Report summary cleaning agents, polishes, and waxes (non-industrial uses)

Contents

1. Uses / Applications

PFAS are utilised in:

- Cleaners (for glass, metal, ceramic, carpet and upholstery);
- Waxes and polishes (for i.e. furniture, floors and cars);
- Floor polish removers;
- Dry cleaning products;
- Dishwashing products as rinse aid;
- Windscreen treatments for automobiles and also windscreen wiper fluids;
- Car care products;
- Rain-repellent fluids in the aviation industry.

2. Examples for PFAS substances

In the table below, the main substances are mentioned based on Glüge et al., 2020)

Table 1. Examples for specific PFAs used for certain applications (Glüge et al., 2020)

Use	Name	CAS number
General cleaning agents	Potassium *N*-ethyl perfluoroalkane sulfonamido acetate	67584-51-4, 67584-52-5, 67584-53-6, 67 584-62-7, 2991-51-7
	Ammonium (n:2) fluorotelomer phosphate monoester	65530-71-4
	3,3-Dichloro-1,1,1,2,2-pentafluoropropane	422-56-0
	Methyl perfluoroalkyl ether	22410-44-2, 375-03-1, 163702-07-6
Cleaning agents for dishes and glasses	Perfluoroalkyl carboxylic acids (PFCAs)	375-22-4, 335-67-1
Glass cleaners	Potassium *N*-ethyl perfluoroalkane sulfonamide acetate	67584-53-6, 2991-51-7
Carpet and upholstery cleaners	Perfluoroalkyl phosphonic acids (PFPAs)	40143-76-8, 40143-78-0, 52299-26-0

Use	Name	CAS number
	Perfluoroalkyl phosphinic acids (PFPiAs)	40143-77-9, 610800-34-5, 1240600-40-1, 1240600-41-2, 40143-79-1, 500776-81-8
Dry cleaning of metals, glass, ceramics, etc.	Ethyl perfluoroalkyl ether	163702-05-4
Cleaning for optical devices	Pentane, 1,1,1,2,2,3,4,5,5,5-decafluoro-	138495-42-8
Floor polish	Potassium *N*-ethyl perfluoro alkane sulfonamidoacetate	67584-51-4, 67584-52-5, 67584-53-6, 67584-62-7, 2991-51-7

3. PFAS concentrations

Information on concentrations of PFAS in cleaning compositions, polishes, and waxes is sparse and comes with a wide range of uncertainty. Three different information sources were used for the purpose of this dossier:

1. information given by industry on websites and in brochures;
2. information found in safety data sheets or submitted by companies during the call for evidence;
3. information from the literature (mainly measurements).

Information on specific PFAS concentrations is rather sparse; however, end-use concentrations of PFAS in cleaning compositions, polishes and waxes generally are reported to be in the range of 10 - 1000 ppm, concentrations of 200 ppm or less are typical (Chemours, 2017), (ICT).

For concentrations significantly below 10 ppm, an intended functional role seems doubtful. More information could be obtained via an explorative research of product labels and information gained from the Call for Evidence. Rather large concentrations were found in a car polish product (12 % PTFE (waxyclean, 2020)) and a rain repellent fluid used for the aviation industry. Due to the limited number of products for which information is available, it is rather unclear whether these concentrations are typical for such products.

4. Manufacturing & market price + market development

No information available.

5. Tonnage

Only incomplete information is available to the dossier submitter regarding the tonnage of PFAS manufactured for cleaning agents, polishes, and waxes (and musical instruments). It can only be inferred that these quantities are not negligible and will contribute significantly to global PFAS emissions. No information on historic tonnages and future (expected) tonnages

6. Emissions

No information on former, current and future emission.

7. Exposure (workers, consumers)

No information available.

