TA-2562/2009

Swerea IVF
Project report 09/46

Survey of the extent of use and occurrence of PFNA (perfluorononanoic acid) in Norway

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swerea IVF

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Swerea IVF Project report 09/41

Preface

The Norwegian policy and goal is to eliminate the use and emissions of chemicals that cause injury to health or environmental damage. These chemicals shall be completely eliminated before 2020. Therefore, the Norwegian Pollution Control Authority (SFT) has commissioned a survey carried out by Swerea IVF (Sweden) that aims to identify and quantify the consumption, uses and occurrence of PFNA in Norway with a certain focus on import of consumer and industrial products that may be sources of PFNA. The overall aim for SFT is to prioritize increased awareness and risk reduction for health and environment related to perfluorinated substances, among them PFNA and its precursors.

This report outlines relevant perfluorinated products and possible user companies of these products that were surveyed as potential sources of PFNA in Norway. PFNA is present in low concentrations in consumer and industrial products such as coated and impregnated textiles, carpets, paper, cleaning agents, paints and lacquers and similar commercial products.

The conclusions and results from this study are that;

- There are a wide range of volatile PFNA precursors that may enter Norway origin from manufacturing plants in several parts of the world or from imported or manufactured products used in Norway since there is no production of perfluorinated substances in Norway.
- Approximately 40.000 companies in various sectors in Norway were identified to be potential users of perfluorinated products
- From the latest OECD survey and overview from 2007 of identified perfluorinated precursors and intermediates, 152 PFNA related substances were identified as potential sources to PFNA.
- Of these 152 PFNA related substances, 30 substances were identified in 229 products in the Norwegian Product Register, reported to be used in a total amount of 1.6 kilograms. The explanation of this low volume reported is partly that neither PFNA nor any of the identified precursors are classified as hazardous in Directive 67/548/EEC.
- Knowledge of PFNA content in products is in general low among producers and users.
- There are still data gaps concerning the extent of uses and “real” substance content in industrial and consumer products that need to be further investigated. This is mostly caused by limited or lack of information from industrial users and manufacturers of PFNA related substances.

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Summary

Perfluorinated chemicals are extremely versatile and are used in a variety of industrial and consumer applications and products. Some of these perfluorinated products contain or release perfluoroalkyl carboxylates (PFCAs), among them perfluorononaoic acid (PFNA). PFNA is described in a few literature sources as being persistent and better described in literature as widely spread in man and environment. Some of the polyfluorinated products, known as PFNA-precursors, can be degraded to PFNA in the environment.

In context to Norwegian policy, the discharges of perfluorinated substances should be significantly reduced by 2010 and completely eliminated before 2020. Therefore the Norwegian Pollution Control Authority (SFT) has commissioned Swerea IVF (Sweden), to perform a survey that aims to identify and quantify the consumption, uses and occurrence of PFNA in Norway, with a certain focus on import of consumer and industrial products that may be sources of PFNA since there is no production of fluoro chemicals in Norway

This report outlines relevant perfluorinated products and possible user companies of these products that were surveyed as potential sources of PFNA in Norway. Since the Norwegian market is complex, priorities in the selection of relevant products and companies for a survey were necessary for the source identification and quantification of PFNA in Norway. For the determination of the quantities of relevant products on the Norwegian market and the companies that trade these products, a substantial search in the Norwegian Product register was performed. The search was based on the current published version of the OECD preliminary list of Perfluorinated Substances from August 2007, which cover around 1000 fluorinated substances. From this list 152 substances that may degrade into PFNA have been identified. In addition a search in the Norwegian product register at SFT found 30 substances of these 152 identified precursors in the OECD preliminary list from 2007 that may possibly be used in chemical products in Norway. However, the total amount reported for these 30 substances in the 229 products where it occurred was 1.6 kilograms. The explanation of this low volume reported is partly that neither PFNA nor any of the 152 precursors are classified as hazardous in Directive 67/548/EEC

The study of use and occurrence has included a number of searches in different library, database and literature sources. The documented uses are mainly as surfactants and surface treatment agents and the product groups that are known today to contain PFNA is mainly water and dirt repellence treated textiles such as clothing and home textiles, but also as non-stick treated cookware and dental care products. The main conclusion that can be drawn from this study is that there is little knowledge about many of the PFNA related substances, including PFNA precursors that are probable high volume chemicals in the EU.

A parallel search was conducted in the Nordic Business Key by D&B (www.nordicbusinesskey.com) updated in the beginning of 2009. This database covers registered companies in Norway, and among these approximately 40.000 companies in various sectors were identified to be potential users of

perfluorinated products. Since a direct contact with all these companies was a time consuming and unrealistic task, only a few companies in each sector were contacted selected to their size (turnover and number of employees) of relevant companies, or if they already were known from previous studies as users of perfluorinated products. It was also recommended to identify companies that are positioned early in the Norwegian distribution chain, such as importers and distributors.

In this survey a range of impregnated consumer products and cleaning agents have been identified as potential sources of perfluorinated substances and consequently as potential sources of PFNA into Norwegian society and environment. The information from contacted manufacturers of for instance, outdoor clothing support that these consumer products may be a source of perfluorinated substances. Other consumer products like greaseproof paper seem, in Norway, not to be manufactured with perfluorinated substances. This does not exclude the possibility that the same products imported to Norway may not be potential sources of PFNA. Most of the companies did not provide the project team with sufficient data within the fields of wholesale and retail sale.

This survey describes a range of quantitative data concerning consumer products and historical data of possible indirect and direct emissions of PFNA from manufacturing use and processing of perfluorinated products in Norway. Due to the lack of sufficient data, this study cannot fully assess the relative importance of either manufactured or imported consumer articles for PFNA exposure in Norway. However there is no doubt that there are potential sources of PFNA, either long range transport into Norway or emissions from products used in Norway.

It is strongly recommended to have a continuous follow –up of the current emission sources and fate of perfluorinated substances into the Norwegian environment in order to support future prioritization and risk reduction measures.

This data gathered in this study, taking into account all identified data gaps and the sometimes limited information available can be supportive and serve as a guideline for the future work of assessments of important potential sources to PFNA and other perfluorinated substances in Norway.

1 Introduction

1.1 Background and purpose

The Norwegian policy and goal is to eliminate the use and emissions of chemicals that cause injury to health or environmental damage. These chemicals shall be completely eliminated before 2020 which is stated in the so-called one generation target report (State of Norway, 2006-2007). In this context the Norwegian government wishes to improve knowledge of a wide range of potential toxic perfluoro carboxylic acids (PFCA), among them perfluorononanoic acid (PFNA), and find out whether they are just as dangerous as perfluorooctane sulfonate (PFOS), which is banned in EU and several other countries and regions worldwide due to its known hazard characteristics to human health and the environment.

With this background the Norwegian Pollution Control Authority (SFT) has issued an action plan for 2008-2010 to prioritize increased awareness and risk reduction for health and environment related to perfluorinated substances (SFT, 2008).

SFT has therefore commissioned a survey carried out by Swerea IVF (Sweden) that aims to identify and quantify the consumption, uses and occurrence of PFNA in Norway with a certain focus on import of consumer and industrial products that may be sources of PFNA. There is no production of fluoro chemicals in Norway.

1.2 Project methodology

The methodology used for the product survey is

- Identification of relevant business sectors and contact with major companies in Norway or importers to Norway within the following sectors.
  - Impregnation of packaging (paper/cardboard)
  - Impregnation/surface protection of clothing, footwear, rugs, carpets, and furniture based on leather or textile fabrics
  - Cleaning agents, waxes and polishes for cars and floors
  - Waxes for skiing
  - Paints and varnishes
  - Oil and mining industry
  - Photo industry
  - Electric and electronic parts manufacturing
  - Aviation hydraulic fluids
  - Pesticides
  - Medical devices
  - Metal plating
  - Fire fighting foams

- Identification of relevant companies operating in Norway through the Nordic Key business database updated in the beginning of 2009 (Nordic Key business database, 2009). The largest and the most relevant companies and branch organisations operating in Norway that might be potential users of PFNA are contacted primarily by personal contact (phone interviews) supplemented by e-mail correspondence.

- Parallel search and cross assessment in the Norwegian Product Registry, the preregistration database of ECHA[1] within REACH, the SPIN database[2] and other significant databases compiled with the extensive "Lists of PFOS, PFAS, PFOA, PFCA, related compounds and chemicals that may degrade to PFCA" issued by the Organization for Economic Co-operation and Development (OECD) on 21st of August, 2007 (OECD, 2007). If later versions of lists are published by OECD during the project, complementary compiling will be compared to these relevant databases mentioned.

- All the important major international producers of perfluorinated compounds are contacted primarily by personal contact (phone interviews) supplemented by e-mail correspondence. These are DuPont, 3M, Asahi Glass, Clariant International, Daikin, and Dyneon.

2 Chemistry

Fluorochemicals, of which perfluorinated carboxylic acids (PFCAs) are a sub-group, do not occur naturally. They have been manufactured for 50 years and represent a large and complex group of organic substances with unique characteristics that are extremely versatile and used in a variety of industrial and household applications.

Presently the knowledge of the exact chemical compositions in articles and preparations of perfluorinated compounds is very limited.

Recent years of research have substantially improved our knowledge of this wide range of poly- and perfluoroalkylated substances (PFAS) and their uses, but there is lot still a to explore concerning their uses and occurrence in the environment.

The main characteristics of polyfluorinated compounds are the replacement of most hydrogens by fluorine in the aliphatic chain structure. Some of these organic fluorine compounds are known as perfluorinated, which means that all hydrogens have been replaced with fluorine with a large variety of chemical forms and structures. Due to the diversity of fluoro organic substances it is important to understand the developed chemical terminology. These terms are described in annex 1 in this report.

[1] http://apps.echa.europa.eu/preregistered/pre-registered-sub.aspx
[2] http://195.215.251.229/fmi/xsl/spin/SPIN/maininfo.xsl?-db=SPINstof&-lay=SpinNavn&-max=1&-findall

The chemical structure of PFNA contains a perfluorinated carbon chain with eight carbons connected to a carboxylate group (RCO_2^-).

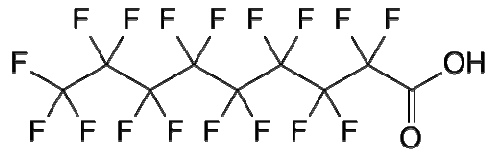

Figure 1 The chemical structure of perfluorononanoic acid.

There are sparse physical data of PFNA publicly available in literature, but as a higher homologue to the much more studied PFOA, we may assume that the physical properties of PFNA are close to those of PFOA (SFT, 2007). If this assumption is in order, PFNA is probably a stronger acid than PFOA that has a pKa value below 2.5
This is also supported by one published data of the pKa value of 0.3 (Sinclair, 2007).

A probable equilibrium reaction for the dissociation of PFNA to PF N^- in the environment is shown below.

Equilibrium

$$CF_3(CF_2)_7COO^- + H^+ \leftrightarrow CF_3(CF_2)_7COOH$$

PFN^- **PFNA**
Majority Minority

2.1 Production processes of fluoro chemicals

Commercially important perfluoroalkylated substances of the R_F-X type (where R_F is a perfluorinated alkyl group, and X is any substituent) are produced by one of two general approaches:

A. Organic compounds with the carbon skeleton of the desired product are subjected to electrochemical perfluorination processes to produce the target molecule.
The commercially operated perfluorination processes are:

- electrochemical fluorination, (ECF)
- cobalt trifluoride mediated fluorination (CTMF) with elemental fluorine
- direct fluorination with elemental fluorine

B. The perfluoroalkyl skeleton of the target molecule is constructed using a perfluorinated "building block" containing some potentially useful functional group as in the telomerisation technologies. The most important "building blocks" are the low molecular weight perfluoroolefins and their derived perfluoroalkyl iodides. (Peter Fisk associates, 2001).

2.1.1 Electrochemical fluorination processes

Direct fluorination, "electro-chemical fluorination", (ECF), reaction for the formation of PFOSF is shown below:

$C_8H_{17}SO_2Cl + 18\ HF \rightarrow C_8F_{17}SO_2F + HCl$ + by-products

Note: Example with fluoroacid above. If HF is replaced with an alcohol or phenol the corresponding sulfonic ester is formed. If amides are added corresponding sulfonic amides are formed etc.

In the ECF process, all hydrogens are replaced by fluorine in a radical reaction. The ECF process yields 10-30% branched isomers and has inherent lack of selectivity in respect to the position of fluorination resulting in a wide range of fluorinated products and by-products.

Through the ECF process initially perfluorinated sulphonyl- and carbonylfluorides or the corresponding amides are manufactured. The perfluorinated sulphonyl- and carbonylfluorides or corresponding amides are not sold as such on the market but are primarily used as important intermediates for the manufacture of different fluorpolymers and further converted monomers (Stedingk et al, 2004), (Poulsen et al 2005).

2.1.2 PFNA formation in the ECF process

The production of PFOS derivatives from linear alkyl precursors using ECF is not a clean process but instead gives complex mixtures that contain approximately 86% PFOS. This process also produces homologues of PFCAs and sulphonates (PFSAs). Recent studies show that PFNA is among the major impurities in a commercial mixture of PFOS and is likely produced during the ECF process in measurable quantities. (Arsenault et al 2008).

A likely source for the formation of PFNA is through the chemical intermediate N-Alkylperfluorooctanesulphonamidoethanol (FOSE), see figure 2 below (Kissa 2001). Conclusively it is likely that PFOS related products are indirect sources to emissions of PFNA when used as articles and preparations.

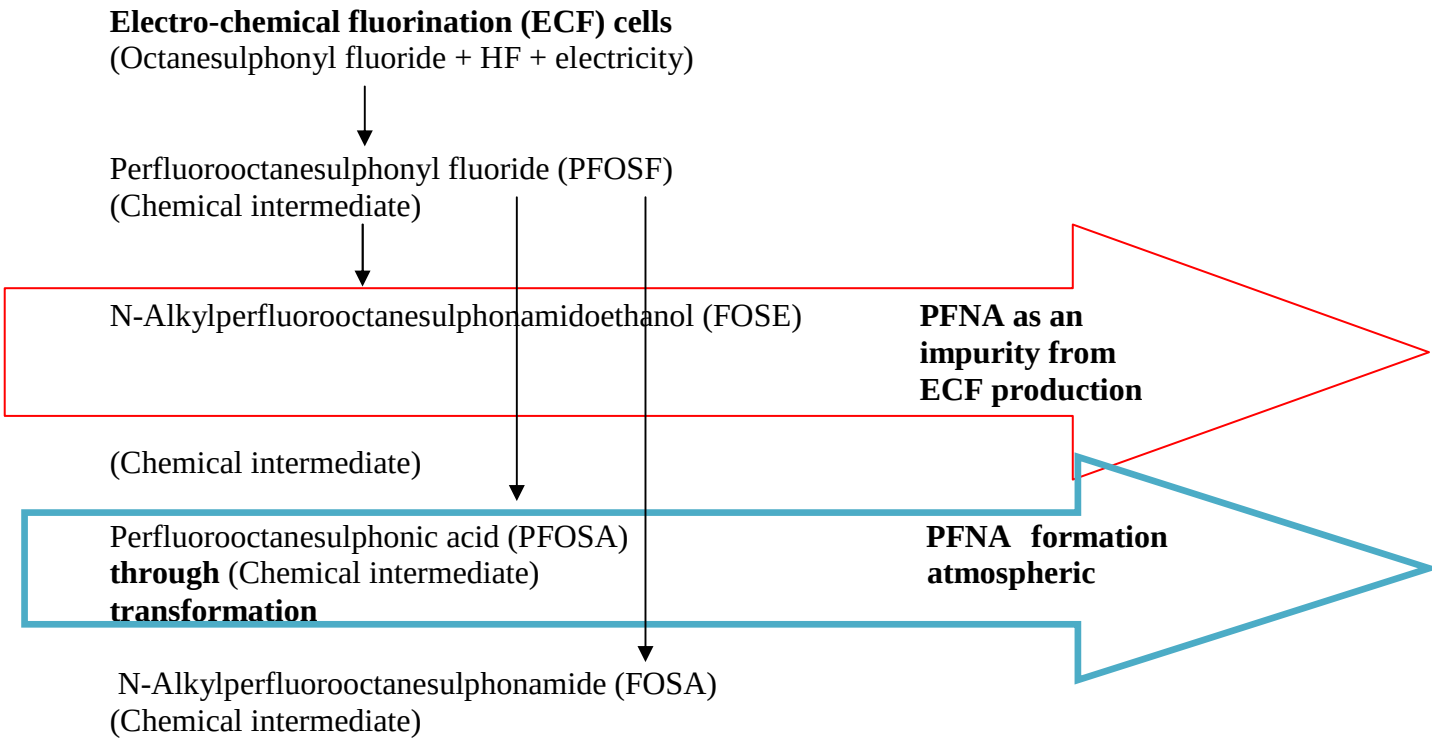

Figure 2 ECF chart will probably indirect formation of PFNA from perfluorooctylsulfonamido alcohols (PFOSAs).

2.1.3 Telomerisation processes

A second process used to manufacture perfluorinated compounds is by the telomerisation process. The telomerisation process a molecule, called a telogen reacts, with two or more unsaturated molecules in the ethylene family, called taxogens. The principal reaction is:

$$YZ + nA \rightarrow Y-(A)_n-Z$$

Telogen Taxogen Telomer

When pentafluoroethyl iodide (telogen) as an example is reacted with tetrafluoroethylene (taxogen) straight, short chain "telomers" are with the general formula: $F[CF_2CF_2]_nI$ where *n* is between 4 and 8 (Kissa, 2001).

The telomerisation process yield only linear, even carbon number substances as it is practiced commercially.

There are two commercially operated telomerisation processes (preparation of linear polymer chains of limited and relatively short length) used for producing highly fluorinated compounds, referred to as:

A. Telomer iodide process
B. Telomer alcohol process

Telomer iodide technology is by far the most important. It is based on pentafluoroethyl iodide as the telogen reacting with a fluoroolefin, usually

tetrafluoroethylene which is described below.

$C_2F_5I + 3\ C_2F_4 \rightarrow C_8F_{17}I \rightarrow C_8F_{17}$-surfactants

2.1.4 PFNA formation in the telomerisation process

Fluorotelomer alcohols are manufactured in the telomerisation process as described above. These telomer alcohols are volatile and may be transported over vast geographical areas with an influence of atmospheric transformations etc.

A model of the North American continent for fluorotelomer alcohols emitted from the entire life-cycle has been published (Yarwood et al 2007). Similarly Ellis and research colleagues have shown the atmospheric transformation of 8:2 fluorotelomer alcohol (8:2 FTOH) yields PFNA, which could in this sense mean that the telomerisation process may be indirect sources for PFNA. (Ellis et al 2004).

