Literature Survey of Surfactants in the Nordic Countries

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Summary

As an assignment from the Swedish Environmental Protection Agency, Goodpoint has performed a literature survey of surfactant use in the Nordic countries (Sweden, Finland, Denmark, Norway) including the Faroe Islands, Iceland and Greenland. The approach involved the utilization of the SPIN database (Substances in Preparations in the Nordic Countries). Relevant use categories in the SPIN database were selected for screening in order to identify surfactants used in high volumes. Apart from the selected use categories, specific surfactant categories (*siloxanes, alkylphenolethoxylates, linear alkylbenzene sulfonates (LAS), fluorinated surfactants* and *quaternary ammoniums*) were highlighted in more detail due to their known or suspected harmful effects in the environment.

By screening the SPIN database, 141 high volume surfactants were identified in the use categories *Surface-active agents, Cleaning/washing agents, Non-agricultural pesticides and preservatives* and *Pesticides, agricultural*. Ecotoxicity data was collected for the surfactants occurring in a quantity of more or equal to 100 tonnes in these use categories. No information on specific substances (CAS numbers) for surfactants from Greenland, Iceland and the Faroe Islands could be found within the limits of the study. Instead, data for relevant tariff-codes for these countries were collected.

The results of the SPIN search confirmed that anionic and nonionic surfactants are the most common types of surfactants used in the Nordic countries. The study also showed that many high volume surfactants are expected to end up in the municipal waste water treatment plants where they will be efficiently degraded. However, some high volume surfactants are not readily biodegradable and are therefore expected to be released to some extent into the environment via waste water treatment plants, either to surface waters or via application of sewage sludge on *e.g.* agricultural lands. Apart from the general SPIN search, a number of additional substances within surfactant categories siloxanes, alkylphenolethoxylates, LAS and quaternary ammoniums were also identified as high volume surfactants used in the Nordic countries. In general, these surfactants have properties that make them likely to be released into the environment and they have also previously been detected in various compartments such as water and sediments. It is concluded that due to their ecotoxicity, alkylphenolethoxylates and quaternary ammoniums are the ones most likely to cause problems in the environment.

1. Scope of the study

The main objective of this screening study is to describe the situation in the Nordic countries (Sweden, Finland, Denmark, Norway, Faroe Islands, Iceland and Greenland) regarding the use of surfactants. By reviewing existing literature and data sources, the intention is to provide information on names, quantities and applications of surfactants used in the Nordic countries. Also, ecotoxicity data is included and some measured levels in the environment, including an assessment of where identified surfactants may be found in the environment.

Due to the numerous uses of surfactants, a survey of their occurrence in the Nordic countries has to focus on some key areas. One also needs to consider the possibility for easy data access from different countries. The approach taken in this study involves the use of the SPIN database (Substances in Preparations in the Nordic Countries) which contains information on substances from the Product Registers of Denmark, Finland, Norway and Sweden. At the moment it is not possible to search for substances only used as surfactants in the database. However, the preparations are divided into different use categories which gives the possibility to extract information on quantities of substances used in the different use categories. Currently there are 62 different use categories that preparations are divided into. The different use categories are listed in Appendix 1.

Relevant use categories in the SPIN database have been selected for screening in order to identify surfactants used in the Nordic countries. Apart from the use categories, some specific surfactant categories are highlighted in some more detail due to their known or suspected harmful effects in the environment. These surfactant groups include *siloxanes, alkylphenolethoxylates, linear alkylbenzene sulfonates (LAS), fluorinated surfactants* and *quaternary ammoniums*.

Products known to contain large proportion of surfactants but are not included in the study include *e.g.* cosmetics and personal care products. This area has been of special focus in recent years due to suspected environmental effects of some constituents.[1,2,3] Surfactants are major ingredients in cosmetic products but the market share of total volume is relatively small, only around 4%. Cosmetics are not part of the Swedish Product Register and therefore not included in SPIN, although various starting materials used in the formulation of cosmetic products may be included.

2. Surfactant properties and use

Surfactants are substances that contain one hydrophilic part and one hydrophobic part, *i.e.* the substances are amphiphilic. As such, the substances have found numerous applications as main components in detergents, as wetting agents, emulsifiers and dispersants, and for foaming control. The combined hydrophilic/hydrophobic properties is what makes the surfactants valuable as cleansers, the hydrophobic part dissolves in grease while the hydrophilic part keeps the surfactant water soluble. Also, when surfactants are dispersed in water, the substances tend to accumulate at air/water or solid/water interfaces, thereby reducing the surface tension of water. Surfactants thereby facilitate water distribution over various surfaces.

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[1] *Miljöaspekter på kosmetiska och hygieniska produkter*, The Medical Products Agency – Sweden, **1993**.
[2] *Miljöpåverkan från läkemedel samt kosmetiska och hygieniska produkter*, The Medical Products Agency – Sweden, **2004**.
[3] *Avloppsreningsverkens förmåga att ta hand om läkemedelsrester och andra farliga ämnen*, The Swedish Environmental Protection Agency, **2008**.

Due to their physico-chemical properties surfactants find numerous uses. In household detergents and industrial cleaning products, liquid products may contain approximately 50 % surfactants while powder products usually contain less than 25 %. In many other uses, the proportion surfactant is often considerably lower although the total use may still be extensive. Surfactants are for example, as mentioned above, used in cosmetics but also in the textile and leather industries, in paints, lacquers and other coatings, in plant protection products, and in plastics and composite materials. In the textile industry, surfactants are *e.g.* used as dispersants to facilitate dyeing. For polyurethane plastics, surfactants are added to stabilize foam cells during curing, and in paints surfactants may be added as wetting and leveling agents to improve flow properties of the coating. The wetting aid function is also important in plant protection products where the surfactants improve application efficiency. Even the active pest control agents may sometimes have surfactant properties.

From the above discussion it is obvious that a comprehensive discussion of surfactants is beyond the scope of this study.[4] Since many surfactants have several uses it is usually not practical to classify them according to their use. Instead, they are often classified according to their dissociation in water in the following four main types:

1) **Anionic surfactants**, negatively charged in water at neutral pH and are generally associated with Na^+, K^+ or a quaternary ammonium. Anionic surfactants are, together with the nonionic type, the most common form of surfactants in use. Examples of anionic surfactants are e.g. alkyl sulfates (AS) and alkyl ether sulfates (AES), linear alkylbenzene sulfonates (LAS) and fatty acid soaps. Their uses include *e.g.* detergents, wetting agents and as emulsifiers.

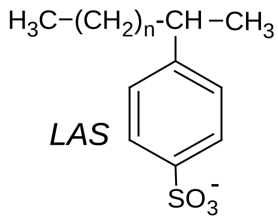
$R{-}CH_2{-}O{-}SO_3^-$

AS

$R{-}CH_2{-}O{-}(CH_2{-}CH_2{-}O)_n{-}SO_3^-$

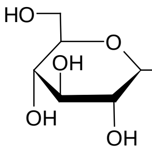
AES

LAS



2) **Nonionic surfactants**, neutral in aqueous solution. To increase the hydrophilicity of the polar end this type of surfactant is often combined with polyethyleneglycol chains (PEG), sometimes also abbreviated EO (ethylene oxide). Common nonionic surfactants comprise the alcohol ethoxylates (AE), alcohol alkoxylates (AA, normally containing both ethylene oxide (EO) and propylene oxide (PO) chains), alkyl glycosides (AG) and alkyl phenolethoxylates (APE). Nonionic surfactants have similar uses as the anionic surfactants but their mild properties make them especially suitable for use in household products.

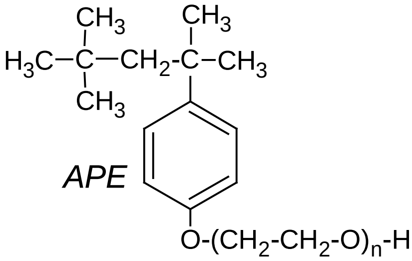
[4] Readers are instead referred to *e.g*: D. Meyers, *Surfactants Science and Technology*, Wiley, **2006**.



AG

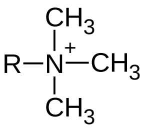
$R{-}CH_2{-}O{-}(CH_2{-}CH_2{-}O)_n{-}H$

AE

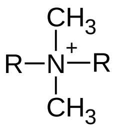


APE

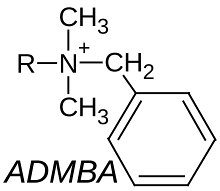
3) **Cationic surfactants**, positively charged in water and most often based on fatty amines and the corresponding quaternary derivatives. Common classes are the alkyltrimethylammonium (ATMA), dialkyldimethylammonium (DADMA) and alkyldimethylbenzylammonium (ADMBA) salts. Cationic surfactans are often used for their antistatic properties and as bactericides.



ATMA

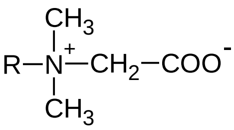


DADMA

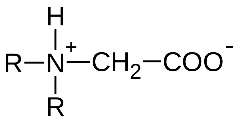


ADMBA

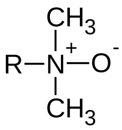
4) **Amphoteric (or zwitterionic) surfactants**, containing two functional groups and may in some cases be positively or negatively or amphoteric depending on pH. Examples are the alkyl betaines, alkyl amphoacetates and N-oxides. Often found in softeners for textiles and hair rinse formulas due to their mild properties.



alkyl betaine



amphoacetates



N-oxide

The annual production and consumption of surfactants is extensive. More than 1,5 million tonnes of surfactants were used in household detergents and industrial cleaning products in Europe in 2007,[5] product categories where surfactants play a major role. The total surfactant world market have been estimated to 18,2 million tonnes in 2003.[6] Of these, linear alkylbenzene sulfonates (LAS), soaps, alcohol ethoxylates (AE), alkylphenol ethoxylates (APE), alcohol ether sulfates (AES) and alcohol sulfates (AS) accounts for around 60% of the total surfactant market of which LAS is considered to be the most important type.[4] Given the large amounts and multiple uses of surfactants in society, these substances will end up in the environment to some extent depending on use and waste water treatment facilities. Their toxicity and, most importantly, their biodegradation in nature or in waste water treatment plants is therefore of major interest.

[5] European Commission, **2009**: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0230:FIN:sv:PDF

[6] B. Brackmann; C.-D. Hager, Proceedings 6th World Surfactant Congress, **2004**.

3. Ecotoxicity of common surfactants

Surfactants are in general toxic to aquatic organisms due to their surface-active properties. Historically, synthetic surfactants were often composed of branched alkyl chains resulting in poor biodegradability which led to concerns about their environmental effects. Today however, many of them, for example those used in large amounts in Europe as detergents, are linear and therefore readily biodegradable[7] and considered to be of rather low risk to the environment. A linear structure of the hydrophobic chain facilitates the approach of microorganism while branching, in particular at the terminal position, inhibits biodegradation. Also, the bioaccumulation potential of surfactants is usually low due to the hydrophilic units. Linear surfactants are not always preferred however, as some branching (that ideally does not hinder ready biodegradability) is often preferable from a performance point of view. Many commercial surfactants are also complex mixtures of homologues which makes the toxicity evaluation difficult.

General ecotoxicity data of the four main types of surfactants can be found *e.g.* at the website of HERA (Human and Environmental Risk Assessment on ingredients of household cleaning products) supported by A.I.S.E. and Cefic.[8] The Danish Environmental Protection Agency compiled in 2001 ecotoxicity data for the most important families of surfactants in household detergents and cosmetics.[9] A summary of ecotoxicity data are summarized below for the most important families of surfactants. Data usually refers to linear surfactants with alkyl chain lengths between C10-C20 unless otherwise noted as these represents typical surfactants in use. For a more complete overview the reader is referred to the sources listed above.

3.1 Anionic surfactants

Alkyl sulfates and alkyl ether sulfates: Linear alkyl sulfates (AS) and alkyl ether sulfates (AES) are generally readily biodegradable, although branching of the alkyl chains may slow down degradation. Neither class of surfactants is expected to bioconcentrate in aquatic organisms. The EC/LC_{50} values are usually between 1-100 mg/L although occasional lower numbers have been reported. The toxicity has been shown to increase with alkyl chain length for some trophic levels.

Linear alkylbenzene sulfonates (LAS): Linear alkylbenzene sulfonates are readily biodegradable and no accumulation of metabolites occurs. LAS is however not easily degraded in anaerobic compartments. The toxicity of LAS has been shown to increase with alkyl chain length for daphnia and fish with LC_{50} values sometimes below 1 mg/L (for C12-C14 for fish).

Sulfosucccinates: Sulfosuccinates are sulfonated succinic acid esters[10] used as detergents and as emulsifiers in *e.g.* textile and leather industry. They are not readily biodegradable and their EC/LC50 values are reported to be around 30-40 mg/L.

[7] A positive result in a test for ready biodegradability (e.g. OECD 301 A-F) is indicative of a rapid and ultimate degradation in the environment.
[8] http://www.heraproject.com/RiskAssessment.cfm
[9] *Environmental and Health Assessment of Substances in Household Detergents and Cosmetic Detergent Products*, The Danish Environmental Protection Agency, **2001**.
[10] Succinic acid esters are esters of 1,4-dicarboxylic acid.

Lignosulfonates: Lignosulfonates have complex degradation pathways and can be expected not to be readily biodegradable. Their toxicity to the environment and aquatic life can be expected to be low based on results from the widespread use of this class of polymers.

3.2 Nonionic surfactants

Alcohol ethoxylates and alcohol alkoxylates: Alcohol ethoxylates (AE) are generally readily biodegradable unless the alkyl carbon chain is branched and/or the ethylene oxide chain is too long (>20 EO units). Longer ethylene oxide (EO) chains increase the molecular weight (MW) and the hydrophilicity of the surfactant and therefore decrease the bioavailability. A similar situation holds for alcohol alkoxylates (AA). Common AE´s and AA´s show moderate bioaccumulation potential. The toxicity of AE´s to algae is high with EC50 below 1 mg/L for AE´s with longer alkyl chain lengths, while branching decreases the toxicity. The toxicity to invertebrates and fish varies from high to low depending on alkyl chain length and degree of branching.

Block copolymers: The EO/PO (ethylene oxide/propylene oxide) polymers are not readily biodegradable due to limited intracellular degradation; the high MW reduces the rate of transport through cell walls. The toxicity of EO/PO polymers is generally low with EC/LC50 values higher than 100 mg/L.

Alkylphenolethoxylates: Nonylphenolethoxylates (NPE) are generally not readily biodegradable and forms nonylphenols (NP) as degradation products, notably under anaerobic conditions. Nonylphenols (NP) are in general toxic to aquatic organisms (some R50/53 classified) although not fulfilling the PBT criteria. Both nonylphenols and octylphenols may bioaccumulate in aquatic organisms, and they have both been shown to exhibit estrogenic activities.

Alkyl glucosides: Alkyl glucosides are in general readily biodegradable and display low to moderate toxicity to aquatic organisms.

3.3 Cationic surfactants

Alkyltrimethylammonium and dialkyldimethylammonium salts: Common quaternary ammonium salts have been reported to be readily biodegradable although there is some inconsistency in the data. Limited information has been found on the anaerobic degradation and some reports suggest that the concentration only slightly decreased under anaerobic conditions. Being positively charged, they are expected to be adsorbed to particulate matter in sludge and other potentially anaerobic compartments. The toxicity to aquatic organisms is high with EC/LC50 often below 1 mg/L.

