ATIEL Position on EU PFAS Restriction Proposal
1 June 2023

ATIEL is the Technical Association of the European Lubricants Industry.

ATIEL welcomes the opportunity to comment on the EU proposal for the restriction of Per- and polyfluoroalkyl substances (PFASs).

We would like to take this opportunity to provide comments on the PFAS Restriction proposal on behalf of the Lubricant Industry in the EU and to reiterate the importance of the derogation proposed for our industry with respect to the time needed for research, development and implementation of alternatives which is further explained in this document.

The structure of this document follows the 'SECTION III. Non-confidential comments' in the Consultation questionnaire wherein ATIEL has checked the boxes.

Scope or restriction option analysis

ATIEL would like to express our support to the Commission for their continued effort to improve legislation in the EU regulatory framework.

According to the Restriction Option 2 (RO2: Ban with use-specific derogations) in the Proposal for a restriction of Per- and polyfluoroalkyl substances (PFASs),12 years derogation period with a transition period of 18 months is proposed for Lubricants containing PFASs, applied under harsh conditions or for safe functioning or safety of equipment. We would like to emphasize the importance of the derogation proposed for our industry with regards to the time needed for research, development, and implementation of alternatives. It is also important to re-evaluate the timeframe before the end of the proposed derogation period and allow a re-assessment of available alternatives, so that the ban should not have negative consequences for society.

Hazard or exposure

Lubricants containing PFAS, especially greases but not only, represent a specific niche category of lubricants (less than 1% of the market in volume) with unique properties.
PFAS present in the lubricant industry comprise mostly of two types of polymers:

- **PFPE :** Perfluoropolyether are polymers used as a base oil, additive or solvent for dilutions, lubricants and greases formulation

- **PTFE :** Polytetrafluoroethylene is a fluorocarbon polymer, used as a thickener for greases and pastes, as well as a friction modifier additive in lubricants and greases.

According to our suppliers, these fluoropolymers are very specific substances: not mobile in the environment given their negligible solubility and non-volatility, with no demonstrated systemic toxicity and no bioaccumulation potential [1]. PFAS polymers used in lubricant formulations are considered as polymers of low concern, based on OECD defined criteria and their intrinsic properties [2, 3].

Based on the very specific use of PFPE/PTFE lubricants, the only users will be most likely industrial and very few professional. No consumer will be exposed to such products, as lubricating equipment are made for the overall lifetime.

In addition, Fluoropolymers manufacturers have committed to responsible manufacturing principles and already implement them [4].

PFPE lubricants and greases are expensive components, mainly applied in automotive systems like EGR (Exhaust Gas Recirculation) valves, hydraulic clutch systems, and in electronic and electronic contacts. The applied quantity per system is going from 0,3g to 3g depending on the product function and the application. In most of the cases the lubricant or grease is applied in a very thin film and for the entire lifetime of the system, enclosed in a sealed container to avoid any product loss, which could lead to a reduction of the system lifetime. For this reason, it is unlikely for the final system user to be in direct contact with the PFPE lubricant.

Environmental emissions

PFAS containing lubricants are **manufactured** in highly controlled industrial processes, which are subject to stringent chemical emissions and release monitoring and permitting regulations.

The combination of lower total manufacture tonnage and limited emissions to environment via manufacturing process controls strongly supports the limited potential for exposure to humans and the environment.

The PFPE oils are among the less volatile lubricants on the market, so the emissions into air compartment are very limited or null depending on the working conditions of the system. As explained above, considering how expensive these substances are, specific industrial practices are put in place to ensure there is no loss of product that could lead to soil and water emissions during lubricant manufacturing.

When you consider the **transportation** phase of lubricant formulations, they are packaged and distributed in sealed containers and there are no possible emissions during this stage.

For **use phase** of a PFAS lubricant, an important element to consider is the International Material Data System (IMDS) for the automotive industry, based on the ELV directive (End of Life Vehicle Directive, 2000/53/EC), which can track the PFAS substances across the supply chain. The IMDS is the automobile industry's material data system. Initially, it was a joint development of Audi, BMW, Daimler, EDS (after acquisition in 2008 part of HP, now DXC Technology), Ford, Opel, Porsche, VW and Volvo. To date around 50

manufacturers have joined the community and IMDS has become a global standard used by almost all the global OEMs with more automotive manufacturers expected to join this system.

