Specific Environmental Release Categories (SPERCs) for the Industrial use of Water-borne Processing Aids

Background Document

Brussels, January 2021

A.I.S.E, International Association for Soaps, Detergents and Maintenance Products

Boulevard du Souverain 165 - 4th floor

1160 Brussels (Belgium)

www.aise.eu

Content

1 Statement of purpose

To carry out an environmental exposure assessment, the quantification of the rates of substances released to the environment is key. While the ECHA Guidance R16 provides a generic set of release factors, they are less meaningful for several industry sectors, among them A.I.S.E., that have refined the Environmental Release Categories (ERCs) by detailed analysis of the sector specific typical operational conditions to build 'SPecific Environmental Release Categories' (SPERCs).

Thus, the A.I.S.E. SPERCs refine and specify emission scenario information (ERCs) for the use of substances throughout their life cycle (Reihlen et al., 2016) in the detergent and maintenance products industry.

The SPERCs described in this document are specific to the Industrial use of Water-borne Processing Aids. Yet, they still reflect emission estimates of broadly defined industrial use processes. This applies for processes which are operated according to common good practices. The SPERC for the industrial use of Water-borne Processing Aids refines the single set of generic release factors for the *Use of non-reactive processing aid at industrial site* provided in the ECHA Guidance R16.

This document provides the background information to the SPERC factsheet for the Industrial use of Water-borne Processing Aids, referring to ERC 4 (Table 1). It provides specific information with regards to the product types covered by the SPERC, use conditions that are relevant to the environmental exposure, a justification of the applied release factors and indicative use rates (chapter 5). Some details refer to tertiary references (e.g. publications) which are listed in chapter 8 and 9.

The SPERC Factsheet covered in this document is:

Table: SPERC Factsheet covered in this document

AISE SPERC Code	Type of ingredient	Product characteristic
AISE SPERC 4.1.v3	Water-borne Processing aids	Substances used as processing aids in industrial processes not being included into or onto articles

As outlined below, the SPERCs described in this document are conservative for use in lower tier REACH safety assessments. In fact, the emission factors described in this specific document represent no change to the default. However, there are multiple pieces of information that may be of use further specifying the emission scenario of water borne processing aids, such as use amounts and application technologies.

The detergents and maintenance product industry is highly regulated and detergent and maintenance products are subject to an array of regulatory requirements including the CLP No 1272/2008, Biocides No 528/2012, REACH No 1907/2006 and Detergents Regulation No 648/2004 along with other regulations at member state level. Due to the regulatory requirements, individual ingredients in detergent and maintenance products are subject to additional criteria (e.g. biodegradability criteria for surfactants, VOC regulation). Industrial processes for which water-borne processing aids are use may be affected by national, regional, local and process specific regulations. These can include requirements for training to ensure safe and sustainable use. However, the SPERC emission estimates are conservative and not intended to reflect all regulatory requirements that may relate to environmental emission thresholds. Risk management measures which may apply for specific processes at individual sites cannot be described on a general level for the products in scope.

2 Scope Industrial use of Water-borne Processing Aids:

The term processing aids refers to substances which are used to facilitate processes in a broad range of different industrial applications without being consumed (reacted) or included into or onto the matrix of an article (ECHA Guidance, Chapter R.16). Processing aids in aqueous solutions covered by this document are generally of negligible volatilization with a boiling point usually above 250°C (WHO 1989, USEPA 2017)) or are intended to remain in the application solution. Spray applications are assumed to be performed indoor. Examples of processing aids targeted in the next chapters of this document are detergents used in industrial laundries to facilitate the washing process or water-borne solvents used in industrial cleaners. After use, these substances will typically be directly released to waste-water streams resulting in 100% emission to water. Due to heterogeneity in industrial applications we hold this assumption for all uses as a worst case, while acknowledging cases with less emissions.

