# Specific Environmental Release Categories (SPERCs) for formulation of liquid and powder coatings

# Background Document

CEPE

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# Content

## General Disclaimer

SPERCs are specific environmental release categories and are meant to specify broad emission scenario information (ERCs) as suggested for the use of substances throughout their life cycles (Reihlen et al., 2016). Although specific, SPERCs still reflect emissions of a broad application area of a substance within an industry sector. For their purpose, SPERCs are conservative and, therefore, their emission estimates are not intended to reflect all regulatory requirements that may relate to environmental emissions.

# 1 Purpose of the document

This document provides background information to the CEPE SPERC factsheets for the application of liquid and powder coatings and inks. The REACH Guidance on Information Requirements and Chemical Safety Assessment, Chapters R12: Use description and R.16: Environmental exposure assessment, introduce Environmental Release Categories (ERC) as conditions for initial tier assessment. These provide default generic emission scenarios and define emission factors for certain processes. SPERCs are refined emission estimates compared to ERCs.

The ECHA Guidance provides one set of release factors each for the industrial use of a substance. This document focusses on the formulation of mixtures (ERC2).

As processes that have integrated risk management measures with impacts on the fate of volatile and non-volatile compounds, the CEPE SPERCs refer to ERC 2. Thus, specific information is provided on exposure relevant operational conditions/risk management measures for product formulation (Ch. 3), on the application of risk management measures, including non-obligatory ones (Ch. 4), on the information sources on the derivation method and justification of release factors, days emitting and indicative use rates (Ch.5).

The SPERC Factsheets covered by this document, which comprise a number of (sub-)SPERCs are:

| **CEPE SPERC Code** | **Type of ingredient** | **Application area** |
|---|---|---|
| CEPE SPERC 2.1a.v1 | volatile ingredients | Formulation of organic solvent-borne coatings and inks - large scale (>1,000 tpa solvent use) |
| CEPE SPERC 2.1b.v1 | volatile ingredients | Formulation of organic solvent-borne coatings and inks - small scale (<1,000 tpa solvent use) |
| CEPE SPERC 2.1c.v1 | non-volatile ingredients | Formulation of organic solvent-borne coatings and inks – non volatiles |

| | | |
|---|---|---|
| CEPE SPERC 2.2a.v1 | volatile ingredients | Formulation of water-borne coatings and inks - large scale (>1,000 tpa solvent use) |
| CEPE SPERC 2.2b.v1 | volatile ingredients | Formulation of water-borne coatings and inks - small scale (<1,000 tpa solvent use) |
| CEPE SPERC 2.2c.v1 | non-volatile ingredients | Formulation of water-borne coatings and inks – non volatiles |
| CEPE SPERC 2.3a v.1 | non-volatile ingredients | Formulation of powder coatings and inks |
| CEPE SPERC 2.4a.v1 | volatile ingredients | Formulation of liquid coatings and inks (where specific formulation not known) - large scale(>1,000 tpa solvent use) |
| CEPE SPERC 2.4b.v1 | volatile ingredients | Formulation of liquid coatings and inks (where specific formulation not known) - small scale (<1,000 tpa solvent use) |
| CEPE SPERC 2.4c.v1 | non-volatile ingredients | Formulation of liquid coatings and inks (where specific formulation not known) |

# 2 Scope

The SPERCs in this area are valid for refinement of release factors for substances used in an industrial setting in formulating coatings, comprising solvent-borne, water-borne, liquid solvent-free and powder coatings.

**Short title:**

Formulation, including mixing, handling repacking
Use at industrial sites (PC 9a, 9b, 18)
Use by professional workers

A separate Background Document[1] is available for the application of coatings.

[1] CEPE Background Document on SpERCs for the application of liquid and powder coatings, August 2018

## 2.1 Formulation of coatings: Process Description

### 2.1.1 Liquid coatings

A wide variety of manufacturing routes and process steps are used in the formulation and production of coatings. Importantly, the process is geared to ensuring solvents and other raw materials are added to, and retained in, manufactured products – market economics demand that process losses are kept to the minimum at each and every stage involving handling and use.

Solvents and other raw materials leave the process as components of products in a variety of sealed containers. They can be sold by mass, volume or unit container. It is not uncommon for there to be 1000s of variations of products and packs from the one installation.