3 Historic production and emission sources of PFNA and related compounds

PFNA has been manufactured since about 1975 by the ozonolysis of fluorotelomer olefins and has been used principally in the form of ammonium salt as an essential surfactant for the manufacture of fluoropolymers such as polyvinylidinfluorid (PVDF). There are some manufacturers that apply the ECF process for commercial production of perfluorinated substances. In China there are 15 plants reported that manufactured approximately 200 tonnes PFOS precursors in 2006 for export to Brazil, Japan and EU (Jiang, 2009).

Ammonium perfluorononanoate is manufactured primarily in Japan by oxidation of a mixture of linear fluorotelomer olefins (FTOs) to the corresponding odd numbered PFCAs. The simple raw material is 8:2 fluorotelomer olefin (8:2 FTO). Patent citations also indicate fluorotelomer iodide carboxylation as a process for APFN production. The starting fluorotelomer or iodide dictates the resulting PFCA composition. APFN production is believed to have started in 1975 and probably continues today. Estimated annual production of APFN in 2004 was between 15 and 75 tonnes, where estimated emissions to environment are around 10% of the annual production. Based upon APFN production from 1975 to 2004 estimated global emissions from APFN manufacture are between 70 and 200 tonnes (PERFORCE, 2004).

Prevedouros et al. (2006) summarized through modelling the recent and the historical global use of fluorinated chemicals, in the last 50 years, distinguishing between direct and indirect sources of fluorinated chemicals.

Typical direct sources are represented by the manufacture of fluorochemicals and fluoro treated articles and typical indirect sources are emissions from fluoro treated articles and disposed fluorochemical preparations.

The same research group published a model for the long-term (1950-2050) global fate of fluorinated chemicals by composing an initial global-scale mass balance model to evaluate identified direct emissions of fluorinated substances from manufacture and use that could account for observed concentrations of these substances in the environment.

Using this model, cumulative global emissions between 2005 and 2050 are predicted to be at least 80% lower than the estimated cumulative emissions between 1950 and 2004 (Prevedouros et al., 2006).

According to the model calculations done by this research group, the contribution of indirect sources is expected to decrease both in absolute numbers and relative to direct sources within the year 2050 (Prevedouros et al., 2006).

3.1 International activities

There is international ongoing research to learn more about sources, fate, and pathways of exposure to PFCs. Furthermore, there is parallel research on reactive PFC intermediates for potential toxicities, identification and exploration of the properties of perfluorinated phosphate acids (PFPAs) and other per- and poly-fluorinated chemicals. Research is also on-going on degradation of fluorinated polymers, a large potential source of PFCs production.

The Organization for Economic Cooperation and Development (OECD) reviewed progress in the sense to identify and explore properties of reactive PFC intermediates and precursors followed by recommendations as a result of the 2006 Workshop on Perfluorocarboxylic Acids (PFCAs) and Precursors.

As a result of the OECD workshop in 2006, a reviewed list of at that time globally existing and identified PFC intermediates and precursors were issued in 2006. An update was issued in 2007 (OECD, 2007), based on earlier survey results along with plans for a near term updated survey soon to be circulated for completion probably before the end of 2009.

Notable feedback showed a dramatic decline in production volume of PFOS from 2004-2006, while volumes of PFCA precursors increased. A 2009 survey will endeavour to collect more reliable data on the production and use of PFCs, including information from producers on environmental releases of targeted substances from manufacturing and the content of targeted substances in products. The OECD was further encouraged to follow-up on additional recommendations, particularly to engage non-participating countries in this work, and to also consider how its work might inform or be coordinated with the Stockholm Convention secretariat.

In February 2009 the OECD hosted a workshop concerning international action for better international management and understanding of PFCs. The Workshop highlighted risk management activities across governments. A number of common

features could be found with several regulatory actions, for instance, with respect to restrictions and exemptions or derogations for certain essential uses where alternatives may not currently exist. Programmes also indicated that additional research and monitoring was ongoing in several countries to inform assessments and future potential actions and safer alternatives. In context an internet platform on sustainable ("green") chemistry will soon be posted along with harmonized bioaccumulation test methods for PFCs that will be hosted by OECD. (OECD 2009)

3.1.1 USA

On January 25th 2006, the US EPA invited eight major fluoropolymer and telomer manufacturers to participate in a global stewardship programme on perfluorooctanoic acid (PFOA) and related chemicals. Participating companies were asked to commit to reducing PFOA and related chemicals from facility emissions and in product content by 95% no later than 2010, and to work toward eliminating PFOA from emissions and in product content no later than 2015. All eight companies, Arkema, Asahi, Ciba, Clariant, Daikin, DuPont, 3M/Dyneon, and Solvay Solexis, submitted letters of commitment to the PFOA Stewardship Program by the March 1, 2006 deadline (US EPA 2006).

Each of the eight companies expressed support for a global stewardship programme addressing reductions in PFOA, PFOA precursor chemicals, and related higher homologues from both emissions and product content, which include emission, fate and occurrence of PFNA. Participation in the stewardship programme is in addition to a company's existing commitments to the Agency. Companies also expressed their general commitment to continue their ongoing research on the sources, pathways of exposure, and potential risks of these chemicals.

At the moment U.S. EPA is conducting research on telomer biodegradation, toxicology and pharmacokinetics, and analytical techniques including aged article analysis. EPA has also issued provisional health advisories for PFOA and PFOS to protect against potential risk from exposure to these chemicals through drinking water.

3.1.2 Canada

Canada showed cases on how assessments to date of new notified substances with alternative chemistries have not been suspected to be toxic under their authorities. No specific actions on PFNA are addressed (OECD, 2009).

3.1.3 Australia

Australia relayed how safe handling and use information were provided in Material Safety Data Sheets (MSDS) and also shared results of a hazard assessment with potassium perfluorobutane sulfonate (PFBS), a four-chain length carbon compound. This assessment led Australia to develop definitions of and limit uses to non-dispersive applications, similar to restrictions in EPA consent orders with companies. No specific actions on PFNA are addressed (OECD, 2009).

3.1.4 EU

In 2008 the European Commission (DG Enterprise and Industry) carried out a survey of PFOA and related substances and exempted PFOS where a questionnaire, see appendix 4, addressed to EU manufacturers, importers and suppliers of these perfluorinated substances that include higher homologues such as PFNA.

The objective of this study is to collect information to assess the risks to workers, the environment and consumers and the potential socio-economic impact of possible restrictions on the marketing and use of PFOA (and related compounds) with a view to advise on whether derogations could be justified for certain uses of PFOA and related compounds.

This study will also include an evaluation of the alternatives to PFOS for those uses, exempted by the restrictions such as photoresists, photographic coatings, hydraulic fluids for aviation and chromium electroplating process. This analysis will help the Commission to monitor the development of possible alternatives or technologies. The study was finalized by the end of October 2009.

3.1.5 Japan

Japan has conducted extensive environmental monitoring, published an environmental risk assessment in March 2008, and added PFOS to its Pollutant Release and Transfer Register (PRTR) for annual reporting. No specific actions on PFNA are addressed. (OECD, 2009).

3.1.6 China

China has experienced increased production of PFOS precursors as a result of withdrawal of PFOS production from U.S. and European markets and is therefore implementing EU requirements for PFOS and PFOS precursors in certain applications. Noted challenges include test methods, controlling market demand, risk management, alternative technologies, increased public awareness and guidance for industry. Strengthening cooperation on capacity building, import and export figures and health effects were some of the suggestions discussed by the OECD workshop in February 2009. (OECD, 2009). However no specific actions on PFNA are addressed.

Since early 2009 the OECD has currently a survey underway addressing PFNA. The deadline for responses by participants to OECD was 30 September 2009 and the survey report will be completed by New Year 2009.

3.2 Producers of PFNA and related compounds

The real proportions of direct and indirect source emissions of fluoro chemicals are not fully known. The US EPA Stewardship programme, which is mentioned and shortly described in chapter 3.2.1, has kept protocols of emissions, fate and occurrence of PFOA and higher homologues including PFNA. The protocols include information from the 8 major chemicals producers worldwide since 2005. (US EPA 2006)

These major manufacturers represent more than 90%[3] of the global annual production of perfluorinated chemicals and fluoropolymers. However there are uncertainties of any annual production of fluorochemicals in China concerning annual production volumes and these potential producers, if they exist, are not included in the US EPA Stewardship programme.

The progress annual reports issued by US EPA contain emissions, fate and occurrence information of the following compounds:

PFOA and its salts

Octanoic acid, pentadecafluoro- (CAS 335-67-1)
Octanoic acid, pentadecafluoro- ammonium salt (CAS 3825-26-1)

PFOA precursors

Octane, 1,1,1,2,2,3,3,4,4,5,5,6,6,7,7, 8,8-heptadecafluoro-8-iodo- (CAS 507-63-1)
1-Decanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluoro- (CAS 678-39-7)
1-Decene, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluoro- (CAS 21652-58-4)
2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl ester (CAS 27905-45-9)
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl ester (CAS 1996-88-9)
2-Decenoic acid, 3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-hexadecafluoro- (CAS 70887-84-2)
Decanoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluoro- (CAS 27854-31-5)

Higher homologues

Dodecane, 1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12-pentacosafluoro-12-
iodo- (CAS 307-60-8)
Decane, 1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10-heneicosafluoro-10-iodo- (CAS 423-
62-1)
Nonanoic acid, heptadecafluoro- (CAS 375-95-1) (PFNA)
Decanoic acid, nonadecafluoro- (CAS 335-76-2)
1-Decanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluoro- (CAS 678-39-7)
Decane, 1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-heptadecafluoro-10-iodo- (CAS 2043-53-0)
Dodecane, 1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10-heneicosafluoro-12-iodo- (CAS
2043-54-1)
2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl ester (CAS
4980-53-4)
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12

[3] Personal communication with Robert Buck, Du Pont (2009)

Table 1 and 2 below show the latest production and emission data reported from these 8 major manufacturers in 2008.

Table 1 Reported Emissions and Product Content of PFOA, Precursors, and Higher Homologues from U.S. Operations[4]

Company	Chemical Category	Releases to all media from FP and Telomer Manufacturing (kg)	kg of release / kg of product produced	Dispersions (ppm wet-weight basis)	Other Fluoropolymers (ppm dry-weight basis)	Telomers (ppm dry-weight basis, unless stated otherwise)
Arkema	PFOA and Higher Homologues	>1,000 - 10,000	For FP Production: (> 0.1 - 1) kg / 100 kg	>500 - 1,000	>70 - 150	Not Applicable
	Precursors	Not Applicable				
Asahi	PFOA and Higher Homologues	5,027	For FP Production: < 1 kg / 100 kg	100 - 1,570	0.12	Not Applicable
	Precursors	Not Applicable				
Ciba	PFOA	0 kg (total for emissions and product content)				
	Higher Homologues	0 kg (total for emissions and product content)				
	Precursors	0 kg (total for emissions and product content)				
Clariant	PFOA and PFOA salts	Not Applicable				
	Precursors	Not Applicable				
Daikin	PFOA	<100	None reported	<10	<10	<5
	Precursors and Higher Homologues	<100	None reported	Not Applicable	Not Applicable	CBI
DuPont	PFOA and PFOA Salts	960	None reported			21 kg
	Higher Homologues	Not Reported	None reported	36	14	None reported
	Precursors	CBI	None reported	None reported	None reported	3 kg
Dyneon/ 3M	PFOA, PFOA salts and Higher Homologues	0	0	Not Applicable	Not Applicable	Not Applicable
	Precursors	Not Applicable				
Solvay Solexis	PFOA, PFOA salts and Higher Homologues	1,000 - 10,000	For FP Production: 0.161 kg / 100 kg	400-450	170-200	Not Applicable
	Precursors	Not Applicable				

[4] http://epa.gov/oppt/pfoa/pubs/stewardship/preports2.html#summary

Table 2 *Reported Emissions and Product Content of PFOA, Precursors, and Higher Homologues from Non-U.S. Operations*

Company	Chemical Category	Emissions		Product Content		
		Releases to all media from FP and Telomer Manufacturing (kg)	kg of release / kg of product produced	Dispersions (ppm wet-weight basis)	Other Fluoropolymers (ppm dry-weight basis)	Telomers (ppm dry-weight basis, unless stated otherwise)
Arkema	PFOA and Higher Homologues	>1,000 - 10,000	For FP Production: (> 0.1 - 1) kg / 100 kg	Not Applicable	>70 - 150	Not Applicable
	Precursors	Not Applicable				
Asahi	PFOA, PFOA salts and Higher Homologues	3,91	For FP Production: < 1 kg / 100 kg	5-2,900	18	Negligible compared to precursors
	Precursors	2,31	For Telomer Production: < 1 kg / 100 kg	Not Applicable	Not Applicable	Average 50% (range: 0-100%)
Ciba	PFOA	16 kg (total for emissions and product content)				
	Higher Homologues	14 kg (total for emissions and product content)				
	Precursors	545 kg (total for emissions and product content)				
Clariant	PFOA and PFOA Salts	1	For Telomer Production: 2.0 E-5 kg / 100 kg	None reported	None reported	2 kg
	Direct Precursors	<3	For Telomer Production: 6.0 E-5 kg / 100 kg	None reported	None reported	60 kg
Daikin	PFOA	<2,500	None reported	<100	<120	<5kg
	Precursors and Higher Homologues	<1000	None reported	Not Applicable	Not Applicable	CBI
DuPont	PFOA and PFOA salts	1,410	None Reported	120	0	21 kg
	Higher homologues	None Reported	None Reported			None Reported
	Precursors	None Reported	None Reported	None Reported	None Reported	3 kg
Dyneon/3M	PFOA, PFOA salts and Higher Homologues	1,27	For FP Production: < 1 kg / 100 kg	8	Not Applicable	Not Applicable
	Precursors	Not Applicable				
Solvay Solexis	PFOA, PFOA salts and Higher Homologues	Not Applicable				
	Precursors	Not Applicable				

The annual figures summarized by US EPA in the table 1 and 2 above clearly show substantial contents and emissions of PFOA and higher homologues, including PFNA from these major production sites. However, only lump sums of "higher homologues" are presented in the public information provided by US EPA on their home page[5]. It is therefore hard to distinguish which of all higher homologues reported in the US EPA Stewardship programme are included in the respective reported sum values from each participating PFC manufacturer.

Since we have no information on international trade routes of PFNA, it is hard to assess which data are relevant for Norway and the other Scandinavian countries. As far as emissions are concerned, parts of the "higher homologue" emissions, including PFNA reported to US EPA, may probably reach Norway and other Scandinavian countries through long-range transport precipitation and other water currents from remote production sites. Due to lack of monitoring data of PFNA from these sites makes it impossible to assess any specific quantities of PFNA emissions that may occur in Norway.

One of the participating manufacturers in the US EPA Stewardship programme, Solvay Solexis, a world leader in polyvinylidene fluoride (PVDF) has a wide product range in EU. Solvay Solexis produce and distribute chemicals, semiconductors, oil & gas and pipes & fittings with their market brand SOLEF® PVDF and additionally "PTFE fine powders and micro powders, Hyflon® MFA/PFA, PFPE Fluorofluids, Polysulfones, PEEK, Ultrapolymers and PVDC barrier polymers.

In 2005 Solvay Solexis declared several new SOLEF® PVDF applications are developing rapidly in other high-end markets, such as environmental technologies – with membranes for water purification or key components in rechargeable lithium-ion batteries.

In 2007, Solvay Solexis announced an increase in the production capacity for this specialty fluoropolymer, which is marketed under the SOLEF® brand name. The new capacity expansion will increase Solvay Solexis' existing PVDF capacity at its plant in Tavaux (France) by some 30% and was scheduled to come on stream early in 2009[6].

4 Applications in products of PFNA and precursors

This chapter gives initially an overview of all globally known precursors per August 2007 that may degrade into PFNA (OECD, 2007). The overview is then filtered precursor by precursor through the ECHA preregistration list and similar relevant databases to create a list of PFNA and related substances that may occur on the European and Norwegian market today.

[5] (http://epa.gov/oppt/pfoa/pubs/stewardship/index.html).
[6] http://www.azom.com/news.asp?newsID=8435

Finally a literature survey of published results from chemical analyses on various relevant industrial and consumer products (see chapter 4.3) that have been analysed of their content of sources to PFNA will be described.

4.1 PFNA related substances

The basis for the review in this chapter on identified precursors to PFNA is the OECD lists of PFOS, PFAS, PFOA, PFCA and related compounds and chemicals from 21st of August (OECD, 2007).

This preliminary list contains about 1,000 CAS numbers in total. It is divided in the following categories:

- Annex 1: List of perfluorooctanesulfonate (PFOS) and related compounds.
- Annex 2: List of perfluoroalkylsulfonate (PFAS) and related compounds
- Annex 3: List of perfluorooctanoic acid (PFOA) and related compounds
- Annex 4: List of perfluoro and fluoro chemicals that potentially degrade to perfluorocarboxylic acid (PFCA)

Annex 4 in the OECD publication contains a list of PFCAs and its salts, and polymers that contain PFNA as a part of the entire polymer. Both linear and branched polyfluorinated octanoic acid derivatives, telomers and polymers are included. Since PFNA contains a linear C_9-backbone, only chemicals/fluorotelomers, mentioned on that list, containing a linear perfluorinated C_8-chain connected to a carbon atom have the potential to form PFNA and be PFNA precursors.

A full table of identified and possible precursors will be presented in appendix 2 together with the information whether each precursor are preregistered/registered in REACH (explain) for imported or manufactured preparations in EU.

4.1.1 Identifying substances that potentially can degrade to PFNA (PFNA precursors)

From the "Preliminary OECD list (OECD, 2007) a compiled list of substances that potentially degrades to PFNA was carried out in the following way:

- None of the substances from annex 1 (PFOS) are included since these compounds only can form PFOS which is outside the scope of this study.
- Substances with a chain length of 8 or 9 from annex 2 (PFAS) are included as substances with this chain length potentially can degrade to PFNA. Furthermore, substances that are polymers are included regardless of the chain length as they potentially can degrade to PFNA.
- No substances from annex 3 (PFOA and related compounds) are included.
- Substances with a carbon chain length of 8 or 9 from annex 4 (fluoro chemicals potentially degrading to PFCA) are included as substances with this chain length potentially can degrade to PFNA, as described in chapter

2. Furthermore, substances that are polymers are included regardless of the chain length as they potentially can degrade to PFNA.

- Substances that are alcohols and esters with chain lengths of 10 from annex 4, since the base is 8:2 FTOH and its esters.

As a result, 152 substances were found to fulfil these requirements and are presented in appendix 2.

