# Specific Environmental Release Categories (SPERCs) for the industrial use of adhesives and sealants

# Background Document

February 2023

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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 overly conservative and, therefore, their emission estimates are not intended to reflect all regulatory requirements that may relate to environmental emission thresholds.

# 1 Statement of purpose

The ECHA Guidance R16 provides one set of release factors each for industrial applications for the industrial use of a substance as a processing aid (ERC4) or resulting in inclusion of a substance into a matrix (ERC5). The use of monomers in polymerisation processes (ERC 6c) or as reactive process regulators (ERC 6d) is subsumed in this exposure scenario, because these substances behave similar as those simply enclosed into a matrix. However, for technical reasons ERC 6c,d are depicted by separate SPERCs. This document provides background information to the SPERC factsheets for the industrial use of adhesives and sealants, i.e. the so-called FEICA-SPERCs, referring to ERC 4, 5 and ERC 6 c,d. Thus, specific information is provided on operational use conditions relevant to exposure and on product application (chapter 2 and 3), on risk management measures (chapter 4) and on the derivation method and justification of release factors and indicative use rates (chapter 5).

The SPERC Factsheets covered in this document are:

| **FEICA SPERC Code** | **Type of ingredient** | **Application area** |
|---|---|---|
| FEICA-SPERC 4.2b | volatile ingredients | Industrial use of solvent-based and solvent-less adhesives and sealants |
| FEICA-SPERC 5.1a | non- volatile ingredients | |
| FEICA-SPERC 6c.1a | | |
| FEICA-SPERC 6d.1a | | |
| FEICA-SPERC 4.1c | volatile ingredients | Industrial use of water-based adhesives and sealants |
| FEICA-SPERC 5.1c | non- volatile ingredients | |
| FEICA-SPERC 6c.1c | | |
| FEICA-SPERC 6d.1c | | |

This background document provides information on the derivation of the relevant parameters of the above-mentioned factsheets. Some details refer to tertiary references, e.g. publications listed in chapter 8 and 9.

# 2 Scope

Adhesives and sealants are used to join and/or seal two or more substrates. Adhesives are used in bonding, facilitating the production of materials which are lightweight and/or flexible, and which are used as components in aircraft and automobiles, in cell-phones, and in packaging materials. In addition, adhesives are used in the assembly of many products such as furniture, electronic devices, cars, etc.

Sealing allows the infilling of gaps between two or more substrates and is an important function in building and construction. Today it is an essential part of modern engineering including in the automotive and aerospace industries.

Some 4,000,000 tonnes of adhesives and sealants are produced and used in Europe each year in very diverse applications, most of which represents customised products.

The SPERCs of this application area are applied for emission refinements of substances used in industrial uses of solvent- and water- borne adhesives and sealants. Volatile and non-volatile ingredients are distinguished by the boiling point threshold of 250°C according to the definition of volatile organic compounds by the World Health Organization (WHO, 1989).

Industrial uses of adhesives and sealants are assumed for 300 working/emission days per year. This figure is a reasonable assumption accounting for maintenance and holidays.

## 2.1 Adhesives and Sealants: ingredients and product types

The major constituents of adhesives and sealants are binders, fillers, and solvents. In addition, minor ingredients use include additives such as catalysts and preservatives. Details on ingredients and their application in different product types can be found in Tolls et al. (2016).

Besides differentiating between ingredient classes, it is necessary to distinguish between water-borne adhesives/sealants and those which are basically water free to arrive at adequate emission estimates. The latter group comprises of solvent-borne adhesives, reactive adhesive/sealant systems, and hotmelts. These have in common, that water is not used in cleaning the equipment used for manufacturing and application. As a result, there are no emissions to the water from equipment cleaning. These product types are jointly referred to as solvent-borne/solvent-less adhesives/sealants.Application technologies

Industrial uses have in common, that the adhesives/sealants are applied in a very much targeted manner to the substrates which are to be bonded or sealed. In industrial uses dedicated machines are employed for that purpose. Application technologies mainly covering roll-, curtain- or dip coating as well as spraying and syringe/bead applications are described in more detail elsewhere (OECD 2013, FEICA 2014, Tolls et al. 2016). Spraying is rare for adhesive/sealant and occurs in booths.

