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Mapping and environmental assessment of cleaning products for outdoor use

Survey of chemical substances in consumer products
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Authors:
Anne Rathmann Pedersen, DHI (projektleder)
Michelle Christiansen, DHI
Dorte Rasmussen, DHI
Jens Tørsløv, DHI
Martin Karkov Kristensen, TI
Sara Kobbelgaard, TI

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Content

1. Preface

Mapping and environmental assessment of cleaning products for outdoor use

This project maps products for outdoor cleaning sold to private consumers. The focus of the project is surfactants with a cleaning effect, but which are also identified as biocidal active substances. Based on an analysis of the product labels, products have been selected for chemical analysis of selected surfactants and an environmental risk assessment has been carried out for the use of representative products within the product categories: Tile cleaner, wood wash, roof cleaner and boat cleaner.

This report presents the results of the mapping, the product declaration analysis, the chemical analyses, and the environmental risk assessment. The chemical analyses of two surfactants, alkyldimethylbenzylammonium chloride (ADBAC) and didecyldimethylammonium chloride (DDAC), have been carried out for a total of 20 products. The environmental risk assessment has been carried out for the use of products with ADBAC for tile cleaning and for products with DDAC for wood washing. In addition, environmental risk assessment has been carried out for the use of products with alkyldimethylamine oxide (ADAO) for roof cleaning and for products with cocamidopropyl betaine for boat cleaning.

The project was carried out by DHI A/S (DHI) with the Danish Technological Institute (TI) as subcontractor for the chemical analyses.

Project participants:
- Anne Rathmann Pedersen, DHI (Project Manager)
- Michelle Christiansen, DHI
- Dorte Rasmussen, DHI
- Jens Tørsløv, DHI
- Martin Karkov Kristensen, TI
- Sara Kobbelgaard, TI

The project was followed by the Danish Environmental Protection Agency represented by:
- Nadine Heidi Nepper-Rasmussen
- Peter Juhl Nielsen
- Nina Falk Gregersen
- Dorrit Skals

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2. Summary and conclusions

The aim of the project is to contribute with knowledge about the ingredients of cleaning products for outdoor use and their potential risk to the environment. This knowledge will be used to assess whether the products should be handled differently in legislation and will contribute to advising consumers on limiting emissions to the environment and seepage into groundwater.

The content of the project is a mapping of cleaning products for outdoor use, including a mapping of the substances contained in the products. The focus is particularly on surfactants, some of which are biocidal active substances. Selected products are analysed for biocidal content and an environmental risk assessment is carried out to clarify whether concentrations in use scenarios pose an unacceptable environmental risk.

2.1 Mapping

The mapping includes outdoor cleaning products sold to private consumers and covers applications for tile cleaning, wood washing, roof cleaning and boat cleaning.
The mapping of products available to private consumers either via in retail in Denmark or through online purchase in the EU and outside the EU via websites in Denmark has been carried out through a screening and includes:

- relevant Danish retail chains and special suppliers of cleaning products to private consumers who sell via their websites
- a web search for European retailers selling via their website to private consumers
- a Google search of keywords like "Outdoor Cleaning", "Patio Cleaning", "Boatwash", etc.

A total of 128 products have been found, of which 80 have been found on Danish websites, 37 on EU websites and 11 products have been found on websites outside the EU. Among the identified products, 44 products have been selected for declaration analysis and mapping of ingredients. The products have been selected in consultation with the Danish Environmental Protection Agency and represent the four categories: tile cleaning, wood washing, roof cleaning and boat cleaning.

The result of the mapping of ingredients in cleaning products for outdoor use is summarised in a gross list of ingredients identified in the 44 selected products. The list contains a wide range of surfactants as well as substances used as biocidal active substances according to information on ECHA's website (ECHA 2022).

Four different surfactants have been identified and also registered as biocidal active substances under the Biocidal Products Regulation (Regulation (EU) No 528/2012). There are three different quaternary ammonium compounds (ADBAC (C12-C14), ADBAC (C12-C16), DDAC) and pelargonic acid (nonanic acid). While pelargonic acid is approved for use in disinfectants and algaecides (PT2), the three quaternary ammonium compounds are under approval.

2.2 Quantitative determination of specific ingredients in selected products

The quaternary ammonium compounds are present as surfactants in many of the outdoor cleaning products and have therefore been selected for analysis. 20 products have been selected and purchased for further analysis.

A quantitative analysis has been performed of the quaternary compounds represented by alkyl dimethylbenzylammonium chloride compounds (ADBAC C8-18, ADBAC C12-14 and ADBAC

C12-16) and didecyldimethylammonium chloride (DDAC). The results show that for 16 out of the 17 products, the stated presence of ADBAC ingredients can be confirmed. Analysis results confirmed the DDAC content for three products out of three products.

2.3 Environmental hazard assessment

Based on the mapping and quantitative analyses, the quaternary ammonium compounds ADBAC and DDAC have been selected for environmental hazard and risk assessment. In addition, two more substances have been selected, although these are not included in the analysis phase of the project. The substances are two surfactants: alkylamidopropyl betaine and alkyl dimethylamine oxide (ADAO), both of which belong to the amphoteric surfactants that can act both as acid and base. Both substances contain a positively charged nitrogen molecule on a par with the quaternary ammonium compounds.

The environmental hazard assessment consists of an environmental hazard profile based on readily available information and existing assessments. Sources of relevant assessments and data are ECHA's database of registered substances, biocidal risk assessment reports, EU risk assessment reports and other easily accessible data sources.

2.4 Exposure and risk assessment

The environmental risk assessment is carried out according to the principles of chemical safety assessment in REACH and follows relevant guidance from ECHA. For the use scenarios, typical values have been used for similar scenarios recommended for the calculation of environmental emissions of biocidal active substances. ECHA's chemical safety assessment tool Chesar has been used for the calculation of environmental exposure and risk assessment, while scenarios of direct release to the soil environment and local exposure to the soil environment have been carried out using a manual calculation, see Annex 5.

Outdoor use of cleaning agents is described for four different product categories: tile cleaner, wood wash, roof cleaner and boat cleaner. The environmental risk assessment is based on the result of the quantitative analysis as well as the suppliers' recommendations for use and dosage.

The environmental risk assessment shows that harmful environmental effects may occur locally from direct discharges to the soil environment and from discharges to the harbour environment from the use of cleaning agents for outdoor use.

- On the assumptions made, the environmental risk assessment for the use of ADBAC in tile cleaning products shows that a risk of effects in freshwater sediment cannot be excluded, while neither regional nor local risk in the aquatic environment or in agricultural land is expected.
- The use of DDAC for washing wooden surfaces where the washing water flows to an underlying unsealed area, the environmental risk assessment shows that a risk of adverse effects on soil living organisms cannot be excluded for the local exposure to the soil environment.
- The environmental risk assessment shows that direct discharge to the soil environment using ADAO for roof cleaning cannot exclude a risk of local effects on the environment. No risk in the environment is expected from the use of ADAO for roof cleaning if the washing water is led to sewers and subsequently to treatment plants.
- The result of the environmental risk assessment of the use of cocoamidopropyl betaine in boat cleaners, with the assumptions made, shows that local exposure to the marine water in the harbour basin cannot exclude a risk of local effects on the harbour environment.
- The result of the environmental risk assessment of local exposure to the soil environment from the remaining 17 products containing ADBAC or DDAC shows a risk of local environmental effects from seven wood washing products and five roof washing products. Two tile cleaning products and three wood washing products are not expected to pose a risk to the environment.

3. Abbreviations

ADAO	Alkyldimethylamine oxide
ADBAC	Alkyldimethylbenzylammonium chloride
BKC	Benzalkonium chloride
DAD	Diode Array Detection
DDAC	Didecyldimethylammonium chloride
EC_{10}	Effect Concentration, 10% of exposed individuals are affected
EC_{50}	Effect Concentration, 50% of exposed individuals are affected
ECHA	European Chemicals Agency
ED	Endocrine Disruptor
ELSD	Evaporative Light Scattering Detector
EqP	Equilibrium Partitioning
EU	The European Union
HPLC	High Performance Liquid Chromatography
LAR	Local rainwater drainage
LC-MS	Liquid chromatography–mass spectrometry
LOQ	Limit of Quantification
NOEC	No Effect Concentration
PEC	Predicted Environmental Concentration
PNEC	Predicted No Effect Concentration
RCR	Risk Characterisation Ratio
SDS	Safety Date Sheet
STP	Sewage Treatment Plant, wastewater treatment plant
UF	Uncertainty Factor

4. Introduction

The Danish Environmental Protection Agency wants to obtain knowledge about ingredients in cleaning products and their potential risk in the environment to assess whether the products should be addressed differently in legislation. For outdoor cleaning products sold to private consumers, particular attention is paid to surfactants that have a cleaning effect, but some of which also are biocidal active substances.

4.1 Background

Products containing surfactants are sold to consumers and professionals to be used for outdoor cleaning of woodwork, tiles, roofs, etc. It is assumed that exposure to the environment is high, as the products are used outdoors often on large areas and without being collected. As a result, it is relevant to know whether the products pose a risk to the environment.

Some of the surfactants are also biocidal active substances. If the products are placed on the market for the control of algae, they are biocidal products and must be approved in accordance with the Biocidal Products Regulation or the Danish Pesticide Executive Order. Many products are only marketed for cleaning of outdoor materials and – as a rule – they do not have to comply with the biocidal rules but meet the requirements of the regulation on detergents as well as the regulation on chemicals and any other relevant legislation.

There is strong political focus on outdoor cleaning products, and the background for this project is to contribute with knowledge that can be used to draw up future regulation of outdoor cleaning products.

4.2 Purpose

The purpose of the project is to contribute with knowledge about the ingredients in outdoor cleaning products and their potential risk to the environment. This knowledge will be used to assess whether it is necessary to change the regulation of these products and will provide an improved background for information to consumers to limit discharges into the environment.

The aim is to study the market for outdoor cleaning products and to assess any environmental risks associated with the use of the products. The scope of the project is to map outdoor cleaning products, including mapping of substances contained in the products. The focus is on surfactants with a cleaning effect, but which are also biocidal active substances. Selected products are analysed for biocidal active substances and an environmental risk assessment is carried out to clarify whether the concentrations in the use scenarios could pose an unacceptable environmental risk.

4.3 Legislation

Generally, ingredients in cleaning products are subject to the REACH Regulation (Regulation (EU) No 1907/2006 on Registration, Evaluation, Authorisation and Restriction of Chemicals) and the CLP Regulation (Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging).

Relevant legislation for outdoor cleaning products is the Regulation on Detergents (Regulation (EU) No 648/2004). In addition, products must comply with the Biocidal Products Regulation (Regulation (EU) No 528/2012) if they are placed on the market for the control of algae.

The Regulation on Detergents lays down requirements for the surfactants that may be used and requirements for the declaration of ingredients. For instance, only surfactants that have been shown to be readily biodegradable in screening tests such as OECD 301 A-F may be used.

The Biocidal Products Regulation requires authorisation of biocidal substances as well as authorisation of the products within their specific area of use, known as the product type. Control of algae is a use that may only be claimed by biocidal products containing biocidal active substances that are authorised for use in product type 2 under the Biocidal Products Regulation. The Danish pesticide executive order (Executive Order no. 1569 of 19/12/2022 valid at the time of product purchases) requires that certain uses that are not yet to be approved under the Biocidal Products Regulation must be approved in accordance with the rules in the pesticides executive order. This applies, for example, to products to control algae growth.

4.4 Delimitation

The mapping includes outdoor cleaning products sold to private consumers. The use of the detergents primarily covers tile cleaning, wood washing, roof cleaner and boat cleaner. Many products have multiple uses beyond the product categories mentioned. Products with at least one of the mentioned uses are included in the mapping. The survey covers products on the Danish market and the remaining EU market as well as products that can be purchased from Denmark via websites from countries outside the EU.

Products registered as biocidal products such as algae repellent agents are not included in the mapping. However, by a mistake a single product approved as a biocidal product has been included.

5. Mapping and selection of products

The first phase of the project, which consists of a mapping of cleaning products for outdoor use, will provide information on substances found in outdoor cleaning products marketed for private consumers. Based on the mapping, products are selected for quantitative analysis of the content of selected surfactants. The focus is on surfactants with a cleaning effect, but some of which are also biocidal active substances.

5.1 Approach

5.1.1 Screening of products on the market

A screening has been carried out to map products available to private consumers through retail outlets or for online purchase in the EU and outside the EU via websites in Denmark.

The screening of Danish products includes relevant Danish retail chains and special suppliers of cleaning products for private consumers for sale via their websites. It is assumed that the suppliers' offers in store are in accordance with their website offerings. A broad Google search has been made for "wood wash", "roof cleaner", "tile cleaner", "boat cleaner" on its own and/or in combination with "outdoor". Distributors of relevant products have been identified and the retail chains or retail websites have been examined for available cleaning products for outdoor use.

The screening of EU products has been carried out by searching online for European retailers who sell via their website to private consumers. A thorough Google search has been made for "outdoor cleaning", "patio cleaning", "boat wash", etc. In addition, retail chains located in neighbouring regions to Denmark have been in focus, such as Sweden, Germany, and Poland, as the proximity close to Denmark is considered attractive to private consumers in Denmark. The websites of the identified retail chains and retailers have been reviewed for available outdoor cleaning products.

Screening of products from outside the EU is done by Google web searches via keywords such as "outdoor cleaning", "patio cleaning", "boat wash", etc. Broad searches have been made on the web and on websites that offer these products including retail chains, websites for certain brands and well-known websites that offer a wide selection of products. Products from the UK, which is no longer part of the EU, are considered EU products in this project, as the UK has had the same requirements as the EU until 2021 and the UK legislation is similar to the European one.

In general, an approach which a private consumer would typically use has been followed and websites not in Danish have not been translated. This means that products described in for instance Chinese are not covered, as the private consumer is not expected to understand the use of the product. The screening only covers websites in Danish, Swedish, German or English. Products targeted at professional users are included if they are available and can be purchased by private individuals without the use of a CVR (Danish VAT) number.

Reviews of the products offered in Denmark and other EU countries have been carried out with a view to identifying cleaning products for outdoor use and to eliminating approved biocidal products.

5.1.2 Analysis of product declaration

The mapping of ingredients in cleaning products for outdoor use has been carried out as an analysis of the product declaration on a selection of the products found in the screening. The product declaration analysis includes information on the product label, text on the website and the product safety data sheet.

About 40 of the identified products have been selected for product declaration analysis and mapping of ingredients. The products have been selected jointly with the Danish Environmental Protection Agency and represent the four categories: tile cleaner, wood wash, roof cleaner and boat cleaner. Furthermore, an attempt has been made to choose products representing 50% from Danish suppliers, 25% from EU suppliers and 25% from suppliers outside the EU.

For the selected products, the product label information and product safety data sheet are obtained via the websites or directly from the supplier.

Based on the analysis of the obtained product labels, a list of ingredients has been drawn up. The list has been reviewed, and the surfactants and the preservatives are identified to the extent that information has been available.

It has been investigated whether the substances found in the selected cleaning products are biocidal active substances and whether these are: approved, under approval, previously approved, or not approved under the Biocidal Products Regulation ((EU) No 528/2012). The status of biocidal active substance has been examined for all surfactants with a CAS number. The biocidal active substance status is examined based on available information on ECHA's website (ECHA 2022) in the biocidal product database for the following biocidal product types:

- PT2 (Disinfectants and algaecides not intended for direct application to humans or animals),
- PT6 (Preservatives for products during storage),
- PT7 (Film preservatives),
- PT8 (Wood preservatives),
- PT9 (Fibre, leather, rubber and polymerised materials preservatives),
- PT10 (Construction material preservatives),
- PT12 (Slimicides) and
- PT21 (Antifouling products).

This means that if an active substance is approved, under approval, previously approved, or not approved under the Biocidal Products Regulation in product types other than those mentioned above, such information will not be included in the report.

5.1.3 Selection of products for chemical analysis

To assess the environmental risk of the use of outdoor cleaning products, products have been selected for chemical analysis based on the results of the product declaration analysis.

In consultation with the Danish Environmental Protection Agency, products representing different application scenarios (tile cleaner, wood wash, roof cleaner and all-purpose cleaner) and various markets have been selected, so that at least 25% of the products are from EU suppliers and at least 10% are from non-EU suppliers. Many non-EU products that could be found via websites were not available for sale to Denmark. Consequently, it was not possible to let products from outside the EU account for 25% of all purchased products. In the choice of products, the analysis programme has been put together with the purpose of analysing as many products as possible within the project budget.

In the choice of products for analysis, the focus is on the content of surfactants with a cleaning effect, but which are also biocidal active substances.

5.2 Results

5.2.1 Products on the market

The result of the screening of products on the market is a list of names of identified outdoor cleaning products, indicating their area of use, product category and supplier. A distinction has been made between the product categories tile cleaner, wood wash, roof cleaner and boat cleaner, and further uses are noted such as patio washing, masonry cleaners, facade cleaning, mould and algae remover. Some products are useful for several types of surfaces and are therefore referred to as all-purpose cleaners in this project. It is also stated whether the products are sold in Denmark, the EU or outside the EU. The list of products forms the basis for further work in the project but is not included in this report for reasons of confidentiality.

