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Alliance for Telomer Chemistry Stewardship

Alliance for Telomer Chemistry Stewardship's Response to the Public Consultation on Restriction Proposal on all PFAS

2nd Contribution

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Introduction

The Alliance for Telomer Chemistry Stewardship (ATCS) represents some of the leading producers of C6 short-chain fluorotelomer-based chemistry, including C6 side chain fluorinated polymers (SPFs) and C6 fluorosurfactants. We welcome the opportunity to submit our opinion to the public consultation on all poly- and perfluoroalkyl substances (PFAS).

In the present document, we wish to complement our previous input by strengthening some of the points made in our first submission, providing more detailed information on the sector-specific uses for which we request additional derogations.

Below you will find a table with our suggested derogation formulations per sector. Please note that the ATCS focused on avoiding repetitive information compared to its previous submission. It is therefore advisable to consult the previous submission where necessary.

Table 1 – Provisional, non-exclusive list of derogation requests[1]

Application	ATCS' suggested derogations
TULAC (second-hand articles)	*4. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* ***d. second-hand clothing, footwear and related accessories;***[2]
Firefighting foams	*4. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* ***e. mixtures and articles subject to Regulation (EU) XXXX/XXX*** *[to be included once it is published in EU OJ]* ***on the use of per- and polyfluoroalkyl substances (PFASs) in fire-fighting foams.***
TULAC (Protective apparel)	*5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* *b. textiles used in personal protective equipment (PPE)* ***for professional use,*** *intended to protect users against risks as specified in Regulation (EU) 2016/425, Annex I, Risk Category III (a),* ~~*and*~~ *(c),* ***(d), (e), (f), (h), (l)*** *until 13.5 years after EiF;*

[1] The ATCS is still working with other stakeholders operating in the relevant sectors in other to propose the most suitable wordings.

[2] While we understand that this is no longer the case, it is important to note that water-repellent consumer apparel was treated with PFAS in the past. In addition, we understand that this derogation is necessary unless the restriction explicitly derogates articles that were placed on the market **for the first time** before entry into force.

Application	ATCS' suggested derogations
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] *c. textiles used in personal protective equipment (PPE) ~~in professional firefighting activities intended to protect users against risks as specified in Regulation (EU) 2016/425, Annex I, Risk Category III (a) - (m)~~* ***and clothing designed for use by the armed forces, in the maintenance of law and order and by emergency responders*** *until 13.5 years after EiF****;***
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] ***xx. high visibility clothing fulfilling the requirements of EN ISO 20471 until 13.5 years after EiF;***
TULAC **(Technical textiles)**	*5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* *f. textiles used ~~in engine bays~~ for* ***ignition protection and*** *noise and vibration insulation in ~~automotive~~* ***means of transport and non-road mobile machinery (NRMM)*** *until 13.5 years after EiF;*[3]
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] *e. ~~textiles for the use in~~ filtration and separation media used in ~~high performance~~ air and liquid applications in industrial or professional settings that require a combination of water and oil repellence until 6.5 years after EiF;*
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] ***xx. woven, knitted and nonwoven medical textiles in scope of Regulation (EU) 2017/745 of the European Parliament and of the Council with a minimum performance requirement of >20 cm hydrostatic head according to EN 13795;***
Medical devices	*5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]*

[3] It is our understanding that filtration and separation applications in transport would be covered by the separate derogation for filtration and separation media. As long as a derogation for filtration and separation media is granted, the reference to filtration will not be needed.

Application	ATCS' suggested derogations
	cc. membranes used for venting of medical devices until 13.5 years after EiF
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] ~~*6. […] i.*~~ ***xx.*** *wound treatment products until 13.5 years after EiF;*[4]
Lubricants	*5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* ***xx. epilame mixtures used in watch making and servicing;*** ***xx. epilame in watches;***
Electronics	*5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]* *ee. the semiconductor manufacturing process until 13.5 year after EiF;*[5]
	5. By way of derogation, paragraphs 1 and 2 shall not apply to: […] ***xx. functional coating used in electrical and electronic equipment and the components thereof until xx [6.5 years after EiF];***

In addition to the derogation needs covered above, we understand that the textile value chain is also strongly concerned about the absence of a derogation for professional protective equipment Classes 1 and 2 as well as for other technical textiles, for which additional derogations would be needed. For information on this matter, please refer to EURATEX.

Moreover, for TULAC applications requiring a 13,5-year transition period, we support the inclusion of a review clause that would allow to assess the status of the transition to alternatives before the restriction becomes effective.

[4] Unless a derogation for medical textiles is included, the proposed derogation for wound treatment products should be moved from paragraph 6 to paragraph 5, as C6 SFPs are also used in professional medical adhesive tapes.

[5] While we welcome the inclusion of a derogation, we are still assessing whether the wording is sufficiently comprehensive. We, therefore, refer to the proposals of ESIA and SEMI.

Specific Information Requests

Question 1: Sectors and (sub-)uses: Please specify the sectors and (sub-)uses to which your comment applies according to the sectors and (sub-)uses identified in the Annex XV restriction report (Table 9). If your comment applies to several sectors and (sub-)uses, please make sure to specify all of them.

In the present document, we wish to complement our previous input by providing information on the supported derogations. Below you find an overview of the uses we will cover per sector.

Sector	Use	Sub-use	Derogation Status
TULAC	Professional apparel (incl. PPE)	Military, police and emergency response, including firefighting activities	Proposed derogation (limited scope) = Missing use
		Worker protection	Proposed derogation (limited scope) = Missing use
		High-visibility clothing	Missing use
	Technical textiles	Filtration and separation media	Proposed derogation
		Construction textiles	Missing use
		Medical textiles	Missing use
	Other	Textiles used in engine bays	For reconsideration
Medical devices	Membranes for venting medical devices		For reconsideration
	Wound treatment		For reconsideration
Lubricants	Lubricants for watchmaking		Other identified uses
Electronics	Semiconductors		For reconsideration
	Coating of electronic devices		Other identified uses

Question 2: Emissions in the end-of-life phase: The environmental impact assessment does not cover emissions resulting from the end-of-life phase. To get a better understanding of the extent of the resulting underestimation, (sub-)use-specific information is requested on emissions across the different stages of the lifecycle of products, i.e. the manufacture phase, the use phase and the end-of-life phase. Please provide justifications for the representativeness of the provided information. In particular:

a) Please provide, at the (sub-)use level, an indication of the share of emissions (as percentages) attributable to these three different stages. An indication of annual emission volumes in the end-of-life phase at sector or sub-sector level would also be appreciated.

i. Volumes

The placing of the market of C6 SFP-treated home and consumer textiles is proposed to be banned from 2026/2027 under the PFHxA restriction proposal, which has been recently published in the form of a legislative draft. The annual growth assumed in the baseline for these products is, therefore, incorrect.

ii. Emissions during textile production

Based on the efforts made by the European textile industry in the last years, the overall expected trend of increasing emissions is wrong. The industry is making the utmost effort to decrease emissions. This can be clearly inferred also by the fact that PFAS are applied in line with increasingly stringent EU provisions to minimize the release of leftover materials into the environment as defined in the Best Available Techniques (BREF/BATs). This document states that process baths should be reused as much as possible and, when this is not possible, they should be collected separately and sent for disposal via qualified processing companies.

iii. Emissions during use of textile articles

Short-chain fluorotelomer based methacrylate polymers are a class of SFPs used for a variety of commercial applications, including textile finishing for professional and industrial applications. It has been suggested that the degradation of these polymers could serve as a source of short-chain perfluoroalkyl carboxylates (PFCAs) to the environment and there is increasing concern regarding the stability of these polymers once in the environment.

The aerobic biodegradation of a specific fluorotelomer-based methacrylate polymer has been evaluated following the OECD testing method guidelines over ~15 months in four different natural soil conditions. The suite of potential degradation products monitored were selected under direction from the USE PA and monitored via liquid chromatography

with tandem mass spectrometry (LC-MS-MS) analysis. At the conclusion of the test, the sum of all potential degradation products were less than 0.04% of 6-2 FTOH equivalents in all four soils.

A recent study revealed that the transformation rates of this short-chain fluorotelomer based methacrylate polymer would be even slower in soils with less aerobic biological activity. The amount of substance that was actually transformed in the course of the study ranged from 0.046 % to 0.114 % for the respective soils in relation to the total amount of 6-2 FTOH equivalents contained in the test item.

We understand that the results of the cited studies will be submitted in the context of the public consultation.

iv. Emissions at end of life

In 2019, pilot scale studies were conducted on PTFE, which were representative of full-scale waste-to energy facilities. The authors found that combustion converted the fluorine into controllable hydrogen fluoride gas and that of the 31 PFAS studied, no fluorine containing products of incomplete combustion were produced above background levels.[6]

In a similar pilot scale set of studies on a mixture of 4 most widely sold fluoropolymers (PTFE, PVDF, PFA, FKM), no residual PFAS were found at the reporting limit of the study. The final results of this study will be published later in 2023.[7]

The US EPA has been conducting incineration studies in their Rainbow Furnace facilities in North Carolina, USA. The recently published work was conducted on legacy AFFF and produced 99.99% destruction efficiency (DE) at 1180 C.[8]

A recent US Department of Defense (DoD) guidance document was published that summarized the current state of PFAS disposal methods. This guidance document indicates that there are several viable disposal methods for PFAS products at their end

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[6] Aleksandrov et al., 2019, "Waste incineration of Polytetrafluoroethylene (PTFE) to evaluate potential formation of per- and Poly-Fluorinated Alkyl Substances (PFAS) in flue gas", *Chemosphere*, 226:898-906, https://doi.org/10.1016/j.chemosphere.2019.03.191.

[7] Gehrmann, Hans-Joachim; habil. Bologa, Andrei; Aleksandrov, Krasimir; Bergdolt, Philipp; Taylor, Philip; Schlipf, Michael; Ameduri, Bruno; Gunasekar, Priyanga; Kapoor, Deepak, 2023, "Pilot-Scale Fluoropolymer Incineration Study: Thermal Treatment of a Mixture of Fluoropolymers under Representative European Municipal Waste Combustor Conditions" [Report and publication in preparation]; Gujarat Fluorochemicals Limited, 2023, "Incineration study on Fluoropolymers at their End-of-Life" [Press Release], https://www.gfl.co.in/upload/pages/64ca54ee691b6f4a8b2649ec9c7b291f.pdf.