# 3 Emission relevance of operational conditions

Table 1 displays the process steps that potentially lead to emissions to the environment originating from the application of adhesives/sealants. Solvent evaporation is the primary emission pathway during the curing stage of the adhesive/sealant application. In the case of industrial uses of water-borne adhesives/sealants 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. Any disposal to the waste stage is already covered in the exposure assessment and is accounted for in the emission factor.

**Table 1:** Overview of the process steps involved in industrial application of adhesives/sealants and their relevance with regard to the emission estimation and derivation of release factors.

| **Processing Step** | **Water-borne adhesives / sealants** | | **Solvent-borne / solvent-less adhesives / sealants** | |
|---|---|---|---|---|
| | non-volatiles | volatiles | non-volatiles | volatiles |
| FEICA SPERC | FEICA SPERC 5.1c<br>FEICA SPERC 6c.1c<br>FEICA SPERC 6d.1c | FEICA SPERC 4.1c | FEICA SPERC 5.1a<br>FEICA SPERC 6c.1a<br>FEICA SPERC 6d.1a | FEICA SPERC 4.2b |
| Container cleaning | No cleaning of containers – empty containers either disposed as waste or handled by 3rd party - no emissions to the environment. | | | |
| Direct disposal of empty containers | Empty containers disposed of as waste – no emissions to the environment. | | | |
| Charging of adhesive/ sealant to application machine | Adhesive/sealant delivered to application machine via dedicated equipment. Manual fitting of adhesive container (cartridge, supply equipment, etc.) to application machine does not result in emissions to environment. | | | |
| Adhesive sealant application | Targeted application of adhesive/sealant to substrate with dedicated machines – low relevance for overall emissions to the environment. Release process for ingredients **accounted for in release factor**s<br>Spraying is rare for adhesive/sealant and occurs in booths. Overspray is captured on disposable paper mats. Paper mats are disposed of as solid waste that is collected and treated as externally - no emissions to the environment. | | | |
| Spills to floor during application | Spills to the floor are incidental and rare due to targeted application of adhesive of sealant to substrate. Emissions to environment irrelevant in comparison with other process steps. | | | |
| Volatilization during curing | Substances not volatile – no emissions to the environment | Low volatile solvent content in water borne adhesive/sealants (<10%). Emissions predominantly to air - **accounted for in release factor**. | Substances not volatile – no emissions to the environment | Primary process for emissions – **accounted for in release factor**. |
| **Equipment cleaning** | Cleaning with water – emissions to water – Significant process step - **accounted for in release factor**. | | Cleaning with organic solvent – solvents collected and disposed of as waste – no emissions to environment. | |
| Disposal of off-spec products | Off-spec product is disposed of as solid waste or reworked – no emissions to the environment. | | | |

# 4 Application of risk reduction measures

Emission reduction measures are required in a significant part of industrial uses of solvent-borne adhesives in order to comply with the VOC-regulation. The respective emission reduction is not accounted for in the SPERC. As a result, the SPERC provides a conservative estimate of the solvent emissions from the affected operations (cf. ch 6).

# 5 SPERC Information sources and justification

Two relevant Emission Scenario Documents (ESD) were published by the Organization for Economic Cooperation and Development (OECD) on adhesive manufacturing (OECD, 2009a) and on the industrial use of adhesives (OECD, 2015). These documents provide detailed descriptions of the manufacturing and industrial use processes for adhesives and sealants, but they do not contain release factors. Consequently, the OECD ESD on paints and coatings (OECD 2009b) was used as a source for the release factors. The derivation of the release factors for adhesives and sealants from these information sources is described in Tolls et a. (2016) (see also chapter 9).

A search of the open literature from 1999 to 2014 with the key words “estimation, emission, and chemical” did not yield references relevant to emissions of substances from manufacturing or using adhesives or sealants.

