruction and removal efficiencies of the control devices, with the amount captured and separated to another medium reported as a discharge to water or a transfer to an off-site facility as appropriate.

3.2.10 Pesticides/Herbicides

Commonly Reported TRI Chemicals. Bromine, naphthalene, and various pesticides and herbicides (e.g., captan, 2,4-D, lindane, maneb, parathion, zineb, atrazine, malathion, diazinon).

Process Description. Pesticide and herbicide chemicals may be handled as solids or as solids dissolved in or mixed with a liquid to form a sprayable solution or suspension. In such formulations the pesticides are typically sprayed (applied) mechanically over the area being treated. Agricultural activities are normally not subject to EPCRA, but the quantities of herbicide or pesticide chemicals that are also TRI chemicals should be considered towards TRI reporting thresholds if the uses occur at a covered facility, such as multi-establishment facilities which encompass farm establishments. Such a covered multi-establishment facility must report releases and other waste management activities for all listed chemicals, even from establishments that do not fall under a NAICS code covered by TRI reporting. For example, an establishment that processes sugarcane grown at a farm at the same facility may have to submit a TRI report for 2,4-D.

Additionally, food manufacturing facilities may receive crops or other raw agricultural commodities that contain residues of pesticide or herbicide chemicals included on the TRI chemical list from off-site farms. If a pesticide residue in or on a crop is at a concentration above the *de minimis* level for that chemical, the total quantity of the TRI chemical pesticide in the crop should be considered towards the respective reporting threshold should any such manufacturing, processing, or otherwise use occur with regard to residue in or on the crop. For example, 2,4-D is commonly applied to control weeds when growing crops such as wheat, rye, or corn. The total quantity of 2,4-D in the crop should be considered when making the threshold determination.

Estimating Release and Other Waste Management Quantities. Pesticides and herbicides sprayed onto the area being treated should be considered released on-site to land. Minor amounts of these chemicals could be released to air and/or water from aerial spraying.

COMMON ERRORS – Reporting

A common reporting error in regard to otherwise use of pesticide or herbicide chemicals that are on the TRI chemical list is failure to submit a Form R or Form A for these chemicals because they were used only for agricultural purposes at a covered facility. As explained above, a Form R or Form A may be required depending on the primary NAICS code of a multi-establishment facility.

The threshold determination for pesticides and herbicides should be based upon the quantities of these chemicals used within a given reporting year, not the quantity of the pesticide formulation used. Formulations of herbicides or pesticides often contain these chemicals in low concentration.

Some facilities also may fail to report application of pesticides or herbicides to land as releases because the chemicals are broken down by soil microorganisms, and do not accumulate in the soil following proper agricultural use. The total amount of a TRI chemical applied to land should be considered towards the otherwise use reporting threshold and, if the threshold is exceeded, should be reported as released to land, regardless of its disposition after it is applied.

3.2.11 On-site Energy

Commonly Reported TRI Chemicals. Hydrogen fluoride, sulfuric acid (acid aerosol), hydrochloric acid (acid aerosol), formaldehyde, metal compounds, nitrate compounds, and dioxin and dioxin-like compounds.

Process Description. Many food manufacturing facilities use coal and/or fuel oil in boilers or furnaces for both process and non-process operations. The combustion of these fuels results in the coincidental manufacture of several TRI chemicals and chemical compounds including: dioxin and dioxin-like compounds, mercury compounds, lead compounds, formaldehyde, hydrogen fluoride, and aerosol forms

of sulfuric acid and hydrochloric acid. These fuel combustion-generated quantities should be applied to the respective manufacturing thresholds for these chemicals and, if exceeded, release and other waste management estimates will need to be made and disclosed.

Estimating Release and Other Waste Management Quantities. As with any TRI chemical, the specific amounts released are often best estimated using monitoring data for the waste stream. U.S. EPA's *Guidance for Electricity Generating Facilities* describes estimation techniques for combustion processes in detail.

COMMON ERROR – Reporting

A common reporting error is failure to take the manufacture of these chemicals into consideration when performing threshold determinations or release and other waste management estimates. If the only source of the chemical at a facility was from coincidental manufacture, the 25,000-pound manufacturing threshold may not have been exceeded. On the other hand, if the chemical is already reportable at your facility for other reasons, the release and other waste management amounts from its formation must be reported. (Note that the *de minimis* exemption does not apply to manufacturing byproducts).