Application technologies covered in this background document are related to the industries represented by the A.I.S.E (AISE, 2013) and refer to the industrial use of those water-borne processing aids. In contrast to professional applications, industrial applications have to be done in a supervised surrounding and one site usually serves larger areas (no correlation with local infrastructure).

Application technologies that are out of scope of this document are water conditioning technologies including cooling water treatment preventing scaling, fouling and corrosion and Metal Working. The reasons are as follows:

In contrast to the applications covered by the ERC 4 SPERC cooling water treatment often results in a direct release of the cooling water discharges (blowdown) to surface water without a Sewage Treatment plant. The absence of an STP is also mentioned as the recommended worst-case approach in the latest ESD documents for liquid cooling systems (EC/RIVM, 2003). Furthermore, the releases are very much depending on the site-specific operational conditions and would not be sufficiently reflected by the generic process steps described in a SPERC document.

In Metal Working/Treatment processes a number of mandatory Risk Management Measures are being applied. Any processing aids used, e.g. in pre-cleaning of Metal Surfaces, would undergo individual RMMs, respectively. Details on operational conditions and RMMs relevant for Metal Working would also apply for processing aids used, e.g. in the pre-cleaning of metal surfaces, and can be found in the background document developed for ERC 5 [AISE, 2020]. As this document provides a conservative estimate excluding any mandatory RMM, Metal Working processes would not be appropriately reflected.

The aim of this document is to provide a conservative estimation of the releases caused by the industrial application technologies applied under ERC 4. Because no RMM have been included in the SPERC a generic scope is provided for industrial laundry and cleaners for several industrial sectors. These are further described below. It should however be noted where RMM may be present on site they would significantly reduce the presented release factors.

2.1.1 ingredients and product types

The activities in scope of this document represent the different industrial applications of water-borne reactive processing aids in the industries covered by AISE.

2.1.1.1 Industrial use of laundry products

Industrial laundries are off-premise laundries that receive soiled laundry e.g. from hospitals, repair shop, industrial kitchens or doctor’s offices. Following various washing cycles to clean the laundry, a number of products can be used for textile finishing. Examples of processing aids used in industrial laundry include builders, chelating agents, pH regulators and detergents. The main products in scope of this document are:

- **Laundry products** and boosters for cleaning of soiled laundry
- **Bleaching products** used for bleaching/brightening of cleaned laundry using
- **Softner/Starch** used for fabric softening and conditioning of cleaned laundry

2.1.1.2 Industrial cleaners

Cleaners are used in a wide range of different applications within the Industrial sectors. These include technical cleaning activities within industrial plants to clean storage and equipment, cleaning of specific objects (e.g. vehicle cleaning in large automobile producing industries), building care for large industrial surfaces like floors and specific cleaning operations like CIP (Cleaning in Place) chemicals or equipment cleaners (OECD, 2015). These processes can either be continuous or batch processes applying dedicated or multi-purpose equipment. Processes can either be technically controlled or operated by manual interventions. Examples of processing aids used in these cleaners are surfactants and solvents. The range of products in scope of the document is given below:

- **Vehicle cleaning** products (Trains, Aeroplanes, Car washing, Boat cleaning, Dewaxing)
- **Process cleaners** used for food and beverage and pharmacos industry (CIP process, Semi-closed process), equipment cleaners
- Industrial Use of **Surface Cleaning** Products (surface cleaner (high pressure process, medium pressure process)

2.2 Application technologies

Industrial uses have in common that the processing aids are applied in a supervised area using dedicated machines. Application technologies include dipping, pouring, soaking, wiping and spraying and are explained in more detail in the following paragraph.