Alkyldimethylbenzylammonium salts: These surfactants have been reported to be more readily biodegradable than the dialkyldimethyl analogues. The toxicity to aquatic organisms is high.

Dialkyldiethylesterammonium salts: Have often replaced the most common dialkyldimethyl-ammonium salts in some applications due to better degradation in both aerobic and anaerobic compartments.

3.4 Amphoteric surfactants

Betaines: Alkylbetaines and alkylamido betaines (*e.g.* coco amido betaine) are regarded as readily biodegradable with considerable variation of the aquatic toxicity. EC/LC50 values range from below 1 mg/L for algae to 1-100 mg/L for crustaceans and fish.

Imidazoline derivatives: Designated as "imidazoline" due to the formation of an imidazoline ring during synthesis; common members include alkylamphoacetate and alkylamphodiacetate. The former surfactants are considered to pass the level for readily biodegradable. Aquatic toxicity data are scarce, but data for sodium cocoamphoacetate show low to moderate toxicity for daphnia and fish respectively.

4. Municipal sewage treatment

The municipal sewage treatment plants are designed to remove contaminants in waste water among which organic contaminants is a major part. Surfactants, in particular those from household detergents and industrial cleaning products, is one important group of substances that reaches the municipal sewage treatment system. Most sewage treatment plants combine mechanical, chemical and biological treatment of the incoming waste water. The reduction in waste water of organic contaminants such as surfactants can either be a consequence of adsorption onto sludge or aerobic biodegradation in the biological step. Similar sorption and degradation processes occur in the environment as a consequence of direct release of surfactants into the environment from product use, or through effluent discharge from sewage treatment plants in surface waters or the application of sewage sludge on land. However, a major part of surfactants in waste water will be efficiently eliminated in the sewage treatment plant. Although toxic to various organisms, surfactants in general only have a limited effect on the bacteria in the biological step. There are occasions however, where adverse effects have been noticed due to *e.g.* large accidental releases of softeners from laundry companies.

While many of the surfactant groups are efficiently biodegraded in the biological step, some surfactants, most notably the quaternary ammonium salts, are efficiently adsorbed into sludge. To stabilize the sludge it is often anaerobically treated leading to a reduction of some organic material. The release of quaternary ammonium salts from sewage treatment plants into the environment therefore depends to a large extent on the anaerobic degradation potential of these substances. A similar situation holds for linear alkylbenzene sulfonates (LAS) which due to the poor anaerobic degradability may lead to high concentrations in sludge.

The sewage treatment plants also receive surfactants in waste water that are highly regulated in the European Union. Nonylphenol ethoxylates (NPEs) may only be used in detergents in closed systems (see below) but still reaches the waste water via import of mainly textile articles. During washing, these surfactants are released to the waste water where they end up in sewage treatment plants. It has been shown that a significant portion of NPEs are adsorbed into sludge where they are anaerobically degraded into nonylphenols and subsequently released into the environment.

5. Legislation on surfactants

The Detergent Regulation (EC) No 648/2004[11] which entered into force in October 2005 includes provisions on the biodegradability on surfactants in detergents intended for household and industrial uses. All surfactants used in detergents must be readily biodegradable according to some specified tests (OECD 301-tests). As all products intended for washing and cleaning are thought of as detergents, product categories such as "auxiliary washing preparations" (pre-washing, rinsing, bleaching etc), "laundry fabric-softeners", "other cleaning and washing preparations" are also covered by the regulation. However, derogation may be requested for detergents used in some industrial sectors. In those cases, primary biodegradability must be fulfilled for the surfactants according to some specified tests.

As a consequence of the Detergent Regulation, high-volume surfactants used as detergents are readily biodegradable meaning that they will to a large extent degrade rapidly under aerobic conditions. As most detergents end up in the sewage system, a large portion of these surfactants will be efficiently biodegraded in the sewage treatment plant and not released into the environment.

In 2009, the commission published a report on the anaerobic biodegradation of detergent surfactants (with an emphasis on LAS) with the aim to elucidate the effectiveness of current detergent legislation on risk management.[5] Poorly anaerobically degradable surfactants such as LAS will sometimes accumulate in high concentrations in sludge and subsequently be released into the environment. Once in an aerobic compartment however, LAS will be rapidly biodegraded and no accumulation in sediments will occur. The commission therefore concluded that no further legislative measures for LAS are needed.

Other surfactants regulated in EU include nonylphenolethoxylates (and nonylphenol) and perfluorooctane sulfonate (PFOS) including derivatives thereof. The former substances are listed in Annex XVII in Reach (Regulation (EC) No 1907/2006) and restricted to use in mixtures at concentrations equal to or exceeding 0,1 % in *e.g.* cleaning products.[12] There are exemptions however, for example for industrial cleaning purposes in closed systems. PFOS and its derivatives are included in Regulation (EC) No 850/2004 on persistent organic pollutants.[13] The production, placing on the market and use of these substances are therefore prohibited except for some specific uses.

6. Identification of surfactants using the SPIN database

The SPIN database consists of summarized information from the Nordic product registers on the use of chemical substances in different kinds of products. No specific product names can be found in the database, the only names specified are the names of commonly used substances. In SPIN, data can be found on *e.g.* CAS numbers and names of substances, use categories of the products and preparations in which the substances are included, and substance volumes for each country and year.

In order to identify substances that may be used as surfactants the searches in the SPIN database was conducted in two steps. First, substances used in preparations in use category 50 (*Surface-active*

[11] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2004R0648:20120419:EN:PDF
[12] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006R1907:20120605:EN:PDF
[13] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2004R0850:20120710:EN:PDF

agents)[14] in 2009[15] were identified. Only substances used in quantities equal to or more than 10 tonnes per year and country were selected. This search generated a list of substances that not necessarily are defined as surfactants, but are used in products defined as *Surface-active agents*. In a second step, an individual assessment was subsequently performed for each substance in order to identify substances with surfactant properties.

A screening of surfactants in chemical products necessarily involves the selection of substances with known or expected surfactant properties. All amphiphiles do not exhibit surfactant properties as that depends on the relative proportion of the hydrophilic/hydrophobic residues. In the present study, alcohols (long- and short-chain) are for example excluded since their ability to change surface properties is probably limited compared to other surfactants. In contrast, long chain carboxylic acids and esters are included. Short-chain alkylbenzene sulfonates and polyethylene glycol (PEG) are not included while *e.g.* block copolymers consisting of ethylene oxide/propylene oxide (EO/PO), or siloxanes containing polyethylene glycol residues are included. For the former substances their surfactant properties (although rather weak) are well established. The most difficult substances to predict the surfactant properties for are the polymeric surfactants. Unless there are clear indications of their properties they have therefore been left out in the current study. In the end, the selection of substances has in many occasions relied on chemical knowledge based on the name listed in SPIN or ChemIDPlus as a more thorough examination of compound structure was deemed impossible within the scope of the study. All identified surfactants in use category *Surface-active agents* are included in Appendices 3 and 4.

Surfactants in use category *Surface-active agents* may also be present in products in other use categories. In order to quantify all possible uses of identified surfactants a second step of the search was therefore conducted. The total use of each substance was extracted from the database together with information on which other use categories the substances are present. The data is included in Appendix 4. The total use of a substance in SPIN includes the quantity of the specific substance in all use categories. There are, however, some problems associated with the accuracy of the total use data which is further discussed in Appendix 2.

In order to identify other use categories where surfactants are likely to be found, the most commonly occurring use categories were selected from the list of surfactants in the use category *Surface-active agents*. The three use categories where the substances in this list occur most commonly, next after *Surface-active agents*, were use categories 9 (*Cleaning/washing agents*), 59 (*Paints, lacquers and varnishes*) and 61 (*Surface treatment*).

The search described above was subsequently repeated for use categories 9, 59 and 61 except that only substances in a quantity equal to or more than 100 tonnes per year and country were selected. The substances identified as surfactants in these use categories were then compared to the list of

[14] Surface-active agents and household detergents are expected to contain the largest proportion of surfactants of all use categories. This was confirmed in interviews with representatives from an industry organization (Kemisk-tekniska leverantörsförbundet).

[15] The year 2009 was selected since some data from Sweden was reported incorrectly to SPIN in 2010. The export from Sweden was not taken into consideration when the quantity of substances in the different use categories was calculated for 2010. However, in order to report the most current information and since the data for the total use of the substances are correct for 2010, data from 2010 have been selected regarding the total use of the substances.

surfactants in use category *Surface-active agents* and substances already occurring in this list were removed. The total use of each substance was extracted from the database, together with information on which other use categories the substances are present in.

In addition, use categories 39 (*Non-agricultural pesticides and preservatives*) and 38 (*Pesticides, agricultural*) were selected for screening due to the suspected direct release of identified surfactants into the environment. Since the occurrence of surfactants in these categories probably are lower than for the other identified use categories, substances in a quantity equal to or more than 10 tonnes per year and country were selected. The same procedure for identifying substances as surfactants and collecting additional data on total use and other use categories were practiced for these two use categories.

Ecotoxicity data was finally collected for the surfactants occurring in a quantity of more or equal to 100 tonnes in use categories *Surface-active agents, Cleaning/washing agents, Non-agricultural pesticides and preservatives* and *Pesticides, agricultural.*

6.1 Results of the SPIN search

The number of substances identified as surfactants in the different use categories are presented in Table 1. The numbers of surfactants in the other use categories than *Surface-active agents* are presented in the table as the number of surfactants not already identified in *Surface-active agents.* All together, a total number of 141 surfactants were identified using the SPIN database.

Table 1.

Use Category	Quantity range (year)	Number of surfactants
50 *Surface-active agents*	≥10 tonnes (2009)	102
09 *Cleaning/washing agents*	≥ 100 tonnes (2009)	26
59 *Paints, lacquers and varnishes*	≥ 100 tonnes (2009)	0
61 *Surface treatment*	≥ 100 tonnes (2009)	0
39 *Non-agricultural pesticides and preservatives*	≥10 tonnes (2009)	12
38 *Pesticides, agricultural*	≥10 tonnes (2009)	1
Total amount		**141**

In the use category *Cleaning/washing agents* a total number of 60 substances were identified as surfactants in quantities equal to or more than 100 tonnes. In the use category *Paints, lacquers and varnishes* only 3 substances were identified as surfactants and in *Surface treatment* none were identified as surfactants in the above mentioned quantities. In the use category *Non-agricultural pesticides and preservatives* the total number of identified surfactants was 21, and for *Pesticides, agricultural* the number of surfactants was 8 in quantities equal to or more than 10 tonnes.

The surfactants in the use categories *Surface-active agents* and *Cleaning/washing agents* are most likely used in applications where they end up in waste water that reaches the municipal sewage water treatment system. Regarding the surfactants in use categories *Non-agricultural pesticides and preservatives* and *Pesticides, agricultural* the direct distribution into the environment is likely to be more extensive.

The list of substances identified as surfactants in the above mentioned use categories are presented in Appendices 3 and 4 and summarized in Table 2. Ecotoxicity data for selected surfactants are included in Appendix 3 while Appendix 4 contains information on identified uses, with both appendices subdivided into the four main types of surfactants (anionic, nonionic, amphoteric and cationic). The surfactants are further sorted in order of quantity of total use. Substances for which no ecotoxicity data have been collected are highlighted in grey in the tables (Appendices 3 and 4).[16]

Table 2.

Surfactant category	Number of surfactants
Anionic surfactants	42
Nonionic surfactants	77
Amphoteric surfactants	8
Cationic surfactants	14
Total amount	**141**

6.2 Ecotoxicity data collection of identified surfactants

Ecotoxicity data for identified surfactants in Appendix 3 were collected mostly from publicly available databases. eChemPortal, from the Organisation for Economic Co-operation and Development (OECD) in collaboration with other stakeholders, which gathers information from various data sources is the primary source of information. Some data originate from D-Tox, a database at Goodpoint AB which contains information of substances mostly in cosmetics. For some defined surfactants, QSAR predictions using EPI Suite 4.1 have been performed. In most cases a limited set of data or information was found and no further searches were conducted. For some surfactants however, several sets of data were apparent. In those cases one representative data set (or a range of values if more appropriate) was selected and is listed in Appendix 3. When evaluating the data in Appendix 3, one should also take into account that much information is gathered from tests on surfactants of variable compositions.

6.3 Selected surfactant groups

Apart from the general approach to search for surfactants used in high volumes in specified use categories, some surfactant categories were highlighted in more detail in an effort to identify other substances used in high volumes. These categories include siloxanes, alkylphenolethoxylates, linear alkylbenzene sulfonates, fluorinated surfactants and quaternary ammoniums. Although identified through other means, the occurrence of these substances in the list of surfactants identified through use categories has been noticed. The selection of surfactant categories were done based on potential adverse effects on human health and the environment.

6.3.1 Siloxanes

Siloxanes which consist of alternating Si-O units are stable compounds used in a range of applications. Due to their persistence in the environment and reports on potential endocrine

[16] The total use volume is data from 2010 and includes the quantity of the substance in all use categories. In contrast, the identification of individual surfactants was done based on volume data for 2009 in a specific use category in a specific country. Since ecotoxicity data have been collected only for substances exceeding 100 tonnes in a specific use category in a specific country (2009), data are sometimes presented for substances that are used in quantities less than 100 tonnes in Appendix 3. Ecotoxicity data for substances that are used in quantities more than 100 tonnes are similarly not always presented.

disrupting properties for some relatively small derivatives,[17] this class of compounds has been the focus in some recent studies.[18,19,20] The properties of these compounds depend on their molecular size, the length of the Si-O backbone, and on their substituents. Although most siloxanes are hydrophobic, the introduction of hydrophilic groups such as ethylene oxide chains or polyethers on the Si-O backbone gives them surfactant properties (see below). Relevant uses are *e.g.* as surface-active agents in polyurethane (PUR) foam and as wetting agents in water-based paints.[21] A screening study by the Danish Ministry of the Environment in 2005 listed 20 different siloxanes on the Danish market that were imported/manufactured in approximately 10-350 tonnes.[19] Several of these siloxanes had hydrophilic functionalities linked to the Si-O chain. A similar screening of the SPIN database for 2010 on the text string "silox" gave 365 hits. Of these, 9 siloxanes in total volumes of approximately 10 tonnes or above were also listed as "ethoxylated" and/or "polyethylene" (Table 3).[22] Although not intended to be comprehensive, the siloxanes identified can be viewed as illustrative examples of this class of compounds that possibly are used in considerable amounts in the Nordic countries.

$$R[-Si(CH_3)_2O]_x-(CH_2-CH_2-O)_n-H$$

Polyethylene (glycol) functionalized siloxane

Table 3. Siloxanes

CAS	Volume for 2010 (Total use)	Relevant uses[a]
64365-23-7	8	50; 02; 59; 10
67762-85-0	34	55; 50; 10; 59; 02
68037-64-9	22	55
68554-65-4	15	50; 55; 20; 02; 59
68937-54-2[b]	46	55; 50; 59; 39; 02
68937-55-3	80	55; 50; 33; 02; 13
156012-96-3	40	28; 27
162567-97-7	16	59
192726-52-6	721	59

[a] Use categories with largest volume in 2010 irrespective of country (sorted in descending order).