[8] E. P. Shields, 2023, "Pilot-Scale Thermal Destruction of Per- and Polyfluoroalkyl Substances in a Legacy Aqueous Film Forming Foam in EST Engineering", https://doi.org/10.1021/acsestengg.3c00098.

of life, including incineration. The guidance clearly specifies that incineration must be done by certified hazardous waste incinerators under specific conditions and all effluent appropriately monitored. [9]

Given these results as well as other published studies, it is expected that incineration under appropriately controlled conditions (i.e., temperature, residence time, and emissions control), that fluoropolymers, AFFF and the various fluorotelomer-based products, such as SFPs, can be successfully treated via incineration. It is likely that the most appropriate conditions will be ca. 1100 C, with at least a 2-second residence time and air/gas and solids emissions control among other parameters.

b) If possible, please provide for each (sub-)use what share of the waste (as percentages) is treated through incineration, landfilling and recycling. Please provide information to justify the estimates as well as information on the form of recycling referred to.

It should be noted that C6 is used to treat technical textiles for professional and industrial uses (PPE, medical), and this type of textiles is disposed according to existing waste codes, i.e., incinerated.

Regarding home and consumer textiles, which will no longer allowed to be produced, they will be addresses by the legal obligation to ensure that textiles are collected separately in all Member States by 2025, ensuring adequate handling of products at end-of-life. More information on waste handling is provided under Question 4.

[9] Assistant Secretary of Defense, 11 July, 2023, “Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States”, https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/news/Memorandum_for_Interim_Guidance_on_Destruction_or_Disposal_of_Materials_Containing_PFAS_in_the_U.S.pdf.

Question 4: Impacts on the recycling industry: To get an understanding of the impacts of the proposed restriction on the recycling industry, information is requested on:

a) The impacts that the concentration limits proposed in paragraph 2 of the proposed restriction entry text (see table starting on page 4 of the summary of the Annex XV restriction report) have on the technical and economic feasibility of recycling processes (together with a clear indication on the waste streams to which the described impacts relate).

We would like to reiterate that it is not possible for second-hand articles[10] and recycled articles containing C6 SFPs to comply with the proposed thresholds. In order to continue the reuse, repurposing and recycling placed on the market before the entry into force of the PFAS restriction, derogations may need to be considered, especially for textile products, where the rotation cycles are longer than for other types of articles (e.g., paper).[11]

This is in line with European legislative initiatives, such as the Proposal for Ecodesign for Sustainable Products Regulation[12], including a potential ban on the destruction of unsold textiles, the Proposal on common rules promoting the repair of goods[13], and the

[10] The term 'second hand articles' refers to articles that have already been sold to an end user in the EU but are subsequently transferred to another actor in the supply chain, e.g. through selling or disposal, https://www.echa.europa.eu/documents/10162/13641/stocks_2nd_hand_goods_en.pdf/7cf76c3d-4e3a-a048-1233-8b3b9248b3df.

[11] While we understand that this is no longer the case, it is important to note that water-repellent consumer apparel was treated with PFAS in the past.

[12] European Commission, March 30, 2022, Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC, COM(2022) 142 final, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative_en.

[13] European Commission, March 22, 2023, Proposal for a Directive of the European Parliament and of the Council on common rules promoting the repair of goods and amending Regulation (EU) 2017/2394, Directives (EU) 2019/771 and (EU) 2020/1828, COM(2023) 155 final, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13150-Sustainable-consumption-of-goods-promoting-repair-and-reuse_en.

Revision of the Waste Framework Directive[14], which incentivise the reuse, repurposing and recycling of textiles.

i. Second-hand articles

We would like to emphasise that enforcement of restrictions on the placing on the market of second-hand articles is difficult, more so where the goods are being re-sold by consumers. Since the second-hand market for textile and leather articles is significant[15] and becomes increasingly complex with platforms enabling customer to customer sales, such enforcement is expected to be impossible in terms of identification of second-hand articles and testing of these articles.

Note that the 2019 European Commission Staff Working Document 'Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy, concluded that "*if an increase in duration of first use, reuse and repair of garments could lead to a reduction in production and sale of new garments by just 5%, this would deliver a sustainability benefit equivalent to 20.000 kg of CO2 emissions*".[16]

Moreover, in light of the establishment of separate waste streams for textiles from 2025 onwards, supplemented with mandatory eco-modulated Extended Producer Responsibility (EPR) schemes, measures will be in place that significantly improve the waste management of textiles, ensuring that textiles that were placed on the market before the entry into force of the all PFAS restriction will be handled correctly.

Given the minimal consumer risk associated with direct skin exposure to apparel and footwear containing C6 SFPs, as well as the challenging enforcement and the abovementioned sustainability-related implications, we believe it would be disproportionate to ban the placing on the market of second-hand products.

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[14] European Commission, Environmental impact of waste management – revision of EU waste framework, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13225-Environmental-impact-of-waste-management-revision-of-EU-waste-framework_en (accessed on June 2, 2023)

[15] Some predictions estimate that in 2028 the second-hand market will be one and a half times as large as fast fashion: Zico Saerens, May 12, 2021 "Tweedehandskledij wint aan populariteit, vooral bij jongeren: "En het zal nog groeien"." VRT nws,. https://www.vrt.be/vrtnws/nl/2021/05/12/succes-tweedehands/ (accessed June 2, 2023).

[16] European Commission, *Commission Staff Working Document: Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy*, March 4, 2019, SWD(2019) 92 final, p. 38.

ii. Articles made of mechanically recycled fibres

Mechanical recycling is currently the most robust, proven recycling process for textiles available. It can be easily scaled up as textile waste volumes grow and has the lowest environmental impact due to limited energy use and because almost no water or chemicals are used in the recycling and creation of new yarns.

Mechanically recycled textiles are made of fibres and other raw materials that have been manufactured at different times and may contain substances proposed to be restricted or subject to future enacted restrictions. It is, therefore, possible that consumer apparel that was manufactured before the entry into force of the restriction on PFHxA contains C6 SPFs or PFHxA impurities. The same applies to the PFAS restriction proposal.

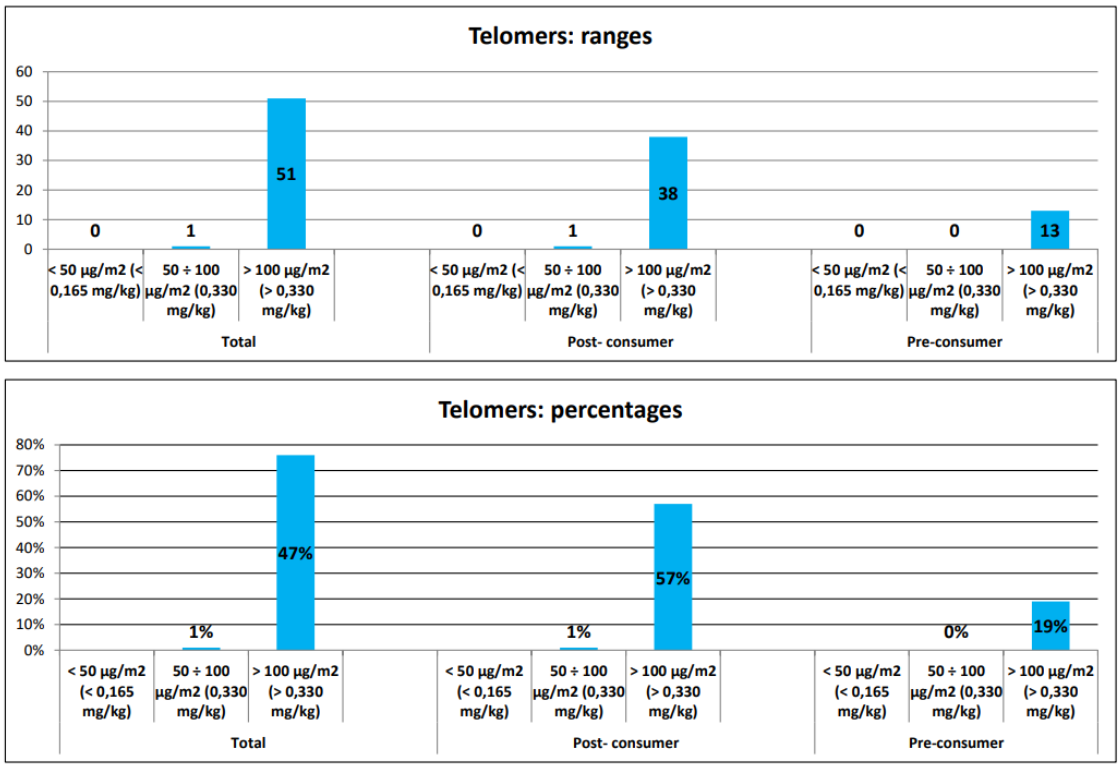
This is particularly important because the textile recycling industry is currently experiencing a change of paradigm, moving from recycling of post-industrial waste to post-consumer waste[17]. Post industrial waste is very homogeneous in type and material composition, i.e., less diverse than post-consumer waste. The challenge of complying with the restriction will therefore be significantly higher with post-consumer waste.

While it can be assumed that the content of C6 SFPs/PFHxA in recycled textiles can be reduced over time, it should be noted that the cycle of textile waste can vary from five to thirty years from the production date, including time for manufacturing, placement on the market, usage, waste, recovery, sorting and recycling. As a result, C6 SFPs/PFHxA may still be present in articles made of recycled fibres above the concentration limits after 2027.

The textile institute T. Buzzi conducted a study a few years ago on recycled textile materials and the state of play regarding the presence of certain chemicals. PFAS were detected in 67 out of the 108 samples. Based on existing limits in voluntary industry schemes, only 53% of tested lots passed the tests.[18]

[17] Post-industrial waste is mainly composed of cutting clips, i.e., pre-consumer garment waste from garment production processes. Other types of industrial waste include yarn waste and hard waste (e.g., ring frames, winding, doubling).

[18] Bartolini Giuseppe, Franchi Andrea, Dall'Anese Riccardo, Stefano Zanobetti, (2019), 'Materie tessili rigenerate laniere e cotoniere: la situazione dei principali parametri di sicurezza chimica', *BuzziLab*, https://www.fi.camcom.gov.it/sites/default/files/uploads/documents/BuzziLab.pdf



b) *The measures that recyclers would need to take to achieve the proposed concentration limits.*

In order to ensure reuse practices can continue for textiles in line with the circular economy objectives, a derogation for second-hand apparel and footwear articles is needed. Our proposal reads as follows:

> *4. By way of derogation, paragraphs 1 and 2 shall not apply to: […]*
>
> ***d. second-hand clothing, footwear and related accessories;***[19]

We also believe that to allow for the continuation of recycling of post-consumer textile waste, a longer transition period for recycled textile articles is required, similar to the approach adopted for recycled paper in the context of the restriction on bisphenols.[20] However, we do not have the required expertise to propose a specific timeframe.