In the IMDS, all materials present in finished automobile manufacturing are collected, maintained, analyzed and archived. IMDS facilitates meeting the obligations placed on automobile manufacturers, and thus on their suppliers, by national and international standards, laws and regulations.

Considering **waste storage and disposal** - the storage, transport, and disposal of waste, particularly petroleum hydrocarbon fluids in the EU, are highly regulated under the waste framework directive (WFD) as dangerous wastes. Further, national and local legislation and permitting requirements may enhance or even provide more stringent requirements.

When it comes to PFAS based greases, they are added to the equipment and normally last for the complete lifetime; they are disposed usually with the equipment. However, as they are applied in very small quantity (thin layer), it is not easy to recover and collect from the equipment. This is a step that must be further developed by the end users.

Information on alternatives

PFPE base oils can't be currently replaced by any other base oil type. All other chemistries tested are not able to guarantee the performance, reliability, safety and durability like PFPE lubricants or greases in use in all concerned industries today. Other synthetic base oils can't be applied for several reasons, like temperature resistance, flammability or elastomer compatibility.

Silicone lubricants and greases are compatible with most elastomers (except silicone), so they can be used for some specific applications. Nevertheless, silicone is not standing very high temperatures (maximum 200°C compared to 300°C for PFPE) and is more affected by radiations. Breakdown voltage of silicone is relatively poor compared to PFPE formulated lubricants. Finally, silicone is not considered as flammable material but can burn when it reaches a certain temperature, which is not the case of PFPE formulated lubricants. If some stakeholders would consider silicones as possible alternative, this would generate same issue as silicones are also inert components. Moreover, Silicone availability decreases due to the high use in batteries, solar, etc.

PTFE can't be replaced by any other solid into grease or paste formula. PTFE has a unique elastic structure, allowing very low friction, a very low starting torque and reducing noise as well as stick-slip phenomenon on elastomer/plastic and elastomer/metal contacts. Graphite and MoS_2 (Molybdenum Disulfide), Boron nitride, Zinc oxide, Titanium oxide can’t be used alone as a thickener for PFPE base oils due to incompatibility.

MoS_2 is being widely used as a solid additive in grease formulation, especially to prevent metal-to-metal contact and protects the parts against wear on heavy duty applications or when shocks are regulars. Nevertheless, it has been proven by many studies that PTFE is having a much lower friction coefficient than MoS_2 (due partially to the particle shape,

MoS_2 particles having sharp edges where PFPE have curved edges), protecting much more efficiently the contact and reducing the wear. Last but not least, MoS_2 is electrically conductive, PTFE is resistive.

Graphite is also being used in grease formulation, especially for heavy duty application like in open-gears for cement and mining industries. Graphite presents a low friction coefficient but can lead to a lot of dirt and health issue, creating carbon oxides after oxidation process.

Boron nitride is considered more toxic as it contains boron with CMR potential impact. Graphite and Molybdenum disulfide are not known as dangerous. Nevertheless, they could contain nanoparticles.

Properties	**Graphite**	**Molybdenum Disulfide**	**Boron Nitride**	**Graphite Fluoride**	**PTFE**
Formula	C	MoS_2	BN	CF_x	$(C_2F_4)_n$
Relative price	1	3	20	50-60	6
Density (Kg/m3)	2000 to 3000	4800 to 5000	2200 to 2300	2650	2100 to 2300
Color	Grey-black	Grey-black	White-cream	Grey to white	White
Friction coefficient	0,05 to 0,2	0,02 to 0,2	0,2 to 0,5	0,02 to 0,2	0,02 to 0,1
Max. working Temperature (°C)	450	350	750	400	250
Performance : - In vacuum - In humid atmosphere - In oxidizing atmosphere - In presence of radiation	 Very bad Excellent Limited Good	 Excellent Bad Medium Good	 Not possible Bad Good Good	 Good Good Good Good	 Excellent Excellent Very Good Good
Chemical stability	Excellent	Medium	Good but Hydrolysis	-	Excellent until 450°C

Table 1: Comparison of PTFE alternative Lubricants

In conclusion, there are currently no known alternatives able to assure the same technical properties and performance. Using substitution products, at the current stage of our knowledge and technology, would lead to loss of technical performance. For many situations, the industrial process would not be possible anymore. In other situations, using alternatives to PFAS would mean that industry would have to compensate by means redefining the methodology of equipment lubrication, changing industrial processes and how maintenance is assured.