[b] Listed in appendices 3 and 4.

6.3.2 Alkylphenolethoxylates

Alkylphenolethoxylates (APE) have been in focus for several years due to the suspected endocrine-disrupting properties of their degradation products, alkylphenols (in particular nonylphenols). The use of nonylphenolethoxylate (NPE) is strictly regulated in EU, but nonylphenols can still be found in municipal sewage sludge. One of the main uses of NPE is as detergents for textiles due to their ease of manufacture and effectiveness. Although generally not allowed for these applications in Europe,

[17] Decamethyl cyclopentasiloxane (CAS: 541-02-6) and octamethyl cyclotetrasiloxane (CAS:556-67-2) are under evaluation for their potential PBT/vPvB properties (Oct 2012).

[18] *Results from the Swedish National Screening Programme 2004, Subreport 4: Siloxanes*, Swedish Environmental Research Institute, **2005**.

[19] *Siloxanes – Consumption, Toxicity and Alternatives*, Danish Ministry of the Environment, **2005**.

[20] *Siloxanes in the Nordic Environment*, Nordic Counsil of Ministers, **2005**.

[21] *Silicone Surface-Active Agents*, Dow Corning Corporation, **2005**.

[22] Alkoxylated side chains are also introduced in siloxanes for curing purposes. In this screening, no attempts have been made to further examine the specific use for the compounds listed in Table 3.

there are exemptions for use in closed processes where the waste (NPE) is recycled or incinerated and does not reach the waste water. Due to these restrictions, it is therefore intriguing that NPEs and their degradation products can still be found in sewage sludge in relatively high concentrations and it is believed that these compounds for instance reach the European market via imported textiles.[23] To get an overview on the general uses and volumes of notified APEs (in spite of current restrictions), a specific search in the SPIN database was performed for those CAS numbers listed on the SIN-list (Substitute It Now) which relates to different alkyl chain lengths and degrees of branching (Table 4). Five NPEs and three octylphenolethoxylates (OPEs) are currently included on the SIN-list as potential endocrine disruptors and congeners to alkylphenols.[24] Alkylphenolethoxylates used in high volumes in 2010 and listed in Appendices 3 and 4 include CAS: 9016-45-9 (NPE), CAS: 68412-54-4 (NPE) and CAS: 9036-19-5 (OPE).

Table 4. Alkylphenolethoxylates

CAS	Volume for 2010 (Total use)	Relevant uses[a]
9016-45-9 (NPE)[b]	172	09; 35; 43; 39; 02
26027-38-3 (NPE)	<2 (excluding conf. inf.)	59; 09; 39; 61
68412-54-4 (NPE)[b]	194	50; 55; 59; 09; 02
127087-87-0 (NPE)	2	33; 59
37205-87-1 (NPE)	10	09; 02; 10; 35; 50
9002-93-1 (OPE)	15 (excluding conf. inf.)	34; 02
9036-19-5 (OPE)[b]	110	50; 02; 59; 61; 02
68987-90-6 (OPE)	(conf. inf.)	No data

[a] Use categories with largest volume in 2010 irrespective of country (sorted in descending order).

[b] Listed in Appendices 3 and 4.

6.3.3 Linear alkylbenzene sulfonates

Linear alkylbenzene sulfonates (LAS) were previously common in detergents but were phased out to a large extent during the 90´s as a consequence of environmental labeling. However, due to import of low-cost detergents, the levels of alkylbenzene sulfonates in sewage sludge and the environment have increased again. A number of compounds appear in Appendices 3 and 4 illustrating the continued use of LAS. A search in the SPIN database on the text string “benzenesulfonic acid, alkyl” gave 100 hits, of which 17 occurred in volumes exceeding 10 tonnes (Table 5, many CAS numbers displayed confidential information with no total volume listed). The search is crude however, as linear alkylbenzene sulfonate are listed under a range of different names.[25]

[23] *T-tröjor med ett smutsigt förflutet*, The Swedish Society for Nature Conservation, **2008**.
[24] SIN List Database 2.0: http://w3.chemsec.org/
[25] A similar search on “benzenesulfonic acid, dodecyl” gives another 42 hits.

Table 5. Linear alkylbenzene sulfonates

CAS	Volume for 2010 (Total use)	Relevant uses[a]
68081-81-2[b]	560	09
68411-30-3[b]	346	09; 55; 50; 02; 61
68584-22-5	36	59; 09; 39; 28
68584-24-7	55	43; 09; 38; 61
70024-69-0	50 (excluding conf. inf.)	35; 14
70024-71-4	12	35
85117-49-3	60	09; 61; 55
85117-50-6[b]	1084	09; 50; 61
85536-14-7[b]	9891	09; 50; 55; 39; 61
90194-26-6	427 (excluding conf. inf.)	55
90194-27-7	45	35; 56; 30
90194-45-9[b]	91 (excluding conf. inf.)	09; 36
115733-10-3	19 (excluding conf. inf.)	35
134759-03-8	15	35
156105-31-6	31 (excluding conf. inf.)	35
722503-68-6	15 (excluding conf. inf.)	35
722503-69-7	42	35

[a] Use categories with largest volume in 2010 irrespective of country (sorted in descending order).

[b] Listed in Appendices 3 and 4.

6.3.4 Fluorinated surfactants

Perfluoroalkylated and polyfluoroalkynated substances (PFAS) have been widely used as surfactants in various applications. These substances are very resistant towards degradation in general and have the potential to bioaccumulate in *e.g.* fish. The most common PFAS, perfluorooctanesulfonate (PFOS), is therefore prohibited for use in products and articles within the EU, but other fluorinated compounds are in use instead. In a recent report on an environmental risk characterization of PFAS in Sweden, 65 different CAS numbers were listed. A screening of listed CAS numbers revealed that 7 of those are also listed in the SPIN database for 2010 (below), all with confidential information regarding total volume. For specific details on PFAS including the health and environmental risk assessment and occurrence in the environment for these compounds, the reader is referred to the report by D. Borg et al.[26]

- 3872-25-2 Perfluoropentane sulfonate
- 3871-99-6 Perfluorohexane sulfonate
- 60270-55-5 Perfluoroheptane sulfonate
- 2795-39-3 Perfluorooctane sulfonate
- 67906-42-7 Perfluorodecane sulfonate
- 3825-26-1 Perfluorooctanoate
- 27619-97-2 1,1,2,2-Tetrahydroperfluorooctane sulfonate

[26] *Environmental and Health Risk Assessment of Perfluoroalkylated and Polyfluoroalkylated Substances (PFASs) in Sweden*, The Swedish Environmental Protection Agency, **2012**.

6.3.5 Quaternary ammoniums

Quaternary ammoniums adsorb to negatively charged surfaces and are therefore much used for softening purposes in hair rinsing and in fabric softeners. They are also effective as bactericides and highly toxic to aquatic organisms. Due to poor degradability in anaerobic compartments, the most common dialkyldimethylammoniums have often been replaced by dialkyldiethylesterammoniums which is expected to degrade more rapidly. A search in the SPIN database on the text string "quaternary" gave 104 hits, of which 22 occurred in volumes exceeding 10 tonnes (many CAS numbers displayed confidential information with no total volume listed). Neither of those are alkyl ester ammonium salt although a few are 2-hydroxyethylsubstituted (congeners to alkyl ester ammoniums) or derivatives thereof (Table 6).

Table 6. Quaternary ammoniums

CAS	Volume for 2010 (Total use)	Relevant uses[a]
8030-78-2 (ATMA)	227	09; 20; 02; 32
61789-18-2 (ATMA)	204	09; 39; 55; 59
61789-71-7 (ADMBA)[b]	82	39; 55; 09; 47; 36
61789-77-3 (DADMA)	927	55; 27; 61; 09; 41
61791-10-4 ("ATMA")[b]	254	09; 61; 55
63449-41-2 (ADMBA)[b]	60	39; 09; 05; 55
68002-60-8 (ATMA)	11	No data
68139-30-0 -	59 (excluding conf. inf.)	22; 09
68153-30-0 (DAMBA)	86 (excluding conf. inf.)	59
68391-01-5 (ADMBA)[b]	89	39; 09; 35; 55; 15
68424-85-1 (ADMBA)[b]	775	09; 39; 50; 14; 55
68911-87-5 (DADMA)	88 (excluding conf. inf.)	39; 59; 14; 20; 61
68953-58-2 (DADMA)[b]	1690	52; 59; 45; 14; 20
68989-03-7 ("ATMA")	82	09; 50; 55; 61
71011-24-0 (ADMBA)	13 (excluding conf. inf.)	59; 35; 09; 02
71011-25-1 (ADMBA + DADMA)	39	59; 35; 39
71011-26-2 (ADMBA)	48	59; 02; 10; 20; 45
71011-27-3 (DADMA)	108 (excluding conf. inf.)	59; 39; 14; 20; 35
85409-22-9 (ADMBA)[b]	84	39; 09; 61
121888-66-2 (DAMBA)	14 (excluding conf. inf.)	59
121888-68-4 (ADMBA)	28	59; 39; 02; 14; 20
863679-20-3 ("ATMA")[b]	242	09; 55

[a] Use categories with largest volume in 2010 irrespective of country (sorted in descending order).

[b] Listed in Appendices 3 and 4.

Abbrev.: ATMA is AlkylTriMethylAmmonium, ADMBA is AlkylDiMethylBenzylAmmonium, DADMA is DiAlkylDiMethylAmmonium, DAMBA is DiAlkylMethylBenzylAmmonium.

7. Surfactants in Iceland, Greenland and the Faroe Islands

Attempts to inquire information on specific CAS numbers for surfactants from Greenland, Iceland and the Faroe Islands had little success. However, it was confirmed that the data in the SPIN database for Denmark also include Greenland as all statistics data for Greenland originates from Denmark. To get a general overview of the volumes of surfactants used in these countries, data for relevant tariff-codes for these countries were collected and are listed in Table 7. The product categories selected were those most similar to SPIN use categories 50 and 09, namely 3401 (various organic surface-active products and preparations for use as *e.g.* soap and washing the skin) and 3402 (organic surface-active agents other than soap). Based on the known content of surfactants (25-50 % or less) in household detergents and products for industrial cleaning (see above), maximum volumes of surfactants may be estimated. However, one should be aware that for many product categories, *e.g.* cosmetic and hygienic products, the proportion of surfactants might be lower.[27]

Table 7. Total volumes of products with tariff codes 3401 and 3402 (2011)

Tariff code	Greenland	Iceland	The Faroe Islands
3401	142 tonnes	831 tonnes	116 tonnes
3402	1179 tonnes	4145 tonnes	825 tonnes

8. Risk to the environment

The vast majority of identified surfactants used in high volumes are in the use categories *Surface-active agents* and *Cleaning/washing agents*. Products included in these categories are *e.g.* detergents and degreasers for consumer and industrial use but also *e.g.* wetting agents, emulsifiers and dispersion agents. The major part of surfactants used in these applications is likely to reach the municipal sewage treatment system. Depending on their properties the surfactants will be more or less degraded or adsorbed into sludge. As all surfactants used for detergents must be readily biodegradable according to EU legislation, the substances will only to a minor extent pass the municipal sewage plant and be released into surface waters. Some surfactants will to a higher degree be adsorbed into sludge, in particular the cationic surfactants, in the order of cationic > nonionic > anionic and potentially be spread on landfills or on agricultural lands.[28] The data collected on selected surfactants in this study confirms that the high volume surfactants in the Nordic countries are either readily biodegradable or expected to be so (Appendix 3) and will be efficiently degraded in the sewage treatment plant. Of the identified surfactants more than half were nonionic and about one third were anionic. Only a minor part of the identified surfactants were cationic and amphoteric. Some of the identified surfactants are however not readily biodegradable, such as alkylphenol ethoxylates and various polymeric surfactants. Those substances are probably the ones most likely to pass the municipal sewage plant and potentially be released into the environment, together with some of the substances in the surfactant groups *siloxanes, alkylphenolethoxylates, linear alkylbenzene sulfonates (LAS)* and *quaternary ammoniums*.

A direct release of surfactants into the environment may take place when surfactants are used in pesticides. In this study, 21 surfactants used in quantities more or equal to 10 tonnes were identified in the use category *Non-agricultural pesticides and preservatives* and 8 surfactants were identified in the same quantities in the use category *Pesticides, agricultural*. Pesticides must be authorized by the competent authority in each member state in the EU and a thorough assessment concerning the environmental effects of biocidal products is made before they are placed on the market. The surfactants used in these applications are therefore likely to be readily biodegradable to a high

[27] Surfactants account for around 30 % of the contents in cosmetic and hygienic products excluding water. Since water usually accounts for more than 50 % of the product volumes, the actual proportion of surfactants is considerably lower.
[28] G.-G. Ying, *Environ. Int.* **2006**, *32*, 417-431.

extent. However, a few exceptions can be found in Appendix 3, such as the use of a not readily biodegradable NPE (CAS 9016-45-9) in pesticides.[29]

Lignosulfonate, a branched polymer prepared from wood lignin and bisulfate or sulfate ions, was identified as a high volume anionic surfactant. It can be expected to be released directly to the environment and into waste water treatment plants depending on use.[30] Lignosulfonate (and lignin) have complex degradation pathways and is not readily biodegradable. However, natural mechanisms exist that degrade these polymers and they are considered to be of low risk for the environment.

Regarding the searches on specific surfactant categories, a number of siloxane surfactants were identified in SPIN. In contrast, only one siloxane was identified in the general SPIN search on use categories (Appendices 3 and 4). Small-molecule siloxanes have been screened for environmental occurrence in Sweden[18] and the Nordic countries[20] and have been found in various compartments. No specific information on the occurrence of non-volatile siloxanes (*e.g.* polymeric surfactants) in the environment in the Nordic countries have been found in the general literature screening performed within the limits of this study. However, high molecular weight polydimethylsiloxanes in general have been detected in various environmental compartments although their occurrence has not been considered to be of high risk.[31] It may be anticipated that the siloxanes identified in Table 3 in use categories 50 and 55 to a large extent will end up in the municipal sewage system and subsequently into sludge where it will be disposed of in landfills or spread on agricultural fields.[19] Non-volatile siloxanes used in paints and/or PUR (*e.g.* use category 59 in Table 3) will most likely end up in incineration plants where they are destructed.

The levels of alkylphenols, which often originate from alkylphenolethoxylates, are not decreasing in environmental compartments in spite of regulations and previous voluntarily commitments. Various alkylphenols and APEs have been part of the Swedish national screening program[32] as well as in screening studies in the Nordic countries[33] and detected in *e.g.* effluent water, recipients, sludge and landfills. The highest concentrations of nonylphenols (various nonylphenol isomers) listed in the TemaNord report[33] were those in sludge (1.5-28.4 mg/kg dw). Nonylphenolethoxylates and nonylphenols are not readily biodegradable and the primary degradation product of nonylphenolethoxylate, nonylphenol, is more persistent that its congener, particularly in anaerobic compartments. The slow degradation in anaerobic compartments may explain the high concentrations of nonylphenols in sludge. Nonylphenols with CAS: 25154-52-3 and CAS: 84852-15-3 have been under evaluation for their potential PBT properties, and although they do not fulfill the PBT criteria, the compounds are classified R50/53, have estrogenic properties, and have been shown to have moderate potential to bioaccumulate. Nonylphenols have also been found outside closed municipal sewage treatment plants for long periods of time. Octylphenols have been shown to have similar estrogenic properties as nonylphenols, and three octylphenolethoxylates (OPE) are also included on the SIN-list. Of the eight alkylphenolethoxylates included on the SIN-list, three CAS-numbers were identified in the general SPIN search in the current study (Table 4 and Appendices 3

[29] Note that use category 38 is not represented in Table 4 for this CAS number for 2010 as this use category was not among the top five in 2010 (see also footnote 16).

