ESIG/ESVOC SpERC
Background Document

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Specific Environmental Release Categories (SpERCs) for the consumer use of solvents and solvent-borne substances for agrochemical use, de-icing applications, and water treatment chemicals

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Introduction

There is an array of solvent-containing household products sold commercially to consumers. These consumer products may result in the widespread release of substances into the environment (ECHA, 2016). Widespread uses of a product may either be indoors or outdoors and are characterized by small point-source releases at many different locations spread over a large area. Engineering controls to prevent or reduce the environmental release of product components are generally absent or ineffective when the uses are widespread. Procedural controls may be put in place to minimize releases in consumer applications where a task is performed intermittently on an irregular schedule. These measures are often conveyed to the user as written instructions designed to ensure the safe application, storage, and disposal of a product.

Product labels also contain warnings and cautionary statements that highlight notable dangers or hazards to human health and the environment. Compliance with these directions is essential for minimizing environmental release and the potential for harm. Continuous improvements in the language and characters used to convey noteworthy product-related information have helped improve consumer understanding and acceptance of the need for care when handling many solvent-containing products (Rogers, et al., 2000). Precautionary statements often take the form of signal words such as WARNING or CAUTION, which alert consumers to particularly important risks inherently associated with a product's use. The signal words are generally accompanied by specific directions for the proper use, storage, and handling of a product (USEPA, 2012). Precise conveyance of this information in a clear and concise manner that is readily understood by the product user helps guarantee proper application in an environmentally conscientious manner that minimizes the air, water, and soil release.

Other product design characteristics also aid in controlling the unintentional release of a product's ingredients to the environment. Specialized packaging prevents or minimizes accidental spillage during transfer operations. This includes designs with drip-free nozzles, leakproof materials, and anti-glug vents that reduce the amount of spillage (Smith, 2018). These innovations have proved to be particularly helpful in controlling the unintentional releases of liquid pesticides and lubricants during transfer operations. The opportunity for environmental release is substantially reduced when these design improvements are used together with safe/sensible handling practices that include strict adherence with manufacturer's instructions, promptly attending to leaks and spills, and conscientiously disposing of any unused or outdated products.

The following guidance document provides a description of the logic and reasoning used to create three Specific Environmental Release Categories (SpERCs) covering the consumer use of solvent-containing products. The air, water, and soil release factors associated with these SpERCs and sub-SpERCs provide an alternative to the default release factors associated with the environmental release categories (ERCs) promulgated by ECHA. The following sections of this background document have been aligned with those of the SpERC Factsheet and provide additional descriptive details on the genesis and informational resources used to generate each SpERC.

1. Title

The enclosed background information corresponds with the information provided in the following three factsheets:

1. ESVOC SPERC 8.11b.v3 – Agrochemical uses
2. ESVOC SPERC 8.14b.v3 – De-icing applications
3. ESVOC SPERC 8.22c.v3 – Water treatment chemical use

Since these newly released SpERC factsheets include some corrections and or modifications, the version number has been changed to reflect the updates.

2. Scope

The applicability domain for a particular SpERC includes an initial determination of the life cycle stage (LCS) that best describes the industrial operation involved and the intended use of the substance being evaluated. The relevant life cycle stages and their interrelationships are depicted in Figure 1 (ECHA, 2015). The three SpERCs highlighted in this guidance document are all associated with a single life cycle stage: widespread use by consumers. This assignment is consistent with ECHA guidelines for distinguishing solvent uses in industrial applications versus their widespread use in professional or consumer applications.

Other use descriptors such as the sector of use (SU) and the chemical product category (PC) have been assigned in accordance with the naming conventions outlined by ECHA (ECHA, 2015). These have been summarized in Table 1 along with the use descriptions characterizing the three SpERCs. The terminology used to describe the individual applications is consistent with the list of standard phrases associated with the Generic Exposure Scenarios (GESs) that have been created to describe the exposures associated with the industrial production and use of solvents (ESIG/ESVOC, 2017). Use of standard phrases in these SpERC descriptions provides consistency and harmonization, and avoids confusion among potential SpERC users.

