PAINTING & SURFACE COATING OPERATIONS

Date Initiated:

December 10, 1992

Dates Modified / Updated:

April 2, 1998; May 23, 2019; May 1, 2023; June 13, 2023; Oct. 2023, August 2025

PROCESS DESCRIPTION:

Surface coating operations using paints, coatings, thinners, and cleanup solvents result in the release of volatile solvents and/or particulates to the atmosphere. Emissions volatile compounds can be estimated using mass balance, purchase records, inventory records, waste records and safety data sheets (SDSs). In addition, nonvolatile solids (particulates) can be estimated using transfer efficiencies, fall out percent, capture efficiencies and control efficiencies. Volatile compound emissions typically include TOG, VOC, benzene, toluene, xylenes, methylene chloride, 1,1,1- trichloroethane, perchloroethylene, alcohols, glycol ethers, while particulates include copper, chromium, lead, zinc, and crystalline silica. The standard estimation techniques used by the District are based upon material usage, material composition, transfer efficiencies, and control efficiencies:

For volatile compounds:

$$\mathbf{Ea = [(Ua - W) \times D \times Ci] \times [(100 - e_{capture}) + (e_{capture}) \times (100 - e_{control})]}$$

$$\mathbf{Eh = [Uh \times D \times Ci] \times [(100 - e_{capture}) + (e_{capture}) \times (100 - e_{control})]}$$

For particulates:

$$\mathbf{Ea = [(Ua - W) \times D \times Ci \times (100 - T) \times (100 - FO)] \times [(100 - e_{capture}) + (e_{capture}) \times (100 - e_{control})]}$$

$$\mathbf{Eh = [Uh \times D \times Ci \times (100 - T) \times (100 - FO)] \times [(100 - e_{capture}) + (e_{capture}) \times (100 - e_{control})]}$$

Where:

Ea = Annual emissions of each listed toxic air contaminant per device, (lbs/year)

Eh = Maximum hourly emissions of each listed toxic air contaminant per device, (lbs/hour)

Ua = Annual usage of each material containing a listed substance, (gals/year)

Uh = Maximum hourly usage of each material, (lbs/hour)

W = Total amount of annual usage disposed as waste, (gals/year)

D = Density of material used, (lbs/gal)

Ci = Concentration of each listed substance in each material used (lbs/lb)

T = Transfer efficiency of Ci for the application method used, (%)

FO = Fallout percent of Ci for the application method used, (%)

$\mathbf{e_{capture}}$ = Capture efficiency of Ci , (%)

$\mathbf{e_{control}}$ = Control efficiency of Ci , (%)

EMISSIONS INFORMATION:

Information regarding material composition can usually be obtained from SDS documentation. Facilities must provide the following information for each material used in each device; material composition, application method used, average transfer efficiency (solids only), average fallout fraction (solids only), control device capture efficiency, control device VOC removal efficiency, and control device solids removal efficiency. All VOC's are assumed to be released (no controls and no polymerization) unless otherwise specified. All solids emitted are assumed to have particle sizes of PM10 or less. Facilities must estimate the amount of annual waste generated by each coating and solvent used on site.

DIISOCYANATES

Due to the high toxicity of diisocyanates like Toluene Diisocyanate (TDI), Methylene Diphenylene Diisocyanate (MDI), and 1,6-Hexamethylene Diisocyanate (HDI), the District has found it necessary to include specific guidance when determining the concentration (**Ci**) relating to diisocyanates. The District has reviewed the following studies related to diisocyanates and there are two main factors to consider when determining the concentration of diisocyanates: whether the pollutant listed in the SDS is a monomer or oligomer, and the pollutant's polymerization rate.

Please apply the following composition factors in the cases where the chemical composition in an SDS only lists the diisocyanates as a ‘mixture’, ‘polymer’, or ‘pre-polymer.’

Process Type	Diisocyanate Type	CAS Number	Monomer or Oligomer	Composition Factor (%)
Spray Coating	HDI	822-06-0	Monomer	1
	HDI	Polymeric (Oligo) HDI[1]	Oligomer	75
Polyurethane Foam Insulation	MDI	101-68-8	Monomer	55
	MDI	9016-87-9	Oligomer	55
Polyurethane Glue	MDI	101-68-8	Monomer	3
	MDI	9016-87-9	Oligomer	97

In practice, not all the diisocyanates sprayed are emitted into the air as a monomer; some of these diisocyanates are polymerized. Please use the following polymerization rate factors when determining the concentration of each diisocyanate.

Diisocyanate Type	Polymerization Rate Factor (diisocyanate emitted / diisocyanate sprayed)
HDI	8.1%[a]
MDI	0.0001%[b]
TDI	0.0025%[c]
[a] 81 g / kg HDI used (MOE, 2017) [b] 1 g / tonne of MDI used (Tury, et al., 2003) [c] 25 g / tonne TDI used (Tury, et al., 2003; OEHHA, 2016)	

The following literature was used to create the factors described above.