OECD, in cooperation with other country representatives, has recently drafted the 2009 PFC Survey Questionnaire, "Survey of Product Content and Environmental Release Information on PFOS, PFAS, PFOA, PFCA, their Related Substances and Products/Mixtures Containing these Substances," that will be distributed to participating companies this year, to report on their 2008 activities (see annex 3). The OECD report from this recent survey will be completed and issued by Christmas 2009[7].

4.2 Present use of PFNA and related substances

A series of parallel searches has been carried out in a range of significant databases for the present use of the PFNA related substances identified in 4.1.1 and listed in appendix 2.

4.2.1 Search in the ECHA preregistration database

The 1st of December 2008 was the deadline for preregistration of substances that will be produced or imported in volumes of more than 1 tonne per year and company in the EU. In the ECHA list of preregistered substances[8], PFNA itself and132 of the 152 PFNA related substances identified in 4.1.1 were found, see appendix 2 for detailed information about these substances. It should be noted however that import of *articles* containing substances which have not been preregistered is still allowed.

In the preregistration of substances to ECHA, companies submit, among other data, the volume that they assumed that they will import or produce of the substance together with known health and environmental hazards. The production or import volume dictates the registration deadline of the substances. The deadline for registration can thus give some information on the volumes used of a substance.

Substances that have a deadline for registration on the 1st of December 2010 are such that will be produced or imported in volumes of more than 1000 tonnes per year and company in the EU *or* are classified as very hazardous (either CMR[9] or PBT/vPvB[10]) and will be produced or imported in volumes of more than 1 ton per year and company,.

[7] Personal communication Henrik Harjula, OECD.
[8] http://apps.echa.europa.eu/preregistered/pre-registered-sub.aspx
[9] Cancerogenic, Mutagenic or Reproductive toxic
[10] Persistent, Bioaccumulative and Toxic/very P and very B

Substances that have the 1st of June 2013 as registration deadline will be produced or imported in volumes between 100 and 1000 tonnes per year and company in the EU.

Substances that have the 1st of June 2018 as registration deadline and is assumed to be produced or imported in volumes between 1 and 100 tonnes per year and company in the EU.

As the PFNA related substances are relatively unknown, and none of them have been classified as hazardous according to Directive 67/548/EC, it is supposed that the registration deadline of 2010 is based on high volume of the chemicals.

Table 3 Volumes of compounds put on the EU market based on the registration deadline for REACH. Note that substances can be both e.g. a fluoro alcohol compound and a fluoro ether compound.

#	Type of compound:	REACH registration deadline	Yearly volume put on EU market per compound and company (tonnes):
6	Fluoro alcohol compounds	30/11/2010	> 1000
2	Fluoro ammonium compounds	30/11/2010	> 1000
6	Fluoro ester compounds	30/11/2010	> 1000
1	Fluoro ether compound	30/11/2010	> 1000
4	Fluoro phosphate compounds	30/11/2010	> 1000
2	Fluoro iodide compounds	30/11/2010	> 1000
3	Fluoro sulfonate/sulfonamide/sulfonyl compounds	30/11/2010	> 1000
3	Fluoro thioether compounds	30/11/2010	> 1000
5	Partial fluoro& miscellaneous fluoro compounds	30/11/2010	> 1000
2	Partial perfluoro & miscellaneous perfluoro compounds	30/11/2010	> 1000
1	Perfluoro amine compound	30/11/2010	> 1000
3	Perfluoro carboxylic compounds[11]	30/11/2010	> 1000
1	Perfluoro ester compound	30/11/2010	> 1000
1	Perfluoro ether compound	30/11/2010	> 1000
3	Perfluoro iodide compounds	30/11/2010	> 1000
3	Perfluoro phosphonic/phosphinic compounds	30/11/2010	> 1000
2	Perfluoroalkyl sulfonate and related compounds	30/11/2010	> 1000
46	**Sum PFNA related compounds**	**30/11/2010**	
16	Fluoro alcohol compounds	31/05/2013	100-1000
5	Fluoro amine compounds	31/05/2013	100-1000
7	Fluoro ammonium compounds	31/05/2013	100-1000
1	Fluoro carboxylic compound	31/05/2013	100-1000
6	Fluoro ester compounds	31/05/2013	100-1000
3	Fluoro ether compounds	31/05/2013	100-1000

[11] One of the perfluoro carboxylic compounds is PFNA, CAS RN 375-95-1.

2	Fluoro iodide compounds	31/05/2013	100-1000
6	Fluoro phosphate compounds	31/05/2013	100-1000
3	Fluoro sulphate compounds	31/05/2013	100-1000
2	Fluoro sulfonate/sulfonamide/sulfonyl compounds	31/05/2013	100-1000
4	Fluoro thioether compounds	31/05/2013	100-1000
4	Fluoro thiols compounds	31/05/2013	100-1000
4	Partial fluoro& miscellaneous fluoro compounds	31/05/2013	100-1000
4	Partial perfluoro & miscellaneous perfluoro compounds	31/05/2013	100-1000
8	Perfluoro carboxylic compounds	31/05/2013	100-1000
1	Perfluoro ether compound	31/05/2013	100-1000
1	Perfluoro iodide compound	31/05/2013	100-1000
1	Perfluoro phosphonic/phosphinic compound	31/05/2013	100-1000
10	Perfluoroalkyl sulfonate and related compounds	31/05/2013	100-1000
1	Poly fluoro compound	31/05/2013	100-1000
80	**Sum PFNA related compounds**	**31/05/2013**	

1	Fluoro ester compound	31/05/2018	1-100
1	Fluoro phosphate compound	31/05/2018	1-100
2	Fluoro siloxane/silicone/silane compounds	31/05/2018	1-100
1	Partial perfluoro & miscellaneous perfluoro compound	31/05/2018	1-100
2	Poly fluoro compounds	31/05/2018	1-100
7	**Sum PFNA related compounds**	**31/05/2018**	

1	Fluoro amine compound	Not preregistered	0
2	Fluoro ester compounds	Not preregistered	0
2	Fluoro urethane compounds	Not preregistered	0
3	Perfluoroalkyl sulfonate and related compounds	Not preregistered	0
11	Poly fluoro compounds	Not preregistered	0
19	**Sum PFNA related compounds**	**Not preregistered**	

4.2.2 Library search

A library search was performed by the Royal Institute of Technology Library in Sweden. The search in CAplus included all scientific articles, patents and books published[12].

The library search was performed in two steps. In the first step, documentation from the last century about uses of PFNA (CAS RN 375-95-1) and the 30 PFNA related substances found in the Norwegian Product Register (see chapter 5.1.1) was analysed. The result from the first step was 129 documented uses of PFNA, while only 2 of the 30 precursors had documented uses from year 2003 to present. Five precursors had nine documented uses in total, see appendix 3.

[12] CAplus is the largest chemical bibliographical database in the world today, edited and published by American Chemical Society. http://www.cas.org/expertise/cascontent/caplus/index.html

As the first search gave so few results, a second search was made for the remaining 121 PFNA related substances identified in chapter 4.1.1. This search gave far too many hits to be possible to handle. With a time restriction on the documentation of uses from year 2003 to present, 1166 hits was still achieved, which was also too many. Therefore, only the use of high volume chemicals was analysed. High volume chemicals were defined as chemicals with registration deadline in 2010 which included additional 38 chemicals (see appendix 2).

The two searches included in together 69 PFNA related substances, divided in 18 groups of substances, see appendix 3. 23 of the substances had documented uses between 2003 and 2009. The result is compiled in the table below.

Table 4 Documented uses of selected PFNA related substances found in the library search between 2003 and 2009. Precursors found in the Norwegian Product Register are marked NPR and high volume chemicals are marked HV.

Chemical group	**CAS RN**	**NPR or HV**	**Documented uses**
Fluoro alcohol compounds	678-39-7	HV	Water and oil repellent coating
	865-86-1	HV	Surfactant in copolymerization, oxide superconductor production
Fluoro ammonium compounds	61798-68-3	HV	Battery electrolyte, cationic surfactant for electrodeposition of tin
Fluoro esther compounds	17741-60-5	HV	Anti-bleed agents for adhesives in semiconductor devices, contained layers for organic electronic device, water-repellent agent in clothing, tires, pharmaceuticals
	1996-88-9	HV	Printing plates, hydrophobic coatings, antistatic coatings, pharmaceuticals
	2144-54-9	HV	Adhesives, water repellent agent in clothing, surfactant in copolymerization
	27905-45-9	HV	Pretreatment paste for ink-jet printing of polyesther fabrics, anti-bleed agents for adhesives in semiconductor devices
Fluoro iodide compounds	2043-53-0	HV	Catalyst for manufacturing olefin polymers, laboratory chemical
Fluoro sulfonate/sulfonamide/ sulfonyl compounds	27619-90-5	HV	Surfactants for perfluoroalkylation agents, additives for fire-extinguishing foams
Partial fluoro& miscellaneous fluoro compounds	1841-46-9	HV	Pharmaceuticals
	307-70-0	HV	Solubilising of organometallic compounds in fluorinated solvents, pharmaceuticals
	376-18-1	HV	Polymer production, laboratory chemical
	38565-53-6	HV	Adhesives, surfactant in copolymerization
	4180-26-1	HV	Polymerizable films, liquid crystal display retardation film
Partial perfluoro &	76-21-1	HV	Oxide superconductor and method for

miscellaneous perfluoro compounds			producing the same, liquid repellent agent preparation for antireflection layer for displays
Perfluoro carboxylic compounds	335-76-2	HV	Super-amphiphobic agent for corrosion-resistance and self-cleaning
	375-95-1	HV	Lubricating oil additive, surfactant for fire extinguishers, cleaning agent, textile antifouling finishing agent, liquid crystal display panels, polishing surfactant
Perfluoro ether compounds	335-36-4	HV	Micro porous membranes, surface treatment agents for resist pattern formation
Perfluoro iodide compounds	507-63-1	HV	Production of fluoropolymers (PVDF) and elastomers by emulsion polymerization
	558-97-4	HV	Copolymerization of vinyl polymers
Perfluoroalkyl Sulfonate and Related Compounds	335-24-0	HV	Nonfoaming surfactant for metal electrowinning
Poly fluoro compounds	65530-66-7	NPR	Preparation of magnetic nanoparticles for enhance gas mass transfer in fermentations
	65605-70-1	NPR	Antifouling agent for cotton, antiwear additive for lubricants

4.2.3 Search in SPIN Online database

SPIN – Substances in Preparations in the Nordic countries – is a database that contains "non-confidential" information on substances from each of the Nordic product registers[13]. The substances are registered with NACE code and use category UC62 code, sometimes national codes for industry branches and uses are used. The most recent data is from 2007.

The search in the SPIN database was made for the 30 substances found in the Norwegian Product Register, see 5.1.1 and added to this list was also PFNA and APFN[14]. The search resulted in that 28 of the selected substances were found, mostly under the use categories impregnation materials, surface treatment, paints, lacquers and varnishes, cleaning/washing agents, polishing agents.

[13] http://195.215.251.229/fmi/xsl/spin/SPIN/maininfo.xsl?-db=SPINstof&-lay=SpinNavn&-max=1&-findall

[14] CAS RN 4149-60-4

Table 5 Compounds found in the SPIN Online database together with their classification to different business sectors and use categories.

Chemical group	CAS RN	Business sector (NACE or national classification)	Use category (UC62 or national classification)
Fluoro alcohol compounds	68391-08-2	-	-
Fluoro ester compounds	85631-54-5	-	-
Fluoro thioether compounds	68187-47-3	Extraction of crude petroleum and natural gas, Wholesale trade and commission trade, except of motor vehicles and motorcycles	Flame retardants and extinguishing agents
	70983-60-7	-	-
Perfluoro phosphonic/phosphinic compounds	68412-68-0	-	Pesticides, agricultural
	68412-69-1	-	-
Fluoro thiols compounds	68140-19-2	-	-
Perfluoroalkyl Sulfonate and Related Compounds	17202-41-4	-	-
Poly fluoro compounds	65545-80-4	Publishing, printing and reproduction of recorded media, Other printing works, Extra-territorial organisations and bodies, Industrial cleaning companies, Other business activities	Cleaning/washing agents, Surface treatment, Surface-active agents
Partial perfluoro & miscellaneous perfluoro compounds	86508-42-1	Manufacture of other transport equipment n.e.c.	Cleaning/washing agents
Fluoro amine compounds	70969-47-0	Extraction of crude petroleum and natural gas, Wholesale trade and commission trade, except of motor vehicles and motorcycles	Flame retardants and extinguishing agents
Fluoro ester compounds	115592-83-1	-	-
	203743-03-7	-	-
Fluoro urethane compounds	135228-60-3	-	-
	68990-40-9	-	-
Perfluoroalkyl Sulfonate and Related Compounds	67584-42-3	Manufacture of fabricated metal products, except machinery and equipment	-
	68298-62-4	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel, Manufacture of fabricated metal products, except machinery and equipment, Manufacture of furniture; manufacturing n.e.c., Construction	Paints, lacquers and varnishes, Reprographic agents

Poly fluoro compounds	144468-32-6	-	-
	148878-17-5	-	-
	65530-63-4	-	Paints, lacquers and varnishes
	65530-64-5	-	Paints, lacquers and varnishes
	65530-66-7	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	Surface treatment
	65530-69-0	Extra-territorial organisations and bodies, Other business activities	Cleaning/washing agents, Surface-active agents
	65530-70-3	Construction, Manufacture of chemicals and chemical products, Specialized cleaning activities, Painting, General cleaning activities, Industrial cleaning, Industrial cleaning companies, Other business activities	Impregnation materials, Surface treatment, Paints, lacquers and varnishes, Cleaning/washing agents, Polishing agents, Impregnation/ proofing - for protection from damp, fungus etc., Other polishing agents
	65530-71-4	Construction, Painting, Specialized cleaning activities, General cleaning activities, Industrial cleaning, Industrial cleaning companies, Other business activities	Paints, lacquers and varnishes, Impregnation materials, Surface treatment, Cleaning/washing agents, Polishing agents, Impregnation/ proofing - for protection from damp, fungus etc., Other polishing agents
	65530-72-5	Construction, Manufacture of chemicals and chemical products, Specialized cleaning activities, Painting, General cleaning activities, Industrial cleaning, Industrial cleaning companies, Other business activities	Impregnation materials, Surface treatment, Paints, lacquers and varnishes, Cleaning/washing agents, Polishing agents, Impregnation/ proofing - for protection from damp, fungus etc., Other polishing agents
	65530-74-7	Construction	Impregnation materials, Paints, lacquers and varnishes, Impregnation/ proofing - for protection from damp, fungus etc.
	65605-70-1	-	Impregnation materials

The information gathered from the SPIN Online database was used as a guide to identify which companies and sectors that were interesting to contact (see 5.2) in order to find information about substances that potentially can degrade to PFNA. PFNA itself and APFN were not found.

4.3 Literature study of occurrence of PFNA in products

In this chapter different literature sources are reviewed where the occurrence of PFNA in products is described.

4.3.1 Combustion of carpeting

Some of the stain-resistant coatings that carpeting is treated with contain perfluorinated compounds (PFCs) (Lemieux et. al., 2007). In a study where carpets were combusted and the incineration gases analysed for different PFCs, PFNA was detected as emission from combustion of all the carpets. The amount of detected PFNA varied with the method of extraction from the incineration gases but the highest concentration found was 2.7 ng PFNA per m^3 carpet combusted. This can be compared to the highest concentration found for PFOA, which was 564 ng/m^3. However, the results for PFOA were achieved using another method of extraction.

4.3.2 Greenpeace study of perfluorinated substances in products

An overview of analyses of perfluorinated substances was made in 2006 at Greenpeace Research Laboratories, focusing mostly on PFOA (Walters & Santillo, 2006). Several sources of analyses of both fluoropolymer and fluorotelomer products were reviewed.

Manufacturers of fluoropolymer products also claim that polyester garment treatment products (containing fluorotelomers) are suggested as a source for perfluorinated compounds in the atmosphere. Greenpeace recommends treating this information with caution as the emissions of 8:2 FTOH (a fluorotelomer alcohol and precursor to PFNA, see chapter 2.1.4) and PFOA seems to contradict the direct reported concentrations found in garments elsewhere.

A couple of other articles report content of PFOA in textile and textile care products, all in the range of 0.08 to 3.6 mg/kg product. PFNA was found in two water repellent sprays, in concentrations between 0.25 and 0.77 mg/kg product.

4.3.3 SNF study on fluorinated substances in textile waterproofing agents

The Swedish Society for Nature Conservation (SNF or Svenska Naturskyddsföreningen) has made a study of 13 different waterproofing agents for textiles (SNF, 2007). The results were measured as nanogram extractable analyte per mL fluid (ng/mL). 27 different compounds were analysed, amongst them PFNA and 8:2 FTOH (see chapter 2.1.4). In two of the agents, there were no fluorinated substances detected.

PFNA was detected in 4 of the agents, with a concentration above 1 mg/L in one agent. The alcohol 8:2 FTOH was detected in 8 of the agents, with a concentration above 1 g/L in two of the agents.

4.3.4 SFT study on PFAS in textiles

SFT has previously studied the occurrence of different perfluoroalkyls in water and stain resistant textiles, such as child storm suits, sports clothes and tablecloth (SFT, 2006). In the 11 analysed products, 27 different compounds were analysed, amongst them PFNA and 8:2 FTOH (see chapter 2.1.4). PFNA was found in 10 of the 11 products, 8:2 FTOH was also found in 10 of the 11 products. The product where 8:2 FTOH was not detected was not the same as the product where PFNA was not detected.

Both the extractable amount per area product ($\mu g/m^2$) and the extractable amount per gram product (ng/g) were measured. The table below show the results for PFNA and 8:2 FTOH.

Table 6 Occurrences of PFNA and 8:2 FTOH in water and stain resistant textiles.

	PFNA		8:2 FTOH	
	µg/m^2	µg/kg	µg/m^2	µg/kg
Maximum amount	49,4	249	10578	123006
Meridian amount	2,03	13,6	125	771
Minimum amount	0,14	0,9	24,9	199
Detection limit	0,04	0,3	3,5	23

4.3.5 US EPA study of PFCAs in articles

The US EPA analyzed 116 articles of commerce purchased from retail outlets in the United States between March 2008 and May 2008 to determine the extractable content of C5 to C12 PFCAs (US EPA, 2009). Of the 13 article categories, the US EPA concluded that the most important PFCA sources were carpets, stone/tile/wood sealants, textiles and textile care products.

Table 7 Sample breakdowns by article category.

