United States Environmental Protection Agency | Office of Pollution Prevention and Toxics Washington, DC 20460 | EPA 740-B-23-004 April 2023

TOXICS RELEASE INVENTORY

Reporting Guidance for the Leather Tanning and Finishing Industry

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires certain facilities manufacturing, processing, or otherwise using listed toxic chemicals to report the annual quantity of such chemicals entering each environmental medium. Such facilities must also report pollution prevention data 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).

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DISCLAIMER

This guidance document is intended to supplement the Toxics Release Inventory (TRI) Reporting Forms and Instructions (www.epa.gov/tri/rfi) and assist facilities in the leather tanning and finishing industry 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 leather tanning and finishing industry sector to consider the 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 leather tanning and finishing facilities. The circumstances at a specific leather tanning and finishing 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 leather tanning and finishing 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.

[1] "Reasonable estimates" are only allowed to "be used where actual data are not available." For a reasonable estimate to be sufficient, the estimates "may be based on engineering estimates and computation process material balance studies, or other estimation techniques." 131 Cong. Rec. S11770-01 (1985), pp.11.

ACKNOWLEDGMENTS

The original version of this document was published in April 2000. In the original version the U.S. EPA acknowledged the valuable contributions made by the staff and members of Leather Industries of America Inc. and Garden State Tanning Inc. Since 2000, changes have occurred with respect to the processes used in the leather tanning and finishing industry, TRI reporting requirements, the chemicals included on the EPCRA Section 313 chemical list, and the technology facilities must use to disclose the required information. In developing this revised version, EPA invited the input of the Leather and Hide Council of America and the member companies of the association. EPA greatly appreciates the insight provided by individuals with experience in the leather tanning and finishing industry and fulfilling the reporting requirements of EPCRA Section 313 and PPA Section 6607. Special thanks go to Mr. Joseph Green and Mr. Stephen Sothmann of the Leather and Hide Council of America and to Mr. Steven Lange of the Leather Research Laboratory at the University of Cincinnati.

SECTION 1.0 INTRODUCTION

This document contains guidance information and recommendations specific to Toxics Release Inventory (TRI) reporting[2] for facilities in the leather tanning and finishing industry. EPA recognizes that not all leather tanning and finishing 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 leather tanning and finishing 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 common TRI reporting issues applicable to leather tanning and finishing operations. These examples are based on information identified during voluntary site surveys of facilities that have filed EPCRA Section 313 reports in the past, discussions with representatives of the Leather and Hide Council of America, and questions received by the EPCRA Hotline.

This document supersedes the 2000 document entitled *Emergency Planning and Community Right-to-Know Act Section 313 Reporting Guidance for Leather Tanning and Finishing Industry* (EPA 745-B-00-012; April 2000). Changes to this new 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 leather tanning and finishing industry (compared to other TRI sectors);
- Combined Section 2 and Section 3 from the 2000 version into a single Section 2 in this document;
- Removed repetitive language describing how to design a site-specific process flow diagram for each step of a facility's operations (Section 3);
- Removed the previous Example 4 (ammonia release reporting) and replaced with a reference to the more detailed *Toxics Release Inventory Guidance for Reporting Aqueous Ammonia*;
- Edited Example 2 in this document ("Chromium Release and Other Waste Management Activities"; previously Example 5);
- Updated Tables 2-1, 2-2, 2-3, and 2-4 to reflect more recent TRI reporting form data from the leather tanning and finishing industry and literature reviews; and
- Edited language throughout the document to reflect regulatory updates since 2000, including: updating the Standard Industrial Classification (SIC) codes to North American Industrial Classification System (NAICS) codes; deleting mentions of chemicals delisted from TRI (e.g., phosphoric acid); adding current electronic reporting requirements; and providing additional chemical activity subcategories on the Form R.
- Where appropriate, identified changes in processes used in the leather tanning and finishing industry that have occurred since 2000 and the relevance of these changes to TRI reporting.

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.

[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) and Section 6607 of the Pollution Prevention Act (PPA).

SECTION 2.0 REPORTING REQUIREMENTS AND THRESHOLD DETERMINATIONS

Section 2.1 NAICS Code Determination

Facilities engaged in leather tanning and finishing are typically classified in North American Industrial Classification System (NAICS) Code 316110: Leather and Hide Tanning and Finishing. 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/eos/www/naics/, or 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 EPCRA Section 313 Chemicals in Leather Tanning and Finishing

While every chemical and chemical category on the EPCRA Section 313 chemical list must be considered, certain chemicals are more likely than others to be encountered at leather tanning and finishing facilities. As a guide, please refer to Table 2-1 for a list of EPCRA Section 313 chemicals and chemical categories commonly encountered in leather tanning and finishing facilities based on reports submitted to TRI as of reporting year 2021 and relevant literature sources.

Note that this table is merely a starting point for identifying chemicals for threshold determinations and may not be inclusive of all EPCRA Section 313 chemicals and chemical categories at a specific leather tanning and finishing facility.

Table 2-1: Examples of EPCRA Section 313 Chemicals and Chemical Categories Reported by Leather Tanning and Finishing Facilities

Chemical or Chemical Category	Process
Ammonia (anhydrous and 10% of aqueous)[1]	Liming/unhairing[2] Deliming[2,3,4,6] Dyeing[2] Wastewater Treatment[9]
Certain glycol ethers[1]	Finishing[2]
Chromium[1]	Tanning
Chromium compounds[1]	Tanning[2,3,4,6] Coloring[1] Finishing[3,7,8]
Formic acid[1]	Soaking (*less common*)[2] Pickling[2,3,5] Tanning[2,4] Coloring[1,5,7] Fatliquoring[2]
Hydrogen sulfide[1]	Unhairing[2,4] Deliming[2,3] Pickling[2]
Manganese compounds[1]	Tanning (auxiliary)[2] Wastewater Treatment[2,9]

Chemical or Chemical Category	Process
N-methyl-2-pyrrolidone[1]	Coloring[1] Finishing[9]
Nonylphenol ethoxylates (NPEs)*	Soaking[2] Liming[2] Tanning[2] Dyeing[2]
Per- and polyfluorinated alkyl substances (PFAS)	

* NPEs were added to the TRI chemical list effective for RY2019; EPA did not receive any TRI reporting forms for NPEs from facilities in this sector as of RY2021. However, literature reviews indicate NPEs may be commonly used at leather tanning and finishing facilities, and EPA is including them in Table 2-1 for facilities' reference.

†Certain PFAS were added to the TRI chemical list effective January 1, 2020. No TRI reporting forms for PFAS have been submitted as of RY2021. However, literature reviews indicate PFAS may be used at leather tanning and finishing facilities, and EPA is including them in Table 2-1 and in subsequent tables for facilities' reference.

Sources:

(1) US. EPA. (2022). *RY2021 TRI dataset for years 2015-2021.* Accessed March 2023.
(2) European Commission. (2013). *Best Available Techniques Reference Document for the Tanning of Skins and Hides.* https://ec.europa.eu/jrc/en/publication/reference-reports/best-available-techniques-bat-reference-document-tanning-hides-and-skins-industrial-emissions
(3) Covington, A. (2009). *Tanning Chemistry: The Science of Leather.* The Royal Society of Chemistry.
(4) Reich, G. (2005). Leather. In *Ullmann's Encyclopedia of Industrial Chemistry.* Wiley. https://doi.org/10.1002/14356007.a15_259.pub2
(5) Hietala, J., Vuori, A., Johnsson, P., Pollari, I., Reutemann, W., & Kieczka, H. (2016). Formic acid. In *Ullmann's Encyclopedia of Industrial Chemistry.* Wiley. https://doi.org/10.1002/14356007.a12_013.pub3
(6) Thorstensen, T. (2000). Leather. In *Kirk-Othmer Encyclopedia of Chemical Technology*. Wiley. https://doi.org/10.1002/0471238961.1205012020081518.a01
(7) Bide, M. (2016). Dyeing. In *Kirk-Othmer Encyclopedia of Chemical Technology*. Wiley. https://doi.org/10.1002/0471238961.0425051919130920.a01.pub3
(8) Howells, R., (2009). Waterproofing and Water and Oil Repellency. In *Kirk-Othmer Encyclopedia of Chemical Technology*. Wiley. https://doi.org/10.1002/0471238961.2301200508152305.a01.pub2
(9) U.S. EPA. (2000). *Emergency Planning and Community Right-To-Know Act Section 313 Reporting Guidance for the Leather Tanning and Finishing Industry.* (EPA Publication ID 745-B-00-012).