2.2.1 Industrial laundry

The washing process in industrial laundries is fairly automated. Dirty laundry is received, sorted and added to the washing machine. Afterwards, automated loading of chemicals using a wash formula specific to the laundry and soil loading occurs and the washing circle of 25-95 min (ENV/JM/MONO (2011)19 begins. The typical steps within a washing process are shown in Figure 1. Although comparable by technology we distinguish between large and small scale laundries In terms of emission amounts (cf. Ch 5). Any non-volatile compounds will be released through the wastewater during the washing cycle. Some industrial laundries have wastewater treatment on-site. These can include the collection of wastewater and the use of settling basins or pH neutralization (OECD, 2013) (EU Commission 2011). However, this document provided a conservative estimate of emissions to the environment for this application and is consequently assuming that 100 % is disposed via wastewater to a municipal wastewater treatment facility without pre-treatment on-site.

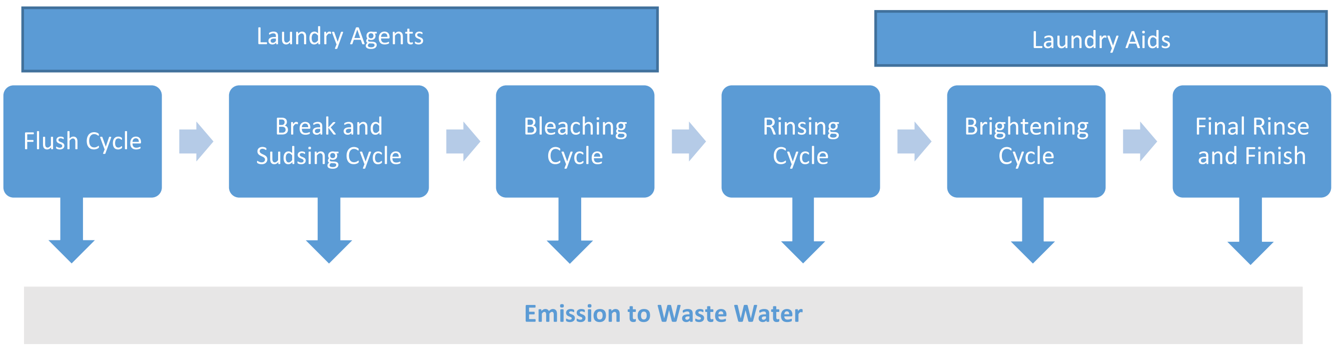

Figure 1: Typical steps within a washing process with emission sources (modified after ENV/JM/MONO(2011)19)

2.2.2 Industrial cleaners

Car washing/Boat cleaning:

Cleaning of cars and boats can either automated, semi-automated or manual (spray and wipe) and happens indoor. Targeted facilities in the industrial sector include large sites for maintenance of public transport infrastructure (e.g. trains, airports/harbours) or utility vehicles (trucks, busses) where the structure of service does not correlate with the municipal infrastructure.

Typically, oil-based contaminations need to be removed during the washing process. The typical steps within the cleaning process are shown in Figure 2. First the car/boat is pre-soaked with water via an automated nozzle or a hand-held spraying application. Following the pre-soaking, the car/boat is cleaned by spraying or brushing using a detergent solution. Afterwards, a high-pressure rinse with water occurs. This step can be followed by an optional surface finishing step (waxing and sealing) before the final low-pressure rinsing step with water. Any non-volatile compounds will be released through the wastewater during the washing cycle. Some car washing system use reclaiming systems to reduce the amount of wastewater by reusing the water in the car washing (Brown, 2000). These treatments can include separation, oxidation and filtration. However, this document provided a conservative estimate of emissions to the environment for this application and is consequently assuming that 100 % is disposed via wastewater without pre-treatment on-site.