A number of routes are used for coating materials Formulation/manufacture:

a) 'traditional' process - this route produces a batch of coating from first principles. It consists of four key steps:

- pre-assembly and premixing;
- pigment dispersing and grinding/milling;
- product let-down, tinting and finishing;
- product filtering and filling. PG6/44(11) 12

b) 'dispense' process - this route produces a batch of coating from the blending of finished or semi-finished components ("intermediates"). The intermediates are either:

- dispensed, via a dispensing machine equipped with dosing heads, directly into the final containers, in which they are mixed in order to produce the coating; or
- dispensed into a mixing vessel, blended and filled into the supply package

c) 'single step' process - this route produces a batch of coating from first principles. It consists of the first three key steps of the "traditional" process in a single dispersing machine with pigmented pre-dispersed chips followed by product filtering and filling.

In addition to the above, there are a number of supporting steps, which are critical to the coating material manufacturing process. These include the following:

- delivery, unloading and storage of raw materials;
- storage, warehousing and despatch of finished goods;
- cleaning of manufacturing vessels;
- disposal of raw material packaging, process wastes.

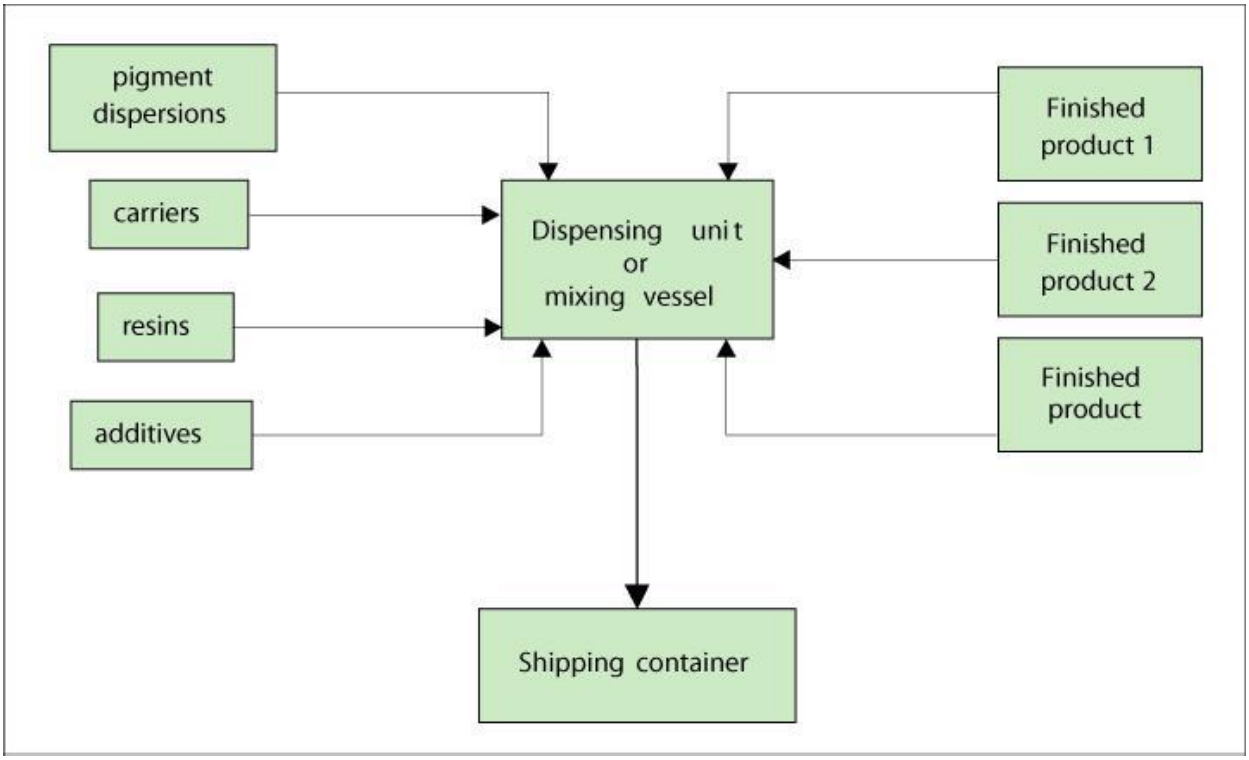
The main emission points are:

- Air
    - powered vents (e.g. local exhaust ventilation, vessel extracts)

    - non-powered process vessel vents (e.g. breather vents)
    - general extraction and building ventilation systems
    - bulk storage vessel (solvent, resin, intermediate) breather vents
    - fugitive emissions
    - abatement plant discharges
- Water
    - washings from water-borne coatings may be treated on, or sent for treatment off, site
- Waste
- materials and containers sent for disposal

**Figure 1 - Traditional process**

**Figure 2 - Dispense process**




### 2.1.2 Formulation of powder coatings: Process Description

The powder coatings manufacturing process produces a batch of coating from first principles. It consists of five key steps:

- pre-assembly and premixing (dry blending);
- compounding of raw materials - melted together under high shear conditions;
- pelletisation/milling;
- addition of additives/finishing;
- product sieving and filling.