Figure 1. ECHA identified life cycle stages and their interrelationship

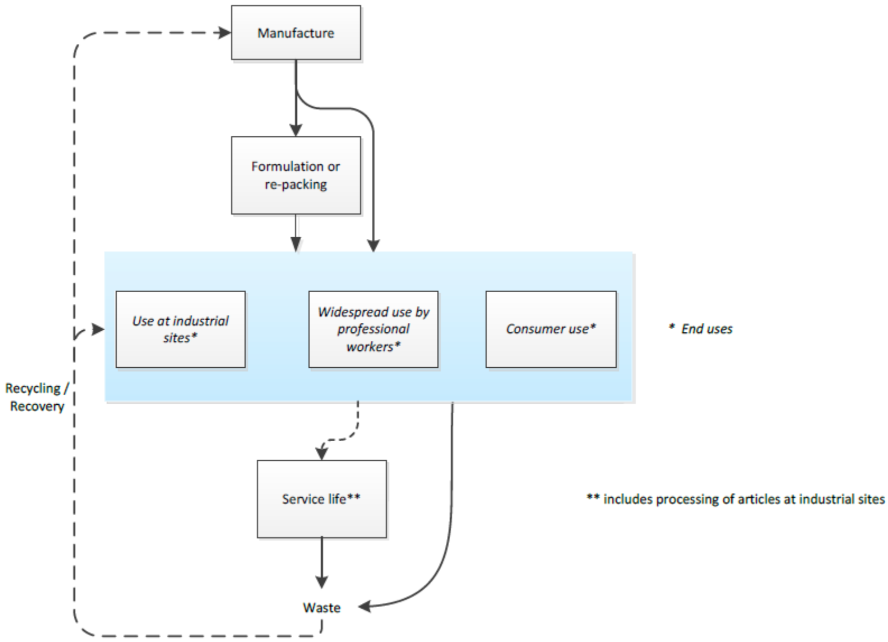

Table 1. SpERC background information

SpERC Code	Title	Life Cycle Stage (LCS)	Sector of Use (SU)	Chemical Products Category (PC)	Use Description
ESVOC SPERC 8.11b.v3	Agrochemical use	Widespread use by consumers0	SU1 Agriculture, forestry, fishery	PC8 Biocidal products	Covers the consumer use as an agrochemical excipient for application by manual or machine spraying, smokes and fogging; including equipment clean-downs and disposal; and consumer use in agrochemicals in liquid and solid forms.
ESVOC SPERC 8.14b.v3	De-icing applications	Widespread use by consumers	SU0 Other	PC4 Anti-freeze and de-icing products	Covers use for ice prevention and de-icing of vehicle, aircraft and other equipment by spraying.
ESVOC SPERC 8.22c.v3	Water treatment chemical use	Widespread use by consumers	SU0 Other	PC20 Processing aids such as pH-regulators, flocculants, precipitants, neutralization agents	Covers the use of the substance for the treatment of water in open and closed systems.

3. Operational conditions

The operating conditions define a set of procedures and use conditions that limit the potential for environmental release. The consumer use of solvent-containing products in households and private dwellings are not associated with a specific group of mandatory requirements or constraints to minimize the likelihood of an environmental release. There are, however, recommended procedures that should be implemented by a product user to reduce the potential for air, water, and soil release. **Conditions of use**

Several conditions characterize the consumer use of a product in a widespread manner. These include i) the potential use and handling at a large number of broadly found locations whose distribution density is roughly proportional to the number of local inhabitants; ii) unimpeded usage that does not need to conform with local, regional, or national permitting requirements; iii) basic and simplified pollution control equipment for controlling environmental release; iv) tasks and workflows that limit the product use volumes and the overall emissions potential; and v) access to a municipal sanitary sewer system capable of handling any extraneous waste streams from the site.

Although many solvent-containing consumer products should not be indiscriminately poured down the drain, residual amounts often find their way into municipal wastewater systems (NMSU, 2007) . As such, a standard municipal wastewater treatment facility (WWTP) is presumed to exist when these solvent-containing products are used in widespread applications. A standard municipal facility uses both mechanical and biological treatment stages and has an effluent discharge rate of 2,000 m3/day, which is equivalent to a wastewater generation rate of 200 L/person/day for a community with 10,000 inhabitants (ECHA, 2016). At the regional scale, ECHA assumes that 80% of the generated wastewater is funnelled through a standard municipal WWTP, with the remaining 20% released directly to surface waters. Further, stormwater drainage systems are not connected to a standard WWTP and the effluents are discharge untreated to local surface waters. The sludge resulting from the municipal wastewater treatment is also recognized to be suitable for direct application to agricultural soil.

