PFAS PUBLIC CONSULTATION: BRIEF PLASTIC ENERGY STORAGE SYSTEMS

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***EuPC** is the leading EU-level Trade Association, based in Brussels, representing European Plastics Converters. EuPC now totals about 51 European Plastics Converting national and European industry associations, it represents close to 50,000 companies, producing over 50 million tonnes of plastic products every year. The European plastics industry makes a significant contribution to the welfare in Europe by enabling innovation, creating quality of life to citizens and facilitating resource efficiency and climate protection. More than 1.6 million people are working in about 50,000 companies (mainly small and medium-sized companies in the converting sector) to create a turnover in excess of 280 billion € per year.*

Introduction

Following our initial submission, EuPC intends to comment on specific applications. Since those are very diverse, each application will be covered in a separate submission. This brief addresses the **Plastic Energy Storage Systems** within the automotive sector. This submission is built upon a survey conducted across plastic energy storage systems providers for the automotive sector in Europe.

In 2021, about 9.7 million new passenger cars were registered in the European Union. [Statista Research Department (2023), New passenger car registrations in the EU up to 2022, https://de.statista.com/statistik/daten/studie/1197724/umfrage/pkw-neuzulassungen-in-der-eu/]. Although the share of electric vehicles is increasing, the vast majority of Europe's new cars continue to be powered by gasoline or diesel engines [The International Council of Clean Transportation (2022), European Vehicle Market Statistics Pocketbook 2022/23, https://theicct.org/wp-content/uploads/2023/01/ICCT-European-Vehicle-Market-Statistics-Pocketbook_2022_23.pdf]. Including plug-in hybrid electric (PHEV), full hybrid electric (HEV), mild hybrid electric (MHEV) vehicles, the projected market share of light vehicles with fuel tanks sold in the EU in 2025 would be 82 % and remain more than one third of new light vehicles sold by 2035.

Additionally, the average global "car park" takes roughly two decades to turn over. If half of new cars sold around the world in 2035 are zero-emission vehicles, 70 % of the vehicles on roads will still be burning fuel [Arora, A. et al. (2021), Why Electric Cars Can't Come Fast Enough, https://web-assets.bcg.com/6c/5f/f6a715ff4b80b917eec574fa5c77/bcg-why-electric-cars-cant-come-fast-enough-apr-2021-r.pdf].

Use of fluoroelastomers in plastic fuel systems

Due to their unique chemical and physical properties, per- and polyfluoroalkyl substances (PFAS) have been widely used in various industrial and commercial applications. Within the automotive sector fluoropolymers are used in several parts of the fuel delivery and energy storage systems, such as seals, gaskets wires and hoses. This includes, without limitations:

- Seals, such as
  - Seals for the fuel delivery module
  - Quick connects of various fuel and vapor lines
  - Vapor venting valves
  - Fill limit vent valves

- Fuel hoses connecting the filler pipe and the fuel tank
- Seals used for SCR systems
- Wire insulation for fuel pumps, gauge/ level senders and grounding of metal components
- Typical interface of fuel system and engine or interface of tank and filler pipe to transfer liquid fuel or fuel vapor

In Europe, around 90 % of fuel tank in vehicles are made of plastics (HDPE) [The ITB Group, Ltd. (2022), *Automotive fuel systems – 2022 Update, 1-18*]. With most plastic fuel storage systems, fluoroelastomers are used because of their remarkable properties regarding heat resistance, stability against aggressive chemicals (different kinds of fuel, ammonia and urea) and low hydrocarbon permeation rates [Drobny, J.G. (2007), Fluoropolymers in automotive applications. Polym. Adv. Technol., 18: 117-121. https://doi.org/10.1002/pat.807].

Due to these properties, fluoroelastomers ensure the leaktightness of the fuel system and limit contamination of fuel to the environment. Moreover, the fluoroelastomer parts used in fuel system limit hydrocarbon evaporative emissions to the atmosphere and are therefore mandatory necessary to meet current and prospective EU regulations on gas emissions for gasoline vehicles (Euro 6 and Euro 7).

Besides that, PFAS have shown benefits regarding assembly reason and their self-lubricating properties.

Toxicity

Fluoropolymers are very stable because of their intrinsic physicochemical properties. If lost in the environment, they are therefore currently considered as persistent. However, they do not display any hazardous property/property of concern referred to by the dossier submitter; i.e., bioaccumulation, mobility, long-range transport potential (LRTP), accumulation in plants, ecotoxicity, endocrine activity/endocrine disruption, effects on human health and concerns triggered by a combination of these properties.