[30] *Surfactants from Renewable Resources*, Eds. Kjellin, M.; Johansson, I., WILEY, **2010**,

[31] B. O Clarke, S. R. Smith; *Environ. Int.* **2011**, 37, 226-247.

[32] *Vilka halter av miljöfarliga ämnen hittar vi i miljön? Resultat från miljöövervakningens screeningprogram 2008-2010*, The Swedish Environmental Protection Agency, **2011**.

[33] *Screening of phenolic substances in the Nordic environments*, TemaNord, **2008**.

and 4). These compounds also showed the highest total use volumes for 2010 (not taking into account confidential information). Several applications identified in this study, including use category 9 and potentially some applications in use category 50, are currently restricted in EU. Given the previously discussed contribution of alkylphenolethoxylates from *e.g.* imported textiles, it is difficult to draw any conclusions from the results in this study, apart from that the identified uses discussed herein most likely contribute to environmental levels of these classes of compounds.

The levels of linear alkylbenzene sulfonates (LAS) in the environment have been in focus of several screening studies.[34] It has been found in outgoing water in municipal sewage treatment in spite being readily biodegradable in aerobic compartments (usually reduced by >95%). LAS adsorbed into sludge will be spread on agricultural fields where it may last for a long time, although most of it will be rapidly degraded. Although LAS was detected in some waters and landfill leachates as well as in sediments, it was concluded in the Swedish National Screening Programme[34a] that the levels are lower than the derived PNEC-values and therefore of low risk to the environment. A number of compounds were identified in the general and specific SPIN searches, although the list is by no means complete. However, the most important large volume uses are in household detergent mixtures which are also identified in Appendices 3 and 4 and in Table 5 above (use category 9). The annual use in Sweden has been estimated to 900 tonnes,[34a] which is less than the total volumes listed in Appendices 3 and 4 and in Table 5, illustrating the limitations in the total use data in SPIN. LAS has been reported to degrade into sulfophenyl carboxylates which are more toxic to aquatic organisms than LAS. However, sulfophenyl carboxylates, being more polar than LAS, are less prone to accumulation in sediments and will most likely be mineralized in various environmental compartments.[35]

Quaternary ammoniums are released to the environment mainly via sewage sludge. Some recent data has been presented on total concentrations in sludge.[36] There are conflicting reports on the relative amounts biodegraded in the waste water treatment plants which may depend on the alkyl chain lengths. It can therefore be concluded that the biodegradability of quaternary ammoniums, in particular the anaerobic degradability, depends to a large extent on the structure. Several literature sources state that the more easily biodegradable dialkyldiethylesterammoniums have replaced other less biodegradable surfactants and which has led to considerable reductions in sewage sludge. In the general SPIN search above, 14 quaternary ammoniums were identified and another 14 were identified in the specific search (Table 6). Use categories that seem to dominate are 09, 39 and 59 although some other use categories are represented in high volumes. The surfactants in several of these uses may end up in the municipal sewage system and to sludge where they may be released to the environment and subsequently bound to particulate matter. The Swedish Medical Products Agency in 2004 concluded that the use of a specific quaternary ammonium salt (cetrimonium chloride, CAS: 112-02-7) was associated to some risk for aquatic organisms although there was some uncertainty in the result.[2]

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[34] a) *Vilka halter av miljöfarliga ämnen hittar vi i miljön? Resultat från miljöövervakningens screeningprogram 2006-2008*, The Swedish Environmental Protection Agency, **2009**. b) *Förekomst av organiska miljöföroreningar i slam och utgående avloppsvatten från avloppsreningsverk och i slam från enskilda avloppsbrunnar*, Länsstyrelsen Jämtlands län, **2006**.
[35] *Organic Farming, Pest Control and Remediation of Soil Pollutants*, Ed. E. Lichtfouse, Springer, **2009**.
[36] M. Clara, S. Scharf, C. Scheffknecht, A. Gans, *Water Research*, **2007**, 41, 4339-4348.

9. Conclusions

The results of the SPIN search in this study confirm that anionic and nonionic surfactants are the most common types of surfactants used in the Nordic countries. The initial screening of surfactants in the use category *Surface-active agents* led to an identification of other relevant use categories where surfactants may be used. As anticipated, it was found that surfactants were frequently used in high volumes also in use category *Cleaning/washing agents*. In contrast, surfactants are much less commonly used in high volumes in use categories *Paints, lacquers and varnishes* and *Surface treatment*. However, the use of surfactants in these latter use categories has been confirmed in the current study although they only contribute to a minor part of the total use. A few more surfactants were identified in use categories *Non-agricultural pesticides and preservatives* and *Pesticides, agricultural* where the direct distribution into the environment is likely to be more extensive.

The most common high volume surfactants are expected to be used in applications where they end up in waste water that reaches the municipal sewage water treatment system. As all surfactants used for detergents must be readily biodegradable according to EU legislation, the substances will only to a minor extent pass the municipal sewage plant and be released into surface waters. The data collected on selected surfactants in this study confirms that most of the high volume surfactants in the Nordic countries are either readily biodegradable or expected to be so and therefore will be efficiently degraded in the sewage treatment plant. Some of the identified surfactants are however not readily biodegradable and are expected to pass the municipal sewage plant and may be adsorbed into sludge and released into the environment due to the application of sewage sludge on agricultural land.

The specific surfactant groups discussed in some detail in this report which includes siloxanes, alkylphenolethoxylates, linear alkylbenzene sulfonates (LAS) and quaternary ammoniums have properties that make them likely to pass the sewage treatment plant and also to be adsorbed into sludge. The same groups of substances have also previously been detected in the environment in various compartments such as water and sediments. These surfactants are therefore the ones that, within the current study, are most likely to pose a risk to the environment. However, the occurrence of siloxanes and LAS in the environment has generally not been considered to be a high risk. LAS may accumulate in high concentrations in sludge and subsequently be released into the environment. Once in an aerobic compartment however, LAS will be rapidly biodegraded and no accumulation in sediments is likely to occur. For both quaternary ammoniums and alkylphenolethoxylates it has been established that their use may be associated with risks for aquatic organisms. Nonylphenolethoxylates are degraded to nonylphenols in the environment, and it has previously been shown that the levels of nonylphenols in some environmental compartments in Europe may affect the reproductivity of fish. Also octylphenols formed from octylphenolethoxylates have been shown to have similar properties as nonylphenols regarding estrogenic effects. It can however not be concluded in this study that the levels of alkylphenols in the environment is a result of the use of such substances in the use categories identified in the SPIN search. It is instead believed that these compounds for instance reach the European market via imported textiles.

No information on specific CAS numbers for surfactants from Greenland, Iceland and the Faroe Islands was found within the limits of this study. However, it was confirmed that the data in the SPIN database for Denmark also include data from Greenland. Instead of specific surfactants and CAS numbers, data for relevant tariff-codes for these countries were collected. This data include information on products excluded from the SPIN search, such as cosmetics and personal care products. The data shows that the use of surfactants in Greenland, Iceland and the Faroe Islands is, as expected, much less extensive than in the other Nordic countries.

Appendix 1. List of use categories in SPIN

Code	Text
01	Absorbents and Adsorbents
02	Adhesives, binding agents
03	Aerosol propellants
04	Anti-condensation agents
05	Anti-freezing agents
06	Anti-set-off and antiadhesive agents
07	Anti-static agents
08	Bleaching agents
09	Cleaning/washing agents
10	Colouring agents
11	Complexing agents
12	Conductive agents
13	Construction materials
14	Corrosion inhibitors
15	Cosmetics
16	Dustbinding agents
17	Electroplating agents
18	Explosives
19	Fertilisers
20	Fillers
21	Fixing agents
22	Flame retardants and extinguishing agents
23	Flotation agents
24	Flux agents for casting
25	Foaming agents
26	Food/feedstuff flavourings and nutrients
27	Fuels
28	Fuel additives
29	Heat transferring agents
30	Hydraulic fluids and additives
31	Impregnation materials
32	Insulating materials
33	Intermediates
34	Laboratory chemicals
35	Lubricants and additives
36	Odour agents
37	Oxidizing agents
38	Pesticides, agricultural
39	Non-agricultural pesticides and preservatives
40	pH-regulation agents
41	Pharmaceuticals
42	Photochemicals

43	Process regulators
44	Reducing agents
45	Reprographic agents
46	Semiconductors
47	Softeners
48	Solvents
49	Stabilizers
50	Surface-active agents
51	Tanning agents
52	Viscosity adjustors
53	Vulcanizing agents
54	Welding and soldering agents
55	Others
56	Cutting fluids
57	Friction agents
58	Grinding materials
59	Paints, laquers and varnishes
60	Radioactive agents
61	Surface treatment
62	Electromechanical components

Appendix 2. Limitations and uncertainties in SPIN

The Nordic product registers contain information on the use of chemical preparations and substances in terms of volumes, number of products, composition of products and the function and industrial categories where the substances can be found. The regulations regarding which products shall be registered in the Nordic countries are however slightly different. The Danish and Swedish product registers contain the largest numbers of products and the highest proportion of products on the market. In Sweden the declaration requirement apply to all chemical products produced or imported in a quantity of more than 100 kg per year, regardless if the products are classified as dangerous or not. In Norway declaration is mandatory for all the chemical products to which the regulations on classification, labeling and packaging of dangerous substances apply, including consumer products. In Denmark and Finland the declaration requirements also applies to dangerous products according to these regulations and additionally chemicals that can cause danger although they are not classified. Solvents, biocides and pesticides must also be registered in Denmark. All four countries exempt products within the scope of legislation on foodstuffs and medical products, as well as cosmetic products, from the declaration requirement. In Norway and Finland, quantities less than 100 kg per year must not be registered.

In addition to the differences in declaration requirements between the Nordic countries there are a number of other uncertainties in the information in the SPIN database. If a substance is registered first as a raw material and then as a part of a new preparation, this substance will be accounted for twice in the statistics. This means that substances that are used for formulation of preparations and that also are imported will be presented as double the actual amount. Another factor that may cause inaccurate values is when concentrations have been registered as intervals. In Denmark, Finland and Norway the upper limit has been chosen for calculations of the substance amount. The Swedish data are however given as the mean percentage. Secrecy rules have also lead to the exclusion of some data in SPIN. Quantities and number of products have not been reported to the database if a substance is contained in less than four products and is registered by less than three companies. In general, the SPIN database gives a rough estimation of quantities of substances used in different areas in the Nordic countries.

Appendix 3

Surfactants arranged in decreasing amount of volume used in 2010 (in each surfactant type)

Dark Grey: Surfactants for which data have not been collected, UC50, UC39<100 ton