[19] This derogation is necessary unless the restriction explicitly derogates articles that were placed on the market **for the first time** before the date of entry into effect.

[20] European Chemicals Agency (ECHA), *October 7, 2022, Annex XV dossier proposing restrictions on 4,4'-isopropylidenediphenol (Bisphenol A) and bisphenols of similar concern for the environment.* 6b2321cf-5334-9354-cbcd-57a9345ae0fb (europa.eu)

c) The costs associated with these measures.

Enforcement costs for second-hand articles are expected to be very high, given their diversity and origin. In the case of recycled materials, testing can only be carried out after reprocessing. A failure at this stage means the destruction of approximately 8,000 kg of already recycled material, which is a significant loss of sunk costs by recyclers.

The proposed measures are expected to help prevent the destruction of second-hand articles and processed secondary raw materials, while reducing enforcement and compliance efforts.

Additional Information on Derogations

Sector: Firefighting foams (not identified)

1. Firefighting foams

1.1. Exclusion from the scope

The Dossier Submitters indicate that this restriction proposal is not meant to overrule the firefighting foam restriction proposal but is intended to be complementary.[21] On the other hand, ECHA stated that the strictest regulation will apply.[22] As it currently stands, this means that a restriction without derogations for fire-fighting foams will prevail over a restriction with specific derogations for firefighting foams.

We, therefore, believe that the clear exclusion for firefighting foams should be included under paragraph 4. Our proposal reads as follows:

> *4. By way of derogation, paragraphs 1 and 2 shall not apply to: […]*
>
> ***e. mixtures subject to Regulation (EU) XXXX/XXX** [to be included once it is published in EU OJ] **on the use of per- and polyfluoroalkyl substances (PFASs) in fire-fighting foams.***

Sector: TULAC

2. Personal protective equipment for professional use

2.1. Derogation request

We welcome the derogations for PPE under paragraphs 5(b) and 5(c). Nonetheless, we believe that the proposed wording does not properly cover all equipment that ensure the compliance with health and safety requirements, such as for the protection against

[21] European Chemicals Agency (ECHA), March 23, 2023, *Annex XV Restriction Report on Per- and polyfluoroalkyl substances (PFASs)*, p.12, https://echa.europa.eu/documents/10162/1c480180-ece9-1bdd-1eb8-0f3f8e7c0c49.

[22] #Question 1.4.11., 'Answers by ECHA to questions on the consultation, opinion making and the restriction process', *Webinar: Restriction of per- and polyfluoroalkyl substances (PFAS) under REACH*, https://echa.europa.eu/documents/10162/21388210/230405_upfas_webinar_qa_en.pdf/7a22138a-7250-85a8-cf57-2817ec91f5ff?t=1683031720099.

dangerous liquids (e.g., fuels and solvents). We would, therefore, like to propose the following alternative wording:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to: […]*
>
> *b. textiles used in personal protective equipment (PPE)* ***for professional use,*** *intended to protect users against risks as specified in Regulation (EU) 2016/425, Annex I, Risk Category III (a)*~~*, and*~~ *(c)****, (d), (e), (f), (h), (l)*** *until 13.5 years after EiF;*

2.2. Description of the use

As discussed in our first contribution, C6 SFP-treated PPE protects workers against water, oil-based dirt, abrasions, electric hazards, as well as hazardous, acidic or caustic liquids, gases or vapours.[23]

This type of protection is crucial for workers who can be exposed to hazardous substances, as well as to flash fires that commonly occur during well drilling, servicing, and production-related operations. It is, however, our understanding that the current derogation does not apply to certain types of PPE used by emergency services, oil and gas workers, as well as workers on construction sites.

Another example is surgical medical apparel, which needs to provide excellent barrier properties to prevent medical staff and patients from exposure to infectious agents. This type of equipment is generally classified as Class I and II PPE and, therefore, not fully covered under the proposed derogation. It is neither covered by the proposed derogations for medical devices, which are limited to membranes for venting devices and certain fluoropolymer uses.

2.3. Emissions

Significant efforts have been conducted by the industry over the past years to reduce emissions from PFAS in the textile sector, including the development of Best Available Techniques (BREF/BATs) with specific provisions on C6 SFPs.

It should be noted that C6 SFPs are used to treat textiles and nonwovens for professional and industrial uses (e.g., PPE, medical), and the reimpregnation of these articles takes place in closed systems. Additionally, this type of textiles is disposed according to existing waste codes, i.e., generally incinerated.

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[23] Steffen Schellenberger et al., 2019, “Highly fluorinated chemicals in functional textiles can be replaced by re-evaluating liquid repellence and end-user requirements,” *Journal of Cleaner Production, 217*: 134–143. doi: 10.1016/j.jclepro.2019.01.160.

2.4. Alternatives

PFAS-free alternatives provide reduced water repellence and lack oil repellence, which constitutes an issue for occupational protective clothing (e.g., military uniforms, firefighting garments, protective clothing used in the oil and gas industry), where repellence towards non-polar stains as part of hazard management is required.

For applications requiring repellence against blood, solvents, fuels and liquid chemicals, fluorine-free finishing agents are not currently able to meet the same levels of performance.[24]

In the current stage of development, it is evident that non-fluorinated water repellent alternatives cannot match the performance of products which are coated with C6 SFPs. Although achieving a similar level of initial water repellence is achievable, there is no existing solution for providing oil repellence. Meeting standards such as ISO 14439 is not commercially feasible. Oil repellence is crucial in preventing contamination, which is a primary reason for water repellence failure. Therefore, non-fluorinated water repellents cannot match the same level of water repellence durability.

When considering switching to an alternative, it is also important to take into account changes in technology for material production, formulation, and process conditions. The performance of water repellent coatings depends not only on chemistry, but also on the formulation of that chemistry and the textile substrate being processed. Therefore, the development of a new water repellent chemistry requires careful consideration of all of these parameters, resulting in a complex process. Additionally, alternatives must undergo hazard assessment and meet third-party chemical stewardship standards. It is also crucial to consider the life cycle footprint of any potential alternatives.[25]

2.5. Socio-economic implications

PPE protects against risks where reduced oil, dirt and soiling properties might endanger the needed protective function. In addition, reduced stain and oil repellence can lead to costs caused by a reduced service-life and more frequent textile cleaning. Overall, transitioning to fluorine-free alternatives could lead to functional losses, resulting in

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[24] European Commission, Directorate-General for the Environment, Directorate B. Circular Economy, Unit B.2 Safe & Sustainable Chemicals, October 22, 2020, *The use of PFAS and fluorine-free alternatives in textiles, upholstery, carpets, leather and apparel*, Doc Ref. 42054-WOOD-XX-XX-RP-OP-0004_S4_P01.3, p.95, https://echa.europa.eu/documents/10162/13641/pfas_in_textiles_final_report_en.pdf/0a3b1c60-3427-5327-4a19-4d98ee06f041.

[25] Comment #3015, Comments on REACH restriction proposal on PFHxA, its salts and related substances, p. 114-116, https://echa.europa.eu/documents/10162/2b03c56b-8d05-d471-cca3-bd84efc4de79.

decreased safety and increased human health costs, e.g. transmission of diseases in the medical sector or serious injuries.

3. Personal protective equipment and clothing used by military, police and emergency responders

3.1. Derogation request

We would like to note that Article (2) of Regulation (EU) 2016/425, which sets the scope of the proposed derogations for PPE under paragraphs 5(b) and 5(c), indicates that it does not apply to PPE specifically designed for use by the armed forces or in the maintenance of law and order. While Member States can request an individual exemption for **defence uses** according to Art 2 (3) of REACH, the national approval of this type of exemption is associated with much effort and administrative hassle, and creates a need for European harmonization. A legal act of the European Union would help ensure legitimacy and transparency and create legal certainty.

Regarding **police-related uses**, we would like to highlight that even if a derogation was requested by Member States according to Art 2 (3) of REACH, this would not cover police and emergency response uses, as noted in the SEAC final opinion.[26]

Based on the PPE Regulation Guidelines, PPE used by police is fully excluded from the scope of the Regulation and, therefore, is not covered by the derogation proposed by the Dossier Submitter:

> PPE designed and manufactured for […] police purposes means PPE designed and intended to be used exclusively for such purposes. This exclusion applies to all categories of PPE.[27]

Concerning **emergency response applications**, it should be noted that while some fall within the scope of Regulation (EU) 2016/425, the PPE Guidelines state that the

[26] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), June 9, 2021, *Opinion on the Annex XV dossier proposing restrictions on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, p. 18, ECHA/RAC/RES-O-0000006976-57-01/F, https://echa.europa.eu/documents/10162/97eb5263-90be-ede5-0dd9-7d8c50865c7e.

[27] European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Deputy Director-General - Chief Standardisation Officer, Directorate C. Investments, Unit C.4 Intangible Economy, May 3, 2018, *PPE Regulation Guidelines: Guide to application of Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016 on Personal Protective Equipment and repealing Council Directive 89/686/EEC*, p. 25. https://ec.europa.eu/docsroom/documents/29201.

certification category depends on the type of protection – e.g., resuscitation masks, anti-avalanche airbags.[28]

We, therefore, propose a derogation in line with SEAC's final opinion on the PFHxA restriction proposal:[29]

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> *c. textiles used in personal protective equipment (PPE) ~~in professional firefighting activities intended to protect users against risks as specified in Regulation (EU) 2016/425, Annex I, Risk Category III (a) - (m)~~* ***and clothing designed for use by the armed forces, in the maintenance of law and order and by emergency responders*** *until 13.5 years after EiF**;***

3.2. Description of the uses

C6 SFPs are used in these applications to ensure maximum water- and oil-repellence, protection against liquid chemicals, and high durability against dry cleaning fastness and during repeated washing cycles.

3.3. Alternatives

See Section 3 – Personal protective equipment for professional use.

3.4. Socio-economic implications

These uses provide life protecting functions. The absence of products performing well could cause serious health damage and casualties, and the related impacts both in terms of human suffering and economic consequences could be large. There could also be losses relating to distress and related inability to work properly due to mistrust in the available equipment.