A total of 128 products have been found, of which 80 have been identified on Danish websites, 37 on EU websites and 11 products have been identified on websites outside the EU.

There are 42 products that can be used for tile cleaning, 43 products for wood washing, 24 products for roof cleaning and 27 products for boat cleaning. In addition, 29 products can be used for masonry and facade cleaning. For another 7 products, other uses than the above are indicated, such as mould remover or algae remover.

The result of the screening and the used approach, including restrictions on language and the possibility of sales to Denmark, shows a limited number of markets and products. The number of products from the EU (outside Denmark) has been limited to products from Sweden and Germany, and products from outside the EU have been found to be available only in the US. On several American websites it appears that the products are not sold to Denmark, or it is not possible to order the product unless you have an address in the United States.

Concerning products from Sweden and Germany, it turns out that although the products are available on the website it is often not possible to buy the products for delivery in Denmark.

5.2.2 Analysis of product declaration

A total of 44 products were included in the analysis of product declaration. Table 21 in Appendix 1 gives an overview of the information available from the websites and the safety data sheet for each product. However, information available through the product labelling based on images on the website is varied and limited.

The result of the mapping of ingredients in outdoor cleaning products, shown in Table 1, is a gross list of ingredients identified in the 44 selected outdoor cleaning products and representing the product categories wood wash, roof cleaner, tile cleaner and boat cleaner. The identified substances are listed in the safety data sheet, either because they are classified or included based on the Regulation on Detergents (Regulation (EU) No 648/2004). As far as possible, the name and CAS number of the identified ingredients have been indicated.

The list contains a wide range of surfactants as well as substances used as biocidal active substances according to information on ECHA's website (ECHA 2022).

Table 1. Ingredients identified in outdoor cleaning products. Result of the analysis of product labels covering a total of 44 products.

Substance name	CAS No.
Anionic surfactants	
Non-ionic surfactants	
Amphoteric surfactants	
Cationic surfactants	
Surfactant Blend	
(2-methoxymethylethoxy)propanol	34590-94-8
1,2-Propylene glycol	57-55-6
2-(2-butoxyethoxy)/2-(2-butoxyethoxy) ethanol	112-34-5
2-ethylhexanol polyglycol ether phosphoric acid ester, sodium salt	111798-26-6
2-methylisothiazol-3(2H)-one	2682-20-4
2-octyl-2H-isothiazol-3-on	26530-20-1
3-Iodo-2-propynyl butylcarbamat	55406-53-6
Acetone	67-64-1
Alanine, N,N-bis(carboxymethyl)-,trisodium salt,	164462-16-2
Alcohol	
Alcohol ethoxylate C10-18	
Alcohols C12-14, ethoxylated, 7-14 EO	68439-50-9
Alcohols, C9-11_ethoxylated	68439-46-3
Alkyldimethylbenzylammonium chloride	68424-85-1
Alkyldimethylbenzylammoniumchloride	85409-22-9
alkylimidazoliniumcarboxylat	68604-71-7
Alkylpolyglycoside	68515-73-1
Alkylpolyglykoside C10-16	110615-47-9
Amines, C12-14-alkyldimethyl, N-oxides	308062-28-4
Benzensulfonsyra, 4-C10-13-sek-alkylderivat	85536-14-7
Benzalkonium chloride	63449-41-2
Benzenesulfonic, acid,1-methylethyl,-,sodium,salt	28348-53-0
Benzisothiazolinone	
Benzyl salicylate	118-58-1
Benzyl alcohol	100-51-6
Betaines, coconut-alkyldimethyl-	67424-94-2
C18-unsatd., N,N-bis (hydroxyethyl)	68155-07-7
Calcium hypochlorite	7778-54-3
Cellulose Gum	
Citric acid	77-92-9
Cocamide DEA	
Cocamidopropyl betaine	61789-40-0
Dialkyldimethyl ammonium chloride	
Didecyldimethylammonium chloride	7173-51-5
Dinatriummetasilicate	10213-79-3
Dodecyldimethylaminoxide	1643-20-5
Fragrances	
EDTA	64-02-8
Ethanol	64-17-5
Ethoxylated alcohol	

Fatty alcohol ethoxylate (Alcohols, C13, branched, ethoxylated)	69011-36-5
Fettalkohol (C10)-polyethylenglycol (5 EO)-ether	26183-52-8
Glucoside	161074-93-7
Glutaral	
Hexyl D-glucoside	54549-24-5
Hydrogen Peroxide	
Isopropanol	67-63-0
Isotridecanolethoxylat	61827-42-7
Potassium carbonate	584-08-7
Potassium hydroxide	1310-58-3
Potassium silicate	1312-76-1
Hydrocarbons C10-C13, n-alkanes,isoalkanes, cyclic, <2% aromatics	918-481-9
Lactic acid	79-33-4
Metasilicate de disodium	6834-92-0
Myristyl alcohol	
Natriumalkyl(C12-14)ethersulfat, ethoxyleret	68891-38-3
Sodium carbonate	497-19-8
Natriumglukonat	527-07-1
Natriumhexametaphosphat	68915-31-1
Natriumlaurylethersulfat	68585-34-2
Natriummetasilikat, pentahydrat	10213-79-3
Natriumsilikat	1344-09-8
Natriumtalgamfopolykarboxiglycinat	97659-53-5
n-butylacetat	123-86-4
Nichtionic surfactants, phosphonates	
Nitrilotriacetate de trisodium	5064-31-3
Nonansyre (pelargonsyre)	112-05-0
Oxalic acid dihydrate	6153-56-6
Oxalic acid	144-62-7
Oxiran, 2-methyl-, polymer med oxiran, mono (2-propylheptyl) ether	166736-08-9
Oxide (Coco fraction) dimethylamine	61788-90-7
Paraffin,oils,sulfochlorinated,saponif	68188-18-1
Phenoxyethanol	
Phosphorsyre	7664-38-2
PnB	5131-66-8
Poly(oxy-1,2-ethanediyl), α-(2-propylheptyl)-ω-hydroxy	160875-66-1
Quaternary C12-14 alkyl methyl amine ethoxylate methyl chloride	1554325-20-0
Hydrochloric acid	7647-01-0
Sodium chloride	
Sodium Hydroxide	1310-73-2
Sodium hypochlorite	7681-52-9
Sodium laureth sulfate	
Sorbic acid	
Sulfamid acid	5329-14-6
Sulfonic acids, C14-17-sec-alkanes, sodium salts	97489-15-1
Terpen alcohols	94266-48-5
tetranatrium-N,Nbis(carboxylatomethyl)-Lglutamat	51981-21-6
Tetrapotassium pyrophosphate	7320-34-5

Tetrasodium Glutamate Diacetate	
Triethanolamine	102-71-6
Trimethyl-3[{-1-oxo-10-undecenyl) amino]propylammonium methyl sulphate	94313-91-4
Trisodium orthophosphate	7601-54-9
Wax	
β-Alanine, N-C8-18-alkyl derivs., monopotassium salts	90170-42-6

The result of the product declaration analysis is also shown as a list of surfactants with information on the biocidal active substance status (Table 2) and as a list of all biocidal active substances with information on biocidal active substance status (Table 3).

It has not been possible to determine the function of the surfactants as this is not indicated on the product label or in the safety data sheet. Surfactants are having a cleaning effect due to their simultaneous hydrophilic and hydrophobic properties, which help promoting surface wetting and release of dirt from surfaces. In addition, the surfactants may have other functions in the products such as emulsification or dispersion of the ingredients or they are added to control foaming. In particular, the cationic surfactants (surfactants with a positive charge) such as the quaternary ammonium compounds also have a disinfecting effect as they are toxic to algae and microorganisms (Madsen *et al*. 2000). As appears from the table below, four different surfactants have been identified which have also been registered as biocidal active substances under the Biocidal Products Regulation (Regulation (EU) No 528/2012). These include three different quaternary ammonium compounds (ADBAC (C12-C14), ADBAC (C12-C16), DDAC) and pelargonic acid.

While pelargonic acid is approved for use in disinfectants and algaecides (PT2), the three quaternary ammonium compounds are under approval.

The use of the three biocidal active substances ADBAC C12-14, ADBAC C12-16 and DDAC in PT2 products is still under evaluation in the EU under the regulatory framework of the Biocidal Products Regulation. As long as this use has not yet been fully assessed at EU level, the special Danish transitional rules apply to products claiming control of algae growth. This special Danish transitional rule states that products may only be placed on the Danish market if they have been approved by the Danish Environmental Protection Agency. To obtain such an approval, an application with data on the biocidal active substance and the biocidal product must be submitted to the Danish Environmental Protection Agency. Data required on the biocidal product are physico-chemical data, results of durability studies, validated analytical methods of the active substance and results of efficacy studies. The application is processed by the Danish Environmental Protection Agency and may take up to 18 months after submission of the application.

Table 2. Surfactants and their biocidal status

Surfactant	CAS No.	Biocide status[1, 2]
Alkyldimethylbenzylammonium chloride (ADBAC/BKC (C12-C16))	68424-85-1	Approved for use for PT8. Under approval for use for PT2 [3], PT10, and PT12.
Alkyldimethylbenzylammonium chloride (ADBAC (C12-C14))	85409-22-9	Under approval for use for PT2, PT10, and PT12.
Didecyldimethylammonium chloride (DDAC)	7173-51-5	Approved for use for PT8. Under approval for use in PT2, PT6, PT10 and PT12
Nonanoic acid (Pelargonic acid)	112-05-0	Approved for use for PT2. No longer approved for PT10.
Benzalkonium chloride	63449-41-2	Not biocidal active substance

Surfactant	CAS No.	Biocide status[1, 2]
Quaternary C12-14 alkyl methyl amine ethoxylate methyl chloride	1554325-20-0	Not biocidal active substance
Poly(oxy-1,2-ethanediyl), α-(2-propylheptyl)-ω-hydroxy	160875-66-1	Not biocidal active substance
Dodecyldimethylaminoxide	1643-20-5	Not biocidal active substance
Amines, C12-14-alkyldimethyl, N-oxides	308062-28-4	Not biocidal active substance
Cocamidopropyl betaine	61789-40-0	Not biocidal active substance
Isotridecanolethoxylate	61827-42-7	Not biocidal active substance
Paraffin,oils,sulfochlorinated,saponif	68188-18-1	Not biocidal active substance
Alcohols_C9-11_ethoxylated	68439-46-3	Not biocidal active substance
Natriumlaurylethersulfate	68585-34-2	Not biocidal active substance
Alkylimidazoliniumcarboxylate	68604-71-7	Not biocidal active substance
Fatty alcohol ethoxylate (Alcohols, C13, branched, ethoxylated)	69011-36-5	Not biocidal active substance
Benzensulfon acid, 4-C10-13-sek-alkylderivate	85536-14-7	Not biocidal active substance
β-Alanine, N-C8-18-alkyl derivs., monopotassium salts	90170-42-6	Not biocidal active substance
Alkylpolyglucoside C10-16	110615-47-9	Not biocidal active substance
Hexyl D-glucoside	54549-24-5	Not biocidal active substance
Natriumtalgamfopolykarboxiglycinat	97659-53-5	Not biocidal active substance
Natriumalkyl(C12-14)ethersulfate, ethoxyleret	68891-38-3	Not biocidal active substance
Coco-alkyldimethylamine oxide	61788-90-7	Not biocidal active substance
Alkylpolyglycosid	68515-73-1	Not biocidal active substance
Trimethyl-3[{-1-oxo-10-undecenyl) amino]propylammonium methyl sulphate	94313-91-4	Not biocidal active substance
Fettalkohol (C10)-polyethylenglycol (5 EO)-ether	26183-52-8	Not biocidal active substance
Alcohols C12-14, ethoxylated, 7-14 EO	68439-50-9	Not biocidal active substance
Sulfonic acids, C14-17-sec-alkanes, sodium salts	97489-15-1	Not biocidal active substance
C18-unsatd., N,N-bis (hydroxyethyl)	68155-07-7	Not biocidal active substance
Betaines, coconut-alkyldimethyl-	67424-94-2	Not biocidal active substance

[1] Biocide status, source: https://echa.europa.eu/da/information-on-chemicals/biocidal-active-substances/ (July 2022)

[2] Focus on the following product types (PT):

- PT2 (Disinfectants and algaecides not intended for direct application to humans or animals)
- PT6 (Preservatives for products during storage)
- PT7 (Film preservatives)
- PT8 (Wood preservatives)
- PT9 (Fibre, leather, rubber and polymerised materials preservatives)
- PT10 (Construction material preservatives)
- PT12 (Slimicides)
- PT21 (Antifouling products)

Source: https://echa.europa.eu/da/regulations/biocidal-products-regulation/product-types

[3] COMMISSION IMPLEMENTING REGULATION (EU) 2022/1991 states that didecyldimethylammonium chloride is officially authorised for use in biocidal products in product types 1 and 2 under BPR as of 1 February 2024.

Table 3. Biocidal active substances and their biocidal status

Biocidal active substance	CAS No.	Biocide status[1, 2]
Alkyldimethylbenzylammonium chloride (ADBAC/BKC (C12-16))	68424-85-1	Approved for use for PT8. Under approval for use for PT2, PT10, and PT12.
Didecyldimethylammonium chloride (DDAC)	7173-51-5	Approved for use for PT8. Under approval for PT2 [3], PT6, PT10 and PT12
Alkyldimethylbenzylammonium chloride (ADBAC (C12-C14))	85409-22-9	Under approval for use for PT2, PT10 and PT12.
Nonanoic acid (Pelargonic acid)	112-05-0	Approved for use for PT2. No longer approved for use for PT10.
2-octyl-2H-isothiazol-3-on (OIT)	26530-20-1	Approved for use for PT8. Under approval for use for PT6, PT7, PT9 and PT10
3-Iodo-2-propynyl butylcarbamat (IPBC)	55406-53-6	Approved for use for PT6 and PT8. Under approval for use for PT7, PT9, and PT 10.
Ethanol	64-17-5	Under approval for use for PT2 and PT6.
Isopropanol	67-63-0	Approved for use for PT2.
Citric acid	77-92-9	Approved for use for PT2. Approved Annex I active substance under the BPR, i.e. low toxicity and may be used for all product types.
Lactic acid	79-33-4	Approved for use for PT2. Under approval for use for PT6.
Terpen alcohols	94266-48-5	No longer approved for use for PT10.
Hydrochloric acid	7647-01-0	Approved for use for PT2.
Phenoxyethanol	-	Under approval for use for PT2. Application cancelled for PT6.
Benzisothiazolinone (BIT) [4]	-	Under approval for PT2, PT6, PT9, PT10 and PT12
Sorbic acid	-	Under approval for use for PT6.
Hydrogen Peroxide	-	Approved for use for PT2 and PT6. Under approval for use for PT12.
Benzyl alcohol	100-51-6	Under approval for use for PT6.
Glutaral	-	Approved for use for PT2, PT6 and PT12.
Calcium hypochlorite	7778-54-3	Approved for use for PT2.
Sodium hypochlorite	7681-52-9	Approved for use for PT2. Under approval for use for PT12.
2-methylisothiazol-3(2H)-one (MIT)	2682-20-4	Approved for use for PT12. Under approval for use for PT6.

[1] Biocide status, source: https://echa.europa.eu/da/information-on-chemicals/biocidal-active-substances/ (July 2022)

[2] Focus on the following product types (PT):

- PT2 (Disinfectants and algaecides not intended for direct application to humans or animals)
- PT6 (Preservatives for products during storage)
- PT7 (Film preservatives)
- PT8 (Wood preservatives)
- PT9 (Fibre, leather, rubber and polymerised materials preservatives)
- PT10 (Construction material preservatives)
- PT12 (Slimicides)
- PT21 (Antifouling products)

Source: https://echa.europa.eu/da/regulations/biocidal-products-regulation/product-types

[3] COMMISSION IMPLEMENTING REGULATION (EU) 2022/1991 states that Didecyldimethylammonium chloride is officially authorised for use in biocidal products in product types 1 and 2 under the BPR as of 1 February 2024.

[4] Assumes that it is 1,2-benzisothiazol-3(2H)-one, CAS No. 2634-33-5

5.2.3 Products selected for chemical analysis

Because quaternary ammonium compounds are present as surfactants in many outdoor cleaning agents, they have been selected for chemical analysis. 20 products have been selected for further analysis of the content of quaternary ammonium compounds. The quaternary compounds are represented by alkyldimethylbenzylammonium chloride compounds (ADBAC C8-18, ADBAC C12-14 and ADBAC C12-16) and didecyldimethylammonium chloride (DDAC).

The surfactants ADBAC C12-14, ADBAC C12-16 and DDAC are registered biocidal active substances, while ADBAC C8-18 is not registered as a biocidal active substance.

It has been a challenge to purchase products via European websites, either because of the method of payment or for delivery to an address in Denmark. Because it has not been possible to buy selected products through a Swedish website, the products were purchased directly from the Swedish retailer.