The three SpERCs described in this background document are associated with indoor and outdoor applications typically undertaken by consumers with commercial access to the product. The widespread use of these products can occur at various household locations including basements, garages, workshops, and kitchens. The users are typically untrained individuals that possess little technical knowledge of the product and its uses. Proper use conditions are therefore explicitly stated in the instructions (BCERF, 1999). Although the manufacturer's directions often focus on the steps taken to prevent any adverse health effects, these same actions may also curtail any unintended environmental releases. For instance, storage in a securely closed container that is placed in a cool and dry location helps prevent inhalation exposure as well as atmospheric release. In addition, product labels often describe proper disposal techniques for unused or outdated products. These statements warn against open burning, discharging large volumes down the drain, and mixing wastes with normal household trash (Clemson University, 1995).

Rigorous industrial containment is not a necessary prerequisite for the application of these SpERCs to an environmental exposure analysis. The European Chemical Agency (ECHA) has outlined the technical and operational requirements necessary to demonstrate that a volatile organic compound (VOC) has been rigorously contained and these conditions are not applicable to the regional widespread use of a product in a consumer setting (ECHA, 2010).

3.2. Waste handling and disposal

Under most circumstances, the residual waste generated during the consumer use of a solvent-containing product is handled as a liquid or solid hazardous waste (Inglezakis and Moustakas, 2015). Every effort should be made to minimize the generation of waste at every point in a products' life cycle including consumer uses. This necessitates the communication of sensible waste minimization practices that stress the importance of proper disposal at the consumer level. Many organizations and government agencies have issued useful guidelines on the proper handling and disposal of household hazardous waste. Tips for identifying, recycling, sorting, storage, and community collection of household hazardous wastes provide consumers with a blueprint for proper handling (EC, 2002, USEPA, 2005). These recommendations include directions for avoiding and/or minimizing the generation of wastes requiring special disposal arrangements. Regardless of user compliance with the advice from government agencies, product users need to be aware of the waste handling practices promoted in any waste directives issued by local, regional, and national authorities.

4. Obligatory risk management measures onsite

There are few obligatory risk management measures associated with the widespread consumer use of a solvent-containing product. All incidental discharges to a local sanitary sewer system need to be treated at a municipal WWTP capable biologically degrading wastewater contaminants before surface water release. The operating conditions for this facility are expected to conform with the standard default specifications outlined by ECHA (ECHA, 2016). This includes meeting or exceeding effluent discharge rate for a standard municipal WWTP and the creation of sludge that is suitable for release onto agricultural land.

There are, however, several voluntary initiatives that may be undertaken to control environmental releases during the use of these consumer products. These include adherence to several procedural use conditions that are described below in more detail.

4.1. Optional risk management measures limiting release to air

Sound practices for reducing the widespread atmospheric release of a substance include specific storage, handling, and spill containment strategies (USEPA, 2016). Storage examples include the correct handling of damaged containers susceptible to spillage, the proper closure and sealing of containers following use, and the use of drip pans or trays to contain any spills that may occur during storage. Similar examples describe basic handling procedures to circumvent the unintended release of potentially hazardous constituents. These techniques are effective at minimizing the impact of an accidental release on air emissions as well as any accompanying water and/or soil contamination.

The most effective means of limiting the unintended atmospheric release of the volatile components in a consumer product focus on the prevention and prompt cleaning of leaks and spills. Spill prevention is achieved through the proper storage of products in their original containers with the caps tightly secured (PSE, 2017). Likewise, unused products should not be stored for extended periods of time in any appliance, machine, or tool that can develop a leak. If a spill does occur then recognized and accepted practices for clean-up and removal should be adopted. This includes the use of an adsorbent to soak up any liquid and a detergent to emulsify any residue that remains.**Optional risk management measures limiting release to water**

The wastewaters generated following the use of consumer product need to be treated in a biological wastewater treatment plant that is capable of biodegrading any water-soluble substances discharged to the local sanitary sewer system. The primary source of treatable wastewater results from the runoff that is generated when containers, tanks, and transfer equipment are washed and cleaned. Small releases may also result from unintentional spills and leaks, which need to be guarded against at all junctures. Discharges to storm sewers must be guarded against in all of these cases since this water is directly released to local waterways. Home maintenance activities including equipment repairs and upkeep should take place in locations where fluid releases to local storm drains can be avoided (USEPA, 2003).