In addition to the above, there are a number of supporting steps, which are critical to the coating material manufacturing process. These include the following:

- delivery, unloading and storage of raw materials;
- storage, warehousing and despatch of finished goods;
- cleaning of manufacturing vessels;
- disposal of raw material packaging, process wastes.

Potential releases

The following parts of the process may give rise to particulate matter:

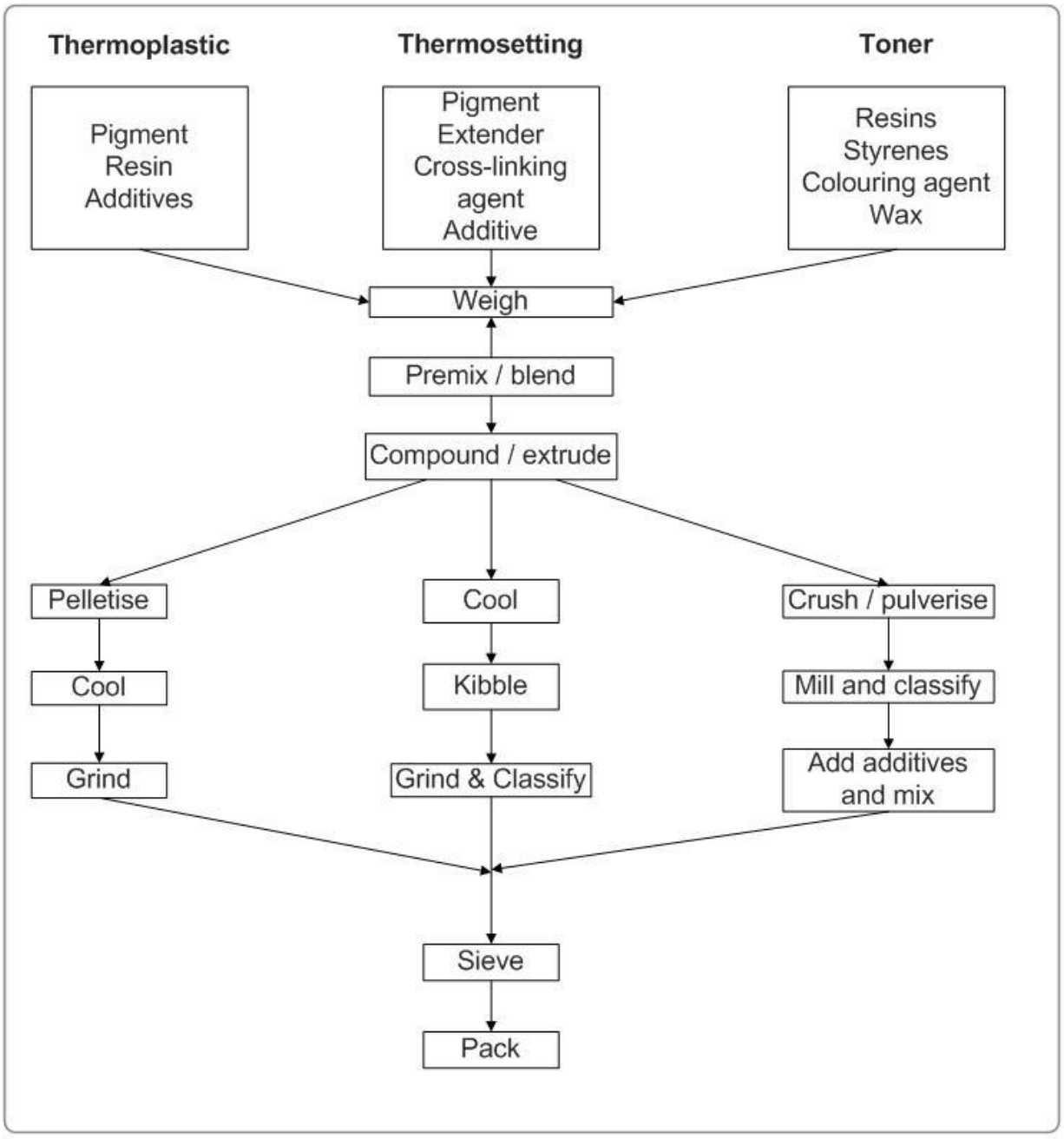
- Raw material and pre-mix weighing, handling and additive handling and mixing
- Grinding / milling and classification
- Boxing, bagging and loading into bulk containers