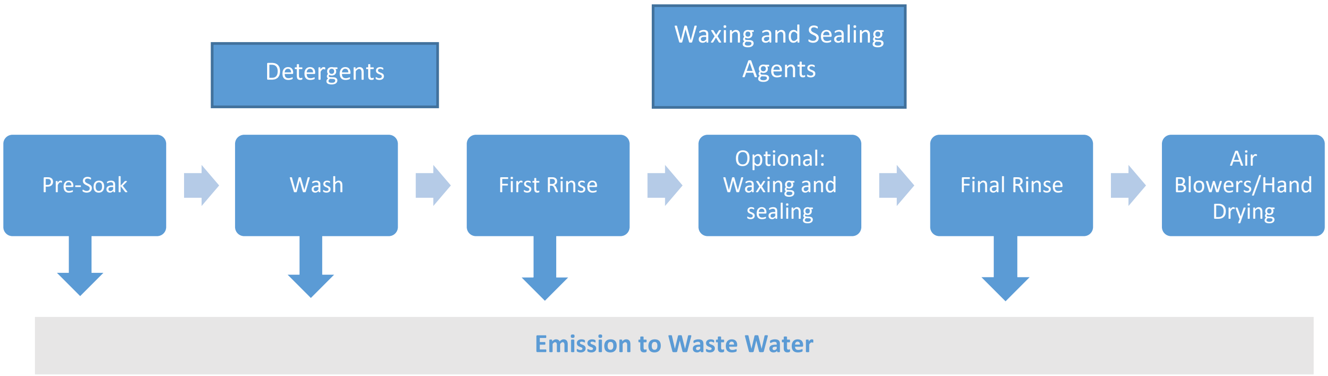

Figure 2: Typical steps within a car/boat cleaning process with emission sources (modified after Brown, 2000)

Process cleaning

The large category of process cleaners covers a wide range of different cleaning activities in the food and beverage and pharmacos' industry. These can include closed applications like 'Cleaning in Place' (CIP) processes or semi-closed to open processes such as transportation and storage cleaning (see surface cleaning). Whilst the applications differ in the level of containment, they are assumed to be housed-in and any emissions are 100 % disposed via wastewater to a municipal sewage treatment faclility.

Cleaning-in-place (CIP) describes a method used to clean interior surfaces of reactions vessels, process equipment, pipes and fittings without disassembly (in-situ). CIP systems are used e.g. in food processing plants to avoid any cross-contamination between production runs and ensure that quality standards are met. Processing aids used in CIP cleaning detergents include surfactants, sequestering agents, complex forming agents and oxidation agents.

During a CIP cleaning process, cleaning liquid is circulated through the equipment in a cleaning circuit. The typical process steps for CIP cleaning in food processing plants are shown in Figure 3. First the equipment is pre-rinsed to remove any water-soluble soiling. Afterwards, detergents are circulated through the system e.g. to remove organic soil (using alkaline detergents) followed by a rinsing step with water. Depending on the type of soiling, the rinsing step can be followed by another cleaning cycle e.g. using acidic detergents to dissolve any mineral deposits. Following the second step the equipment is rinsed again to remove the detergents.

In **single-use** CIP processes, cleaning detergents move through the equipment and are immediately put down the drain afterwards resulting in 100% release to wastewater. Single-use CIPs are mostly used in small facilities. In bigger facilities, **recovery CIPs** are used. In these systems, the cleaning solution is reused during several rinsing cycles. The only detergents discharge between the cleaning cycles results from any phase separator losses and detergents that adhere to the equipment and are blown down during rinsing. This loss is expected to be around 5-10 % of the cleaning solution. The cleaning solution, used during several CIP cycles, is ultimately put down the drain resulting in 100 % emission to municipal wastewater (company expert knowledge).