Each of the three TRI activity categories (i.e., manufacture, process, or otherwise use) is divided into subcategories. As discussed in the TRI Reporting Forms and Instructions, you are required 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 Manufacturing Subcategories

Manufacturing Activity Subcategory	Definition	Examples in Leather Tanning and Finishing Operations
Produced or imported for on-site use/processing	A chemical or chemical category that is produced or imported and then further processed or otherwise used at the same facility.	Chromium compounds, Hydrogen Sulfide

Manufacturing Activity Subcategory	Definition	Examples in Leather Tanning and Finishing Operations
Produced or imported for sale/distribution	A chemical or chemical category that is produced or imported specifically for sale or distribution outside the manufacturing facility.	N/A
Produced as a byproduct	A chemical or chemical category that is produced coincidentally during the production, processing, or otherwise use of another chemical substance or a mixture and is separated from that substance or mixture. EPCRA Section 313 chemicals or chemical categories produced and released as a result of waste treatment or disposal are also considered byproducts.	Ammonia, hydrogen sulfide
Produced as an impurity	A chemical or chemical category that is produced coincidentally as a result of the manufacture, processing, or otherwise use of another chemical and remains primarily in the mixture or product with that other chemical.	N/A

Note: More complete discussions of the industry-specific examples can be found in Section 3 of this guidance manual.

Table 2-3: Definitions and Examples of Processing Subcategories

Processing Activity Subcategory	Definition	Examples in Leather Tanning and Finishing Operations
Reactant	A natural or synthetic chemical or chemical category used in chemical reactions for the manufacture of another chemical substance or product. Examples include feedstocks, raw materials, intermediates, and initiators.	Ammonia (ammonium salts), chromium compounds, formic acid, manganese compounds, hydrogen sulfide
Formulation component	A chemical or chemical category 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, dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers.	Ammonia, Chromium and chromium compounds, certain glycol ethers, formic acid, n-methyl-2-pyrrolidone, and triethylamine
Article component	A chemical or chemical category that becomes an integral component of an article distributed for industrial, trade, or consumer use.	Chromium and chromium compounds, certain glycol ethers, certain per- and polyfluoroalkyl substances (PFAS)
Repackaging only	A chemical or chemical category 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.	N/A
Processed as an impurity	A toxic chemical or chemical category that is processed but is not separated from and remains in the mixture or other trade name product with those chemicals.	N/A

Processing Activity Subcategory	Definition	Examples in Leather Tanning and Finishing Operations
Recycling	A toxic chemical or chemical category is prepared for distribution in commerce in a different form, state, or quantity for recycling or reclamation.	Chromium

Note: More complete discussions of the industry-specific examples can be found in Section 3 of this guidance manual.

Table 2-4: Definitions and Examples of Otherwise Use Subcategories

Otherwise Use Activity Subcategory	Definition	Examples in Leather Tanning and Finishing Operations
Chemical processing aid	A chemical or chemical category 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.	Formic acid, ammonia, certain glycol ethers, chromium compounds
Manufacturing aid	A chemical or chemical category 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 solvents, process lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids.	Chromium, manganese compounds, triethylamine, certain glycol ethers
Ancillary or other use	A chemical or chemical category 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.	Manganese compounds, certain glycol ethers, triethylamine

Note: More complete discussions of the industry-specific examples can be found in Section 3 of this guidance manual.

See below for an example of calculating TRI reporting thresholds for chemical processing aids (Example 1) as well as common errors related to mass balance calculations.

Example 1: Chemical Processing Aid

A spray-painting operation uses a covered glycol ether as the carrier solvent. Ideally all the solvent would evaporate, however, studies have shown 1% of the applied solvent remains on the workpiece. Since the function of the solvent is to improve the application of the paint and is a non-incorporative activity, the entire amount of glycol ether is considered otherwise used. If the solvent's function was such that it was intended to remain with the workpiece, it would be considered processed, as is the case for pigments, binders, and other paint components intended to remain with the workpiece.

COMMON ERROR - Mass Balances for Otherwise Used Chemicals

Facilities often do not account for the entire quantity of EPCRA Section 313 chemicals or chemical categories that are otherwise used. Many EPCRA Section 313 chemicals and chemical categories in leather tanning and finishing operations are classified as otherwise used. Such chemicals and chemical categories may or may not leave the facility with the product. For those instances where the EPCRA Section 313 chemical or chemical category does not leave the facility with the product, all throughput may be lost during processing through on-site releases to air, water, or land, or it may be shipped off-site for further waste management activities. Thus, the entire throughput is often reportable on Form R as releases and other waste management activities to various media. Be sure to consider the entire throughput in these circumstances and partition it as appropriate. A mass balance may be the best starting point to estimate the releases and other waste management quantities. Examples applicable to leather tanning and finishing include triethylamine (CASRN: 121-44-8) and some glycol ethers.

SECTION 3.0 ESTIMATING RELEASE AND OTHER WASTE MANAGEMENT QUANTITIES

Section 3.1 Purpose

This chapter is intended to guide the user in developing a systematic approach for estimating release and other waste management quantities of EPCRA Section 313 chemicals and chemical categories from leather tanning and finishing operations.

This chapter also includes common EPCRA Section 313 and PPA Section 6607 reporting and compliance issues as they apply to leather tanning and finishing and a presentation of the general steps in the manufacture of leather tanning and finishing products 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 Leather Tanning and Finishing Operations

Leather tanning and finishing converts raw hides and skins into leather that has thermal stability, is soft and flexible, and non-putrescible. Current leather tanning and finishing operations involve many chemical and mechanical operations. The processes involved in leather tanning and finishing are discussed in five major groupings; detailed process flow diagrams are presented in the subsequent discussion on each set of unit operations.

- *Beamhouse operations* – receiving and storage of hides, soaking, unhairing, reliming, deliming, and bating;
- *Tanyard operations* – pickling, tanning, wringing, sorting, trimming, siding, splitting, and shaving;
- *Retanning, coloring and fatliquoring operations*;
- *Finishing operations* – setting out, drying, conditioning, staking, dry milling, buffing, finishing, plating, grading, and measuring; and
- *Wastewater treatment* – pre-treatment and treatment.

For discussion purposes, some of the individual process steps are combined. Not all leather tanning facilities will have all operations and facilities may vary in the sequence of operations. You should analyze the process flow in your facility and prepare a site-specific process flow diagram showing the individual operations present in your facility.

Sources of quantities of EPCRA Section 313 chemicals and chemical categories that are released or otherwise managed as waste in leather tanning operations include wastewater from several of the wet operations such as unhairing, deliming, tanning, wringing, and sorting, retanning, coloring, and fatliquoring. Various dry operations such as buffing and finishing release pollutants to air in the form of dust, while processes involving solvents may release volatile organic chemicals (VOCs) and other chemicals to the air through evaporation. Scraps and shavings from trimming, siding, splitting, shaving, buffing, and finishing activities may contribute to solid wastes, along with shipping container residues (refer to the TRI Reporting Forms and Instructions for a summary of residue quantities from pilot-scale experimental study). On-site wastewater treatment systems at these facilities often generate sludge that may contain EPCRA Section 313 chemicals or chemical categories.

