Specific Environmental Release Categories (SpERCs) for the consumer use of solvents and solvent-borne substances in high release

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 8.6e.v2 – Use in lubricants – high release
2. ESVOC SPERC 9.12c.v3 – Use in fuels
3. ESVOC SPERC 9.6d.v2 – Use in lubricants – low release

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

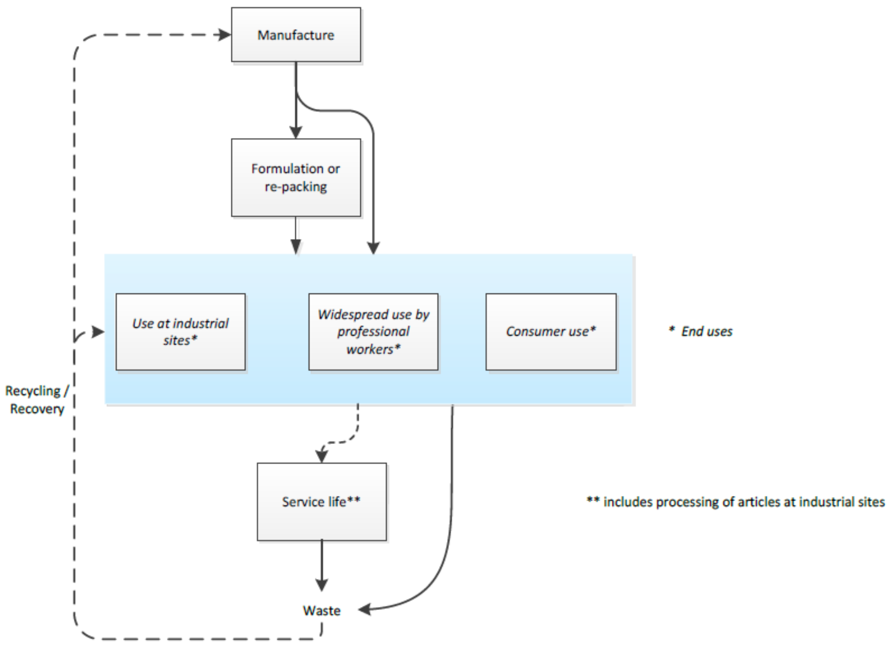

Table 1. SpERC background information

SpERC Code	Title	Life Cycle Stage (LCS)	Sector of Use (SU)	Chemical Products Category (PC)	Use Description
ESVOC SPERC 8.6e.v2	Use in lubricants - high release	Widespread use by consumers	SU17 General manufacturing	PC24 Lubricants, greases, release products	Covers the use of formulated lubricants in open systems including transfer operations, application, operation of engines and similar articles, reworking on reject articles, equipment maintenance and disposal of waste oil.
ESVOC SPERC 9.12c.v3	Use in fuels	Widespread use by consumers	SU8 Manufacture of bulk large-scale chemicals (including petroleum products)	PC13 Fuels	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste and consumer uses in liquid fuels.
ESVOC SPERC 9.6d.v2	Use in lubricants – low release	Widespread use by consumers	SU17 General manufacturing	PC24 Lubricants, greases, release products	Covers the professional and consumer use of formulated lubricants in closed or contained systems including transfer operations, application, operation of engines and similar articles, reworking on reject articles, equipment maintenance and disposal of waste oil.

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.

3.1. 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 m^3/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.

4.3 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 assignment of a single definitive annual use amount is both impractical and potentially misleading. Consequently, 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 product market 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 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.

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

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

The magnitude of an environmental emission following the consumer use of a volatile solvent may be impacted by its volatility (OECD, 2011). Since this physical property can vary over a wide range for many commercial products, a single emission factor does not always suitably describe the environmental release potential. This property prompted the identification of individual emission factors for products that broadly varied in composition and methods of application. The differentiation allows solvent-containing products with a high volatilization potential to be distinguished from those with a low to intermediate capability. When deemed appropriate, several vapor pressure categories were identified along with a single water solubility category to define multiple sub-SpERCs. This was the case for two of the three widespread consumer uses described in this background document.

a) Release factor to air

Several different approaches were used to establish air release factors for the three SpERCs highlighted below. In some cases, a worst-case default approach was taken to ensure adequate precaution when verified information was unavailable. In other instances, the factors were extracted from an authoritative resource once the information was appropriately vetted. Table 2 provides a listing of the vapor pressure categories and emission factors applicable to the three SpERCs.