- Moving, cleaning and maintaining bag filters
- Handling and storing waste powders

The main emission points are:

- Air
  - powered vents (e.g. local exhaust ventilation, vessel extracts)
  - non-powered process vessel vents (e.g. breather vents)
  - general extraction and building ventilation systems
  - fugitive emissions
  - abatement plant discharges
- Waste
  - materials and containers sent for disposal

**Figure 3: Stages in the Formulation of Powder Coatings**



## 2.2 Emission relevance of operational conditions

The formulation/manufacture of coatings and inks is a multi-stage batch process. The process is arranged to maximise the efficiency of use of input raw materials through the highest conversion into formulated products. Process losses are reduced to the absolute minimum through use of general and manufacturing plant extraction to maintain workplace concentrations of airborne VOCs and particulates below respective OELs; and through use of closed or covered manufacturing equipment, wherever possible, to minimise evaporative losses of VOCs or particulates. The composition of products and the overall process are such that there are no discharges of raw materials or products to waste-water or to soil from the manufacturing plant.

### 2.2.1 Liquid Coatings

The coatings manufacturing sector is in a unique situation in relation to use of organic solvents. Unlike other solvent-using sectors covered by the Industrial Emissions Directive (IED), virtually all of the input solvent is retained in the process and leaves in the product manufactured at the installation. This contrasts with the subsequent downstream use of coatings, where evaporation of all solvents (and creation of VOCs) during application and drying has to occur for the coating film to be formed.

In the case of formulation of water-borne coatings, the emissions to water are almost exclusively caused by cleaning the equipment with water and disposing of the washings to wastewater. In contrast, equipment cleaning is irrelevant for solvent-borne and solvent-less products. The equipment is cleaned with solvent washings, which are collected and disposed of as chemical waste, that is treated by third party industries. As a consequence, the emissions of volatiles to water are negligible and the corresponding release factors are zero.

In total only a very small fraction of the substance ends up in the waste stage.

No emissions to soil are expected.

| **Process step** | **Solids** | **Volatiles** |
|---|---|---|
| Unloading and storage of raw materials (dry powders, drummed liquids, bulk liquids) | Potential spillage of powders; contained on site | Potential spillage of liquids<br>Minimal emissions |
| | | |
| Dispensing and weighing of raw materials<br>(dry powders, drummed liquids) | Potential spillage of powders; contained on site | Potential spillage of liquids |
| | | |
| | | |
| Transfer of raw materials to manufacturing areas<br>(dry powders, drummed liquids) | Potential spillage of powders; contained on site | Potential spillage of liquids<br>Minimal emissions |
| | | |
| Charging of raw materials to manufacturing equipment<br>(dry powders, drummed liquids, bulk solvents) | Potential spillage of powders; contained on site | Potential spillage of liquids<br>Minimal emissions |
| | | |
| | | |

| | | |
|---|---|---|
| Dispersion, mixing and sampling of coatings<br>(closed vessels, local exhaust ventilation design) | Emissions captured by filters | Emissions controlled under IED |
| | | |
| Transfer of coatings to filling operations | | Emissions controlled under IED |
| | | |
| Filtration<br>(fixed vessels, pans) | | Emissions controlled under IED |
| | | |
| Filling | | Emissions controlled under IED |
| | | |
| Cleaning of manufacturing vessels | | Emissions controlled under IED |
| | | |
| Transfer of finished goods to storage, warehousing | | Potential spillage of liquids<br>Minimal emissions |
| | | |
| Waste disposal | Potential spillage of powders; contained on site | Disposed of through waste contractor |

### 2.2.2 Powder Coatings

The following parts of the process may give rise to particulate matter:

- Raw material and pre-mix weighing, handling and additive handling and mixing
- Grinding / milling and classification
- Boxing, bagging and loading into bulk containers
- Moving, cleaning and maintaining bag filters
- Handling and storing waste powders