8. Alternatives

Cleaners

It is not clear whether the drastic reduction of static surface tension which can be achieved by using PFAS is really necessary for cleaning or whether other surfactants (e.g. hydrocarbon or silicone based surfactants) could also be employed. For example, the surface energy of metal and glass is rather large; therefore, PFAS are not really necessary for use as a surfactant to achieve a drastic reduction in surface tension of the formulation. For example, the most recognised glass cleaner brand in the USA does not seem to use PFAS in their glass cleaners but claims to leave the treated surface streak free (S. C. Johnson & Son, 2020). The Danish EPA (Jensen et al., 2008) also states that fluorinated products do not seem to be used in ordinary glass cleaners. It is not known whether alternative substances can replace the repellence for water and re-soiling as the PFAS containing metal- and ceramic cleaners.

Furthermore, extremely low surface tensions can also be achieved by siloxane Gemini surfactants that achieve a surface tension of 21 mN/m (Evonik). Gemini surfactants are characterised by more than one hydrophilic head and hydrophobic tail group linked by a spacer close to or at the head groups (Kamal, 2015).

Waxes

Regarding PFAS in waxes, a document of the Stockholm Convention (UNEP, 2012) describes that softer waxes (which are more or entirely biodegradable) may eliminate the need for fluorinated compounds. Instead, non-ionic or anionic surfactants can be used, which have good wetting properties.

Floor polish

Alternatives to the use of fluorinated components in floor polish are in principle available. One patent claims to have developed a non-fluorinated water-based floor wax, which maintains the same gloss and similar or even better levelling properties as C8-PFAS (Patent WO2008134180A1). Fluorinated wetting agents were replaced by silicone, alkynediol-based hydrocarbons, oleo alkylene oxide block copolymer wetting agents and others. It was also found that products are on the market that are based on Gemini structures which is advertised as a cost-effective alternative to traditional fluorosurfactants with even better performance (Evonik, 2017).

Aftermarket carpet care

Alternatives to PFAS employed in aftermarket carpet care to achieve stain and dirt resistance exist and are on the market. One chemical alternative for fabric protectors in general is based on silicon dioxide (Washington State Department of Ecology, 2020), (Start Bio-Solutions, 2020). Another alternative is the use of proprietary anionic non-fluorinated polymers in the cleaning products (Washington State Department of Ecology, 2020), (Bridgepoint Systems, 2020). Finally, the use of inherently stain resistant fibres like wool, polypropylene, polyethylene terephthalate, and polytrimethylene terephthalate (Washington State Department of Ecology, 2020) is feasible.

Dry cleaning products;
No information available.

Dishwashing products/ rinse aid
Rinse aids for dishwasher products that do not contain PFAS in a functional role are on the market (Borg and Ivarsson, 2017).

Windscreen treatments and windscreen wiper fluids
An alternative for PFAS in car windscreen treatments is on the market (e.g. (Ctra. Urnieta, 2020)). The company uses polydimethylsiloxanes in their products to achieve water and stain repellence. The non-polar methyl groups result in a similar hydrophobic surface as the one achieved by the fluorinated alkylchain of fluoroalkylsilanes. (Justo, 2010), (Ctra. Urnieta, 2020) Since the silicones used in this product are not chemically bound to the glass surface, the effect is not as long-lasting and the product may have to be applied more frequently (Acton Media Inc., 2019).
Windscreen wiper fluids without fluorinated compounds are also available with alternatives such as silicone-based substances (e.g. non-ionic amino-modified silicone-polyalkyl copolymer (Patent US 7585828 B2) achieving similar results to PFAS. Non-fluorinated surfactants which are also used for windscreen wiper fluids are well established (e.g. sodium dioctyl sulfosuccinate). US patent US5922665A also covers the use of a branched or linear primary alcohol ethoxylate*, a secondary alcohol ethoxylate, a branched decyltridecyl alcohol ethoxylate, a branched or linear alkylphenol ethoxylate, a branched or linear alkyl amine ethoxylate, an alkyl ether amine ethoxylate, a linear alcohol alkoxylate, and a mixture thereof as non-ionic surfactants. Polyols including a fluorinated polyether diol can be added, but the addition of glycols is possible instead as well. (Patent US 7,585,828 B2). The additions of polyols increases the flash point and thus the safety of the product (Patent CA2216888C).