Special attention should be given to the consumer use and application of water immiscible products such as motor oils and lubricants. These products need to be recycled and reused to the extent possible and should never be directly discharged down the drain (Okoye and Elbeshbishy, 2019). Small spills and leaks may be cleaned with an emulsifying detergent before release to a municipal sewer. Larger spills need to be treated with adsorbent material before washing. Many manufacturers of these and other consumer products routinely provide recommendations for the safe disposal of any waste that is generated.**Optional risk management measures limiting release to soil**

Many of the same pollution prevention practices exercised to reduce releases to air and water will also be effective in containing emissions to soil. Those procedures and practices associated with general equipment maintenance and household upkeep provide the first line of defence in minimizing the soil release of solvent-containing products. Specific steps, such as the use of tightly sealed puncture-resistant containers can help prevent soil spills and leaks. If a spill or leak does occur then the user should promptly attend to the problem using the three C's approach: control, contain, and clean-up (Clemson University, 1999). The leak can be controlled by simply setting the container upright or by setting it inside an impervious catch vessel. Containment involves the creation of a dam to prevent the liquid from blanketing a larger area, and the application of an adsorbent material to soak up the pooled liquid. The final step in spill control focuses on the collection, accumulation, and proper disposal of the contaminated adsorbents and other waste materials used to address the spill or leak. These actions can help minimize the soil releases that may be associated with the use of a solvent-containing consumer product.

5. Exposure assessment input

The SpERCs described in this background document are associated with a specific set of use conditions that have been directly adopted from ECHAs appraisal of the factors influencing the widespread dispersive use of a substance by consumers (ECHA, 2016). The derived default values are associated with the conditions that presumably exist within a "standard town" occupied by 10,000 inhabitants and serviced by a municipal WWTP with an effluent flow rate of 2000 m^3/day, which corresponds to a wastewater generation rate of 200 L/day/person for those residing in the "standard town". The number of individuals living in the "standard town" assumes that it is positioned within a densely populated "standard region" of Western Europe with 20 million inhabitants living within a land area measuring 200 km x 200 km (10% of the European land mass). The following paragraphs describe the underlying reasoning used to assign a numerical value to the parameters affecting the emissions resulting from the widespread consumer use of solvent-containing products.

5.1. Substance use rate

The regional use tonnage for a substance in a consumer product formulation is dependent on several key parameters that dictate the extent and magnitude of a product's use at the regional scale. Since product formulations may vary widely in composition, the use tonnage will be highly dependent on the product formulation and regional sales distribution. Registrants using these consumer SpERCs are, therefore, in the best position to define the regional use rate based on detailed knowledge of their product portfolio, product compositions, and penetration. Specification of multiple putative regional tonnages based on available knowledge of the product types available to consumers is not a tenable option given the ambiguities it creates (OKOPOL, 2014).

The following equation describes the default calculation of a daily use rate of substance in a "standard town" using ECHA recognized default parameters. This calculation is applicable once an annual use rate is supplied by the registrant.

$$Daily\ use\left(\frac{tonnes}{day}\right) = \frac{annual\ use\left(\frac{tonnes}{year}\right) x\ adjustment\ factor\ x\ regional\ fraction\ used\ locally\ x\ annual\ fraction\ used\ regionally}{emission\ days\ (\frac{days}{year})} \quad (1)$$

The assessment factor of 4 used in this calculation adjusts for any spatial and temporal variability in the consumer use of a substance within a region. The application of this factor accounts for any localized spikes in the usage rate within a confined geographical area or narrow span of time. The regional fraction used locally is proportional to the ratio of the number of inhabitants living in the "standard town" and the "standard region". This equates to a default value of 0.0005 or 0.05% assuming a "standard town" population of 10,000 and a "standard region" with 20 million residents. According to convention, the fraction of the annual EU tonnage used regionally has been assigned a default value of 0.1 or 10%. The derivation outlined above describes the standard approach for determining the daily use rate using available default parameters along with the registrants' estimate of the annual tonnage associated with the production of particular consumer product.