The following table provides a summary of the best available techniques that can be used to control the process in order to control emissions. Provided that an equivalent level of control will be achieved, then other techniques may be used. There are no emissions of volatiles or emissions to water or soil.

| **Process step** | **Solids** |
|---|---|
| Unloading and storage of raw materials | Potential spillage of powders; contained on site |
| | |
| Dispensing and weighing of raw materials | Potential spillage of powders; contained on site |
| | |
| Transfer of raw materials to manufacturing areas | Potential spillage of powders; contained on site |
| | |

| | |
|---|---|
| Charging of raw materials to manufacturing equipment | Potential spillage of powders; contained on site |
| | |
| Dispersion, mixing and sampling of coatings<br>(closed vessels, local exhaust ventilation design) | Emissions captured by filters |
| | |
| Filling | Emissions captured by filters |
| | |
| Moving bag fliters and dry cleaning | Emissions captured by filters |
| | |
| Cleaning of manufacturing equipment | Emissions captured by filters |
| | |
| Transfer of finished goods to storage, warehousing | |
| | |
| Waste disposal | Potential spillage of powders; contained on site |

## 2.3 Application of risk reduction measures

### 2.3.1 Liquid Coating Formulation

#### *2.3.1.1 Volatiles*

RMMs primarily are aimed at controlling emissions of VOCs at source, rather than at "end of pipe" to meet the relevant total emission limit value set out in Section 17, Annex VII,2010/75/EU (IED).

A wide range of RMMs are used to minimise emissions to atmosphere:

- use of closed storage facilities (e.g. bulk storage tanks, IBCs, drums) for VOC-containing raw materials
- use of closed transfers of liquids from storage to production equipment (e.g. metered piped or pumped additions)
- use of closed production equipment, with no extraction, except when opening vessels for additions/sampling etc
- use of semi-closed production vessels with extraction to atmosphere to maintain workplace airborne VOC concentrations below respective OELs
- use of impermeable covers on work in progress
- use of closed filling equipment
- use of closed equipment cleaning and use of non-organic solvent based cleaning fluids.
- storage of finished products in closed containers (bulk tanks, IBCs, drums, cans etc)
- recycling and reuse of overmake product in subsequent batches
- storage of all VOC-containing wastes in closed, secure containers (bulk tanks, IBCs, drums)

#### *2.3.1.2 Efficiency of Volatiles RMMs*

As the IED VOC emission controls are focused on controlling global emissions from the manufacturing plant, the performance of individual RMMs is not relevant – the overall efficiency of the total manufacturing process (process steps + RMMs) is a minimum either 95% or 98%, depending on the throughput of the site.

#### *2.3.1.3 Non-volatiles*

RMMs are primarily aimed at controlling emissions of particulates at the most significant emission points to atmosphere from sources within the manufacturing process where airborne particulates can be created.

Typically:

- particulate raw materials are delivered in bulk tankers and discharged to closed silos
- particulate raw materials are delivered in closed packaging (IBCs, drums, boxes, sacks)
- closed transfers of particulates from storage to production equipment (e.g. metered piped or pumped additions) is used
- no extraction is used on closed production equipment, when adding and incorporating particulate raw materials
- use of semi-closed production vessels with extraction to atmosphere are used to maintain workplace airborne particulate concentrations below respective OELs
- cyclone and bag filters, connected to (often multiple) emission sources, are used to control emissions from manufacturing plant
- particulate wastes are stored in closed containers.

#### *2.3.1.4 Efficiency of particulate RMMs*

Bag and cyclone filters are typically rated at 99% efficient.

### 2.3.2 Powder coating Formulation

#### *2.3.2.1 Non-volatiles*

RMMs are primarily aimed at controlling emissions of particulates at the most significant emission points to atmosphere from sources within the manufacturing process where airborne particulates can be created.

Typically:
- particulate raw materials are delivered in bulk tankers and discharged to closed silos
- particulate raw materials are delivered in closed packaging (IBCs, drums, boxes, sacks)
- closed transfers of particulates from storage to production equipment (e.g. metered piped or pumped additions) is used

- no extraction is used on closed production equipment, when adding and incorporating particulate raw materials
- use of semi-closed production vessels with extraction to atmosphere are used to maintain workplace airborne particulate concentrations below respective OELs
- cyclone and bag filters, connected to (often multiple) emission sources, are used to control emissions from manufacturing plant
- particulate wastes are stored in closed containers.