3.2.12 Can Making/Coating

Commonly Reported TRI Chemicals. Metal can components such as manganese, nickel, and chromium; various inks, coatings and coating solvents (e.g., *n*-butyl alcohol, certain glycol ethers, methyl isobutyl ketone (MIBK), toluene, 1,1,1-trichloroethane, xylenes); and various metal compounds used as pigments (e.g., copper compounds, barium compounds, chromium compounds, zinc compounds, lead compounds).

Process Description. Some food processing plants fabricate cans using various stamping and coating operations. Strip metal is formed into can bodies and lids using stamping machines. Reportable chemicals may also be used during the fabrication of cans during welding, cementing, or soldering processes.

The types of TRI chemicals used in the largest quantities in can making are solvents and pigments in the form of ink and coating formulations. Coatings may be applied to both the interiors and exteriors of cans, generally using roll coating, printing, or spraying processes. In larger operations, the coatings may be formulated on-site. Various solvents may be used in printing and coating processes, both as pigment carriers and to clean up equipment and spills.

Estimating Release and Other Waste Management Quantities. While release or other waste management quantities of a TRI chemical from strip metal stamping operations are typically minor, they still need to be reported if a reporting threshold for the chemical was exceeded.

Scrap metal from the stamping and coating processes is usually shipped off-site for metal recycling. If scrap metal shipped off-site is directly reused, this should not be reported as an off-site transfer on the Form R. Releases of TRI chemicals from large soldering or welding operations should be considered and, when required, reported. Such release quantities are typically low because emissions of the chemicals are often limited by air permitting requirements. Releases to air in such instances may therefore best be determined by the permit conditions or monitoring of the process.

Most ink and coating solvents are volatile chemicals, and it is reasonable to assume the entire quantity used will evaporate during handling, blending, or drying of the ink or coating. The quantity released as a fugitive air emission is therefore equal to total solvent usage for these purposes minus any amount captured by control devices such as carbon absorbers or thermal oxidizers (e.g., incinerators). If destructive controls are used (e.g., thermal oxidizers) for managing solvent waste, you should estimate the amount of solvent destroyed using engineering assumptions of the quantity entering the control device

and its destruction efficiency. If nondestructive controls are used (e.g., absorbers), the amount of the captured solvent in wastes sent off-site for recycling, treatment, or disposal can be estimated through analysis of these wastes. Any release following an air pollution control device (APCD) is considered a point release. If the APCD simply transfers the TRI chemical from the air stream to another medium, the quantity released or otherwise managed should be partitioned as appropriate.

The wastes shipped off-site may also contain pigment chemicals that are included on the TRI chemical list. The quantity of the TRI chemicals involved can be estimated through analysis of the wastes or knowledge of the coating operation transfer efficiency. Engineering assumptions can be used to determine the media of these releases or waste management activities.

A portion of the solvents used to clean ink rollers or spills also will evaporate and should be reported as a fugitive air release (unless captured and sent through a stack/point source). The remaining portion is typically collected, placed in drums, and shipped off-site for disposal, treatment, or reuse. The quantity of the TRI chemicals can be determined through analysis of these wastes. The amount of cleanup solvent released to air can be estimated by mass balance, based on that total solvent used minus the waste solvent from this application sent for recycle or disposal.

Additional information on estimating release and/or other waste management quantities for printing and coating solvents can be found in *EPCRA Section 313 Release Reporting Guidance for Printing, Publishing, and Packaging Industry*, available on GuideME.

COMMON ERRORS – Reporting

An error when considering threshold or reportable quantity determinations of a TRI-listed chemical in regard to can making/coating operations is the universal assumption that the article exemption applies to cans, and therefore, the quantities of the TRI chemicals do not need to be considered for TRI reporting purposes. The applicability of the article exemption in regard to can making/coating operations is not universal and must be made on a case-by-case basis.

A common reporting error for solvents used in ink and coating applications is failure to account for the entire mass of the solvent. Typically, none of the solvent remains with the printed or coated product. The total quantity of the solvent used should be accounted for through air emissions, amounts captured or destroyed in control devices, releases to water, waste amounts managed on-site, and amounts sent off-site. Total usage is best determined from purchasing records for the coating or ink and the percentage of the solvent in these materials (as reported in the SDS).

Overestimation of the amount of solvent in waste sent off-site also can occur. This quantity should be based on analysis of the waste. Most likely, the waste is not 100% solvent, and the total amount of waste shipped off-site must be adjusted to estimate the weight of the TRI solvent chemical. Facilities that send waste solvents offsite for waste management will sometimes provide information on the concentrations of the chemical and other chemicals present in the waste. This information is a key component if a mass balance is used for estimating the quantity of the TRI solvent sent offsite for further waste management.