Release and other waste management pathways for EPCRA Section 313 chemicals and chemical categories include stack and fugitive air, wastewater discharge either direct to a receiving stream or off-site to a Publicly Owned Treatment Works (POTW), off-site recycling, and land or off-site disposal of solid wastes.

3.2.1 Beamhouse Operations

In a typical tannery, beamhouse operations begin when the raw or cured hides are received. Raw hides, generally fresh (green) hides, are transported to the tannery in a refrigerated truck and placed directly into the soaking drums. Cured hides are normally placed in a large, cool, well-ventilated storage facility. These hides usually have been cured with a concentrated salt (sodium chloride) solution to prevent putrefaction. The cured hides are sorted, weighed, and assembled in packs for further processing. When the hides are ready for processing, they are soaked to remove the salt and restore the moisture. Wetting agents and bactericides are typically added in the soaking step. After soaking, hair, epidermis, and soluble proteins are removed from the hides by chemical and sometimes mechanical means. The final steps in the beamhouse operations are deliming to remove residual chemicals used during liming and unhairing and bating to fully break down and remove unwanted proteinaceous material, yielding a clean surface. (Ref: *Leather Facts,* Third Edition. New England Tanners Club, Peabody, MA. 1994.) An example process flow diagram for beamhouse operations is shown in Figure 3-1.

Anhydrous ammonia is a prevalent EPCRA Section 313 chemical in this industry. There are two sources of coincidentally manufactured aqueous ammonia in beamhouse operations. The first source is the removal of the soluble proteins during the soaking and unhairing steps. The chemicals involved in these steps deaminate the proteins to yield ammonia. The high (alkaline) pH typically found in the unhairing and liming water solutions, pH ~12.0-12.6, results in the coincidental manufacture of aqueous ammonia in this step. A small portion of aqueous ammonia coincidentally manufactured in the process is released to the atmosphere as anhydrous ammonia. The second source is the addition of ammonia salts, ammonium chloride, and ammonium sulfate in the deliming step. The ammonia that is generated due to these additions is considered to be the coincidental manufacture of ammonia. Both sources of manufacturing ammonia take place in water, and the resulting ammonia would thus be considered aqueous ammonia. 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).

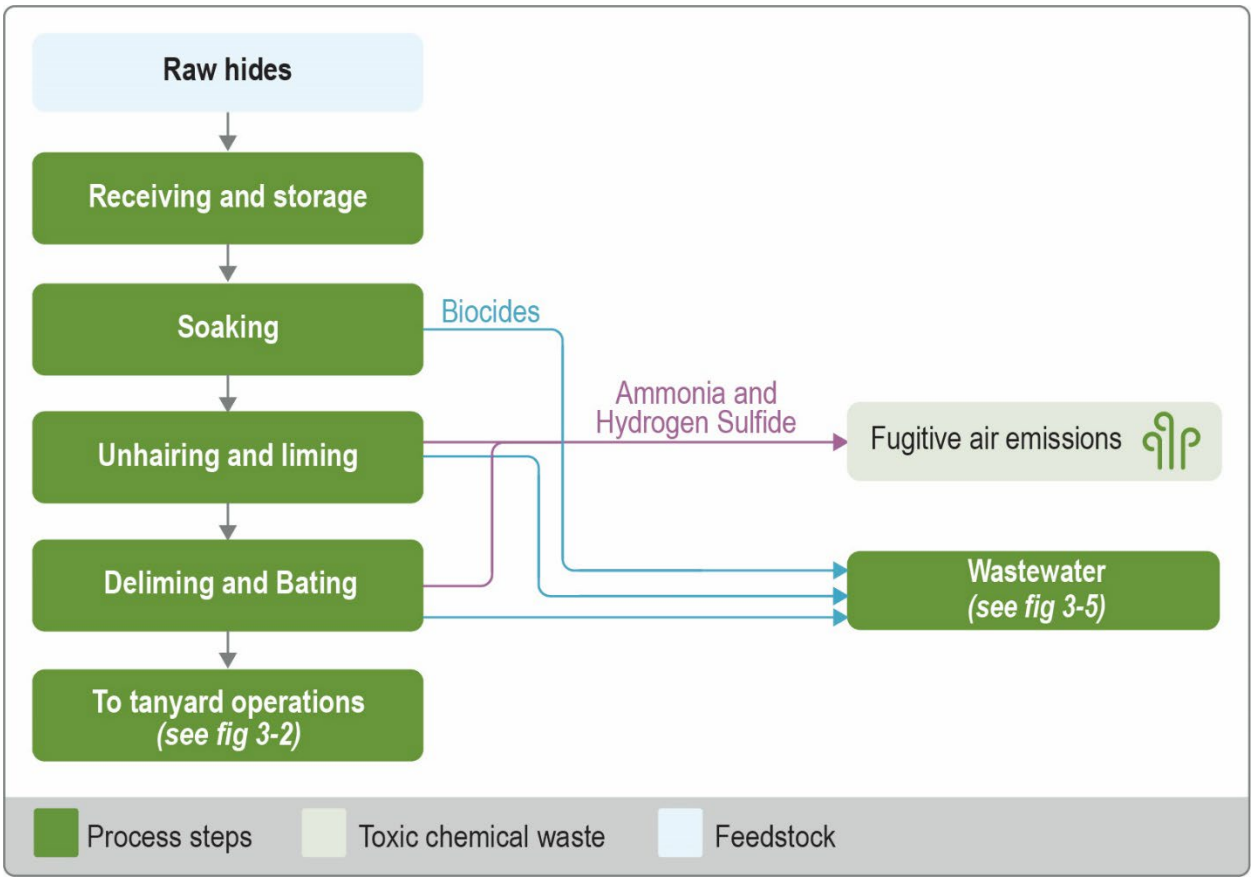

Figure 3-1: Process Flow Diagrams – Beamhouse Operations

Anhydrous ammonia may be generated by the deamination of hide substances during unhairing, and ammonium sulfate and ammonium chloride salts are used in deliming. Hydrogen sulfide may also be produced in beamhouse operations as pH is adjusted.

Typical sources of EPCRA Section 313 chemicals and chemical categories are process wastewaters, evaporation of volatile compounds such as ammonia, and residues in "empty" shipping containers.

Monitoring data for on-site wastewater treatment plant permits and NPDES permit requirements can generally provide wastewater concentrations of EPCRA Section 313 chemicals and chemical categories that are directly or indirectly discharged in your facility's wastewater. Pre-treatment permit compliance monitoring may provide information on wastewater concentrations discharged to POTWs. The aqueous ammonia will partition itself between the wastewater and the sludge during the treatment process. Amounts in each will be determined by analysis.

The releases and waste management activities associated with anhydrous ammonia are of particular concern for leather tanning and finishing operations, specifically during hide deamination where anhydrous ammonia will be generated (and the subsequent treatment of process water). Site-specific emissions factors, or other standardized emissions factors for the industry, may be combined with estimates of the anhydrous ammonia that is generated from the process, and the amount of anhydrous ammonia purchased to estimate the quantities released to air as fugitive emissions and discharged in wastewater.

3.2.2 Tanyard Operations

The actual tanning of leather takes place in the tanyard operations within a facility. Salt and acid are added in the pickling step to provide the low pH (acidic) environment that will prepare the hides to accept the tanning chemicals in the next step (note that some facilities consider deliming and salting to be included as the first step, prior to pickling, of tanyard operations). Tanning converts the hides into a stable, non-putrescible material. The industry commonly uses the chrome tanning method in which the chrome tanning agent is introduced into a revolving drum containing the hides floating in brine. Following the application of the tanning chemicals the excess moisture is removed, perimeter areas are trimmed to remove the less desirable material, and the thickness is adjusted to uniform dimension suitable for the desired end use of the finished leather (Ref: *Leather Facts,* Third Edition. New England Tanners Club, Peabody, MA. 1994). A typical flow diagram is presented in Figure 3-2.

