General comments

Aalberts Surface Technologies uses PFAS and especially fluoropolymers as ingredients and components of different types of thin films. Either these are independent coatings or they are upgrades for other basic coating systems, such as electroless nickel plating and anodization.

The resulting thin films do have thickness of less than 100 µm. Nevertheless, the properties of the coated parts show similar surface properties and performance as a massive fluoropolymer part. So these thin films are a very canny, ecologic and enonomic use of fluoropolymers and, compared to massive polymer parts, do save huge amount of PFAS. Moreover, this use of fluoropolymers saves resources by replacing more energy-intensive and more expensive alternatives such as stainless steel.

The fluoropolymer components are fully integrated in a solid matrix. There is no intentional and no predictable release of PFAS. In the Annex XV report on microplastics, such type of micropowder polymers is considered to be generally safe, so this consideration should be applied to the present report, too.

We would like to give some details about the background and the use of our thin films in different fields of application. We are convinced that a professional and responsible use of PFAS and in particular fluoropolymers in this field is not a risk for future generations and is a reasonable alternative to more energy- or resource-consuming technologies. Accordingly, this type of use should not get restricted.

1. Sectors and (sub-) uses

Following the scheme of Table 9 in the Annex XV restriction report, the following sectors and subuses are affected:

- Metal plating and manufacture of metal products
  - Manufacture of metal products not addressed elsewhere
- Transport
  - Use of PFASs in applications affecting the proper functioning related to the safety of vehicles, and affecting the safety of operators, passengers or goods
- Lubricants
  - Sector as a whole

5. Proposed derogations – Tonnage and emissions

Approximately 8000 kg of fluoropolymers per year are used as additives for and components of coatings at the surface division of Aalberts Surface Technologies. About 95% of these coatings are applied for reduction of friction and stick-slip effect. Both are cases of solid / dry-film lubrication. Since substrates coated with these thin films (Thickness in the range of to up to 35 µm) are able to provide similar performance as a comparable massive fluoropolymer part, our coatings are a very thrifty use of PFAS.

Despite the outstanding performance of PTFE and PFA, there may be a certain abrasion of the solid coating films during the use phase. However, this is hard to quantify. In comparison to liquid lubricants and greases the release potential is at least one order of magnitude lower.

The substrates coated are steel, aluminium and other non-ferrous metals for automotive and professional industrial applications, but not for consumer products. Accordingly, the recycling rate should be at least 95%. So approximately 95%of the fluoropolymers we use for lubrication purposes might end up in pyrolytic decomposition when the scrap is melted for recycling.

The importance of reliable and durable lubrication for many industries and applications is mentioned at several points in the restriction report and its annexes A and E, e. g. table A.41 (transport sector), A.3.15.1.8 (example firearms), and E.2.14.5 (examples chemical industry, medical industry and renewable energy sector). Solid film lubrication based on fluoropolymers offers the advantage that the PFAS are embedded in the matrix of the thin film, which minimises the release of PFAS and makes this type of lubrication very safe. This is also exemplified in the annex XV report on intentionally added microplastics, where „Substances or mixtures containing microplastic where the microplastic is permanently incorporated into a solid matrix when used" are excluded from the proposed ban.

One major advantage of PFAS-based lubrication systems is mentioned several times in the report: Its endurance, which often even lasts for the whole lifetime of the corresponding parts. However, in the annexes A and E the passages mainly refer to oils, greases and release agents based on micropowder PTFE. Since the PFAS components in such systems are only working by adherence to the surface to be lubricated, there may be a certain release of PFAS during the use phase. In contrast to these systems, our solid permanent thin films are based on fluoropolymers that are embedded in a solid matrix. So the release of PFAS during the use phase is minimized. This is even considered to be a safe use of microplastics (see corresponding Annex XV report), and for this reason this concept should also be considered to be safe for the present report. For all these reasons we do not agree with the conclusion drawn in table E.146. On the contrary, we are of the opinion that a reasonable and canny use of fluoropolymers for lubrication applications, such as solid thin films, saves resources and can be a economic and ecologic solution. This is not outweighed by the small amount of PFAS emitted during the use of such systems.