4. High-visibility clothing

4.1. Derogation request

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[28] European Commission, 2018, *PPE Regulation Guidelines*, p. 162.

[29] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), June 9, 2021, *Opinion on the Annex XV dossier proposing restrictions on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, ECHA/RAC/RES-O-0000006976-57-01/F, https://echa.europa.eu/documents/10162/97eb5263-90be-ede5-0dd9-7d8c50865c7e.

We support a derogation as proposed by the German Federal Institute for Occupational Safety and Health (BAuA) in the context of the restriction proposal on PFHxA for high visibility clothing fulfilling the requirements of EN ISO 20471.[30] Nonetheless, we believe this derogation should not be limited to Class 3.

Our proposal read as follows:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> ***xx. high visibility clothing fulfilling the requirements of EN ISO 20471;***

The extension to Class 3 is necessary, as EN ISO 20471 stipulates strict requirements on the amount of *bleeding*[31] between the reflective strips and the fluorescent and contrast materials, regardless of the items' classification.

The different classes under EN ISO 20471 are not linked to those of Regulation (EU) 2016/425 but are based on the size of the surface of the reflectors and fluorescent materials:

	Class 3	Class 2	Class 1
Reflective tape	0.20 m^2	0.13 m^2	0.10 m^2
Fluorescent material	0.8 m^2	0.5 m^2	0.14[2]

Items that commonly meet Classes 1 and 2 include hi-vis trousers sold separately and hi-vis sleeveless vests, respectively. Class 3 garments can be achieved by either:

- Wearing items rated as Class 3, covering the torso, such as a hi-vis jacket or hi-vis coverall; or
- Wearing certified products that together are jointly Class 3 certified based on the total area of fluorescent and reflective material.

At the time of placing on the market, it is not possible to know whether the final user will combine different Classes of hi-vis equipment that together qualify as Class 3.

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[30] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), June 9, 2021, *Background Document to the Opinion on the Annex XV dossier proposing restrictions on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, https://echa.europa.eu/documents/10162/5c011606-5891-d26a-03e7-ceba0a35126f.

[31] "Bleeding" refers to residues of colour within the material that can stain the sensitive parts of hi-vis garments. As the fluorescent material is always a bright colour, it can be affected by the darker colour of the contrast material.

Therefore, a derogation limited to Class 3 high-visibility clothing will only apply to garments that individually rate as Class 3, i.e., leaving out many relevant articles e.g., hi-vis trousers sold separately, hi-vis sleeveless vests.

4.2. Description of the use

C6 SFPs are used in high visibility equipment to prevent soiling and contamination from dirt and body oils like sweat and sebum. This is particularly important for workers in industries such as railroad, garbage collection, road construction, and oil platforms. Without oleophobic protection, water beading performance can fail early. This was acknowledged by the Dossier Submitter in the context of the PFHxA restriction proposal.[32]

4.3. Alternatives

The prevention of soiling and contamination is directly linked to oil repellence, which can only be provided by C6 SFPs. Oil repellence is also important as it reduces the risk of fuels and oils soaking into textiles, which could lead to a fire risk and reduce the clothes' visibility, a key characteristic for workers as those in road construction, as expressed in EN ISO 20471 expresses the importance of this. Moreover, in foul weather conditions, extended water repellence, which is also linked to oil repellence, is necessary for workers required to work outdoors for extended periods or to effect emergency repairs on critical infrastructure with no possibility of shelter.[33]

4.4. Socio-economic implications

C6 SFPs protect workers in roads and construction sites by providing good visibility. As discussed, these garments require oil repellent materials to not impair the fluorescent colour and luminance stains such as bitumen asphalt (sticky, black and highly viscous mixture of hydrocarbons). An impairment of the garment's fluorescent ability contributes to a greatly impaired visibility of workers, leading to an increased risk of accidents,

[32] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), June 9, 2021, *Background Document to the Opinion on the Annex XV dossier proposing restrictions on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, https://echa.europa.eu/documents/10162/5c011606-5891-d26a-03e7-ceba0a35126f.

[33] Comment #3015, Comments on REACH restriction proposal on PFHxA, its salts and related substances, p. 114-116, https://echa.europa.eu/documents/10162/2b03c56b-8d05-d471-cca3-bd84efc4de79.

especially during dark hours. C6 SFP treatment helps to keep garments cleaner for a longer period of time, which ultimately increases working safety.

5. Textiles used in transport and Non-Road Mobile Machinery (NRMM)

5.1. Derogation request

The ATCS proposes a series of modifications to the derogation recommended for reconsideration by the Dossier Submitters:

- The term 'automotive' should be replaced by 'means of transport and non-road mobile machinery', as proposed in the SEAC Opinion on the PFHxA restriction proposal; [34]
- The derogation should refer to the functions of the textiles and not to their location in the vehicle.

Our proposal reads as follows:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> *f. textiles used ~~in engine bays~~ for **ignition protection and** noise and vibration insulation in ~~automotive~~ **means of transport and non-road mobile machinery (NRMM).** [35]*

5.2. Description of the use

Technical textiles are defined by the European Economic and Social Committee on Growth Driver Technical Textiles as follows:

> Textile fibres, materials and support materials meeting technical rather than aesthetic criteria, even if, for certain markets, both types of criteria are met. Technical textiles bring a functional answer to a wide range of specific requirements: lightness, **resistance**,

[34] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), June 9, 2021, *Opinion on the Annex XV dossier proposing restrictions on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, ECHA/RAC/RES-O-0000006976-57-01/F, https://echa.europa.eu/documents/10162/97eb5263-90be-ede5-0dd9-7d8c50865c7e.

[35] It is our understanding that filtration and separation applications in transport would be covered by the separate derogation for filtration and separation media. As long as a derogation for filtration and separation media is granted and extended, the reference to filtration will not be needed.

reinforcement, **filtration**, fire-retardancy, conductivity, **insulation**, flexibility, absorption and so on.[36]

In the case of textiles used in transport and NRMM, C6 SFP-treated nonwoven fabrics are used for **three main purposes**:

Function	Why are C6 SFPs needed?
Ignition protection (ASTM D4814, UL1500, J1171_201609)	C6 SFP-treated textiles prevent fuel absorption and promote temperature resistance due to its oil-repellent properties. This constitutes a key safety feature in case of accident, providing more time to rescue people before the vehicle starts to burn out.
NVH insultation (EU Regulation 540/2014)	C6 SFPs are also used to provide strong fuel/oil-repellence and heat resistance to non-combustible sound absorbing material made of e.g., nonwovens, polyurethane. This helps increase the safety of the vehicle by insulating the components and reducing noise, vibration, and harshness (NVH).[37] We also would like to point out that, due to EU Regulation 540/2014 on the sound level of motor vehicles, all types of vehicles are required to be equipped with insultation parts that provide airborne transmission reduction, damping and sound absorption. These need to be reliably protected against the infiltration of oil and fuel. Otherwise, the fuels can permeate the textiles, undermining their sound-absorbing performance and increasing the risk for passengers in case of accident. Sound absorbing parts are used not only in cars but also in aircraft, trains, ships and spacecrafts.[38]
	Fuel filtration (ISO19438, ISO4020): Filtration media used in transport allow to remove dirt and dust particulates from the fuel before it reaches the fuel pump. Water and oil-repellent properties increase the fuel-cleanliness level, leading to increased fuel efficiency and reduced fuel consumption.

[36] European Economic and Social Committee, April 17, 2013, *Opinion of the European Economic and Social Committee on Growth Driver Technical Textiles (own initiative opinion)*, CCMI/105-EESC-2012-1966. https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/technical-textiles.

[37] EDANA, "Nonwovens in Automotive and Transportation," EDANA, the voice of nonwovens, https://www.edana.org/nw-related-industry/nonwovens-in-daily-life/automotive.

[38] Jorge P. Arenas, 2016, "Applications of Acoustic Textiles in Automotive/Transportation," *Acoustic Textiles*: 143–163. doi: 10.1007/978-981-10-1476-5_7.

Function	Why are C6 SFPs needed?
Filtration and separation[39]	*Fuel/water separation* (SAEJ 1488, ISO 16332, ISO 21963): Modern car and truck engines require the removal of water, which is naturally dissolved in diesel and biodiesel. C6-treated filters allow to separate emulsified or finely dispersed water droplets from these fuels in order to avoid corrosion of pits and nozzles in the fuel injection system and cavitation effects during combustion.
	Hydraulic filtration (ISO23369, ISO16889): The hydraulic filter is used in the power transmission system to keep hydraulic fluid contaminant-free from e.g., dust and soil, ensuring ultimate protection and equipment uptime in any harsh environment.

An overview of the interplay of the derogations for textiles used in transport and filtration and separation applications can be found on the following page.

[39] Please note that these three last applications are covered by the separate derogation for filtration and separation media. As long as a derogation for filtration and separation media is granted, the reference to filtration will not be needed.

Table 2 – Interplay of derogations

Function	Derogation for textiles used in the engine bay for noise and vibration insultation		Derogation for filtration and separation media	
	In/out scope	**Comments**	**In/out scope**	**Comments**
Ignition protection	Not covered.	Function not mentioned in the wording. In addition to the engine bay, C6-treated textiles are also located under the dashboard.	Not covered.	Function not mentioned in the wording.
NVH insultation	Only partially covered.	C6 SFPs are also used in other parts of vehicles, e.g., as isolator between dashboard and engine compartment (front engine), between seats and the rear engine, at the transmission tunnel. [40]	Not covered.	Function not mentioned in the wording.
Filtration and separation	Filtration not covered.	Function not mentioned in the wording. Also, these types of filters are not only used in automotive but also in aerospace and NRMM. Filters for aircrafts, due to weight needs, are not located inside the plane, but on the ground, either at the main fuel storage or at the refuelling trucks at the airport.	Fuel filtration covered.	The filtration function is explicitly mentioned in the wording.
	Fuel/water separation not covered.		Fuel/water separation covered.	The filtration function is explicitly mentioned in the wording.
	Hydraulic filtration not covered.	Function not mentioned in the wording. Also, filtration media used in power transmission systems can be composed of fibres other than textiles, such as cellulose.	Hydraulic filtration only partially covered.	Filtration media used in power transmission systems can be composed of fibres other than textiles/nonwovens, such as cellulose.

[40] EDANA, "Why use nonwovens in automotive and transportation?," *EDANA, nonwovens in daily life*, https://www.edana.org/nw-related-industry/nonwovens-in-daily-life/automotive (accessed December 12, 2022).