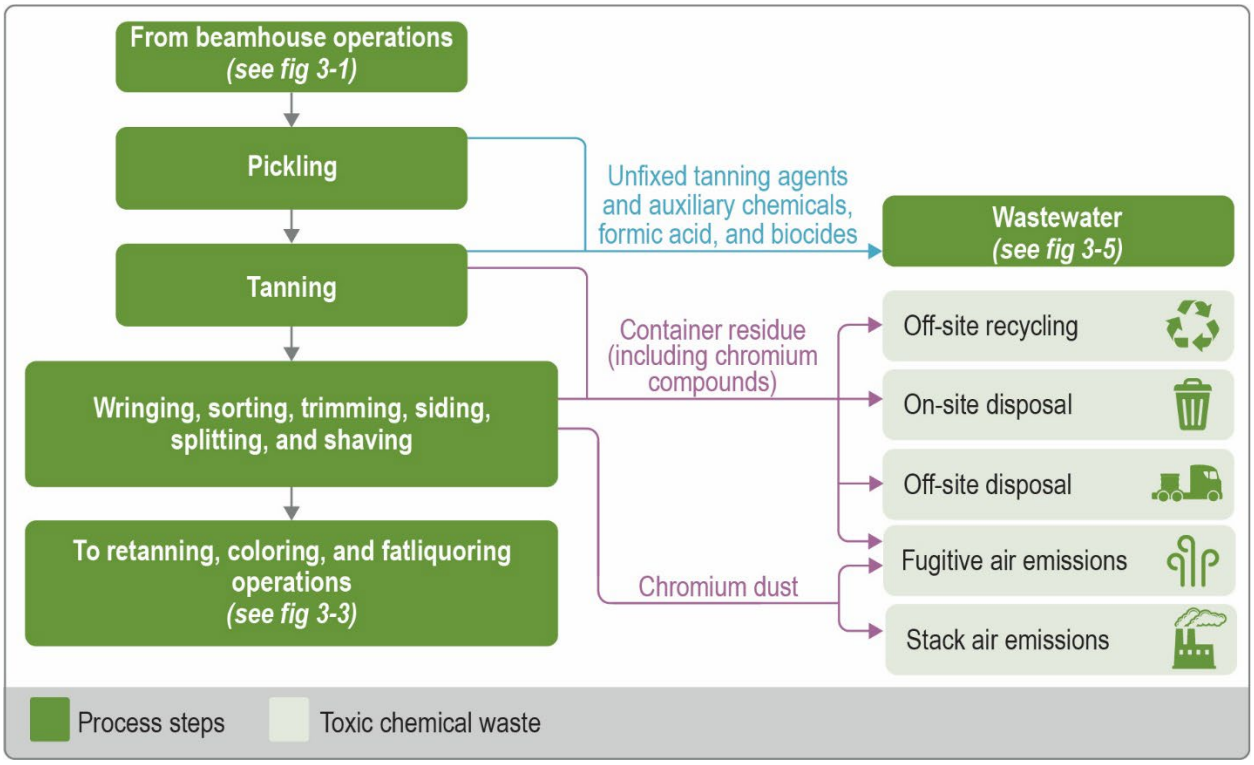

Figure 3-2: Process Flow Diagram – Tanyard Operations

The predominant EPCRA Section 313 chemicals and chemical categories involved in the chrome tanyard operations are chromium compounds used in the tanning step and formic acid used in the pickling step. Solutions of sulfuric acid are also used in pickling; however, only aerosol forms of sulfuric and hydrochloric acids are included on the TRI list of chemicals (see the searchable EPCRA section 313 list). There is also the possibility of coincidentally manufacturing anhydrous ammonia and hydrogen sulfide during pickling and tanning operations.

Typical sources of releases of individual chemicals or chemicals in chemical categories included on the EPCRA Section 313 chemical list include direct and indirect wastewater discharges, which may contain aqueous ammonia or chromium; wastewater treatment; fugitive emissions from evaporation of EPCRA Section 313 chemicals or chemical categories; fugitive and stack emissions of dust containing chromium; and on-site or off-site management of container residues and any dust collected in air pollution control devices, which may result in the release or management of wastes that contain EPCRA Section 313 chemicals or chemical categories to on-site or off-site disposal, treatment, energy recovery, or recycling,

as appropriate. Additionally, EPCRA Section 313 chemical releases may come from small particles formed from trimming and shaving operations of articles or other materials, and residues in "empty" shipping containers that are discarded.

Note that a TRI chemical, whether listed individually or as a member of a chemical category, which is put through a pollution control device is considered to have been treated for destruction if it is converted to another chemical or if it is hydrochloric acid or sulfuric acid in the form of aerosols. (Note that metals and metal compounds are generally not considered to be treated for destruction for the purposes of TRI reporting. The reader is referred to the current version of the TRI Reporting Forms and Instructions for additional guidance on metals and metal compounds.) The treatment efficiency of the device should be reported in Section 7A, and the quantity treated for destruction should be reported in Section 8.6. Also, note that any EPCRA Section 313 chemical sent through an air pollution control device is considered to have been captured for further waste management if it is not converted to another chemical or it is not hydrochloric aerosol or sulfuric acid aerosol. The capture efficiency of the device should be reported in Section 7A, and the quantity captured should be reported in Sections 6 and/or 8, depending on the final disposition of the chemical.

Monitoring data obtained as prescribed under on-site wastewater treatment permits and NPDES permit requirements can generally provide wastewater concentrations of EPCRA Section 313 chemicals that are directly or indirectly discharged in your facility's wastewater.

EPCRA Section 313 chemicals that are individually listed or are in chemical categories, which are volatile (e.g., certain glycol ethers) and not intended to remain with the product can be assumed to be 100% released to air as either fugitive or stack emissions, as appropriate, after subtracting any potential container residue. For dry materials, a residue factor of 1% can be used if actual data are not available.

See Section 3.2.1 of this document for a more detailed discussion of ammonia, if applicable. See below for examples of release and other waste management for chromium compounds (Example 2).

Example 2: Threshold Determination and Estimation of Release and Other Waste Management Quantities of Chromium Compounds

In this example, mass balance and engineering calculation methods are used to determine if a facility meets the reporting threshold for chromium compounds and to estimate quantities of chromium released to the environment or otherwise managed as waste.

Your facility uses chromium (III) sulfate monobasic (basic chrome sulfate, BCS, CrOHSO4) as a tanning agent to manufacture leather goods. The concentration of the tanning solution is 17.5% expressed as chromium (III) oxide (Cr2O3).1 On January 1 of the reporting year, your facility had 350 55-gallon steel drums containing the CrOHSO4 tanning solution. During the reporting year, your facility purchased 2,250 drums, with 600 drums remaining in inventory on December 31. The solution is poured from the open-top drums, with "empty" drums returned to the supplier to be refilled and sold again to your facility. The tanning solution has properties similar to water, but with a density of 1.7 g/mL (14.18 lb/gal). During the tanning process, chromium taken into the hide stabilizes collagen subunits, giving the hide greater durability and resistance to biodegradation. You estimate roughly 80% of chromium is taken up into the leather during the tanning process.