Category	**Samples**	**# with PFNA detected**	**Maximum conc.**
Pre-treated carpeting	9	5	292 ng/g fibre
Commercial carpet-care liquids	9	6	8860 ng/g liquid
Household carpet/fabric-care liquids and foams	12	6	1710 ng/g liquid
Treated apparel	16	14	235 ng/g product
Treated home textile and upholstery	14	11	437 ng/g product
Treated non-woven medical garments	5	5	334 ng/g product
Treated floor waxes and stone/wood sealants	11	10	939 ng/g product
Treated food contact paper	5	2	15,3 ng/g paper
Membranes for apparel	10	10	12,8 ng/g product
Thread sealant tapes and pastes	10	7	40,6 ng/g product
Non-stick cookware	14	7	0,00985 ng/cm2 coated surface
Dental floss and plaque removers	8	4	5,81 ng/g liquid
Miscellaneous[15]	7	3	82,6 ng/g product

For most article categories, the PFCA content in a small number of samples was significantly higher than in the rest of samples. The range for PFNA is from non-

[15] Includes four car-care products, two boat-care products, one deck cleaner, and one dry sack for outdoor use.

detectable to 8860 ng/g (in a carpet care liquid). The highest concentration of PFNA in a solid article was 437 ng/g in a treated home textile and upholstery product. In the case of non-stick cookware, the range is from non-detectable to 0.00985 ng/cm^2 coated surface.

4.3.6 Alternatives study by Danish EPA

The Danish EPA published a report about alternatives to PFOS and related substances (Poulsen et al 2005). Also PFNA was mentioned as a water contaminant after use of fire-fighting foam. Several PFOS related substances are however also possible precursors to PFNA. The overall picture given in this report is that the formerly most used PFOS related substances in general have been phased out and substituted with other fluorinated surfactants, such as C6-fluorotelomer based products or short chained perfluorinated compounds like PFBS (perfluorobutane sulfonate). The reason for continuing use of fluorinated compounds is that polyfluorinated surfactants have superior properties compared to other and less expensive surfactants. The largest use areas for PFOS related substances were found to be:

- Cleaning agents for glass cleaning
- Waxes and floor polishes
- Photographic industry
- Manufacturing of semiconductors
- Metal surface treatment

4.3.7 Alternatives study by Danish EPA

The Danish EPA published a survey of fluorinated substances in consumer products in 2008 (Poulsen et al 2008). PFCAs were found in textile care products and treated textiles. They also refer to the SNF study in 4.3.3.

4.3.8 Survey of PFOA in Norway by SFT

The SFT survey of PFOA in Norway confirms the above mentioned product groups for PFCAs (SFT, 2007). The majority of fluoropolymers are sold as solids, where the PFNA processing aid is removed during industrial processing. However some fluoropolymer dispersions, which still contain PFNA, are used in coatings for non-stick cookware, paint formulations, as photographic film additives, as breathable barrier films for textiles and in the textile finishing industry. These fluoropolymer dispersions were mainly for industrial uses, but some paint products could be for consumer use as well.

4.3.9 SNF study on PFC in consumer products

In a recent report from SFT the occurrence of different perfluorinated compounds in consumer products were studied. The product groups covered a range of different articles. Among them were waterproofing agents, non-stick household ware, impregnated paper, carpets, textile and leather as well as electronics, like PCBs and battery and fire fighting agents. In the 34 analysed products, 29 different compounds were analysed, amongst them PFNA and 8:2 FTOH. PFNA was found in 3 of the 34 products, 8:2 FTOH was found in 12 of the 34 products. In only one of the products, a waterproofing agent, both PFNA and 8:2 FTOH was detected. In the fire fighting foams, waterproofing agents and printing

inks where 8:2 FTOH were found, the amounts varied from 85 µg/L for the ink to 330 mg/L for one of the waterproofing agents. In the coated products (leather, textiles and carpets) 8:2 FTOH was found in every sample and the content varied from 13 µg/m2 to 368 µg/m2. The highest amount, 593µg/L, of PFNA was detected in one of the waterproofing agents.

4.4 Conclusions on applications in products

There are 152 substances that may potentially degrade to PFNA (see appendix 2). The possible use and occurrence of these precursors and PFNA itself has been analyzed. A matching against the ECHA list of preregistered substances showed that PFNA itself and 132 precursors were preregistered. PFNA and the 152 precursors were also matched against Annex I of Directive 67/548/EEC and none of these substances had any hazard classification. This finding and the low knowledge level about perfluorinated substances leads to the assumption that the deadlines for registration is based solely on volume estimations.

A library search for uses of PFNA and 68 precursors selected on the basis of either their occurrence in the Norwegian Product Register or deadline for registration in 2010 (with an assumed volume of over 1,000 tonnes per year and company). 23 of these 69 substances had documented occurrences in literature from 2003 to present. The documented uses were mainly as surfactants used in the production of polymers or as surface treatment agents in textile and electronic products.

The SPIN Online database gives information about which statistics codes for industry branches and use categories the PFNA related substances have been classified with. Of the 30 substances found in the Norwegian Product Register, 28 were also in the SPIN Online database. Industrial manufacturing, cleaning and painting were the industrial branches mostly occurring. The most commonly occurring use categories were as impregnation materials, surface treatment, paints, lacquers and varnishes, cleaning/washing agents and polishing agents.

A literature study was also made; summarizing the findings of PFNA related substances in chemical analyses of consumer products. The more persistent perfluorinated substances have in general been substituted with other fluorinated surfactants, telomer based products or short chained perfluorinated compounds. The product groups that are known today to contain PFNA is mainly water and dirt repellence treated textiles such as clothing and home textiles, and correspondent textile care products, but also as non-stick treated cookware and dental care products where PFNA related substances also were found, mostly in low quantities.

The main conclusion that can be drawn from this chapter is that there is little knowledge about many of the PFNA related substances, including the PFNA precursors that are expected to be used in volumes over 1,000 tonnes per year and companies in the EU.

5 Mapping of uses and occurrence of PFNA in Norway

This chapter describes the manufacture and potential uses of PFNA in Norway. It is known from earlier studies (SFT, 2007) that perfluorinated substances (PFS) are not manufactured in Norway.

5.1 Database information on manufacture and uses of PFNA in Norway

5.1.1 Search in the Norwegian Product Register

The Product Register is the Norwegian government's central register over chemical products that are on the market in Norway. The register contains information about chemical products that are classified as hazardous, and contained about 25 000 products in 2009. The threshold limit for reporting a chemical product to the Product Register is 100 kg per year and company.

In order to find products with a content of PFNA or substances that may potentially degrade to PFNA in the environment, a search has been performed in the Norwegian Product Register for the 152 PFNA related substances identified in 5.1.1. 30 such substances were found, se table 8.

Table 8 Type and number of compounds found in the Norwegian Product Register.

#	Type of compound:	whereof preregistered in EU:
1	Fluoro alcohol compound	1
1	Fluoro amine compound	0
3	Fluoro ester compounds	1
1	Fluoro phosphate compound	1
2	Fluoro thioether compounds	2
1	Fluoro thiols compound	1
2	Fluoro urethane compounds	0
1	Partial perfluoro & miscellaneous perfluoro compound	1
2	Perfluoro phosphonic/phosphinic compounds	2
4	Perfluoroalkyl sulfonate and related compounds	1
12	Polyfluoro compounds	1

In total 229 products containing any of these substances were found. The sum of the reported volumes of the substances was 1.6 kilograms. No information about the companies or sectors that used them could be retrieved.

PFNA itself was not found, nor was ammonium perfluorononanoate (APFN), the most common salt of PFNA found. A non-classified substance that has not been

found in the product register can still be part of either non-classified chemical products or products that are not chemical products.

5.1.2 Search in SPIN Online database for Norwegian use

The SPIN database (see 4.2.3) also contains information about the volumes reported for each substance. The search in the SPIN database was made for the 30 substances found in the Norwegian Product Register, see 5.1.1 and added to this list was also PFNA and APFN.

Table 9 Compounds found in the SPIN Online database together with the volume reported for Norway 2007.

Chemical group	CAS RN	SPIN use NO (tons)	SPIN use NO (# of prep.)
Fluoro alcohol compounds	68391-08-2	conf	conf
Fluoro ester compounds	85631-54-5	0	0
Fluoro thioether compounds	68187-47-3	0,1	7
	70983-60-7	conf	conf
Perfluoro phosphonic/phosphinic compounds	68412-68-0	conf	conf
	68412-69-1	conf	conf
Fluoro thiols compounds	68140-19-2	0	0
Perfluoroalkyl Sulfonate and Related Compounds	17202-41-4	0	0
Poly fluoro compounds	65545-80-4	0	5
Partial perfluoro & miscellaneous perfluoro compounds	86508-42-1	0	0
Fluoro amine compounds	70969-47-0	0,1	7
Fluoro ester compounds	115592-83-1	0	0
	203743-03-7	0	0
Fluoro urethane compounds	135228-60-3	0	0
	68990-40-9	0	0
Perfluoroalkyl Sulfonate and Related Compounds	67584-42-3	conf	conf
	68298-62-4	conf	conf
Poly fluoro compounds	144468-32-6	0	0
	148878-17-5	conf	conf
	65530-63-4	conf	conf
	65530-64-5	conf	conf
	65530-66-7	conf	conf
	65530-69-0	0	0
	65530-70-3	5	0
	65530-71-4	0	5
	65530-72-5	0	5
	65530-74-7	conf	conf
	65605-70-1	conf	conf

5.2 Company source information on manufacture and uses of PFNA in Norway

The information gathered from the SPIN Online database was used as a guide to identify which companies and sectors that were interesting to contact in order to find information about substances that potentially can degrade to PFNA. The search resulted mostly under NACE codes for cleaning, and the use categories impregnation materials, surface treatment, paints, lacquers and varnishes, cleaning/washing agents, polishing agents. Since the system with NACE codes have change in Norway during the last years, a search in the Nordic business key could not be done directly by using the found NACE codes or the NACE codes used in a previous study of perfluorinated substances (SFT, 2007).

As far as possible the found NACE codes were "translated" to the corresponding Norwegian business codes. A few of the NACE codes were covered by a less detailed business code and a few had no correlation at all. Using the business codes, a search was made in the database Nordic Business key, resulting in more than 40 000 companies in Norway which may be relevant users of articles and preparations that may contain PFNA precursors. The largest companies in each product group were identified. Information from earlier studies regarding cantacted companies (SFT, 2007) has also been taken under consideration. Slightly more than 20 of these companies were contacted. Their responses are described in chapter 5.3.

As the study proceeded it was realised that contacting companies was in many cases unsuccessful. The article producers or distributors could not give detailed answers either due to lack of knowledge or business secrets.

5.3 Surveyed Norwegian business sectors

5.3.1 Textiles (out-door clothing, apparel, tarpaulins, tents)

A few manufacturers of awnings were contacted, however little information was received. One of the companies imported awning cloth from Italy where the cloth had been impregnated with a fluorinated resin. No further information was received. The contacted producers of tent, tarpaulins and work wear claimed they did not use PFNA.

Manufacturers of out-door clothing or their suppliers gave some more information about their impregnated products. However, even though perfluorinated substances are used, at least one of the producers expected no PFNA residuals in the products due to the process chemicals used are even numbered carbon chemicals. No more information about how much of these products are sold in Norway was received.

5.3.2 Foot wear and tannery

The contacted shoe producers in Norway had little information to give and referred to the tanning industry. At least one of the tanneries contacted used fluorinated substances, mainly in the dry processes. The annual use of this leather protector was estimated to approximately 50 kilo. Information from the supplier gave that the amount of fluorinated substance is app. 20% in the leather protector. This product was exported.
The tannery could also inform that fluorinated substances, during some ten years, have been removed in some processes and in others the amount is reduced.
Another tannery company gave us information from their supplier. It is found from that information that several “protective material leather products” from one of the suppliers contain fluoropolymer, however the tannery said not to use these specific products.

5.3.3 Other

The four contacted paper manufacturer all claimed that they did not use any perfluorinated substances in their impregnated paper or in production.

A company specializing in textile protection (i.e. carpet and furniture protection) was contacted and informed us all their products have been free from PFOS since 2007 (when the Norwegian legislation banned PFOS). Today there are also several products free from PFOA and they expect that all their products will be PFOS and PFOA free within 2 years. From their submitted analysis results of PFCs in three products it was found that all these products included PFNA in various amount. They also informed us that they sell to both industry and consumers within Norway but also export the products. The total sale of concentrated primary product is approx. 10 tons. The concentrated product contains 10 to 25% polyfluorinated substances and is diluted in water or alcohol to a concentration of 3 to 10 %.

The contacted companies in oil and paint industry asked for more time before answering but have not replied so far.

Three companies producing cleaning agents were contacted. Two of them gave at once an answer that they did not use any perfluorinated chemicals in their products. The third have not replied so far.

Table 10 Results from company contacts.

Article/preparation	No. of companies contacted	Company information regarded fluorinated compounds	Comments
Impregnated products			
Textiles, work and sportswear	4	Perfluorinated substances used or no infromation	
Textiles, impregnated clothes for outdoor use.	4	Perfluorinated substances used or no information	
Foot wear	2	No information	
Impregnated/coated paper	4	No perfluorinated substances used	
Impregnated leather /Tannery	2	50 kilo of a leather protector annually including 17-20% fluorinated acrylate polymer	Exported product
Other			
Textile protection	1	Perfluorinated substances used. PFNA reported in analysis result	
Cleaning agents	3	No perfluorinated substances used or no information	
Oil and mining	1	No information	
Paint and lacquer	1	No information	
Electronic industry	1	No information	Production closed

6 Discussion

The globalisation of trade has moved the actual manufacture and production processes far away from the consumer markets in Europe. As a consequence we lack knowledge about chemicals applied deliberately or as impurities/degradation products in consumer products through the distribution chain into the Norwegian market. This is definitely a global problem. However, the Scandinavian countries have a long tradition of close attention to flows of chemicals that enter the Scandinavian markets, either through legislation or by customer agreements with Scandinavian companies.

This project has clearly shown the complexity of mapping sources to PFNA in Norway, and the cause of PFNA emissions into the environment, especially from consumer products. Many different sources of information have been applied in this project, such as interviews with companies that manufacture and distribute articles that could be sources to PFNA, or search in different relevant databases and market information of manufacture, import and export of products that may contain PFNA and related substances. There is, however, little or no knowledge available on how these information sources interrelate. Beside the lack of

correspondence between these different important information sources, there are also knowledge gaps along the distribution chain of chemicals, where the article manufacturer or distributor could not give detailed answers during our interviews. There is also a commercial perspective, where the supplier of perfluorinated products does not distribute important information along the distribution chain, since it is considered business secrets.

6.1 Alternatives to fluortelomers that may transform into PFNA

Recently, commercial alternatives to the fluortelomer-chemistry that cause PFNA emissions from impregnated articles such as carpets and leather have appeared on the market. Major chemical manufacturers[16] carry out extensive research at the moment to improve commercial soil repellent properties for their chemical preparations based on the so called C4 or C6 chemistry that are alternatives that has no chemical possibility to transform into PFNA.

There are also surfactant alternatives that can provide similar wetting properties in coating formulations to fluortelomers that may transform into PFNA. They are described in short in the following chapters below.

6.1.1 Fluorinated polyether

Fluorinated polyethers can be used as surfactants and as flow, level, and wetting additives for coating formulations. These formulations are currently being used as a surfactant in floor polish and are polymers with a molecular weight greater than 1,000 g/mol. The polymers are based on ether links – both the polymer backbone linkages and the link between the backbone and the perfluoroalkyl pendant. The fluorosurfactants are synthesized from perfluoroalkyl starting materials with a fully fluorinated carbon chain length of C_4 or less (Poulsen et. al 2005).

The basic structure of these compounds is illustrated in the figures below.

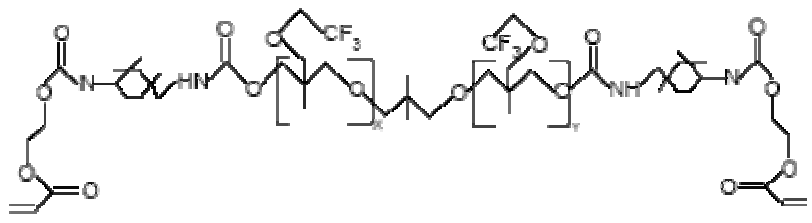

Figure 3 *The basic structure of a fluorinated ether compound. x+y equals about 20.*

[16] Oral information from Clariant

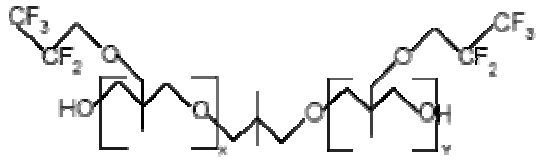

Figure 4 The basic structure of a fluorinated ether compound as the basic perfluoralkyl group.

6.1.2 Fatty alcohol polyglycolether sulphate

BASF produces a fatty alcohol polyglycolether sulphate, which can be used as a levelling and wetting agent in paints and coatings (Poulsen et al 2005).

6.1.3 Silicone polymers

Silicon polymers can be used as wetting agents, replacing for fluorinated surfactants in several cases in the paint and ink industry. Their products contain 3-(polyoxyethylene) propylheptamethyl trisiloxane with (CAS No 67674-67-3) (Poulsen et. al 2005).

6.1.4 Sulfosuccinate

Sulfosuccinate can be used as a wetting agent for paints and coatings. In one product the sulfosuccinate is mixed with water and ethanol, and in the other the sulfosuccinate is mixed with water and 2, 2-dimethylpropane-1, 3-diol (Poulsen et. al 2005).

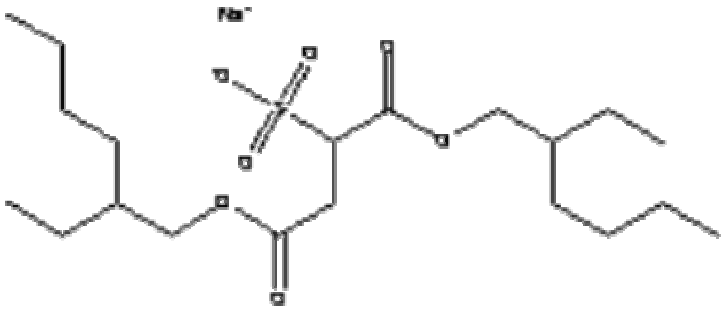

Figure 5 The chemical structure of the sodium salt of di(2-ethylhexyl) sulfosuccinate (CAS No. 577-11-7).

6.1.5 Propylated aromatics

Propylated aromatics, naphthalenes and biphenyls, can be used as water repelling agents for different applications, such as corrosion protection systems, marine paints, resins, printing inks, coatings, electrical, electronical and mechanical applications

The presented propylated aromatic products are all colourless liquids with a boiling point at about 300 °C. Their flash point lies all about 140 °C. The substances have a very low solubility in water. Common for the substances is that none of them are classified as hazardous substances (Poulsen et. al 2005).