Information on benefits

PFPE lubricants present unique properties:

- Uninflammable
- Inert even in presence of corrosive gases
- No volatile
- Odorless, colorless
- Compatible with all types of plastic and elastomers
- High radiation stability
- Excellent electrical resistance (very high breakdown voltage)
- Very wide working temperature range (from -95°C to 330°C depending on the PFPE type and viscosity)

a) Temperature Stability

PFPE lubricants present the widest operating temperature range on the market, from -85°C to 260°C in service temperature (depending on the viscosity and PFPE type). PFPE brings the required lubrication performances in severe environment, where other lubricants fail.

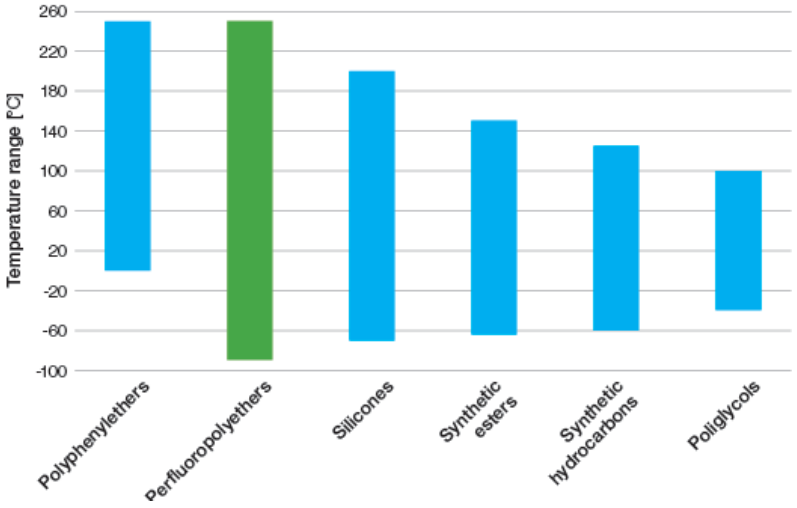

Figure 1 : Average Temperature Range for different types of lubricants [5]

b) Lifetime

PFPE lubricants have very low evaporation in comparison with PAO or esters of similar viscosity at room temperature. Such advantage is a necessity to lubricate vacuum pumps for instance, but also to reduce drastically the lubricant consumption in application with temperature between 150 and 250°C. PFPE strongly **reduce the lubrication consumption** for any application.

Figure 2 : Base oil evaporation comparison [5]

c) Elastomer and plastic compatibility

PFPE lubricants have the best compatibility with plastics and elastomers compared to other lubricants. EPDM or natural rubber are very sensitive to hydrocarbons or esters and can be lubricated/protected only with PFPE or silicone. Silicone have limited friction reduction performance and can't be a choice in many applications.

	Plastic																Elastomer							
	Acetal	ABS	Phenolic	Polyamide-imide	Polyamide (nylon)	Polycarbonate	Polyester	Polyetherimide	Polyethylene	Polyimide	Polyphenylene oxide	Polystyrene	Polysulfone	PTFE	Polyvinyl chloride	Terephtalate	Buna S	Butyl	EPDM, EPR	Fluoroelastomer	Natural rubber	Neoprene	Nitrile	Silicone
Mineral or synthetic hydrocarbons (PAO etc.)	+	+	+	+	+	+	+	+	o	+	+	o	+	+	o	+	-	-	-	+	-	+	+	o
Polyglycols	+	-	+	+	+	-	-	+	o	+	-	+	-	+	-	+	-	-	+	+	-	-	o	+
Esters	+	-	+	+	+	-	-	+	o	+	-	-	-	+	-	+	-	-	o	+	-	-	o	o
Silicones	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
Perfluorinated oils (PFPE)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Polyphenylether (PPE)	+	-	+	+	+	-	-	+	o	+	-	-	-	+	-	+	-	-	o	+	-	-	o	o