Threshold Determination
Since your facility uses chromium (III) sulfate monobasic to produce leather products that will be distributed in commerce, you must determine if your facility has exceeded the processing threshold of 25,000 pounds during the previous calendar year. To do so, you must calculate the total amount of chromium compounds, in the form of chromium (III) sulfate monobasic, processed during the reporting year. This means that, where concentrations are presented in terms of chromium (III) oxide, you must convert to find the mass of the actual chromium compound(s) processed at the facility. If other facility operations use chromium compounds such as pre-metallized dyes, you must include those quantities in any threshold determinations and estimates of releases and other waste management quantities. Keep in mind that the quantity (in pounds) of the metal compound is used for threshold determinations. For estimates of releases and other waste management quantities, only the quantity of the parent metal is reported on the Form R.

The amount of chromium (III) sulfate monobasic processed at the facility during the reporting year is:

$$(350+2{,}250\text{-}600 \text{ drums}) \times \left(55\frac{\text{gal}}{\text{drum}}\right) \times \left(14.18\frac{\text{lb}}{\text{gal}} \text{ (solution density)}\right) \times (0.175\ \text{Cr}_2\text{O}_3 (17.5\%\ \text{Cr}_2\text{O}_3))$$

$$\times \left(\frac{1 \text{ mol } \text{Cr}_2\text{O}_3}{151.99 \text{ g } \text{Cr}_2\text{O}_3}\right) \times \left(\frac{2 \text{ mol Cr}}{1 \text{ mol } \text{Cr}_2\text{O}_3}\right) \times \left(\frac{1 \text{ mol } \text{CrOHSO}_4}{1 \text{ mol Cr}}\right) \times \left(\frac{165.071 \text{ g } \text{CrOHSO}_4}{1 \text{ mol } \text{CrOHSO}_4}\right)$$

$$= \mathbf{592{,}915 \text{ lbs chromium (III) sulfate monobasic}}^{1}$$

This exceeds the 25,000 pounds per year processing threshold of an EPCRA Section 313 chemical or chemical category. Thus, TRI reporting is required, and you must now determine the quantities of chromium released and/or otherwise waste managed.

Calculating Waste Management Quantities
Now you must determine how to calculate the quantities of chromium your facility released to the environment or otherwise managed as waste. Consider the ways in which chromium leaves your facility:

- As a component in the final product, including the product itself and leather dust, shavings, and other scraps generated during manufacturing;
- In the residue of "empty" shipping containers;
- In the liquid effluent and sludge solids from the wastewater treatment plant.

Keeping this in mind, you can use a mass balance calculation to determine how much of the chromium processed at your facility is ultimately managed as waste or released to the environment. Because releases and other waste management quantities are reported as pounds of the parent metal, first determine the mass of chromium present in the total quantity of chromium (III) sulfate monobasic processed during the reporting year. The atomic mass of chromium is 52 g/mol and the molecular mass of chromium (III) sulfate monobasic is 165 g/mol.

$$(\mathbf{592{,}915 \text{ lbs}}\ \text{CrOHSO}_4) \times \left(\frac{1 \text{ mol } \text{CrOHSO}_4}{165.071 \text{ g } \text{CrOHSO}_4}\right) \times \left(\frac{1 \text{ mol Cr}}{1 \text{ mol } \text{CrOHSO}_4}\right) \times \left(\frac{52 \text{ g Cr}}{1 \text{ mol Cr}}\right) = 186{,}778 \text{ lbs chromium}$$

Using this total quantity of chromium metal processed, you can calculate quantities of chromium managed as waste.

Example 2: Threshold Determination and Estimation of Release and Other Waste Management Quantities of Chromium Compounds (continued)

Leather Products

As previously stated, you estimate that 80% of chromium is taken up into leather during the tanning process.

$$(0.80) \times (186{,}763 \text{ lb total Cr}) = \mathbf{149{,}422 \text{ lbs chromium in leather}}$$

You estimate that 5% by weight of the leather is lost in the form of dust and scraps during the finishing process. The dust and scraps are sold to a fertilizer manufacturer for direct reuse. Thus, all chromium taken up into leather during the tanning process is sold in commerce. You do not need to report this quantity in the TRI reporting Form R. You must determine quantities of the remaining chromium that were returned to the supplier in the "empty" steel drums, discharged to surface waters in effluent, and managed in sludge solids from wastewater treatment.

"Empty" Shipping Containers

An average of 0.034% of a liquid with water characteristics remains as the residue in an open-top steel drum, unloaded by pouring. That is, for any given drum that contained an aqueous solution of a chemical, when emptied, the drum will contain about 0.034% of the total original volume as remaining in the container. All of the chromium (III) sulfate monobasic processed by the facility comes from these containers, which are all returned to the supplier in the "empty" drums. This can be estimated as:

$$(0.00034) \times (186{,}778 \text{ lbs total chromium}) = \mathbf{63.5 \text{ lbs of chromium returned to the supplier}}$$

If you know that the drums are refilled and returned to you without being cleaned or otherwise managed, your facility should not report this amount as a release or other waste management activity on the Form R. However, if they are cleaned, this quantity should be reported as being sent off-site for disposal, treatment, energy recovery, or recycling, as appropriate.

Wastewater Treatment Plant

The liquid effluent from your facility wastewater treatment plant discharges directly to a receiving stream while the sludge from the plant is disposed on-site in a RCRA Subtitle C landfill. The NPDES permit for the effluent requires monitoring for, among other items, flow, and chromium concentration. The flow was 150,000,000 gallons for the reporting year and the chromium content averaged 0.75 µg/L.

The amount of chromium in the liquid effluent is:

$$\left(150{,}000{,}000 \tfrac{\text{gal}}{\text{year}}\right) \times \left(0.75 \tfrac{\mu\text{g}}{\text{L}} \text{ Cr concentration}\right) \times \left(10^{-9} \tfrac{\text{kg}}{\mu\text{g}}\right) \times \left(2.2 \tfrac{\text{lb}}{\text{kg}}\right) \times \left(3.78 \tfrac{\text{L}}{\text{gal}}\right)$$
$$= \mathbf{0.9 \text{ lbs chromium in the liquid effluent}}$$

This quantity should be reported in Part II, Sections 5.3 and 8.1 of the Form R. You can now use a mass balance to determine the amount of chromium in the wastewater treatment plant sludge:

$$(186{,}778 \text{ lbs total Cr}) - (149{,}422 \text{ lbs Cr in leather}) - (63.5 \text{ lbs Cr in drum residue}) - (0.9 \text{ lbs Cr in effluent})$$
$$= \mathbf{37{,}291.6 \text{ lbs chromium in sludge}}$$

This should be reported in Part II, Sections 5.5.1A and 8.1 of the Form R.

Note that this quantity is also the amount that was removed from the wastewater stream in your on-site wastewater treatment system. Therefore, Part II, Sections 7 and 8.6 should also be completed. The quantity reported in Section 8.6 should be the amount actually destroyed and for the purposes of EPCRA Section 313 reporting metals cannot be destroyed. Therefore, you must complete Section 7 (with the appropriate removal efficiency of 100% in this case) and enter zero in Section 8.6 as the quantity destroyed.

3.2.3 Retanning, Coloring, and Fatliquoring

Retanning, coloring, and fatliquoring make the physical properties of the leather conform to the requirements of the desired end use of the finished product. In the retanning process several tanning agents may be combined to achieve a certain leather quality. Dyes may be added to achieve the desired color. The fatliquoring process involves the use of oils and waxes to lubricate the collagen fibers to produce the flexibility and softness needed for the final leather product (Ref: *Leather Facts,* Third Edition. New England Tanners Club, Peabody, MA. 1994). A typical flow diagram for the retanning, coloring, and fatliquoring operations is presented in Figure 3-3.