Moreover, fluoropolymers and fluoroelastomers, such as **FKM, PTFE, FEP and ETFE,** meet the OECD criteria for polymers of low concern [Henry, B.J., Carlin, J.P., Hammerschmidt, J.A., Buck, R.C., Buxton, L.W., Fiedler, H., Seed, J. and Hernandez, O. (2018), A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers. Integr Environ Assess Manag, 14: 316-334. https://doi.org/10.1002/ieam.4035; Korzeniowski, S. H. et al. A critical review of the application of polymer of low concern regulatory criteria to fluoropolymers II: Fluoroplastics and fluoroelastomers. 2022. *https://setac.onlinelibrary.wiley.com/doi/full/10.1002/ieam.4646]*.

Regarding residual monomers in articles made from fluoropolymers, it is theoretically possible that small quantities of residual monomers can migrate from finished products. Although on PTFE demonstrated that TFE is not detectable in finished articles, manufactured using standard recommended processing conditions, at detection limits down to about 0.01 ppm wt/wt [Society of the Plastics Industry. 2005. SPIs guide to safe handling of fluoropolymers. Washington (DC)].

Fluoropolymers should be excluded from the scope of the restriction

Based on the non-toxic properties described above, fluoropolymers (including fluoroelastomers) should in our view be excluded from the scope of this restriction. We however provide additional information showing both its negligible emission and the disproportionate socio-economic impact that would be linked to its substitution.

Some fluoroelastomers may contain residuals such as BPAF but in very low quantities. Please note that BPAF is studied into the restriction on BPA and Bisphenol of similar concern. **To avoid double regulation, we therefore request BPAF and its uses in FKM to be exempted from the scope of this restriction and be addressed in the other restriction which is substance specific and more focused.**

Needed transition period and inclusion in the proposed derogation combined with a review clause

There are no suitable potential substitutes for fluoroelastomers used in fuel systems meeting the EU regulations on evaporative emissions. Given the long lifetime of vehicles, gasoline powered engines will still be commercialized well beyond the proposed derogation. **We would therefore ask for a time unlimited derogation for those or if not possible the longest considered derogation period (Entry into Force + 13.5 years)**.

There is currently considerable uncertainty whether or not suitable alternatives can be Implemented at industrial level within the proposed transition periods. The restriction should therefore include a **review clause** and process whereby it may be evaluated whether or not the alternatives could be successfully placed on the market potentially allowing if needed extension of those transition periods.

We assume that the derogation applying to transport vehicles would apply to fluoropolymers used in fuel systems, but the element relating to “safety” is subjective in its interpretation. However, this definition is too narrow as the use of fluoropolymers and fluoroelastomers is necessary to meet current and future Euro 6/ Euro 7 environmental limits (i.e. necessary for allowing the placing on the market of cars meeting those emissions requirements). **Specific clarification would be needed** on the applications mentioned above.

Note: the following sections numbers correspond to the sections numbers from ECHA’s Comments for Annex XV restriction report for Per- and polyfluoroalkyl substances (PFAS).

1. Sector and sub-use

This comment is related to the following use: Plastic components containing PFAS used in fuel delivery and energy storage systems in the automotive industry.

The following fluoropolymers have been reported as used in plastic energy storage systems:

- Fluorine Kautschuk Material (FKM) / Fluorinated propylene monomer (FPM)
- Fluorosilicone rubber (FVMQ)
- Ethylene tetrafluoroethylene (ETFE)
- PTFE (EC number: 618-337-2, CAS number: 9002-84-0)
- FEP (EC number: 607-524-4, CAS number: 25067-11-2)
- THV (1-Propene, 1,1,2,3,3,3-hexafluoro-, polymer with 1,1-difluoroethene and 1,1,2,2-tetrafluoroethene, EC number: 607-638-4; CAS number: 25190-89-0)

Additionally, following monomers are used for manufacturing the listed polymers:

- 1,1-difluoroethylene, VDF (EC number: 200-867-7; CAS number: 75-38-7)
- Hexafluoropropene, HFP (EC number: 204-127-4; CAS number: 116-15-4)
- Tetrafluoroethylene, TFE (EC number: 204-126-9; CAS number: 116-14-3)

2. Emissions during the end-of-life phase

A recent study made by Conversio on behalf of pro-K estimates the collected fluoropolymer waste from End-of-life vehicles (ELV) is predominantly incinerated or disposed in landfill (accounting approximately 70 % and 23.3 % of total collected fluoropolymer waste, respectively). For 2020, it was assumed that around 8.6 - 8.7 Mio. ELV were officially collected in the EU27+3 countries [Fluoropolymer Waste in Europe 2020 – End-of-life (EOL) Analysis of Fluoropolymer Applications, Products and Associated Waste Streams." Final Report Made on Behalf of pro-K, Conversio. July 2022., https://www.ft.dk/samling/20222/almdel/euu/spm/49/svar/1951975/2698345.pdf].