5.3. Emissions

During manufacture, the emissions are effectively zero based on the use of BATs, while production scraps are incinerated in line with the European Waste Catalogue (CER 04 02 22).[41]

During use, C6 SFPs are well embedded in the fabric matrix and there are, therefore, no expected emissions.

At end-of-life, removal and disposal are covered by ELV Directive (2000/53/EC), which ensures proper handling and treatment.[42]

5.4. Alternatives

Side-chain fluorinated polymers' properties include stain, oil, grease and water repellence, as well as compatibility with flame retardant agents.

Assessed water-repellent agents –e.g., wax-based repellents consisting of paraffin-metal salt formulations, resin-based repellents consisting of fatty modified melamine resins, and hydrophobic modified polyurethanes–, cannot provide efficient repellence against oil, alcohol and oil-based stains. Therefore, these agents cannot be considered suitable candidates.[43]

5.5. Socio-economic implications

C6-treated technical textiles help reduce the weight of the car, lowering fuel consumption, and provide advanced insulation, fire retardancy and resistance to water, fuels, extremes of temperature and abrasion. They contribute to extending the product lifetime and making cars safer, more cost-effective and more sustainable. The combination of the abovementioned properties can only be granted with fluorinated compounds.

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[41] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32008L0098&from=EN.

[42] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32000L0053&from=EN.

[43] Lassen C. et al, 2015, 'Alternatives to perfluoroalkyl and polyfluoroalkyl substances (PFAS) in textiles', *Survey of chemical substances in consumer products*, p. 137, https://www2.mst.dk/Udgiv/publications/2015/05/978-87-93352-16-2.pdf.

6. Filtration and separation media

6.1. Derogation request

The ATCS welcomes the proposed derogation for filtration and separation media used in high performance air and liquid applications that require a combination of water- and oil-repellence.

The wording refers to 'high-performance' applications. We understand that this wording raises enforceability questions. From our side, we would like to clarify that "high performance" media mean the same as media "that require a combination of water and oil repellency". We, therefore, suggest removing the terms "high performance" it from the wording.

In addition, the term 'textiles' should be removed, as filtration media does not only cover woven materials but also nonwovens, polyurethane membranes and cellulose-based media, which do not fit under the current wording. In absence of a definition for textiles, we propose the following changes:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> *e. ~~textiles for the use in~~ filtration and separation media used in ~~high performance~~ air and liquid applications in industrial or professional settings that require a combination of water and oil repellence until 6.5 years after EiF;*

We believe that such derogation will help address the enforcement and compliance issues linked to filters intended for 'consumer use', i.e., filters available to the general public via retail outlets as defined in ECHA Guidance R.15.[44] Such filters, for which we understand that alternatives to C6 SFPs are available, include, for instance, those used in vacuum cleaners or air purifiers, which are replaced by consumers.

Regarding how to enforce the requirement related to a 'combination of water and oil repellency', several standards, which are well known in the filtration and separation media industry, are used to check both properties. An overview of these standards is provided in Table 3.

[44] European Chemicals Agency (ECHA), 2016, Guidance on Information Requirements and Chemical Safety Assessment – Chapter R.15: Consumer exposure assessment, https://echa.europa.eu/documents/10162/17224/information_requirements_r15_en.pdf/35e6f804-c84d-4962-acc5-6546dc5d9a55.

Table 3 – Standards to assess water- and oil-repellency

Filtration and separation media - Performance in terms of repellency	Performance Standards
Water repellency	EN20811 (Hydrostatic pressure)
	ISO811 (Hydrostatic pressure)
	EDANA NWSP 080.6 (Hydrostatic pressure)
	Mil Std 282 (Q-101) (Hydrostatic pressure)
	NWSP 080.11.R0 (15) Mason Jar
	WSP 80.11 (09) Mason Jar
	ASME-AG-1-2017; FC-I-3241 (prior to gamma irradiation)
	ASME-AG1-2017; FC-I-3242 (after gamma irradiation)
Oil repellency	ISO 14419 / AATCC 118
	Tappi T559

Finally, we believe that the transition period of the restriction could be used to develop a guidance document indicating the different standards that can be used by enforcement authorities.

6.2. Description of the use (non-exhaustive list)

Filtration and separation media consist primarily of nonwovens composed of manmade fibres, natural fibres or a combination of both, with resins that contribute to the structural or physical properties of the media. Out of these, medium made from microglass fibres is historically the benchmark technology in filtration and separation applications. C6 SFPs are used to treat these types of media only in high performance applications where a combination of water and oil repellence is required. Where these properties are not required, C6 SFPs are not used.

The properties provide various benefits according to applications, such as barrier properties against airborne harmful pollutants and microbial contaminants, dust holding capacity, optimal pressure drop, and the required level of glue-repellence to ensure optimal converting.

These media are used in equipment intended for various safety critical sectors, such as hospitals, personal protective equipment, medical devices, pharmaceutical, energy, food, chemical, transport. Please find some examples of applications below.

- Gas turbines (air filtration)

Gas turbines require air intake filters to percolate air entering the combustion chamber of the turbine. Filter media rely on a high level of particulate removal efficiency, as well as a high level of hydrophobicity and oleophobicity, to protect the turbine against fine dust, soot, salts, water and other particulates. C6 SFPs also ensure the optimal level of pressure drop, which helps maximize output and minimize energy consumption. We understand that this is one of the major sectors of use. [45]

- HVAC applications (air filtration)

Air filters are an essential element of any modern mechanical ventilation system in non-residential buildings. Their primary function is to purify the air supplied to the building of pollutants contained in the outdoor air and provide adequate Indoor Air Quality (IAQ). The contaminants include particles matters (PM) which have an adverse effect on health. The smaller the size of the pollution particle, the more harmful it is to human health. Depending on the outdoor air quality in a specific location, air filters classified as ISO ePM1, ePM2.5 or ePM10 are normally used to provide correct IAQ. While, in applications requiring very clean indoor environment (e.g. medical applications including operating theatres, pharmaceutical production), ULPA, HEPA, EPA or ISO ePM1 filters are required. [46]

- Defence applications (air filtration)

C6 SFP-treated filter media is a crucial component in filters for defence applications. This includes gas masks, air filtration system for air raid shelters, defence vehicles, ships, and vessels. This chemistry allows to comply with high industry standards, which helps ensure protection against chemical, biological, radiological or nuclear threats.

- Air-oil separation (air or liquid separation)

Air-oil separation (AOS) is used in the medical and food sectors, among others, to provide clean process fluid, complete aeration, equipment protection and energy savings. Delivering oil-free compressed air allows low-maintenance, as well as efficient and safer manufacturing systems in these markets.

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[45] ECHA, (2021), *ORCOM Comment 903*, https://echa.europa.eu/documents/10162/ba9716b8-3392-3cf8-13ca-f88025921d42.

[46] ECHA, (2021), *ORCOM Comment 854*, https://echa.europa.eu/documents/10162/c4a9b509-38c2-8b13-1c88-cce95a477afa.

6.3. Volumes

Based on information from media manufacturers, we understand that the average estimate of the volumes of C6 SFPs used for the filtration and separation media placed on the EU market is approximately 67 tonnes per year.

6.4. Emissions

According to the filtration and separation industry, measurements from wastewater have shown very limited emissions, either non detectable or close to the detection limit.

Regarding air emissions from the drying process, no releases are expected since the temperature remains below degradation possibility. Moreover, solid residuals from the process are fully captured and then disposed according to waste codes 150202* or 150203.[47]

Furthermore, the majority of C6 SFP-based filters stem from professional and industrial applications. These filters are, therefore, collected separately and incinerated in line with waste codes 150202* and 150203.

6.5. Alternatives

We would like to contest the statement included in Annex A to the Restriction Dossier that indicates that only water-repellence is needed for the listed applications (p. 26). During the public consultation on the PFHxA restriction proposal, both producers and downstream users highlighted the need for oil-repellence and indicated that 'no adequate alternatives have been discovered, despite great efforts to do so'.[48] In fact, the filtration sector was one of the most engaged sectors during the public consultation on the SEAC draft opinion, based on the number of comments provided.[49]

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[47] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02000D0532-20150601&from=EN; Commission Decision 2000/532/EC replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098.

[48] ECHA, 2021, *ORCOM Comment 961*, https://echa.europa.eu/documents/10162/f1a33a2f-e008-b3d0-1c46-96d1c9eadf10.

[49] ECHA, 2022, *ORCOM Summary on restriction on Undecafluorohexanoic acid (PFHxA), its salts and related substances*, p. 2, https://echa.europa.eu/documents/10162/fe088703-317c-4323-7eca-97d68cd2454d.

- Alternatives to C6 SFPs

Industry provided evidence that assessed alternatives – i.e., flat modified polymers, hyperbranched functionalized polymers, paraffins, silicones and polymeric compounds – show a lower level of water repellence and no oil repellence. Therefore, we can assume that there are currently no PFAS-free alternatives available to provide filtration and separation media with a combination of these two essential properties.

- Alternatives to C6 SFP-treated media

Unlike indicated in the Restriction Dossier, polyurethane membranes cannot be considered a suitable replacement to C6 SFP-treated media due to their physical and chemical degradation, which occurs even under standard environmental conditions. Moreover, these membranes require C6 SFP-treatment in order to ensure oil-repellence.

In addition, we understand that fluoropolymer membranes may be used for the last filtration stage of multi-stage filtration systems. This use generally takes place in combination with C6 SFP-based media (for the earlier stages of filtration). Also, we understand that it is only possible to use these membranes for applications requiring high filtration efficiency[50], and they are generally applied in applications where high chemical resistance and/or mechanical strength are needed.

- Requalification process: Gas turbines (air filtration) – ETN contribution on PFHxA

Based on the information provided by the European Turbine Network (ETN), we understand that a change in the composition of filters used in gas turbines would trigger an extended requalification process. This process would not be limited to water and oil repellence but would cover a large spectrum of requirements. The requalification process would take several years and imply significant costs. As a reference, the transition from C8 SFPs to C6 SFPs, which has been recently completed, took several years with high related costs. The table below shows an example of the approval process per grade change of any media. [51]

[50] Due to its highly porous, ePTFE membranes can only serve high filtration efficiency, i.e., they can only be used for Efficiency Particulate Air (EPA) and High Efficiency Particulate Air (HEPA) filtration and cannot be used for in coarse, fine and medium filters.