Furthermore, it has not been possible to import products from the United States even that they were available for purchase. A product registered by the US EPA as a pesticide was stopped at customs because the Danish regulations restrict the import of certain goods. We were not aware that the product was registered as a pesticide. Furthermore, a cleaning product for removal of algae was rejected with reference to import or shipping restrictions under the Global Shipping Program[1].

As a result, products from outside the EU are not included in the chemical analysis in the project.

Table 4 shows the list of products purchased for analysis, indicating the surface-active substance and concentration.

Table 4. Overview of selected and purchased products for analysis with indication of the primary use as well as the surface-active substance and concentration.

Product no.	DK/EU	Primary use	Surface-active substance	CAS No.	Concentration
7	DK	Tile	ADBAC	68424-85-1	5-10%
16	DK	Universal	ADBAC	68424-85-1	<3%
17	DK	Wood	DDAC	7173-51-5	<1.5%
21	DK	Wood	ADBAC	68424-85-1	10-21%
41	DK	Universal	ADBAC	68424-85-1	<2%
46	DK	Roof	ADBAC (C12-C14)	85409-22-9	5-10%
47	DK	Universal	ADBAC (C12-C16)	68424-85-1	1-5%
50	DK	Wood	ADBAC	68424-85-1	1-5%
52	DK	Tile	DDAC	7173-51-5	<1%
53	DK	Roof	ADBAC	68424-85-1	1-5%
55	DK	Wood	ADBAC	68424-85-1	<5%
67	DK	Roof	ADBAC	68424-85-1	<1%
68	DK	Roof	ADBAC	68424-85-1	40-60%
69	DK	Universal	ADBAC	68424-85-1	5-10%
70	DK	Roof	ADBAC	68424-85-1	40-60%
76	EU	Tile	DDAC	7173-51-5	5%

[1] Global Shipping Program is a service affiliated with eBay, which facilitates sales between countries globally

93	EU	Universal	ADBAC (C12-C16)	68424-85-1	5-10%
95	EU	Universal	ADBAC (C 8-18)	63449-41-2	1-2.5%
110	EU	Universal	ADBAC (C12-C16)	68424-85-1	4.95%
132	EU	Universal	ADBAC	68424-85-1	<2.5%

6. Quantitative determination of specific compounds in selected products

Twenty selected products were analysed for the content of seven specific compounds that all are quaternary ammonium compounds.

According to the knowledge obtained in connection with the survey of various outdoor detergents, a quantitative determination of seven specific compounds (see Table 5) was carried out. The quantitative determination was carried out either by means of HPLC-DAD, HPLC-ELSD, or LC-MS and compared with information obtained through the declaration analysis. The analysed content of selected products was used in the exposure and risk assessment of the selected products (see Chapter 8).

The specific quaternary ammonium compounds declared in the selected products appear in Table 4. Substance names with the designation ADBAC covers quaternary ammonium compounds with a hydrophobic alkyl chain of varying lengths (C8 to C18), and a benzyl group (see Figure 1). Three CAS numbers under the general term ADBAC exist in the selected products. CAS no. 63449-41-2 contains BAC-C8 to C18. CAS no. 68424-85-1 contains BAC-C12 to C16, whereas CAS no. 85409-22-9 contains BAC-C12 to C14. Six of the seven specific compounds that were quantified by liquid chromatography was BAC-C8 to C18 (see Table 5). If DDAC is declared on the label, then only one compound is present. DDAC contains two hydrophobic alkyl chains (see Figure 2).

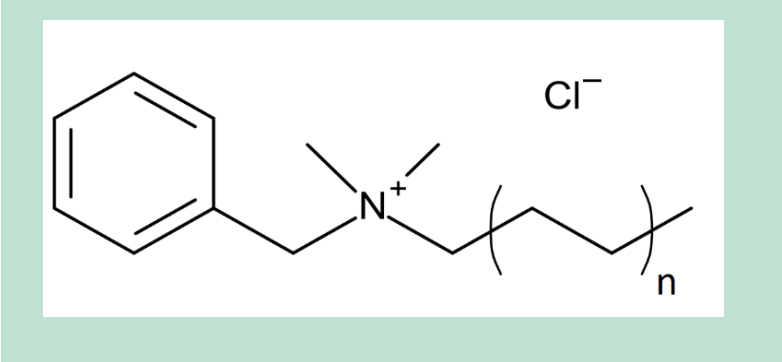


FIGURE 1: Chemical structure of BAC compounds (n = 3, 4, …, 8).

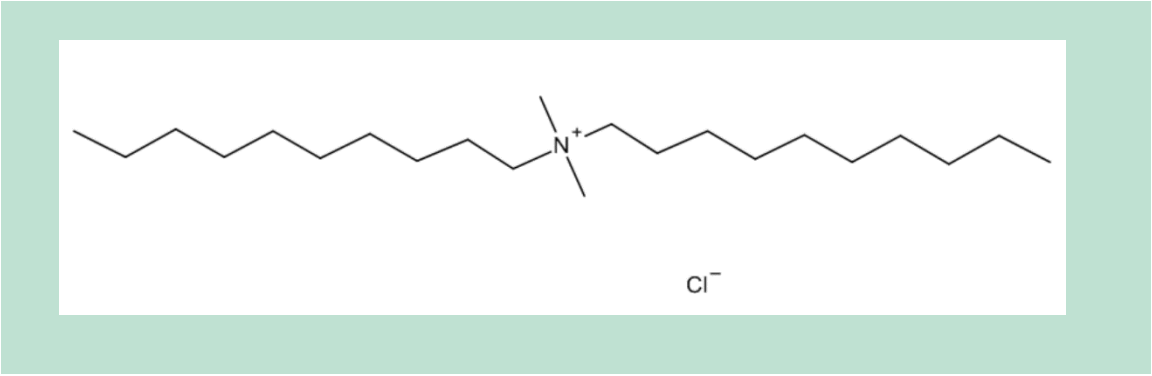


FIGURE 2: Chemical structure of DDAC (CAS No. 7173-51-5).

Table 5. Specific compounds quantified by liquid chromatography

Sub-stance no.	Constituent (synonym)*	CAS No.
1	Benzyldimethyloctylammonium chloride (BAC-C8), n = 3	959-55-7
2	Benzyldimethyldecylammonium chloride (BAC-C10), n = 4	965-32-2
3	Benzyldimethyldodecylammonium chloride (BAC-C12), n = 5	139-07-1
4	Benzyldimethyltetradecylammonium chloride (BAC-C14), n = 6	139-08-2
5	Benzyldimethylhexadecylammonium chloride (BAC-C16), n = 7	122-18-9
6	Benzyldimethyloctadecylammonium chloride (BAC-C18), n = 8	122-19-0
7	Didecyldimethylammonium chloride (DDAC)	7173-51-5

** "n" refers to the chemical structure as stated in Figure 2.*

6.1 Quantitative determination of BAC-C8 to C18

The specific mixtures of quaternary ammonium compounds of the type ADBAC that is present in the selected products can be quantified based on the CAS numbers presented in Table 5.

The analytical method for quantification of BAC-C8 to C18 is described in Appendix 2.1. The results presented in Appendix 3 and shown in

Table 7 are as a minimum determined based on two replicates for each product. The results confirm that 16 of the 17 products contain ADBAC compounds as stated on the label. The content of BAC-C8 to C18 in product no. 93 could not be confirmed.

The expanded uncertainty (k = 2) was calculated based on the spread of the analysis results and bias and was determined on two products, with five individual preparations. The bias was determined based on a recovery study, where subsamples of the product was spiked with a known amount BAC-C8 to C18. The uncertainty was between 3-19% depending on the concentration level and compound. The uncertainty was then extrapolated to the remaining calculations. Thereby, a 95% confidence interval concerning the analysis result of the product was determined. If the expanded uncertainty of the quantification of BAC-C8 to C18 is taken into account, then two products turned out to contain less ADBAC than what was given by the declaration analysis (see
Table 7, product no. 21 and 93), and one product contained more ADBAC than stated (see

Table 7, product no. 41).

If regard is given to the individual compounds in the various products with ADBAC, then the analysis results show that BAC-C12 (CAS no. 139-08-2) constitutes the main compound in the selected products. The relative content of BAC-C12 is app. 70-75%. In addition, the compound BAC-C14 is quantified and constitutes the remaining content of summed up ADBAC. The content of BAC-C8, -C10, -C16, and -C18 was lower than the quantification limit (LOQ) for all products.

6.2 Quantitative determination of DDAC

Three products had a declared content of DDAC (see Table 4) with the chemical structure as shown in Figure 2. The CAS no. for DDAC is 7173-51-5.

The applied method for quantification of DDAC are described in Appendix 2.2 and 2.3. The obtained results are presented in Appendix 3 and shown in Table 6 as an average of minimum duplicate determination for each product.

The analysis results confirmed the present of DDAC for all three products. For product no. 52 and 76 the analysed content was in accordance with the content stated in the declaration analysis. Based on the expanded uncertainty (k=2) of the analytical results, then product no. 17 contains more DDAC than the declared content (see Table 6).

Table 6. Analysis results (%w/w) for content of DDAC in purchased products.

Product no.	DDAC [w/w%]	Declared content
17	2.0	<1.5%
52	0.26	<1%
76	4.5	5%

Table 7. Analysis results (%w/w) of the individual ADBAC compounds in the purchased products.

Product no.	Content [%w/w]						Total content BAC-C12 to C14 [%w/w]	Declared content
	BAC-C8*	BAC-C10*	BAC-C12*	BAC-C14*	BAC-C16*	BAC-C18*		
7	< LOQ	< LOQ	5.6	2.0	< LOQ	< LOQ	7.6	5-10%
16	< LOQ	< LOQ	0.92	0.34	< LOQ	< LOQ	1.3	< 3%
21	< LOQ	< LOQ	5.6	2.0	< LOQ	< LOQ	7.6	10-21%
41	< LOQ	< LOQ	5.4	2.0	< LOQ	< LOQ	7.4	< 5% [2]
46	< LOQ	< LOQ	3.4	1.1	< LOQ	< LOQ	4.5	5-10%
47	< LOQ	< LOQ	0.76	0.28	< LOQ	< LOQ	1.0	1-5%
50	< LOQ	< LOQ	0.80	0.30	< LOQ	< LOQ	1.1	1-5%
53	< LOQ	< LOQ	0.87	0.32	< LOQ	< LOQ	1.2	1-5%
55	< LOQ	< LOQ	0.84	0.31	< LOQ	< LOQ	1.2	< 5%
67	< LOQ	< LOQ	3.4	1.1	< LOQ	< LOQ	4.5	< 5% [3]
68	< LOQ	< LOQ	32	11	< LOQ	< LOQ	43	40-60%
69	< LOQ	< LOQ	3.4	1.2	< LOQ	< LOQ	4.6	5-10%
70	< LOQ	<LOQ	33	11	< LOQ	< LOQ	44	40-60%

[2] SDS states content of <2%, while label states <5%

[3] SDS states <1%, while label states <5%

93	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	5-10%
95	< LOQ	< LOQ	1.7	0.56	< LOQ	< LOQ	2.3	1-2.5%
110	< LOQ	< LOQ	3.3	1.1	< LOQ	< LOQ	4.4	4.95%
132	< LOQ	< LOQ	1.7	0.58	< LOQ	< LOQ	2.3	< 2.5%

** "LOQ" refers to the content being below the quantification limit of the established method and sample preparation.*

7. Environmental hazard assessment

In the third phase of the project, an environmental hazard assessment of selected surfactants in outdoor cleaning products is carried out to assess whether the substances have potential hazards to the environment.

7.1 Substances selected for environmental hazard and risk assessment

The selected substances are surfactants that are also biocidal substances, and which have been selected for analysis in the first phase of the project. Based on the mapping, and as described in section 5.2.3, the quaternary ammonium compounds ADBAC and DDAC have been selected for chemical analysis and hazard and risk assessment. In addition, it has been decided to carry out environmental hazard and risk assessment of two more substances, even though these are not included in the chemical analyses. The two substances are based on the following criteria:

- Surface-active substances
- Identified in more than one outdoor cleaning product
- Identified by CAS number
- A concentration or concentration range is indicated for content in the product
- The substance is registered under REACH (for reasons of data availability).

Within this context, two surfactants have been selected, both belonging to the amphoteric surfactants, which are surfactants that can act as both acid and base. The selected substances, alkylamidopropyl betaine and alkyldimethylamine oxide (ADAO), contain a positively charged nitrogen molecule equal to the quaternary ammonium compounds.

Thus, four substances are selected for the environmental hazard and risk assessment:

ADBAC C12-16
DDAC
Cocamidopropyl betaine
ADAO, amines, C12-14-alkyldimethyl, N-oxides.

ADBAC may consist of different lengths of the alkyl chain. In this project focus is on ADBAC C12-16, which is the most used substance in the examined cleaning products according to information in the product safety data sheets (SDSs). Data for ADBAC C12-14 are also included in the environmental hazard assessment. In the REACH registration for the two substances, the same data set is used for environmental hazard, biodegradability and bioaccumulation since read-across of data for ADBAC C12-14 has been used for ADBAC C12-16.

7.2 Approach

The environmental hazard assessment includes an environmental hazard profile based on easily accessible information and existing assessments. Sources of relevant assessments and data are ECHA's database of registered substances, risk assessment reports on biocides, EU’s risk assessment reports and other easily accessible data sources such as the eChemPortal.

When possible, data assessed by the authorities have been used such as data from risk assessment reports for biocidal active substances under the Biocidal Products Regulation. Data in ECHA's database are not assessed by the authorities but based on assessments by the registrants.

The environmental hazard assessment follows ECHA's guidelines on risk assessment (ECHA 2022f).

The environmental hazard assessment consists of an assessment of the physicochemical properties and fate properties of the substances to determine which matrices are relevant to include in the risk assessment.

The degradability of the substances has been assessed based on environmental degradation data, including biodegradation, abiotic degradation (primarily hydrolysis) and atmospheric reactions. The potential for bioaccumulation and biomagnification is assessed from available BCF (bioconcentration factor) values and data on log K_{OW} (octanol-water partition coefficient).

The environmental hazard is assessed according to data on acute toxicity indicated as LC_{50}/EC_{50} values and according to chronic toxicity indicated as EC_{10} or NOEC values for aquatic life: algae, crustaceans and fish and other relevant organisms.

Predicted No Effect Concentrations (PNEC values) from existing assessments have been collected. When possible, PNEC values from risk assessment reports of biocidal active substances have been used. PNEC values from REACH registration dossiers were used if they were derived according to ECHA's guidance (ECHA 2022f) and exist for relevant matrices in the environment.

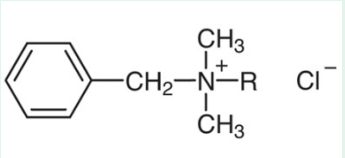
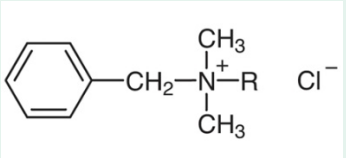
Information on the carcinogenic, mutagenic, reprotoxic (CMR) and endocrine disrupting (ED) properties of the substances has also been gathered and included in the environmental hazard assessment.

7.3 Environmental hazard profile of selected substances

Data for the four selected substances are collected and shown in Appendix 4. The environmental hazards are summarised for each substance in the tables below.

7.3.1 ADBAC

Table 8. Substance information and physicochemical properties of ADBAC.