From 2011 to 2019, the number of new car registrations in the EU fluctuated between 9.6 - 13 Mio [European Automobile Manufacturers' Association (18 May 2023), *New passenger car registrations in the EU, https://www.acea.auto/figure/new-passenger-car-registrations-in-eu/*]. Therefore, the 8.7 Mio. ELV can be considered as representative for the upcoming decade. The average weight of fluoropolymer and fluoroelastomers components per fuel system can be estimated with 40 g, which accounts for around 350 t fluoropolymer materials collected from ELV fuel systems in the EU27+3 countries in 2020.

Fluoropolymers and -elastomers being very stable in the polymeric form, migration is assumed to be negligible. Therefore, only residuals oligomers or monomers are considered to migrate from fluoropolymers and fluoroelastomers. However, the quantities of those molecules being present in the final article are very low (< 50 ppt to < 5 ppm residual monomers and < 1 % wt residual oligomers for FKM, < 1 ppm residual monomers and < 0.1 % concentrations of residual oligomers in PTFE, ETFE and FEP) [Korzeniowski, S. H. et al. (2022) A critical review of the application of polymer of low concern regulatory criteria to fluoropolymers II: Fluoroplastics and fluoroelastomers. *https://setac.onlinelibrary.wiley.com/doi/full/10.1002/ieam.4646]*, Henry, B.J. et al. (2018), A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers. Integr Environ Assess Manag, 14: 316-334. https://doi.org/10.1002/ieam.4035].

It can be assumed, that FKM materials accounts for more than half of fluoropolymers/ fluoroelastomers used in fuel systems (around 55.6 %), which amounts around 195 t FKM material in ELV fuel systems per year. To determine the emission of residual monomers from fluoroelastomers in landfill, a migration model has been developed to simulate the release of BPAF from cured FKM in an environmental scenario. For a time period of 20 years and an estimation of 9 kt of FKMS placed on the market in total per year, the modulated emissions to the environment are 9.86 kg. Taking into account the share of 195 t FKM waste collected from ELV fuel systems per year, emissions from residual monomers in fluoropolymers and fluoroelastomers exceeding 1 kg per year are not expected.

For more information, please see *Initial input into public consultation on the restriction of BPA and Bisphenols of Similar Concern* of the Bisphenol AF Consortium and ETRMA from 21 June 2023 (submission #4744).

Based on this analysis, the total emissions of PFAS from plastic fuel systems are expected to be in the range of few kg (significantly lower than estimated by the dossier submitter).

For behaviour in incineration, see the next section.

3. Emissions from incineration

As stated above, around 70 % of the fluoropolymer waste from ELV is incinerated.

Incineration above 850 °C does not release PFAS-related materials nor detectable levels of Trifluoroacetic acid (TFA) [Aleksandrov, K. Waste Incineration of Polytetrafluoroethylene (PTFE) to Evaluate Potential Formation of Per- and Poly-Fluorinated Alkyl Substances (PFAS) in Flue Gas. 2019, 226, 898-906., DOI: *https://doi.org/10.1016/j.chemosphere.2019.03.191 ;* Taylor, P. H. Investigation of Waste Incineration of Fluorotelomer-Based Polymers as a Potential Source of PFOA in the Environment. Chemosphere 2014, 110, 17-22, DOI: *https://doi.org/10.1016/j.chemosphere.2014.02.037;* Bakker, J., et al. (2021) Per- and Polyfluorinated Substances in Waste Incinerator Flue Gases. Rijksinstituut voor Volksgezondheid en Milieu (RIVM) Report 2021-0143.DOI: *https://doi.org/10.21945/RIVM-2021-0143)].*, Gujarat Fluorochemicals Limited (GFL), Karlsruhe Institute of Technology (KIT) & Société Générale de Surveillance (SGS) consulted by the German Federal Environment Agency (UBA), *Incineration study on Fluoropolymers at their End-of-Life,* https://www.gfl.co.in/upload/pages/64ca54ee691b6f4a8b2649ec9c7b291f.pdf].