## 5.1 Justification of use rates

To gather representative information on adhesive and sealant compositions, FEICA conducted a survey among its membership. The individual company members were asked to provide their estimates of typical ingredient concentrations, as well as daily consumptions in large adhesive/sealant application machines.

Analysis of the anonymised data from senior professionals from four large member companies - representing a large share of the European market - revealed the results detailed below (Table 2 and 3), which are also summarised in Tolls et al. (2016).

**Table 2:** Poll results and expert evaluation in % for solvent-borne / solvent-less adhesives/sealants

| Ingredient type | Expert 1 | Expert 2 | Expert 3 | Expert 4 | Consensus Range | Indicative Value |
|---|---|---|---|---|---|---|
| Solvent / Volatile | 40 – 90 | 40 – 90 | 40 – 90 | 40-90 | 40-90 | 80 |
| Fillers: Inorganic or polymeric* | 20 – 40 | 20 – 40 | 20 – 60 | 20-60 | 20-60 | 50 |
| Reactive Resins* | 20 – 60 | 20 – 60 | 20 – 60 | 25-50 | 20-60 | 50 |
| Fillers: Non-polymeric ** | 5 – 20 | 5 – 20 | 5 – 20 | 5 – 30 | 5 – 30 | 25 |
| Pigments*** | < 0.5 | < 0.5 | <5 | < 0.5 - 1.0 | <1 | 1 |
| Catalysts | < 0.5 | < 0.5 | < 1 | < 0.5 | <1 | 1 |

**Table 3:** Poll results and expert evaluation in % for water-borne adhesives/sealants.

| **Ingredient type** | **Expert 1** | **Expert 2** | **Expert 3** | **Expert 4** | **Consensus Range** | **Indicative Value** |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Water | 20-40 | 20-40 | 20-40 | 20 – 60 | 20-60 | 30 |
| Solvent / Volatile / Emulsifier | 5 - 10 | 5 - 10 | 5 - 10 | 5 – 10 | 5 – 10 | 10 |
| Fillers: Inorganic or polymeric* | 20 – 40 | 20 – 40 | 20 – ~~40~~ 60 | 20 – 40 | 20-60 | 50 |
| Reactive Resins* | 20 – 40 | 20 – 40 | 20 – 40 | 20 – 60 | 20-50 | 40 |

**Table 3** (cont.)**:**

| **Ingredient type** | **Expert 1** | **Expert 2** | **Expert 3** | **Expert 4** | **Consensus Range** | **Indicative Value** |
|---|---|---|---|---|---|---|
| Fillers: Organic, non-polymeric ** | 5 – 10 | 5 – 10 | 5 – 10 | 5 – 10 | 5 – 10 | 10 |
| Pigments *** | < 0.5 | < 0.5 | < 4 | < 0.5 – 1.0 | <1 | 1 |
| Catalysts | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 | 0.5 |
| Preservatives | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 | 0.3 |

* This may include materials, that are polymers according to the REACH definition. They are included in order to be comprehensive.

** This may include plasticizers and flame retardants and possibly other organic substances.

*** Pigments should only include such substances that are added to provide colour. Titanium dioxide, iron oxide and carbon black added at up to 5% also act as fillers.

A typical use rate of 3000 kg per day was approximated for the use of adhesives and sealants at an industrial site. The indicative ingredient use rates are estimated in a conservative manner. These are obtained by multiplying the indicative ingredient concentrations with estimated rates of manufacturing or use of adhesives/sealants. According to FEICA expert's opinion, the values of the indicative ingredient concentrations cover more than 90% of adhesive/sealant products. Similarly, the values of the rates of manufacturing or use of adhesives/sealants cover more than 90% of the formulation sites and of the industrial use sites. The estimated indicative ingredient use rates are specified in Tolls et al. (2016).

## 5.2 Justification of days emitting

The justification of the emission days is a reasonable worse case assumption of an industrial site operating at >300 days a year. The 300 days per year excludes holidays (Sundays) and days for maintenance where operations are stopped or limited.

