Specific Environmental Release Categories (SPERCs) for the Formulation of Liquid and Powder Coatings and Printing Inks (ERC 2)

Background Document

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CEPE

European Council of the Paint, Printing Ink and Artists' Colours Industry

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Glossary: List of Acronyms and Abbreviations

BAT	Best available technologies
CEPE	European Council of the Paint, Printing Ink and Artists' Colours Industry
COD	Chemical oxygen demand
ECHA	European Chemicals Agency
ERC	Environmental release category
ESD	Emission scenario document
IED	Industrial emissions directive
MERV	Minimum efficiency reporting value
OECD	Organisation for Economic Co-operation and Development
OEL	Occupational exposure limit
REACH	Registration, evaluation, authorization and restriction of chemicals
RMM	Risk management measure
SPERC	Specific environmental release category
STP	Sewage treatment plant
UV	Ultraviolet (radiation)
VdL	Verband der deutschen Lack- und Druckfarbenindustrie
VOC	Volatile organic compounds

General Disclaimer

SPERCs are specific environmental release categories and are meant to specify generic emission scenario information (ERCs) (Reihlen et al., 2016). However, SPERCs still reflect emissions of a broad application area of a substance within an industry sector. For their purpose, SPERCs are conservative for use in lower tier REACH safety assessments and, therefore, their emission estimates are not intended to reflect all regulatory requirements that may relate to environmental emissions. These SPERCs might be further refined based on the provision of additional site-specific data.

1 Purpose of the Document

To carry out an environmental exposure assessment, the quantification of the rates of substances released to the environment is key. While the European Chemicals Agency's (ECHA) Guidance R.16 Environmental exposure assessment (ECHA, 2016) provides a generic set of release factors (cf. Table R16-7 of the document), they are less meaningful for several industry sectors. Sector organizations, including CEPE, have refined the generic Environmental Release Categories (ERCs) by detailed analysis of the sector's specific typical operational conditions in order to build 'SPecific Environmental Release Categories' (SPERCs).

Thus, the CEPE SPERCs refine and specify emission scenario information (ERCs) for the use of substances throughout their life cycle (Reihlen et al., 2016) in the coatings and printing inks industry.

The SPERCs described in this document are specific to the formulation of coatings and printing inks. Yet, they still reflect emission estimates representative for broadly defined formulation processes. They apply for processes which are operated according to common efficient industry practices.

This document provides background information to the CEPE SPERC factsheets for the formulation of liquid and powder coatings and printing inks, referring to ERC 2. A separate background document[1] is available for the application of coatings and printing inks.

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.v3	volatile ingredients	Formulation of organic solvent-b. coatings/printing inks - large scale (>1,000 tpa solvent use)
CEPE SPERC 2.1b.v3	volatile ingredients	Formulation of organic solvent-borne coatings and printing inks - small and medium scale (≤1,000 tpa solvent use)
CEPE SPERC 2.1c.v3	non-volatile ingredients	Formulation of organic solvent-borne coatings and printing inks – non volatiles
CEPE SPERC 2.1d.v3	non-volatile ingredients	Formulation of solvent-free liquid coatings and printing inks – non volatiles

[1] CEPE Background Document on SpERCs for the application of liquid and powder coatings and printing inks, 2025

CEPE SPERC 2.2a.v3	volatile ingredients	Formulation of water-borne coatings and printing inks – large scale (>1,000 tpa solvent use)
CEPE SPERC 2.2b.v3	volatile ingredients	Formulation of water-borne coatings and printing inks – small and medium scale (≤1,000 tpa solvent use)
CEPE SPERC 2.2c.v3	non-volatile ingredients	Formulation of water-borne coatings and printing inks – non volatiles
CEPE SPERC 2.3.v3	non-volatile ingredients	Formulation of powder coatings

Table 1: Overview on CEPE SPERCs in scope

In this context, the distinction between volatile and non-volatile ingredients is referring to the definition of volatile organic compounds in the European Industrial Emissions Directive (IED) which addresses organic compounds with a vapour pressure at standard conditions of 0.01 kPA or above as volatile. It is known that other legislative acts have diverging conditions for this threshold (e.g. a boiling temperature of 250°C in the so-called deco paint directive). However, for the determination of release factors to air in the context of formulation, the IED reference is more relevant (Dir. 2010/75/EU).

Specific information is given as regards the operational conditions of use relevant to exposure in formulation (chapter 2 and 3), the risk management measures (chapter 4), as well as the derivation method and justification of release factors plus indicative use rates (chapter 5).