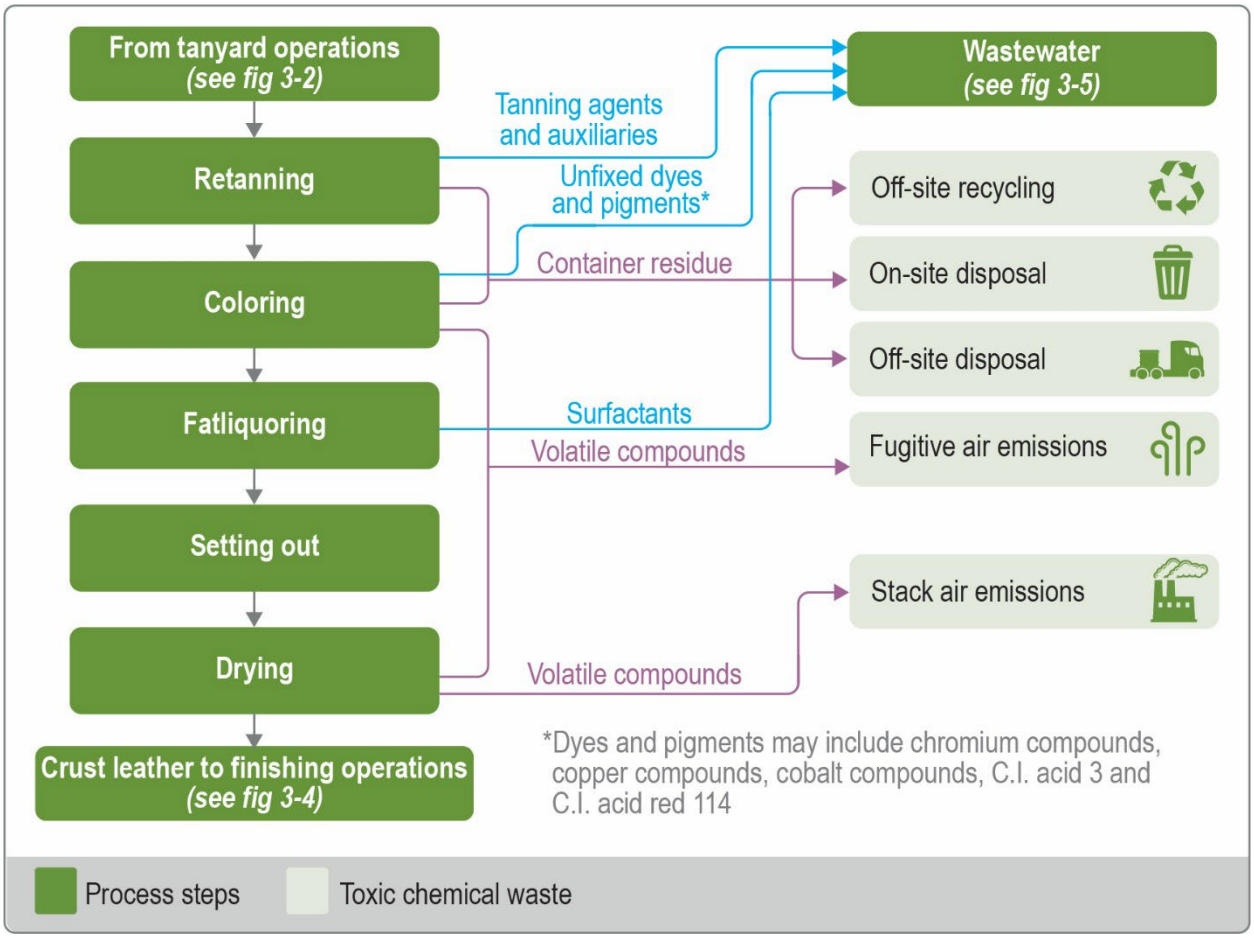

Figure 3-3: Process Flow Diagram – Retanning, Coloring, and Fatliquoring Operations

Retanning operations may use the following EPCRA Section 313 chemicals: formaldehyde, formic acid, sulfuric acid (only an EPCRA Section 313 chemical when in an aerosol form), chromium compounds, copper compounds, cobalt compounds, 2-phenylphenol, C.I. Acid Green 3, C.I. Acid Red 114, and xylene.

Melamine-based resins, used to retan leather, may contain formaldehyde (an EPCRA Section 313 chemical). Synthetic tanning agents may also contain formaldehyde when used to polymerize sulfonated phenols to synthesize the syntans. While a residual amount of free formaldehyde is sometimes present in these products, the formaldehyde usually combines with the leather, rather than being released. Its use in tanning operations has been largely replaced with alternative chemicals such as glutaraldehyde (which is not an EPCRA Section 313 chemical).

Chromium compounds also can be used as mineral tanning agents, and chromium is often the metal moiety in pre-metallized dyes used to dye leather. The pre-metallized dyes also may be based on copper or cobalt. Most of the dye is absorbed into the leather. Other EPCRA Section 313 chemicals include 2-phenylphenol which functions as a fungicide in these operations; the two dyes, C.I. Acid Green 3 and C.I. Acid Red 114, which are not commonly used in leather manufacturing facilities but may be used by some facilities for coloring processes, and; xylene, which may be used as a solvent for the application of silicone (not an EPCRA Section 313 chemical). Additionally, certain per-and polyfluoroalkyl substances (PFAS) (e.g., fluorocarbon polymers, perfluorinated carboxylates and acrylates) in the fatliquoring operation.

Typical sources of releases of EPCRA Section 313 chemicals during retanning, coloring and fatliquoring operations are similar to those presented in beamhouse and tanyard operations. These sources include processing wastewaters (surface water discharges or transfers to a POTW), evaporation of EPCRA Section 313 chemicals such as xylene and other solvents (fugitive or stack air emissions), and residues in "empty" shipping containers that are discarded.

After identifying the sources and types of releases or other reportable quantities of EPCRA Section 313 chemicals, the method(s) used to estimate the quantities released or otherwise managed as waste from retanning, coloring, and finishing operations are identical to those previously discussed for beamhouse and tanyard operations.

Monitoring data gathered for on-site wastewater treatment plant operating permits and/or NPDES permit requirements can generally provide flow data and wastewater concentrations that can be used to estimate quantities of EPCRA Section 313 chemicals and chemical categories directly discharged to receiving streams or indirectly discharged to POTWs.

EPCRA Section 313 chemicals that are individually listed or are in chemical categories and that are volatile (e.g., xylene) and not intended to remain with the product (e.g., xylene used as a solvent) can be assumed to be 100% released to air either as fugitive or stack emissions, as appropriate after subtracting any potential container residue. For dry materials, a residue factor of 1% can be used if actual data are not available.

3.2.4 Finishing Operations

Finishing operations may be comprised of several steps designed to achieve the desired physical properties and dimensions for the intended end use of the leather. The steps may include achieving the proper level of residual moisture; mechanical softening; smoothing/buffing the surface; and imparting the desired grain pattern, grading, and measuring and cutting patterns to fit customer specifications (Ref: *Leather Facts,* Third Edition. New England Tanners Club, Peabody, MA. 1994). A typical flow diagram of finishing operations is presented in Figure 3-4.