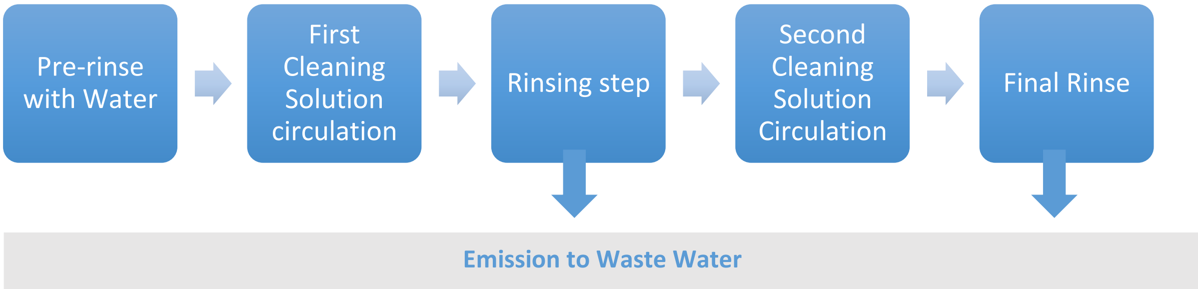

Figure 3: Example of CIP cleaning process steps in a food processing plant (own figure)

Surface cleaning:

The category of surface cleaners includes the cleaning of various surfaces in the industrial setting (indoor only). These can include floors, walls, storage rooms & equipment or metal cleaning. Cleaning solutions contains processing aids like surfactants or solvents are applied either manually, semi-automated or automated via spraying, brushing or mopping to the concerned surface. Afterwards, the surface is rinsed with fresh water which goes down the drain resulting in 100 % emission to wastewater dedicated to a municipal sewage treatment facility.

Metal working:

As described in section 2 on the scope of this document, details on operational conditions and RMMs relevant for Metal Working would also apply for processing aids used, e.g. in the pre-cleaning of metal surfaces, and can be found in the background document developed for ERC 5 [AISE, 2020]. However, the ERC 5 SPERC focusses on metals only and substances that do not become part of a matrix are excluded per definition. Chemicals like organic processing aids in Me-salt surface treatment can instead be assessed via ERC 4, which represents the worst-case by the emissions.

3 Emission relevance of operational conditions

Emission to Water

Table 1 displays the process steps that potentially lead to emissions to the environment originating from the application of water borne processing aids. It is assumed that in the case of industrial uses of these substances, the emissions to water are almost exclusively caused by treatment of the article/laundry/equipment and disposing of the washings/treatment solution to wastewater subsequently leading to a municipal sewage treatment. As a consequence, the emission to water is assumed to be 100%.

Table 1: Overview of the processing steps involved in the Industrial use of Water-borne Processing Aids, and their relevance with regard to the emission estimation and derivation of release factors.

Processing Step		**Industrial use of Water-borne Processing Aids**	**Details**
AISE SPERC		AISE SPERC 4.1.v3	
a	Charging of application fluid including processing aid to machine	Processing aid is delivered to application machine via dedicated equipment. Manual fitting of reservoir/container (cartridge, supply equipment, etc.) to application machine does not result in emissions to environment.	Application machines may include multiple washing/treatment and rinsing tanks. Application occurs indoor and system can be closed or open.

b	Application of processing aid	Application of processing aid in application machine or in dedicated indoor area (e.g. vehicle cleaning). The used application fluid including processing aid, is either collected first and disposed via wastewater afterwards or disposed at a steady-state during the application, both resulting in 100 % emission to water. Significant process step - **accounted for in release factor**	For some applications (e.g. CIP cleaning) spend application fluid is re-used (with only limited losses between cycles) several times before being disposed. For other applications, spend application fluid is first collected and then disposed. Finally, disposal can also occur at a steady-state during application.
c	Disposal of application fluid from reservoir	Periodically application fluid is disposed to allow cleaning of reservoir resulting in 100 % release to waste water - **Discontinuous release**	Some processing aids are operated in closed-loop systems, including internal cleaning steps and recovery. Such reservoirs/baths need to be exchanged at a certain point in time as a whole.
d	Cleaning of Reservoir	Periodically reservoir is cleaned to remove remaining application fluid. Spent rinsing water is discharged via waste water - **Discontinuous release**	
f	Equipment cleaning	Periodically cleaning equipment is rinsed with water – emissions to water – Significant process step - **accounted for in release factor**	
	On site pre-treatment of waste-water	Contaminated waste-water may be pre-treated with on site wastewater treatment devices. Those pre-treatment may result in a reduction of the release factor to wastewater **- optional RMM – not account for in release factor**	Pre-treatment devices can include e.g. natural sedimentation, microbiological degradation.
	Recycling or Disposal of Product Packaging	Small amounts of product may remain in the product packaging and may be disposed via waste **– accounted for in release factors**	E.g. product adhering to surfaces after residual emptying of packaging