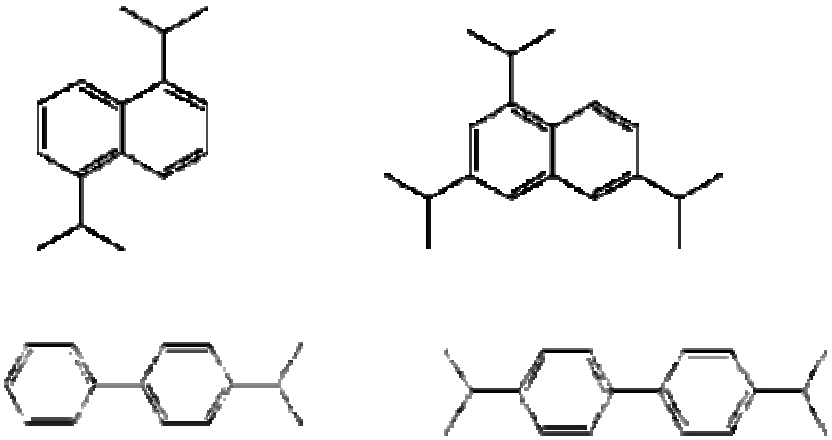

Figure 6 Chemical structures of propylated aromatics

7 Conclusions

Perfluorinated products are extremely versatile and are used in a variety of industrial and consumer applications and products. Some of these perfluorinated products contain or release perfluoroalkyl carboxylates (PFCAs), among them perfluorononaoic acid (PFNA) which is described in a few literature sources as being persistent and better described in literature as widely spread in man and environment. Some of the polyfluorinated products, known as PFNA-precursors, can be degraded to PFNA in the environment.

This report outlines relevant perfluorinated products and possible user companies of these products that were surveyed as potential sources of PFNA in Norway. Since the Norwegian market is complex, priorities in the selection of relevant products and companies for a survey were necessary for the source identification and quantification of PFNA in Norway.

This survey describes a range of quantitative data concerning consumer products and historical data of possible indirect and direct emissions of PFNA from manufacturing use and processing of perfluorinated products in Norway. Due to the lack of sufficient data, this study cannot fully assess the relative importance of either manufactured or imported consumer articles for PFNA exposure in Norway. However there is no doubt that there are potential sources of PFNA, either long range transported into Norway or emitted from products used in Norway.

There are still data gaps concerning the extent of uses and "real" substance composition in industrial and consumer products that need to be further investigated. This is mostly caused by limited or lack of information from industrial users and manufacturers of PFNA related substances.

In order to improve knowledge of the wide range of per- and polyfluorinated substances and to assess their potential hazards and risk they may pose to society and environment, it is strongly recommended to have a continuous follow –up through

- ***Improved public knowledge and awareness*** through fact sheets published on relevant Norwegian authorities' web pages.

- ***Improved knowledge and awareness among professional importers and users*** in Norway through standardized product information of the chemical composition of intentionally used perfluorinated chemicals, especially those chemicals that may pose any health and/or environmental risk to humans and environment. A certain priority should be given to perfluorinated substances that have the potential to transform into present and future legally restricted and hazard classified degradation substances.

- ***Standardized routines for authority reporting from professional users and manufacturers*** concerning emissions of perfluorinated substances into the Norwegian environment in order to support future priorization and risk reduction measures.

The data achieved in this survey, with respect to all identified data gaps and parts of limited information in this study, can be supportive and a guideline for the future work of assessments of important potential sources to PFNA and other perfluorinated substances in Norway.

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Appendix 1 Plastics Europe latest draft glossary of terms for fluorinated substances, dated autumn 2009[17]

PART 1 – GLOSSARY OF TERMINOLOGY GENERAL TERMINOLOGY

Fluorochemical / Fluorinated Chemical
General, non-specific, broad term for all chemicals containing the element fluorine.

Fluorosurfactant / Fluorinated Surfactant / Fluorinated Tenside[1]
Synonymous terms for a surface active, low molecular weight (<1000 daltons), substance which contains fluorinated carbon atoms. Example: $F(CF_2)_6CH_2CH_2SO_3^-NH_4^+$.

Fluoropolymer[2]
A general term for a polymer which has fluorine attached to the majority of carbon atoms which comprise the polymer chain backbone. Common fluoropolymers are: polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF), fluorinated ethylene-propylene (FEP), etc. They are typically high molecular weight polymers used in high performance applications where chemical resistance and thermal stability are essential.

Polyfluorinated
A general term to describe substances where multiple, but not all, hydrogen atoms bound to carbon are substituted with fluorine.

Side-Chain-Fluorinated Polymer
A general term for a polymer which has a hydrocarbon backbone (polyamide, polyester, polyurethane, etc.) to which is appended a fluorinated carbon chain, also known as a fluorinated alkyl chain; an example would be a polymer such as $[-CH_2CH(C(O)OCH_2CH_2(CF_2)_8F)-]_n$.

Surfactant / Tenside
General non-specific, synonymous terms both meaning a surface active agent. See also “Tenside” below. The recommended term is Surfactant.

Tenside
Alternative (less preferred) term for surfactant, derived from the German “Tensid”.

[17] The final glossary will be issued 2010 by Plastics Europe.

PERFLUORO- TERMINOLOGY

Perfluoro- / Perfluorinated

A general term for a substance where fluorine (F) is substituted for all hydrogen (H) atoms attached to carbon atoms except carbon atoms whose substitution would affect the nature of the functional group(s) present[2]. Examples: $F(CF_2)_nCHO$, $F(CF_2)_nCO_2H$, $F(CF_2)_nSO_3H$, $(CF_3)_2NH$

Perfluoroalkyl Substance / Compound (PFA)

A general term for a substance that is perfluorinated according to the definition given above, but excluding perfluorocarbons.

Comments: The term has also been used to describe substances which contain a perfluoroalkyl moiety attached to other atoms that may not be perfluorinated but may have potential to transform to a perfluoroalkyl substance. Justification for the acronym PFA is given in Part 3 of this document.

Perfluorocarbon (PFC)

A perfluorinated hydrocarbon, especially a perfluorinated alkane, C_nF_{2n+2}. Perfluorocarbons contain only carbon and fluorine atoms.

Perfluorinated Surfactant / "Perfluorinated Tenside (PFT)" (in publications of German origin)

A general term for a surface active, low molecular weight (<1000 daltons), substance where fluorine (F) is substituted for all hydrogen (H) atoms attached to carbon atoms except carbon atoms whose substitution would affect the nature of the functional group(s) present[2]. Example: $F(CF_2)_6SO_3^-NH_4^+$.

Perfluoroalkyl Acid / Perfluorinated Acid (PFAA)

A general term for a substance which contains a perfluoroalkyl, $F(CF_2)_n$-, functionality bound to an acid functionality, e.g., carboxylate, sulfonate, phosphonate.

Perfluoroalkyl Carboxylic Acid / Perfluoroalkyl Carboxylate (PFCA)

A general term for a substance whose chemical structure is $F(CF_2)_nCO_2H$ and its anionic form $F(CF_2)_nCO_2^-$.

Comments: This term may also be used to describe the salts of these acids (e.g., ammonium, sodium, potassium). Justification for the acronyms proposed to represent the various species (free acid, anion and salts) is given in Part 3 of this document.

Examples:

PFNA:

Perfluorononanoic acid, $F(CF_2)_8CO_2H$, is a fully fluorinated, nine-carbon chain length carboxylic acid (C9) (CAS No. 375-95-1).

PFOA:

Perfluorooctanoic acid, $F(CF_2)_7CO_2H$, is a fully fluorinated, eight-carbon chain length carboxylic acid (C8) (CAS No. 335-67-1).

APFO:
Ammonium perfluorooctanoate, $F(CF_2)_7CO_2NH_4$ (CAS No. 3825-26-1), is the ammonium salt of PFOA.

PFBA:
Perfluorobutanoic acid, $F(CF_2)_3CO_2H$, is a fully fluorinated, four-carbon chain length carboxylic acid (C4) (CAS No. 375-22-4).

Perfluoroalkyl (or Perfluoroalkane) Sulfonic Acid / Perfluoroalkyl (or Perfluoroalkane) Sulfonate (PFAS)
A generic term for a substance whose chemical structure is $F(CF_2)_nSO_3H$ and its anionic form $F(CF_2)_nSO_3^-$.
Comments: This term may also be used to describe its salts (e.g., ammonium, sodium, potassium). Justification for the acronyms proposed to represent the various species (free acid, anion and salts) is given in Part 3 of this document.

Examples:
PFOS:
Perfluorooctane sulfonic acid (CAS No. 1763-23-1) / sulfonate (CAS No. 45298-90-6) is a fully fluorinated, eight-carbon chain homologue.

PFHxS:
Perfluorohexane sulfonic acid (CAS No. 355-46-4) / sulfonate (CAS No. 108427-53-8) is a fully fluorinated, six-carbon chain homologue.

PFBS:
Perfluorobutane sulfonic acid (CAS No. 375-73-5) / sulfonate (CAS No. 45187-15-3) is a fully fluorinated, four-carbon chain homologue.

Perfluoroether
A general term for a substance which contains short perfluoroalkyl moieties, typically 1-3 carbon atoms, connected to an oxygen and capped by the same type of perfluoroalkyl / perfluorocarbon functionality or/and by other non-fluorinated functionality.

Polyfluoroether
A general term for a substance which contains short fluoroalkyl moieties that are not fully fluorinated and do contain hydrogen bound to carbon, typically 1-3 carbon atoms, connected to an oxygen and capped by a fluoroalkyl / fluorocarbon functionality or/and by other non-fluorinated functionality.

Perfluoropolyether (PFPE)
A general term for a substance which contains short perfluoroalkyl moieties, 1-3 carbon atoms, connected by oxygen bridges and capped by the same type of

perfluoroalkyl / perfluorocarbon functionality or/and by other non-fluorinated functionality.

ECF & TELOMERS - TERMINOLOGY

Electrochemical fluorination[1]

A process technology used to manufacture fluorinated chemicals where an organic raw material is dissolved in hydrogen fluoride and electrolyzed, resulting in the replacement of hydrogen with fluorine The free-radical nature of the process leads to rearrangement resulting in a product mixture of linear and branched isomers of multiple carbon chain lengths.

Comment: A systematic numbering system for identifying the linear and branched congeners of several families of perfluoroalkyl substances has been proposed[3].

Telomerization (or Telomerisation)[1]

A process technology used to manufacture fluorinated chemicals where pentafluoroethyl iodide (telogen) is reacted with tetrafluoroethylene (TFE, taxogen) to yield a mixture of even carbon-numbered perfluoroalkyl iodides $F(CF_2CF_2)_nI$.

Telomer (or Fluorotelomer[1]**)**

A general term for a substance derived from a raw material produced from the telomerization process.

Examples

Fluorotelomer alcohol (FTOH)

A general term for substances with the general structure $F(CF_2CF_2)_nCH_2CH_2OH$.

Fluorotelomer olefin (FTO)

A general term for substances with the general structure $F(CF_2CF_2)_nCH{=}CH_2$.

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2. Banks, R. E., Smart, B.E., Tatlow, J.C. , Organofluorine Chemistry: Principles and Commercial Applications. *Plenum* **1994**.

3. Rayne, S., Forest, K., Friesen, K.J., Congener-specific numbering systems for the environmentally relevant C4 through C8 perfluorinated homologue groups of alkyl sulfonates, carboxylates, telomer alcohols, olefins, and acids, and their derivatives, J. Environ. Sci. Health A, 43, 1391-1401, **2008.**

PART 2 – SUBSTANCE ACRONYMS

FAMILY OR INDIVIDUAL COMPOUND	CHEMICAL STRUCTURE	PROPOSED ACRONYM
1. FAMILIES OF SUBSTANCES		
Poly- and Perfluorinated compounds (or poly- and perfluoroalkyl substances) (generic)	PFAs (see Part 3 of this document)	
Perfluoroalkyl acids	Including perfluorinated carboxylic, sulfonic, phosphonic and other acids and their corresponding anions	PFAAs
Perfluorocarboxylic acids / perfluorocarboxylates	$C_nF_{2n+1}COOH$ / $C_nF_{2n+1}COO^-$	PFCAs
Fluorotelomer alcohols	$C_nF_{2n+1}CH_2CH_2OH$	FTOHs
Fluorotelomer olefins	$C_nF_{2n+1}CH=CH_2$	FTOs
Fluorotelomer acrylates	$C_nF_{2n+1}CH_2CH_2OC(O)CH=CH_2$	FTACs
Fluorotelomer methacrylates	$C_nF_{2n+1}CH_2CH_2OC(O)C(CH_3)=CH_2$	FTMACs
Fluorotelomer aldehydes	$C_nF_{2n+1}CH_2CHO$	FTALs
Fluorotelomer carboxylic acids	$C_nF_{2n+1}CH_2COOH$	FTAs
Fluorotelomer unsaturated carboxylic acids	$C_{n-1}F_{2n-1}CHF=CHCOOH$	FTUAs
Perfluorinated aldehydes	$C_nF_{2n+1}CHO$	PFALs
Perfluoroalkane sulfonic acids / Perfluoroalkane sulfonates	$C_nF_{2n+1}SO_3H$ / $C_nF_{2n+1}SO_3^-$	PFASs
Perfluoroalkane sulfinates	$C_nF_{2n+1}SO_2^-$	PFASi's
Perfluoroalkane sulfonamides	$C_nF_{2n+1}SO_2NH_2$	PFASAs
N-Alkyl perfluoroalkane sulfonamides	$C_nF_{2n+1}SO_2NH(C_mH_{2m+1})$ or $C_nF_{2n+1}SO_2N(C_mH_{2m+1})(C_pH_{2p+1})$	R-PFASAs
Perfluoroalkane sulfonamidoethanols	$C_nF_{2n+1}SO_2NHCH_2CH_2OH$	PFASEs
N-Alkyl perfluoroalkane sulfonamidoethanols	$C_nF_{2n+1}SO_2N(C_mH_{2m+1})CH_2CH_2OH$	R-PFASEs
N-Alkyl perfluoroalkane sulfonamidoacetic acids	$C_nF_{2n+1}SO_2N(C_mH_{2m+1})CH_2COOH$	R-PFASAAs
Fluorotelomer sulfonates	$C_nF_{2n+1}CH_2CH_2SO_3^-$	FTSs
Perfluoroalkane sulfonyl fluorides	$C_nF_{2n+1}SO_2F$	PASFs
Perfluoroalkyl phosphonic acids / Perfluoroakyl phosphonates	$O=P(OH)_2C_nF_{2n+1}$ / $O=P(OH)(O^-)C_nF_{2n+1}$ / $O=P(O^-)_2C_nF_{2n+1}$	PFPAs
Perfluoroalkyl phosphinic acids / Perfluoroakyl phosphinates	$O=P(OH)(C_nF_{2n+1})(C_mF_{2m+1})$ /	PFPiAs

	$O=P(O^-)(C_nF_{2n+1})(C_mF_{2m+1})$	
Polyfluoroalkyl phosphoric acid esters	$(O)P(OH)_{2-x}(OCH_2CH_2C_nF_{2n+1})_x$	PAPs
Polyfluoroalkyl phosphoric acid monoesters	$(O)P(OH)_2(OCH_2CH_2C_nF_{2n+1})$	monoPAPS
Polyfluoroalkyl phosphoric acid diesters	$(O)P(OH)(OCH_2CH_2C_nF_{2n+1})$-$(OCH_2CH_2C_mF_{2m+1})$	DiPAPs
Perfluoropolyethers	Examples: $CF_3O(CF_2CF_2O)_m(CF2O)_nCF_3$ or $XCF_2O(CF_2CF_2O)_m(CF2O)_nCF_2X$, where X is a functional group	PFPEs

PART 3 – NOTES ON PROPOSED ACRONYMS FOR PERFLUOROALKYL SUBSTANCES

In drawing up the list of proposed acronyms for perfluoroalkyl substances in Part 2 of this document, our objective was to reach an acceptable compromise between two challenging aspirations:

- to derive an internally consistent, fully rational set of acronyms for the variousfamilies of compounds;

- to preserve certain key acronyms that have become broadly accepted by the scientific community over the past decade, while avoiding overlap with acronyms commonly used in other areas of fluorine chemistry.

Justification for some of the most important decisions made in reaching the desired compromise is given below.

1. GENERIC ACRONYM FOR PERFLUOROALKYL SUBSTANCES

Perfluoroalkyl substances are defined here as those compounds containing a perfluoroalkyl (C_nF_{2n+1}-) moiety, bound to a functional group (specifically excluding -H or -F).
Several acronyms have been adopted in the scientific literature for this large family of substances that have very different chemical, physical and biological properties. The most commonly used acronym is PFCs, standing for perfluoroalkyl compounds.
This situation is deemed unsatisfactory, given that “perfluorocarbons”, meaning fully fluorinated alkanes (C_nF_{2n+2}), are one of the groups of compounds regulated under the Kyoto Protocol on greenhouse gases, where they are designated in official documents as “PFCs”.
To avoid this ambiguity, we suggest that it would be preferable to use the acronym PFAs for perfluoroalkyl substances, bearing in mind that we have reserved the term PFASs for perfluoroalkyl sulfonic acids/sulfonates, with PFAAs

standing for perfluoroalkyl acids (encompassing carboxylic, sulfonic, phosphonic and other acids).

2. NOMENCLATURE FOR PERFLUOROALKYL ACIDS AND THEIR ANIONS

The various families of perfluoroalkyl acids may potentially exist either in the protonated form or as anions, depending on the pH of the medium considered. The perfluoroalkyl sulfonic acids (PFASs) are very strong acids (pKa < 1) and probably are present in the fully ionized state in most, if not all, environmental and toxicological media. For the perfluoroalkyl carboxylic acids (PFCAs), there is an ongoing debate in the scientific literature regarding their acid strength (Burns et al., 2008; Goss, 2008; Ellis and Webster, 2009; Goss and Arp, 2009; Cheng et al., 2009a,b). It is conceivable that under certain conditions of environmental or ecotoxicological relevance, they may be present in the partially protonated state. Other acids containing a perfluoroalkyl moiety, such as the fluorotelomer carboxylic acids ($C_nF_{2n+1}CH_2COOH$) are expected to have pKa values comparable to their corresponding hydrocarbon acids (pKa 3-4) and therefore a greater tendency to be protonated.
In any case, all these acids are most commonly analyzed as their anions, by LC/MS/MS.
In view of this situation, we suggest using a single acronym, in general, to denote both ionized and neutral forms of an acid, except in contexts for which it is essential to make a distinction between them.