Surfactant family and name in SPIN database	Other	CAS No	Total use (tonnes)	Toxicity			Bioaccumulation	Biodegradation	Long-term toxicity
				Algae	*Daphnids*	*Fish*			
Anionic surfactants:									
Fatty acids, tall-oil		61790-12-3	23566						
Benzenesulfonic acid, 4-C10-13-sec-alkyl derivs.	LAS	85536-14-7	9891	Scenedesmus subspicatus (read across): NOEC 72h 2,4 mg/L; EbC50 72h 47,3 mg/L; ErC 72h 127,9 mg/L, C11.6 LAS (Echa).	1. Daphnia magna (read across): EC50 48h 2,9 mg/L (OECD 202) (Echa) 2. Daphnia magna: EC50 48h 5,2 mg/L (HSNO-CCID).	Bluegill (Lepomis macrochirus): LC50 96h 1,67 mg/L (Echa).	BCF determined for fish (various alkyl chain lengths): 2-1000, low potential to bioaccumulate (Echa).	Readily biodegradable: 94 % in 28 d (OECD 301A) (Echa).	Fish (Tilapia mossambica): NOEC 90d 0,25 mg/L (Apha 1975) (Echa).
Lignosulfonic acid, sodium salt	Sodium polignate, sodium salt of polysulfonated lignin	8061-51-6	6718	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	Golden orfe (Leuciscud idus): LC50 1,4-2 g/L (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. QSAR (EPI Suite 4.1) indicate that the compound is not ready biodegradable.	No data.
Fatty acid, rape-oil	Use Category 9	85711-54-2	6606	No data.	No data.	Brachydanio rerio: LC50 96h 300 mg/L (OECD 203) (IUCLID).	No data. Not expected to bioaccumulate (CCR).	Readily biodegradable: 69-95 % in 30d (OECD 301D) (IUCLID).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-hydroxy-,C12-14-alkyl ethers, sodium salts	AES. C12-C14 Alkyl alcohol ethoxylate sulfate	68891-38-3	4117	Algae: EC50 varies 4-65 mg/L for various AES (Danish EPA).	Daphnids: EC50 varies 1-50 mg/L for various AES (Danish EPA).	Fathead minnow (Pimephales promelas): LC50 24h 1,5 mg/L ($C_{12}AE_2S$) (Danish EPA).	AES have in general low potential to bioaccumulate (Danish EPA).	AES are in general readily biodegradable (Danish EPA, HERA).	Fish: LOEC 1y 0,22 mg/L, AES unspecified (Danish EPA).
Sulfuric acid, monododecyl ester, sodium salt	AS. Sodium Lauryl Sulfate, Sodium Dodecyl Sulfate	151-21-3	2281	Desmodesmus subspicatus: EC50 72h >120 mg/L; NOEC 72h 30 mg/L (Echa).	Ceriodaphnia dubia: LC50 48h 5,55 mg/L (Echa).	Pimephales promelas: LC50 96h 29 mg/L (OECD 203) (Echa).	Not expected to bioackumulate (CCR); log Kow = 1,60 (EPI Suite database) .	Readily biodegradable: 95 % in 28d (OECD 301B) (Echa).	Pimephales promelas: NOEC 42d 1,357 mg/L (Echa).
Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-, hydrogen sulfate, sodium salt	AES. Sodium Lauryl Trioxyethylene Sulfate	13150-00-0	1749	No data. See 68891-38-3 above.	No data. See 68891-38-3 above.	No data. See 68891-38-3 above.	Estimated log Kow = 1,6 (HSDB), see 68891-38-3.	No data. Expected to be readily biodegradable, see 68891-38-3 above.	No data. See 68891-38-3 above.
Fatty acids, palm-oil, sodium salts	Use Category 9	61790-79-2	1678	No data, hydrolysis products of naturally occurring oil.	No data, hydrolysis products of naturally occurring oil.	No data, hydrolysis products of naturally occurring oil.	No data.	No data, but expected to be readily biodegradable.	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-hydroxy-, C10-16-alkyl ethers, sodium salts	AES. C10-C16 Alkyl alcohol ethoxylate sulfate	68585-34-2	1443	No data. See 68891-38-3 above.	Ceriodaphnia dubia: EC50 48h 3,43 mg/L (HSNO-CCID).	No data. See 68891-38-3 above.	No data. AES have in general low potential to bioaccumulate, see 68891-38-3 above.	No data. Expected to be readily biodegradable: 1. see 68891-38-3 above; 2. HSNO-CCID.	No data. See 68891-38-3 above.
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-(dodecyloxy)-, sodium salt	AES. Sodium Laureth Sulfate	9004-82-4	1309	No data. See 68891-38-3 above.	Ceriodaphnia dubia: EC50 48h 3,12 mg/L (CCR).	No data. See 68891-38-3 above.	No data. AES have in general low potential to bioaccumulate, see 68891-38-3 above.	No data. Expected to be readily biodegradable: 1. see 68891-38-3 above; 2. HSNO-CCID.	No data. See 68891-38-3 above.
Benzenesulfonic acid, mono-C10-14-alkyl derivs., sodium salts	LAS. Use Category 9	85117-50-6	1083	Scenedesmus subspicatus: EC50 72h 43,2 mg/L (IUCLID).	Daphnia magna: EC50 24h 6,8 mg/L (DIN 38412 Teil 11) (IUCLID).	Leuciscus idus: LC50 48h 4,6 mg/L (DIN 38412, Teil 15) (IUCLID).	No data. Not expected to bioaccumulate (CCR). See 85536-14-7 above.	Readily biodegradable: 86 % in 21d (OECD 301E) and other (IUCLID).	No data. See 85536-14-7 above.
Ethanol, 2-[2-(dodecyloxy)ethoxy]-, hydrogen sulfate, sodium salt	AES. Use Category 9	3088-31-1	1067	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	BCF = 4 (calc.), low potential to bioaccumulate (HSDB).	1. Expected to be biodegradable in aerobic compartments (HSDB).	No data.
Paraffin oils, sulfochlorinated, saponified		68188-18-1	867						
Benzenesulfonic acid, dodecyl-, sodium salt	LAS	25155-30-0	779	Algae: NOEC 0,24-5 mg/L depending on species (HSNO-CCID).	Daphnia magna: EC50 48h 5,88 mg/L (HSNO-CCID).	Gadus morhua: LC50 96h 1 mg/L (HSNO-CCID).	BCF = 64 (exp.) and 107 (calc.), low potential to bioaccumulate (HSDB).	Several tests indicate readily biodegradable. 73-84 % in 28d (OECD 301E) (Danish EPA).	1. Marine species: NOEC <0,02 mg/L (HSNO-CCID). 2. Fathead minnow (Pimephales promelas): NOEC (30d) 0,15-0,9 mg/L (Danish EPA).
Fatty acids, tallow, sodium salts	Use Category 9	8052-48-0	717	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	No data. Not expected to bioaccumulate (CCR).	No data, but expected to be readily biodegradable.	No data.
Sulfuric acid, mono-C12-18-alkyl esters, sodium salts		68955-19-1	689						
Sulfuric acid, mono-C10-16-alkyl esters, sodium salts		68585-47-7	594						
Benzenesulfonic acid, mono-C10-16-alkyl derivs., sodium salts	LAS. Use Category 9	68081-81-2	562	No data. Toxicity depends on alkyl chain length: IC50 9,1 mg/L (geometric means several records) (HERA).	No data. Toxicity depends on alkyl chain length: EC50 17-1,5 mg/L for C10-C14 (HERA).	No data. Toxicity depends on alkyl chain length: LC50 40-0,5 mg/L for C10-C14 (HERA).	No data. Not expected to bioaccumulate, see 85536-14-7 above and HERA.	No data. Expected to be readily biodegradable, see 85536-14-7 above and HERA.	Brachydanio rerio (fish): NOEC 2,3 mg/L (mortality) (HERA).
Fatty acids, tall-oil, potassium salts	Use Category 9	61790-44-1	534	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. 1. Not expected to be persistent (CCR). 2. Readily biodegradable (tall-oil fatty acids, Goodpoint).	No data.
Butanedioic acid, sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt	Sulfonated diester of succinic acid	577-11-7	462						
.beta.-Alanine, N-(2-carboxyethyl)-N-(2-ethylhexyl)-, monosodium salt		94441-92-6	420	No data.	Daphnia magna: EC50 48h >100 mg/L (Goodpoint).	Oncorhynchus mykiss: LC50 96h >100 mg/L (Goodpoint).	No data.	Readily biodegradable: >60 % 28d (OECD 301B) (Goodpoint).	No data.
Fatty acids, coco, potassium salts	Use Category 9	61789-30-8	349	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.

Benzenesulfonic acid, C10-13-alkyl derivs., sodium salts	LAS	68411-30-3	346						
Blancol	Sodium polynaphthalenesulfonate.	9084-06-4	336	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Potentially bioaccumulative (CCR).	Limited biodegradability likely (CCR).	No data.
Sulfonic acids, C13-17-sec-alkane, sodium salts	Branched alkane sulfonate	85711-69-9	312						
Ethene, homopolymer, oxidized	Presumable carboxylated polymer ends	68441-17-8	309						
Benzenesulfonic acid, dodecyl-	LAS	27176-87-0	301						
Benzenesulfonic acid, dodecyl-, calcium salt	LAS	26264-06-2	296						
Benzene, 1,1'-oxybis-, tetrapropylene derivs., sulfonated, sodium salts		119345-04-9	267	No data.	Daphnia magna: LC50 48h 1,64 mg/L (CCR).	Fathead minnow (Pimephales promelas): LC50 96h 3,85 mg/L (46 % in H_2O) (Dow).	No data. Not expected to bioaccumulate (CCR).	Inherently biodegradable: <70 % in 28d (OECD 302B) (46 % in H_2O) (Dow).	No data.
9-Octadecenoic acid (Z)-, potassium salt	Use Category 9	143-18-0	223	No data.	Daphnia magna: EC50 48h 0,57 mg/L (CCR).	No data.	Not expected to bioaccumulate based on QSAR, log BCF = 1-3.2 (CCR).	Not expected to be persistent based on QSAR (CCR).	No data.
Octadecanoic acid, sodium salt	Sodium Stearate. Use Category 9	822-16-2	203	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Not expected to bioaccumulate based on QSAR, log BCF = 1-3.4 (CCR).	Not expected to be persistent based on QSAR (CCR).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, phosphate		9046-01-9	124						
Sulfonic acids, C14-16-alkane, sodium salts	Alkane sulfonate	68439-57-6	120						
Benzenesulfonic acid, dodecyl-, compd. with 2-aminoethanol (1:1)	LAS. Use Category 9	26836-07-7	119	No data. Toxicity depends on alkyl chain length: IC50 9,1 mg/L (geometric means several records) (HERA).	No data. Toxicity depends on alkyl chain length: EC50 17-1,5 mg/L for C10-C14 (HERA).	No data. Toxicity depends on alkyl chain length: LC50 40-0,5 mg/L for C10-C14 (HERA).	No data. Not expected to bioaccumulate, see 85536-14-7 above and HERA.	No data. Expected to be readily biodegradable, see 85536-14-7 above and HERA.	No data. See 85536-14-7 above.
Benzenesulfonic acid, mono-C10-13-alkyl derivs., sodium salts	LAS. Use Category 9	90194-45-9	91	Selenastrum capricornutum: EC50 96h 4,3-12,5 mg/L (OECD 201) (ESIS, several records).	Daphnia magna: EC50 48h 1,6 mg/L (OECD 202) (ESIS, several records).	Brachydanio rerio: LC50 96h 5,1 mg/L (OECD 203) (ESIS, several records).	Brachydanio rerio: BCF = 231 (5d) (ESIS, several records).	Readily biodegradable: 84% in 28d (OECD 301E) (ESIS, several records).	Salmo gairdneri: NOEC (28d) 0,43-0,89 mg/L (ESIS, several records).
Fatty acids, coco, sodium salts	Use Category 9	61789-31-9	90	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.
Sulfuric acid, mono(2-ethylhexyl) ester, sodium salt	AS	126-92-1	55						
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-, phosphate	Isotridecyl alcohol, ethoxylated, phosphated	73038-25-2	34						
Ethanol, 2-(2-ethoxyethoxy)-, 2''-[(C12-15-branched and linear alkyl)oxy] derivs., hydrogen sulfates, sodium salts	AES. Sodium Laureth Sulfate. Use Category 9	91648-56-5	29	No data. See 68891-38-3 above.	No data. See 68891-38-3 above.	No data. See 68891-38-3 above.	No data. AES have in general low potential to bioaccumulate, see 68891-38-3 above.	No data. Expected to be readily biodegradable, see 68891-38-3 above.	No data. See 68891-38-3 above.
Poly(oxy-1,2-ethanediyl), .alpha.-phenyl-.omega.-hydroxy-, phosphate	Phenol, ethoxylated, phosphated	39464-70-5	16	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.
Octadecanoic acid, aluminum salt		637-12-7	16						
1-Tetradecanol, hydrogen sulfate, sodium salt		1191-50-0	14						
Nonionic surfactants:									
Alcohols, C12-15, ethoxylated	AE	68131-39-5	5267						
Oxirane, methyl-, polymer with oxirane, ether with 1,2,3-propanetriol (3:1)	Polyoxyethylene (12) polyoxypropylene (66) glyceryl ether	9082-00-2	4309						
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, branched	AE	69011-36-5	4296	Algae: EC50 1-10 mg/L (Goodpoint).	Daphnia magna: EC50 48h 1-10 mg/L (Goodpoint).	Fish: LC50 96h 1-10 mg/L (Goodpoint).	1. Not expected to bioackumulate (CCR). 2. log Kow = 3,59 (calc. EPI Suite 4.1).	Readily biodegradable: >90 % (OECD 301E); >60 % in 28d (OECD 301B) (HSNO-CCID).	No data.
Alcohols, C10-16, ethoxylated	AE	68002-97-1	3939						
Alcohols, C13-15, ethoxylated	AE. C12-14EO7, C13-15EO11, C13-15EO3, C13-15EO7 (Hera). Data taken for similar substances.	64425-86-1	3715	Algae: EC50 ≤1 mg/L for C12-15EO6-8 (Danish EPA).	Daphnia magna: EC50 approx. 0,1-10 mg/L (Danish EPA).	Fish: LC50 approx. 0,4-10 mg/L (Danish EPA).	Low to moderate potential to bioackumulate depending on alkyl chain length (Danish EPA).	Linear C12-18 AE with 5-14 EO in general readily biodegradable (Danish EPA).	No data.
Fatty acids, tall-oil, ethoxylated	PEG-XX tallate	61791-00-2	3282	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	No data. Potentially bioaccumulative (CCR).	No data. Not expected to be persistent (CCR).	No data.
Alcohols, C9-11, ethoxylated	AE. C9-11EO4, C9-11EO6, C9-11EO8 (Hera). Data taken for similar substances.	68439-46-3	2947	Algae: EC50 estimated to ≥1 mg/L, toxicity increases with alkyl chain length (see 64425-86-1).	Invertebrates: EC50 5-15 mg/L (Danish EPA).	Fish: LC50 estimated to 1-10 mg/L, limited amount of data for C9-11 (see 64425-86-1) (Danish EPA).	Low potential to bioackumulate (see 64425-86-1) (Danish EPA).	Readily biodegradable (see 64425-86-1) (Danish EPA).	No data.
Alcohols, C12-14, ethoxylated	AE. C12-14EO7 (Hera). Data taken for similar substances.	68439-50-9	2739	No data. See 64425-86-1 above.	No data. See 64425-86-1 above.	No data. See 64425-86-1 above.	No data. See 64425-86-1 above.	No data. See 64425-86-1 above.	No data.
Amines, tallow alkyl, ethoxylated	PEG-XX hydrogenated tallow amine	61791-26-2	1906	No data.	Daphnia Pulex: LC50 48h 2,35 mg/L (HSNO-CCID).	Blue Gills: LC50 96h 1,3 mg/L (HSNO-CCID).	No data. Potentially bioaccumulative (CCR).	No data. Readily biodegradable (HSNO-CCID).	No data.
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy-		25322-69-4	1807						