Another potential error in this category is incorrectly classifying the chemical activity of the coating pigments. While solvents are typically intended to serve as carriers and do not remain with the product (meaning they are otherwise used), metals and other chemicals in pigments are often part of the formulation that intentionally stays with the product. These chemicals are processed and are subject to their processing reporting thresholds.

A final reporting error in these applications is incorrectly submitting a Form R or Form A for isopropyl alcohol, which is often used as an ink solvent. A Form R or Form A is only required for isopropyl alcohol if the facility manufactures the chemical on-site using the strong acid process. Use of isopropyl alcohol as an ink or coating solvent at a facility is therefore not subject to TRI reporting unless the facility manufactured the isopropyl alcohol using the strong acid process.

SECTION 4.0 REPORTING POLLUTION PREVENTION ACTIVITIES

Section 4.1 Pollution Prevention Activities in Food Manufacturing Facilities

The previous sections discuss TRI chemicals commonly encountered at food manufacturing facilities and provide guidance on how these facilities are to comply with the TRI reporting requirements for these chemicals. This section is intended to assist food manufacturing facilities in identifying newly implemented source reduction (pollution prevention) practices at their facilities. As illustrated in the waste management hierarchy and discussed in the Pollution Prevention Act (PPA) of 1990, the preferred methods to be used in the management of waste in descending order are: source reduction (don't create the chemical waste in the first place), recycling, treatment and, as a last resort, disposing of or releasing the waste into the environment. Within the realm of treatment, combusting for energy recovery is preferred over treatment for destruction. EPA encourages facilities to strive to avoid the creation of TRI chemical waste through source reduction activities. Each year, you should consider implementing source reduction practices and, if you do, report any practices in your Form R reports, as required. The Agency seeks to highlight facilities that have made noteworthy achievements in improving their environmental performance through implementation of pollution prevention practices, as well as to investigate potential barriers to source reduction activities faced by facilities. For spotlights, national emphasis areas, and other relevant pollution prevention information, refer to https://www.epa.gov/toxics-release-inventory-tri-program/pollution-prevention-p2-analyses-and-publications.

Practices typically reported to TRI by food manufacturers include:

- **Process and equipment modifications** implemented to reduce energy consumption and use less of TRI chemicals
    - *Example*: Reducing energy use by placing ovens in areas away from processes requiring cooler environments
    - *Example*: Reducing toxic chemical use by replacing bisphenol A in food packaging

- **Material substitutions and modifications** implemented to prevent or reduce the use of TRI chemicals
    - *Example:* Switching from chlorine gas to sodium hypochlorite in cooling towers
    - *Example*: Replacement of chlorine in poultry disinfection systems with the less toxic peroxyacetic acid (another less toxic TRI chemical)

- **Operating practices and training** implemented to enhance operator and housekeeping measures to eliminate or minimize waste
    - *Example:* Working to ensure proper concentration of ethylene glycol, so as to reduce unnecessary usage during operational shifts.

Other sustainability practices reported by food manufactures include:

- **Recycling of food packaging and organic waste** to reduce environmental impacts after the useful life of a material such as reusing skin, bone, and fin as fish meal and fertilizer (seafood subsector)
- **Wastewater technology modifications** to destroy TRI chemicals such as transition away from traditional disinfectants (e.g., chlorine) to use of alternative technologies (e.g., ultraviolet treatment systems)

To learn more about TRI pollution prevention activities and regulatory requirements, as well as information on pollution prevention opportunities within the food manufacturing industry, visit https://www.epa.gov/tri/P2.

EPA's P2 homepage (https://www.epa.gov/p2) houses information on P2 grants, Environmentally Preferable Purchasing, Green Chemistry, Safer Choice, the Low Embodied Carbon Construction Materials Program, and other P2-related programs.

The P2 Hub Resources Center (https://www.epa.gov/p2/p2-hub-resources-center) offers P2 resources and tools to businesses and technical assistance providers. These include the P2 Hub Helpline and the ability to search for webinars, practices and technologies, tools and articles about P2 solutions, and successful P2 implementation case studies.

The Smart Sectors Program has developed a table of P2 reduction opportunities specific to food manufacturing (https://www.epa.gov/smartsectors/food-manufacturing-pollution-prevention-techniques).