2 Scope

The SPERCs in this area are valid for refinement of release factors for substances used in an industrial setting in formulating coatings and printing inks. Coatings and ink product types include:

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

Short title: Formulation, including mixing, handling, repacking

Synthesis of resins, cleaning of refillable containers and application at training centers are not in scope. Formulation of toners (inks in powder form) is not in scope as the manufacturing process is specific.

2.1 Product Types and their Main Ingredients

2.1.1 Liquid coatings and printing inks

Coatings and inks 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. Coating materials are composed 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.).

Solvent-borne coatings and printing inks may have a vast range of non-volatile content between 25% and 85% (in few cases like wood stains, impregnation materials or adhesion promoters also less) and vice versa a vast range of organic solvent content. Like for solvent-free liquid coatings and inks, all installation and equipment cleaning is done with organic solvents.

Water-borne coatings and printing inks may require a distinction between (wall) paints/dispersions/inks (solvent content 0.1% to 2%) and lacquers (solvent content up to 20%) as the discharge of cleaning liquids may be different depending on tolerable chemical oxygen demand (COD) values in effluent water.

Solvent-free liquid coatings and printing inks comprise
- low molecular weight resin compounds and reactive substances with relatively low viscosity, or
- unsaturated resins and reactive diluents which polymerize after impact of radiation (e.g. UV, electron beam), enhanced by photo initiators, or
- natural oil-based materials.

2.1.2 Powder coatings

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

There are two main categories of powder coating:

- Thermoset coatings: typically particle sizes are in the range 15 – 50 micrometres
- Thermoplastic coatings: for electrostatic application grade many particles are around 100 micrometres, 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 micrometres, and have no potential to emit particulate matter to the air. Fine and ultra-fine particles which are present to a certain extent in thermoset powders tend to agglomerate which leads to reduced dustiness at transfer operations during the formulation process.

2.2 Production Scale

For the formulation of liquid coatings and printing inks, a distinction is made for production scale. Two size classes were defined: small and medium ($\leq$ 1,000 tonnes solvent use per year); large (> 1,000 tonnes solvent use per year).

This is mainly due to the applicable legislation, i.e. the European Industrial Emissions Directive which defines restrictions with regard to the overall tolerable releases to air and thus has an indirect influence on the specific design of risk management measures in installations (Dir. 2010/75/EU).

2.3 Measurement of Chemical Emissions

Installations in scope of the European Industrial Emissions Directive, i.e installations with an annual solvent use of 100 tonnes or more, have the option to provide a solvent management plan according to

annex VII, part 5 of that directive respectively its national transpositions for demonstrating compliance with the applicable total emission limit values (Dir. 2010/75/EU).

This may be documented by either direct measurement of releases to air and water or by indirect calculation (solvent input from raw materials minus solvent output in finished products, minus solvent transfer to waste, minus solvent volume destroyed or recovered by abatement). As a consequence of the most typical production design (batch processes in a large number of mixing vessels, huge number of formulations, many cleaning cycles between batches, decentralized structures), the indirect method is applied for most sites.

2.4 Formulation Technologies: Process Description

2.4.1 Liquid coatings and printing inks

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 processing.

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 or ink 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;
- cleaning of manufacturing vessels, pipes and equipment

b) 'dispense' process - this route produces a batch of coating or ink 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
- cleaning of manufacturing vessels, pipes and equipment (in the second case)

c) 'single step' process – this route produces a batch of coating or ink 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.

The overall purpose of the milling and dispersing stage is to break down solid compounds (pigments, extenders) into small particles with typical diameters < 3 µm in case of inorganic substances and < 1 µm in case of organic substances and to ensure that each single particle is completely enveloped by the resin.

Nowadays, the milling process is usually performed under contained conditions. The stirring process is linked to the generation of heat which may accelerate the vaporization of solvents.

For high viscous materials (certain inks, artist colours), milling and dispersing by rotating cylinders is still practiced. Typically, this kind of devices is not completely contained.

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

- delivery, unloading and storage of raw materials, including transfer into tanks;
- storage, warehousing and despatch of finished goods;
- cleaning of manufacturing vessels, pipes and equipment;
- product application on test objects (e.g. panels, sheets);
- disposal of raw material packaging, process wastes.