Those temperatures can be found in municipal waste incinerators, as they are mandatory according to the Industrial Emissions Directive 2010/75/EU (Article 50), which prescribes that waste incineration plants must be designed to ensure that flue gases reach a temperature of at least 850 °C for at least 2 seconds in order to ensure the proper breakdown of toxic organic substances).

5. Proposed derogation - Tonnage and emissions

5.1. Volumes of fluoroelastomers/ fluoropolymers used in automotive fuel systems

According to the information received to our survey, the volume of fuel systems components containing fluoroelastomers/ fluoropolymers is around 700 t/ year. This represents around 16.6 Mio. fuel systems produced and placed on the EU market per year.

The EU automobile industry exports more than 6.3 Mio. motor vehicles each year, therefore the number of fuel systems containing fluoroelastomers/ fluoropolymers used in the EU is lower [Eurostat (2023): Found at European Automobile Manufacturers' Association (22 May 2023), *EU exports of motor vehicles,* https://www.acea.auto/figure/eu-exports-of-motor-vehicles/].

5.2. Related emissions during manufacturing of fluoropolymers

Concerning the fluoropolymer **manufacturing stage**, the Fluoropolymers Product Group (FPG) of Plastics Europe established a program focusing on the emission reduction of non-polymeric PFAS chemicals from European fluoropolymer manufacturing, including average emission targets, promoting state-of-the-art technologies to minimize emissions and a commitment to inform downstream users of fluoropolymers on their safe handling of fluoropolymer resins [The Fluoropolymers Product Group (FPG), Plastics Europe (2023), *FPG Manufacturing Programme for European Manufacturing sites, https://fluoropolymers.eu/wp-content/uploads/2023/09/FPG-Manufacturing-Programme-for-European-Manufacturing-sites-Final-September-2023.pdf*].

5.3. Related emissions during converting and service life

During the **masterbatching, compounding and converting stage**, the spillage of pellets is negligible, there is only presence of dustiness; although air filters reduce the risk of emitting dust, as well as the presence of filters in water drains prevents the emission into water.

As stated in the Annex XV report, polymeric PFASs considered to be stable up to 300 °C [Section B.9.11.3 of Annex B of the Annex XV Restriction report]. During the extrusion of all HDPE material based liquid fluid containers in automotive applications, including gasoline and diesel tanks, as well as SCR tanks or similar, temperatures of max. 250 °C are reached. However, all further manual or automated assembly steps of the fluoroelastomers/ fluoropolymer containing components on final fluid containers are performed at room temperature.

During **service life** in the car, operational temperatures between -40 °C to 80 °C can be reached.

Therefore, no significant emissions of polymeric PFAS are expected during manufacturing and service life and the exposure of workers or consumers is assumed to be low.

5.4. Releases during recycling

According to the Conversio study, the amount of fluoropolymer waste from ELV being recycled is negligible [Fluoropolymer Waste in Europe 2020 – End-of-life (EOL) Analysis of Fluoropolymer Applications, Products and Associated Waste Streams." Final Report Made on Behalf of pro-K, Conversio. July 2022., https://www.ft.dk/samling/20222/almdel/euu/spm/49/svar/1951975/2698345.pdf].

7. Derogation for reconsideration: Information on socio-economic impact and analysis of alternatives

7.1. Analysis of Alternatives

7.1.1. Properties of fluoroelastomers/ fluoropolymers

Fluoroelastomers and fluoropolymers, such as FVMQ, FKM/ FPM, THV, PTFE and FEP, are used as materials in various applications within the automotive fuel system due to their outstanding sealing properties and resistance to fuel. They are showing limited fuel swelling and compatibility with different kind of fuels, including high ethanol content fuel (like E85) and low maintenance requirements during their service life.

Moreover, fluoropolymers and fluoroelastomers minimize evaporative hydrocarbon emissions to ensure compliance with the evaporative emission requirements of Euro 6 and Euro 7.

7.1.2. Discussion of technical properties of alternatives compared to fluoroelastomers

Based on the information of the survey, the only available alternatives for FVMQ, FKM and THV-based materials are Nitrile Butadiene Rubber (NBR) and Hydrogenated Nitrile Butadiene Rubber (HNBR).