Alcohols, C13-15-branched and linear, butoxylated ethoxylated	AE (AA). Some data taken for similar substances.	111905-53-4	1780	Algae: EC50 estimated to ≥1 mg/L, toxicity decreases with alkyl branching (see 64425-86-1) (Danish EPA).	Daphnia magna: EC50 estimated to 1-10 mg/L, toxicity decreases with branching (Danish EPA).	Fish: LC50 estimated to 1-10 mg/L, no clear effect of branching (Danish EPA).	1. No data. Not expected to bioaccumulate (CCR). 2. Low to moderate potential to bioackumulate depending on alkyl chain length (see 64425-86-1) (Danish EPA).	Readily biodegradable: >70 % (OECD 301E) (Goodpoint).	No data.
Sorbitan, mono-9-octadecenoate, (Z)-	Sorbitan monooleate	1338-43-8	1646	Algae: IC50 72h 3 mg/L (Goodpoint).	No data.	No data.	1. Not expected to bioaccumulate based on QSAR (CCR). 2. BCF <200 (calc. EPISuite 4.1).	1. Inherently biodegradable: 58 % in 14 d MITI (EnviChem). 2. Readily biodegradable: 55 % in 5 days (Goodpoint).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-(2-propylheptyl)-.omega.-hydroxy-	AE. Ethoxylated 2-propylheptanol	160875-66-1	1577	Desmodesmus subspicatus: EC50 72h 10-100 mg/L (MSDS Sto).	Daphnia magna: EC50 48h 1-10 mg/L (MSDS Sto).	Danio rerio (zebra fish): LC50 96h 10-100 mg/L (MSDS Sto).	No data.	No data. Readily biodegradable (detergent mixture) (MSDS Sto).	No data.
Octadecanamide, N,N'-1,2-ethanediylbis-	N,N'-Ethylene distearylamide	110-30-5	1373						
Oxirane, methyl-, polymer with oxirane, mono(2-propylheptyl) ether	MW: 1100 (average)	166736-08-9	1270	No data, but block copolymers are less toxic than other nonionic surfactants (Danish EPA).	No data, but block copolymers are less toxic than other nonionic surfactants (Danish EPA).	No data, but block copolymers are less toxic than other nonionic surfactants (Danish EPA).	No data. High MW indicates limited bioavailability.	No data, but long PEG chains have limited biodegradability.	No data.
Sorbitan, mono-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs., (Z)-	Polysorbate 80	9005-65-6	1172	No data.	No data.	Data for Polysorbate 60: Salmo gairdneri: LC50 90 mg/L (Goodpoint).	1. No data. Uncertain if bioackumulates (CCR). 2. log Kow = 0,70 (calc. EPI Suite 4.1).	1. May not be readily biodegradable: 17,8 % in 20d in soil (HSDB). 2.Uncertain if persistent (CCR).	No data.
Alcohols, C6-12, ethoxylated	AE. Data taken for similar substances.	68439-45-2	1124	Algae: EC50 estimated to ≥1 mg/L, toxicity increases with alkyl chain length (see 64425-86-1 above).	Toxicity not related to chain length (see 64425-86-1 above).	Fish: LC50 estimated to 1-10 mg/L, limited amount of data for C6-12 (see 64425-86-1 above).	Low potential to bioackumulate (see 64425-86-1 above).	Readily biodegradable (see 64425-86-1 above).	No data.
D-Glucose, decyl octyl ethers, oligomeric	AG	68515-73-1	1014						
Ethylenoxid/propylenoxid polymer	Poloxalene	9003-11-6	969	No data.	Invertebrates: EC50 > 100 mg/L (Danish EPA).	Fish: LC50 >100 mg/L (Danish EPA).	No data. Not expected to bioaccumulate (CCR).	No data. Limited biodegradability for PEG/PPG polymers.	No data.
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-butyl-.omega.-hydroxy-	Butoxypolypropylene glycol	9003-13-8	776	No data.	Gammarus fasciatus: LC50 96h 17 mg/L (HSNO-CCID).	No data, but PEG/PPG polymers ususally have low toxicity.	No data. Not expected to bioaccumulate (CCR). High MW indicates limited bioavailability.	No data. Limited biodegradability for PEG/PPG polymers.	No data.
Alcohols, C12-14, ethoxylated propoxylated	AE (AA)	68439-51-0	751	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	No data.
Ethanol, 2,2'-(9-octadecenylimino)bis-	Use Category 9	25307-17-9	676	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 <0,1 mg/L (CCR).	Not expected to bioaccumulate based on QSAR (CCR).	Not persistent based on QSAR (CCR).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-	AE. Polyethylene glycol monoisotridecyl ether. Data taken for similar substances.	9043-30-5	557	Data for Oxo-C9-15EO2-10: EC50 4-50 mg/L (HSNO-CCID).	Data for Oxo-C13-15EO7-8 10% branching: EC50 48h 0,5 mg/L (HSNO-CCID).	Data for C9-15EO2-10: LC50 0,25-4 mg/L (HSNO-CCID).	Not expected to bioaccumulate (HSNO-CCID).	Data for Oxo-C13-15EO7-8 10% branching: Readily biodegradable: 100 % in 28d (OECD 301E).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-phenyl-.omega.-hydroxy-	Polyethylene glycol phenyl ether	9004-78-8	530	No data. Not inherently toxic to aquatic organisms (CCR).	No data. Not inherently toxic to aquatic organisms (CCR).	No data. Not inherently toxic to aquatic organisms (CCR).	No data. Not expected to bioaccumulate (CCR).	1. No data. Not expected to be persistent (CCR). 2. Degradation may be slow with longer EO chains (Danish EPA).	No data.
D-Glucoside, hexyl	AG. Use Category 9	54549-24-5	449	Skeletonema costatum: EL50 72h 435 mg/L (ISO 10253) (Echa).	Daphnia magna: EC50 48h 490 mg/L (OECD 202) (Echa).	Oncorhynchus mykiss: LC50 96h 420 mg/L (OECD 203) (Echa).	No data.	Readily biodegradable: 71 % in 28d (OECD 301D) (Echa).	No data.
Castor oil, ethoxylated	Ethoxylated vegetable oil	61791-12-6	445	Not inherently toxic, LC/EC50 = 448 mg/L (CCR).	Not inherently toxic, LC/EC50 = 448 mg/L (CCR),.	1. Fish: LC50 96h > 10 000 mg/L (PEG-40 hydrogenated castor oil, Goodpoint).	No data. Uncertain if bioaccumulates (CCR).	Inherently biodegradable (PEG-40 hydrogenated castor oil, Goodpoint)	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-	AE. Polyethylene glycol (5) undecyl ether. Data taken for similar substances.	34398-01-1	440	Algae: EC50 estimated to ≥1 mg/L, toxicity increases with alkyl chain length (see 64425-86-1 above).	Data for C0-13EO4-610: EC50 0,5-5,6 mg/L (Danish EPA).	Data for C10-14EO4-11: LC50 0,8-6,4 mg/L (Danish EPA).	Data for C12EO4: BCF = 309 (fish), not expected to bioaccumulate (Danish EPA).	Data for C9-11EO8: Readily biodegradable: 80 % in 28d (OECD 301D) (Danish EPA).	No data.
D-Glucopyranoside, C10-16-alkyl, oligomeric	AG	110615-47-9	435						
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-	AE. PEG tridecyl ether	24938-91-8	397						
Ethanol, 2,2'-iminobis-, N-coco alkyl derivs.	Coconut fatty acid diethanolamide (Similar, if not identical, to CAS 68603-42-9, Coconut diethanolamide)	61791-31-9	387	Data for 68603-42-9: Scenedesmus subspicatus: EC50 72h 2,2 mg/L; NOEC 0,32 mg/L (Lmv 2004).	Data for 68603-42-9: Daphnia pulex: EC50 48h 2,39 mg/L (Lmv 2004).	Data for 68603-42-9: Brachydanio rerio: LC50 96h 3,6 mg/L (Lmv 2004).	Data for 68603-42-9: Not expected to bioaccumulate: BCF = 102 (calc) (Lmv 2004).	Data for 68603-42-9: Readily biodegradable: 71 % in 30d (OECD 301D) (Lmv 2004).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-, branched and linear	Polymer, minimum molecular weight 1100 (ChemIDPlus).	127036-24-2	359						
Polyethyleneglycoldioleat		9005-07-6	318	No data.	No data.	No data. Toxicity for alkoxylated fatty acids are between 35-3100 mg/L (Lmv 1993).	No data.	1. Readily biodegradable: >70 % (DOC reduction) (BASF). 2. Alkoxylated fatty acids (mono- and di-) are in general readily biodegradable (Lmv 1993).	No data.
Alcohols, C12-18, ethoxylated propoxylated	AE (AA). Use Category 9	69227-21-0	317	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	Inherently toxic based on QSAR, EC/LC50 >0,1 mg/L (CCR).	No data. Potentially bioaccumulative (CCR).	No data. Not expected to be persistent (CCR).	No data.

Poly(oxy-1,2-ethanediyl), .alpha.-(2-ethylhexyl)-.omega.-hydroxy-	AE. Use Category 9	26468-86-0	311	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Not inherently toxic (CCR).	No data. Not expected to bioaccumulate (CCR).	Not persistent based on experiments (CCR).	No data.
Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-	Laureth-3 oxyethylene ether	3055-94-5	308						
Alcohols, C12-18, ethoxylated	AE	68213-23-0	307						
Alcohols, C11-15-secondary, ethoxylated	AE	68131-40-8	296						
Alcohols, C16-18, ethoxylated	AE	68439-49-6	288						
Alcohols, C13-15-branched and linear, ethoxylated, propoxylated	AE (AA)	111905-54-5	282						
Glycerides, C16-18 mono- and di-	AG	85251-77-0	258	No data. Low to high aquatic toxicity.	No data. Low to high aquatic toxicity.	No data. Low to high aquatic toxicity.	No data. Not expected to bioaccumulate (CCR).	No data, but readily biodegradable can be anticipated for hydrolysis products of triglycerides.	No data.
Amides, coco, N-(hydroxyethyl), ethoxylated	Coconut oil fatty acids, ethoxylated monoethanolamide	68425-44-5	252	Scenedesmus subspicatus: EC50 72h 20 mg/L (Akzo Nobel).	Daphnia magna: EC50 48h 1-10 mg/L (Akzo Nobel).	Rainbow trout: LC50 96h 1-10 mg/L (Akzo Nobel).	No data. Not expected to bioaccumulate (Akzo Nobel).	Readily biodegradable: 60 % in 28d (OECD 301B) (Akzo Nobel).	No data.
Oxirane, methyl-, polymer with oxirane, monobutyl ether	Propylene oxide ethylene oxide polymer monobutyl ether	9038-95-3	232	No data.	Data for EO/PO block copolymers: Invertebrates: EC50 > 100 mg/L (Danish EPA).	Data for EO/PO block copolymers: Fish: LC50 >100 mg/L (Danish EPA).	No data. Not expected to bioaccumulate (CCR).	No data. Limited biodegradability for PEG/PPG polymers.	No data.
Amides, coco, N,N-bis(hydroxyethyl)-		68603-42-9	229						
Poly(oxy-1,2-ethanediyl), .alpha.-(1-oxo-9-octadecenyl)-.omega.-hydroxy-, (Z)-	AE. Polyoxyethylene monoleate	9004-96-0	219	No data.	Data for PEG 400 monooleate: Daphnia magna: EC50 48h 1-10 mg/L (BASF).	1. Toxicity for alkoxylated fatty acids are between 35-3100 mg/L (Lmv 1993). 2. Data for PEG 400 monooleate: LC50 96h 1-10 mg/L (BASF).	No data. Not expected to bioaccumulate (CCR).	1. Alkoxylated fatty acids (mono- and di-) are in general readily biodegradable (Lmv 1993). 2. Data for PEG 400 monooleate: Readily biodegradable: >60 % in 28d (OECD 301B) (BASF).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-decyl-.omega.-hydroxy-	AE. Use Category 9	26183-52-8	213	No data.	Idotea balthica: LC50 48h 10-25 mg/L (HSNO-CCID).	Data for Dodecyl alcohol ethoxylate (CAS: 9002-92-0): Cyprinus carpio: LC50 96h 1,4 mg/L (HSNO-CCID).	No data. Not expected to bioaccumulate (HSNO-CCID and CCR).	No data. Rapidly biodegradable (HSNO-CCID).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-(nonylphenyl)-.omega.-hydroxy-, branched	NPE. C9 branched alkyl phenol ethoxylate (ChemIDplus)	68412-54-4	194	Pseudokirchnerella subcapitata: E_yC50 72h 2,02 mg/L (OECD 201) (Echa).	Daphnia magna: LD50 48h 0,716 mg/L, NP2EO (Echa).	Pimephales promelas: LC50 96h 0,323 mg/L, NP2EO (EPA OPP 72-1) (Echa).	BAF determined for various organisms (fish, algae, aquatic plants): 0-20 (NP2EO), low potential to bioackumulate (Echa).	Inherently biodegradable: 21 % in 28 d (OECD 301D), CAS 37205-87-1 (linear) (Echa).	Oryzias latipes: NOEC (100d) 0,380 mg/L (endpoint: growth), NP4EO (Echa).
Fatty acids, tall-oil, reaction products with polyethylenepolyamines		68910-93-0	191	No data.	No data.	Brachydanio rerio: LC50 96h 0,43 mg/L (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.
Sorbitan, monododecanoate, poly(oxy-1,2-ethanediyl) derivs.	Polysorbate 20	9005-64-5	179						
Poly(oxy-1,2-ethanediyl), .alpha.-(nonylphenyl)-.omega.-hydroxy-	NPE. Use Category 38	9016-45-9	172	No data.	Daphnia magna: LC50 48h 4,8 mg/L (HSNO-CCID).	Lepomis macrochirus (Blue gill): LC50 96h 1,3 mg/L (HSNO-CCID).	1. Low potential to bioackumulate (HSNO-CCID). 2. NPE´s have in general low potential to bioaccumulate, degradation products more prone to bioaccumulation.	Not readily biodegradable (HSNO-CCID).	Medaka: NOEC 0,0082 mg/L (HSNO-CCID).
Poly(oxy-1,2-ethanediyl), .alpha.-9-octadecenyl-.omega.-hydroxy-, (Z)-	AE. Polyoxyl 10 oleyl ether	9004-98-2	166						
Poly(oxy-1,2-ethanediyl), .alpha.-isodecyl-.omega.-hydroxy-	AE. Polyoxyethylene isodecyl ether	61827-42-7	165	No data for specific CAS. Algae: EC50 estimated to ≥1 mg/L, toxicity increases with alkyl chain length, decreases with branching (see 64425-86-1 above).	No data for specific CAS. Invertebrates: EC50 estimated to >5 mg/L, branching reduces toxicity (see 64425-86-1 and 68439-46-3 above).	No data for specific CAS. Fish: LC50 approx. 0,4-10 mg/L (see 64425-86-1 and 68439-46-3 above).	1. No data. Not expected to bioaccumulate (CCR). 2. Low potential to bioackumulate (see 64425-86-1 above).	Data for Iso-C10EO7-8: Readily biodegradable: 90 % in 28d (OECD 301D) (Danish EPA).	No data.
Alcohols, C12-15, ethoxylated propoxylated	AE (AA). Use Category 9	68551-13-3	148	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	No data.
Alcohols, C16-18 and C18-unsatd., ethoxylated	AE	68920-66-1	138						
Alcohols, C8-10, ethoxylated propoxylated	AE (AA)	68603-25-8	129						
Alcohols, C8-10-alkyl, ethoxylated propoxylated, benzyl ether	AE (AA)	68154-99-4	119						
3,6,9,12,15,18,21,24,27-Nonaoxanonatriacontan-1-ol	Laureth-9. Use Category 9	3055-99-0	116	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	See 64425-86-1 above.	No data.
Dodecanoic acid, methyl ester	Use Category 9	111-82-0	110	Scenedesmus subspicatus: EC50 96h 1,5 mg/L (DIN 38412) (ESIS).	No data.	Lepomis macrochirus: LC50 96h >1000 mg/L (ESIS, several records).	Not expected to bioaccumulate based on QSAR (CCR).	Readily biodegradable: 1000% in 30d (OECD 301D) (ESIS, several records).	No data.
Poly(oxy-1,2-ethanediyl), .alpha.-[(1,1,3,3-tetramethylbutyl)phenyl]-.omega.-hydroxy-	OPE. Polyethylene glycol mono(octylphenyl) ether	9036-19-5	110						