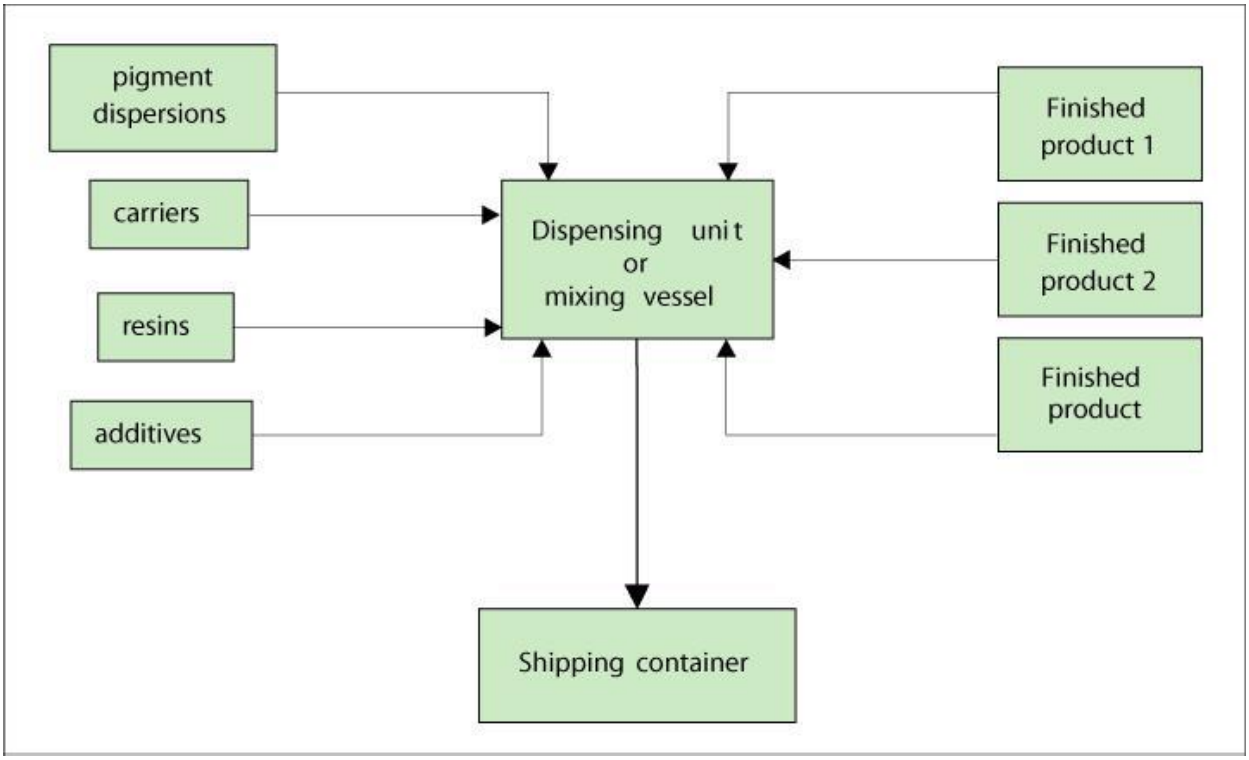
The main emission points are:

- 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
    - spraying of test panels in R&D, colour development and batch control
- Water
    - washings from water-borne coatings may be treated on-site before discharge into municipal sewers or may be sent for treatment off- site
    - wet cleaning of areas around transfer of solid compounds
- Waste
    - residual compounds adhering to the surface area of vessels, pipes, transportation containers and equipment
    - cleaning liquids which are collected for recycling or disposal
    - materials and containers sent for recycling or disposal

Figure 1: Traditional process for formulation of liquid paints and printing inks



Figure 2: Dispense process for formulation of liquid paints and printing inks



2.4.2 Powder coatings

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, pipes and equipment;
- product application on test panels;
- disposal of raw material packaging, process wastes.