2.1. Perfluoroalkyl carboxylic acids

Thus, PFOA (for instance) would be used to denote indifferently perfluorooctanoic acid and/or its anion in publications on environmental monitoring or toxicological studies for which the precise distribution between ionized and protonated forms is either unknown or irrelevant.
On the other hand, for a paper describing (for example) studies on the pKa of PFOA, then each form would need to be identified by a specific acronym. Our suggestion is to use PFOA for the protonated form and PFO for the anion, in line with papers already published by several groups of researchers. Salts would be designated by adding a prefix, for example “Na-PFO” for the sodium salt of PFOA. This nomenclature can be easily extended to homologues of PFOA, i.e. the family of PFCAs.

2.2. Perfluoroalkyl sulfonic and sulfinic acids

For the perfluoroalkyl sulfonic acids, the generic name would be PFASs, standing for perfluoroalkyl (or perfluoroalkane) sulfonic acids or sulfonates and the individual compounds would be PFOS, PFBS, etc, consistent with current usage. If it is essential to specify the protonated form, then this could be done by using “H” as the prefix, so “H-PFOS” would be perfluorooctane sulfonic acid. Salts would be designated by a prefix (e.g. Na-PFOS), as for the carboxylates. Sulfinates would be treated in an analogous manner to sulfonates, with the “S” of sulfonates changed to “Si”.

2.3. Perfluoroalkyl phosphorus-containing acids

A recent paper reports on perfluoroalkyl phosphonic acids/phosphonates [$O=P(OH)_2C_nF_{2n+1}$ and ionized forms] in the environment, referring to them collectively as PFPAs (D'Eon et al., 2009).

This usage does not however allow the individual members of the family to be named by replacing one letter in the generic name by another letter (or pair of letters) representing the specific homologue, as for the carboxylates and sulfonates (e.g. PFHxA derived from PFCAs, or PFBS derived from PFASs).

The Mabury group identifies the individual PFPAs by using a prefix, e.g. C8-PFPA, C4-PFPA, etc.

it is necessary to distinguish between the various protonated and ionized forms of these (dibasic) acids, this can once again be done by adding prefixes, e.g. H2-C8-PFPA, H-Na-C8-PFPA, etc.

Perfluoroalkyl phosphinic acids/phosphinates [$O=P(OH)(C_nF_{2n+1})(C_mF_{2m+1})$ and ionized forms] could be treated similarly, using the generic nomenclature PFPiA.

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Appendix 2 Full list of PFNA related substances

Chemical group	CAS-Number	Name	Norwegian Product Register	REACH registration deadline
Fluoro alcohol compounds	678-39-7	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecan-1-ol	No	30/11/2010
Fluoro alcohol compounds	865-86-1	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecanol	No	30/11/2010
Fluoro alcohol compounds	90622-43-8	Alcohols, C7-22, ε-ω-perfluoro-, β-δ-fluoro	No	30/11/2010
Fluoro alcohol compounds/Fluoro ether compounds	94158-62-0	1-[2-(2-butoxyethoxy)ethoxy]-4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-10-(trifluoromethyl)undecan-2-ol	No	30/11/2010
Fluoro alcohol compounds/Fluoro phosphate compounds	54009-73-3	4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl dihydrogen phosphate	No	30/11/2010
Fluoro ammonium compounds	61798-68-3	1-(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl)pyridinium toluene-p-sulphonate	No	30/11/2010
Fluoro ammonium compounds	98219-29-5	Betaines, N-(hydroxyethyl)-N-methyl-N-(2-sulfoethyl)-N-(1,1,2-trihydroperfluoro-C8-14-2-alkenyl)	No	30/11/2010
Fluoro ester compounds	17741-60-5	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecyl acrylate	No	30/11/2010
Fluoro ester compounds	1996-88-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl methacrylate	No	30/11/2010
Fluoro ester compounds	2144-54-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecyl methacrylate	No	30/11/2010
Fluoro ester compounds	27905-45-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl acrylate	No	30/11/2010
Fluoro ester compounds	94166-88-8	Butanedioic acid, sulfo-, 1,4-bis(α-ω-perfluoro-C6-12-alkyl) esters, sodium salts	No	30/11/2010
Fluoro thioether compounds	68187-47-3	1-Propanesulfonic acid, 2-methyl-, 2-[[1-oxo-3-[(γ-ω-perfluoro-C4-16-alkyl)thio]propyl]amino] derivs., sodium salts	Yes	30/11/2010
Fluoro iodide compounds	2043-53-0	1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-heptadecafluoro-10-iododecane	No	30/11/2010
Fluoro iodide compounds	85995-91-1	Alkyl iodides, C8-14, γ-ω-perfluoro	No	30/11/2010

Fluoro phosphate compounds	92332-25-7	Phosphoric acid, bis(γ-ω-perfluoro-C8-14-alkyl) esters, compds. with diethanolamine	No	30/11/2010
Fluoro alcohol compounds	68391-08-2	Alcohols, C8-14, γ-ω-perfluoro	Yes	30/11/2010
Fluoro phosphate compounds	94291-77-7	bis[3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl] hydrogen phosphate, compound with 2,2'-iminodiethanol (1:1)	No	30/11/2010
Fluoro sulfonate/sulfonamide/sulfonyl compounds	27619-90-5	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecanesulphonyl chloride	No	30/11/2010
Fluoro sulfonate/sulfonamide/sulfonyl compounds	65702-24-1	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-nonadecafluoroundecane-1-sulphonyl chloride	No	30/11/2010
Fluoro sulfonate/sulfonamide/sulfonyl compounds	66008-69-3	2-[[(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluorononyl)sulphonyl]methylamino]ethyl acrylate	No	30/11/2010
Fluoro thioether compounds	68187-42-8	Propanamide, 3-[(γ-ω-perfluoro-C4-10-alkyl)thio] derivs.	No	30/11/2010
Perfluoro phosphonic/phosphinic compounds	68412-68-0	Phosphonic acid, perfluoro-C6-12-alkyl derivs.	Yes	30/11/2010
Perfluoro phosphonic/phosphinic compounds	68412-69-1	Phosphinic acid, bis(perfluoro-C6-12-alkyl) derivs.	Yes	30/11/2010
Fluoro thioether compounds	70983-60-7	1-Propanaminium, 2-hydroxy-N,N,N-trimethyl-, 3-[(γ-ω-perfluoro-C6-20-alkyl)thio] derivs., chlorides	Yes	30/11/2010
Partial fluoro& miscellaneous fluoro compounds	1841-46-9	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononyl methacrylate	No	30/11/2010
Partial fluoro& miscellaneous fluoro compounds	307-70-0	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11-icosafluoroundecan-1-ol	No	30/11/2010
Partial fluoro& miscellaneous fluoro compounds	376-18-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononan-1-ol	No	30/11/2010
Partial fluoro& miscellaneous fluoro compounds	38565-53-6	(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluorononyl)oxirane	No	30/11/2010
Partial fluoro& miscellaneous fluoro compounds	4180-26-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononyl acrylate	No	30/11/2010
Partial perfluoro & miscellaneous perfluoro compounds	423-95-0	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononanoyl chloride	No	30/11/2010
Partial perfluoro & miscellaneous perfluoro compounds	76-21-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononan-1-oic acid	No	30/11/2010

Fluoro ester compounds	85631-54-5	2-Propenoic acid, γ-ω-perfluoro-C8-14-alkyl esters	Yes	30/11/2010
Perfluoro amine compounds	90622-99-4	Amides, C7-19, α-ω-perfluoro-N,N-bis(hydroxyethyl)	No	30/11/2010
Perfluoro carboxylic compounds	335-76-2	nonadecafluorodecanoic acid	No	30/11/2010
Perfluoro carboxylic compounds	375-95-1	perfluorononan-1-oic acid	No	30/11/2010
Perfluoro carboxylic compounds	72968-38-8	Carboxylic acids, C7-13, perfluoro, ammonium salts	No	30/11/2010
Perfluoro ester compounds	85681-64-7	2-Propenoic acid, perfluoro-C8-16-alkyl esters	No	30/11/2010
Perfluoro ether compounds	335-36-4	2,2,3,3,4,4,5-heptafluorotetrahydro-5-(nonafluorobutyl)furan	No	30/11/2010
Perfluoro iodide compounds	507-63-1	heptadecafluoro-1-iodooctane	No	30/11/2010
Perfluoro iodide compounds	558-97-4	nonadecafluoro-9-iodononane	No	30/11/2010
Perfluoro iodide compounds	90622-71-2	Alkyl iodides, C6-18, perfluoro	No	30/11/2010
Fluoro phosphate compounds	92332-26-8	Phosphoric acid, mono(γ-ω-perfluoro-C8-14-alkyl) esters, compds. with diethanolamine	Yes	30/11/2010
Perfluoro phosphonic/phosphinic compounds	93062-53-4	Phosphinic acid, bis(perfluoro-C6-12-alkyl) derivs., aluminum salts	No	30/11/2010
Perfluoroalkyl Sulfonate and Related Compounds	335-24-0	potassium 1,2,2,3,3,4,5,5,6,6-decafluoro-4-(pentafluoroethyl)cyclohexanesulphonate	No	30/11/2010
Perfluoroalkyl Sulfonate and Related Compounds	68608-13-9	Sulfonamides, C4-8-alkane, perfluoro, N-ethyl-N-(hydroxyethyl), reaction products with TDI	No	30/11/2010
Fluoro alcohol compounds	67824-44-6	4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-10-(trifluoromethyl)undecane-1,2-diol	No	31/05/2013
Fluoro alcohol compounds	93776-01-3	1,1'-[oxybis[(isopropylene)oxy]]bis[4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluorotridecan-2-ol]	No	31/05/2013
Fluoro alcohol compounds	93776-07-9	33,33,34,34,35,35,36,36,37,37,38,38,39,39,40,40,41,41,42,42,42-henicosafluoro-2,5,8,11,14,17,20,23,26,29-decaoxadotetracontan-31-ol	No	31/05/2013
Fluoro alcohol compounds	94158-70-0	4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluoro-2-hydroxytridecyl dihydrogen phosphate	No	31/05/2013

Fluoro alcohol compounds	94159-80-5	1-[[3-(dimethylamino)propyl]amino]-4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluorotridecan-2-ol	No	31/05/2013
Fluoro alcohol compounds	94159-92-9	4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-1-phenoxy-10-(trifluoromethyl)undecan-2-ol	No	31/05/2013
Fluoro alcohol compounds	94200-46-1	diammonium 4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluoro-2-hydroxytridecyl phosphate	No	31/05/2013
Fluoro alcohol compounds/Fluoro amine compounds	73353-25-0	(2-carboxyethyl)-3-[[4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl]amino]propyldimethylammonium hydroxide	No	31/05/2013
Fluoro alcohol compounds/Fluoro amine compounds	73353-26-1	1-[[3-(dimethylamino)propyl]amino]-4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-10-(trifluoromethyl)undecan-2-ol	No	31/05/2013
Fluoro alcohol compounds/Fluoro amine compounds	93776-13-7	(2-carboxylatoethyl)[3-[(4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluoro-2-hydroxytridecyl)amino]propyl]dimethylammonium	No	31/05/2013
Fluoro alcohol compounds/Fluoro amine compounds	94159-89-4	potassium N-[4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl]-N-methylaminoacetate	No	31/05/2013
Fluoro alcohol compounds/Fluoro ammonium compounds	80909-29-1	[4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl]trimethylammonium iodide	No	31/05/2013
Fluoro alcohol compounds/Fluoro ammonium compounds	93776-17-1	[4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,13-henicosafluoro-2-hydroxytridecan-1-yl][bis(2-hydroxyethyl)]methylammonium iodide	No	31/05/2013
Fluoro alcohol compounds/Fluoro ammonium compounds	94159-78-1	[(4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl]bis(2-hydroxyethyl)methylammonium iodide	No	31/05/2013
Fluoro alcohol compounds/Fluoro ester compounds	24407-09-8	4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl acrylate	No	31/05/2013

Fluoro alcohol compounds/Fluoro phosphate compounds	63295-18-1	diammonium 4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl phosphate	No	31/05/2013
Fluoro amine compounds	97660-44-1	Ethanol, 2-(methylamino)-, N-(γ-ω-perfluoro-C8-14-β-alkenyl) derivs.	No	31/05/2013
Fluoro ammonium compounds	31841-41-5	(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl)bis(2-hydroxyethyl)methylammonium iodide	No	31/05/2013
Fluoro ammonium compounds	85631-40-9	Quaternary ammonium compounds, dimethyl(γ-ω-perfluoro-C8-14-β-alkenyl)[2-(sulfooxy)ethyl], hydroxides, inner salts	No	31/05/2013
Fluoro ammonium compounds	91081-09-3	Quaternary ammonium compounds, (hydroxyethyl)dimethyl(γ-ω-perfluoro-2-C8-14-alkenyl), chlorides	No	31/05/2013
Fluoro ammonium compounds	92129-34-5	Quaternary ammonium compounds, (hydroxyethyl)dimethyl(γ-ω-perfluoro-C8-14-β-alkenyl), Me sulfates	No	31/05/2013
Fluoro carboxylic compounds	72623-70-2	Acid chlorides, C8-14, β-ω-perfluoro	No	31/05/2013
Fluoro ester compounds	15166-00-4	3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl methacrylate	No	31/05/2013
Fluoro ester compounds	15577-26-1	3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl acrylate	No	31/05/2013
Fluoro ester compounds	68954-01-8	1,2,4,5-Benzenetetracarboxylic acid, mixed 3-chloro-2-hydroxypropyl and γ-ω-perfluoro-C8-14-alkyl esters	No	31/05/2013
Fluoro ester compounds	91648-32-7	2-Propenoic acid, ε-ω-perfluoro-C8-22-alkyl esters, γ-δ-fluoro derivs.	No	31/05/2013
Fluoro ester compounds	91745-16-3	Alcohols, C8-14, γ-ω-perfluoro, reaction products with 5,5'-carbonylbis[1,3-bisbenzofurandione] and epichlorohydrin	No	31/05/2013
Fluoro thiols compounds	68140-19-2	Thiols, C4-20, γ-ω-perfluoro	Yes	31/05/2013
Fluoro ether compounds	84029-54-9	tetratriacontafluoro-10,13,16,19-tetraoxaoctacosadiene	No	31/05/2013
Fluoro ether compounds	93776-05-7	1,1'-[oxybis(propyleneoxy)]bis[4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-10-(trifluoromethyl)undecan-2-ol]	No	31/05/2013

Fluoro ether compounds	93776-11-5	33,33,34,34,35,35,36,36,37,37,38,38,39,40,40,40-hexadecafluoro-39-(trifluoromethyl)-2,5,8,11,14,17,20,23,26,29-decaoxatetracontan-31-ol	No	31/05/2013
Fluoro iodide compounds	65510-56-7	1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-nonadecafluoro-11-iodoundecane	No	31/05/2013
Fluoro iodide compounds	68188-12-5	Alkyl iodides, C4-20, γ-ω-perfluoro	No	31/05/2013
Fluoro phosphate compounds	101896-22-4	9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,17,17,17-nonadecafluoro-3-(2-hydroxyethyl)-5-[(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-nonadecafluoroundecyl)oxy]-4,6-dioxa-3-aza-5-phosphaheptadecan-1-ol 5-oxide	No	31/05/2013
Fluoro phosphate compounds	78974-41-1	bis[3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl] hydrogen phosphate	No	31/05/2013
Fluoro phosphate compounds	78974-42-2	3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl dihydrogen phosphate	No	31/05/2013
Fluoro phosphate compounds	93776-24-0	ammonium bis[3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro9-(trifluoromethyl)decyl] phosphate	No	31/05/2013
Fluoro phosphate compounds	93857-49-9	diammonium 3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl phosphate	No	31/05/2013
Fluoro sulfate compounds	101940-12-9	Sulfuric acid, mono(γ-ω-perfluoro-C8-14-alkyl) esters, ammonium salts	No	31/05/2013
Fluoro sulfate compounds	84238-62-0	Sulfuric acid, mono(γ-ω-perfluoro-C8-12-alkyl) esters, ammonium salts	No	31/05/2013
Fluoro sulfate compounds	85995-90-0	Sulfuric acid, mono(γ-ω-perfluoro-C8-14-alkyl) esters	No	31/05/2013
Fluoro sulfonate/sulfonamide/sulfonyl compounds	66008-68-2	2-[[(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-icosafluoroundecyl)sulphonyl]methylamino]ethyl acrylate	No	31/05/2013
Fluoro sulfonate/sulfonamide/sulfonyl compounds	72276-05-2	2-[[(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecyl)sulphonyl]methylamino]ethyl acrylate	No	31/05/2013
Fluoro thioether compounds	68187-24-6	1,4-Butanediol, 2,3-bis[(γ-ω-perfluoro-C6-20-alkyl)thio] derivs.	No	31/05/2013

Fluoro thioether compounds	68187-25-7	Butanoic acid, 4-[[3-(dimethylamino)propyl]amino]-4-oxo-, 2(or 3)-[(γ-ω-perfluoro-C6-20-alkyl)thio] derivs.	No	31/05/2013
Fluoro thioether compounds	71608-60-1	Pentanoic acid, 4,4-bis[(γ-ω-perfluoro-C8-20-alkyl)thio] derivs.	No	31/05/2013
Fluoro thioether compounds	94095-37-1	Pentanoic acid, 4,4-bis[(γ-ω-perfluoro-C6-12-alkyl)thio] derivs., compds. with diethanolamine	No	31/05/2013
Fluoro thiols compounds	68140-18-1	Thiols, C4-10, γ-ω-perfluoro	No	31/05/2013
Fluoro thiols compounds	68140-20-5	Thiols, C6-12, γ-ω-perfluoro	No	31/05/2013
Fluoro thiols compounds	68140-21-6	Thiols, C10-20, γ-ω-perfluoro	No	31/05/2013
Partial fluoro& miscellaneous fluoro compounds	41925-33-1	[2,2,3,3,4,4,5,5,6,6,7,7,8,9,9,9-hexadecafluoro-8-(trifluoromethyl)nonyl]oxirane	No	31/05/2013
Partial fluoro& miscellaneous fluoro compounds	71726-31-3	1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-hexadecafluoro-9-(vinyloxy)nonane	No	31/05/2013
Partial fluoro& miscellaneous fluoro compounds	91770-94-4	Alcohols, C4-8-tertiary, ω-(ethenyloxy), perfluoro	No	31/05/2013
Partial fluoro& miscellaneous fluoro compounds	94159-90-7	4-[2,2,3,3,4,4,5,5,6,6,7,7,8,9,9,9-hexadecafluoro-8-(trifluoromethyl)nonyl]-2,2-dimethyl-1,3-dioxolane	No	31/05/2013
Partial perfluoro & miscellaneous perfluoro compounds	1868-86-6	ammonium 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononan-1-oate	No	31/05/2013
Partial perfluoro & miscellaneous perfluoro compounds	3658-57-9	ammonium 8-chlorohexadecafluoro-7-methyloctanoate	No	31/05/2013
Partial perfluoro & miscellaneous perfluoro compounds	68156-00-3	nonafluorobis(trifluoromethyl)cyclohexanesulphonyl fluoride	No	31/05/2013
Partial perfluoro & miscellaneous perfluoro compounds	68555-67-9	sodium heptadecafluorooctanesulphinate	No	31/05/2013
Perfluoro carboxylic compounds	15742-62-8	2,2,3,3,4,4,5,5,6,6,7,8,8,8-tetradecafluoro-7-(trifluoromethyl)octyl fluoride	No	31/05/2013
Perfluoro carboxylic compounds	15899-31-7	tetradecafluoroisononanoic acid	No	31/05/2013
Perfluoro carboxylic compounds	3108-42-7	ammonium nonadecafluorodecanoate	No	31/05/2013
Perfluoro carboxylic compounds	3658-62-6	ammonium tetradecafluoro-7-(trifluoromethyl)octanoate	No	31/05/2013