## 5.3 Justification of release factors

The justification method applied for deriving the release factors is read across (Reihlen et al., accepted for publication). The read across of the release factors is based on the similarities in the chemical ingredients and in the application process of coatings and paints, for which explicit OECD scenarios exist. The release factors of the SPERC for adhesives/sealants have been selected as worst-case values in the course of reading across from emission scenarios to SPERCs (see Annex 1). The details of the justification and the read across are provided in Tolls et al. (2016). The release factors are tabulated in Table 4.

It should be noted that binders are typically natural or synthetic high molecular weight polymers and would be best described under ERC 5. However, binders may alternatively contain reactive organic compounds (e.g. prepolymers, oligomers, monomers) that form polymers during the bonding process.

The industrial use of monomers would be best described under ERC 6c and ERC 6d. As all types of binders will after curing end-up in the adhesive matrix, the release factors for monomers are considered similar to other binders in a product. In conclusion, the applicability domain of the SPERC factsheets of non-volatile ingredients extends beyond ERC 5 to include ERC 6c and ERC 6d.

**Table 4.** Summary of release factors for the SPERCs for industrial use of adhesives and sealants.

| Release factors | **FEICA SPERC 4.2b** | **FEICA SPERC 5.1a FEICA SPERC 6c.1a FEICA SPERC 6d.1a** | **FEICA SPERC 4.1c** | **FEICA SPERC 5.1c FEICA SPERC 6c.1c FEICA SPERC 6d.1c** |
|---|---|---|---|---|
| | Solvent-borne / solvent-less adhesives and sealants | | Water-borne adhesives and sealants | |
| | volatile | solid | volatile | solid |
| | % of amount applied | | | |
| To air | 98.5% | 1.7% | 98.5% | 1.7% |
| To water | 0% | 0% | 0.3% | 0.3% |
| To soil | 0% | 0% | 0% | 0% |
| To waste | 0 -6% | 0 -6% | 0 -6% | 0 -6% |

Risk Management Measures (RMMs) are not considered in the derivation of release factors. Hence, the SPERC release factors do not account for the possible effect of for example VOC emission reduction, that may be a regulatory requirement under the VOC directive, and thus represent conservative estimates. As outlined in Tolls et al. the environmental release factors from the process can be considered to be conservative and to overestimate the actual fractions emitted during adhesive/sealant manufacturing and use.

The release factors to waste (0-6% for solids and volatiles) were obtained as worst case values from the OECD ESD on coatings and paints. The compilation of the data and the derivation of the worst-case values is detailed Annex 2. Based on the figures for the release factors, indicative overall mass fluxes are provided for each SPERC in Annex 3.

# 6 Conservatism

The conservatism in the emission estimation of the SPERCs for the industrial use of adhesives and sealants is warranted by assuming worst cases in both, the release factors and the use rates. The conservatism in the use rates is detailed in section 5.1.

The conservatism in the release rates is rooted in two causes. First, the worst case values of the release factors have been selected in the read-across process (Tolls et al, 2016, further information on the selection of worst case release factors is provided in Annex 2). Second, the read-across uses historic 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 industrial use of adhesives and sealants reflect technology that is more than ten year old.

Given the need for continuous efficiency gains in industrial processes and the concurrent technological advancement it is fair to assume that adhesive and sealant application processes have become more efficient. This implies that the fractions of adhesives and sealants, that are released to air, water, and waste, have decreased. In conclusion, this also contributes to the conservatism of the emission estimation of the SPERCs for the industrial use of adhesives and sealants.

# 7 Applicability of SPERCs

## 7.1 Tiered assessment

Due to the characteristics described above we consider the adhesives/sealants SPERCs to be suitable for use in standardised, 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, efforts can be focused on further (higher tier) assessments and refinement of problematic issues.

## 7.2 Regional assessment

In view that that there is very limited regional variation in the industrial use processes of adhesives /sealants, SPERCs may be applicable for emission estimation of the industrial use of adhesives / sealants not only in the EU but also in other regions.