The air release factors for high release lubricants were extracted from a compendium of published release factors for a range of products and applications. The values have been posted in the A-Tables of Appendix 1 in the Technical Guidance Document (TGD) on Risk Assessment PART II (EC, 2003). A total of 17 Industrial Categories (ICs) have been established for categorizing the use sectors for a wide range of products and processes (OECD, 2003). The air release factors for the high release lubricant SpERC have been aligned with the mineral oil and fuel industry category (IC 9), which includes a wide range of volatile hydrocarbons used for heating, lubrication, and power generation. Separate release tables have been created for each IC depending on the life cycle stage under consideration. The private use stage, which considers the widespread consumer use and application of a commercial product, was in exact alignment with the widespread use of high release lubricants. This assignment allowed the appropriate table of compiled release factors to be identified (Table A4.2) and cited.

Three commercial fuels were used to delineate the air emissions resulting from the consumer use of fuels. Gasoline (VP = 4100-160,000 Pa @ 37.8 °C/100 °F), diesel (VP = 500-<5000 Pa @ 37.8 °C/100 °F), and kerosene, (VP = <1000-3700 Pa @ 37.8 °C/100 °F) were used to characterize the air emission for the high, medium, and low vapor pressure categories, respectively (CONCAWE, 2010). A study using the USEPAs Motor Vehicle Simulator (MOVES) model described the hydrocarbon emission factors for gasoline fuelled passenger cars placed on the road from 1990 to 2020 (ANL, 2013). For vehicles from the 2019 model year, the lifetime average VOC emissions from the engine exhaust and the evaporative sources associated with fuel vapor venting, permeation, and leaks were estimated to be 0.1074 and 0.0598 g/mi, respectively. The average fuel efficiency value for 2019 gasoline-powered vehicles used in Germany has been reported to be 36 mi/gal (NimbleFins, 2019). Adjusting for a gasoline density of 2.83 kg/gal, a total air emission factor of 0.2% was determined (Aqua-Calc, 2019b). A similar determination was performed for 2019 diesel-powered passenger cars. The exhaust emission from these vehicles were predicted to produce a lifetime average VOC release of 0.0179 g/mi without any appreciable evaporative release. Using an average German vehicle mileage measurement of 43 mi/gal and a diesel density value of 3.22 kg/gal, the air emission factor for consumer diesel fuel use was 0.1% (Aqua-Calc, 2019a). To account for the higher evaporative emissions that would be expected to occur during the refuelling of residential equipment, the air release factors associated with the consumer use of gasoline and diesel fuel were adjusted upwards by a factor of two. The results in reasonably accurate and appropriately cautious air emission factors of 0.4% and 0.2% for the high (> 5000 Pa) and medium (500 – 5000 Pa) volatility sub-SpERCs .

Since kerosene is rarely used to power automobiles, the VOC release factor was obtained from its use as a residential heating fuel (Haneke and Johnson, 2001). The value was calculated by using the emission factor for distillate fuel oil, then adjusting for the kerosene content of the fuel. The resulting emission factor of 0.0007 lb/gal was corrected for a kerosene density of 3.03 kg/gal and a mass conversion constant of 0.46 kg/lb to obtain an air release factor of 0.01% (Aqua-Calc, 2019c).

The air factor for the use of low release lubricants used in closed systems has not been differentiated according to vapor pressure since discharges to this environment are restricted by the containment that the enclosure supplies. Consequently, a single air release factor was assigned regardless of the products' vapor pressure. The value corresponds to ECHAs default assignment for the two ERC (Environmental Release Category) descriptors that are applicable to lubricants with a low release potential. The value of 5% corresponds to the wide dispersive use of low release lubricants indoors and outdoors (ERC 9a and ERC 9b). (ECHA, 2016).

Table 2. SpERC air release factors

Vapour pressure (Pa)	SpERC air release factor (%)		
	lubricants – high release	fuels	lubricants – low release
>10000	60	NA	See text
>5000	NA	0.4	
1000-10000	40	NA	
500-5000	NA	0.2	
100-1000	15	NA	
<500	NA	0.01	
10-100	1.5	NA	
<10	0.5	NA	

NA – not applicable

b) Release factor to water

Several sources of information were used to identify a water release factor for the widespread consumer use of lubricants and fuels. These sources are individually highlighted in Table 3 along with the applicable value. In some cases, a definitive factor could not be determined after scrutinizing the information contained in existing reviews and technical reports. The absence of information was offset using expert professional judgement and industry sector knowledge acquired by a variety of means including networking activities, trade association meetings, and social media interactions.