Potential releases

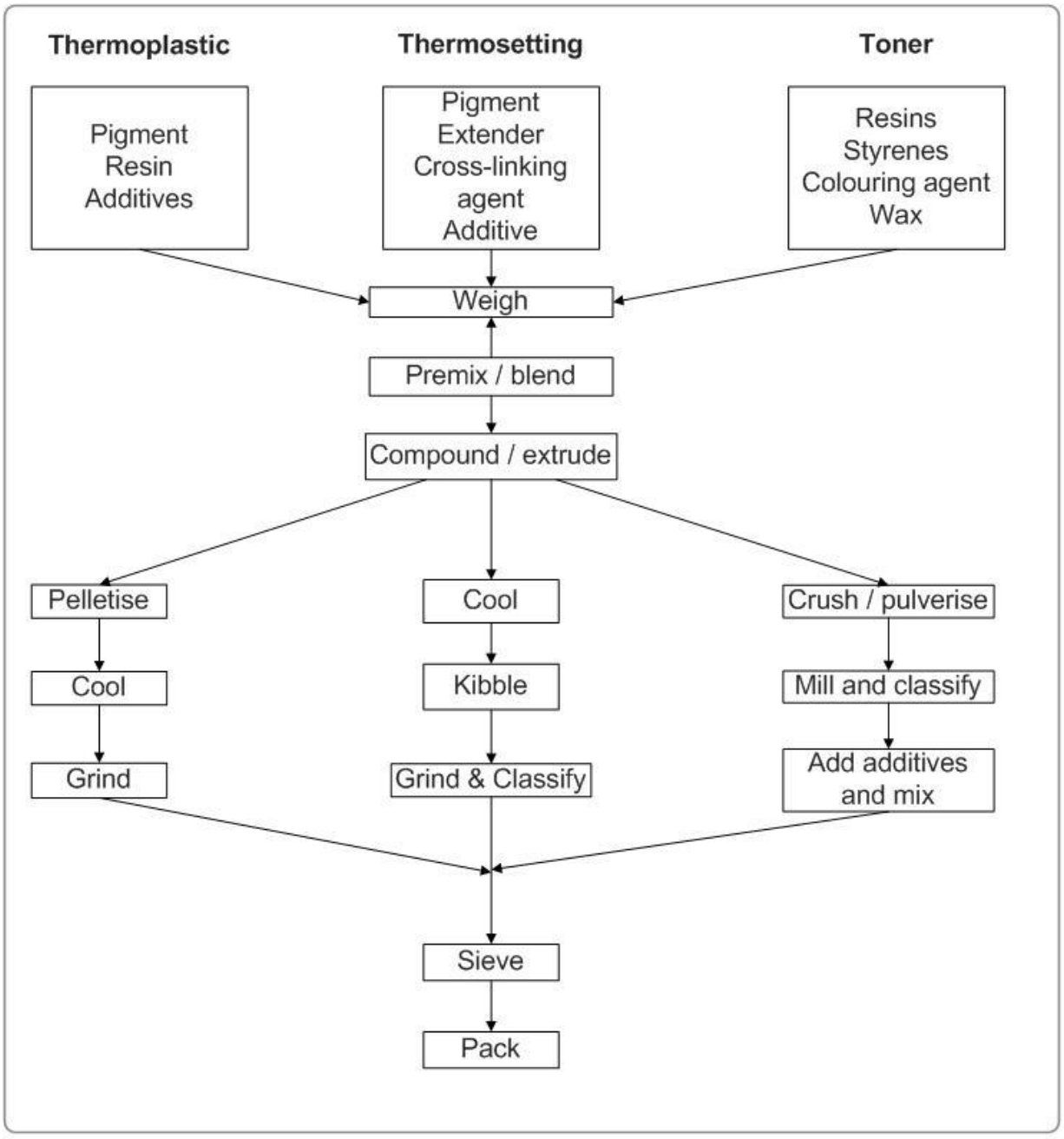
The following parts of the process may give rise to solid particulate matter:

- raw material and pre-mix weighing, handling and additive handling and mixing
- grinding / milling and classification
- boxing, bagging and loading into bulk containers
- product application on test panels
- 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)
    - general extraction and building ventilation systems
    - fugitive emissions
    - filter discharges
- Water
    - wet cleaning of equipment
    - wet cleaning of areas around installations
- Waste
    - materials and containers sent for disposal
    - material retained in filters

Figure 3: Stages in the formulation of powder coatings



3 Emission Relevance of Operational Conditions

The formulation/manufacture of coatings and printing 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 closed or covered manufacturing equipment, wherever possible, to minimise evaporative losses of VOCs or particulates; and through use of general and manufacturing plant extraction to maintain workplace concentrations of airborne VOCs and particulates below respective OELs. The composition of products and the overall process are such that there are no discharges of raw materials or products to surface water or to soil from the manufacturing plant. Appropriate systems for spill retention are in place.

3.1 Liquid Coatings and Printing Inks

The coatings and inks 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 or in purging liquids recovered and collected for recycling. 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.

For solvent-free liquid coatings and inks the description below for non-volatile compounds applies as well.

In the case of formulation of water-borne coatings and printing inks, 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-free 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 small fraction of the substance ends up in the waste stage, depending on the number of transfers between containers and vessels and residues adhering to walls and hoses/tubes.

No emissions to soil are expected.