5.2. Days emitting

The number of emission days for each of the SpERCs described in this guidance document has been set at the ECHA default value of 365 days/year (ECHA, 2016). Since the substances described in these SpERCs may see widespread continuous use over a large geographical domain, the use frequency has been maximized to reflect the broad regional usage of these consumer products.

5.3. Release factors

Although vapor pressure and water solubility may be important considerations when examining the environmental emission magnitudes from consumer products, their impact is minimized in materials that are not formulated using a wide range of solvent types. The

SpERC release factors highlighted in this background document have not been assigned to specific vapor pressure or water solubility categories. As such, the stated values apply to the entire range consumer products included in the SpERC description.

5.3.1. Release factors to air

1. Agrochemical use

Garden and household pesticides include a wide array of insecticides, rodenticides, herbicides, fungicides, and preservatives. These products may be sold as trigger or aerosol sprays, liquids, sticks, powders, crystals or as foggers. Perhaps the most informative assessment of air releases for the agrochemicals use by consumers is contained in the regularly revised EMEP (European Monitoring and Evaluation Programme) emission guidebook (EEA, 2019). Two approaches were used to establish a VOC emission factor for the consumer use of garden and household pesticides such as fungicides, herbicides, and insecticides. The first, tier 1, approach yielded a non-methane VOC emission factor for domestically used pesticides of 865 g/kg of solvent with a 95% confidence interval of 800 to 930 g/kg. The second more detailed tier 2 method yielded a value of 150 g/kg of product with a 95% confidence interval of 140 to 160 g/kg of product. The second factor was adjusted for VOC content using data from a UK study indicating that water-based and solvent-based consumer insecticide sprays possessed a solvent content of 40.4% and 74.9%, respectively (Nourian, et al., 2021). The average value of 57.6% was used to adjust the tier 2 value upper limit value of 160 g/kg of product to obtain a factor of 285 g/kg of solvent. An average of the upper limit values for the two emission factor determinations yields a value of 60.8%, which has been rounded to a value of 60% to obtain a well-sourced and duly precautionary release factor applicable to the consumer use of agrochemical products.

2. De-icing applications

Consumer deicing products are best exemplified by alcohol-containing automotive windshield washer fluids (WWF) applied under snowy or icy conditions. Recycling and reuse of WWFs is not a viable pollution prevention technique; however, automobile scrap yards do recover and resell a small fraction of the fluid that is sold to consumers (Rovinaru, et al., 2019). Ethanol and methanol are completely miscible in water and have a low Henry's law constant which indicates a preference for the water over vapor phase (AMI, 1999). Consequently, the methanol contained in a windshield deicing product is not expected to volatilize to an appreciable degree since it is applied as an aqueous solution that is then further diluted by melting snow and ice on the windshield. Two investigations have examined the air emissions accompanying the use windshield deicing agents. The first, Canadian study, estimated the emission factor for a winter washer fluid blend based on the usage volume and assumed 100% volatilization of the methanol component with no wet deposition (Carrière, et al., 2000). The unadjusted monthly emission factors over a four-month period ranged from 3.25% to 24%. In another Dutch/Finnish study, the emission factors for the ethanol, methanol, and isopropanol used to formulate WWFs were determined on an annual basis from 2002 to 2014 (Visschedijk, et al., 2021). The amount of WWF methanol emitted on Finnish roads reportedly ranged 0.01 to 0.03 g/km, the average distance traveled was 34833 km/yr and the market volume for methanol-containing WWF ranged from about 900 to 2560 tonnes/yr. These data yielded methanol release factors ranging from 0.00003% to 0.00006%. The large disagreement between the Canadian and European datasets may be due to the higher prevalence of colder conditions in Canada and the underlying assumptions regarding volatilization. Taking both sets of data into consideration an air release factor of 2% is advocated as a value that is both prudent and practical.