[51] ECHA, 2021, *ORCOM Comment 903*, https://echa.europa.eu/documents/10162/ba9716b8-3392-3cf8-13ca-f88025921d42.

Table 4 – High Level Technical Approval Map for Media Change (per grade change)

Phase	Description	Estimated Duration	Comments/Risk
0	Media suppliers propose alternative media options	unknown	Currently alternative chemistry unknown – Media suppliers to advise on potential timescale
1	Sample sheet benchmarking against current media or target specification	3 – 6 months	Structural & performance parameters – Refining media recipes may extend phase duration
2	Determination of processability of sample media rolls	3 – 6 months	Equipment modification / investment may be required or recipe change which would extend phase duration
3	Filter product evaluation – laboratory testing	3 – 6 months	Test plan dependent on product application
4	Filter product validation – 3rd party testing	3 – 6 months	Typically industry standard testing (i.e. EN1822, EN779, ASHRAE, ISO29461, ISO16890, Saudi Aramco, etc.)
5	Field trial evaluation	6 – 24 months	Real world evaluation – product specific
6	Reference sites (controlled market release)	12 – 24 months	Operational performance evaluation in active installations

6.6. Socio-economic implications

Due to its highly hydrophobic and oleophobic nature, C6 SFPs provide various benefits depending on the application, such as glue-repellence, dust holding capacity, reduced energy consumption, as well as protection against corrosion and damages. This results in long lifetime and efficient filtration and separation media.

- Example: Gas turbines (air filtration)

The following statements were provided by ETN in the context of the PFHxA restriction proposal, in support of the permanent derogation for filtration and separation media:

> *C6 is critical to ensure optimal operations in challenging and variable environments*
>
> Due to its unique low surface tension, C6-treated filters help preventing fouling and ingress of water, salts, and oil droplets in the turbine, ensuring the good functioning of the turbines even in challenging environments. Among the others, the coastal and offshore environment probably represents the harshest conditions for gas turbines. Humidity, rainfall and wind dust are the most obvious visible conditions that operators face on site. Hidden in the combustion air, alkali such as potassium, sodium or magnesium, as well as sulfur, soot, volatile hydrocarbons, oily vapors, and particles all generate gas turbine issues including compressor fouling, air-cooling passage fouling, vane and blade erosion, and compressor corrosion. Combined with sulfur in fuels, these alkali in combustion air create hot corrosion. Finally, heavy rainfall may induce filter washings that release filtered particles into the compressor. All these phenomena impact the gas turbine availability on site. On top of that, C6-treated filters demonstrated unique performances in case of fog and icing conditions, which cannot be achieved without C6-based treatment.
>
> *C6 contributes to protect the gas turbine*
>
> The high levels of hydrophobicity provided by C6 fluorotelomer chemistry also help protecting gas turbines from corrosion and damages. This is particularly necessary in offshore applications since it prevents corrosion in the compressor and turbine. Additionally, C6 filter media ensure a high level of particulate removal efficiency, which protects the turbine against fine dust, soot, and salts.
>
> *C6 is critical for energy efficiency and GHG emissions reduction*
>
> C6-treated filters ensure reduced pressure drop[52] The higher the pressure drop, the more energy is needed to run the air filtering systems. Therefore, C6-treated filters contribute to reduce energy consumption and GHG emissions.
>
> Gas-fired power generation is expected to continue to play a strategic role in a decarbonised energy system. There is also a constant effort from the sector to further reduce GHG emissions. Yet, current levels of specifications for gas turbines can only be achieved with C6-treated filters.

[52] Pressure drop means loss of pressure across a filter device in an air (or liquid) flow, due to resistance to flow, which can be caused by filter media, humidity, or contamination.

New standards are also in development (to be published by 2024), with even stricter requirements, such as:

- ISO/PWI 29461-4 — Part 4: Test methods for static filter systems in marine and offshore environments
- ISO/AWI 29461-7, AWI, Filter element endurance test in Fog and Mist environments

A degradation of the air filters is causing the following gas turbines performance losses:

- GT power loss due to increased dP over the filters (recoverable after filter change);
- GT efficiency loss due to compressor fouling (partial recoverable after water wash);
- GT efficiency loss due to compressor erosion (non-recoverable in between overhaul);

A loss in performance would lead to an increase of fuel injection, which cause a surplus of exhaust gas emissions. Therefore, energy consumption and related GHG emissions are expected to increase in the absence of C6-treated filtration media. This is not in line with the objective of decarbonisation of the energy sector. [53]

7. Construction textiles

7.1. Derogation request

Please refer to the contribution of EURATEX.

7.2. Description of the use

C6-treated fluoropolymer- and nonwoven-based membranes are used as light shorings/surface structure, reinforcement fabric, textile substructures, insulation materials or solar protection to construct roofs, façades or building envelops.

C6 SFP treatment is intended to ensure maximum dynamic water-, oil- and dirt-repellency, low susceptibility to soiling, and excellent cleaning characteristics. Outdoor fabrics must also resist UV radiation and temperature variations.

[53] ECHA, 2021, *ORCOM Comment 903*, https://echa.europa.eu/documents/10162/ba9716b8-3392-3cf8-13ca-f88025921d42.

Besides translucency, material efficiency and transportability, textile membrane building offers many possibilities for lightweight buildings and contributes to thermal insultation, reducing energy consumption and increasing durability.[54]

7.3. Emissions

To the best of our knowledge, C6 SFP substances are not expected to be released during use. In addition, we would like to underline that fluorine-free treated textiles present a reduced service-life leading to a higher environmental impact, including higher disposal and replacement rates, as well as increased waste.

7.4. Alternatives and socio-economic implications

Due to the stability of its F-C bond, only fluorinated compounds can ensure the required combination of repellence to water, oil and dirt due to the unique low surface tension provided. Moreover, UV resistance can only be granted by fluorine-containing finishing.

For instance, nonwovens used for light weight construction provide high environmental benefits compared to traditional construction models, including quicker construction, higher insulation efficiency and cost-effectiveness. Similarly, textiles used as insultation materials maintain the temperature in buildings, contributing to reduced consumption of energy and the corresponding CO_2 emissions.[55]

8. Medical textiles

8.1. Derogation request

A derogation for medical textiles, in line with the PFHxA restriction proposal, needs to be included under paragraph 5:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> ***xx. woven, knitted and nonwoven medical textiles as specified in Regulation (EU) 2017/745 of the European Parliament and of the Council with a minimum performance requirement of >20 cm hydrostatic head according to EN 13795 until 13.5 years after EiF;***

[54] EDANA, "Why use nonwovens in construction?," *EDANA: the voice of nonwovens*. https://www.edana.org/nw-related-industry/nonwovens-in-daily-life/building-and-construction (accessed June 2, 2023).

[55] EDANA, " Why use nonwovens in construction?," *EDANA: the voice of nonwovens.*

8.2. Description of the use

C6 SPFs are used in surgical textiles – including drapes, gowns, and clean air suits – that require a combination of durable water-, oil- and stain-repellence to prevent occupational exposure and equipment contamination. In particular, repellence towards non-polar liquids is part of the hazard management, such as preventing transmission of infectious agents.

8.3. Emissions

During manufacture, the emissions are effectively zero based on the use of BATs, while at end of life the articles are incinerated.[56]

Risk management measures implemented by manufacturers include:

- Minimizing the amount of C6 SFP applied to the nonwoven to achieve specific barrier performance properties as required by fitness for use in medical apparel.
- The addition of non-fluorinated auxiliary chemistry allows for a reduction of C6 SFPs by at least 30%, while still achieving barrier performance properties.
- The chemical application process is designed, and constantly monitored through automated controls, to minimize fluorine emissions via air or water.
- Barrier performance requirements are routinely reviewed with customers in order to determine if any reduction in performance is acceptable.[57]

8.4. Alternatives

Recent studies have concluded that these repellent properties cannot be reached by existing non-fluorinated alternatives – e.g., wax-based repellents consisting of paraffin-metal salt formulations, silicone repellents, resin-based repellents consisting of fatty modified melamine resins, and hydrophobic modified polyurethanes.[58]

8.5. Socio-economic implications

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[56] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0075&from=EN.

[57] ECHA, 2021, *ORCOM Comment 964*, https://echa.europa.eu/documents/10162/f1a33a2f-e008-b3d0-1c46-96d1c9eadf10.

[58] Philippa J. Hill et al, 2017, "Substitution of PFAS chemistry in outdoor apparel and the impact on repellence performance," *Chemosphere 181*: 500-507. https://doi.org/10.1016/j.chemosphere.2017.04.122; Danish Ministry of the Environment, Environmental Protection Agency, *Alternatives to perfluoroalkyl and polyfluoroalkyl substances (PFAS) in textiles, Survey of chemical substances in consumer products No.137*, 2015, 978-87-93352-16-2. https://www2.mst.dk/Udgiv/publications/2015/05/978-87-93352-16-2.pdf.

Without C6 SFPs, nonwovens will not provide an effective barrier. This barrier is critical to human health by protecting both the patient and the clinician from low surface tension fluids which have the potential to contain viruses and bacteria, from passing between the patient and clinician(s). C6-treated repellent medical nonwovens provide superior barrier, comfort (breathability, hyperthermia, perspiration) and range of movement without negative effects on human health per cytotoxicity, primary skin irritation and skin sensitization testing.

Sector: Medical devices

9. Membranes for venting devices

9.1. Derogation request

The ATCS supports the proposed derogation. Nonetheless, we would like to note that the term 'membrane' may be too restrictive, as it is more specific than 'media' and, therefore, may leave out certain types of materials other than fluoropolymers.

9.2. Description of the use

Certain medical devices require C6 SFP-treated filtration media. For instance, filters are used for personal respiratory equipment, including respirators and ventilators to assist or replace breathing when a person is unable to breathe adequately on its own. Additionally, in recent decades, Heat and Moisture Exchange (HME) devices have been employed increasingly for short-term use in anaesthesia and long-term use in intensive care units.

C6 SFPs provide highly hydrophobic properties to venting and respiratory filters necessary to provide excellent barrier properties to airborne microbial contaminants, offering protection against bacteria and viruses before they enter the patient's airway and thus bringing a crucial contribution in the prevention of healthcare-associated infection. At the same time, venting filters reduce the number of pathogens a patient exhales into the air and protects equipment from being contaminated, contributing to protecting healthcare staff and other patients.

9.3. Emissions

See above – Medical textiles.

9.4. Alternatives

See above – Medical textiles.

9.5. Socio-economic implications

See above – Medical textiles.