Emission to Air and Soil

No emissions are leading to the air because only non-volatile substances are concerned. Likewise, the emissions to soil are zero because water-borne processing aids are applied in aqueous solutions and emissions are leading to waste water only.

Emission to Waste

Finally, only a small fraction of the substance is expected to end up in the solid waste, subsequently only referred to as “waste”. This would apply for any product left over in packaging used in the industrial setting that is not returned to the supplier but disposed or recycled after use. Large packaging like IBC tanks or barrels are returned to the supplier after use, cleaned and refilled with product, resulting in 0% release to waste. For smaller packaging that is disposed or recycled after use, a small amount of product may be left over in the packaging (mainly due to the adherence of the product to the walls of the packaging) and would be disposed via waste.

The European packaging regulation requires any packaging to be reasonably emptied after use. Additionally, due to the size of the packaging and product usage in the industrial setting, any losses due to product left-over would have a big economic impact and plants are assumed to have dedicated measures (e.g. suction lances) in place to reduce any product residues. In addition, some specific EU countries like Germany have additional regulatory limitations on the amount of left-over that is allowed in packaging. However, the lack of a fully harmonized picture across Europe means it is difficult to derive an exact value for waste residue. In the absence of specific data on product residues in packaging, a conservative value of max. 1% was included in the SPERC document. This value considers the setting and requirements for industrial use of detergent and maintenance products in Europe and has been obtained via the input of an A.I.S.E expert group. Due to the measures described above that are implemented to reduce the amount of waste left in packaging, and potential for economic losses, this is assumed to be a worst-case estimation.

4 Application of risk reduction measures

The SPERC provides a conservative estimate of the emissions caused by the industrial use of water-borne processing aid. Consequently, no obligatory RMMs were included in this SPERC.

5 SPERC Information sources and justification

5.1 Justification of use rates

5.1.1 Indicative use rates

To evaluate typical indicative substance use rates per day at a typical site (M_{SPERC}) in the different industrial applications an expert poll of industry members, representing an estimated >50% of the relevant industry, has been conducted. The poll asked for typical and reasonable worst-case concentrations, product dilutions and typical use amounts of different applications.

To derive the specific use rate M_{sperc} the following equation may be used:

$$\mathbf{M_{SPERC} = M_{Site} \times C_{SP}}$$

C_{SP} = Concentration of substance in product, M_{Site} = the amount of product used per day

- **Typical concentration**: 90% percentile of the range of typical concentration values reported in the expert poll.
- **Reasonable worst-case**: 90% percentile of maximum concentration values reported in the expert poll which is assumed to be a reasonable worst-case covering almost the complete range of products.

Operational conditions:

- **Typical dilution of the product during operation**: Provides the full range of dilutions reported by the respondent companies of the survey.

- **Maximum amount of product used per day**: Provides the full range of values reported by the survey respondents and may be used by registrants as an indication for the reporting of $\mathbf{M_{Site}}$.