Parameter	ADBAC (C12-14)	ADBAC (C12-16)	Reference
IUPAC name	Benzyl-C12-14-alkyldimethylammoniumchlorides	N-benzyl-N,N-dimethyltetradecan-1-aminium chloride	ECHA 2022
CAS No.	85409-22-9	68424-85-1	ECHA 2022
EC No.	939-350-2 / 287-089-1	935-232-5 / 270-325-2	ECHA 2022
Molecule structure	 where R represents C12-C14	 where R represents C12-16	TCI 2022
Chemical formula	C21 H38 CL1 N1	C12-14 H25-29-(CH_3)2-C6H5-N.Cl	ECHA 2022

Classification [4]	Acute Tox. 4, H302 (Harmful if swallowed) Skin Corr. 1B, H314 (Causes severe skin burns and eye damage) Eye Dam. 1, H318 (Causes serious eye damage) Aquatic Acute 1, H400 (Very toxic to aquatic life) Aquatic Chronic 1, H410 (Very toxic to aquatic life with long lasting effects)	Acute Tox. 4, H302 (Harmful if swallowed) Skin Corr. 1B, H314 (Causes severe skin burns and eye damage) Eye Dam. 1, H318 (Causes serious eye damage) Aquatic Acute 1, H400 (Very toxic to aquatic life) Aquatic Chronic 1, H410 (Very toxic to aquatic life with long lasting effects)	ECHA 2022
Biocide status	Under approval for use for PT2, PT10, and PT12	Approved for use for PT8. Under approval for use for PT2, PT10, and PT12 [5]	ECHA 2022
Water solubility	409 - 455 g/L (10 - 20°C)	810 mg/L (20°C)	ECHA 2022
Vapour pressure	0,002 Pa (20 - 25 °C)	0.006 Pa (25 °C)	ECHA 2022
Melting point	28,9 °C	28,9 °C	ECHA 2022
Boiling point	102 °C	> 180 °C	ECHA 2022
Log K_{OW}	2,75 (20 °C)[6]	2,75 (20 °C)[7]	ECHA 2022
Log K_{OC}	5.8 -6.8 (0.1 - 2% organic carbon)	6,2 (20 °C)	ECHA 2022
Kd (at 2%OC)	$3.2*10^4$ L/kg	$3.2*10^4$ L/kg	ECHA 2022
Distribution in the environment	Strong binding to sludge, soil and sediment		ECHA 2022a, 2022b
Aquatic toxicity (See 04)	Acute, aquatic environment lowest EC_{50} <0.1 mg/L Chronic, aquatic environment lowest EC_{10} <0,01 mg/L		ECHA 2022a, 2022b, 2022i
Terrestrial toxicity (See 04)	Acute, soil environment lowest EC 50/LC_{50}<1000 mg/kg soil dry weight Chronic, soil environment lowest EC 10/LC_{10}<1000 mg/kg soil dry weight		ECHA 2022a, 2022b, 2022i
Biodegradability	Readily biodegradable		ECHA 2022a, 2022b
Half-life in soil	17 days [8]		ECHA 2022
Bioaccumulation	No or low potential		ECHA 2022a, 2022b

ADBAC binds strongly to sediment and soil due to its positive charge and is therefore not mobile in soil (ECHA 2022a, ECHA 2022b, US EPA 2006a). Considering the very low vapour pressure, the presence of ADBAC in air is assessed as insignificant. In the aquatic environment, ADBAC is hydrolytically stable, nor does it decompose by photolysis (US EPA 2006a). ADBAC has been assessed as readily biodegradable in screening tests and as a result it is expected to degrade to a large extent in wastewater treatment plants (ECHA 2022a, ECHA 2022b). ADBAC has no or low potential for bioaccumulation and does not accumulate in biota (ECHA 2022a, ECHA 2022b, US EPA 2006a).

Data on ADBAC for mutagenic, carcinogenic and reprotoxic properties do not justify classification as CMR (ECHA 2022 a, ECHA 2002b). ADBAC is not included in the lists of endocrine disrupting effects (ED List 2022).

[4] Self-classification, joint indication in C&L Inventory

[5] According to the COMMISSION IMPLEMENTING REGULATION (EU) 2022/1991, didecyldimethylammonium chloride is per 1 February 2024 officially approved for use in biocidal products in product types 1 and 2 under the BPR.

[6] Based on critical micelle concentration

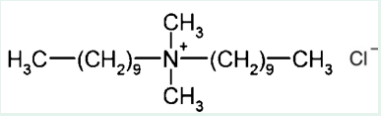
[7] Experimentally determined by OECD guideline 107

[8] Soil half-life is given for ADBAC (C12-16)

In the case of exposure to the environment, it is therefore relevant to assess the risk to aquatic and sediment organisms as well as to terrestrial organisms.

7.3.2 DDAC

Table 9. Substance information and physicochemical properties of DDAC

Parameter	DDAC	Reference
IUPAC name	Didecyldimethylammonium chloride	ECHA 2022
CAS No.	7173-51-5	ECHA 2022
EC No.	230-525-2	ECHA 2022
Molecule structure		ResearchGate 2022
Chemical formula	C22 H48 N Cl	ECHA 2022
Harmonised classification	Acute Tox. 4, H302 (Harmful if swallowed) Skin Corr. 1B, H314 (Causes severe skin burns and eye damage)	ECHA 2022
Classification[9]	Acute Tox. 3, H301 (Toxic if swallowed) Skin Corr. 1B, H314 (Causes severe skin burns and eye damage) Eye Dam. 1, H318 (Causes serious eye damage) Aquatic Acute 1, H400 (Very toxic to aquatic life) Aquatic Chronic 2, H411 (Toxic to aquatic life with long lasting effects)	ECHA 2022
Biocide status	Approved for use for PT8. Under approval for use in PT2, PT6, PT10 and PT12	ECHA 2022
Water solubility	650 mg/L (25°C)	ECHA 2022
Vapour pressure	0,006 Pa (25 °C)	ECHA 2022
Melting point	94 °C	ECHA 2022
Boiling point	> 180°C	ECHA 2022
Log K_{OW}[10]	2,8 (20 °C)	ECHA 2022
Log K_{OC}	5,75 (20 °C)	ECHA 2022
Kd (at 2%OC)	$1.1*10^4$ L/kg	Calculated
Distribution in the environment	Strong binding to sludge, soil, and sediment	ECHA 2022c
Aquatic toxicity (See 04)	Acute, aquatic environment EC_{50} <0.1 mg/L Chronic, aquatic environment EC_{10} <0,1 mg/L	ECHA 2022c, 2022j
Terrestrial toxicity (See 04)	Acute, soil environment lowest EC_{50}/LC_{50}<1000 mg/kg soil dry weight Chronic, soil environment lowest EC_{10}/LC_{10}<1000 mg/kg soil dry weight	ECHA 2022c, 2022j
Biodegradability	Readily biodegradable	ECHA 2022c
Half-life in soil	21 days	ECHA 2022
Bioaccumulation	No or low potential	US EPA 2006b

[9] Self-classification, joint indication in C&L Inventory

[10] Based on solubility in octanol and critical micelle concentration

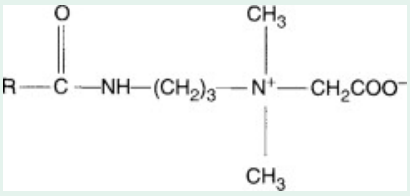
DDAC binds strongly to sludge, sediment, and soil due to its positive charge and is therefore not mobile in soil (ECHA 2022c, US EPA 2006b). Considering the very low vapour pressure, the presence of DDAC in air is assessed as insignificant. DDAC is hydrolytically stable and does not decompose by photolysis in either water or soil (US EPA 2006b). DDAC has been assessed as readily biodegradable in screening tests (ECHA 2022c), whereas studies in the environment suggest a long degradation time in aqueous environment and in soil (half-life calculated at 180 days and 1048 days respectively) (US EPA 2006b). DDAC is not bioaccumulative and does not accumulate in biota (ECHA 2022c, US EPA 2006b).

Data on DDAC for mutagenic, carcinogenic and reprotoxic properties do not justify classification as CMR (ECHA 2022c). The substance is not included in the lists of endocrine disrupting effects (ED List 2022).

In the case of exposure to the environment, it is therefore relevant to assess the risk to aquatic and sediment organisms as well as to terrestrial organisms.

7.3.3 Cocamidopropyl betaine

Table 10. Substance information and physicochemical properties of cocamidopropyl betaine

Parameter	Cocamidopropyl betaine	Reference
IUPAC name	1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs., hydroxides, inner salts	ECHA 2022
CAS No.	61789-40-0	ECHA 2022
EC No.	263-058-8	ECHA 2022
Molecule structure	 where R represents the coco-alkyl chain	ScienceDirect 2022
Chemical formula	C19 H38 N2 O3	ECHA 2022
Classification [11]	Skin Irrit. 2, H315 (Causes skin irritation) Skin Sens. 1, H317 (May cause an allergic skin reaction) Eye Irrit. 2, H319 (Causes serious eye irritation) Aquatic Chronic 3, H412 (Harmful to aquatic life with long lasting effects)	ECHA 2022
Biocide status	Not a biocidal active substance	
Water solubility	24 g/L (no information on temperature)	ECHA 2022
Vapour pressure	0 Pa (25 °C)	ECHA 2022
Melting point	< 0 °C	ECHA 2022
Boiling point	104.3°C	ECHA 2022
Log K_{OW} [12]	-1,28	ECHA 2022
Log K_{OC}	2,8 (20 °C)	ECHA 2022
Distribution in the environment	Low potential for binding to sludge, sediment, and soil	OECD 2006a

[11] Self-classification, joint indication in C&L Inventory

[12] Estimated value

Aquatic toxicity (See 04)	Acute, aquatic environment EC_{50} <10 mg/L Chronic, aquatic environment EC_{10} <1 mg/L	ECHA 2022d
Biodegradability	Readily biodegradable	ECHA 2022d
Bioaccumulation	No or low potential	ECHA 2022d

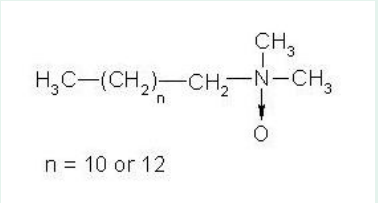
It is estimated that cocamidopropyl betaine has low potential for binding to sludge, sediment, and soil. According to the OECD (2006a), experimental values confirm low potential for adsorption for alkylamidopropyl betaines with chain length between C12 and C14, while alkylamidopropyl betaines with chain lengths of C16 and C18 have high potential for adsorption. The length of the cocoalkyl chain is typically C12-14. Cocamidopropyl betaine is considered hydrolytically stable. Based on the very low vapour pressure, the presence of alkylamidopropyl betaine in air is assessed as insignificant (OECD 2006a). Cocamidopropyl betaine is readily biodegradable (ECHA 2022d). Additionally, the substance has shown to decompose in wastewater treatment plants under both aerobic and anaerobic conditions, which means that the substance decomposes even if it accumulates in the sludge (OECD 2006a). Cocamidopropyl betaines are estimated not to be bioaccumulative and not to accumulate in biota (ECHA 2022d, OECD 2006a).

Data on cocamidopropyl betaine for mutagenicity and reprotoxicity do not give rise to classification as M and R. There are no available data on carcinogenicity (ECHA 2022d). The substance is not included in the lists of endocrine disrupting effects (ED List 2022). Based on the information available in the REACH registration dossier for the group of alkylamidopropyl betaines, ECHA (2019) has not identified the need for further regulation as the substances do not meet the criteria for PBT or vPvB, relevant tests do not raise concerns about CMR effects, and further, the substances are unlikely to have ED properties due to the absence of ED related triggers.

In the case of exposure to the environment, it is therefore relevant to assess the risk to aquatic life. It is not considered relevant to assess the risk to sediment-living organisms or to soil-living organisms due to the low potential of the substance to bind to soil and sediment.

7.3.4 ADAO

Table 11. Substance information and physicochemical properties of ADOA (amines, C12-14-alkyldimethyl, N-oxides)

Parameter	Amines, C12-14-alkyldimethyl, N-oxides	Reference
IUPAC name	Amines, C12-14 (even numbered)-alkyldimethyl, N-oxides	ECHA 2022
CAS No.	308062-28-4	ECHA 2022
EC No.	931-292-6	ECHA 2022
Molecule structure		ECHA 2022
Chemical formula	C_n H (2 n+3) N O, hvor n=14/16	ECHA 2022
Classification [13]	Acute Tox. 4, H302 (Harmful if swallowed) Skin Irrit. 2, H315 (Causes skin irritation) Eye Dam. 1, H318 (Causes serious eye damage) Aquatic Acute 1, H400 (Very toxic to aquatic life)	ECHA 2022

[13] Self-classification, joint indication in C&L Inventory

	Aquatic Chronic 2, H411 (Toxic to aquatic life with long lasting effects)	
Biocide status	Not a biocidal active substance	
Water solubility	410 g/L (20°C)	ECHA 2022
Vapour pressure	0 Pa (25 °C)	ECHA 2022
Melting point	125 °C	ECHA 2022
Boiling point	> 180°C	ECHA 2022
Log K_{OW}[14]	2,7 (20 °C)	ECHA 2022
Log K_{OC}	3,2 (20 °C)	ECHA 2022
Distribution in the environment	Low potential for binding to sludge, sediment and soil	
Aquatic toxicity (See 04)	Acute, aquatic environment EC_{50} <10 mg/L Chronic, aquatic environment EC_{10} <1 mg/L	ECHA 2022e
Biodegradability	Readily biodegradable	ECHA 2022e
Bioaccumulation	No or low potential	OECD 2006e

Information on ADAO on the potential for binding to sludge, sediment or soil has not been found, and based on the low K_{OC}, the potential is estimated to be low. It is added that according to the REACH registration dossier (ECHA 2202e), the substance will primarily be in the cationic form at a pH below approx. 4-5, which is rarely observed in the environment. ADAO is hydrolytically stable. Considering the very low vapour pressure, the presence of ADAO in air is assessed as insignificant. ADAO is biodegradable (ECHA 2022e). At the same time, it has been shown that the substance decomposes in wastewater treatment plants under both aerobic and anaerobic conditions, which means that the substance decomposes even by accumulation in sewage sludge (OECD 2006b). It is estimated that ADAO is not bioaccumulative and does not accumulate in biota (OECD 2006b).

Data on ADAO for mutagenic, carcinogenic and reprotoxic properties do not justify classification as CMR (ECHA 2022e). The substance is not included in the lists of endocrine disrupting effects (ED List 2022).

In the case of exposure to the environment, it is therefore relevant to assess the risk to aquatic life. It is not considered relevant to assess the risk to sediment-living organisms or to soil-living organisms due to the generally low potential of the substance to bind to soil and sediment.

[14] Based on solubility in octanol and critical micelle concentration

8. Exposure and risk assessment

Relevant scenarios have been set up for the use of selected surfactants in outdoor cleaning products. The scenarios describe exposure to the environment during use as a tile cleaner, wood wash, roof cleaner or boat cleaner, and it is assessed whether the use gives rise to harmful effects in the environment.

8.1 Use scenarios

Outdoor use of cleaning agents is described for four different product categories: tile cleaner, wood wash, roof cleaner and boat cleaner. Typical products within the four product categories have been selected for the risk assessment to assess the environmental risk of the four selected surfactants. The use scenarios that form the background for the risk assessment are shown in Table 12.

As the project focuses on cleaning agents that can be purchased by private consumers, only consumer use is described. Commercial use, where professionals are hired to clean and wash tiles or roofs at private homes, is not covered.

Table 12. Selected use scenarios for outdoor cleaning products

Substance	Product no.	Use	Application	Product dilution	Exposure to the environment
ADBAC	7	Tile cleaner	Directly on the tile area	1:10	Soil environment, groundwater, wastewater
DDAC	17	Wood wash	Directly on wooden terrace surface	1:5	Soil environment, groundwater
ADAO	71	Roof cleaner	Washing of roof with drain via gutter to sewer, fascine, or LAR	Undiluted	Soil environment, wastewater
Betaine	126	Boat cleaner	Washing of boat standing on a paved area with drain to the harbour basin	1:20	Aquatic environment, sediment

8.2 Approach

The environmental risk assessment is carried out according to the principles of chemical safety assessment in REACH and follows relevant guidelines from ECHA, including chapter R.12: Use-descriptor system, chapter R.16: Environmental exposure assessment and part E: Risk characterisation (ECHA 2022f).

ECHA's chemical safety assessment tool Chesar is used to calculate environmental exposure and used for the risk assessment (ECHA 2022g) for scenarios with sewer discharge. It is noted that the calculations in Chesar assume that the water discharged to the sewer is directed to a

treatment plant. Before using Chesar, substance data from the environmental assessment in Chapter 7 are entered into IUCLID and then imported into Chesar. For direct emissions to the soil environment, Chesar does not calculate a local but only a regional concentration in the soil. Therefore, scenarios for direct discharge to the soil environment have been made by manual calculation of local exposure to the soil environment. Further, Chesar is not suitable for calculating the environmental exposure directly to marine water, and a manual calculation of the local exposure to the marine environment has also been made for boat cleaning.

To describe the use scenarios and calculate the emissions to the environment, typical values for similar scenarios recommended when calculating emissions to the environment of biocidal active substances have been applied, including PT2 (ECHA 2022h), PT8 (OECD 2013), PT18 (OECD 2008) and PT21 (European Commission 2004; OECD 2007).

The risk of environmental effects is calculated as the risk characterisation ratio, RCR, which is the ratio between the estimated environmental concentration, PEC, and a zero-effect concentration, PNEC. At RCR less than 1, environmental effects are acceptable at the estimated environmental concentration, whereas for RCR above 1, harmful and undesirable effects in the environment may occur.

The PNEC values used are given for the four substances in Appendix 4. The PNEC values for AD-BAC (C12-C14) and ADBAC (C12-C16) are the same as they are based on the same dataset. The main purpose of this project is not to carry out a review of data for environmental hazard and risk assessment. Consequently, the risk assessment is based on PNEC values from existing assessments. If available, PNEC values from risk assessment reports of biocidal active substances have been used, as they have been assessed by the authorities. Otherwise PNEC values from REACH registration dossiers have been used.

8.3 Calculation of exposure to the environment

In general, consumer uses are considered to be widespread uses because there are many sources (consumers). The environmental exposure assessment is made for local exposure from consumers. For a rural area, the local exposure is defined as being use at a given location, while the local exposure for an urban area is defined as the exposure from an area that directs wastewater to the same treatment plant. For discharge of wastewater to sewers, the local scenario predicts a catchment area of a treatment plant with estimated 10,000 users (ECHA 2022f).

It is assumed that the washing water led to a sewer is directed to a wastewater treatment plant. This is not the case in areas with separate sewers, where rainwater from paved areas is directed directly to the recipient and not to a treatment plant.