# 8 References

FEICA website from http://www.feica.com/our-industry/application-sectors/paper-&-packaging, (as updated on May 30, 2014).

OECD 2009a, OECD Environment, Health and Safety Publications Series on Emission Scenario Documents No. 20, EMISSION SCENARIO DOCUMENT ON ADHESIVE FORMULATION, Paris 2009.

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.

OECD 2013, OECD Environment, Health and Safety Publications Series on Emission Scenario Documents, REVISED DRAFT, EMISSION SCENARIO DOCUMENT ON THE INDUSTRIAL USE OF ADHESIVES FOR SUBSTRATE BONDING, Paris 2013.

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)

Tolls, J.; Gomez, D.; Guhl, W.; Funk, T.; Seger, E.; Wind, T.; Estimating emissions from adhesives / sealants uses and manufacturing for the use in environmental risk assessment. Intergr Environ Assess Manag. (Jan 2016, in press)

WHO 1989, Indoor Air Quality: Organic Pollutants – Report on a WHO Meeting, Euro Reports 111, World Health Organisation, Regional Office for Europe, Copenhagen, 1989.

# 9 Annexes

## Annex 1 – Derivation of release factors for industrial application of adhesives and sealants.

### 9.1.1 Derivation of release factors – volatiles - Table S3 of Tolls et al. (2016) publication

Overview of release factors for solvents from industrial coating application of coatings. The data can be found for wooden furniture, automotive OEM, metal packaging, coil coating, marine coatings, aircraft painting, rail vehicles, and in OECD (OECD 2009b) on pages 123, 145, 150, 153, 161, 169, 174, and 180, respectively.

| **Paint application** | **Processes applied** | **Release factor in %– Solvents** | | | |
|---|---|---|---|---|---|
| | | **Air** | **Water** | **Land** | **Disposal** |
| Wooden furniture painting | Spraying / Overspray | 94.5 | 0 | 0 | |
| | Rolling / Brushing | 98.5 | 0 | 0 | |
| | Residues in drums & coating equipment | | | | 1.5 |
| Automotive refinishing (body shop) | Spraying / Overspray | 96.8 | 0 | 0 | 3.2 |
| Automotive OEM | Spraying / Overspray | 100 | 0 | 0 | |
| Metal packaging – internal coating | Spraying / Overspray | 100 | 0 | 0 | |
| Metal packaging – external coating | Spraying / Overspray | 100 | 0 | 0 | |
| Metal packaging: food and general line | Spraying / Overspray | 100 | 0 | 0 | |
| Coil coating | Roll coating | 97.5 | 0 | 0 | |
| | Roll coating losses | | | | 2.5 |
| Marine coating | Spraying / Overspray | 100 | 0 | 0 | |
| Coating aerospace | Spraying / Overspray | 95 | 0 | 0 | |
| | Equipment Residues | | | | 5 |
| Rail Vehicles | Spraying / Overspray | 95 | 0 | 0 | |
| | Sanding | | | | |
| | Equipment Residues | | | | 5 |
| Worst-Case – Solvents | | 98.5 | 0 | 0 | |

### 9.1.2 Derivation of release factors – solids - Table S4 of Tolls et al. (2016) publication

Overview of release factors for non-solvents from industrial coating application of coatings. The data can be found for wooden furniture, automotive OEM, metal packaging, coil coating, marine coatings, aircraft painting, rail vehicles, and in OECD (OECD 2009b) on pages 123, 145, 150, 153, 161, 169, 174, and 180, respectively.