Perfluoro carboxylic compounds	68015-86-1	tetradecafluoro-7-(trifluoromethyl)octanoic acid, compound with ethylamine (1:1)	No	31/05/2013
Perfluoro carboxylic compounds	68333-92-6	Fatty acids, C7-13, perfluoro	No	31/05/2013
Perfluoro carboxylic compounds	71356-38-2	1-(carboxylatomethyl)-1-(2-hydroxyethyl)-4-(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-nonadecafluoro-1-oxodecyl)piperazinium	No	31/05/2013
Perfluoro carboxylic compounds	91032-01-8	Fatty acids, C7-19, perfluoro	No	31/05/2013
Perfluoro ether compounds	40464-54-8	heptafluorotetrahydro(nonafluorobutyl)furan	No	31/05/2013
Perfluoro iodide compounds	865-77-0	1,1,1,2,3,3,4,4,5,5,6,6,7,7,8,8-hexadecafluoro-8-iodo-2-(trifluoromethyl)octane	No	31/05/2013
Perfluoro phosphonic/phosphinic compounds	90481-10-0	Phosphonic acid, perfluoro-C6-12-alkyl derivs., aluminum salts	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	161074-58-4	Fatty acids, C18-unsatd., trimers, reaction products with 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro -N-(2-hydroxyethyl)-N-methyl-1-octanesulfonamide, 1,1,2,2,3,3,4,4,4-nonafluoro -N-(2-hydroxyethyl)-N-methyl-1-butanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro -N-(2-hydroxyethyl)-N-methyl-1-heptanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro -N-(2-hydroxyethyl)-N-methyl-1-hexanesulfonamide and 1,1,2,2,3,3,4,4,5,5,5-undecafluoro -N-(2-hydroxyethyl)-N-methyl-1-pentanesulfonamide	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	17202-41-4	ammonium nonadecafluorononanesulphonate	Yes	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	68081-83-4	Carbamic acid, (4-methyl-1,3-phenylene)bis-, bis[2-[ethyl[(perfluoro-C4-8-alkyl)sulfonyl]amino]ethyl] ester	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	68156-01-4	potassium nonafluorobis(trifluoromethyl)cyclohexanesulphonate	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	68156-06-9	decafluoro(pentafluoroethyl)cyclohexane sulphonyl fluoride	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	68259-06-3	perfluorononanesulphonyl fluoride	No	31/05/2013

Perfluoroalkyl Sulfonate and Related Compounds	68391-09-3	Sulfonic acids, C6-12-alkane, perfluoro, potassium salts	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	68649-26-3	N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-N-(2-hydroxyethyl)-1-octanesulfonamide, reaction products with N-ethyl-1,1,2,2,3,3,4,4,4-nonafluoro-N-(2-hydroxyethvl)-1-butanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-(2-hydroxyethyl)-1-heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-(2-hydroxyethyl)-1-hexanesulfonamide, N-ethyl- 1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-(2-hydroxyethyl)-1-pentanesulfonamide, octadecan-1-ol and polymethylenepolyphenylene polyisocyanate	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	91081-99-1	Sulfonamides, C4-8-alkane, perfluoro, N-(hydroxyethyl)-N-methyl, reaction products with epichlorohydrin, adipates (esters)	No	31/05/2013
Perfluoroalkyl Sulfonate and Related Compounds	93572-72-6	Sulfonic acids, C6-12-alkane, perfluoro	No	31/05/2013
Poly fluoro compounds	65545-80-4	Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, ether with α-fluoro-ω-(2-hydroxyethyl)poly(difluoromethylene) (1:1)	Yes	31/05/2013
Fluoro ester compounds	479029-28-2	2-Propenoic acid, 2-methyl-, 2-(dimethylamino)ethyl ester, polymers with γ-ω-perfluoro-C8-14-alkyl acrylate, acetates, N-oxides	No	31/05/2018
Fluoro phosphate compounds	74499-44-8	Phosphoric acid, γ-ω-perfluoro-C8-16-alkyl esters, compds. with diethanolamine	No	31/05/2018
Fluoro siloxane/silicone/silane compounds	78560-44-8	Silane, trichloro(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl)-	No	31/05/2018
Fluoro siloxane/silicone/silane compounds	83048-65-1	Silane, (3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl)trimethoxy-	No	31/05/2018
Partial perfluoro & miscellaneous perfluoro compounds	86508-42-1	Perfluoro compounds, C5-18	Yes	31/05/2018
Poly fluoro compounds	65530-65-6	Poly(difluoromethylene), α-fluoro-ω-[2-[(1-oxooctadecyl)oxy]ethyl]-	No	31/05/2018
Poly fluoro compounds	69991-61-3	Ethene, 1,1,2,2-tetrafluoro-, oxidized, polymd.	No	31/05/2018

Fluoro ester compounds	115592-83-1	2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester	Yes	not preregistered
Fluoro urethane compounds	135228-60-3	Hexane, 1,6-diisocyanato-, homopolymer, g-w-perfluoro-C6-20-alc.-blocked	Yes	not preregistered
Fluoro ester compounds	203743-03-7	2-Propenoic acid, 2-methyl-, hexadecyl ester, polymers with 2-hydroxyethyl methacrylate, g-w-perfluoro-C10-16-alkyl acrylate and stearyl methacrylate	Yes	not preregistered
Fluoro urethane compounds	68990-40-9	Fatty acids, C18-unsatd., dimers, diisocyanates, polymers with 2,3-bis(g-w-perfluoro-C4-18-alkyl)-1,4-butanediol, 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane and 2,2'-(methylimino)bis[ethanol]	Yes	not preregistered
Fluoro amine compounds	70969-47-0	Thiols, C8-20, g-w-perfluoro, telomers with acrylamide	Yes	not preregistered
Fluoro ammonium compounds	4149-60-4	Ammonium perfluorononanoate (APFN)	No	not preregistered
Perfluoroalkyl Sulfonate and Related Compounds	68298-62-4	2-Propenoic acid, 2-[butyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester	Yes	not preregistered
Perfluoroalkyl Sulfonate and Related Compounds	67584-42-3	Cyclohexanesulfonic acid, decafluoro(pentafluoroethyl)-, potassium salt	Yes	not preregistered
Perfluoroalkyl Sulfonate and Related Compounds	306974-63-0	Fatty acids, C18-unsatd., dimers, 2-[methyl[(perfluoro-C4-8-alkyl)sulfonyl]amino]ethyl esters	Yes	not preregistered
Poly fluoro compounds	144468-32-6	1,3-Propanediol, 2,2-bis(bromomethyl)-, reaction products with ethanethioltetrafluoroethylene telomer, polymers with 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane,2-heptyl-3,4-bis(9-isocyanatononyl)-1-pentylcyclohexane and 2,2'-(methylimino)bis[ethanol] telomer	Yes	not preregistered
Poly fluoro compounds	148878-17-5	2-Propenoic acid, 2-methyl-, C2-18-alkyl esters, polymers with α-fluoro-w-[2-[(1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene) and vinylidene chloride	Yes	not preregistered
Poly fluoro compounds	65530-63-4	Ethanol, 2,2’-iminobis-, compd. With α-fluoro-w-[2-(phosphonooxy)ethyl] poly(difluoromethylene) (2:1)	Yes	not preregistered
Poly fluoro compounds	65530-64-5	Ethanol, 2,2’-iminobis-, compd. With α, α’-[phosphinicobis(oxy-2,1-ethanediyl)] bis[w-fluoropoly(difluoromethylene)] (1:1)	Yes	not preregistered

Poly fluoro compounds	65530-66-7	Poly(difluoromethylene), α-fluoro-w-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]-	Yes	not preregistered
Poly fluoro compounds	65530-69-0	Poly(difluoromethylene), α -[2-[(2-carboxyethyl)thio]ethyl]- w-fluoro-, lithium salt	Yes	not preregistered
Poly fluoro compounds	65530-70-3	Poly(difluoromethylene), α, α'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[w-fluoro-, ammonium salt	Yes	not preregistered
Poly fluoro compounds	65530-71-4	Poly(difluoromethylene), α -fluoro-w-[2-(phosphonooxy)ethyl]-, monoammonium salt	Yes	not preregistered
Poly fluoro compounds	65530-72-5	Poly(difluoromethylene), α -fluoro-w-[2-(phosphonooxy)ethyl]-, diammonium salt	Yes	not preregistered
Poly fluoro compounds	65530-74-7	Ethanol, 2,2'-iminobis-, compd. With α -fluoro-w-[2-(phosphonooxy)ethyl] poly(difluoromethylene) (1:1)	Yes	not preregistered
Poly fluoro compounds	65605-70-1	Poly(difluoromethylene), α-fluoro-w-[2-[(1-oxo-2-propenyl)oxy]ethyl]-	Yes	not preregistered

Appendix 3 Results from library search for use and occurrence of PFNA related substances

The library search was performed in two steps.
All documentation from the last century about uses of PFNA (CAS RN 375-95-1) and 30 PFNA related substances found in the Norwegian Product Register. The result from the first step was 129 documented uses of PFNA, while only 2 of the 30 precursors had documented uses from year 2003 to present. Five precursors had nine documented uses in total.

Documentation from 2003 to present for the remaining 121 PFNA related substances identified in chapter 4.1.1. This search gave too many hit to be possible to handle. Therefore, only the use of high volume chemicals is included. High volume chemicals were defined as chemicals with registration deadline in 2010 which included additional 38 chemicals (see appendix 2).

Results from 1

Chemical group	CAS RN	Name	Last reference	Use or occurrence
Fluoro alcohol compounds	68391-08-2	Alcohols, C8-14, γ-ω-perfluoro		-
Fluoro amine compounds	70969-47-0	Thiols, C8-20, g-w-perfluoro, telomers with acrylamide		-
Fluoro ester compounds	115592-83-1	2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester		-
Fluoro ester compounds	203743-03-7	2-Propenoic acid, 2-methyl-, hexadecyl ester, polymers with 2-hydroxyethyl methacrylate, g-w-perfluoro-C10-16-alkyl acrylate and stearyl methacrylate		-
Fluoro ester compounds	85631-54-5	2-Propenoic acid, γ-ω-perfluoro-C8-14-alkyl esters		-
Fluoro phosphate compounds	92332-26-8	Phosphoric acid, mono(γ-ω-perfluoro-C8-14-alkyl) esters, compds. with diethanolamine		-
Fluoro thioether compounds	68187-47-3	1-Propanesulfonic acid, 2-methyl-, 2-[[1-oxo-3-[(γ-ω-perfluoro-C4-16-alkyl)thio]propyl]amino] derivs., sodium salts		-
Fluoro thioether compounds	70983-60-7	1-Propanaminium, 2-hydroxy-N,N,N-trimethyl-, 3-[(γ-ω-perfluoro-C6-20-alkyl)thio] derivs., chlorides		-
Fluoro thiols compounds	68140-19-2	Thiols, C4-20, γ-ω-perfluoro		-
Fluoro urethane compounds	135228-60-3	Hexane, 1,6-diisocyanato-, homopolymer, g-w-perfluoro-C6-20-alc.-blocked		-

Fluoro urethane compounds	68990-40-9	Fatty acids, C18-unsatd., dimers, diisocyanates, polymers with 2,3-bis(g-w-perfluoro-C4-18-alkyl)-1,4-butanediol, 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane and 2,2'-(methylimino)bis[ethanol]		-
Partial perfluoro & miscellaneous perfluoro compounds	86508-42-1	Perfluoro compounds, C5-18		-
Perfluoro carboxylic compounds	375-95-1	perfluorononan-1-oic acid (PFNA)	2009	lubricating oil additive, surfactant for fire extinguishers, cleaning agent, textile antifouling finishing agent, LCD panels, polishing surfactant
Perfluoro phosphonic/phosphinic compounds	68412-68-0	Phosphonic acid, perfluoro-C6-12-alkyl derivs.		-
Perfluoro phosphonic/phosphinic compounds	68412-69-1	Phosphinic acid, bis(perfluoro-C6-12-alkyl) derivs.		-
Perfluoroalkyl Sulfonate and Related Compounds	17202-41-4	ammonium nonadecafluorononanesulphonate	1993	floor care maintenance system
Perfluoroalkyl Sulfonate and Related Compounds	306974-63-0	Fatty acids, C18-unsatd., dimers, 2-[methyl[(perfluoro-C4-8-alkyl)sulfonyl] amino]ethyl esters		-
Perfluoroalkyl Sulfonate and Related Compounds	67584-42-3	Cyclohexanesulfonic acid, decafluoro(pentafluoroethyl)-, potassium salt	2001	printing ink, etchant solutions for integrated circuit manufacture, insecticide
Perfluoroalkyl Sulfonate and Related Compounds	68298-62-4	2-Propenoic acid, 2-[butyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester		-
Poly fluoro compounds	144468-32-6	1,3-Propanediol, 2,2-bis(bromomethyl)-, reaction products with ethanethioltetrafluoroethylene telomer, polymers with 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane,2-heptyl-3,4-bis(9-isocyanatononyl)-1-pentylcyclohexane and 2,2'-(methylimino)bis[ethanol] telomer		-

Poly fluoro compounds	148878-17-5	2-Propenoic acid, 2-methyl-, C2-18-alkyl esters, polymers with α-fluoro-w-[2-[(1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene) and vinylidene chloride		-
Poly fluoro compounds	65530-63-4	Ethanol, 2,2'-iminobis-, compd. With α-fluoro-w-[2-(phosphonooxy)ethyl] poly(difluoromethylene) (2:1)		-
Poly fluoro compounds	65530-64-5	Ethanol, 2,2'-iminobis-, compd. With α, α'-[phosphinicobis(oxy-2,1-ethanediyl)] bis[w-fluoropoly(difluoromethylene)] (1:1)		-
Poly fluoro compounds	65530-66-7	Poly(difluoromethylene), α-fluoro-w-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]-	2005	preparation of magnetic nanoparticles for enhance gas mass transfer in fermentations
Poly fluoro compounds	65530-69-0	Poly(difluoromethylene), α -[2-[(2-carboxyethyl)thio]ethyl]- w-fluoro-, lithium salt	1992	antistatic lead screens for use with x-ray films, gypsum scale removal by solution containing chelating agent and fluorene-substituted surfactant
Poly fluoro compounds	65530-70-3	Poly(difluoromethylene), α, α'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[w-fluoro-, ammonium salt		-
Poly fluoro compounds	65530-71-4	Poly(difluoromethylene), α -fluoro-w-[2-(phosphonooxy)ethyl]-, monoammonium salt		-
Poly fluoro compounds	65530-72-5	Poly(difluoromethylene), α -fluoro-w-[2-(phosphonooxy)ethyl]-, diammonium salt		-
Poly fluoro compounds	65530-74-7	Ethanol, 2,2'-iminobis-, compd. With α -fluoro-w-[2-(phosphonooxy)ethyl] poly(difluoromethylene) (1:1)		-
Poly fluoro compounds	65545-80-4	Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, ether with α-fluoro-ω-(2-hydroxyethyl)poly(difluoromethylene) (1:1)		-
Poly fluoro compounds	65605-70-1	Poly(difluoromethylene), α-fluoro-w-[2-[(1-oxo-2-propenyl)oxy]ethyl]-	2008	antifouling finishing method for natural color cotton knitwear, antiwear additive for lubricants

Results from 2

Chemical group	CAS RN	Name	Användning CA
Fluoro alcohol compounds	678-39-7	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecan-1-ol	water and oil repellent coating
Fluoro alcohol compounds	865-86-1	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecanol	copolymerization, oxide superconductor and method for producing the same
Fluoro alcohol compounds	90622-43-8	Alcohols, C7-22, ε-ω-perfluoro-, β-δ-fluoro	-
Fluoro alcohol compounds/Fluoro ether compounds	94158-62-0	1-[2-(2-butoxyethoxy)ethoxy]-4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-10-(trifluoromethyl)undecan-2-ol	-
Fluoro alcohol compounds/Fluoro phosphate compounds	54009-73-3	4,4,5,5,6,6,7,7,8,8,9,9,10,11,11,11-hexadecafluoro-2-hydroxy-10-(trifluoromethyl)undecyl dihydrogen phosphate	-
Fluoro ammonium compounds	61798-68-3	1-(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl)pyridinium toluene-p-sulphonate	battery electrolyte, perfluorinated cationic surfactant for electrodeposition of tin
Fluoro ammonium compounds	98219-29-5	Betaines, N-(hydroxyethyl)-N-methyl-N-(2-sulfoethyl)-N-(1,1,2-trihydroperfluoro-C8-14-2-alkenyl)	-
Fluoro ester compounds	17741-60-5	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecyl acrylate	anti-bleed agents for adhesives in semiconductor devices, contained layers for organic electronic device, water-repellent agent in clothing, tires, pharmaceuticals
Fluoro ester compounds	1996-88-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl methacrylate	Printing plates, hydrophobic coatings, antistatic coatings, pharmaceuticals
Fluoro ester compounds	2144-54-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-henicosafluorododecyl methacrylate	Adhesives, water-repellent agent in clothing, surfactant in polymerization
Fluoro ester compounds	27905-45-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl acrylate	pretreatment paste for ink-jet printing of polyester fabrics, anti-bleed agents for adhesives in semiconductor devices,
Fluoro ester compounds	94166-88-8	Butanedioic acid, sulfo-, 1,4-bis(α-ω-perfluoro-C6-12-alkyl) esters, sodium salts	-
Fluoro iodide compounds	2043-53-0	1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-heptadecafluoro-10-iododecane	Laboratory use, catalyst for manufacturing olefin polymers
Fluoro iodide compounds	85995-91-1	Alkyl iodides, C8-14, γ-ω-perfluoro	-
Fluoro phosphate compounds	92332-25-7	Phosphoric acid, bis(γ-ω-perfluoro-C8-14-alkyl) esters, compds. with diethanolamine	-
Fluoro phosphate compounds	94291-77-7	bis[3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-hexadecafluoro-9-(trifluoromethyl)decyl] hydrogen phosphate, compound with 2,2'-iminodiethanol (1:1)	-