1,3-Propanediamine, N-(3-aminopropyl)-N-dodecyl-	Use Category 39	2372-82-9	100	No data.	No data.	No data.	Not expected to bioaccumulate based on QSAR (EPISuite 4.1): BCF <250.	Not readily biodegradable based on QSAR (EPISuite 4.1).	No data.
Fatty acids, C14-18 and C16-18-unsatd., ethoxylated propoxylated		68154-27-8	97						
Poly(oxy-1,2-ethanediyl), .alpha.,.alpha.'-[(9-octadecenylimino)di-2,1-ethanediyl]bis[.omega.-hydroxy-, (Z)-	Ethoxylated long chain tertiary amine	26635-93-8	84						
Alcohols, C16-18, ethoxylated propoxylated	AE (AA)	68002-96-0	71	No data.	No data for specific CAS. AE with 2-5EO4PO: EC50 2,4-6,0 mg/L (HSNO-CCID).	No data for specific CAS. AE with 2-5EO4PO: LC50 0,7-5,7 mg/L (HSNO-CCID).	No data. Not expected to bioaccumulate (HSNO-CCID).	No data. Linear C12-18 AE with 5-14 EO in general readily biodegradable, increasing number of PO units might decrease biodegradation rates (Danish EPA).	No data.
Amines, C12-14-tert-alkyl, ethoxylated propoxylated		68603-58-7	59						
Poly(oxy-1,2-ethanediyl), .alpha.-2-propenyl-.omega.-hydroxy-	AE	27274-31-3	58						
Alcohols, C11-14-iso-, C13-rich, ethoxylated	AE. C11-14EO7 (Hera)	78330-21-9	57	No data for specific CAS. Algae: EC50 estimated to ≥1 mg/L, toxicity increases with alkyl chain length, decreases with branching (see 64425-86-1 above).	No data for specific CAS. Invertebrates: EC50 estimated to >5 mg/L, branching reduces toxicity (see 64425-86-1 and 68439-46-3 above).	No data for specific CAS. Fish: LC50 approx. 0,4-10 mg/L (Danish EPA).	1. No data. Not expected to bioaccumulate (CCR). 2. Low potential to bioackumulate (see 64425-86-1 above).	Data for Iso-C10EO7-8: Readily biodegradable: 90 % in 28d (OECD 301D) (Danish EPA).	No data.
Lanolin, ethoxylated	Use Category 39	61790-81-6	57						
Castor oil, hydrogenated, ethoxylated		61788-85-0	56						
Aziridine, polymer with methyloxirane		31974-35-3	55						
D-Glucoside, decyl	AG	54549-25-6	53						
Alcohols, C6-12, ethoxylated propoxylated	AE (AA)	68937-66-6	50						
Amines, coco alkyl, ethoxylated		61791-14-8	49	No data.	Scolelepis fuliginosa: LC50 96h 8 mg/L (HSNO-CCID).	No data.	1. No data. Not expected to bioaccumulate (CCR). 2. Calc. BCF = 68 (EPI-Suite 4.1).	No data. Not expected to be persistent (CCR).	No data.
Siloxanes and Silicones, di-Me, 3-hydroxypropyl Me, ethoxylated		68937-54-2	46						
Octadecanoic acid, 1,2-ethanediyl ester	Glycol distearate	627-83-8	34						
Poly(oxy-1,2-ethanediyl), .alpha.,.alpha.'-[1,4-dimethyl-1,4-bis(2-methylpropyl)-2-butyne-1,4-diyl]bis[.omega.-hydroxy-	AE. Ethoxylated-2,4,7,9-tetramethyl-5-decyne-4,7-diol	9014-85-1	30						
Sorbitan, monooctadecanoate, poly(oxy-1,2-ethanediyl) derivs.	Polysorbate 60	9005-67-8	21						
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-(1-oxo-9-octadecenyl)-.omega.-butoxy-, (Z)-	Polypropylene glycol butyl ether oleate	37281-78-0	18						
Alcohols, C11-15-secondary, ethoxylated propoxylated	AE (AA)	68551-14-4	11						
Amphoteric surfactants:									
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs., hydroxides, inner salts	Coco Amido Betaine	61789-40-0	1586	Scenedesmus subspicatus: EC50 72h 1-30 mg/L (ESIS, several records).	Daphnia magna: EC50 48h 6,5 mg/L (OECD 202) (ESIS, several records).	Brachydanio rerio: LC50 96h 2 mg/L (ISO 7346/1-3) (ESIS, several records).	No data. Not expected to bioaccumulate (CCR and Goodpoint).	Readily biodegradable: 80-100 % (OECD 301E) (ESIS, several records).	Daphnia magna: NOEC 21d 0,9 mg/L (ESIS).
Lecithin	Naturally occurring phospholipid.	8002-43-5	1307	No data.	No data.	No data.	No data.	No data, naturally occurring phospholipid.	No data.
Amines, C10-16-alkyldimethyl, N-oxides	Use Category 9	70592-80-2	575	No data.	Daphnia magna: LC50 96h 1 mg/L (ESIS).	No data.	No data. Not expected to bioaccumulate (HSNO-CCID and CCR).	No data. Not expected to be persistent (CCR).	No data.
1-Dodecanamine, N,N-dimethyl-, N-oxide		1643-20-5	300						
Amines, coco alkyldimethyl, oxides	Use Category 39	61788-90-7	212	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	Not inherently toxic based on QSAR (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.
1-Tetradecanamine, N,N-dimethyl-, N-oxide		3332-27-2	108						
Imidazolium compounds, 1-[2-(2-carboxyethoxy)ethyl]-1(or 3)-(2-carboxyethyl)-4,5-dihydro-2-norcoco alkyl, hydroxides, disodium salts		68604-71-7	100						
Glycine, N-methyl-N-(1-oxododecyl)-, sodium salt	Sodium lauroylsarcosinate	137-16-6	44						
Cationic surfactants:									

Fatty acids, C10-20 and C16-18-unsatd., reaction products with triethanolamine, di-Me sulfate-quaternized		91995-81-2	2542						
Quaternary ammonium compounds, bis(hydrogenated tallow alkyl)dimethyl, chlorides, reaction products with bentonite	Use Category 39. The quaternary ammoniums are tightly held to the clay by strong ionic forces and through chemisorption.	68953-58-2	1690	Skeletonema costatum: ErC50 72h >1000 mg/L (OECD-HPV).	Daphnia magna: EC50 48h >100 mg/L (OECD-HPV).	Rainbow trout: LC50 96h >500 mg/L (OECD-HPV).	No data. Not expected to bioaccumulate (CCR).	Not readily biodegradable: <35% in 28d (OECD TG 306) (OECD-HPV).	Daphnia magna: NOEC 21d 3,2 mg/L (OECD-HPV).
Quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	Use Category 9	68424-85-1	774	Inherently toxic based on QSAR (CCR).	Inherently toxic based on QSAR (CCR).	Inherently toxic based on QSAR, LC50 (fish) <0,1 mg/L (CCR).	No data. Potentially bioaccumulative (CCR).	No data. Not expected to be persistent (CCR).	No data.
Quaternary ammonium compounds, coco alkylbis(2-hydroxyethyl)methyl, ethoxylated, chlorides	Use Category 9	61791-10-4	254	Not inherently toxic based on QSAR, EC/LC50 >1 mg/L (CCR).	Not inherently toxic based on QSAR, EC/LC50 >1 mg/L (CCR).	Not inherently toxic based on QSAR, EC/LC50 >1 mg/L (CCR).	No data. Not expected to bioaccumulate (CCR).	No data. Not expected to be persistent (CCR).	No data.
Quaternary ammonium compounds, coco alkyl(hydroxyethyl)dimethyl, ethoxylated, chlorides	Use Category 9	863679-20-3	242	EC50 72h 1-10 mg/L (Gipeco).	Daphnia magna: EC50 48h 0,11-1 mg/L (Gipeco).	LC50 96h 10-100 mg/L (Gipeco).	No data. Not expected to bioaccumulate (Gipeco).	Readily biodegradable: >60% in 28d (OECD 301D) (Gipeco).	No data.
1-Decanaminium, N-decyl-N,N-dimethyl-, chloride	Use Category 39	7173-51-5	154	Chlorella pyrenoidosa: EC50 96h 0,110 mg/L (HSNO-CCID).	Americamysis bahia: LC50 48h 0,039 mg/L (HSNO-CCID).	Fathead minnow: LC50 96h 0,33 mg/L (HSNO-CCID).	1. Not expected to bioaccumulate (HSNO-CCID). 2. Not expected to bioaccumulate based on QSAR (CCR).	1. Readily biodegradable (HSNO-CCID). 2. 72% in 28d (OECD 301D) (HSDB).	No data.
1-Tetradecanaminium, N,N,N-trimethyl-, bromide	Use Category 39	1119-97-7	107	Microcystis aeruginosa: EC50, 96h, 0,03 mg/L (HSNO-CCID).	Gammarus sp.: EC50 48h 0,1 mg/L (HSNO-CCID).	No data.	No data. Not expected to bioaccumulate (HSNO-CCID).	Not persistent based on QSAR (CCR).	Selenastrum capricornutum: EC50 21d <2,5 mg/L (HSNO-CCID).
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	Use Category 39	68391-01-5	89						
Quaternary ammonium compounds, benzyl-C12-14-alkyldimethyl, chlorides	Use Category 39	85409-22-9	84						
Quaternary ammonium compounds, benzylcoco alkyldimethyl, chlorides	Use Category 39	61789-71-7	83						
Quaternary ammonium compounds, benzyl-C8-18-alkyldimethyl, chlorides	Use Category 39	63449-41-2	60						
1-Hexadecanaminium, N,N,N-trimethyl-, chloride	Cetrimonium chloride	112-02-7	27	Desmodesmus subspicatus: EC50 72h 0,01 mg/L (Lmv 2004).	Daphnia magna: LC50 48h 0,01 mg/L (HSNO-CCID).	Lepomis macrochirus (Blue gill): LC50 96h 0,1 mg/L (HSNO-CCID).	log Kow = 3,2 (EPI Suite database, HSNO-CCID), not expected to bioaccumulate.	Readily biodegradable: 63 % in 28d (OECD 301E), 74% BOD/COD (OECD 301D) (Lmv 2004).	No data.
Benzenemethanaminium, N-dodecyl-N,N-dimethyl-, chloride	Use Category 39	139-07-1	25						
Quarternary ammonium compounds, alkylbenzyldimethyl, chlorides	Use Category 39	8001-54-5	25						

Appendix 4

Surfactants arranged in decreasing amount of volume used in 2010 (in each surfactant type)

Dark Grey: Surfactants for which data have not been collected, UC50, UC39 <100 ton

Surfactant family and name in SPIN database	CAS No	Total use					Use Categories			
		SE	DK	NO	FI	Total	SE	DK	NO	FI
Anionic surfactants:										
Fatty acids, tall-oil	61790-12-3	23191	161	211	3	23566	55;27;02;50;09	28;35;59;14;09	59;14;13;28;09	9
Benzenesulfonic acid, 4-C10-13-sec-alkyl derivs.	85536-14-7	128	19	9711	33	9891	50;09;02;59	09;39;61	9	55;09;48;61
Lignosulfonic acid, sodium salt	8061-51-6	1815	175	4727		6717	50;55;39;13;43	13;10;09;38;50	13;40;59;09;38	
Fatty acid, rape-oil	85711-54-2	6606				6606	9			
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-hydroxy-,C12-14-alkyl ethers, sodium salts	68891-38-3	2388	489	573	667	4117	09;50;55;02;61	50;09;15;02;10	50;09;59;13	09;15;38
Sulfuric acid, monododecyl ester, sodium salt	151-21-3	1824	64	27	366	2281	09;50;02;59;55	09;15;50;02;59	13;09;39;61	55;34;09
Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-, hydrogen sulfate, sodium salt	13150-00-0	1531	24	144	50	1749	50;02;09;59	09;59	50;09	9
Fatty acids, palm-oil, sodium salts	61790-79-2	1641		37		1678	55;09		9	
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-hydroxy-, C10-16-alkyl ethers, sodium salts	68585-34-2	162	356	47	879	1444	55;09;50;02;52	50;09;15;02;39	10;36;09;59	09;50
Poly(oxy-1,2-ethanediyl), .alpha.-sulfo-.omega.-(dodecyloxy)-, sodium salt	9004-82-4	766	421		122	1309	09;50;55;22;02	15;50;59;09;02		9
Benzenesulfonic acid, mono-C10-14-alkyl derivs., sodium salts	85117-50-6	30	5	12	1036	1083	9	9		9
Ethanol, 2-[2-(dodecyloxy)ethoxy]-, hydrogen sulfate, sodium salt	3088-31-1	540	186	38	303	1067	09;55;50;41;59	09;15;39	9	9
Paraffin oils, sulfochlorinated, saponified	68188-18-1	48	784	7	28	867	50;09;55;02	09;50;02;20;39	09;59;39	9
Benzenesulfonic acid, dodecyl-, sodium salt	25155-30-0	206	124	53	396	779	50;09;38;59;55	09;02;10;13;14	09;36;39;59	09;55
Fatty acids, tallow, sodium salts	8052-48-0	538	57	122		717	9	09;35	9	
Sulfuric acid, mono-C12-18-alkyl esters, sodium salts	68955-19-1	113	9		567	689	09;50;61	09;50;59	9	9
Sulfuric acid, mono-C10-16-alkyl esters, sodium salts	68585-47-7	418	49	2	125	594	09;50;61	09;61		9
Benzenesulfonic acid, mono-C10-16-alkyl derivs., sodium salts	68081-81-2	4	1	243	314	562				
Fatty acids, tall-oil, potassium salts	61790-44-1	517	5		12	534	09;56;59			
Butanedioic acid, sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt	577-11-7	165	19	66	212	462	50;59;55;09;61	50;35;02;09;10	59;09;11;39	55;50;38;09
.beta.-Alanine, N-(2-carboxyethyl)-N-(2-ethylhexyl)-, monosodium salt	94441-92-6	227	90		102	419	50;09;55;61	50;09;39		9
Fatty acids, coco, potassium salts	61789-30-8	275	10	7	57	349	09;50	09;55	9	9
Benzenesulfonic acid, C10-13-alkyl derivs., sodium salts	68411-30-3	90	19	60	177	346	09;02;50;55;61	09;39;55;59;61	09;50;59	09;55;61
Blancol	9084-06-04	324	12			336	50;02;10;38;43	13;10;02;09;17		
Sulfonic acids, C13-17-sec-alkane, sodium salts	85711-69-9	164	36	6	106	312	50;55;09;61;10	09;50;39;59;61	09;59	9
Ethene, homopolymer, oxidized	68441-17-8	234	48	27		309	55;35;59;61;49	61;35;50;59;14	59;39;10;45;61	
Benzenesulfonic acid, dodecyl-	27176-87-0	46	191	51	13	301	50;09;10;35;59	39;09;50;02;45	09;27;59	9
Benzenesulfonic acid, dodecyl-, calcium salt	26264-06-2	201	88		7	296	38;35;39	50;39;38;59		38

