# Releases from Roll Coating and Curtain Coating Operations - Generic Scenario for Estimating Occupational Exposure and Environmental Releases

Draft

U.S. Environmental Protection Agency
Office of Pollution Prevention and Toxics
Chemical Engineering Branch
1200 Pennsylvania Avenue
Washington, D.C. 20460

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## Introduction:

Under Section 5 of the Toxic Substances Control Act (TSCA), the U.S. Environmental Protection Agency's (EPA's) Office of Pollution Prevention and Toxics (OPPT) evaluates new chemicals (i.e., those chemicals not listed on the TSCA Inventory), for potential risks associated with their stated and potential uses. Existing chemicals may also be evaluated under Sections 4 and 6 of TSCA for potential risks associated with their various uses. In these cases, EPA may develop regulatory controls and/or non-regulatory actions to protect human health and the environment from harm resulting from manufacturing, processing, transport, disposal, and current and potential new uses of existing and new chemical substances.

A new chemical, with certain exceptions, is any chemical that is not currently on the TSCA Chemical Substance Inventory. Under Section 5 of TSCA, companies are required to submit a Premanufacture Notification (PMN) at least 90 days prior to commercial production (including importation). The Chemical Engineering Branch (CEB) is responsible for preparing the occupational exposure and release assessments of the new chemicals. These assessments are based on information provided by the PMN submitter, information from readily available databases and literature sources, and standard estimating techniques used by CEB. Frequently, data on the new chemical being assessed are not available. In the event that information is unavailable, CEB relies on other approaches for developing release and exposure assessments.

CEB has developed a number of standard models to provide estimates of environmental releases and occupational exposures from standard release sources (e.g., equipment cleaning) and worker activities (e.g., unloading). These models are designed to provide conservative screening-level estimates where industry-specific or chemical-specific information is not available.

## Scope:

This model estimates an environmental release of coating formulation or its chemical components due to coating application inefficiencies during roll and curtain coating operations. The scope of this model is limited to losses from the coating operation due to overall application loss due to transfer inefficiencies. Specifically, this loss represents the fraction of the coating formulation that does not remain on the substrate during the coating process. The generic model is only applicable to estimate releases from the application of the coating and not to releases from other activities at the site (e.g., spills during loading, cleaning, etc.).

## Approach:

The Generic Scenario Literature Search SOP (last revised June 13, 2006) was completed for the Emission Scenario Document (ESD) on the *Application of Radiation Curable Products*. One relevant reference provided a transfer efficiency range for roll and curtain coating operations in general. The transfer efficiency range given in the reference is 90% to 98%. No other reference sources were found to have transfer efficiency or transfer loss estimates or data for these operations. This transfer efficiency range is used to estimate an overall application loss from these operations. The draft ESD noted above has more information about coating processes, and this model documentation will be updated to cite the ESD, thereby providing access to the coating processes information, once the ESD has been completed.

## Model:

The maximum amount of coating (or a component) lost due to roll and curtain coating operation application inefficiency may be assumed to be equal to the amount of coating (or a component) applied minus the amount of coating (or a component) adhering to the substrate. The amount of coating (or a component) adhering to the substrate may be estimated by multiplying the transfer efficiency by the amount of coating (or a component) applied to the substrate.

One reference was found as a source for a transfer efficiency range for roll and curtain coating operations in general. The transfer efficiency range given in the reference is 90% to 98% (PA DEP, 1997). The reference does not cite the source for this range, nor did the reference provide other data or detailed information related to the range.

Therefore, based on the range of estimated transfer efficiencies, the following model equation may be used to calculate a screening-level estimate of the quantities of a given chemical that may be released from coating process due to transfer inefficiencies:

$$\text{Elocal}_{\text{appl\_loss}} = Q_{chem\_applied} \times \left(1 - \text{F}_{\text{transfer\_efficiency}}\right)$$

Where,

$\text{Elocal}_{\text{appl\_loss}}$ = Daily release of chemical in coating from application loss (kg/ site-day)

$Q_{chem\_applied}$ = Quantity of chemical in coating applied (kg/ site-day)

$\text{F}_{\text{transfer\_efficiency}}$ = Fraction of chemical adhering to substrate following the coating process (Default = 0.90 to 0.98 kg adhering/ kg applied)

This daily release will occur over the number of days per year during which the coating containing the chemical will be applied at the site. The daily release may be characterized as a "what-if" type estimate as noted in the "Uncertainties and Limitations" section below.

## Media of Release:

In curtain coating, a stream of coating flows at a controlled rate as the substrate is conveyed across the stream. The amount of coating that is not transferred to the substrate drips down collection tunnels and may be recycled to the feed reservoir or possibly disposed to water, incineration, or landfill. Roll coating processes may involve high line speeds that have a potential for splatter and mist generation during application that may be disposed to water, incineration, or land. Disposal of the coating in the reservoir may also be sent to water, incineration, or land.

Therefore, a conservative assumption would be to assume this loss may be to water, incineration, or landfill.

**Assumptions, Uncertainties, and Limitations:**

The basis, source, and actual representativeness for the range of transfer efficiencies in the reference are not known. For example, the range could be based on actual measured data from some number of roll and curtain coating operations. Alternately, the range could be based on professional judgment of those knowledgeable about these operations. The range may represent some subset of all roll and curtain coating operations, and a significant number of operations could have transfer efficiencies outside of this range. Alternately, the range may fairly represent transfer efficiencies at nearly all roll and curtain coating operations in the U.S.

For operations where the transfer efficiency falls within the range used by this model, the model may overestimate losses for chemicals that are transformed during the coating process. For example, some chemicals may partially or totally react due to radiation exposure or other chemical reactions prior to disposal.

Another uncertainty is the model assumption that the transfer efficiency represents an overall process efficiency and not a one-pass application efficiency.

Despite these uncertainties, the range of transfer efficiencies can be used to estimate losses from this source when no other information or data may be available to estimate these losses. The estimates may be characterized as "what-if" estimates, conveying that both the representativeness of model input parameters and results, and where these results may fall on the distribution of actual releases from real sites, are not known.

**Sample Calculation:**

A chemical at 10% by weight in a coating is applied at a rate of 10,000 kg/ site-day over 100 days per year at a site. The amount of chemical applied daily is 10% of 10,000, or 1,000 kg/ site-day. To estimate the application loss of the chemical, the model equation is used as follows:

$$\text{Elocal}_{\text{appl\_loss}} = Q_{chem\_applied} \times \left(1 - \text{F}_{\text{transfer\_efficiency}}\right)$$

$$\text{Elocal}_{\text{appl\_loss}} = 1{,}000 \frac{kg}{site - day} \times (1 - 0.98) \quad \{\text{low end of release range}\}$$

$$\text{Elocal}_{\text{appl\_loss}} = 1{,}000 \frac{kg}{site - day} \times (1 - 0.9) \quad \{\text{high end of release range}\}$$

$$\text{Elocal}_{\text{appl\_loss}} = 20 \frac{kg}{site - day} \quad \{\text{low end of release range}\}$$

$$\text{Elocal}_{\text{appl\_loss}} = 100 \frac{kg}{site - day} \quad \{\text{high end of release range}\}$$

(release occurs over 100 days per year to water, incineration or landfill)

**References:**

(PA DEP, 1997) *Pollution Prevention Opportunities for Painting and Coatings Operations*; Pennsylvania Department of Environmental Protection. Available on the following web page (as of the date of this draft): http://www.p2pays.org/ref/01/00151.pdf