The annual amount used of each of the four substances is estimated based on the assumptions of the four different uses described below and summarized in Table 13. Substance concentration in the products as well as recommended dilution and application amount are indicated on the product labels or in the technical data sheet for the products for tile cleaning, wood washing and roof cleaning. The estimated amount for boat washing is explained below.

Since the cleaning products are aqueous solutions with a low content (1.6-7.6%) of surfactants, it is assumed that the density is equal to 1 kg/L for all products.

Exposure to the environment when using tile cleaners

For the tile cleaners, it is assumed that tiles are cleaned once a year and that the washed area is a total of 104 m^2. This is estimated as a tiled path of 54 m^2, corresponding to 1 m of tiled path around a typical house (OECD 2013), a tiled terrace of 30 m^2 (OECD 2008) and a parking area of 20 m^2 (corresponding to the size of a single carport).

According to the label on the product for the tile cleaning, 1 litre of the product covers 200 m^2 corresponding to 5 ml per m^2. The concentration of the surfactant ADBAC is measured to be 7.6%. As the total amount of the substance is used in the risk assessment, the recommended dilution of the product is not included in the calculation. The amount of substance used when cleaning a tiled area of 104 m^2 can thus be calculated to be 40 g (76 g/L x 0.005 L/ m^2 x 104 m^2).

A distinction is made between urban areas and rural areas. In urban areas the daily exposure from cleaning of tiles is assumed to come from 6 different locations that discharge to the same treatment plant. In rural areas the exposure is calculated for one location, where tiles are cleaned on the day in question (ECHA 2022h). Tiled areas in urban areas are assumed to be paved areas with drains for sewers, where the rainwater is led to a wastewater treatment plan, but in rural areas the water is assumed to seep directly into the soil environment.

For rural areas exposure to the soil environment is calculated manually, assuming that for emission to the soil environment the substance is distributed in the soil volume below the tiles at a depth of 50 cm (ECHA 2022h). Hence, in rural areas discharge to the soil environment will not be greater if treatment is carried out at two or more locations, as each discharge ends up in separate soil volumes.

Exposure to the environment when using wood wash

For wood washing, the exposure to the environment is calculated for washing a wooden terrace. It is assumed that the terrace is washed once a year and that the terrace area is 30 m^2 (OECD 2008). The exposure to the environment is calculated for a scenario with 100% emission to the soil. It is assumed that the wooden terrace is built on a non-paved area and that all water is rinsed off the wooden terrace and discharged to the subjacent non-paved area and thus directly to the soil environment.

The wood washing product covers 2-5 m^2 per litre, corresponding to 500 ml per m^2, and assuming that the maximum amount of use is applied. The concentration of the surfactant DDAC is measured to be 2%. The amount of substance used when washing a wooden terrace of 30 m^2 can thus be calculated to be 300 g (20 g/L x 0.5 L/ m^2 x 30 m^2).

The exposure to the soil environment is calculated manually, assuming that for emission to the soil the substance is distributed in the soil volume under the wooden terrace at a depth of 50 cm (ECHA 2022h).

Exposure to the environment when using roof cleaners

It is assumed that roof cleaning is carried out once a year and that the washed roof area is 145 m^2 (ECHA 2022h). A distinction is made between urban and rural areas. In urban areas the daily exposure from cleaning of roofs is assumed to come from 6 different locations that discharge to the same treatment plant, while in rural areas the exposure is calculated for cleaning one roof for a given location (ECHA 2022h). When cleaning roofs in urban areas, the washing water is diverted to the sewer or to the ground via fascines (newer homes). However, it is assumed that in urban areas the washing water is directed to wastewater treatment plants, while in rural areas the washing water is discharged directly to the soil environment (either via a fascine or via LAR). Dwellings in urban areas diverting roof water via fascines are covered by the scenario for rural areas.

The roof cleaner product covers 3-5 m^2 per litre, corresponding to 333 ml per m^2 assuming that the maximum amount of use is applied. The concentration of the surfactant ADAO is given as 1.6%. The amount of substance used when cleaning a roof of 145 m^2 can thus be calculated to 773 g (16 g/L x 0.333 L/ m^2 x 145 m^2).

The exposure to the soil environment is calculated manually, assuming that for emission to the soil environment the substance is distributed in a soil volume of 13 m^3 (ECHA 2022h).

Exposure to the environment when using boat cleaner

For boat cleaning, one annual wash per boat is assumed using 1 litre of the undiluted product per boat. This assumes that the product is sold in bottles of 1 litre and that a dilution of the product by 20 times is recommended for use. The boat size varies from 18 m^2 to 31 m^2 (European Commission 2004), and if 333-500 ml of product per m^2 is used per boat cleaning, it corresponds to 645-1111 ml of the undiluted product per m^2.

It is assumed that boat cleaning takes place on a paved area with direct discharge to the harbour basin. In addition, it is assumed that 276 boats are washed locally in a port during a 30-day-period. This estimate is based on a typical marina (OECD 2007) and that a boat is washed once a year when it is taken ashore at the end of the sailing season.

With a given concentration of betaine of 3% in the boat cleaning product, the amount of the substance used can be calculated at 30 g per boat cleaning (30 g/L x 1 L/boat). The daily and annual quantity is thus calculated to be 0.276 kg/d (0.03 kg/boat x 276 boats/30 days) and 8.3 kg/year (0.03 kg/boat x 276 boats/year).

The resulting concentration in the marine water is estimated based on the assumption that when cleaning a boat, two times the volume of the washing water is used for rinsing and that a 10-fold dilution occurs in the harbour basin. This dilution factor is an empiric and conservative estimate that can be used when looking at acute effects from discharge to the harbour environment.

Table 13. Description of selected use scenarios for outdoor cleaning products

Substance	Use	Conc. in product	Quantity of product used per m^2	Washed area m^2	Frequency of use	Amount of substance used	Number of users locally per day	Amount of substance used kg/year	Amount of substance used kg/d
ADBAC	Tile cleaner, urban area	7.6%	5 ml	104	1 x annually	40 g	6	88[15]	0.240
	Tile cleaner, rural area						1		0.040
DDAC	Wood wash, Urban and rural area	2%	500 ml	30	1 x annually	300 g	1		0.300
ADAO	Roof cleaner, urban area	1.6%	333 ml	145	1 x annually	773 g	6	1700	4.6
	Roof cleaner, rural area						1		0.773
Betaine	Boat cleaner	3%	1 litre/boat	-	1 x annually	30 g	9	8.3[16]	0.276

As part of the exposure assessment in REACH, established environmental release categories (ERC) can be used as a conservative estimate of how much of a substance is released into the environment during use. Consumer use of cleaning agents outdoors will be assigned an environmental release category ERC 8d; Wide dispersive outdoor use of processing aids in open systems. ERC 8d estimates that 100% is released to air, 100% to water and 20% to soil. Since no emissions to air are expected of the surfactants, more realistic but conservative estimates for the

[15] Quantity has been rounded-off

[16] Quantity has been rounded-off. Use occurs during a shorter period per year, 30 days

release to the environment have been used here. A 100% discharge to sewers and subsequently to wastewater treatment plants is assumed for tile cleaners and roof cleaners in an urban area and 100 % discharge to the soil environment when using tile cleaning, wood washing or roof cleaning in a rural area. For boat cleaning, a 100% discharge to marine water is assumed. Table 14 shows the assumptions that have been made for the four selected use scenarios and that are used in the calculation of the environmental exposure.

Table 14. Description of emission pathways and release factors used in the selected use scenarios for outdoor cleaning products.

Substance	Use	Emission %				
		Water – freshwater	Water – marine water	Soil	Sewage treatment plant (STP)	Air
ADBAC	Tile cleaner, urban area	0	0	0	100	0
	Tile cleaner, rural area	0	0	100	0	0
DDAC	Wood wash	0	0	100	0	0
ADAO	Roof cleaner, urban area	0	0	0	100	0
	Roof cleaner, rural area	0	0	100	0	0
Betaine	Boat cleaner	0	100	0	0	0

8.4 Result of the environmental risk assessment

Environmental risk assessment of ADBAC for tile cleaning

Environmental risk assessment of the tile cleaner has been carried out for ADBAC in a solution of 7.6%, which is diluted 1:10 when used. A local discharge for the urban area of 88 kg/year of the substance is calculated, corresponding to a local discharge to wastewater of 0.24 kg/d and a local discharge to the soil environment of 0.04 kg/d for the rural area, see Table 13.

PNEC values represent both ADBAC (C12-C14) and ADBAC (C12-C16), as they are based on the use of read-across and thus based on the same dataset (ECHA 2022a; ECHA 2022b, 2022i). PNEC values and their background are shown in Appendix 4.

The result of the assessment for local exposure shows that based on the assumptions made and with the exception of freshwater sediment, no risk is expected in the environment when using ADBAC for cleaning of tiles in urban areas as all RCRs are below 1 (Table 15). The RCR is above 1 for freshwater sediment and thus indicates a risk of harmful effects on sediment-living organisms in the environment when using ADBAC for tile cleaning.

Table 15. Environmental risk assessment of ADBAC for tile cleaning - urban area. Result from Chesar.

Protection goal	PEC (method of calculation)	PNEC	RCR
Freshwater	2.7E-4 mg/L (EUSES 2.1.2)	0.42 µg/L	0.643
Sediment (freshwater)	44.27 mg/kg dry weight (EUSES 2.1.2)	6.8 mg/kg sediment dry weight	6.51
Marine water	2.7E-5 mg/L (EUSES 2.1.2)	0.096 µg/L	0.281
Sediment (marine water)	4.428 mg/kg dry weight (EUSES 2.1.2)	16 mg/kg sediment dry weight	0.277
STP	9.34E-3 mg/L (EUSES 2.1.2)	77.5 µg/L	0.121
Agricultural land	0.262 mg/kg dry weight (EUSES 2.1.2)	0.83 mg/kg soil dry weight	0.316

The environmental risk assessment of ADBAC for tile cleaning in rural areas has been carried out by calculating the local impact on the soil environment at the given location.

When cleaning a tiled area of 104 m^2, 520 ml of the product is used corresponding to 40 g of the substance. Assuming that the 40 g of substance is distributed in the soil volume under the tiled area at a depth of 50 cm (ECHA 2022h), the resulting local concentration in the soil can be calculated. When manually calculating the local exposure to the soil environment, the concentration in the soil is calculated to be 0.45 mg/kg wet soil[17] corresponding to 0.51 mg/kg soil dry weight[18]. The calculation is shown in Appendix 5.

Table 16. Environmental risk assessment of ADBAC tile cleaning - rural area. Result from calculation of local exposure.

Substance	Use	PEC_{soil}	$PNEC_{soil}$	RCR
ADBAC	Tile cleaning, rural area	0.51 mg/kg soil dry weight	0.83 mg/kg soil dry weight	0.61

The result shows that there is no risk of effects to the local soil environment when using ADBAC for tile cleaning.

Environmental risk assessment of DDAC for wood washing

The environmental risk assessment of washing a wooden terrace has been carried out for DDAC in a 2% solution, which is diluted 1:5 when used. The calculation is based on a local discharge to the soil environment of 0.3 kg/d at the given location.

The environmental risk assessment has been carried out for local exposure to the soil environment by calculating the local concentration in the soil environment when washing a wooden terrace with DDAC. When washing a 30 m^2 terrace, 15 litres of the product are used corresponding to 300 g of DDAC. At 100% emission to the soil and if the 300 g of substance is distributed in the soil volume under the terrace at a depth of 50 cm (ECHA 2022h), the resulting concentration in the soil can thus be calculated at 12 mg/kg wet soil, which can be converted to 13 mg/kg soil dry weight. The calculation is shown in Appendix 5.

Table 17. Environmental risk assessment of DDAC for wood washing - rural area. Result from calculation of local exposure.

Substance	Use	PEC_{soil}	$PNEC_{soil}$	RCR
DDAC	Wood washing	13 mg/kg soil dry weight	1.58 mg/kg soil dry weight	8.2

The result shows that when using DDAC for washing a wooden terrace, there is a risk of local effects in the environment. However, diminishing effects on the environment is expected after use, as the substance is degradable in the soil environment with a half-life stated to be 21 days (ECHA 2022). It can be calculated that concentration in the soil will be equal to the PNEC value after 67 days after which the concentration will be at a level where no effects are expected. Based on the potential effects that can occur over a period of 67 days, washing a wooden terrace can lead to long-term effects on the soil organisms at the given location.

[17] Soil density of 1700 kg wet weight/m^3 (ECHA 2022h)

[18] Under the assumption of 60% soil matrix, 20% porewater and 20% air. Density of soil matrix of 2500 kg/m^3

Environmental risk assessment of ADAO for roof cleaning

The environmental risk assessment of roof cleaning has been carried out for ADAO in a solution of 1.6%, which is used undiluted. A local discharge of 1700 kg/year for the urban area is calculated, which corresponds to a local discharge to water of 4.6 kg/d. For the rural area, a local discharge to the soil environment of 0.773 kg/d is calculated.

It should be noted that the PNEC values obtained from the registration dossier for ADAO are based on low uncertainty factors (1-2). This means that a significant safety margin for ADAO is not included in the risk assessment of roof cleaning.

As ADAO is readily biodegradable and does not accumulate in sludge, Chesar shows that there is no discharge from the local wastewater treatment plant, and therefore the resulting environmental concentrations are calculated to be zero. Consequently, no environmental risk is expected when using ADAO for roof cleaning if the washing water is discharged to the sewer and subsequently to a wastewater treatment plant (Table 18).

Table 18. Environmental risk assessment of ADAO for roof cleaning - urban area. Result from Chesar.

Protection goal	PEC	PNEC	RCR
Freshwater	0 mg/L (EUSES 2.1.2)	34 µg/L	< 0.01
Marine water	0 mg/L (EUSES 2.1.2)	3 µg/L	< 0.01

When cleaning roofs in rural areas, the substance is expected to be discharged directly to the soil environment via fascine or LAR. Although ADAO is not expected to accumulate in the soil environment, calculation of the local exposure and an assessment of the risk to the soil environment have been carried out. When cleaning a roof at a size of 145 m^2, 48 litres of the product are used at an ADAO concentration of 1.6% corresponding to a total of 773 g of ADAO. As the 773 g of substance is expected to distribute in a soil volume of 13 m^3 (ECHA 2022h), the resulting local concentration in the soil can be calculated. When manually calculating the local exposure to the soil environment, the concentration in the soil is calculated to be 35 mg/kg wet soil corresponding to 39 mg/kg soil dry weight. The calculation is shown in Appendix 5.

Table 19. Environmental risk assessment of ADAO for roof cleaning - rural area. Result from local exposure calculation

Substance	Use	PEC_{soil}	$PNEC_{soil}$	RCR
ADAO	Roof cleaning, rural area	39 mg/kg soil dry weight	1.02 mg/kg soil dry weight	38

The result shows that when using ADAO for roof cleaning in rural areas, there is a risk of local effects in the soil environment. It should be noted that $PNEC_{soil}$ is not determined based on experimental values for the toxicity to terrestrial organisms but is derived from equilibrium considerations based on the toxicity to aquatic organisms.

Environmental risk assessment of cocamidopropyl betaine for boat cleaning

The environmental risk assessment of boat cleaning has been carried out for cocamidopropyl betaine, which is used in a solution of 3% (30 g/L) and diluted 1:20 during use. The amount of washing water per boat cleaning is thus calculated for 20 litres (20 times dilution of 1 litre) at a concentration of the substance of 1.5 g/L (30 g/L / 20). The amount of washing water and rinsing water is calculated to be 60 litres at a resulting concentration of 0.5 g/L (1.5 g/L / 3). A dilution in the harbour basin of 10 times results in a local concentration in the harbour basin of 50 mg/L (0.5 g/L x 1000 mg/g / 10).

Table 20. Environmental risk assessment of cocamidopropyl betaine for boat cleaning. Result from calculation of local exposure in the harbour basin.

Substance	Use	$PEC_{marine\ water}$	$PNEC_{marine\ water}$	RCR
Betaine	Boat cleaner	50 mg/L	0.32 µg/L	>>1

The result shows that when using products with cocamidopropyl betaine for boat cleaning, there is a risk of local effects in the marine environment.

Environmental risk assessment of the remaining 17 products

An environmental risk assessment has been carried of the biocidal active substances in the remaining 17 analysed products in which content of ADBAC or DDAC has been detected. These cover two tile cleaning products, three wood washing products, five roof cleaning products and seven products for universal use. Concerning products for universal use, an environmental risk assessment has been carried out for washing of wooden terraces, which is assumed to be a likely use by private consumers.

The environmental risk assessment has been carried out for direct exposure to the soil environment by calculating the local concentration in the soil for tile cleaning, wood washing and roof cleaning. The calculations have been made according to the calculations shown in Appendix 5.

At local exposure to the soil environment, seven wood washing products and all five roof cleaning products are expected to cause an environmental risk of local effects. Two tile cleaning products and three wood washing products are not expected to cause an environmental risk of local effects.

The result of the environmental risk assessment of the remaining 17 products is shown in Appendix 6.