Benzene, 1,1'-oxybis-, tetrapropylene derivs., sulfonated, sodium salts	119345-04-9	267				267	50;02			
9-Octadecenoic acid (Z)-, potassium salt	143-18-0	207	16			223	09;56	09;38		
Octadecanoic acid, sodium salt	822-16-2	92	10	101		203	35;55;09;39;50	09;61;35	9	
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, phosphate	9046-01-9	120	3		1	124	50;55;59;02;10	59		
Sulfonic acids, C14-16-alkane, sodium salts	68439-57-6	43	21	7	49	120	50;09;55	09;13;20	09;13	9
Benzenesulfonic acid, dodecyl-, compd. with 2-aminoethanol (1:1)	26836-07-7	52	7		60	119	9			9
Benzenesulfonic acid, mono-C10-13-alkyl derivs., sodium salts	90194-45-9	3			88	91	9			9
Fatty acids, coco, sodium salts	61789-31-9	70		15	5	90	9		9	9
Sulfuric acid, mono(2-ethylhexyl) ester, sodium salt	126-92-1	18	1	3	33	55	50;09;17;61	09;17;61		09;17;50
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-, phosphate	73038-25-2	19	1	13	1	34	50	59	10	
Ethanol, 2-(2-ethoxyethoxy)-, 2''-[(C12-15-branched and linear alkyl)oxy] derivs., hydrogen sulfates, sodium salts	91648-56-5	29				29	9			
Poly(oxy-1,2-ethanediyl), .alpha.-phenyl-.omega.-hydroxy-, phosphate	39464-70-5	12	1	3		16	50;56;09	56;09	9	
Octadecanoic acid, aluminum salt	637-12-7	14	1	1		16	50;20;35;55;59	02;10;13;20;35	13;35;20;59;02	
1-Tetradecanol, hydrogen sulfate, sodium salt	1191-50-0	14				14	50			
Nonionic surfactants:										
Alcohols, C12-15, ethoxylated	68131-39-5	2068	910	735	1554	5267	09;50;55;39;41	55;09;39;61;50	09;39;10	09;55;39;48
Oxirane, methyl-, polymer with oxirane, ether with 1,2,3-propanetriol (3:1)	9082-00-2	3978	331			4309	55;50;20;13	55;13;02;32;43		
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, branched	69011-36-5	1247	1329	542	1179	4297	50;09;55;11;61	50;09;39;10;35	09;50;39;55;11	09;39;55;61
Alcohols, C10-16, ethoxylated	68002-97-1	95	101	3672	71	3939	09;50;55;11	50;09	9	9
Alcohols, C13-15, ethoxylated	64425-86-1	310	395	2924	87	3716	09;50;11;39;55	09;50;39;61	9	9
Fatty acids, tall-oil, ethoxylated	61791-00-2	3180	46	56		3282	50;09	50	09;59	
Alcohols, C9-11, ethoxylated	68439-46-3	805	664	756	721	2946	09;50;61;55;02	09;50;39;38;55	09;50;55;39;61	09;50;39;55
Alcohols, C12-14, ethoxylated	68439-50-9	1121	101	45	1473	2740	50;09;55;47;35	09;39;50;55;43	09;13;59;10	09;55;50;39
Amines, tallow alkyl, ethoxylated	61791-26-2	195	1382	297	33	1907	50;38;55;35;09	50;38;59;09;35		09;39;47;48;61
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy-	25322-69-4	739	571	183	314	1807	35;20;55;13;50	33;55;59;02;09	50;02;13;20;59	55;02;33;61
Alcohols, C13-15-branched and linear, butoxylated ethoxylated	111905-53-4	105	1503	54	118	1780	09;47;50;39;11	47;50;09	9	09;39
Sorbitan, mono-9-octadecenoate, (Z)-	1338-43-8	1551	11	84		1646	50;09;11;35;56	11;01;02;06;09	11;09;14;35;39	
POLY(OXY-1,2-ETHANEDIYL), .ALPHA.-(2-PROPYLHEPTYL)-.OMEGA.-HYDROXY-	160875-66-1	809	238	496	35	1578	50;55;39;61	50;09;39;61	50;09;55	
Octadecanamide, N,N'-1,2-ethanediylbis-	110-30-5	1280	93	0,2		1373	35;61;55;50;56	61;55;59;02;09	59	

Oxirane, methyl-, polymer with oxirane, mono(2-propylheptyl) ether	166736-08-9	421	166	590	93	1270	9	50;09	9	9
Sorbitan, mono-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs., (Z)-	9005-65-6	1161	11			1172	50;10;55;11;31	09;59;61		
Alcohols, C6-12, ethoxylated	68439-45-2	575	20	467	62	1124	50;09;55;35;61	09;39;61	50;09;39;55;61	9
D-Glucose, decyl octyl ethers, oligomeric	68515-73-1	59	818	74	63	1014	50;38;09;55	09;50;39;61	09;22;39	09;39
ETHYLENOXID/PROPYLENOXID POLYMER	9003-11-06	827	142			969	50;35;56;47;43	50;30;56;09;02		
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-butyl-.omega.-hydroxy-	9003-13-8	705	71			776	35;50;23;20;55	02;35;59;20;09		
Alcohols, C12-14, ethoxylated propoxylated	68439-51-0	361	193	82	115	751	50;09;47;55;56	47;09;50;59;61	09;59	09;55
Ethanol, 2,2'-(9-octadecenylimino)bis-	25307-17-9	670	3	2	1	676	55;09;35;61	09;14;55;61		09;14;55
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-	9043-30-5	381	116		60	557	50;55;09;02;56	09;50;02;59;13		38;09;55
Poly(oxy-1,2-ethanediyl), .alpha.-phenyl-.omega.-hydroxy-	9004-78-8	512	3		15	530	50;55;61;09	09;55		
D-Glucoside, hexyl	54549-24-5	232	4	114	99	449	09;55;39	9	09;55	9
Castor oil, ethoxylated	61791-12-6	342	91	11		444	50;56;38;35;10	50;38;35;61;39	39;09;59	
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-	34398-01-1	213	18	118	91	440	50;09;55;39;36	09;50;39;61	09;39	9
D-Glucopyranoside, C10-16-alkyl, oligomeric	110615-47-9	174	66	55	140	435	50;55;09;61	50;09;15;39	9	09;39
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-	24938-91-8	279	9	51	58	397	09;50;55;45;06	09;15;39;45;59	09;55;39;10	9
Ethanol, 2,2'-iminobis-, N-coco alkyl derivs.	61791-31-9	144	45	48	149	386	50;55;09;41;59	09;50;55;15;59	9	9
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-, branched and linear	127036-24-2	295	6	3	55	359	02;59;09	9	59;09;39	09;50
Polyethylenglycoldioleat	9005-07-06	313	5			318	50;06;09;56;10	50;02;09;13;20		
Alcohols, C12-18, ethoxylated propoxylated	69227-21-0	68	46	25	178	317	09;50	9	9	09;55
Poly(oxy-1,2-ethanediyl), .alpha.-(2-ethylhexyl)-.omega.-hydroxy-	26468-86-0	220	6	39	46	311	09;55	09;61	9	9
Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-	3055-94-5	295		1	12	308	09;50			9
Alcohols, C12-18, ethoxylated	68213-23-0	68	67	34	138	307	09;50;55;11;39	50;09;39;56;61	9	9
Alcohols, C11-15-secondary, ethoxylated	68131-40-8	149	1	9	137	296	50;09;55;39;45	09;45;50;59		09;50;55
Alcohols, C16-18, ethoxylated	68439-49-6	139	62	44	43	288	09;50;61;55;02	50;10;35;39;09	09;13;59	09;55
Alcohols, C13-15-branched and linear, ethoxylated, propoxylated	111905-54-5	8	145	98	31	282	09;47;50;61	50;09	9	9
Glycerides, C16-18 mono- and di-	85251-77-0	258				258	50			
Amides, coco, N-(hydroxyethyl), ethoxylated	68425-44-5	224	11	8	9	252	50;09;10;59	10;39;59	59	59;09
Oxirane, methyl-, polymer with oxirane, monobutyl ether	9038-95-3	98	85		49	232	50;35;55;09;43	09;35;49;45;47		9
Amides, coco, N,N-bis(hydroxyethyl)-	68603-42-9	117	58	26	28	229	09;50;55;61;35	50;09;15;39;61	9	55;09;61
Poly(oxy-1,2-ethanediyl), .alpha.-(1-oxo-9-octadecenyl)-.omega.-hydroxy-, (Z)-	9004-96-0	213	6			219	50;06;35;56;09	50;02;05;06;09		

Poly(oxy-1,2-ethanediyl), .alpha.-decyl-.omega.-hydroxy-	26183-52-8	173	22	6	12	213	09;55;38	09;50;59;61	9	9
Poly(oxy-1,2-ethanediyl), .alpha.-(nonylphenyl)-.omega.-hydroxy-, branched	68412-54-4	68	36	6	83	193	50;55;09;59;02	09;59;02;10;20	10;59	59;09;55
Fatty acids, tall-oil, reaction products with polyethylenepolyamines	68910-93-0	13	150		28	191	50			
Sorbitan, monododecanoate, poly(oxy-1,2-ethanediyl) derivs.	9005-64-5	92	87			179	50;55;38;34;09	59;20;13		
Poly(oxy-1,2-ethanediyl), .alpha.-(nonylphenyl)-.omega.-hydroxy-	9016-45-9	17	114		42	173	59;02;39;50;09	09;43;39;02;10		35;50;59;09;55
Poly(oxy-1,2-ethanediyl), .alpha.-9-octadecenyl-.omega.-hydroxy-, (Z)-	9004-98-2	71	13		82	166	50;56;38;10;55	35;59;09;10;39		10;56
Poly(oxy-1,2-ethanediyl), .alpha.-isodecyl-.omega.-hydroxy-	61827-42-7	49	88	15	13	165	50;09;17;61;39	09;17;39;50;59	9	09;55
Alcohols, C12-15, ethoxylated propoxylated	68551-13-3	53	69	7	19	148	09;47;50;11;55	09;59	9	09;55
Alcohols, C16-18 and C18-unsatd., ethoxylated	68920-66-1	90	30	1	17	138	56;55;02;09;10	50;35;02;09;10	13;20	55;09;35
Alcohols, C8-10, ethoxylated propoxylated	68603-25-8	81	5	4	39	129	47;50;09;61	9		09;59
Alcohols, C8-10-alkyl, ethoxylated propoxylated, benzyl ether	68154-99-4	71	7	1	40	119	47;50;09	50;09	9	9
3,6,9,12,15,18,21,24,27-Nonaoxanonatriacontan-1-ol	3055-99-0	103			13	116	9			9
Dodecanoic acid, methyl ester	111-82-0	68	1	1	40	110	55;09	09;13	09;13	9
Poly(oxy-1,2-ethanediyl), .alpha.-[(1,1,3,3-tetramethylbutyl)phenyl]-.omega.-hydroxy-	9036-19-5	94	14		2	110	50;02;59;09;20	59;50;61;02;09		50
1,3-Propanediamine, N-(3-aminopropyl)-N-dodecyl-	2372-82-9	49	24	4	23	100	39;09	09;39	39	39;09
Fatty acids, C14-18 and C16-18-unsatd., ethoxylated propoxylated	68154-27-8	97				97	50			
Poly(oxy-1,2-ethanediyl), .alpha.,.alpha.'-[(9-octadecenylimino)di-2,1-ethanediyl]bis[.omega.-hydroxy-, (Z)-	26635-93-8	38	9	15	22	84	50;61;09;55	09;59;61	09;61	48;09
Alcohols, C16-18, ethoxylated propoxylated	68002-96-0	65	4	2		71	50;56	50		
Amines, C12-14-tert-alkyl, ethoxylated propoxylated	68603-58-7	57	2			59	09;30;35	9		
Poly(oxy-1,2-ethanediyl), .alpha.-2-propenyl-.omega.-hydroxy-	27274-31-3	29	1	28		58	50;55;02;59;61	02;13;39;43;55	39;59	
Alcohols, C11-14-iso-, C13-rich, ethoxylated	78330-21-9	26	22	9	0,1	57,1	50;02;09;55;59	50;09;55;59;61	09;59	9
Lanolin, ethoxylated	61790-81-6	5	52			57	55;09;39;41	39;09		
Castor oil, hydrogenated, ethoxylated	61788-85-0	38	17	1		56	50;61;55;01;09	39;59	39;59;09	
Aziridine, polymer with methyloxirane	31974-35-3			55		55				
D-Glucoside, decyl	54549-25-6	39	6	4	4	53	09;50;41	9		9

Alcohols, C6-12, ethoxylated propoxylated	68937-66-6	41	1	8		50	50;09		59	
Amines, coco alkyl, ethoxylated	61791-14-8	16	16	6	11	49	50;09;39;55;59	50;09;39;59;61		9
Siloxanes and Silicones, di-Me, 3-hydroxypropyl Me, ethoxylated	68937-54-2	36	5	5		46	55;50;59;45	50;02;13;39;43	39;59	
Octadecanoic acid, 1,2-ethanediyl ester	627-83-8	28	6			34	50;55	50		
Poly(oxy-1,2-ethanediyl), .alpha.,.alpha.'-[1,4-dimethyl-1,4-bis(2-methylpropyl)-2-butyne-1,4-diyl]bis[.omega.-hydroxy-	9014-85-1	22	1		7	30	50;61;45;59;02	09;13;39;45;55		50
Sorbitan, monooctadecanoate, poly(oxy-1,2-ethanediyl) derivs.	9005-67-8	20	1			21	50	09;59		
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-(1-oxo-9-octadecenyl)-.omega.-butoxy-, (Z)-	37281-78-0	16	1	1		18	50;59	02;20;59	13;20	
Alcohols, C11-15-secondary, ethoxylated propoxylated	68551-14-4	11				11	50			
Amphoteric surfactants:										
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs., hydroxides, inner salts	61789-40-0	620	308	379	279	1586	50;55;09;61;41	50;55;09;39;15	09;10;22	50;09;55
Lecithins	8002-43-5	586	29	692		1307	50;55;59;10;26	55;31;45;39;59	59;10;14;39;20	
Amines, C10-16-alkyldimethyl, N-oxides	70592-80-2	301	30	142	102	575				
1-Dodecanamine, N,N-dimethyl-, N-oxide	1643-20-5	213	14	63	10	300	09;50;55;39	09;39	09;39	9
Amines, coco alkyldimethyl, oxides	61788-90-7	123	10	7	72	212	50;09;39	09;39;59	09;39;59	09;39
1-Tetradecanamine, N,N-dimethyl-, N-oxide	3332-27-2	31	4	16	57	108	09;50;55	9	9	9
Imidazolium compounds, 1-[2-(2-carboxyethoxy)ethyl]-1(or 3)-(2-carboxyethyl)-4,5-dihydro-2-norcoco alkyl, hydroxides, disodium salts	68604-71-7	12	75	2	11	100	09;50	50;09;55;61	9	9
Glycine, N-methyl-N-(1-oxododecyl)-, sodium salt	137-16-6	38	1	1	4	44	55;50;09	09;39;55	09;39	9
Cationic surfactants:										
Fatty acids, C10-20 and C16-18-unsatd., reaction products with triethanolamine, di-Me sulfate-quaternized	91995-81-2	1274	1211		57	2542	47;50;07;09;55	47;50;09		9
Quaternary ammonium compounds, bis(hydrogenated tallow alkyl)dimethyl, chlorides, reaction products with bentonite	68953-58-2	151	95	1432	12	1690	52;14;59;20;35	45;59;14;39;31	59;14;39;25;09	14
Quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	68424-85-1	196	350	110	118	774	39;50;09;55;17	09;39;61	14;39;09	39;09
Quaternary ammonium compounds, coco alkylbis(2-hydroxyethyl)methyl, ethoxylated, chlorides	61791-10-4	165	24	32	33	254	09;61;55	09;61	9	9
Quaternary ammonium compounds, coco alkyl(hydroxyethyl)dimethyl, ethoxylated, chlorides	863679-20-3	206	2	25	9	242	09;55	9	9	9
1-Decanaminium, N-decyl-N,N-dimethyl-, chloride	7173-51-5	50	20	28	56	154	39;09;10;36;59	39;09;47;59	39;09;10	39;09

1-Tetradecanaminium, N,N,N-trimethyl-, bromide	1119-97-7		107			107		39		
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	6	66	1	16	89	39;09;55	39;09	39;09	09;39;35
Quaternary ammonium compounds, benzyl-C12-14-alkyldimethyl, chlorides	85409-22-9	6	72	4	2	84	39;09	39;09	39	9
Quaternary ammonium compounds, benzylcoco alkyldimethyl, chlorides	61789-71-7	69	4	4	6	83	39;55;09;47	39;09	39	09;39
Quaternary ammonium compounds, benzyl-C8-18-alkyldimethyl, chlorides	63449-41-2	5	43	2	10	60	09;39	39;09	39	39
1-Hexadecanaminium, N,N,N-trimethyl-, chloride	112-02-7	21			6	27	50;55;10;41			
Benzenemethanaminium, N-dodecyl-N,N-dimethyl-, chloride	139-07-1	4	16		5	25	09;39	39;09		39
Quarternary ammonium compounds, alkylbenzyldimethyl, chlorides	8001-54-5	8	16	1		25	39;09	39;09;61		