3. Water treatment chemical use

Residential hydronic heating and cooling systems are essentially closed-loop boilers or heat pumps that use water along with a heat transfer fluid such as propylene glycol to provide comfort and warmth (Martinopoulos, et al., 2018). All residential hydronic boilers leak to some extent due to faulty relief valves, expansion tanks, or pipe fittings (InspectAPedia, 2022b). The lost fluid volume is typically replaced through a makeup water connection that can be opened or closed by the home owner. Manufacturers often specify the volume of makeup water that should not be exceeded in a single year. For small residential units the limit is 5% of the system fluid capacity (AOS, 2019). The amount of fluid circulating in a residential boiler is dependent on a number of factors including the number and type of radiators in the home, the overall size and geographic location of the home, and the type of ventilation system in use (Cooper, 2022). A home with cast iron radiators has been shown to require 14 liters of circulating fluid per kilowatt of power from the boiler. For an average 3- or 4-bedroom home with ten radiators, a medium sized boiler with a power rating of 30 kW would suffice (USBC, 2019). This value yields an overall circulating volume of 410 L. A leakage loss of 5% would result in the displacement of 21 L of the boiler fluid or 10.5 L of transfer fluid assuming a 50:50 glycol to water ratio. The resulting air release factor following evaporation would therefore be 5%, which provides a suitably prudent value for the consumer use of water treatment chemicals.

5.3.2. Release factors to water

1. Agrochemical use

The release of agrochemical products to water is largely the result of the accidental or intentional disposal of domestically used pesticides down a sink or municipal sewer. A survey of waste generation in 200 Vancouver households found that a maximum of 4.0 L/year and an average of 0.9 L/year of pesticide waste was generated and that 7% of the households disposed of this waste down a house drain or a storm sewer (Jones, 1990). In a more recent survey of 500 households in the United Kingdom, 3.6% reported that they disposed of waste pesticide down-the-drain (Slack, et al., 2005a). More importantly, the study sorted through the waste from each household to determine the quantity of pesticide waste generated over an extended period of time. The mean value was 0.056 kg for the 30-week sampling period or 0.097 kg/yr for each household. This value can be used to determine a water release factor once normalized by the pesticide usage for each UK household. In a survey of 400 UK households, the total amount of pesticide used or stored in residences throughout the UK was estimate to be 6,125 tonnes (Slack, et al., 2005b). Using the stated estimate of 24.5 million households throughout the UK, this value yields an average pesticide amount of 0.25 kg per household (6.125 x 106/24.5 x 106). This use/storage amount yields a release factor of 38.8 % (0.097/0.25 x 100) which assumes that all of the pesticide waste is poured down the drain or into a storm sewer. This value has been adjusted based on the results from a UK waste study which reportedly found that up to 20% of household waste pesticides were directly disposed of down a sink or drain (EC, 2002). This yields a 5-fold downward adjustment and a final recommended value of 7.8% that has been rounded upward to 8% in ensure a worst-case analysis.

2. De-icing applications

Once applied as a spray mist to the windshield of a car the deicing fluid will mix with the melted water and drain off the vehicle onto a road or highway. Although good evidence exists for the release of WWFs into the surface runoff from roadways, little is known about the amount of applied fluid that ultimately partitions into roadway water and soil (Seitz and Winzenbacher, 2017). Wintertime application of a windshield deicer will result in its deposition to the roadside as a result of wind shearing. Its accumulation and removal from the shoulder of the road is directly impacted by the freezing conditions with infiltration into the frozen soil retarded and its removal in snow/frost melt augmented. Release factors were identified from an examination of meltwater movement during daily wintertime thaw events in a Swedish field composed of loam soil) (Engelmark, 1984). Field measurements found that 81% (7 mm) of the meltwater infiltrated the soil, whereas 19% (30 mm) was lost as surface runoff. Mass balance analysis shows that 88% (100 minus air plus waste) of the deicer VOCs will be lost to roadside water and soil after they are sheared from the windshield. The application of the meltwater fractions to this amount yields a water release factor of 71% and a soil release factor of 17%. These values are considered to be representative of the winter conditions that exist on the roadway shoulders receiving the used and sloughed windshield deicing fluid.

3. Water treatment chemical use

Closed-loop geothermal boilers and heat pumps using a thermal exchange fluid must be serviced on a regular basis. This includes the periodic drain down and replacement of the heat exchange fluid which is typically disposed of via a residential floor drain that is connected to a municipal sewer system (InspectAPedia, 2022a). Using a mass balance approach, the water release factor can be calculated as the remainder needed to achieve an overall environmental release of 100%. Summing the air, soil, and waste factors of 5%, 0.05%, and 15% yields a subtotal of 20.05% (vide infra). Assuming an overall conservation of mass, the water release factor is predicted to be 79.95% taking into account the stated releases to other compartments.