| **Paint application** | **Processes applied** | **Release factor in % – Non-solvents** | | | |
|---|---|---|---|---|---|
| | | **Air** | **Water** | **Land** | **Disposal** |
| Wooden furniture painting | Spraying / Overspray | 0.9 | 0 | 0 | |
| | Rolling / Brushing | 1.7 | 0 | 0 | |
| | Residues in drums & coating equipment | | | | 1.5 |
| Automotive OEM | Spraying / Overspray | | | | 35 |
| Automotive refinishing (body shop) | Spraying / Overspray | | 1.8- 3.9* | 3.2* | 60.4 |
| Metal packaging – internal coating | Spraying / Overspray | | | | |
| Metal packaging – external coating | Spraying / Overspray | 1 | 0 | 0 | |
| Metal packaging: food and general line | Spraying / Overspray | | | | |
| Coil coating | Roll coating | | | | |
| Marine coating | Spraying / Overspray | | 1.8* | 1.8* | |
| Coating aerospace | Spraying / Overspray | 1.5 | 0 | 0 | |
| | Equipment Residues | | | | 5 |
| Rail Vehicles | Spraying / Overspray | 1.2 | 0 | 0 | |
| | Sanding | 0.5 | 0 | 0 | |
| | Equipment Residues | | | | 5 |
| Worst-Case | | 1.7 | 0.3* | 0 | |

* For explanation – citation from Tolls et al. 2016:

The scenarios ‘marine coating’ and ‘automotive refinishing’ were not included in the mapping and the respective release factors were disregarded. Adhesives/sealants are not used in spray cabins such as they are typically used in automotive refinishing. Likewise, the specific conditions under which coatings/paints are used in a dry dock do not apply to adhesives/sealants applications.

### 9.1.3 Derivation of release factor for solids and volatiles to water in in industrial applications of water-borne coatings/paints.

Citation from Tolls et al. (2016)

Emissions of solid and volatile constituents in industrial applications of water-borne coatings/paints are not specified in the OECD ESD (OECD 2009b) on coatings/paints. Since water-borne adhesives/sealants are increasingly used and result in emission into water, a SPERC has been developed for the industrial uses of such products. To that end, the emission scenarios for manufacturing water-borne products are a suitable starting point. The corresponding release factors address equipment (reactor and filling lines) cleaning with water and amount to ~0.5%. They reflect that equipment is cleaned each time a new batch is produced, typically more than once per day. Since the adhesives/sealants application equipment is cleaned primarily for maintenance purposes (and thus much less frequently) the release factor to water is set at 0.3%. For the emissions of non-solvents to air, the worst-case release factor identified for the emission scenarios for industrial uses (OECD 2009b) of 1.7% was adopted, irrespective of whether the product is water-borne or solvent-borne/solvent-less. It reflects the formation of droplets which are emitted to the air in the rolling applications.

## 9.2 Annex 2

### 9.2.1 Release factors to waste for solids used in different application types of coatings and paints (OECD 2009 b)

The release factors to waste for adhesives is derived as the maximum values of the sum of the equipment residues, waste paints, and container residues. This value is 5.5% and the resulting range is reported as 0 – 6 %. This range excludes the process steps involved in spray applications. These are indicated with an asterisks. Since adhesive spray applications are rare cases they are disregarded for the release factors reported in the factsheet. However, if adhesives are applied by spraying the releases to waste are up to 61% for solids. Likewise, sanding (indicated with two asterisks) is not a relevant process step for adhesive applications. For that reason, the release factor related to sanding for rail vehicles is disregarded for the release factor derivation.

| **Process Step** | **Furniture coating** | | **Automotive OEM** | **Automotive Refinishing*** ** | | **Metal packaging** | | **Coil coatings** | **Marine coatings*** ** | **Aircraft painting** | **Rail vehicle** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Spray | Flatline | | Dry back | Wet back | Beverage can | Food - general line | | | | |
| Direct loss- roll coating | | | | | | | | | | | |
| Process scrap | | | | | | | | | | | |
| Overspray* | 46.3 | 46.3 | 35 | 51.1 | 51.1 | 2 | 1 | | 31.5 | 4.6 | 3.5 |
| Sanding** | | | | | | | | | | | 1.5 |
| Equipment residue | 5 | 1 | | 9.3 | 9.3 | 1 | 0.5 | 1 | | 5 | 5 |
| Waste paints | | | | | | | | 1.5 | | | |
| Container residue | 0.5 | 0.5 | | | | 1.5 | 1.5 | | | | |
| Incinerator | | | | | | | | | | | |
| Captured Overspray* | | | | | | | | | | 24.3 | |
| Masking waste* | | | | | | | | | | | 18.6 |
| | | | | | | | | | | | |
| Sum (Non-Spray) | **5.5** | 1.5 | 0 | 9.3*** | 9.3*** | 2.5 | 2 | 2.5 | 0 | 5 | 5 |

* Process step involved in spray applications. Since adhesive spray applications are rare cases they are disregarded for the release factors reported in the factsheet.