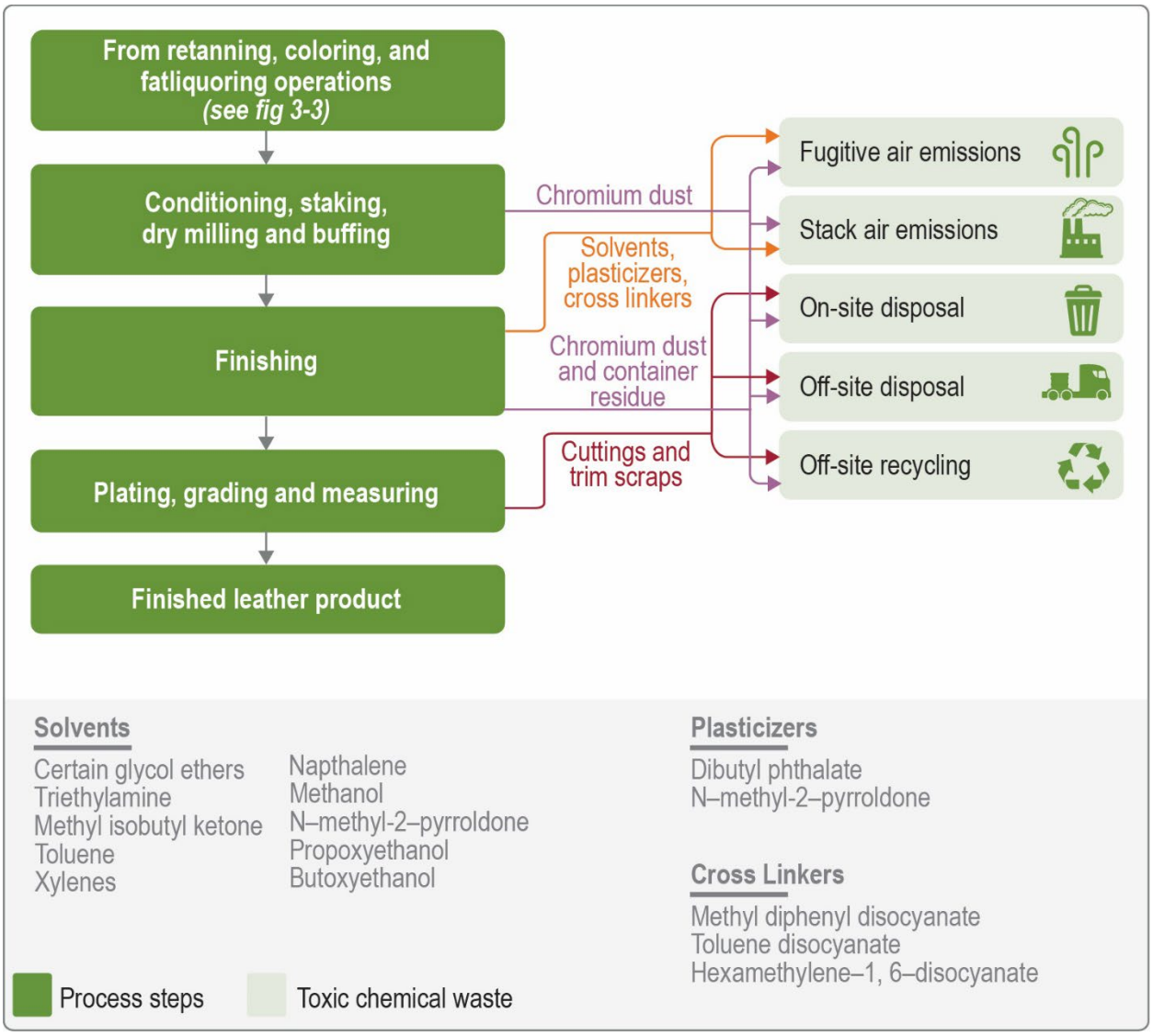

Figure 3-4: Process Flow Diagram – Finishing Operations

Leather dust containing chromium may be generated in some of the unit operations during finishing. Other EPCRA Section 313 chemicals that may be used in finishing operations serve as solvents, plasticizers, or crosslinkers, and are listed in the process flow diagram. According to the Leather and Hide Council of America, a range of leather finishing formulations use propylene glycol and other glycol ethers based on propylene glycol, which are not included in the EPCRA Section 313 certain glycol ethers category; however, other glycol ethers such as 2-butoxyethanol, propoxyethanol, and diethylene glycol monomethyl ether are used by the leather industry and are included in the EPCRA Section 313 certain glycol ethers category.

Typical sources of releases of EPCRA Section 313 chemicals during finishing operations include the generation of dusts containing chromium or chromium compounds; evaporation of chemicals, particularly solvents and plasticizers used in the final finishing steps; scraps and cuttings to make the final product; and "empty" shipping containers that contain residues of EPCRA Section 313 chemicals.

Typically, the quantities of EPCRA Section 313 chemicals that are released or are otherwise managed as waste as a result of finishing operations are lower compared to those of the other leather tanning

processes discussed above. The expected types of releases include fugitive and stack air releases of both dusts and chemicals that have evaporated. Releases also include container residues and any dusts that contain EPCRA Section 313 chemicals that are collected in air pollution control devices that are disposed of (released), treated, burned for energy recovery, or recycled on-site or sent off-site for management. Note that any EPCRA Section 313 chemical sent through a pollution control device is considered to have been treated for destruction if it is converted to another chemical or it is an aerosol of either hydrochloric acid or sulfuric acid. (Note that metals and metal compounds are generally not considered to be treated for destruction for the purposes of TRI reporting. The reader is referred to the current version of the TRI Reporting Forms and Instructions for additional guidance on metals and metal compounds.) The treatment efficiency of the unit should be reported in Section 7A, and the quantity treated for destruction should be reported in Section 8.6 of the Form R. Also, note that any EPCRA Section 313 chemical sent through an air pollution control device is considered to have been captured for further waste management activities if it is not converted to another chemical or it is **not** hydrochloric acid aerosol or sulfuric acid aerosol. The capture efficiency of the unit should be reported in Section 7A, and the quantity captured should be reported in Sections 6 and/or 8 of the Form R depending on the final disposition of the chemical or chemical category. Wastewater is not typically generated in finishing operations.

Many of the solvents and other EPCRA Section 313 chemicals processed and otherwise used in finishing operations are very volatile and evaporate readily, or otherwise have high vapor pressures. One can assume that all of the applied amount will evaporate and be released to the air, either as a fugitive emission, or as a stack emission if vapors are channeled through stacks and other point sources. Do not forget to account for any potential container residue before estimating the quantity that may be volatilized during processing or otherwise use activities. The total amount released can be estimated using a mass balance approach based on purchasing records and beginning and end-of-year facility inventory amounts.

Dusts containing EPCRA Section 313 chemicals (typically chromium or a chromium compound) may be generated and collected in a fabric filter (baghouse). If so, quantities of the EPCRA Section 313 chemical (e.g., chromium) passing through the baghouse should be estimated as stack emissions, and the quantity collected should be reported based on the method used to manage the waste dust. Also, use of the baghouse (an air pollution control device) is considered on-site treatment. Therefore, Part II, Section 7A and 8.6 of the Form R should be completed as appropriate.

Dusts and trim scraps are typically sold and weighed, and the chromium concentration is expected to be the same as in the finished product. If sold, the quantity of chromium in the dusts or scraps does not have to be reported but should be considered in mass balance calculations when determining releases and other waste management quantities. If disposed or otherwise managed as waste, the quantity of EPCRA Section 313 chemical should be reported or approximated with estimates based on the mass disposed multiplied by the concentration.

3.2.5 Wastewater Treatment

Many leather tanning facilities operate their own wastewater treatment plants, while others send their wastewaters to a POTW for treatment. The incoming wastewater is characterized by high biochemical oxygen demand (BOD) and total suspended solids (TSS) content. In many cases the chromium and other heavy metals are removed by pre-treatment using high pH liquors from beamhouse operations to precipitate the metals. Direct discharge permits (NPDES/SPDES) or POTW influent specifications typically establish limits for chromium, sulfides, pH, nitrates, BOD, and TSS. A typical flow diagram is presented in Figure 3-5.