Process step	**Non-volatiles**	**Volatiles**
Unloading and storage of raw materials (dry powders, drummed liquids, bulk liquids)	Potential spillage contained on site	Potential spillage of liquids Minimal emissions
Dispensing and weighing of raw materials (dry powders, drummed liquids)	Potential spillage contained on site	Potential spillage of liquids Minimal emissions
Transfer of raw materials to manufacturing areas (dry powders, drummed liquids)	Potential spillage contained on site	Potential spillage of liquids Minimal emissions

Charging of raw materials to manufacturing equipment (dry powders, drummed liquids, bulk solvents)	Emissions of solid particles captured by filters Potential spillage contained on site	Potential spillage of liquids Minimal emissions
Dispersion, mixing and sampling of coatings (closed vessels, local exhaust ventilation design)		Emissions controlled under IED
Transfer of coatings to filling operations		Emissions controlled under IED
Filtration (fixed vessels, pans)		Emissions controlled under IED
Spraying of test panels in R&D, colour development and batch control	Overspray droplets retained by filters	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 Minimal emissions
Waste disposal	Potential spillage contained on site	Disposed of through waste contractor

Tab. 2: Emission relevance – formulation of liquid coatings and printing inks

3.2 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
- product application on test panels
- 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 (and other non-volatiles)
Unloading and storage of raw materials	Potential spillage of powders; contained on site
Dispensing and weighing of raw materials	Emissions captured by filters 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	Emissions captured by filters Potential spillage of powders; contained on site
Dispersion, mixing and sampling of coatings (closed vessels, local exhaust ventilation design)	Emissions captured by efficient filters (cf. MERV classification)
Spraying of test panels in R&D, colour development and batch control	Overspray particles retained by filters
Filling	Emissions captured by efficient filters (cf. MERV classification)
Moving bag filters and dry cleaning	Emissions captured by efficient filters (cf. MERV classification)
Cleaning of manufacturing equipment	Emissions captured by efficient filters (cf. MERV classification)
Transfer of finished goods to storage, warehousing	
Waste disposal	Potential spillage of powders; contained on site

Tab. 3: Emission relevance – formulation of powder coatings

4 Application of Risk Reduction Measures

4.1 Liquid Coatings and Printing Inks

4.1.1 Release to air

4.1.1.1 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 Annex VII of the IED and its national transpositions (Dir. 2010/75/EU).

A wide range of RMMs are used to minimise emissions to atmosphere. At large installations this may include:

- 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-volatile solvent based cleaning fluids.
- storage of finished products in closed containers (bulk tanks, IBCs, drums, cans etc)
- recycling and reuse of 'off-spec' and excess product in subsequent batches
- storage of all VOC-containing wastes in closed, secure containers (bulk tanks, IBCs, drums)
- abatement connected to local exhaust air from filling of mixing vessels and/or transport containers
- abatement connected to exhaust air from vessel and container cleaning

At small and medium scale installations, emission control may include:

- use of closed storage facilities (e.g. bulk storage tanks, IBCs, drums) for VOC-containing raw materials
- 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 equipment cleaning and use of non-volatile solvent based cleaning fluids
- storage of finished products in closed containers (bulk tanks, IBCs, drums, cans etc)
- recycling and reuse of 'off-spec' and excess product in subsequent batches
- storage of all VOC-containing wastes in closed, secure containers (bulk tanks, IBCs, drums)

Efficiency of Volatiles RMMs

As the IED VOC emission controls are focused on controlling total emissions from the manufacturing plant, the performance of individual RMMs is not relevant – the overall efficiency of the manufacturing process (process steps + RMMs) is a minimum either 95% or 97%, depending on the throughput of the site[2].

4.1.1.2 Non-volatiles

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

Typically:

- non-volatile raw materials are delivered in bulk tankers and discharged to closed silos
- particulate raw materials are delivered in closed packaging (big bags, IBCs, drums, boxes, sacks)
- closed transfers of non-volatile raw materials 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 non-volatile 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 solid particulate matter emissions from manufacturing plant
- overspray droplets are retained by filters when spraying test panels in R&D, colour development and batch control
- particulate wastes are stored in closed containers.

About 0.1 % of the total production volume is supposed to be consumed for spraying of test panels in R&D, colour development and batch control.

Efficiency of particulate RMMs

Bag filters are typically rated at 99% efficient.

4.1.2 Release to water

Release to water may occur after equipment cleaning and purging operations in the formulation process of water-borne coatings. It depends on the kind of water-borne products (wall paints with 0.2% to 2% of VOC content or industrial coatings with up to 20% VOC content), the cleaning liquid (pure water, water with detergent, mixtures of water with organic solvents and/or amines or organic acids), the water solubility of adhering paints and coatings, and the volume relation between adhering residues and the cleaning liquid. Typically, cleaning liquids are treated by precipitation, flocculation and filtration in order

[2] Some member states require higher levels of overall efficiency, e.g. 97.5% or 99%, depending on throughput, which may be considered as best available technology (BAT). However, the European BAT reference document on surface treatment using solvents does not address formulation of paints and coatings.

to remove non-volatile matter. If this happens on-site, cleaning liquids may be recirculated after the chemical-physical treatment to a certain extent.