In E.2.14.2.3 there is a comparison of micropowder PTFE to alternative solid lubrication additives. Boron nitride, molybdenum disulphide, graphite and silicon-based alternatives also have already been tested since several years and for several projects in our laboratories.

For our Gliss-CoatTM dry film lubrication systems PFAS (PTFE) is indispensable if: a high service life and high wear resistance in combination with low friction forces are required. Boron nitride might increase wear resitance and high molecular weight polymers might decrease friction forces. However, their is no combination available that performes similiar to PTFE in case of low to medium force and high amplitude scenarios which are common among general industry and tranport.

A recent example for hexagonal boron nitride is given in the attached file „Prüfbericht 230730_e.pdf“ from 2022. The graph shows the result from a Pin-on-Disc-measurement carried out on a tribometer. The substrate for the coatings were steel plates, and they also served as the reference for the measurement. The basic coating system is an electroless nickel system (NiP). As can be seen, the coefficient of friction for the PTFE-modified coating (NiPPTFE) is as low as 0.15 and remains constant for the whole test distance of 200 m without any detectable effects of degradation. In contrast, the coating with the hexagonal boron nitride (NiPhBN20_06) shows a permanent increase of the friction and after 75 m its performance becomes identical the non-modified electroless nickel and an uncoated steel substrate. This shows that still a lot of development effort is necessary until alternatives to PFAS in lubrication applications with sufficient performance will be available.

We consider a loss of 6 million € in revenues at our Solingen based production site alone. The number of people outplaced will be at least 50. With an income estimate of 1.7 m€ per year. Although the loss in people with our competitors can only be estimated, this might scale up to 1.000 FTE in central Europe. However, we and our competitors deliver into the markets of the chemical industry, consumer goods, printing, general industry and transport. We estimate that the loss in workmanship in this industries will be up to two magnitudes in higher. Summing up to the loss of 10.000 -100.000 jobs in central Europe.

Based on the aspects

- solid film coating systems being a thrifty use of PFAS
- fluoropolymers are no CMR substances, are non-toxic and are considered to be safe materials
- PFAS being embedded in a solid matrix, minimizing their release in the use phase
- durability of the lubrication effect compared to other types of lubrication
- currently still insufficient performance of alternative additives
- significant number of job losses throughout the whole production chain in case of

we recommend an extension of derogation 5.s to the use of fluoropolymers in solid coatings for lubrication purposes in general, not only under harsh conditions, until 13.5 years after EiF.

7. Potential derogations marked for reconsideration – Analysis of alternatives and socio-economic analysis

- The aspect of lubrication and the corresponding derogation 5.s is also closely related to the potential derogation 6.o for the transport sector. In both derogations the safety for the user of devices is a central issue.
- The importance of fluoropolymers for reliable and durable lubrication for the transport sector is mentioned in table A.41 and in A.3.11.2.4. In our processes, however, this can be achieved by a solid coating film without intentional release of PFAS. This type of technical application of fluoropolymer coatings is completely missing in table A.44. Due to their importance, this aspect should be clarified. The range of products lasts from small parts, like screws, sockets and plug valves, to large parts like compressor wheels up to a diameter of 60 cm and hatch covers up to 80 cm. In order to emphasize this aspect, we would like to give some numbers of parts coated at our surface division for lubrication applications:
  - 1 million of washers for water meters
- - 13.5 million armatures / keepers
- - more than 40 million parts in total

- Nevertheless, there are also a lot of parts where reduced friction may not be the primary function of our coatings. The main purpose of our PTFE-modified electroless nickel coating is usually the protection of the surface from mechanical impacts and increased abrasion resistance. However, this function could also be served by an ordinary electroless nickel plating. Our PTFE-modified system comes into play when additional functions are required, such as non-stick properties and low friction. As mentioned at several points in the annex XV report and its annexes, there is no PFAS-free alternative additive with the unique combination of properties available yet. Each of these properties may contribute to the safe function of devices in the transport sector, so we strongly recommend the implementation of derogation 6.o.