Industrial laundry

Frame Formulation			Operational Conditions	
Processing aid ingredient	**Typical concentration [%]**	**Reasonable worst-case [%]**	**Typical dilution of the product during operation [% of formulation]**	**Maximum amount of product used per day [kg/d][3]**
Surfactant	20.70	72.00	0.06-0.5	Small laundry[1]: 30-580 Big laundry[2]: max. 5800
Builders	45.00	72.00		
Optical Brightener	0.27	0.90		
Bleaching agent	9.00	9.00		
Phosphonates	2.70	9.00		
Sequestering agents	9.00	9.00		

Industrial cleaning scale: >1 t processed laundry per day; Values based on data provided by three companies

[1] Small laundry: 1-10 tonnes processed laundry per day

[2] Big laundry: Up to 100 tonnes processed laundry per day

Car washing/Boat cleaning:

Frame Formulation			Operational Conditions	
Processing aid ingredient	**Typical concentration [%]**	**Reasonable worst-case [%]**	**Typical dilution of the product during operation [% of formulation]**	**Maximum amount of product used per day [kg/d][1]**
Acid or Base	13.5	13.5	<50	max. 100
Complexing Agents	9	9		
Corrosion inhibitor	4.5	4.5		
Phosphates	45	45		
Solubilizer	13.5	13.5		
Solvent	18	18		
Surfactants	54	54		

Industrial cleaning scale: > 100 Vehicles [below 100 vehicles is considered as professional] or >10 boats per day;

[1]Typical amount of product used per vehicle 60 g;

Values based on data provided by two companies and literature source [Johanssen, 2007]

Industrial Surface Cleaning

Frame Formulation			Operational Conditions	
Processing aid ingredient	**Typical concentration [%]**	**Reasonable worst-case [%]**	**Typical dilution of the product during operation [% of formulation]**	**How much of the product is max. used per day per facility [kg/d]?[1]**
Surfactant	7.20	22.50	0.005 -10	50
Builders	9.00	22.50		
Solvent	72.00	85.50		
Base/Acids	22.50	23.40		
Sequestering agents	1.80	1.80		
Additives for detergents	0.45	0.45		

Values based on data provided by four companies.

[1]Assuming a large surface of 1500 m^2 is cleaned once per day.

Process Cleaning – CIP Cleaning

Frame Formulation			Operational Conditions	
Processing aid ingredient	**Typical concentration [%]**	**Reasonable worst-case [%]**	**Typical dilution of the product during operation [% of formulation]**	**How much of the product is max. used per day per facility [kg/d]?[1]**
Acid or base	27.00	54.00	0.5-5	200 (50 per cleaning cycle)
Surfactants	9.00	31.50		
Sequestering agents	6.30	22.50		
Complexing agents	9.00	18.00		
Oxidating agents	9.00	27.00		
Additive for detergents	0.45	0.45		
Phosphonates	9.00	9.00		

Values based on data provided by three companies

For compliance purposes the users of water-borne processing aids evaluate their specific situations and compare with the registrant's information. To that end, the users need to know their own substance use rate (M_{Site}), their on-site emission reduction measures (incl. the efficiency, $E_{ER,Site}$), the factor by which their wastewater is diluted ($q_{Dil,Site}$) and the initial release fraction at their site ($F_{release,Site}$). Those parameters can be accounted according to the following equation. Adequate control of risk is indicated if the condition put forward in the following equation is fulfilled for a specific site.
Where a downstream user differs significantly from the generic use pattern described above, he may want to apply a scaling. For that reason, the choice of parameter values which deviate from the default values needs reflect the actual situation. This has to be justified on demand.

$$\frac{M_{SPERC} \ x \ (1-E_{ER,SPERC}) \ x \ F_{release,SPERC}}{q_{Dil,SPERC}} \geq \frac{M_{Site} \ x \ (1-E_{ER,Site}) \ x \ F_{releaseSite}}{q_{Dil,Site}}$$

5.1.2 Periodical disposal of application fluid (batch release)

The scaling equation provided above can also be used for modifying the SPERC for periodical disposal of application fluid. In that case, the substance emission rate is calculated by dividing the amount of substance discharged by the number of days during which the discharge occurs. The amount of substance can be obtained by multiplying the volume of the reservoir (m3) with the concentration of the product in the application fluid (kg/kg), and the concentration of the substance in the product (kg/kg) and the fraction of the substance not being retained by the emission reduction measure applied.