5.3.3. Release factors to soil

1. Agrochemical use

Although pesticide residues are commonly detected in soil samples, these are generally confined to the active ingredients rather than volatile carriers used in the formulation. Direct consumer use of lawn and garden pesticides will by design result in the volatilization and atmospheric release of the inert carrier. Irreversible absorption of the carrier to soil is expected to occur with some types of home and garden pesticides applied in a specific manner (Oguh, et al., 2020). Using a mass balance approach, the water release factor can be calculated as the remainder needed to achieve an overall environmental release of 100%. Summing the air, water, and waste factors of 60%, 8%, and 15% yields a subtotal of 83%. Assuming an overall conservation of mass, the water release factor is predicted to be 17% taking into account the partitioning into the other compartments.

2. De-icing applications

Once applied as a spray mist to the windshield of a car the deicing fluid will mix with the melted water and drain off the vehicle onto a road or highway. Although good evidence exists for the release of WWFs into the surface runoff from roadways, little is known about the amount of applied fluid that ultimately partitions into roadway water and soil (Seitz and Winzenbacher, 2017). Wintertime application of a windshield deicer will result in its deposition to the roadside as a result of wind shearing. Its accumulation and removal from the shoulder of the road is directly impacted by the freezing conditions with infiltration into the frozen soil retarded and its removal in snow/frost melt augmented. Release factors were identified from an examination of meltwater movement during daily wintertime thaw events in a Swedish field composed of loam soil) (Engelmark, 1984). Field measurements found that 81% (7 mm) of the meltwater infiltrated the soil, whereas 19% (30 mm) was lost as surface runoff. Mass balance analysis shows that 88% (100 minus air plus waste) of the deicer VOCs will be lost to roadside water and soil after they are sheared from the windshield. The application of the meltwater fractions to this amount yields a water release factor of 71% and a soil release factor of 17%. These values are considered to be representative of the winter conditions that exist on the roadway shoulders receiving the used and sloughed windshield deicing fluid.

3. Water treatment chemical use

Residential geothermal heat transfer units, commonly known as heat loops, operate by circulating a heat transfer fluid through plastic pipes buried in the ground near the home. The fluid transfers heat to the soil or absorbs heat from the soil depending on the season. Studies have shown that leaks may occur in the ground loops of geothermal heat pumps (Heinonen, et al., 1998). Homeowners with leaking geothermal units have reported fluid losses of about a quart month or 0.008 gallons per day (LeakingLoop, 2010). Glycols and occasionally alcohols are typically used as heat transfer fluids in these systems at levels as high as 30% (Gagné-Boisvert and Bernier, 2017). A residential installation may require the use of up to 450 feet of one-inch diameter plastic pipe to achieve sufficient heating or cooling (Lund, 1990). This length of ground loop plastic pipe is capable of holding 69.5 liters of transfer fluid (Derma, 2021). The fluid flowrate in a typical residential geothermal unit has been reported to range from 5 to 15 gallons per minute or a minimum of 7,200 gallons per day of liquid or 2160 gallons per day of transfer fluid (Butts, 2018). This rate of loss would result in a fluid release to soil of 0.0004%. Since larger leak volumes are an actual possibility, the calculated value has been increased by 125-fold to yield a final recommended soil release factor of 0.05%.

Table 2 provides a listing of the air, water, and soil emission factors applicable to the three SpERCs described in this background document. The assigned release factors were reviewed and agreed upon by a broad group of knowledgeable specialists within the sector organization (CEFIC, 2012). All relevant Emissions Scenario Documents (ESDs) and Best Available Technology Reference Documents (BREF) were examined prior to assigning a release factor. In addition, a secondary literature search was performed to locate any complimentary qualitative information that could be beneficial. This included an examination of emission factors located in PRTR (Pollutant Release and Transfer Register) reports and life cycle inventories for products and processes (CONCAWE, 2017, Frischknecht, et al., 2005).

Table 2. SpERC release factors

Assignments	SpERC title		
	agrochemical use	de-icing applications	water treatment chemical use
ERC	8a 8b	8d	8d
Air release factor (%)	60	2	5
Water release factor (%)	8	71	79.95
Soil release factor (%)	17	17	0.05

5.3.4. Release factors to waste

A thorough and detailed analysis accompanied the assignment of waste release factors for the three SpERCs outlined in this background document. Although a substantial amount of information is available documenting the total amount of different waste types associated with the different consumer products, these data are often in a form that prevents the determination of a normalized release fraction as a function of the use volume. Life cycle studies often provide useful statistics on waste generation in different consumer applications; however, these studies need to be individually examined to determine their relevance to a particular SpERC code.