Fluoro sulfonate/sulfonamide/sulfonyl compounds	27619-90-5	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecanesulphonyl chloride	fluoro surfactants for perfluoroalkylation agents or additives for fire-extinguishing foams
Fluoro sulfonate/sulfonamide/sulfonyl compounds	65702-24-1	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-nonadecafluoroundecane-1-sulphonyl chloride	-
Fluoro sulfonate/sulfonamide/sulfonyl compounds	66008-69-3	2-[[(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluorononyl)sulphonyl]methylamino]ethyl acrylate	-
Fluoro thioether compounds	68187-42-8	Propanamide, 3-[(γ-ω-perfluoro-C4-10-alkyl)thio] derivs.	-
Partial fluoro& miscellaneous fluoro compounds	1841-46-9	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononyl methacrylate	Pharmaceuticals
Partial fluoro& miscellaneous fluoro compounds	307-70-0	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11-icosafluoroundecan-1-ol	Solubilizing of organometallic compounds in fluorinated solvents, pharmaceuticals
Partial fluoro& miscellaneous fluoro compounds	376-18-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononan-1-ol	Laboratory, polymer production
Partial fluoro& miscellaneous fluoro compounds	38565-53-6	(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluorononyl)oxirane	Adhesives, copolymerization
Partial fluoro& miscellaneous fluoro compounds	4180-26-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononyl acrylate	polymerizable films, liq crystal display retardation film
Partial perfluoro & miscellaneous perfluoro compounds	423-95-0	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononanoyl chloride	-
Partial perfluoro & miscellaneous perfluoro compounds	76-21-1	2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononan-1-oic acid	Oxide superconductor and method for producing the same, liquid repellent agent preparation for antireflection layer for displays
Perfluoro amine compounds	90622-99-4	Amides, C7-19, α-ω-perfluoro-N,N-bis(hydroxyethyl)	-
Perfluoro carboxylic compounds	335-76-2	nonadecafluorodecanoic acid	super-amphiphobic property on surface of copper or copper alloy substrate to realize corrosion-resistant and self-cleaning functions
Perfluoro carboxylic compounds	72968-38-8	Carboxylic acids, C7-13, perfluoro, ammonium salts	-
Perfluoro ester compounds	85681-64-7	2-Propenoic acid, perfluoro-C8-16-alkyl esters	-

Perfluoro ether compounds	335-36-4	2,2,3,3,4,4,5-heptafluorotetrahydro-5-(nonafluorobutyl)furan (FC 75)	Microporous membranes, Surface treatment agents for resist pattern formation
Perfluoro iodide compounds	507-63-1	heptadecafluoro-1-iodooctane	Production of fluoropolymers (PVDF) and elastomers by emulsion polymerization
Perfluoro iodide compounds	558-97-4	nonadecafluoro-9-iodononane	polymerization of vinyl polymers
Perfluoro iodide compounds	90622-71-2	Alkyl iodides, C6-18, perfluoro	-
Perfluoro phosphonic/phosphinic compounds	93062-53-4	Phosphinic acid, bis(perfluoro-C6-12-alkyl) derivs., aluminum salts	-
Perfluoroalkyl Sulfonate and Related Compounds	335-24-0	potassium 1,2,2,3,3,4,5,5,6,6-decafluoro-4-(pentafluoroethyl)cyclohexanesulphonate	nonfoaming surfactant for metal electrowinning
Perfluoroalkyl Sulfonate and Related Compounds	68608-13-9	Sulfonamides, C4-8-alkane, perfluoro, N-ethyl-N-(hydroxyethyl), reaction products with TDI	-

Appendix 4 OECD surveys of PFCs

OECD- SURVEY OF PRODUCT CONTENT AND ENVIRONMENTAL RELEASE INFORMATION ON PERFLUOROOCTANE SULFONATE (PFOS), PERFLUOROALKYL SULFONATE (PFAS), PERFLUOROOCTANOIC ACID (PFOA), PERFLUOROCARBOXYLIC ACID (PFCA), THEIR RELATED SUBSTANCES AND PRODUCTS/MIXTURES CONTAINING THESE SUBSTANCES

INTRODUCTION

The Organisation for Economic Cooperation and Development (OECD) monitors the manufacture and use of PFOA and PFOA-related chemicals and other PFAS and PFAS-related chemicals in addition to PFOS and PFOS-related chemicals through surveys conducted every 2-3 years.

The results of the 2004 OECD Survey titled "Production and Use Information on Perfluorooctane Sulfonate (PFOS), Perfluoroalkyl Sulfonate (PFAS), Perfluorooctanoic Acid (PFOA), related Substances and Products/Mixtures containing these Substances" were published in 2005 as ENV/JM/MONO(2005)1 and are available at:

http://www.olis.oecd.org/olis/2005doc.nsf/LinkTo/env-jm-mono(2005)1.

Subsequently lists of these groups of chemicals with CAS numbers were developed to assist in responding to the surveys. These lists were published as ENV/JM/MONO(2006)15 the first time in 2006 and are available at:

http://appli1.oecd.org/olis/2006doc.nsf/linkto/env-jm-mono(2006)15.

The second survey on "Production and Use of PFOS, PFAS, PFOA, PFCA and their Related Substances and Products/Mixtures Containing these Substances" was undertaken in 2006. Among others, the survey identified substances not listed in the "Preliminary Lists". Consequently, the "Lists" were updated in 2007 [ENV/JM/MONO(2006)15]. The outcome of the survey was published in December 2006 as ENV/JM/MONO(2006)36 and can be found at:

http://appli1.oecd.org/olis/2006doc.nsf/linkto/env-jm-mono(2006)36.

One of the recommendations of an OECD sponsored PFCA Workshop held in Stockholm, Sweden in November 2006 was that the Business and Industry Advisory Committee (BIAC) assist the OECD in the development of the next survey with the goal of collecting more useful data associated with the manufacture and use of these substances. Over the past year, a BIAC team worked closely with the OECD PFC Steering Group to design a survey, and develop the forms and instructions needed to conduct it.

This survey differs from the previous surveys in several important ways.

- First, it is targeted at the producers of the basic chemistry. The previous surveys, on the other hand, focused further down the value chain, by asking OECD member countries to collect information on products manufactured in or imported into their jurisdictions. This approach significantly complicated data collection. The revised approach was adopted to address this concern, and better ensure achievement of the underlying goal of the survey, which is to gather information that will assist OECD and countries in assessing potential contributions to environmental loadings of PFOS, PFAS, PFOA and longer chain length Perfluorocarboxylic Acids (PFCA).

- Second, the survey will be administered by a single OECD member country (Australia), which will send out the survey forms to the companies that have been identified as being the producers of the basic chemistry, and summarise the results for use by OECD and other countries. This approach will greatly simplify the handling and processing of Confidential Business Information (CBI). In general, such information will be subject to the protections afforded by the Country administering the survey, and will only be shared with OECD or countries in ways that are consistent with the law of that country governing the protection of CBI.

- Third, the survey focuses on PFAS with chain lengths C6 and higher (including PFOS), PFCAs with chain lengths C8 and higher (including PFOA), and substances that may be potential precursors of these substances that are likely to be produced or present in products, either as residual substances or otherwise. For definitional purposes "precursor" means a substance that has been recognized as having the potential to degrade to a PFAS with a chain length of C6 or higher (including PFOS), or a PFCA with a chain length of C8 and higher (including PFOA). Once entering the environment these precursors may have the potential to degrade to the subject PFAS and PFCA substances. Two kinds of data are sought in the survey concerning the targeted substances: product content data and data on releases to the environment from manufacturing activities. The targeted substance list is attached.

Note that the survey is not intended to capture the content of these substances in consumer products or articles in commerce, to avoid "double counting." In this regard, the focus of the survey is on potential contributions to environmental loadings of the targeted PFAS and PFCAs. This objective is achieved by focusing on manufacturing releases and the presence of targeted substances in products created at the start of the manufacturing process. This objective is achieved by focusing on manufacturing releases and the presence of targeted substances in products created at the start of the manufacturing process. However, it should be kept in mind that the product content information provides a conservative estimate of potential emissions from "products", not an estimate of expected or actual emissions. In fact, downstream processing of "products" of this survey could result in some decrease of the amounts in the product content category.

As a further check to limit "double counting", definitions of "product" and "manufacturer" are included. The definition of "product" is intended to exclude intermediates on the targeted substance list that are sold to other manufacturers and used as reactants. A company that purchases and uses these intermediates will be treated as a "manufacturer" for purposes of the survey and will report, like other "manufacturers", its manufacturing emissions, as well as the content of targeted substances in its products.

A “perfluorochemical product” is a product offered for sale in the marketplace as a solid or as a final finished formulation (solution or dispersion) that consists of or includes one or more chemicals on the targeted substances list. Perfluorochemical products in this definition include certain fluorinated surfactants as well as per- and poly- fluorinated polymeric products and is therefore, by design, over inclusive. Perfluorochemical products are manufactured from fluorochemical intermediates (and other non-fluorinated substances) and then sold to end-use customers and distributors. Perfluorochemical products, for the purposes of this survey, do not include end products and formulated items (*i.e.* cleaning solutions, paints), the articles to which they are applied (paper, textiles, nonwovens, paper, carpet), and articles that are subsequently manufactured from them. Perfluorochemical products also do not include intermediates, when sold and purchased as such. (Note: A company that uses these intermediates will be deemed a manufacturer, so the quantities are accounted for in this survey)

A “manufacturer” is a company that manufactures substances on the targeted substance list, and also any company who uses one or more of the TSL substances to make perfluorochemical-based products.

Appendix 5 Qustionnaire for manufacturers/importers & suppliers of PFOA and related compounds and exempted PFOS uses

Review of restrictions on marketing and use of PFOA and related compounds

Dear Madam, Sir,

We are writing with regard to a study that RPS Advies is currently undertaking for the European Commission, DG Enterprise and Industry.

Directive 2006/122/EC relating the restrictions on marketing and use on PerFluoroOctane Sulfonic acid (PFOS) and related compounds requires the European Commission to:

- keep under review the ongoing risk assessment activities on PerFluoroOctanoid Acid (PFOA) and to propose necessary measures to reduce the risks if needed,
- investigate those industrial uses of PFOS and related compounds excluded from the restrictions.

In a recent OECD study, new hazard information become available on PFOA and APFO. As a consequence, the Commission is required to monitor the ongoing activities in order to propose any restrictions measure if needed.
This study will evaluate the risk of PFOA and APFO, including the availability of possible alternatives for the placing on the market and use by industry of PFOA/APFO and their use in consumer products. Derogations may be made in cases where there are no unacceptable risks or where the socio-economic benefits from using the substance(s) outweigh the risks.
This study will also include an evaluation of the alternatives to PFOS for those uses, exempted by the restrictions such as photoresists, photographic coatings, hydraulic fluids for aviation and chromium electroplating process. This analysis

will help the Commission to monitor the development of possible alternatives or technologies.

RPS Advies has been commissioned by the European Commission, DG Enterprise & Industry, to analyse the risks arising:

- from the industrial uses of PFOA and APFO and;
- from their use in consumer articles and;

to investigate the development of alternative substances and technologies to those uses of PFOS and related compounds that are excluded from the restrictions under the Directive 2006/122/EC. Please find enclosed the letter of confirmation from the Commission._

To undertake this task, we are consulting with the EU manufacturers/importers and suppliers of PFOA and related compounds as well their downstream users (industry sectors), in a multi-step approach, regarding information to be used for :

1. Market Analysis
2. Exposure Scenarios
3. Evaluation of risk profiles of alternatives for PFOA/APFO
4. Identification and definition of specific uses of PFOA/APFO
5. Conclusions and recommendations

This questionnaire relates to topic 1 and 4. Any available information on the other tasks 2 and 3 is welcomed but we have planned to send a separate questionnaire to obtain this information to divide the workload for you.

This questionnaire has been prepared for EU manufacturers/importers and suppliers of PFOA and related compounds; a separate questionnaire is available for downstream users of PFOA and related compounds. We would very much welcome your participation in completing this questionnaire to help ensure that this study provides an accurate and up-to-date picture of the potential impacts of restrictions on the marketing and use of PFOA and related compounds in consumer products for manufacturers and suppliers of these products. We recognise that some of the questions may be difficult to answer precisely; in such

cases, please provide your best estimate. Also, feel free to provide additional information on the last page or as a separate document. Also, please note that quantitative information (in Euros €) - rather than qualitative information - will enable us provide concrete examples of the potential impacts of the restrictions which will significantly assist the Commission's decision making.

Please send your completed questionnaire by email, fax or post to the address on the last page of this questionnaire by 31 March 2008. However, if you would like to respond to this survey but are unable to do so before this date, please let us know. If you would like to discuss the project or these questions further, please feel free to call us. Alternatively, you can email us suggesting a time when we can call you to discuss the questions. Please submit your completed responses in the English language.

Confidentiality

We understand that the information provided could contain confidential business information. Therefore the study team:

- will handle the information in the questionnaires as confidential business information (unless stated otherwise). This information shall not be shared with any other company or institution other then the study team. DG ENTR will be the owner of this information;
- will present the collected and processed data without any link or reference to the specific company and/or company location.

We would be happy to address any further confidentially concerns you may have - as long as this is brought to our attention. Thank you very much for your assistance.

About your Organisation

Organisation name:	
Name of contact person:	
Address:	
Telephone number:	
Fax number:	
E-mail address:	

Number of employees:	<50		<250		>250	
Annual Turnover:	≤€10m		≤€50m		>€50m	

If possible, please specify your annual turnover: €

Q1. Is your company involved in the production/manufacture, import and/or supply of PFOA and related compounds? Please tick the relevant boxes.

Producer of PFOA and related compounds	
Importer of PFOA and related compounds	

Supplier of PFOA and related compounds ☐

Producer of PFOS for exempted uses ☐

Importer of PFOS for exempted uses ☐

Supplier of PFOS for exempted uses ☐

None of the above, please specify ☐

Q2. Please provide the **annual tonnages** of all PFOA/APFO and related compounds manufactured (or produced), imported or supplied by your company to EU customers over the last five years and the **location of production** (i.e. name of country) or source of the imported PFOA and related compounds.

Year	Production volume (tonnes)	Import volume (tonnes)	Supply volume (tonnes)	Production location / Source of import
2008				
2007				
2006				
2005				
2004				

Q3. Following from Q2, please provide us with an indication of **any noticeable trend in the demand for or sales** of the above PFOA and related compounds (including PFOS for exempted uses) in the EU markets and/or national markets in which you operate over the last 5 years. We would be very interested to know about trends in both the sales of your company/organisation *(for example, an explanation of any significant increase or decrease in production on a year-by-year basis)* and overall trends within the EU markets in which you are active as well as about any future trends you envisage.

***Trends in EU market*:**

***Trends in National markets*:**

Q4. For each of the PFOA compounds (including PFOS for exempted uses) presented in the table below, please provide an indication of the **total average quantity (in tonnes) manufactured, imported or supplied to EU customers** by your company in the last five years (*indicate which at the end of the table*)?

Compound name	CAS#	EC#	Volume (t/y)
PFOA and APFO			
Pentadecafluoro octanoic acid	**335-67-1**	**206-397-9**	
Pentadecafluoro octanoic acid, ammonium salt	**3825-26-1**	**223-320-4**	
		Total PFOA and APFO	
PFOA precursors			
Methyl perfluorooctanoate	**376-27-2**	**206-808-1**	
1,1,1,2,2,3,3,4,4,5,5,6,6,7,7, 8,8-Heptadecafluoro-8-iodo-octane	**507-63-1**	**208-079-5**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecyl acrylate	**27905-45-**	**248-722-7**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecyl acrylate	**1996-88-9**	**217-877-2**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluoro-1-decanol	**678-39-7**	**211-648-0**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluoro-1-decene	**21652-58-**	**244-503-5**	
		Total PFOA precursors	
Higher homologues			
1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12-icosafluoro-12-iodo-dodecane	**307-60-8**	**206-205-3**	
1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10-Henicosafluoro-10-iodo-ne	**423-62-1**	**207-030-5**	
Heptadecafluoro-nonanoic acid	**375-95-1**	**206-801-3**	
Nonadecafluoro-decanoic acid	**335-76-2**	**206-400-3**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluoro-1-decanol	**678-39-7**	**211-648-0**	
1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-Heptadecafluoro-10-iodo-decane	**2043-53-0**	**218-053-5**	
1,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10-Henicosafluoro-12-iodo-cane	**2043-54-1**	**218-054-0**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,pnacosafluorohexadecyl methacrylate	**4980-53-4**	**225-627-9**	
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-cosafluorododecyl acrylate	**17741-60-**	**241-732-2**	
		Total higher homologues	
PFOS and related compounds			
Pentafluoro octane sulfonates ($C_8F_{17}SO_2X$; X = OH, metal salts	**n.a.**	**n.a.**	

$(^{+})$, halide, amide)			
Other PFOS derivatives, including polymers	**n.a.**	**n.a.**	
Total PFOS and derivatives			

Q5. Have you manufactured/supplied any other PFOA/APFO related compounds in the last five years which are not included in the table above? If YES, please provide their full names, CAS and EC Numbers as well as their annual production, import or supply volumes.

Name	**CAS No.**	**EC No.**	**Total volume (t/y)**	**EU supply volume (t/y)**	**Exported volume (t/y)**

Q6. Do you manufacture/supply any alternatives to PFOA/APFO and related compounds and/or to the exempted uses of PFOS? If YES, please provide their full names, CAS and EC Numbers as well as their import or supply volumes and specify the use.

Name	**CAS No.**	**EC No.**	**Total volume (t/y)**	**EU supply volume (t/y)**	**Use**

Q7. Finally, if you feel that we have missed anything important, or would like to comment on any of the issues raised by this questionnaire, please let us know (and continue on a separate sheet if necessary).

Thank you for taking the time to complete this questionnaire.
Your response will provide a valuable input to the market analysis of PFOA and related compounds.

Please be aware that we will ask you to send us more information regarding exposure, alternatives and impact of restrictions on your business.

Please send your completed questionnaire (and any enquiries) by **31 March 2009** to the address given below by e-mail, fax or post. Thank you very much for your assistance.

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2600 GB Delft,
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