5.2 Justification of days emitting

In line with the ECHA Guidance document R.16 Appendix A.16-2– the default number of release days is set to 300 days/year. This represents a reasonable worst-case covering all large sizes handling up to 5000 t assuming a total tonnage of a mixture containing the substance or the substance as such.

5.3 Justification of release factors

The release factors presented in Table 2 of this document are based on the generic release factors provided in the ECHA Guidance document R16 Appendix A.16-1 for ERC 4 (Use of non-reactive processing aids at industrial site (no inclusion into or into article) (ECHA 2016) but have been refined to be specific to the physical chemical properties and use conditions of the substances in the AISE portfolio. The justification of these release factors has been discussed in the above sections and values are assumed to present a worst-case based on the processes/release pattern targeted by this document.

Table 2: Summary of release factors for the SPERCs for the Industrial use of Water-borne Processing Aids.

Release factors	**Industrial use of Water-borne Processing Aids**
AISE SPERC	AISE SPERC 4.1.v3
To air	0%
To water	100%
To soil	0%
To waste	0-1%

5.4 Justification of Risk Management Measures

No RMMs are applicable for this SPERC.

6 Conservatism

The use rates identified in this background document and the relevant SPERC factsheets are based on the subject matter expertise of AISE members in addition to peer reviewed scientific publications.

Release factors were chosen in a conservative manner (100% release) since the product uses are intended for its release int the environment after use. In combination, the values provided are considered to be a reasonable worst-case scenario for input into exposure assessments.

7 Applicability of SPERCs

7.1 Tiered assessment

Due to the characteristics described above, we consider the Industrial use of Water-borne Processing Aids 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.

In cases where downstream users differ significantly from the generic use patterns described in this document, they may apply scaling as described in section 5.1 to account for their specific situation.

7.2 Regional assessment

In view that that there is very limited regional variation in the formulation of the Industrial use of Water-borne Processing Aids, SPERCs may be applicable for emission estimation of the Industrial use of Water-borne Processing Aids not only in the EU but also in other regions.

8 References

A.I.S.E, International Association for Soaps, Detergents and Maintenance Products (2020). ENVIRONMENTAL EMISSIONS OF METALS IN INDUSTRIAL SURFACE TREATMENT Background Document

Brown, C, Water Conservation in the Professional Car Wash Industry – International Carwash Association (2000): 10-23

OECD (2015). EMISSION SCENARIO DOCUMENT (ESD) ON INDUSTRIAL USE OF INDUSTRIAL CLEANERS, Series on Emission Documents No. 33

OECD (2011). EMISSION SCENARIO DOCUMENT ON THE CHEMICALS USED IN WATER BASED WASHING OPERATIONS AT INDUSTRIAL AND INSTITUTIONAL LAUNDRIES, Series on Emission Documents No. 29

EU Commission (2013). Reference Document on the Best Available Techniques for the Textiles Industry.

Reihlen, 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) 12(4): 772–781

USEPA (2017). Technical Overview of Volatile Organic Compounds. Indoor Air Quality (IAQ)

WHO (1989). Indoor air quality: organic pollutants. Report on a WHO Meeting, Berlin, 23-27 August 1987EURO Reports and Studies: 111

International Association for Soaps, Detergents and Maintenance Products. (2013). *Product categories from the A.I.S.E. portfolio.* Retrieved from: https://www.aise.eu/documents/document/20131014165516-product_categories_2013.pdf

EC/RIVM (2003). Harmonisation of Environmental Emission Scenarios Biocides: PT 11 – Preservatives for liquid cooling systems

Johansson (2007). Handbook for cleaning/decontamination of surfaces: 442

This document was created from the expert input of the A.I.S.E. SPERC TF in collaboration with other A.I.S.E. expert group