** Sanding is not a relevant process step for adhesive applications. For that reason, the release factor related to sanding for rail vehicles is discarded.

*** For explanation – citation from Tolls et al. 2016:

The scenarios ‘marine coating’ and ‘automotive refinishing’ were not included in the mapping and the respective release factors were disregarded. Adhesives/sealants are not used in spray cabins in the way paints are typically used in automotive refinishing. Likewise, the specific conditions under which coatings/paints are used in a dry dock do not apply to adhesives/sealants applications.

### 9.2.2 Release factors to waste for volatiles used in different application types of coatings and paints (OECD 2009 b)

The release factors to waste for adhesives is derived as the maximum values of the sum of the equipment residues, waste paints, and container residues. This value is 5.5% and the resulting range is reported as 0 – 6 %. This range excludes the process step incinerator since this process steps does not result in physical waste for further treatment or disposal.

| **Process Step** | **Furniture coating** | | **Automotive OEM** | **Automotive Refinishing **** | | **Metal packaging** | | **Coil coatings** | **Marine coatings**** | **Aircraft painting** | **Rail vehicle** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Spray | Flatline | | Dry back | Wet back | Beverage can | Food - general line | | | | |
| Direct loss- roll coating | | | | | | | | | | | |
| Process scrap | | | | | | | | | | | |
| Overspray | | | | | | | | | | | |
| Sanding | | | | | | | | | | | |
| Equipment residue | 5 | 1 | | 3.2 | 3.2 | | | 1 | | 5 | 5 |
| Waste paints | | | | | | | | 1.5 | | | |
| Container residue | 0.5 | 0.5 | | | | | | | | | |
| Incinerator* | | | | | | | 61.7 | | | | |
| Captured Overspray | | | | | | | | | | | |
| Masking waste | | | | | | | | | | | |
| | | | | | | | | | | | |
| Sum (Non-Spray) | **5.5** | 1.5 | 0 | 3.2 | 3.2 | 0 | 0 | 2.5 | 0 | 5 | 5 |

* The process step incinerator does not result in physical waste for further treatment or disposal. For that reason it is disregarded.

** For explanation – citation from Tolls et al. 2016:

The scenarios ‘marine coating’ and ‘automotive refinishing’ were not included in the mapping and the respective release factors were disregarded. Adhesives/sealants are not used in spray cabins in the way paints typically used in automotive refinishing. Likewise, the specific conditions under which coatings/paints are used in a dry dock do not apply to adhesives/sealants applications.

## 9.3 Annex 3 – Overview of mass fluxes

**Table A1.** Indicative mass fluxes for the SPERCs for industrial use of adhesives and sealants.

| Direction of mass flux | **FEICA SPERC 4.2b** | **FEICA SPERC 5.1a**<br>**FEICA SPERC 6c.1a**<br>**FEICA SPERC 6d.1a** | **FEICA SPERC 4.1c** | **FEICA SPERC 5.1c**<br>**FEICA SPERC 6d.1c**<br>**FEICA SPERC 6d.1c** |
|---|---|---|---|---|
| | Solvent-borne / solvent-less adhesives and sealants | | Water-borne adhesives and sealants | |
| | volatile | solid | volatile | solid |
| | % of amount applied | | | |
| To substrate | 0% | > 91.7% | 0% | > 92% |
| To air | 98.5% | 1.7% | 98.5% | 1.7% |
| To water | 0% | 0% | 0.3% | 0.3% |
| To soil | 0% | 0% | 0% | 0% |
| To waste | 0 -6% | 0 -6% | 0 -6% | 0 -6% |