Formulation sites are not supposed to run a biological treatment plant for the degradation of water-soluble organic compounds on-site. Typically, waste water is released to a municipal sewage treatment plant (STP). In this case, the limiting factor for any release is the COD concentration and/or COD freight. Many water-soluble solvents have a COD value of 2,000 to 2,500 mg/l per 0.1 % solvent concentration. Municipal STPs cannot accept high loads due to their limited capacity. If the release to a municipal STP is not possible, cleaning liquids are collected separately and treated off-site by a third party. Filtered non-volatiles are disposed as hazardous waste.

At very low levels, release to water may play a role for solid particulate matter in the formulation of solvent-borne and solvent-free coatings and printing inks. This is due to wet cleaning operations in the vicinity of installations and equipment. Non-volatile compounds may be separated from water by filtration, and will then be disposed.

Efficiency of non-volatiles RMMs

With regard to removal from waste water, precipitation, flocculation and filtration have an efficiency of 90% or more. Filtration after wet cleaning has an efficiency of 95% or more.

4.2 Powder Coatings

4.2.1 Release to air

RMMs are primarily aimed at controlling emissions of solid particulate matter 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)
- 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 particle concentrations below respective OELs
- cyclone and bag filters, connected to (often multiple) emission sources, are used to control emissions from manufacturing plant
- overspray particles are retained by filters when spraying test panels in R&D, colour development and batch control
- particulate wastes are stored in closed containers.

About 0.1 % of the total production volume is supposed to be consumed for spraying of test panels in R&D, colour development and batch control.

Efficiency of solid particulate matter RMMs

Cyclone filters are typically rated at 95 % efficient. A second filtration step which is required specifically for the retainment of fine particles, has an efficiency of 99,99 % due the tendency of fine particles to agglomerate (CEPE, 2024).

4.2.2 Release to water

Most of the material losses during the operations (material transfers, pre-mixing, flaking, classification, spraying of panels, packaging, equipment cleaning) is captured in filter systems. However, there is some unavoidable precipitation on floors and installations (< 5 %). This settled dust is preferably removed by vacuum cleaners. A minor part is collected by up wiping with water (10 %, manually or by machine). Finally, particles are separated from water by filtration, and will then be disposed. Filtration after wet cleaning has an efficiency of 95% or more.

5 SPERC Information Sources and Justification

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 (OECD, 2009). The ESD has been supplemented by industry knowledge. However, the original data enquiry was done around the year 2000 and is therefore partially outdated due to improvements which have been triggered by implementation of the European Solvent Emission directive/Industrial Emission directive during the last two decades.

In 2022, German sector organisation VdL performed a new enquiry on use conditions with relevance for SWEDs and SpERCs by sending questionnaires to member companies. Qualified responses on release rates to water were received from 19 companies with solvent consumption between 0 tonnes per year (powder manufacturing) and 67,400 tonnes per year, including 11 companies with solvent consumption between 100 and 1,000 tonnes per year (medium size) and 4 companies with solvent consumption below 100 tonnes per year (small size). Companies were instructed to link substance concentration in waste water with waste water volumes and with the total solvent throughput (typically, they would only report concentrations). Quantitative results are displayed in chapter 5.3 (VdL, 2022).

Relevant changes refer to release to water only. With regard to non-volatiles from formulation of solvent-borne, solvent-free and powder coatings, there is only a potential indirect release of solid particulate matter due to wet cleaning operations in the vicinity of installations. With regard to non-volatiles from formulation of water-borne paints and coatings, the chemical-physical treatment as described in chapter 4.1.2 needs to be taken into account. This treatment in combination with the recirculation of cleaning liquids also results in low release of volatiles to waste water at large installations. Meanwhile, this is also practiced at medium size installations.

The release factor to waste highly depends on the number of material transfers from one container to another, and on the complexity of customer specifications.

5.1 Justification of Use Rates

Generic data on the composition of coatings and printing inks are displayed in Annex 2 of this document. Based on these compositions, indicative compound use rates can be estimated for typical large- and medium-/small-scale formulation sites.

M_{SPERC}'s can be used by a registrant when starting the environmental assessment. M_{SPERC} represents an indicative worst-case value for the substance use rate per site. The derivation of the M_{SPERC}'s is explained in Annex 1 of this document while typical substance use rate M_{SPERC}'s for Industrial use in formulation of coatings and printing inks can be found in Annex 2.

5.2 Justification of Days Emitting

The justification of the emission days is a reasonable worse case value for large industrial sites, operating at > 300 days a year.