* nonyl-phenol ethoxylate and octyl phenol ethoxylate are heavily regulated.

Car care
Alternatives for PTFE-containing polishes and waxes used for cars are also available on the market. In these products, carnauba wax (a natural wax obtained from carnauba palm trees, CAS: 8015-86-9) is often used to achieve protection of the car's surface and water repellence. It achieves the same effect of closing pores in the car's varnish and is also stable under UV radiation (Krendlinger et al., 2015).

Aviation
Regarding rain repellent fluids used for airplane windscreens, it is not known if PFAS-free alternatives exist besides the mentioned windscreen coatings, which have only a limited lifetime.

9. Economic impacts in case of a full PFAS ban

The dossier submitter has in general too few quantitative information to judge the detailed economic impact of a PFAS restriction regarding cleaning agents, polishes, and waxes (as well as musical instruments). One company considers that the use of fluorosurfactants can lower the total amount of surfactants necessary and therefore lower the costs three to tenfold (Chemours, 2017). It is not known whether this significantly alters overall production costs or not. In general, alternatives exist, and until now no information has been submitted to convincingly show a substantial extent of increasing costs or lowered quality or reduced lifetime for these alternatives. On the basis of the available information and the fact that the available PFAS-free products seem to compete just fine, we infer that a complete ban of PFAS in the non-industrial use of cleaning agents, polishes and waxes will have no-lasting economic effects.

10. References

Acton Media Inc. (2019): Best Windshield Treatments: Improve Safety in Rainy Conditions. https://www.thedrive.com/reviews/30177/best-windshield-treatments (last accessed 27-11-2020)

Bloom C. and Hanssen L. (2015): Analysis of per- and polyfluorinated substances in articles. Nordic Working Papers. DOI: http://dx.doi.org/10.6027/NA2015-911

Borg D. and Ivarsson J. (2017): Analysis of PFASs and TOF in Products. TemaNord 2017:543, ISSN 0908-6692. Nordic Council of Ministers, Copenhagen, DK. http://norden.diva-portal.org/smash/record.jsf?pid=diva2%3A1118439&dswid=9615 (last accessed 2017-12-20)

Bridgepoint Systems (2020): EncapuGuard Green. Post Cleaning Protective Treatment. https://bridgepoint.com/products.php?item_num=CR13GL (last accessed 21-11-2020)

Chemours (2017): Capstone™ Fluorosurfactants. For high value-in-use applications that require maximum performance. The Chemours Company FC, LLC. https://www.chemours.com/en/-/media/files/capstone/capstone-surfactants-brochure.pdf (last accessed 16-11-2020)

Ctra. Urnieta (2020): RainX. Outsmart the elements. https://rainx.de/ (last accessed 27-11-2020)

Evonik: Technical Background. Substrate Wetting Additives. Evonik Industries AG. https://www.coating-additives.com/product/coating-additives/downloads/substrate-wetting-additives.pdf (last accessed 16-11-2020)

Evonik (2017): DYNOL™ superwetting surfactants. https://www.coating-additives.com/product/coating-additives/downloads/dynol%20superwetting%20surfactants.pdf (last accessed 27-11-2020)

Favreau P., Poncioni-Rothlisberger C., Place B.J., Bouchex-Bellomie H., Weber A., Tremp J., Field J.A., and Kohler M. (2017): Multianalyte profiling of per- and polyfluoroalkyl substances (PFASs) in liquid commercial products. Chemosphere 171, 491-501. DOI: 10.1016/j.chemosphere.2016.11.127

Glüge J., Scheringer M., Cousins I., DeWitt J.C., Goldenman G., Herzke D., Lohmann R., Ng C., Trier X., and Wang Z. (2020): An overview of the uses of per- and polyfluoroalkyl substances (PFAS) Preprint. DOI: 10.31224/osf.io/2eqac