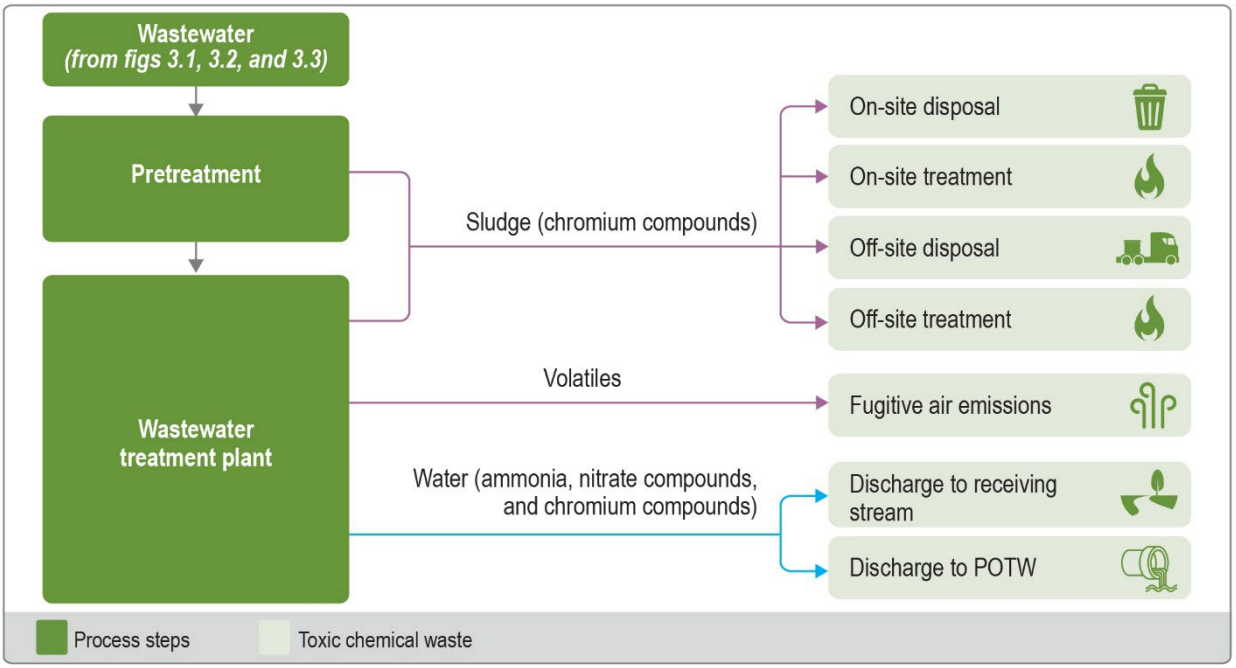

Figure 3-5: Process Flow Diagram – Wastewater Treatment

Manganese sulfate, ammonia, chlorine, chlorine dioxide, chromium, and chromium compounds are some of the EPCRA Section 313 chemicals and chemical categories found in leather tanning and finishing wastewater treatment operations. The wastewater treatment system may use manganese sulfate as a catalyst for sulfide oxidation. This would be classified as otherwise used under EPCRA Section 313. Chromium and chromium compounds from the facility process operations may pass through the system and are found in the wastewater effluent and sludges. Ammonia and nitrate compounds can be coincidentally manufactured in biological treatment systems when proteins are metabolized or decomposed. Ammonia may also be added as a metabolic nitrogen source for the microbes. Chlorine and chlorine dioxide are used for effluent disinfection.

Typical sources of EPCRA Section 313 chemicals are treatment system effluents, evaporation of volatile compounds, and residues in "empty" shipping containers.

Types of release and other waste management activities include direct discharge to receiving streams, indirect discharges to POTWs, fugitive air emissions from evaporation of any volatile materials, and on-site or off-site management of container residues and sludges, which may result in the release or management of wastes that contain EPCRA Section 313 chemicals to on-site or off-site disposal, treatment, energy recovery, or recycling, as appropriate.

As previously discussed, monitoring data gathered for direct discharge permits and POTW influent specifications can provide flow data and concentrations of EPCRA Section 313 chemicals in the wastewater entering and leaving the wastewater treatment system. For dry materials, a residue factor of 1% can be used if actual data are not available.

The quantity of anhydrous ammonia that is coincidentally manufactured should be applied to both the 25,000-pound manufacturing threshold as well as the 10,000-pound otherwise use threshold (assuming it is consumed as a metabolic nitrogen source).

Finally, emissions factors for volatile EPCRA Section 313 chemicals from wastewater treatment plants are available in Chapter 4.3 of AP-42.

SECTION 4.0 Reporting Pollution Prevention Activities

Section 4.1 Pollution Prevention Activities in Leather Tanning and Finishing Facilities

The previous sections discuss commonly used chemicals and reporting of chemical waste that is generated. This section is intended to assist leather tanning and finishing facilities in identifying 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 management of waste is through recycling, followed by combusting for energy recovery, treatment and, as a last resort, disposing of or releasing the waste into the environment. However, EPA encourages facilities to first eliminate the creation of chemical waste through source reduction activities. Source Reduction refers to any practice that reduces, eliminates, or prevents pollution from being released or entering a waste stream. Each year, you should consider the implementation of any source reduction practices and report any practices as required to TRI.

Practices typically reported to TRI by leather tanning and finishing facilities include:

- **Process and equipment modifications** implemented to optimize synthesis and use less toxic chemicals
    - *Example:* Instituting a chrome recovery system.
    - *Example:* Introducing process to remove excess lime, reducing later use of ammonium salts.
- **Material substitutions and modifications** implemented to prevent or reduce the use of EPCRA Section 313 chemicals
    - *Example:* Switching chromium to a different mineral tannage.
    - *Example*: Substituting #6 fuel oil with B50, a product that is 50% vegetable, reducing air emissions of benzo(G,H,I)perylene.
    - *Example:* Replacing liquid chromium with concentrated powder to increase chrome fixation in skins
- **Product modifications** implemented to prevent or reduce the use of EPCRA Section 313 chemicals
    - *Example:* Transitioning to a chrome-free product in response to customer specifications.
    - *Example:* Altering product by shifting to deer from cattle hides, which facilitate formula changes to fit customer needs.
- **Operating practices** and training implemented to enhance operator and housekeeping measures to eliminate or minimize waste
    - *Example:* Changing production schedule to minimize equipment and feedstock changeovers of n-methyl-2-pyrrolidone.

Other sustainability practices reported by leather tanning and finishing facilities include:

- **Recycling of leather hide pieces and chromium** to reduce environmental impacts such as recovering pieces cut off during the leather making process and exploring technology options that allow for recycling of chromium (such as filtration equipment to clean out impurities).
- **Wastewater technology modifications** to destroy or avoid creation of TRI chemicals such as examining the use of waste stream filtering to remove ammonia or avoiding the mixing of effluents containing sulfide with low PH effluent that may generate hydrogen sulfide.

Over time, leather tanning and finishing facilities have transitioned away from the use of EPCRA Section 313 chemicals. As early as 1985, leather tanning facilities began to reduce the use of solvents such as toluene, methyl ethyl ketone, methyl isobutyl ketone, and cyclohexanone. Automotive leather tanneries reduced TRI solvent usage through water-based polyurethane and acrylic resins with water dispersible isocyanate cross-linkers. Similarly, in the early 2000s, leather industry chemical suppliers developed finishing systems using non-TRI solvents such as dibasic ester and dipropylene glycol dimethyl ether, which have largely replaced N-methyl-2-pyrrolidone-based systems. Leather tanneries have also phased out the use of nonylphenol ethoxylated surfactants.

Many factors contribute to these changes including international chemical standards, such as Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), that may limit the use of certain substances internationally, thereby encouraging facilities to move towards more sustainable processes and chemical alternatives. For additional information on possible substitutes, refer to resources such as EPA's Safer Chemical Ingredients List (SCIL) https://www.epa.gov/saferchoice/safer-ingredients.

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