- Guide for Safe Use of Isocyanates: An Industrial Hygiene Approach by The Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST), 2013.
- Emission factors for 1,6-Hexamethylene Diisocyanate (Hdi) emissions from spray booth operations by the Ontario Ministry of the Environment (MOE), 2017.
- Fate and potential environmental effects of methylenediphenyl diisocyanate and toluene diisocyanate released into the atmosphere by Bernard Tury, Denis Pemberton, Robert E Bailey, 2003.
- Appendix D1: Toluene Diisocyanate Reference Exposure Levels - Technical Support Document for the Derivation of Noncancer Reference Exposure Levels, Office of Environmental Health Hazard Assessment (OEHHA), 2016.

[1] Apply to all Polymeric (Oligo) HDI compounds required to be quantified, including those with health risk values as seen in the Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values

ASSUMPTIONS / LIMITATIONS

- Site specific test data, approved by the District, should be used in place of default transfer efficiencies, fallout fractions, capture efficiency, or control efficiencies when appropriate. Where device or material specific information is unavailable, typical default values should be used to estimate emissions.

- The fraction of each material used at a given facility that is disposed of as a waste may vary considerably dependent upon the specific material type, application method, and use. In general, only small fractions (< 5%) of clean up solvents and thinners are expected to become waste. Continuous spray operations with single coatings may generate almost no waste (< 1%). Small job shops with multiple coatings and a variety of parts usually produce a larger fraction of waste disposal (10 - 15% of total material usage). Waste fractions rarely exceed 20% for most sites since waste disposal represents both an ineffective use of raw material and an added production cost.

NOTE: The combined amount of all waste reported for all materials used on site should not exceed the total gallons of waste shipped off site.

- Paint pigment emissions can be significant sources of toxic emissions. Coatings containing chromium, copper, lead, nickel, and other heavy metals can result in potential health risk impacts which far outweigh the effects of concurrent VOC releases. It is important to obtain the most accurate estimates of solid transfer, fall out, capture, and control efficiencies possible for these materials.

- Paints and coating applied by dip coat, brush, and roller (no spraying) should be assumed to have a 100% transfer efficiency for solids.

- Transfer efficiency represents the % of solids actually transferred to the part being coated. Typical values usually range from 10% for airless spraying of small parts (i. e.; bird cages) to 80% for HVLP spraying of large parts (i. e.; flat panels). In general, the larger the part the higher the transfer efficiency due to the increased surface area. The material, part, and application method must all be considered in estimating the transfer efficiency.

- Fall out fraction represents the % of the solids not transferred to the part that drops out in the spray area before the control device. Typical values usually range from 80% for airless spraying of small parts (i. e.; bird cages) to 40% for HVLP spraying of large parts (i. e.; flat panels). In general, the larger the part the smaller the fall out fraction due to the increased fraction of small diameter paint particles in the "non transferred" pigment. The material, part, application method, and spray area ventilation rate must all be considered in estimating fall out fraction.

- Control equipment that does not include separation, extraction, or destruction of organic emissions should be assumed to have a 0% efficiency for VOC's. This would include fabric filters, shrouding, and water curtains (with recycled down wash). This would not include incinerators or activated carbon.

- Overall control device efficiencies must account for the expected capture efficiency of the device as well as the removal efficiency. Fugitive emissions of pigments from unenclosed spray areas often represent the majority of toxic emissions.

- Painting performed by outside contractors at a facility during the reporting period must be included as part of the facility's emissions for reporting, prioritization, and risk assessment purposes.

- Diisocyanate emissions and risk will be calculated for the pollutants listed in EIS. Each pollutant should correspond with the listed CAS and/or pollutant code in order to ensure accurate calculation. Some of those listed are seen below:

- HDI
    - POLYMERIC (OLIGO) HEXAMETHYLENE1,6-DIISOCYANATE (HDI) (1221)
    - BIURET (CAS 108-19-0)
    - DIISOCYANURATE (1226)
    - HDI PREPOLYMER (1227)
    - ISOCYANURATE (1228)
    - URETDIONE (HDI) {URETIDONE} (CAS 23501-81-7)
    - 1,6-HEXAMETHYLENE DIISOCYANATE (monomer) (CAS 822-06-0)
- MDI
    - METHYLENE DIPHENYL DIISOCYANATE (CAS 101-68-8)
- TDI
    - TOLUENE DIISOCYANATE (CAS 26471-62-5)
    - TOLUENE-2,4-DIISOCYANATE (CAS 584-84-9)
    - TOLUENE-2,6-DIISOCYANATE (CAS 91-08-7)

REPORTING:

Individual information for EACH material used in EACH painting operation should be reported. District staff may allow "grouping" of some solvents and coatings to reduce facility reporting tasks where usage and composition are less critical.