9. Conclusions

The mapping and analysis of the product declaration show that outdoor cleaning agents can contain surfactants that are also biocidal active substances. Biocidal active substances identified in the outdoor cleaning products are ADBAC, DDAC and pelargonic acid. In addition to the surfactants, other biocidal active substances have been identified in the products. While surfactants generally have a cleaning function, other biocidal active substances have different functions in the cleaning agents for outdoor use, for instance as preservatives.

The chemical analysis of the content of either ADBAC or DDAC in 20 selected products confirms the presence of the surfactants in the products. However, ADBAC content was not detected in one of the analysed products. According to the analysis results, the measured content of ADBAC and DDAC in the products corresponds to the information on the product labelling with a few exceptions.

The environmental risk assessment made for the four surface-active substances ADBAC, DDAC, ADAO and cocoamidopropyl betaine and for four different uses (tile cleaning, wood washing, roof cleaning and boat cleaning) shows that environmentally harmful effects can occur locally when using outdoor cleaning agents and discharging directly into the soil or the harbour environment.

The result of the environmental risk assessment of local exposure to the soil environment from the remaining 17 products containing ADBAC or DDAC shows a risk of local environmental effects from seven wood washing products and five roof washing products. Two tile cleaning products and three wood washing products are not expected to pose a risk to the environment.

10. References

ECHA (2019). Assessment of regulatory needs. Alkyldimethyl betaines. 21 February 2019.

ECHA (2022). ECHA's database accessed in July-September 2022 via ECHA's website. https://echa.europa.eu/information-on-chemicals

ECHA (2022a). Registration dossier for ADBAC (12-16) in ECHA's database accessed in September 2022 via ECHA's website. https://echa.europa.eu/registration-dossier/-/registered-dossier/13152/

ECHA (2022b). Registration dossier for ADBAC (12-14) in ECHA's database accessed in December 2022 via ECHA's website. https://echa.europa.eu/registration-dossier/-/registered-dossier/13256/

ECHA (2022c). Registration dossier for DDAC in ECHA's database accessed in September 2022 via ECHA's website. https://echa.europa.eu/registration-dossier/-/registered-dossier/5864

ECHA (2022d). Registration dossier for Cocamidopropyl betaine in ECHA's database accessed in September 2022 via ECHA's website. https://echa.europa.eu/registration-dossier/-/registered-dossier/25362

ECHA (2022e). Registration dossier for Amines, C12-14- alkyldimethyl, N-oxides in ECHA's database accessed September 2022 via ECHA's website. https://echa.europa.eu/registration-dossier/-/registered-dossier/15191/

ECHA (2022f). Guidance on Information Requirements and Chemical Safety Assessment: Endpoint specific Guidance (Chapter R.7b and Chapter R. 7c), Characterisation of dose [concentration] - response for environment (Chapter R.10); Use description (Chapter R.12), PBT Assessment (Chapter R.11), Environmental exposure estimation (Chapter R.16) & Risk Characterisation (Part E).

ECHA (2022g). Chesar 3.7.2. desktop version.

ECHA (2022h) Product Type 2. Disinfectants and algaecides not intended for direct application to humans or animals. Emission estimation PT2 – calculation sheet.

ECHA (2022i). Alkyl (C_{12-16}) dimethylbenzyl ammonium chloride. Assessment Report. Product-type 2. Regulation (EU) No 528/2012 concerning making available on the market and use of biocidal products. December 2021, Italy.

ECHA (2022j). Didecyldimethylammonium chloride (DDAC). Assessment Report. Product-type 2. Regulation (EU) No 528/2012 concerning making available on the market and use of biocidal products. December 2021, Italy.

ED List (2022). List I, List II, List III. June 2022. https://edlists.org/

European Commission (2004). ESD for PT21: Harmonisation of Environmental Emission Scenarios. An Emission Scenario Document for Antifouling Products in OECD countries. European Commission, DG Environment 2004.

Madsen T., Boyd H.B., Nylén D., Pedersen A.R., Petersen G.I. & Simonsen F. (2000). Environmental and health assessment of substances in household detergents and cosmetic detergent products. MST 615.

OECD (2013). ESD for PT 8: Revised Emission Scenario Document for Wood Preservatives. OECD series No. 2, 2013.

OECD (2008). ESD for PT18: Emission Scenario Document for Insecticides, Acaricides and products to control other arthropods for household and professional uses. OECD series No. 18, 2008.

OECD (2007). ESD PT21: Final minutes of TM V 2007. Table 0.6. Note: The number of boats in the ESD marina scenario should be reduced to 276 to reflect a more realistic boat density of 1.38 boats / 100 m^2

OECD (2006a). SIDS Initial Assessment Report for SIAM 23. Alkylamidopropyl betaines. Jeju, Korea 17-20 October 2006.

OECD (2006b). SIDS Initial Assessment Report for SIAM 22. Amines Oxides. Paris, France 18-21 April 2006.

ResearchGate (2022). https://www.researchgate.net/figure/Chemical-structure-of-DDAC_fig4_6620665

ScienceDirect (2022). https://www.sciencedirect.com/topics/medicine-and-dentistry/cocamidopropyl-betaine

TCI (2022). https://www.tcichemicals.com/IL/en/p/B0414

US EPA (2006a). Reregistration Eligibility Decision for Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC). EPA739-R-06-009 August 2006.

US EPA (2006b). Reregistration Eligibility Decision for Aliphatic Alkyl Quaternaries (DDAC). EPA739-R-06-008 August 2006.

Appendix 1. Mapping – Result of declaration analysis

Table 21. Result of the declaration analysis covering a total of 44 products. The overview shows available information from websites and product labels as well as information from the safety data sheet for each product.

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
2	Wood wash	Removes dirt, coatings and grey patina. Cleans in depth. [2] Outdoor wood cleaner suitable for outdoor wooden terraces, wall coverings, fences, garden furniture and the like. Can be used on all types of wood. [3]	Ready to use	≤5 % oxalic acid <5% cationic surfactants	DK
6	Universal	Removes coatings. Effective against dirt and grime. Cleaning outdoor surfaces. For example, for masonry, woodwork, roof and garden furniture. [2]	Concentrate. Dilute 1:10	<15 % amines, C12-14-alkyldimethyl, N-oxides <10 % l-(+)-lactic acid <0,5 % of dodecyl dimethyl ammonium chloride	DK
7	Tile cleaner	Effective cleaning of all hard surfaces. Removes coarse dirt from tiles, walls, plinths, roofs, swimming pools, furniture, etc. [2]	Concentrate. Dilute 1:10 or 1:50	5-10 % alkyl dimethyl benzyl ammonium chloride 5% - 15% Cationic surface-active substances	DK
12	Wood wash	For all outdoor surfaces. Bleaches discolorations. Effectively removes coatings. [2] Effective removal of coating on outdoor wooden surfaces such as wood cladding, wooden terraces, fences, garden furniture and the like. Effectively clean surfaces and bleach discolorations. Also, the product can be applied to mineral surfaces such as plaster, masonry and garden tiles. [3]	Ready to use	≥0.30 - ≤2.4% active chlorine, sodium hypochlorite solution ≤0,72 % dodecyl dimethyl amino oxide	DK
13	Wood wash	Wood reinforcing cleaning before processing. Cleaning treated surfaces with heavy dirt and fouling. [2] This is a wood-reinforcing cleaner that removes dirt from treated surfaces. Highly effective product, it is therefore used for treated surfaces that are very exposed and damaged by heavy dirt. [3]	Concentrate. Dilute 1:5 or 1:9	30-45 % potassium silicate <5 % non-ionic surfactants	DK

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
16	Universal	For cleaning and disinfection of woodwork, concrete, stone, granite, roof tiles, roofing felt, light panels, facades and plinths, etc.[2]	Ready to use.	<3 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides <5 % cationic surfactants	DK
17	Wood wash	For garden furniture made of wood or plastic, wooden terraces, as well as other types of outdoor wooden surfaces. [2] The cleaner removes dirt, grease and discoloration on wooden terraces, plastic or wooden garden furniture, and other types of wooden outdoor surfaces. [3]	Concentrate. Dilute 1:5	<1,5 % dodecyl dimethyl ammonium chloride <5 % cationic surfactants	DK
21	Universal	Effectively removes discolorations and coatings on woodwork, wall, garden tiles, eternit roofs, etc. [2] An effective and disinfecting cleaner to remove discolorations and dirt. The cleaning agent is particularly suitable for untreated, wood-protective, painted or varnished surfaces and can also be used on masonry. [3]	Concentrate. Dilute 1:10	≥10 - ≤21 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides ≤3 % propane-2-ol	DK
35	Tile cleaner	Clean and degrease. Not subject to labelling. [2] If you are attacked by chip plague on your stones or tiles, the product is the right solution. It not only removes the chip plague, it also cleans at the same time. It is environmentally friendly. [3]	Concentrate. Dilute 1:1	<5 % alkyl imidazolium carboxylate <5 % of 2-methoxymethylethoxypropanol <5 % alcohols, C9-11, ethoxylated <5 % alanine, N,N-bis(carboxymethyl)-, trisodium salt <1 % disodium metasilicate <5%: non-ionic and cationic surfactants, hydrotropic and complexes.	DK
38	Other	Cleaning agent to combat and clean dirt and grime that has got stuck on composite fences or terrace boards. In addition, this cleanser is an effective remedy against algae formation, and it makes cleaning the surface easier. [3]	Concentrate. Dilute 1:5	5<10 % quaternary ammonium compounds, benzyl-C12-14-alkyldimethyl, chlorides <5 % 2-(2-butoxyethoxy) ethanol <0,25 % 3-iodo-2-propynyl butyl carbamate	DK

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
				<0,25 % 2-octyl-2H-isothiazol-3-on	
41	Universal	Removes coatings on masonry, tiles, roof tiles and fences. [2] Used for outdoor cleaning and cleaning. It removes coating on e.g. masonry, tiles, roof tiles, greenhouses and fences. There are 2.5 litres of concentrate in the container, which can withstand up to 125 litres of ready-mixed product. The cleaner is mixed differently depending on the task. Typically, 1-2 dl for 5 litres of water are used. In severe cases, 1 dl to 2.5 litres of water can be used. 1 litre of ready-mixed means is enough for about 3-5 m^2. The cleaner is sprayed onto what needs to be cleaned and must remain in place. For vertical surfaces, it is recommended to use broom or brush. It is most effective in dry weather and at high temperatures. [3] Declaration: Less than 5% cationic surfactants. [3]	Concentrate Dilute 1:50 or 1:25 For application on masonry, tiles and greenhouses, 1:10 or 1:20 is recommended	<2 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	DK
46	Roof cleaner	Roof cleaner agent is a highly effective way to remove dirt from roofs. [3] 5 litres are enough for approx. 170 m^2. [3]	Concentrate. Dilute 1:50 or 1:25	5-10 % alkyl dimethyl benzyl ammonium chloride 1-3 % alcohol ethoxylate <1 % propan-2-ol isopropyl alcohol isopropanol 5-15 % cationic surfactants <5 % non-ionic surfactants	DK
47	Universal	Used before painting to remove and prevent algae and fungal growth. [2] Is specially developed for outdoor use. It removes existing mould and prevents mould growth as well as the growth of algae, fungi, moss, etc. Provides maximum protection to avoid the paint film peeling off. Can also be used for cleaning without followed paint treatment e.g. for cleaning stone slabs and tiles. [3]	Concentrate. Dilute 1:5	1-<5 % alkyl (C12-16) dimethyl benzyl ammonium chloride (ADBAC/BKC (C12-C16))	DK

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
		1 litre is enough for approx. 10-13 m^2. [2]			
50	Wood wash	Concentrate for cleaning outdoor woodwork. [2] Wooden sink for cleaning outdoor wood (facades, overhangs, gables, etc.). Removes dirt, wax, oil etc. Leaves the item clean and prepared for new treatment with oil, varnish, paint, etc. [3] 1 litre is enough for approx. 5-10 m^2. [2]	Concentrate. Dilute 1:1	1 to <5 % of benzalkonium chloride	DK
51	Tile cleaner	For effective cleaning of tiles, concrete and stone. [2] High-efficiency cleanser for removing dirt and discolorations on tiles, concrete and stone. [3]	Concentrate. Dilute 1:2.	1 to <5 % of benzalkonium chloride	DK
52	Tile cleaner	For the control of algae on hard surfaces such as cement, fiber cement, concrete, brick, wood, glass, metal, plastic solar cells, bricks, roofs, facades, tiles, wooden terraces, garden furniture, fences, etc. [2] 1 litre is enough for approx. 4-6 m^2. [2]	Ready to use.	<1 % dodecyl dimethyl ammonium chloride	DK
53	Roof cleaner	A highly effective cleanser for removing dirt and grime from the roof. [3] 2,5 litres are enough for approx. 75 m^2. [2]	Concentrate. Dilute 1:10	1 to <5 % of benzalkonium chloride	DK
55	Universal	For cleaning and cleaning masonry, woodwork, tiles, terraces, etc. With heavy soiling, the product can be used undiluted. [2]	Concentrate. Dilute 1:10	1 to <5 % of benzalkonium chloride <5 % cationic surfactants[2]	DK
67	Roof cleaner	Clean simply and effectively from mice and other fouling. [2] 2,5 litres are enough for approx. 125-150 m^2. [2]	Concentrate. Dilute 1:5	3-5 % alcohol ethoxylate, C10 3-5 % N,N bis(carboxylate methyl) alanine trisodium salt <1 % alkyl(C12-16) benzyl dimethyl ammonium chloride <1 % citric acid	DK

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
68	Universal	Liquid concentrated disinfectant for cleaning masonry, roofs and facades, as well as woodwork and tiling. Can be used in all outdoor areas where unwanted coatings are to be removed. [3] 5 litres are enough for approx. 2500 m^2. [3]	Concentrate. Dilute to 1-2% use solution	40-60 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	DK
69	Universal	Effective bactericidal agent for indoor and outdoor use. Kills bacteria on surfaces such as tables and cabinets. Used for disinfection of already cleaned surfaces in the food industry, commercial kitchens, restaurants as well as institutions and swimming pools, etc. Can also be used as a fighting agent on tiles, roofs or woodwork to remove fungus, mould, algae, etc. [3]	Concentrated. Dilute to 2-3% or 10% use solution.	5-<10 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	DK
70	Roof cleaner	The product is a highly effective cleanser to remove dirt and coatings from roofs and facades. Sprayed onto the roof, where it settles, and works effectively from the first moment. Product advantages: Effectively removes coatings. Cleans without mechanical impact. Leaves no visible traces. Odourless. [3] 1 litre is enough for approx. 2-8 m^2. [2]	Concentrated. Dilute 1:10	40-60 % quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides (benzalkonium chloride) Detergent: > 30% disinfection agents.	DK
71	Facade-/Roof cleaner	Effective removal of fouling on all types of roofs and facades. [2] It effectively removes coatings right from the start. The full effect is achieved after 3-5 days. It is effective even without mechanical impact, leaves no traces and is odourless. [3]	Ready to use.	≤1,6 % amines, C12-14-alkyldimethyl, N-oxides ≤1,3 % L-(+)-lactic acid	DK
72	Universal	Fast acting. Simply spray on and rinse off. No high pressure cleaning needed. Safe to use around plants and lawn. Cleans stains from algae, mould and mildew. For terraces, fences and painted surfaces. For concrete, brick and masonry. For gutters, façade cladding, plastic and stucco. [2] Decomposes when washed down in soil. [3]	Concentrated. Dilute 1:1 or 1:4.	7-13 % sodium hypochlorite 1-5 % sodium hydroxide 1-5 % sodium metasilicate	Non-EU

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
74	Wood wash	Makes wood look new again in minutes. Restore the natural appearance of weathered and discolored wood. Fence and terrace sink. Cleans and brightens in minutes. Good for composite material. Kills external mould and mildew. [2]	Ready to use.	3-7 % sodium hypochlorite	Non-EU
76	Tile cleaner	A biocide for amateur use to control fungi, mould, lichens, mildew and algae on outdoor surfaces such as masonry, tiles, roofs, walls, terraces, paths, fences, boats, caravans, etc. Also slows down regrowth. [3] 1 litre is enough for approx. 200 m^2. [2]	Dilute 1:20.	≥3 - <5 % dodecyl dimethyl ammonium chloride [4] ≥1 to <5 % propane-2-ol	EU
78	Universal	Combined cleaning and disinfecting product of a watering solution of neighbourhood ammonium compounds. Works mob bacteria, fungi and mould in stables, buildings and machines. Used as a cleaning agent when cleaning roofs, masonry, tiles, stones, raft fences, boats, caravans, greenhouses, garden furniture and dripping nipples in stables. Removes bad odours in damp places. Destroys the surface tension. Used as soap and disinfection in buildings, production premises, etc. [2]	Concentrated. Dilute 1:10	5-15 % benzalkonium chloride	DK
93	Facade cleaner	Effective alkaline cleaner suitable for outdoor cleaning before painting or maintenance washing of painted surfaces. [3]	Concentrated. Dilute 1:20, 1:10 or 1:1.	5-10 % C12-C16 alkyl dimethyl benzyl ammonium chloride 50% 1-5 % alcohols, C9-C11, ethoxylated ~1 % 1,2-propylene glycol ~1 % trimethyl-3[{-1-oxo-10-undecenyl) amino] propylammonium methyl sulphate 1-5 % tetra potassium pyrophosphate (TKPP)	EU
95	Facade cleaner	Kills and cleans at the same time. Effective against smuts and microorganisms (bacteria, mould poppy, algae and moss) on facades, roofs, awnings, garden furniture, brick joints, wetlands, walkways, fences, etc. [2]	Concentrated. Dilute 1:1 or 1:5.	1-2,5 % hexyl-D-glucoside 1-2,5 % (C8-18) alkyl benzyl dimethyl ammonium chloride 1-2,5 % alcohol (C10)-polyethylene glycol (5 EO)-ether <5 % benzalkonium chloride, detech-4	EU