Although NBR and HNBR show comparable to slightly weaker properties in regard to their heat resistance and durability, they are lacking in resisting chemicals and corrosion. The key reasons, why NBR and HNBR based materials as an alternative have failed, are:

- Could not achieve a finished article suitable for application
- Product meeting national or international standards not achieved
- Reduction of performance properties (mechanical, insulation, etc.)
- Product failure in the final market application

It needs to be highlighted, that the Euro 7 proposal determines evaporative emissions limits for petrol fueled M_1 and N_1 vehicles of 0.50 g at worst day and hot soak [Proposal for a Regulation of the European Parliament and the Council on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7) and repealing Regulations (EC) No 715/2007 and (EC) No 595/2009, Annex I Table 3]. Currently the Euro 6 regulation lays down evaporative emission limits of 2 g/48 h test period. These legal requirements can only be archived with fluoropolymer-based materials, which makes fluoroelastomers obligatory for gasoline powered fuel systems.

Fluoroplastics, such as FEP and ETFE, and fluoroelastomers, such as FKM, show lower permeation rates than NBR and HNBR during tests with different kind of fuels, including fuels containing 10 - 15 % alcohol [Ferber, E. et al. (2005) "Low Permeation Elastomeric Fuel Hose Requirements and New Fluoroelastomer Materials," SAE Technical Paper 2005-01-2162, https://doi.org/10.4271/2005-01-2162., Stahl, W. and Stevens, R. (1992) "Fuel-Alcohol Permeation Rates of Fluoroelastomers Fluoroplastics, and Other Fuel Resistant Materials," SAE Technical Paper 920163, https://doi.org/10.4271/920163.] Moreover, it was shown that FKM materials are most suitable for diesel and biofuel systems regarding degradation and premature failure [Farfan-Cabrera, L. I. et al. (2018), Deterioration of seals of automotive fuel systems upon exposure to straight Jatropha oil and diesel, Renewable Energy, Volume 127, 125-133, https://doi.org/10.1016/j.renene.2018.04.048].

Furthermore, as mentioned in Annex E of the restriction report, Nitril rubber is lacking in durability (approx. 10 % of the lifetime of fluorocarbon, above 100 °C even lower) [Annex E, page 351, Table E.114].

7.1.3. Cost of substitution

In general, the costs of research and development including qualification and approval of the final product is accounted approx. 500 k€ per fuel system reference.

However, for gasoline powered vehicles no alternatives with comparable sealing properties in regard to evaporative emissions is known. Therefore, a substitution with non-fluoropolymer materials is currently not feasible.

7.1.4. Time needed for substitution/potential socio-economic effects

For the time being, no alternatives for gasoline powered vehicles are known.

7.2. Socio-economic impact

The estimated annual turnover related to fluoroelastomers and fluoropolymers components of the fuel storage systems on EU level accounts more than 1 bn €. In case an exemption from the scope will not be granted, the restriction could impact up to 3000 employees in the affected companies.

Moreover, without fluoroelastomers and fluoropolymer-based parts used in the fuel system, gasoline powered vehicles will not be able to meet the EU limits for evaporative emissions. In 2021, around 50 % of the new vehicles sold in EU-27 are gasoline powered engines. Including hybrid vehicles, which can also be powered by gasoline, the share of vehicles being possibly impacted by a restriction of fluoroelastomers is 66 % of the total vehicles sold in 2021 engines [The International Council of Clean Transportation (2022), European Vehicle Market Statistics Pocketbook 2022/23, https://theicct.org/wp-content/uploads/2023/01/ICCT-European-Vehicle-Market-Statistics-Pocketbook_2022_23.pdf]. With an estimated share of 69 % by 2025 and 51 % by 2030, the number of gasoline vehicles, HEV, PHEV and MHEV being sold in EU will not significantly decrease within the next 10 years. [Arora, A. et al. (2021), Why Electric Cars Can't Come Fast Enough, https://web-assets.bcg.com/6c/5f/f6a715ff4b80b917eec574fa5c77/bcg-why-electric-cars-cant-come-fast-enough-apr-2021-r.pdf].

7.3. Proportionality

We have demonstrated above that fluoropolymers and fluoroelastomers do not show toxic properties and are unlikely to lead to the release of hazardous PFAS compounds, whilst the restriction will have an impact on all vehicles powered by gasoline being sold in the EU.

Conclusion/Summary

Based on the above, fluoropolymers and fluoroelastomers should in our view be excluded from the scope of this restriction. We provide additional information showing both its negligible emission and the disproportionate socio-economic impact that would be linked to a restriction. For the time being, there are no alternatives with comparable properties available.

Taking into account the average lifespan of vehicles being around 12 years, the vast majority of vehicles being used within the next decades will be powered by gasoline. In order to align with EU hydrocarbon emission limits, and to ensure accessibility of spare parts within the transition period of fuel powered vehicles towards electrical vehicles, a minimum transition period of Entry into force +13.5 years has to be provided.

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