In this context, waste refers to solvent-containing substances and materials that have no further use and need to be disposed of in a conscientious manner (Inglezakis and Zorpas, 2011). Consumer products are capable of producing hazardous waste as a result of spill clean-up, routine maintenance, and equipment repairs. Waste volumes are dramatically affected by recovery and reuse practices that take advantage of any residual value following recycling. In many cases, the amount of waste generated is directly related to the degree of compliance with any agreed upon recovery and reuse programs.

All of the waste release factors cited in Table 3 have been derived from published life cycle assessments (LCAs) or product surveys that inventoried the emissions and wastes generated during the use of a formulated consumer product. The cited values may be supplanted if the actual hazardous waste generation factor is known for the operation described by the SpERC. To guarantee that an adequate margin of protection has been built into the determination, an adjustment factor has occasionally been applied when the reported value was judged to be unrepresentative of the entire range of potential use conditions within a particular operation.

Table 3. SpERC waste release factors and their literature source

Assignments	SpERC title		
	agrochemical use	de-icing applications	water treatment chemical use
Waste release factor (%)	15	10	15
Source	(CARB, 2018)	(Hunt, et al., 1996)	(CARB, 2018)

When relevant waste information was lacking for a particular consumer product line, a generic waste factor was applied that considers the total amount of household hazardous waste (HHW) generated from a wide variety of consumer products commonly purchased and used in the home. This combined HHW factor was calculated using published information on the waste generation rate and the California sales volume for volatile solvent-containing consumer products. An EPA assessment of waste production in the U.S. estimated that each individual was responsible for the creation of 4 lbs/yr (8.8 kg.yr) of HHW, which was equivalent to an annual household rate of 11.2 lbs/yr (24.6 kg/yr) (PSI, 2004). Using census information, the population of California in 2015 was reported to be 39.0 million people (Statistica, 2019). This yielded a total HHW production rate of 343,200 tonnes/yr.

A 2015 California survey of the total sales volume for a wide range of solvent-containing consumer and commercial product found that 6552 tons/day (5944 tonnes/day) were sold within the state (CARB, 2018). Sales information was amassed for over 350 consumer product categories formulated for household and institutional consumer use. The products included, but were not limited to, detergents; cleaning compounds; polishes; floor finishes; personal care products; home, lawn, and garden products; disinfectants; lubricants; aerosol paints; and automotive specialty products. Non-spray paint products as well as furniture and architectural coatings were not included in the survey. The daily sales volume was equivalent to a total volume of 2.17 million tonnes/yr for the array of consumer products examined. The ratio of the HHW production rate and the annual sales volume yielded waste generation factor of 0.158 (15.8%), which represents the average waste fraction that would be expected for a range of consumer products used in the home. This value was adjusted slightly downward to 15%, since the calculation method provides a highly conservative estimate of the waste factor for many types of consumer products. As such, an uncertainty factor was not needed to correct for any waste that was unaccounted for in the analysis.

The generic factor of 15% was used with the SpERCs covering agrochemicals and water treatment chemicals since reliable information could not be located for these two consumer product categories. The waste factor for de-icing applications was based on a life cycle assessment of a commercial antifreeze solution suitable for use in automobiles (Hunt, et al., 1996). The stated value represents the amount of ethylene glycol waste that was generated as a result of unremedied leaks and spills or improper disposal, which included dumping into a storm sewer or onto the ground. A total of 1665 lbs of an aqueous antifreeze waste containing 50% ethylene glycol was generated per 8883 lbs (1000 gallons) of consumed product. This yielded a waste generation factor of 9.4%, which was rounded up to 10% to ensure adequate accounting. An uncertainty factor has not been applied to this value since a portion of the waste includes the improper release to surface water and soil.

6. Scaling Principles

Scaling provides a means for downstream users (DUs) to confirm whether their combination of OCs and RMMs yield use conditions that are in overall agreement with those specified in a SpERC (ECHA, 2014). These adjustments are only applicable to industrial uses and cannot be employed with other life cycle stages where widespread uses take place.

7. References

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