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
96	Facade cleaner	Removes algae, mould and other growths on facades, fences, slabs, etc. [2]	Concentrated. Connect water hose for correct dosage.	<5 % alkyl(C12-16) dimethyl benzyl ammonium chloride <5 % alcohols C9-C11, ethoxylated <3 % quaternary ammonium compounds, C12-14-alkyl-(hydroxyethyl) dimethyl, ethoxylated chlorides. <5% cationic surfactants <5 % non-ionic surfactants	EU
98	Boat cleaner	Easy removal of severe stains on gelcoat. [2] Highly effective gelcoat cleaner. It can be used for cleaning aluminium, steel, plastic, or on fiberglass and teak. Effectively removes yellow-brown coatings on the waterline and hull side. [3]	Ready to use.	5-15 % oxalic acid dihydrate 1-5 % 2-propylheptanol ethoxylate 1-5 % alkyl poly glycoside 5-15 non-ionic surfactants	EU
106	Roof cleaner	Gutters for all types of roofs. Acts against algae, lichens and other growths. [3]	Concentrated. Connects to the water hose for correct dosage.	5-10 % benzyl-C12-14-alkyl dimethyl ammonium chlorides	EU
109	Tile cleaner	Cleaning tiles. [2] Effectively cleans all types of stone surfaces outdoors. Is gentle on the environment and contains only natural substances. [3]	Concentrated. Dilute 1:9.	<0,5 % potassium hydroxide	EU
110	Universal	Particularly effective cleaning agent that can be used wherever algae and green growths are a nuisance. Can be used on stone, wood, glass, concrete and ceramic surfaces. [3] 1 litre is enough for approx. 200 m^2. [2]	Concentrated. Dilute 1:10 or 1:20	4,95 % alkyl (C12-16) dimethyl benzyl ammonium chloride (ADBAC/BKC (C12-16)) (benzalkonium chloride) <5 % non-ionic surfactants, phosphonate.	EU
111	Roof cleaner	Removes green growth, algae and moss. Protects against re-attacks. [2] Deep acting liquid concentrate for effortless removal of green growth and stubborn environmental debris. The acid- and chlorine-free formula is biodegradable and provides lasting protection against new pollution. [3]	Concentrated. Dilute 1:2, 1:5 or 1:10.	<3 % quaternary ammonium compounds, benzyl-C12-C16-alkyl dimethyl chloride 5-10% cationic surfactants	EU

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
113	Tile cleaner	Ideal for sidewalks, patios, patios, paving and wooden surfaces. Fast-acting. Prevents new dirt. Biodegradable. 100% pure natural product. Lasting effect. [2]	Concentrated.	20-30% lactic acid 80% 5-10 % nonanoic acid 1-5 % cocamidopropyl betaine <5 % amphoteric surfactants	EU
115	Tile cleaner	Kills and controls green mould and algae growth. Biodegradable. Long-acting. Antibacterial. For patios, driveways, masonry and many other hard outdoor surfaces. [2]	Concentrated.	≥ 75% water 5-10 % benzalkonium chloride <1 % alcohols, C9-C11, ethoxylated	EU
119	Boat cleaner	Concentrated solvent-free cleaner for effective daily cleaning of gelcoat, as well as painted and varnished surfaces. [3]	Concentrated. Dilute 1:10	≥5 - ≤10 % α-sulfo-ω-hydroxy-poly(oxy-1,2-ethanediyl)-C12-14-alkyl ethers sodium salts ≥5 - ≤10 % amides, C8-18 og C18-unsatd., N,N-bis (hydroxyethyl) ≥3 - ≤5 % 2-propylheptanol ethoxylate ≥1 - ≤3 % 2-(2-butoxyethoxy) ethanol <0,1 % 2-methylisothiazol-3(2H)-one In addition, the SDS specifies content in accordance with Commission Regulation (EC) No 907/2006.	DK
121	Boat cleaner	Mould and stain remover. Mould and mildew remover. Disinfectant cleaner for easy quick and automatic removal of mould, mould stains, algae, moss, green growth and other organic dirt. Eliminates odours. [2]	Ready to use.	<5 % sodium hydroxide >2,5 <10 % sodium hypochlorite solution, about 12% Cl active	DK
125	Boat cleaner	A concentrated boat detergent for dissolving dirt, bird droppings, oil and dirt. Clean fiberglass and plastic surfaces, as well as varnished steel. Cares for and maintains rubber moldings. The result is a shiny clean surface that emphasizes gloss and color depth. The wax leaves a nourishing, pearly and water-repellent film. [2]	Concentrated. Dilute 1:100 or 1:50.	1-5 % sodium alkyl(C12-14) ether sulphate, ethoxylated 1-5 % triethanolamine (TEA) 1-3 % alcohol ethoxylates 1- <2,5 % amides, C8-C18 og C18-unsaturated, N,N-bis(hydroxyethyl). 5-15 % non-ionic surfactants	DK

Product no.	Primary use	Declaration	Proportions	Contents[1]	Market DK/EU/Non-EU
				5-15 % anionic surfactants	
126	Boat cleaner	An effective water-based degreaser and cleaning agent. Removes grease, dirt and salt without matting the surface. Is biodegradable and free of phosphates. Suitable for all types both exterior and interior, including painted and varnished surfaces. Can also be used for washing the engine. [3]	Concentrated. Dilute 1:50-1:100 or 1:20.	≤3 % betaines, coconut-alkyl dimethyl- <5 % non-ionic surfactants.	DK
130	Boat cleaner	Removes algae and shellfish residues. Removes algae and sea splashes. Removes remnants of algae, mucus and rust deposits on ships, Z-drives, sail drives and outboard engines. [2]	Ready to use	<10 % hydrochloric acid <5 % 2-ethylhexanol polyglycol ether phosphoric acid ester, sodium salt <5 % anionic surfactants <5 % non-ionic surfactants	EU
131	Tile cleaner	Moss, mould, mildew and algae stain remover. Multi surface outdoor cleaner. [2]	Ready to use.	1,65 % alkyl dimethyl benzyl ammonium chloride	Non-EU
132	Facade cleaner	Powerful 2-in-1 remedy for dirty and mouldy surfaces. [2] Effective removal of algae, mould and other dirt on facades outdoors in connection with repainting. The product also acts as a disinfectant. [3] 1 litre is enough for approx. 60 m^2. [2]	Concentrated. Dilute 1:10.	<2,5 % C12-C16 alkyl benzyl dimethyl ammonium chloride 0,1-1 % sodium metasilicate pentahydrate	EU

[1] Information from safety data sheet

[2] Declaration from product label

[3] Information from technical data sheet/website

[4] Content product No 76 indicated by reference to authorisation number under BPR: 2.5-10% dodecyl dimethyl ammonium chloride

Appendix 2. Methods

Appendix 2.1 Determination of BAC-C8 to C18 via HPLC-DAD

Liquid chromatography was carried out on an Agilent Technology 1260 HPLC system. The analytical column was a Kinetex EVO C18 150 mm x 4.6 mm, particle size 5 µm (Phenomenex). The column temperature was 40°C, and the flow rate was 1 mL/min. Mobile phase A was 0.01% formic acid in Milli-Q water, mobile phase B was 0.01% formic acid in acetonitrile. A gradient from 5% to 95% of mobile phase B was used. The total run time was 10 minutes followed by a 7-minute recalibration of the column to initial conditions.

The eluent was transferred to a diode array detector (Agilent). BAC-C8 to C18 was measured at 208 nm wavelength. A standard curve with eight calibration points was run. The expanded uncertainty was calculated for two products with a content of app. 1 and 8% w/w. The expanded uncertainty was determined to be between 5-19% and 3-14% for products containing 1 and 8% w/w, respectively.

Sample preparation took place by weighing each product from a representative subsample. The subsample was a homogeneous amount from the product container. The sample was diluted in 50/50% v/v Milli-Q water/acetonitrile. The dilution of the sample was adapted so the concentration was within the calibration area of the method. The analytical concentration was determined through duplicate determination. The method was verified via recovery of known amounts of BAC-C8 to C18 added to the sample.

Appendix 2.2 Determination of DDAC via HPLC-ELSD

Liquid chromatography was carried out on an Agilent Technology 1260 HPLC system. The analytical column was a LUNA C8 150 mm x 4.6 mm, particle size 5 µm (Phenomenex). The column temperature was 25°C, and the flow rate was 1 mL/minute. Mobile phase A was 0.5% TFA in milli-Q water, mobile phase B was acetonitrile. A gradient from 20% to 95% of mobile phase B was used. The total run time was 6 minutes followed by a 7-minute recalibration of the column to initial conditions.

The eluent was transferred to an ELSD detector (Agilent). The ELSD evaporator temperature was 90°C, the nebulizer temperature was 50°C, and the gas flow was 1.1 mL/minute. A standard curve with six points was run. The expanded analysis uncertainty was calculated to 15% for products containing 5% w/w of DDAC.

Sample preparation took place by weighing each product from a representative subsample. The subsample was a homogeneous amount from the product container. The sample was diluted in 20/80% v/v Milli-Q water/acetonitrile. The dilution of the sample was adapted so the concentration was within the calibration area of the method. The concentration was determined through five determinations. The method was verified via recovery of known amounts of DDAC added to the sample.

Appendix 2.3 Determination of DDAC via LC-MS

Liquid chromatography was carried out on an Agilent Technology 1260 HPLC system. The analytical column was a Zorbax C18 50 mm x 2.1 mm, particle size 1.8 µm (Agilent). The column temperature was 25°C, and the flow rate was 0.3 mL/minute. Mobile phase A was 0.01% formic acid in Milli-Q water, mobile phase B was 0.01% formic acid in acetonitrile. A gradient from 50% to 95% of mobile phase B was used. The total run time was 7 minutes followed by a 5-minute recalibration of the column to initial conditions.

The eluent was transferred to an Agilent 6120 Single quadruple mass spectrometer. Electro spray ionization was in positive SIM mode. DDAC was quantified as 326 m/z, whereas internal standard (BAC-C16, CAS No. 122-18-9) was identified as 360 m/z. A standard curve with eight calibration points was run.

Sample preparation took place by weighing each product from a representative subsample. The subsample was a homogeneous amount from the product container. The sample was diluted in 50/50% v/v Milli-Q water/Acetonitrile. The dilution of the sample was adapted so the concentration was within the calibration area of the method. The analytical concentration was determined through five determinations. The method was verified via recovery of known amounts of DDAC added to the sample.

Appendix 3. Analysis results

Table 22. Analysis results (%w/w) for content of BAC-C8 to C18 in outdoor detergents.

Product no.	LOQ [%w/w]	BAC-C8			BAC-C10			BAC-C12			BAC-C14			BAC-C16			BAC-C18		
		%w/w*	%RSD	%Gen	%w/w*	%RSD	%Gen	%w/w*	%RSD	%Gen	%w/w*	%RSD	%Gen	%w/w*	%RSD	%Gen	%w/w*	%RSD	%Gen
7	0.36	< LOQ	-	100	< LOQ	-	99	5.6	0.2	96	2.0	0.6	98	< LOQ	-	98	< LOQ	-	98
16	0.15	< LOQ	-	100	< LOQ	-	100	0.92	3.3	100	0.34	3.6	98	< LOQ	-	100	< LOQ	-	99
21	1.1	< LOQ	-	101	< LOQ	-	100	5.6	1.4	100	2.0	2.2	100	< LOQ	-	100	< LOQ	-	99
41	0.25	< LOQ	-	99	< LOQ	-	98	5.4	0.4	98	2.0	0.7	98	< LOQ	-	96	< LOQ	-	95
46	0.36	< LOQ	-	99	< LOQ	-	98	3.4	2.1	97	1.1	1.9	98	< LOQ	-	99	< LOQ	-	98
47	0.13	< LOQ	-	99	< LOQ	-	98	0.76	3.1	98	0.28	3.3	98	< LOQ	-	98	< LOQ	-	97
50	0.25	< LOQ	-	101	< LOQ	-	100	0.80	1.3	100	0.30	0.0	100	< LOQ	-	101	< LOQ	-	101
53	0.25	< LOQ	-	101	< LOQ	-	100	0.87	0.8	101	0.32	3.7	101	< LOQ	-	101	< LOQ	-	101
55	0.25	< LOQ	-	102	< LOQ	-	101	0.84	2.0	102	0.31	1.0	102	< LOQ	-	102	< LOQ	-	101
67	0.18	< LOQ	-	99	< LOQ	-	98	3.4	1.5	97	1.1	2.3	97	< LOQ	-	95	< LOQ	-	95
68	3.1	< LOQ	-	98	< LOQ	-	97	32	0.9	95	11	0.2	95	< LOQ	-	95	< LOQ	-	95
69	0.18	< LOQ	-	100	< LOQ	-	99	3.4	0.6	98	1.2	0.7	97	< LOQ	-	96	< LOQ	-	95
70	3.1	< LOQ	-	101	< LOQ	-	100	33	0.5	100	11	0.9	101	< LOQ	-	100	< LOQ	-	100
93	0.36	< LOQ	-	98	< LOQ	-	96	< LOQ	-	95	< LOQ	-	95	< LOQ	-	95	< LOQ	-	94
95	0.13	< LOQ	-	100	< LOQ	-	99	1.7	0.2	99	0.56	0.5	100	< LOQ	-	100	< LOQ	-	99
110	0.15	< LOQ	-	100	< LOQ	-	99	3.3	0.9	100	1.1	0.9	99	< LOQ	-	97	< LOQ	-	95
132	0.06	< LOQ	-	98	< LOQ	-	98	1.7	0.3	95	0.58	0.6	97	< LOQ	-	2.4	< LOQ	-	95

** "LOQ" refers to the content being below the quantification limit of the established method and sample preparation.*

Table 23. Analysis results (%w/w) for content of DDAC in outdoor detergents.

Product no.	LOQ [%w/w]	DDAC		
		%w/w	%RSD	%Gen
17	0.23	2.00	1.4	98
52	0.09	0.259	2.3	112
76	0.50	4.46	0.7	93

Appendix 4. Environmental hazard assessment

Appendix 4.1 Data for selected substances - environmental hazard

Table 24. Data on environmental hazards of selected substances. The overview shows available information from relevant assessments. As far as possible, the PNEC values are based biocidal active substance assessments, alternatively on REACH registration data. The effect values underlying the PNEC are marked in bold. UF: Uncertainty factor applied, STP: Sewage treatment plant, EqP: PNEC determined by equilibrium calculation.

Substance name	CAS No.	Stability and mobility	Biodegradability	Bioaccumulation	CMR and ED	Ecotoxicity to relevant matrices in the environment	PNEC
ADBAC (C12-C16)[19]	68424-85-1	Hydrolytically stable (pH range 5-9) Photolytically stable in water (US EPA 2006a) Strongly binds to sediment and soil. Not mobile in soil (US EPA 2006a)	Readily biodegradable	Low potential for bioaccumulation BCF_{fish} 79 L/kg	No CMR classification Not listed as endocrine disruptors (ED List 2022)	Aquatic environment – Acute LC_{50}: 0.28 mg/L (96h, fish, freshwater) LC_{50}: 1.36 mg/L (96h, fish, marine water) EC_{50}: 0.016 mg/L (48h, *Daphnia magna,* freshwater) EC_{50}: 0.32 mg/L (48h, *Acartia tonsa,* marine water) EC_{50}: **7.75 mg/L** (microorganisms, wastewater) (ECHA 2022a, 2022i) Aquatic environment – Chronic NOEC: 32 µg/L (28d, fish, freshwater) NOEC: **4.15 µg/L** (21d, *Daphnia magna,* freshwater) (ECHA 2022a, 2022i) EC_{10}: 9 µg/L (72h, algae, freshwater) EC_{10}: **96 µg/L** (72h, algae, marine water) EC_{10}: 1.6 mg/L (microorganisms, wastewater) Sediment No data available Terrestrial environment - Acute	Freshwater: 042 µg/L (UF: 10) (ECHA 2022a, 2022i) Marine water: 0.096 µg/L (UF: 1000) STP: 77,5 µg/L (UF: 100) (ECHA 2022i) Freshwater sediment: 6.8 mg/kg (dry weight) (EqP) (UF 10) (ECHA 2022i) Sediment, marine: 16 mg/kg (dry weight) (EqP) Soil: 0,83 mg/kg (dry weight) (UF: 100) (ECHA 2022i)

[19] Data are from ECHA 2022a, unless otherwise mentioned.