The water release factor for the high and low release lubricant SpERCs were aligned with a published accounting of the environmental fate of a low release lubricant in automotive applications (OECD, 2004). An examination of crankcase oil use in the United Kingdom found that 1.0% or 4,000 tonnes/year of this lubricant can be released to water as a result of leakages from the engine crankcase, which houses the lubricating oil in a pressurized enclosure. Using expert advice and the recommendations of knowledgeable specialists, the water release factor for high release lubricants was established using a read-across approach that was anchored to the available information for low release lubricants. An adjustment factor of 5 was applied to the low release lubricant water release factor to obtain a factor of 5.0% for high release lubricants. The adjustment factor accounts for the larger spills, leaks, and loses that can occur with these consumer applications.

The release of gasoline hydrocarbons to water and soil was determined from the spillage that occurs during the refuelling of automobiles using convention dispensing nozzles without any vapor recovery capabilities. A California study conducted from 1989-1990 examined the volume of gasoline spilled during the refuelling of vehicles at 21 service stations using conventional nozzles for delivery

(Morgester, et al., 1992). The survey indicated that an average of 0.00061 lb/gal of liquid gasoline was lost during the refuelling process. This equates to a release of 0.01% after applying a density correction factor of 6.25 lb/gal (Aqua-Calc, 2019b). Based on laboratory experiments, another study reported that 50% of the gasoline spilled at service stations evaporated to air (Hilpert and Breysse, 2014). These data indicate that 0.005% of the gasoline delivered at service stations will distribute between water and soil. The distribution ratio between these two compartments was predicted using a Level III multimedia fugacity model available within the USEPAs EPI Suite (v 4.1) software package. The results showed that showed that a vast majority of the spilled gasoline not evaporating remains in the soil compartment with only a small portion distributing to water (Card, et al., 2017). The model estimated soil release rate of 40 mg/hr yielded a soil to water distribution ratio of about 290:1. Applying these results to the portion of the gasoline spill that does not evaporate yields water and soil emission factors of 0.00002% and 0.005%. These estimates are consistent with the limited solubility of petroleum hydrocarbons in water and the high organic carbon to soil partition coefficients (Koc) observed for many of the hydrocarbons in gasoline.

Table 3. SpERC water release factors

Assignments	SpERC title		
	lubricants -high release	**fuels**	**lubricants - low release**
ERC	8a 8b	9a 9b	9a 9b
Water release factor (%)	5.0	0.00002	1.0
Source	(OECD, 2004)	(Card, et al., 2017)	(OECD, 2004)

c) Release Factor - soil

The SpERC-related soil release factors have been largely compiled from same sources used to derive the water release factors. As shown in Table 4, the soil factors are comparable to the factors shown in Table 3 and are supported by the same set of information resources. The soil release values have all been conservatively estimated with the understanding that some release to soil may occur during equipment upsets. These include the spillages that may accompany the transfer or delivery of materials and the development of leaks in the devices, equipment, and machinery used to apply or utilize a consumer product on a broad scale.

As noted above for the water release factors, the soil factor for low release lubricants was anchored to the use crankcase fluids in automobiles (OECD, 2004). Likewise, the soil factor for high release lubricants was tied to the listed value for low release lubricants following the application of an adjustment factor of 5 to account for the containment disparities that are perceived to exist. The soil release factor for the consumer use of hydrocarbon fuels has employed sector knowledge and the expert opinion of seasoned technical consultants responsible for creating the SpERC factsheets (CEFIC, 2012).

Table 4. SpERC soil release factors

Assignments	SpERC title		
	lubricants – high release	**fuels**	**lubricants – low release**
Soil release factor (%)	5.0	0.005	1.0
Source	(OECD, 2004)	(Card, et al., 2017)	(OECD, 2004)

d) Release Factor – 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 in the SpERC. To guarantee that an adequate margin of protection has been built into the determination, an adjustment factor of 10 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 5. SpERC waste release factors and their literature source

Assignments	SpERC title		
	lubricants - high release	fuels	lubricants - low release
Release factor (%)	15	2	15
Source	(CARB, 2018)	(Morales, et al., 2015)	(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 high and low release lubricants since reliable information could not be located for these two consumer product categories. The waste factor for the consumer use of fuels was adapted from an examination of gasoline use in passenger cars (Morales, et al., 2015). The evaluation revealed that 2.1 ml of hazardous waste was incinerated per km driven. At the stated fuel mileage of 150 ml/km, a waste release factor of 1.4% was derived. To ensure broad representation across a range of use conditions, this value which was rounded upward to 2%. An uncertainty factor has not been applied to this value since it is directly applicable to the use of fuels at the consumer stage.

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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