10. Wound treatment products

10.1. Derogation request

The ATCS believes that unless a derogation for medical textiles is included, the proposed derogation for wound treatment products should be moved from paragraph 6 to paragraph 5, as C6 SFPs are also used in professional medical adhesive tapes.

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> ~~*6. […] i.*~~ ***xx.*** *wound treatment products until 13.5 years after EiF;*

10.2. Description of the use

While the proposed derogation is limited to fluoropolymers, C6 SFPs are also used in professional medical adhesive tapes, also known as surgical adhesive tapes. These are used to hold a gaping wound closed while it waits to be stitched shut, or instead of stitches to keep the wound closed while it heals.

Professional medical tapes must be repellent to water and other liquids with a lower surface tension. By using repellent tape for bandaging, liquids will not be able to penetrate the bandage and infect a wound. This type of tape can act as an insulator to prevent bodily secretions and blood from getting out of the bandage.

10.3. Emissions

See above – Medical textiles.

10.4. Alternatives

See above – Medical textiles.

10.5. Socio-economic implications

See above – Medical textiles.

Sector: Lubricants

11. *Epilame* mixtures used for watch manufacturing and watch servicing in mechanical and quartz watches

11.1. Derogation request

We understand that a permanent derogation covering epilame and epilame mixtures used in watchmaking and watch servicing of mechanical and quartz watches needs to be included under paragraph 5.

This is line with the conclusion of the Risk Assessment Committee (RAC) in the context of the PFHxA Restriction Proposal:

> *In the event that a restriction would be imposed, RAC supported derogations for the following uses as credible information on the minimisation of releases from those uses was available: semiconductors and semiconductor related equipment,* ***epilame in watches****, coating for hearing devices, implantable medical devices and transported isolated intermediates.*[59]

We support the following wording:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
> ***xx. epilame mixtures used in watch manufacturing and servicing;***
>
> ***xx. epilame in watches*** *[articles]****;***

11.2. Description of the use

The watchmaking industry uses solubilized C6 SFPs as coating to lubricate mechanical and quartz watch movement parts during watchmaking ang watch servicing.

11.3. Volumes

The production of epilame mixtures takes place mainly outside of the EU, in Switzerland. The watches placed on the EU market contain < 1 kg/y C6 SFPs.

11.4. Emissions

The production of epilame mixtures takes place mainly outside of the EU, in Switzerland. Epilame-coated watch parts are inside the hermetic watch case and there is no expected risk of release.

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[59] European Commission, 2023, *Draft Regulation amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council as regards undecafluorohexanoic acid (PFHxA), its salts and PFHxA-related substances*, p. 2, https://ec.europa.eu/transparency/comitology-register/core/api/integration/ers/338585/090483/1/attachment.

11.5. Alternatives

Based on information from the watchmaking industry, there are currently no PFAS-free alternatives.

Regarding alternatives to mechanical and quartz watches, it should be noted that electronic watches may contain other types of PFAS, even if they do not contain C6 epilame.

11.6. Socio-economic implications

Based on information provided by the watchmaking sector, we understand that the proposed ban on epilame could put at risk between 167,000 and 188,000 jobs and potentially lead to €3.0 billion in loss of export revenues and €1.3 billion in loss of tax incomes and social security contributions. This approach seems largely disproportionated based on the small quantities of C6 annually placed on the market and the proper waste collection implemented throughout the supply chain.

In addition, we would like to highlight that craftsmanship of mechanical watchmaking in France and Switzerland was inscribed in 2020 on the UNESCO's Representative List of the Intangible Cultural Heritage of Humanity. We understand that this is in line with the Commission's definition of essentiality, which will allow for the use of certain hazardous substances when they are critical for the functioning of society and no alternatives are available.[60]

For further information, please refer to the contribution submitted by the Swiss watch industry to the public consultation on the SEAC Draft Opinion on the PFHxA restriction proposal. [61]

Sector: Electronics

12. Semiconductor and semiconductor related equipment

12.1. Derogation request

[60] *United Nations Educational, Scientific and Cultural Organization, Intergovernmental Committee for the Safeguarding of the Intangible Cultural Heritage, 14-18 December 2020, Convention for the Safeguarding of the Intangible Cultural Heritage, https://ich.unesco.org/doc/src/LHE-20-15.COM-Decisions-EN.docx*

[61] Comment #931, Comments on SEAC Draft Opinion on REACH restriction proposal on PFHxA, its salts and related substances, p. 18-19, https://echa.europa.eu/documents/10162/ba9716b8-3392-3cf8-13ca-f88025921d42.

We welcome the inclusion of a derogation for semiconductors in the Restriction Dossier, namely:

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> *ee. the semiconductor manufacturing process until 13.5 year after EiF;*

However, we are still assessing whether the wording is sufficiently comprehensive. We, therefore, refer to the proposals of ESIA and SEMI.

In addition, as at the current time no alternatives are available, we recommend considering a reviewing period after 12 years. It is not possible to estimate when alternative technologies will become available and even if and when an alternative is developed. In addition, it takes a significant amount of time to enable the set-up of a large-scaled production process. Therefore, it is not feasible to include an absolute timeframe for an uncertain transition.

12.2. Description of the use

First, during the photolithography process while manufacturing semiconductors, the silicon wafer of a chip lets incident light through a disc with a pattern etched into it, a photomask. Any potential image change on the surface of the wafer must be prepared through an individual photomask, often resulting in dozens of masks per type of wafer. With each semiconductor having its own variation in patterns/structures. Next, the wafer is rinsed in a developing solution, resulting in an image being transferred to the surface of the wafer (thin film). As no chemical or physical steps can correct image-transfer issues, only when the image is of optimal quality, the manufacturing process can be continued. C6 fluorosurfactants are used for the patterning of the wafers, providing improved permeability and reduced particle adhesion onto silicon wafers.[62]

Second, C6 fluorosurfactants are essential to the wet chemical processes, i.e., acidic and alkaline processes, during the manufacturing of semiconductors, where they are used in the etching agents due to their ability to facilitate the wetting of the microelectronic structures and their chemical resistance.

Third, fluoroalkyl silanes with a linear perfluorohexyl group (C6F13) are used for anti-stiction coatings to be applied on semiconductor-based micro-electromechanical Systems (MEMS) sensors. The MEMS used in semiconductors, invented to grow ultra-thin film, contain microscopic moving structures that respond to physical quantities such

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[62] Semiconductor PFAS Consortium, Photolithography Working Group, *PFOS and PFOA Conversion to Short-Chain PFAS-Containing Materials Used in Semiconductor Manufacturing*, June 5, 2023. https://www.semiconductors.org/pfas/.

as acceleration for in MEMS acceleration sensor.[63] Anti-stiction coatings for this application avoid that surfaces permanently adhere unintentionally to each other causing device failure, prolonging the lifetime of the end use. According to Gunda at al. (n.d.), this phenomenon "occurs when surface adhesion forces are higher than the mechanical restoring force of the miniaturized surfaces of the structural components".[64]

Finally, C6 fluorosurfactants are used in imaging for semiconductor applications, "photo-patterning", for instance in the medical field, e.g., dental x-rays, endoscopy systems, in vitro diagnostic devices and telemedicine applications; in automotive, e.g., image sensors for cameras used in Advanced Driver Assist Systems (ADAS) and Autonomous Vehicles (AV), and in electronics, e.g., image sensors in cameras, video displays, smart phones, and monitoring instruments, where it improves the resolution and accuracy of the sensor.

Contrary to photolithography processes where the resist is removed from the semiconductor component, during "photo-patterning" for imaging the colour filter materials used, i.e., red, green and blue colour films, permanently stay present on the semiconductor component due to their function as colour filters or micro lenses for image reconstruction. The colour films and some black coating layers contain PFHxA as a surfactant, which plays a critical role as wetting agent in the manufacturing process. Additionally the C6 fluorosurfactants contribute to improved sensor resolution and accuracy. This process is used for complementary metal-oxide-semiconductor (CMOS) active pixel sensors.

12.3. Volumes and emissions

The annual volumes are highly limited and estimated to be in the range of 1 - 10 t/y of C6 SFPs. For instance, for anti-stiction coatings a mere 10 kg/y is required to produce more than a billion MEMS sensors (few micrograms per device), while one manufacturer indicated to be able to reduce the amount of C6 SFPs required by at least 30% in the future.[65]

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[63] Comment #893, Comments on SEAC Draft Opinion on REACH restriction proposal on PFHxA, its salts and related substances, p. 12-13, https://echa.europa.eu/documents/10162/ba9716b8-3392-3cf8-13ca-f88025921d42.

[64] Nilesh Gunda, et al., "ANTI-STICTION COATINGS FOR HIGH RELIABILITY MEMS." http://www.surmet.com/docs/(1)Article_MEMS.pdf.

[65] Comment #860, Comments on SEAC Draft Opinion on REACH restriction proposal on PFHxA, its salts and related substances, p. 28, https://echa.europa.eu/documents/10162/c4a9b509-38c2-8b13-1c88-cce95a477afa.

Emissions are effectively zero due to the strictly controlled environment in production facilities, where automated closed systems and cleanroom operations are used and an exemplary control against airborne molecular contamination is managed. As described above, the application levels are very small and the manufacturing process ensures that emissions during manufacturing are effectively zero.

C6 SFPs are necessary for the functioning of essential sectors in society and their environmental concerns can be minimised through properly controlled conditions in the production, lifetime and waste-stages.

12.4. Alternatives

C6 SFPs are responsible for high-performance characteristics ensuring a prolonged durability of semiconductors and its related equipment, which is part of EU's long term digital and ecological vision, designing applications in such a manner that they are sustainable-by-design. At the current time, no suitable alternatives are available that present the same essential characteristics, meaning that alternatives are expected to have a shorter product lifespan without ensuring an overall lower ecological footprint. The increasing obligations for high energy efficient electronics makes C6 SFPs indispensable to society for the time being. It is to be expected that the demand for high-performance and high-value substances by industries will further increase as it provides the best all-round long-term solution when it comes to circularity.

In addition to there not being any suitable alternatives at the time of writing, with alternatives on the European market alone the restriction would miss its purpose as shortcomings in the waste management phase together with uncontrolled import would render this objective void.