+ : Good	o : Medium	- : Low

Figure 3 : Base oil elastomer compatibility [5]

d) Chemical resistance

The strong chemical bonds between carbon, oxygen and fluorine atoms make PFPE/PTFE one of the more stable and inert lubricants in the market to be used in specific demanding applications.

e) Electrical resistance

PFPE lubricants present the best breakdown voltage among known lubricant families. Typical breakdown voltages:

Air : Around 2kV/mm
SF_6 : Around 6,5 kV/mm
PTFE : Around 40kV/mm
PAG : Around 22 kV/mm
PAO : Around 15 kV/mm
PFPE : Around 35 kV/mm

PFPE oils have the highest dielectric strength in available base oil market.

f) Non- flammability

PFPE/PTFE lubricants contain only carbon, oxygen and fluorine, whereas hydrocarbons contain hydrogen. The absence of hydrogen greatly increases the stability of the lubricants and renders them nonflammable. They will not burn or support combustion, even in an environment of 100% liquid or gaseous oxygen.

For these reasons, PFPE/PTFE lubricants are being used in many applications where the conditions are extreme. PFPE brings the required safety in many applications, avoiding health hazards, fatal incidents and bringing reliability.

In presence of corrosive atmosphere, high electrical charge, high temperature, PFPE /PTFE technology is the only known technology allowing a durable and efficient protection of electric contacts.

To conclude, some examples of applications requiring PFPE/PTFE base technology are provided in the following table but the list is not exhaustive. Other harsh conditions (combined) exist and require perfluoropolymers to be used.

Applications	**Extreme / harsh Conditions**
• Coating Lines Automotive Industry	• Temperature, coating chemicals, lacquer solvents
• Automotive actuators and valves	• Very low evaporation even under severe conditions • Uninflammable • High chemical resistance in presence of corrosive gases • High resistance to water wash-out
• Tire Industry – curing mold	• Good adhesion on the metal and high lubricity to reduce wear on the moving parts, and reduce consumption • Noise level highly reduced due to PTFE, reducing shocks and vibrations • High temperature resistance, leading to no deposit, no cocking, and low defective tire ratio • Much lower maintenance operations on the press and moulds
• Industrial Baking Ovens	• High temperature, standard lubricants decompose and contaminate food, PFPE/PTFE lubricants are food safe (NSF H1)
• Chemical Industry	• processing of highly reactive substances which would attack and destroy standard lubricants. • PFPE working fluids vacuum pumps, lubrication of bearing in pumps, seals, fittings, low vapour pressure
• Oxygen – Gaseous and Liquid LOX and GOX manufacture and usage - Air liquefaction and separation for technical and medicinal purposes - Lubrication of valves, seals and fittings for assembly, maintenance and operation	• Steel production, welding, chemical industry & labs, aviation, space flight, diving, medicinal oxygen • High pressurised, highly concentrated oxygen, fast pressure increases • Liquid, extremely cold oxygen (-183°C / 90 K) • Valves, need lubrication at < -183°C and at ambient temperature

	• Insufficient lubrication leads to material wear and debris, which may be ignited explosively and lead to burnout of the surrounding devices • Liquid and highly pressurized oxygen (gas cylinders) would explosively react with standard lubricants in valves, seals, fittings
• Cryogenic Gases like oxygen, nitrogen, argon, krypton, hydrogen, etc	• Resistance to reactive chemicals and extreme temperature
• LNG – Liquified Natural Gases – Petroleum Industry	• Resistance to reactive chemicals and pressure
• Emergency Devices: fire gas ventilation systems, high voltage switches	• Electrical resistance, non-flammability
• Maintenance of electric equipment	• In Germany standard DIN VDE 0105-100 2015:10. Safety related application – wet cleaning is only allowed with non-flammable products.
• Nuclear applications	• Resistance to Gamma radiation
• Military and Aerospace	• Resistance to extreme temperature • Availability and Reliability under harsh conditions

Table 2: Examples of applications which require perfluoropolymers

Other socio-economic analysis (SEA) issues

ATIEL would like to give a detailed overview of those aspects, but considering the time needed to collect such data, we plan to submit it to ECHA by September 2023. Please find below information already submitted in the past:

PFAS in Lubricant Industry Market data according to estimation from FMI Market Study made in 2019 [6]:

- PFPE and PTFE are used for very specific applications where other chemistry can't reach the required performance level, mainly (but not only) in aeronautic, aerospace, electronics, automotive, pharmaceutical and chemistry industries.
- PFPE and PTFE represents around 3000 tons globally in lubricant industry, which represent around 0,2% of the total grease demand, and considered as negligible on the total lubricant demand.
- With regards to the 3000 tons, 60% are sold as lubricants and around 40% a grease or paste.
- Volume of PFAS lubricants are very low but are essentials for many applications.

Currently, PTFE is among the most expensive solid lubricant and thickener to produce and PFPE is the most expensive base oil. Nevertheless, the usage of PFPE/PTFE grease is creating value to our customers thanks to:

- Much longer product lifetime in comparison with lithium or calcium greases.
- Higher safety (non-flammable and highly resistive).
- Improve the global reliability, reducing the maintenance operation and increasing the productivity.

These are some reasons leading to our customers purchasing such expensive materials instead of more standard lithium or calcium greases. If the restriction of PFAS is imposed in the lubricant field, it will have an important and negative economic impact for our customers.

Therefore, if perfloropolymers lubricants would no longer be available, the impact would be in a smaller degree for lubricants business, but to a larger extent for the industries that requires this technology. Furthermore, it would directly affect new technologies and energy transition.

Transitional period

Simple substitution of PFPE/PTFE lubricants for specific applications would not be possible. This could require new designs for the lubricated equipment.

Ban of PFPE/PTFE lubricants will ultimately lead to:

- High investment from industries to find alternatives lubricant or change their technologies when possible.

- Direct impossibility to run some critical systems in sensitive industries.
- Reduction of reliability, yield and performance of the systems.
- Reduction of safety in Automotive, Nuclear and Oxygen/H_2 applications
- Increasing of pollution and energy consumption with higher CO_2 emissions due to higher lubricant consumption and less performance/yield
- Loss of market share and employment in EU companies, in benefit to non-EU companies (industry relocates outside EU)

ATIEL takes the opportunity to ask ECHA to also consider the tests and approvals at the customer end, e.g.: aerospace, vehicle OEMs. In the specific case of OEM approvals (automotive), such tests, assessments and approvals on performance and health effects itself can take a minimum of five years. This timeframe is a minimum required when a lubricant is replaced by a similar one, but PFAS technology is obviously a more complex case where the rules do not apply like for other less demanding applications. For other sectors like aerospace, military, nuclear, it could take considerably longer.

Please note that this timeframe falls at the end of alternative assessment project, many years is already needed by the manufacturers and lubricant formulators to identify, compare, select an alternative considering many factors like hazards, performance and economic viability.

So, considering the different steps in alternative assessment, the transitional period of 13 and a half years, foreseen by the current proposal restriction, is indispensable for finding non-PFAS solutions. The lubricant industry is committed to work with suppliers and customers to find those non-PFAS solutions.

Nevertheless, the impossibility of finding alternatives in due time cannot be ruled out for some very specific/sensitive applications. It is therefore important to consider this aspect and allow a reassessment before the end of transition period, so that the ban should not have negative consequences for society.

Conclusion

ATIEL acknowledges Authorities' concerns which necessitates the PFAS restriction, and we are fully committed to providing all pertinent information from the EU Lubricants Industry. We are hopeful that our comments provided perspective on the challenges faced by the lubricants industry and potential impact for our downstream users with respect to the PFAS Restriction proposal. We also highlight the benefits delivered by PFAS containing lubricants and the issues that will be caused by the ban. As ATIEL, we are willing and supportive of a collaborative approach with the Authorities to progress the restriction proposal as recommended above.

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About ATIEL:
ATIEL is a not-for-profit association (ASBL) representing the combined knowledge and experience of leading European and international engine oil manufacturers and marketers.

By drawing on the technical know-how of its membership, ATIEL promotes consensus on key technical, product stewardship and sustainability issues, ensuring that engine oils continue to contribute to improved wear protection, deposit control, lower emissions, and fuel economy CO_2 emissions efficiency
Website: https://atiel.eu/