ICT: Thetawet. Short-chain fluorosurfactants. Innovative Chemical Technologies, Inc. http://www.ictchemicals.com/media/1575/ict-thetawet-guide-20181104.pdf (last accessed 16-11-2020)

Jensen A.A., Poulsen P.B., and Bossi R. (2008): Survey and environmental/health assessment of fluorinated substances in impregnated consumer products and impregnating agents. Survey of Chemical Substances in Consumer Products, No. 99. The Danish Environmental Protection Agency. https://mst.dk/service/publikationer/publikationsarkiv/2008/okt/survey-and-environmentalhealth-assessment-of-fluorinated-substances-in-impregnated-consumer-products-and-impregnating-agents/ (last accessed 2020-07-23)

Justo P.D. (2010): What's Inside: Rain-X. https://www.wired.com/2010/06/st-whatsinside-rainx (last accessed 27-11-2020)

Kamal M.S. (2015): A Review of Gemini Surfactants: Potential Application in Enhanced Oil Recovery. Journal of Surfactants and Detergents 19 (2), 223-236. DOI: 10.1007/s11743-015-1776-5

Kotthoff M., Müller J., Jürling H., Schlummer M., and Fiedler D. (2015): Perfluoroalkyl and polyfluoroalkyl substances in consumer products. Environmental Science and Pollution Research 22 (19), 14546-14559. DOI: 10.1007/s11356-015-4202-7

Krendlinger E., Wolfmeier U., Schmidt H., Heinrichs F.L., Michalczyk G., Payer W., Dietsche W., Boehlke K., Hohner G., and Wildgruber J. (2015): Waxes. In: ULLMANN'S Encyclopedia of Industrial Chemistry. ISBN: 9783527303854. DOI: https://doi.org/10.1002/14356007.a28_103.pub2

Liu X., Guo Z., Folk E.E., and Roache N.F. (2015): Determination of fluorotelomer alcohols in selected consumer products and preliminary investigation of their fate in the indoor environment. Chemosphere 129, 81-86. DOI: 10.1016/j.chemosphere.2014.06.012

S. C. Johnson & Son (2020): Windex®. Windex® Original Glass Cleaner. S. C. Johnson & Son, Inc. https://www.whatsinsidescjohnson.com/us/en/brands/windex/windex-original-glass-cleaner (last accessed 16-11-2020)

Start Bio-Solutions (2020): Eco friendly fabric protector: ingredients. https://www.protectmeproducts.com.au/eco-friendly-fabric-protector/ (last accessed 24-11-2020)

UNEP (2012): Stockholm Convention on Persistent Organic Pollutants - Technical paper on the identification and assessment of alternatives to the use of perfluorooctane sulfonic acid in open applications (UNEP/POPS/POPRC.8/INF/17). United Nations Environment Programme. https://www.informea.org/en/technical-paper-identification-and-assessment-alternatives-use-perfluorooctane-sulfonic-acid-open (last accessed 27-11-2020)

Washington State Department of Ecology (2020): Priority Consumer Products. Draft Report to the Legislature. Safer Products for Washington. Implementation Phase 2. https://fortress.wa.gov/ecy/publications/documents/2004004.pdf (last accessed 27-11-2020)

waxyclean (2020): X1 Shine & Seal 2 Bottle Treatment (250 ml bottles) - 5 Year Paint Protection System. https://www.waxyclean.co.uk/x1-shine-seal-2-bottle-treatment-250-ml-bottles-5-year-paint-protection-system.html (last accessed 25-11-2020)