12.5. Socio-economic implications

i. <u>Impact semiconductor manufacturing process</u>

Due to the different PFAS materials involved in the semiconductor industry, their provided functions and accompanying diverging scientific advances, and the overall complexity of the manufacturing process, transitioning to non-PFAS alternatives is associated with many uncertainties, requiring a case-by-case evaluation per process and equipment used. We would like to highlight that at least three broad categories should be considered:

1. Relatively short **transition period of 3-4 years** for uses, where non-PFAS alternatives are available and performing well, and no infrastructural changes are requited;
2. General **transition period of 3-10 years**, where a viable non-PFAS alternative has been identified, but challenging infrastructural changes to the manufacturing and related equipment are required;

3. Long **transition of over 25 years**, where no viable non-PFAS alternative has been identified. Here it is uncertain that an alternative chemistry will be found, requiring a substantial trial and error process without guarantee for success.[66]

The Semiconductor PFAS Consortium provides a practical overview of the steps to be considered in any substitution process of PFAS in semiconductors:

1. Reviewing potential alternatives available on the market;
2. R&D to identify non-PFAS alternatives that provide the required performance for the use;
3. R&D to assess the compatibility of the alternative with the materials and equipment used in the manufacturing process to ensure the technical performance of the alternative;
4. Supplier change management;
5. Assessment of negative side-effects; and
6. Qualification and standardization.

Note that several steps may have to be repeated, while, as mentioned above, there is no guarantee for success. It should be highlighted that restricting PFAS in the semiconductors industry will also have a significant impact on future innovation as the past technological semiconductor advancements and PFAS go hand-in-hand, enabling semiconductors to achieve its current node sizes and performance levels.[67]

Moreover, for the abovementioned semiconductor uses, we believe, to the best of our knowledge, that no viable non-PFAS alternatives are available at the current time, and therefore, request **at least a derogation for 12 years, including reviewing period**.

In terms of costs associated with the search of alternatives, it is estimated that each semiconductor manufacturer will spend around 10.8 million dollars (≈ 9.85 million euros) to qualify new materials.[68]

Regarding the etching process during photolithography, determining the perfect spacing of each hole cut into the photomask as well as the dimensions of the imaged feature left on the wafer require precise calculations. Together with the carving of the pattern, it takes approximately six to nine months per mask. It was estimated by the Semiconductor

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[66] RINA Tech UK Ltd on behalf of the Semiconductor PFAS Consortium, Photolithography Working Group, *The Impact of a Potential PFAS Restriction on the Semiconductor Sector,* 2022-0737 Rev. 0, April 13, 2023. https://www.semiconductors.org/pfas/; Semiconductor PFAS Consortium, Photolithography Working Group, *PFAS-Containing Wet Chemistries Used in Semiconductor Manufacturing*, June 2, 2023. https://www.semiconductors.org/pfas/.

[67] *Ibid*.

[68] Semiconductor PFAS Consortium, Photolithography Working Group, *PFAS-Containing Surfactants Used in Semiconductor Manufacturing*, June 2, 2023. https://www.semiconductors.org/pfas/.

PFAS Consortium that the cost these masks to replace PFOS, PFOA and PFOA-related products was $250,000.[69]

ii. Broader socio-economic impact

The World Economic Forum estimated that the semiconductor-related technologies will enable emission reductions of 15% by 2030, covering almost one-third of the emission reductions required by 2030.[70]

As semiconductors are key enablers of a green and digital transition, a global increase in their production and use is already visible, with the global market for semiconductors expected to double from 550 million dollars in 2022 to over 1 trillion dollars by 2030. Being at the heart of the EU's twin transition, the EU is advocating for a competitive and sustainable chip value chain with recent legislative initiatives such as the European chips act.[71]

The EU's market share in the global semiconductor production declined from 20% in 1990s to less than 10% today. The global semiconductor supply chain and associated manufacturing process is characterized by complexity, geographic specialisations and deep interdependencies. The EU mainly produces larger, trailing-edge chips (at 22 nanometres and above), while only two Asian companies are able to manufacture cutting-edge chips (at 2 to 7 nanometres). However, the necessary semiconductor related equipment for the cutting-edge chips is produced solely in Europe, notably by ASML in the Netherlands. In the coming years, the EU market is expected to grow with 12.6%.[72]

In the absence of suitable alternatives, the restriction would further disadvantage the product performance, including miniaturisation, of the European semiconductor industry, and negatively affect the industrial competitiveness and technological autonomy the EU

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[69] Semiconductor PFAS Consortium, Photolithography Working Group, *PFOS and PFOA Conversion to Short-Chain PFAS-Containing Materials Used in Semiconductor Manufacturing*, June 5, 2023. https://www.semiconductors.org/pfas/.

[70] World Economic Forum, "Digital technology can cut global emissions by 15%. Here's how". January 15, 2019, https://www.weforum.org/agenda/2019/01/why-digitalization-is-the-key-to-exponential-climate-action/. (accessed July 10, 2023).

[71] European Parliament, European Parliamentary Research Service, European Strategy and Policy Analysis System, Global Semiconductor Trends and the Future of EU Chip Capabilities, 2022, https://espas.eu/files/Global-Semiconductor-Trends-and-the-Future-of-EU-Chip-Capabilities-2022.pdf. (accessed July 10, 2023).

[72] European Parliament, European Parliamentary Research Service, European Strategy and Policy Analysis System, Global Semiconductor Trends and the Future of EU Chip Capabilities, 2022, https://espas.eu/files/Global-Semiconductor-Trends-and-the-Future-of-EU-Chip-Capabilities-2022.pdf. (accessed July 10, 2023).

is seeking. Due to abovementioned complex value chain, the EU would be left vulnerable with expected shortages of semiconductor-related technology hampering innovation.

13. Coating of electronic devices

13.1. Derogation request

The nature of the coatings for electrical and electronic equipment, which is dependent on electric currents and electromagnetic fields and custom-made equipment for the generation, transfer and measurement of such currents and fields in order to perform adequately, necessitates the use of C6 SFPs. Therefore, we suggest including the following derogation, in line with the SEAC opinion on the PFHxA restriction proposal:[73]

> *5. By way of derogation, paragraphs 1 and 2 shall not apply to:*
>
> ***xx. functional coating used in electrical and electronic equipment and the components thereof until xx [6.5 years after EiF];[74]***

13.2. Description of the use

- Conformal Coatings

C6 SFP coatings are used to provide liquid and moisture protection of electronic components. The coatings are described as conformal coatings as they “conform” to the topography of a component or circuit to protect it from the environment and insure reliable performance.

- Anti-solder coating

Another use of C6 SFPs is anti-solder coating. In soldering of an electronic part, flux is always used to activate the bonding surface, which is included in a solder cream. If this flux penetrates a part, it potentially causes contact malfunction or other imperfections. By using SC SFPs, penetration of the flux can be prevented without disturbing activation.

It is also used in wet chemical processes to facilitate the wetting/coating of difficult to threat surfaces for cleaning, coating, or anti-foaming purposes. They are also used in the manufacture of conductive seals and to help orientation of liquid crystals in liquid-crystal display (LCD) displays.

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[73] European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), Opinion on an Annex XV dossier proposing restrictions on undecafluorohexanoic acid (PFHxA), its salts and related substances, p. 14. https://echa.europa.eu/documents/10162/97eb5263-90be-ede5-0dd9-7d8c50865c7e.

[74] Please note that this transition period is specific to C6 and there may be different requirements for other substances.

13.3. Emissions

As coatings for electronic devices need to be applied in clean room-type working conditions, the emissions during application are effectively zero.

End of life of the components coated with these coatings are covered by the proper treatment defined in the Waste from Electrical and Electronic Equipment (WEEE)[75] and the separate collection defined in the Directive on the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS)[76]. This ensures that emissions at end of life are effectively zero.

13.4. Alternatives

Except for anti-flux migration coating, there are non-fluorinated alternatives for protective coating (e.g., acrylic type, silicon type, polyurethane type, polyolefin type). However, these substances present several disadvantages: flammability, slower drying time, thermal instability, and excessive film thickness.

13.5. Socio-economic implications

C6 fluorotelomer chemistry is a high value chemistry, meaning that the moment that qualitative alternatives become available for substitution producers will voluntarily make the transition. However, as long as this is not the case, the European manufacturers of electronics will experience negative competition consequences following the restriction of PFAS.

Due to the crucial role of the substances in the value chain of several key enabling technologies and markets for Europe's strategic autonomy, i.e., digital applications, the European Union would go against its own agenda by imposing restrictions on its internal market while giving carte blanche to producers importing from outside the EU without a technology in existence to detect substances at border control. Instead of increasing supply capacity within the EU, it will increase excessive import dependence and counteract the achievement of a resilient industrial value chain in the European union, squandering the European Union's internal potential. Furthermore, C6 plays a crucial role in achieving the overall green deal objectives, as the substance is used for

[75] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012L0019&from=EN.

[76] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011L0065&from=ES.

performance enhancing purposes e.g., in semiconductors, gorilla glass – touch screen technology with damage and stain resistance –, and CMOS imaging sensors.

Moreover, experience has shown that if the level playing field is not regulated to the same extent, substances will come into the EU by the back door. Here it worth highlighting that without means ensuring the enforcement of the restriction on imported goods, production will move abroad to countries where less restrictions apply and less control throughout the production process is exercised (e.g., where long-chain PFAS are still allowed). The EU will import the emissions while having less control over what substances are processed in their products and while still taking responsibility in the most important phase of the life cycle from an ecological and health point of view, namely the waste management phase.

This difficulty has already manifested among Member States' authorities who are facing difficulties in preventing the import of products containing banned substances under the EU's REACH framework. For instance, it was reported that chemical nonylphenol (NP) and nonylphenol ethoxylates (NPE) are imported back into the EU in the form of finished products like textiles, cosmetics and cleaning products.[77] The PFAS restriction would therefore not lead to environmental improvement while the cost of enforcement would be very high in an already difficult economic climate. Instead, it would pose a significant risk of importing longer chain PFAS compounds.

A far-reaching restriction such as proposed by the Dossier Submitters would force the production of products with C6 fluorotelomer chemistry to relocate outside the EU. We suggest introducing additional reporting requirements rather than banning the production and critical use of these substances, as it is a proportional tool for obtaining better oversight of the volumes of C6 SFPs in products.

[77] Deutscher Bundestag, 2021, Auf die Kleine Anfrage der Abgeordneten Dr. Bettina Hoffmann, Uwe Kekeritz, Lisa Badum, weiterer Abgeordneter und der Fraktion BÜNDNIS 90/DIE GRÜNEN – Drucksache 19/26516 – Ein Strategischer Ansatz für das Internationale Chemikalienmanagement nach 2020.