5.3 Justification of Release Factors

Release factors for the formulation of water- and solvent-borne coatings (and inks) are provided by OECD in their "Emission Scenario Documents on Coating Industry (Paints, Lacquers and Varnishes)", (OECD, 2009). The release factors obtained from the OECD ESD on coatings and paints have been partly confirmed by expert sector knowledge and partly reassessed after the VdL enquiry (see chapter 5).

CEPE SPERC Code	Substance characteristic	Production Scale (solvent usage)	Release Factors			
			to air	to water	soil	to waste
CEPE SPERC 2.1a	Volatile ingredients	>1,000	<0.03[5]	0	0	0.01-0.06
CEPE SPERC 2.1b		<1,000 t/a	<0.05[5]	0	0	0.01-0.06
CEPE SPERC 2.1c	Non-volatile ingredients*	Solvent-borne	0.00005[6]	0.00001[1]*	0	0.01-0.06
CEPE SPERC 2.1d		Solvent-free	0.00005[6]	0.00001[1]*	0	0.01-0.06
CEPE SPERC 2.2a	Volatile ingredients	>1,000	<0.03[5]	0.0025	0	0.01-0.06
CEPE SPERC 2.2b		<1,000 t/a	<0.05[5]	0.0025[2]	0	0.01-0.06
CEPE SPERC 2.2c	Non-volatile ingredients	Water-borne	0.00005[6]	0.0005[3]	0	0.01-0.06
CEPE SPERC 2.3		Powder	0.00005[7]	0.00001[4]	0	0.01-0.06

* Release factor to water applies for substances which may be removed from surfaces by means of water, e.g. solid particulate matter; release factor is 0 for other non-volatile compounds, e.g. resins

1) OECD ESD says 0.005 %/0.00005 for non-volatiles in formulation of solvent-borne coatings
2) OECD ESD says 0.5 %/0.005 for volatiles in formulation of water-borne coatings (small scale)
3) OECD ESD says 0.5 %/0.005 for non-volatiles in formulation of water-borne coatings
4) OECD ESD says 0.25 %/0,0025 for non-volatiles in formulation of powder coatings
5) Some member states only tolerate lower release factors, e.g. 1% resp. 2.5%
6) Practically no solid particulate matter
7) OECD ESD says 0.025 %/0.00025 for solid particulate matter in formulation of powder coatings

Table 4: Summary of release factors for the SPERCs for formulation of coatings and printing inks

5.4 Justification of Risk Management Measures

RMM and emission control technologies for the manufacturing operations of coatings and printing inks are generally following "good industry practice". They are described in general terms in chapter 3. Chapter 4 further defines elements of the common practice.

Compared to the OECD Emission Scenario Document, on-site treatment of waste water was taken into account for non-volatiles from cleaning of installations for formulation of water-borne coatings and for wet cleaning in the vicinity of installations. Small and medium size installations for the formulation of water-borne coatings are assumed to perform at a level of control comparable to large installations with regard to release to water. A solvent consumption of 200 tonnes per year may be linked to the formulation of more than 10,000 tonnes of finished products.

Compared to the OECD Emission Scenario Document, improved filtration systems (MERV 11 or higher) were taken into account for solid particulate matter after a first level reclaim system (typically by cyclone).

6 Conservatism

As outlined in the European Chemical Industry Council (CEFIC) guidance (CEFIC, 2012), SPERCs are intended to provide realistic but conservative emission estimates. Normally, a realistic worst-case value was taken from the whole of data pool collected.

In addition, and more generally, the use of historical emission information for the RF derivation may contribute to conservatism because those emissions are likely higher than current emissions as a result of ongoing innovation and regulation, thus increasing process efficiency and emission reductions over time (Reihlen et al, 2016). It can be assumed that some literature data (e.g. from OECD ESD collected in the late nineties), are not fully representative anymore, and in a final evaluation more weight was given to the most recent data from 2020 and later.

7 Applicability of SpERCs

7.1 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.

7.2 Regional Assessment

This SPERC is meant for local sources.

8 References

CEFIC, 2012
Cefic Guidance Specific Environmental Release Categories (SPERCs); Brussels 2012

CEPE, 2024
Microplastics and release factors

Dir. 2010/75/EU
Directive on industrial emissions (integrated pollution prevention and control)

ECHA, 2016
Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental exposure assessment.

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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.