11. Annexes

Sum of PFAS and total organic fluorine content for several consumer mixtures (Borg and Ivarsson, 2017). Products sampled in 2016 were analysed for PFBA, PFBS, PFHxA, PFHxS, PFOA, PFNA, PFDA, PFOS, 4:2 FTOH, 6:2 FTOH, 8:2 FTOH, 10:2 FTOH, 6:2 FTA, 8:2 FTA, 10:2 FTA, MeFOSA, EtFOSA, MeFOSE, EtFOSE; products sampled in 2014 were analysed for PFBA, PFBS, PFHxA, PFHxS, PFHpA, PFOA, PFNA, PFDA, PFOS, 4:2 FTOH, 6:2 FTOH, 8:2 FTOH, 4:2 FTS, 6:2 FTS, PFUnDa, PFDoDA, PFTriA, PFTeA, 6:2 diPAP, 6:2 mono-PAP, 8:2 diPAP, 8:2 mono-PAP. Errors in dealing with the units were corrected using (Bloom and Hanssen, 2015). Blank cells symbolise that no PFAS could be detected.

Product	**Year of product sampling**	**Sum (PFAS) [µg/l]**	**Total organic fluorine [µg/l]**
Rinse aid 1	2016	0.75	<1000
Rinse aid 2	2016	1.2	2000
Floor polish	2016	1840	18500
Furniture polish	2016		<1000
Car polish 1	2014	3370	3000
Car polish 2	2014	3130	8000
Dishwasher 1	2014	9680	14500
Dishwasher 2	2014	2.6	<1000
Waterproofing textiles – Wash in	2014	660	<1000

Measured PFAS content for several consumer mixtures (Bloom and Hanssen, 2015); (Borg and Ivarsson, 2017). Blank cells indicate that the PFAS in question could not be detected.

Product	Year of product sampling	PFBA [µg/l]	PFHxA [µg/l]	PFOA [µg/l]	PFDA [µg/l]	6:2 FTOH [µg/l]	8:2 FTOH [µg/l]
Rinse aid 1	2016			0.75			
Rinse aid 2	2016			0.75	0.47		
Shoe wax	2016			0.53			
Floor polish	2016	0.47		0.59		1834	
Furniture polish	2016						
Car wax 1	2016			1.4			
Car wax 2	2016			2.8			
Car polish 1	2014			0.47		263	3110
Car polish 2	2014			0.509			31130
Dishwasher 1	2014	1.12		0.555		391	9290
Dishwasher 2	2014						2.62
Waterproofing textiles – Wash in 1	2014						630
Waterproofing textiles – Wash in 2	2014						680

Quantified PFAs content for a group of polishes and cleansers (Favreau et al., 2017). Samples were collected in 2012/2013 in Switzerland. In total, the product content was analysed regarding 41 different PFAS.

Product group	6:2 FTS		N-EtFOSE		6:2 FTOH	
	Occurrence	Content [mg/kg]	Occurrence	Content [mg/kg]	Occurrence above LOQ	Content [mg/kg]
Cleanser	0 out of 24	-	1 out of 24	1.2	1 out of 24	4
Polish	1 out of 18	0.1	0 out of 18	-	1 out of 18	26.0

Determined Fluorotelomers for a group of cleaning products, waxes and sealants. The products were sampled in 2011 and 2013 in the USA (Liu et al., 2015).

Product group	Product number	6:2 FTOH [mg/kg]	8:2 FTOH [mg/kg]	10:2 FTOH [mg/kg]
Commercial carpet care liquid	A1	3.28	2.95	1.46
	A2	105		
	A3		0.194	
Household carpet/fabric-care liquids and foams	B1			
	B2		0.372	
Floor waxes and wood/stone sealants	C1	1.59	1.4	
	C2	4.01	0.442	
	C3	24.2	6.91	
	C4	331	92.4	
	C5	13.9	0.477	

Quantified PFAS in cleaners (Kotthoff et al., 2015). Six products were used for measuring PFAS except FTOHs and three products for FTOHs. The samples were collected in 2010 in Germany.

	PFOA [mg/kg]	PFOS [mg/kg]	PFTeA [mg/kg]	6:2 FTOH [mg/kg]	8:2 FTOH [mg/kg]	10:2 FTOH [mg/kg]
Maximum concentration	0.0011	0.0016	0.0008	38.7	547.1	81.9
Median concentration	0.0007	0.0012	0	38	63	22.6