#### *2.3.2.2 Efficiency of particulate RMMs*

Bag and cyclone filters are typically rated at 99% efficient.

## 2.4 Ingredients and product types

### 2.4.1 Liquid coatings

Coating materials are manufactured using a similar range of process steps. The manufacturing process/activity is typically a batch process, which involves combining raw materials, in one or more steps, to produce the finished product. All coating materials are comprised of appropriate mixtures of four main raw material component categories:

- resins (organic (usually) or inorganic polymers);
- pigments (primary (colours), extenders/fillers or actives (e.g. anti-corrosives));
- carriers (organic solvents, water, non-volatile liquids); and
- additives (a wide range of specific materials, used in small quantities to provide particular properties during manufacture, in storage, during application, in service life etc).

Coatings product types include:

- solvent-borne coatings, paints and inks
- water-borne coatings, paints and inks
- solvent-free coatings, paints and inks
- powder coatings

### 2.4.2 Powder coatings

Powder coatings are made from solid resin, pigments, and additives which are compounded together to form a coating powder.

There are three categories of powder coating:

- Thermoset coatings: typically particle sizes are in the range 30 - 50 micrometres
- Thermoplastic toners: commonly most particle sizes are in the range 5 – 20 micrometres
- Thermoplastic coatings: for electrostatic grade many particles are around 100 microns and for fluidised bed grades they are significantly larger.

Some powders (especially some thermoplastic powders) have mostly large particles for example those with more than 95% by weight above 75 microns, and have no potential to emit particulate matter to the air.

# 3 SPERC information Sources

The OECD Emission Scenario Document (ESD) for coatings contains a number of assumptions on release factors. In context with this SPERC, whilst the coating ESD focuses on emissions to air, figures for substance release to water (and soil) are also included. The ESD has been supplemented by industry knowledge.

# 4 Justification of release factors

Release factors for Formulation of water- and solvent-borne coatings and inks are given in "EMISSION SCENARIO DOCUMENT ON COATINGS INDUSTRY (PAINTS, LACQUERS AND VARNISHES)", OECD, July 2009. The release factors obtained from the OECD ESD on coatings and paints have been confirmed by expert sector knowledge.

# 5 Justification of use rates

Based on sector knowledge.

## 5.1 Justification of days emitting

Based on sector knowledge: typical industry situation – 5 working days per week, 45 weeks per year, no need for continuous shift working.

# 6 Applicability of SPERC

## 6.1 Conservatism

The conservatism in the emission estimation of the SPERCs is ensured by assuming a worst case release factors. The estimates are based on data from the OECD ESD on coatings and paints (OECD 2009b). This OECD ESD is based on two reference documents from 2000 and 2002. The latest information, which was included in the derivation of the release factors dates from 2003. Hence, the release factors used in the SPERCs for the manufacture of coatings reflect technology that is more than ten years old.
Given the need for continuous efficiency gains in industrial processes and the concurrent technological advancement it is fair to assume that processes have become more efficient with consequent lower emissions to air, water, and waste.

## 6.2 Tiered assessment

Due to this set of characteristics we consider the coating SPERCs suitable for use in standardized, lower tier REACH assessments of the vast majority of their ingredient substances. Their envisaged use is for risk assessors to distinguish trivial substances and emission situations from problematic ones based on standardized emission estimates. Based on this distinction, additional efforts can be focused on assessments of situations beyond the defined scope.

## 6.2 Regional assessment

This SPERC is meant for local sources.

# 7 References


OECD 2009b, OECD Environment, Health and Safety Publications Series on Emission Scenario Documents No. 22, EMISSION SCENARIO DOCUMENTS ON COATING INDUSTRY (Paints, Laquers and Varnishes), Paris 2009 http://www.oecd.org/officialdocuments/displaydocumentpdf?cote=ENV/JM/MONO(2009)24&doclanguage=en.

CEPE Application Information Note http://www.cepe.org/efede/main.htm#!FOLDER/3723?x=8335663198496432

Rheilen, A.; Bahr, T.; Boegi, C.; Dobe, C.; May, T.; Verdonck, F.; Wind, T.; Tolls, J.; Zullo, L. SPERCS – a tool for environmental emission estimation. Intergr Environ Assess Manag. (2016, in press). Corresponding author:: Johannes.Tolls@henkel.com http://onlinelibrary.wiley.com/doi/10.1002/ieam.1745/pdf