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Emission Scenario Documents on Coating Industry (Paints, Laquers and Varnishes), Paris 2009

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Schlussfolgerungen aus der Auswertung der VdL-Fragebögen zu CEPE SWEDs und SPERCs für die Lackherstellung – Änderungsvorschläge für die weitere Umsetzung bei CEPE ESRAG (Conclusions from the evaluation of VdL questionnaires on CEPE SWEDs and SPERCs about formulation of coatings – Amendment proposals for further implementation by CEPE ESRAG), Frankfurt, June 2022

9 Annexes

9.1 Annex 1: Derivation of the M_{SPERC}'s

M_{SPERC} can be used by the registrant when starting the environmental assessment. M_{SPERC} represents an indicative worst-case value for the substance use rate per site. M_{SPERC} is calculated according to:

$$\mathbf{M_{SPERC} = M_{Finished} \times C_{SP} \times T_{Emission,SPERC}^{-1}}$$

Where:

- C_{SP} = Exemplary concentration of substance in finished product
- $M_{Finished}$ = the amount of finished product manufactured (per year),
- $T_{Emission,SPERC}$ = number of days emitting.

Typical parameters values are given in Annex 2. $M_{Finished}$ ranges correspond to the tonnage ranges of finished product as defined in Annex 2. The $M_{Finished}$ ranges are to help formulators find out which SPERC is relevant for their operation. For the large volume plants an arbitrary value of 50,000 tonnes per year has been chosen for the calculation.

9.2 Annex 2: Derivation of typical M_{SPERC}'s values.

Derivation of the default substance use rate M_{SPERC} for Industrial use in formulation of coatings and printing inks The derivation is based on typical values of the operational conditions for the various applications covered by this SPERC.

Product characteristic	Substance's function	Indicative C_{SP} values	$M_{Finished}$ (tonnes/year)		$T_{emission}$ (days)	M_{SPERC} (tonnes/day)	
			Small/medium production	Large production		Small/medium production	Large production
Solvent-borne coatings and printing inks	Resins	50	1,300-6,700	50 000	300	2.22-11.1	83.3
	Reactants	20	1,300-6,700	50 000	300	0.89-4.45	33.3
	Inorganic pigments[1]	20	1,300-6,700	50 000	300	0.89-4.45	33.3
	Organic pigments	10	1,300-6,700	50 000	300	0.45-2.23	16.7
	Extenders	20	1,300-6,700	50 000	300	0.89-4.45	33.3
	Additives (each)[2]	2	1,300-6,700	50 000	300	0.09-0.45	3.33
	VOCs[3]	75	1,300-6,700	50 000	300	3.33	125
	High-boiling solvents	5	1,300-6,700	50 000	300	0.22-1.10	8.33
Solvent-free liquid coatings and printing inks	Resins	55	50 000		300	91.7	
	Reactants	55	50 000		300	91.7	
	Inorganic pigments[1]	20	50 000		300	33.3	
	Organic pigments	10	50 000		300	16.7	
	Additives (each)[2]	2	50 000		300	3.33	
	VOCs[3]	0.5	50 000		300	0.83	
Water-borne paints and printing inks	Resins	25	50 000		300	41.7	
	Inorganic pigments[1]	20	50 000		300	33.3	
	Organic pigments	10	50 000		300	16.7	
	Extenders	30	50 000		300	50	
	Additives (each)[2]	1	50 000		300	1.67	
	VOCs[3]	3	50 000		300	5	
	High-boiling solvents	1	50 000		300	1.67	
	Water	40	50 000		300	66.7	
Water-borne lacquers	Resins	30	5,000-10,000	50 000	300	5	50
	Reactants	15	5,000-10,000	50 000	300	3.5	35
	Inorganic pigments[1]	20	5,000-10,000	50 000	300	3.33	33.3
	Organic pigments	5	5,000-10,000	50 000	300	0.83	8.33
	Extenders	20	5,000-10,000	50 000	300	3.33	33.3
	Additives (each)[2]	1	5,000-10,000	50 000	300	0.17	1.67
	VOCs[3]	20	5,000-10,000	50 000	300	3.33	33.3
	High-boiling solvents	5	5,000-10,000	50 000	300	0.83	8.33
	Water	65	5,000-10,000	50 000	300	10.8	108
Powder coatings	Resins[4]	70	50 000		300	117	
	Reactants	10	50 000		300	16.7	
	Inorganic pigments[1]	20	50 000		300	33.3	
	Organic pigments	1	50 000		300	1.67	
	Extenders	25	50 000		300	41.7	
	Additives (each)[2]	1	50 000		300	1.67	
	VOCs[3]	0.5	50 000		300	0.83	

1) Carbon black is considered as inorganic whereas some publications categorise it as organic
2) UV absorbers, sagging control, neutralising agent, dispersing aid, viscosity adjuster, biocide, levelling agent, adhesion promoter, slip promoter, defoamer, conductivity adjuster
3) VOC solvent consumption at 1,000 tonnes per year is the discriminator between small/medium size and large installations
4) Figure may be higher for powder clearcoat