Substance name	CAS No.	Stability and mobility	Biodegradability	Bioaccumulation	CMR and ED	Ecotoxicity to relevant matrices in the environment	PNEC
						EC_{50}/LC_{50}: 277 mg/kg soil dw (plants) EC_{50}/LC_{50}: 7.07 g/kg soil dw (macroorganisms ÷ arthropods) EC_{50}: 153 mg/kg soil dw (microorganisms) Terrestrial environment - Chronic EC_{10}/LC_{10}/NOEC: 856.2 mg/kg soil dw (plants) EC_{10}/LC_{10}/NOEC: 125 mg/kg soil dw (macroorganisms ÷ arthropods) EC_{10}: **83 mg/kg soil dw** (microorganisms) (ECHA 2022a, 2022i)	
ADBAC (C12-C14)[20]	85409-22-9	Hydrolytically stable (pH range 5-9) Photolytically stable in water (US EPA 2006a) Strongly binds to sediment and soil. Not mobile in soil (US EPA 2006a)	Readily biodegradable	Low potential for bioaccumulation BCF_{fish} 79 L/kg	No CMR classification Not listed as endocrine disruptors (ED List 2022)	Aquatic environment - Acute LC_{50}: 0.28 mg/L (96h, fish, freshwater) LC_{50}: 1.36 mg/L (96h, fish, marine water) EC_{50}: 0.016 mg/L (48h, *Daphnia magna,* freshwater) EC_{50}: 0.32 mg/L (48h, *Acartia tonsa,* marine water) EC_{50}: **7.75 mg/L** (microorganisms, wastewater) (ECHA 2022b, 2022i) Aquatic environment - Chronic NOEC: 32 µg/L (28d, fish, freshwater) NOEC: **4.15 µg/L** (21d, *Daphnia magna,* freshwater) (ECHA 2022b, 2022i) EC_{10}: 9 µg/L (72h, algae, freshwater) EC_{10}: **96 µg/L** (72h, algae, marine water)	Freshwater: 0.42 µg/L (UF: 10) (ECHA 2022b, 2022i) Marine water: 0.096 µg/L (UF: 1000) STP: 77.5 µg/L (UF: 100) (ECHA 2022i) Freshwater sediment: 6.8 mg/kg (dry weight) (EqP) (UF 10) (ECHA 2022i) Sediment, marine water: 16 mg/kg (dry weight) (EqP) Soil: 0.83 mg/kg (dry weight) (UF: 50100) (ECHA 2022i)

[20] Data are from ECHA 2022b, unless otherwise mentioned. In the registration dossier for ADBAC (C12-C14), read-across is made to ADBAC (C12-C16) for which data are used.

Substance name	CAS No.	Stability and mobility	Biodegradability	Bioaccumulation	CMR and ED	Ecotoxicity to relevant matrices in the environment	PNEC
						EC_{10}: 1.6 mg/L (microorganisms, wastewater) Sediment No data available Terrestrial environment - Acute EC_{50}/LC_{50}: 277 mg/kg soil dw (plants) EC_{50}/LC_{50}: 7.07 g/kg soil dw (macroorganisms ÷ arthropods) EC_{50}: 153 mg/kg soil dw (microorganisms) Terrestrial environment - Chronic EC_{10}/LC_{10}/NOEC: 856.2 mg/kg soil dw (plants) EC_{10}/LC_{10}/NOEC: 125 mg/kg soil dw (macroorganisms ÷ arthropods) EC_{10}: **83 mg/kg soil dw** (microorganisms) (ECHA 2022b, 2022i)	
DDAC[21]	7173-51-5	Hydrolytically stable (pH range 4-9) Photolytically stable in water and soil (US EPA 2006b) Strongly binds to sediment and soil. Non-mobile in soil (US EPA 2006b)	Readily biodegradable Degrades slowly in the environment (US EPA 2006b): DT50 (water, aerobic) 180 days, DT50 (water, anaerobic) 261 days, DT50 (soil, aerobic) 1048 days	No studies available. Bioaccumulation of DDAC is not likely in aquatic life (US EPA 2006b)	No CMR classification Not listed as endocrine disruptors (ED List 2022)	Aquatic environment - Acute LC_{50}: 0.19 mg/L (96h, fish, freshwater) EC_{50}: 0.062 mg/L (48h, invertebrates, freshwater) EC_{50}: **14.3 mg/L** (microorganisms, wastewater) (ECHA 2022c, 2022j) Aquatic environment - Chronic NOEC: 32 µg/L (fish, marine water) NOEC: 14 µg/L (21d, freshwater) EC_{10}: **11 µg/L** (96h, algae, freshwater) (ECHA 2022c, 2022j)	Freshwater: 1.1 µg/L (UF: 10) (ECHA 2022c, 2022j) Marine water: 0.11 µg/L (UF: 100) STP: 140 µg/L (UF: 100) (ECHA 2022c, 2022j) Sediment, freshwater: 6.19 mg/kg (dry weight) (EqP) (UF:10) (ECHA 2022j) Sediment, marine: 6.19 mg/kg (dry weight) (EqP)

[21] Data are from ECHA 2022c, unless otherwise mentioned.

Substance name	CAS No.	Stability and mobility	Biodegradability	Bioaccumulation	CMR and ED	Ecotoxicity to relevant matrices in the environment	PNEC
						Sediment No data available Terrestrial environment - Acute EC_{50}: 509 mg/kg soil dw (macroorganisms ÷ arthropods) EC_{50}: 148 mg/kg soil dw (plants) EC_{50}: 120 mg/kg soil dw (microorganisms) Terrestrial environment - Chronic NOEC: 125 mg/kg soil dw (macroorganisms ÷ arthropods) EC_{10}/LC_{10}/NOEC: 857 mg/kg soil dw (plants) EC_{10}/NOEC: **79.1 mg/kg soil dw** (microorganisms) (ECHA 2022j)	Soil: 1.58 mg/kg (dry weight) (UF: 50)
Cocamidopropyl betaine[22]	61789-40-0	Hydrolytically stable, estimated half-life of hydrolysis, DT50 >1 year (OECD 2006a) Low potential for binding to soil (OECD 2006a) Degraded by atmospheric oxidation (OECD 2006a): DT50 6-9 hours	Readily biodegradable Degrading in wastewater treatment plants under aerobic and anaerobic conditions (OECD 2006a)	Low potential for bioaccumulation BCF estimated 71 L/kg	No M and R classification based on available data. No data for C. Not listed as endocrine disruptors (ED List 2022) The group of Alkylamidopropyl betaines is not assessed to have CMR or ED	Aquatic environment - Acute LC_{50}: 2.0 mg/L (96h, fish, freshwater) EC_{50}: 6.4 mg/L (48h, *Daphnia magna,* freshwater) EC_{50}: **3000 mg/L** (microorganisms, *Pseudomonas putida*) EC_{10}: 30 mg/L (48h, algae, freshwater) Aquatic environment - Chronic NOEC: **160 µg/L** (28d, fish, freshwater) NOEC: 900 µg/L (21d, *Daphnia magna,* freshwater) Sediment – not relevant	Freshwater: 3.2 µg/L (UF: 50) Marine water: 0.32 µg/L (UF: 500) STP: 300 mg/L (UF: 10) Sediment, freshwater: 219 µg/kg (dry weight) (EqP) Sediment, marine: 21.9 µg/kg (dry weight) (EqP) Soil: 41.9 µg/kg (dry weight) (EqP)

[22] Data are from ECHA 2022d, unless otherwise mentioned.

Substance name	CAS No.	Stability and mobility	Biodegradability	Bioaccumulation	CMR and ED	Ecotoxicity to relevant matrices in the environment	PNEC
					properties (ECHA, 2019)	Terrestrial environment - not relevant	
ADAO [23]	308062-28-4	Hydrolytically stable (pH range 4-9) Degrades by atmospheric oxidation (OECD 2006b): DT50 ≈ 5 hours	Readily biodegradable Degrades in wastewater treatment plants under aerobic and anaerobic conditions (OECD 2006b)	No studies available Low potential for bioaccumulation based on calculated BCF < 87 (OECD 2006b)	No CMR classification Not listed as endocrine disruptors (ED List 2022)	Aquatic environment - Acute LC_{50}: 2.67 mg/L (96h, fish, freshwater) EC_{50}: 3.1 mg/L (48h, *Daphnia magna,* freshwater) EC_{50}: 143 µg/L (72h, algae, freshwater) Aquatic environment - Chronic NOEC: 420 µg/L (302d, fish, freshwater) NOEC: 700 µg/L (21d, *Daphnia magna,* freshwater) EC_{10}: **67 µg/L** (28d, algae, freshwater) EC_{50}: **24 mg/L** (microorganisms, *Pseudomonas putida*) Sediment – not relevant Terrestrial environment – not relevant	Freshwater: 34 µg/L (UF: 2) Marine water: 3 µg/L (UF: 20) STP: 24 mg/L (UF: 1) Sediment, freshwater: 5.24 mg/kg (dry weight) (EqP) Sediment, marine: 0.52 mg/kg (dry weight) (EqP) Soil: 1.02 mg/kg (dry weight) (EqP)

[23] Data are from ECHA 2022e, unless otherwise mentioned.

Appendix 5. Calculation of concentration in soil

Calculation of ADBAC soil concentration (conc-soil) for tile cleaning – rural area

Substance amount	40	g		
Treated area	104	m^2		
Soil volume	52	m^3	At a depth of 0.5 m	
Soil density	1700	kg wwt/m^3		
Soil matrix density	2500	kg dw/m^3		
Porewater density	1000	kg/m^3		
Substance conc. soil wwt	0.452489	mg/kg wwt		(40 g x 1000 / (52m^3 x 1700 kg wwt/m^3))
Substance conc. soil dw	0.512821	mg/kg dw		(0.452*(0.6*2500+0.2*1000)/(0.6*2500))

Calculation of DDAC soil concentration (conc-soil) for wash of wooden terrasse – urban and rural area

Substance amount	300	g		
Treated area	30	m^2		
Soil volume	15	m^3	At a depth of 0.5 m	
Soil density	1700	kg wwt/m^3		
Soil matrix density	2500	kg dw/m^3		
Porewater density	1000	kg/m^3		
Substance conc. soil wwt	11.76471	mg/kg wwt		(300 g x 1000 / (15m^3 x 1700 kg wwt/m^3))
Substance conc. soil dw	13.33333	mg/kg dw		(11.7*(0.6*2500+0.2*1000)/(0.6*2500))

Calculation of ADAO soil concentration (conc-soil) – for roof cleaning – rural area

Substance amount	773	g		
Treated area	-	m^2		
Soil volume	13	m^3		
Soil density	1700	kg wwt/m^3		
Soil matrix density	2500	kg dw/m^3		
Porewater density	1000	kg/m^3		
Substance conc. soil wwt	34.97738	mg/kg wwt		(773 g x 1000 / (13m^3 x 1700 kg wwt/m^3))
Substance conc. soil dw	39.64103	mg/kg dw		(35*(0.6*2500+0.2*1000)/(0.6*2500))

Following applies to the soil:
Density of soil is 1700 kg wet weight/m^3 (ECHA 2022h)
The soil consists of 60% soil matrix, 20% porewater og 20% air.
Density of soil matrix is 2500 kg/m^3

Appendix 6. Environmental risk assessment of 17 products

The environmental risk assessment has been carried out for direct exposure to the soil environment by calculating the local concentration in the soil for tile cleaning, wood washing and roof cleaning. The calculations have been made according to the calculations shown in Appendix 5.

Product no.	Substance	Use	Conc. in product [24]	Amount of product used per m^2 [24]	Washed area	Amount of substance used [25]	PEC_{Soil}	$PNEC_{Soil}$	RCR
16	ADBAC	Universal/wood washing	1.26%	200 ml (reference volume)	30 m^2	76 g [26]	3.38 mg/kg soil dry weight	0.83 mg/kg soil dry weight	4.07
21	ADBAC	Wood washing	7.6%	60 ml (reference volume)	30 m^2	137 g [27]	6.01 mg/kg soil dry weight	0.83 mg/kg soil dry weight	7.24

[24] Please refer to Appendix 3 for the measured concentrations of ADBAC and DDAC and to Appendix 1 for the recommended amount of the product used per m^2.

[25] Calculated as $conc\ (\% * 10)\ {}^{g}/_{L} * \frac{Used\ {}^{ml}/_{m^2}}{1000\ {}^{ml}/_{L}} * washed\ area\ m^2$

[26] Assuming the same volume as product no. 50 per m^2 due to a lack of information on the product volume in m^2 from the manufacturer.

[27] Assuming the same volume as product no. 41 per m^2 due to a lack of information on the product volume in m^2 from the manufacturer.

Product no.	Substance	Use	Conc. in product [24]	Amount of product used per m^2 [24]	Washed area	Amount of substance used [25]	PEC_{Soil}	$PNEC_{Soil}$	RCR
41	ADBAC	Universal/wood washing	7.4%	60 ml	30 m^2	133 g	5.91 mg/kg soil dry weight	0.83 mg/kg soil dry weight	7.12
46	ADBAC (C12-C14)	Roof cleaning – rural area	4.5%	29.4 ml	145 m^2	192 g	9.85 mg/kg soil dry weight	0.83 mg/kg soil dry weight	11.9
47	ADBAC (C12-C16)	Universal/wood washing	1.04%	100 ml	30 m^2	31.2 g	1.39 mg/kg soil dry weight	0.83 mg/kg soil dry weight	1.67
50	ADBAC	Wood washing	1.1%	200 ml	30 m^2	66 g	2.93 mg/kg soil dry weight	0.83 mg/kg soil dry weight	3.53
52	DDAC	Tile cleaning– rural area	0.259%	250 ml	104 m^2	67.3 g	0.86 mg/kg soil dry weight	1.58 mg/kg soil dry weight	0.54
53	ADBAC	Roof cleaning – rural area	1.19%	33.3 ml	145 m^2	57.5 g	2.95 mg/kg soil dry weight	0.83 mg/kg soil dry weight	3.55
55	ADBAC	Wood washing	1.15%	200 ml (reference volume)	30 m^2	69 g [26]	3.07 mg/kg soil dry weight	0.83 mg/kg soil dry weight	3.69
67	ADBAC	Roof cleaning – rural area	4.5%	20 ml	145 m^2	131 g	6.72 mg/kg soil dry weight	0.83 mg/kg soil dry weight	8.09

Product no.	Substance	Use	Conc. in product [24]	Amount of product used per m^2 [24]	Washed area	Amount of substance used [25]	PEC_{Soil}	$PNEC_{Soil}$	RCR
68	ADBAC	Roof cleaning – rural area	43%	2 ml	145 m^2	127 g	6.51 mg/kg soil dry weight	0.83 mg/kg soil dry weight	7.85
69	ADBAC	Universal/wood washing	4.6%	5 ml (reference volume)	30 m^2	6.9 g [28]	0.31 mg/kg soil dry weight	0.83 mg/kg soil dry weight	0.37
70	ADBAC	Roof cleaning – rural area	44%	500 ml	145 m^2	31.900 g	1636 mg/kg soil dry weight	0.83 mg/kg soil dry weight	1971
76	DDAC	Tile cleaning– rural area	4.46%	5 ml	104 m^2	23.2 g	0.30 mg/kg soil dry weight	1.58 mg/kg soil dry weight	0.19
95	ADBAC (C8-C18)	Universal/wood washing	2.26%	200 ml (reference volume)	30 m^2	136 g [26]	6.04 mg/kg soil dry weight	0.83 mg/kg soil dry weight	7.28
110	ADBAC (C12-C16)	Universal/wood washing	4.4%	5 ml	30 m^2	6.6 g	0.29 mg/kg soil dry weight	0.83 mg/kg soil dry weight	0.35
132	ADBAC	Universal/wood washing	2.28%	16.7 ml	30 m^2	11.4 g	0.51 mg/kg soil dry weight	0.83 mg/kg soil dry weight	0.61

[28] Assuming the same volume as product no. 110 per m^2 due to a lack of information on the product volume in m^2 from the manufacturer.

Mapping and environmental assessment of cleaning products for outdoor use
This project maps products for outdoor cleaning sold to private consumers. The focus of the project is surfactants with a cleaning effect, but which are also identified as biocidal active substances. Based on an analysis of the product labels, products have been selected for chemical analysis of selected surfactants and an environmental risk assessment has been carried out for the use of representative products within the product categories: Tile cleaner, wood wash, roof cleaner and boat cleaner.

This report presents the results of the mapping, the product declaration analysis, the chemical analyses, and the environmental risk assessment. . Chemical analyses and environmental risk assessment of two surfactants, alkyldimethylbenzylammonium chloride (ADBAC) and didecyldimethylammonium chloride (DDAC), have been carried out for a total of 20 products. In addition, environmental risk assessment has been carried out for the use of products with alkyldimethylamine oxide (ADAO) for roof cleaning and for products with cocamidopropyl betaine for boat cleaning.

The Danish Environmental
Protection Agency
Tolderlundsvej 5
DK-5000 Odense C

www.mst.dk