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Introduction

To Introduce I&P Europe

I&P Europe – Imaging and Printing Association is a European association of product manufacturers and technology providers for the imaging and printing industry. I&P Europe members' products include conventional and digital materials and their processing solutions. The product portfolio of the membership includes in particular consumables such as inks for digital printing applications, toners, pressroom chemicals, printing plates, photographic mixtures and films as well as equipment products (e.g. printers, printing machines etc.).

I&P Europe strives for working together with competent authorities in Europe and at the supranational level in the Stockholm Convention.

On behalf of I&P Europe - Imaging and Printing Association e.V., we are pleased to participate in the public consultation on the PFAS Annex XV dossier.

The present submission is addressing the use of PFAS in toners.

Problem analysis

New, PFAS-free toners were developed in a necessary combination with modifications to the printing systems themselves. However, PFAS-free alternatives are not yet available for many existing printers, i.e. for installed base printers already on the market.

I&P Europe wishes to emphasize that from an environmental and health perspective, our organization is fully committed to the replacement of PFAS in printing products. Thanks to the commitment and efforts of our affected members, they now successfully develop and market printers that do not require PFAS in their toners and carriers.

Thanks to R&D investments and efforts, the latest generations of toners are being developed without the use of fluoropolymers or other types of PFAS. Consequently, the new generation of printers is no longer tied to the use of a fluoropolymer to ensure good performance.
It is important to be aware that the new, PFAS-free toners were developed in a necessary combination with modifications to the hardware of the printing systems themselves.
The difficulty is with the existing printers on the market that have been engineered based on a toner and a carrier in which a fluoropolymer (FP) plays a critical role to match with the printer specifications. No solution has yet been found to replace the FP in the current toner-carrier-printer electrophotographic system for many existing printers that use PFAS-containing toners, despite extensive research efforts in the R&D departments.

This means that, if PFAS were to be restricted without providing a transition period that covers the lifetime of such existing printers in the market, these printers (production printers for commercial and industrial applications) will have to be disposed of in the field well before the end of their useful life, and will unnecessarily contribute to the production of electronic waste.
This is leaving aside the economic impact of a restriction without a sufficient transition time.

As an additional note, we would also like to emphasize that in this application we are not dealing with any broad general PFAS, but with fluoropolymers in particular, which are less problematic for the environment and could eventually become a specific category within the restriction, distinct from other PFAS.

Scope and scope limitation

Toners needed in installed base printers already on the market.

Thanks to R&D investments and efforts, the newest generations of toners are developed without the use of fluoropolymers or any other type of PFAS. Consequently, the new generation of printers will no longer be chained to the use of a fluoropolymer to assure high-quality performance.

The request for a 5-year transition period is to allow the earlier generation of toners and carriers to be used to service the printers installed in the field, because

- customers have invested in an expensive machine that is not yet depreciated. Making it unusable by banning the needed toners will amount to an economic fraud for them.
- disposing of printers that are far from reaching the end of their useful life will otherwise contribute to the production of unnecessary electronic waste.

Please note that the lifetime of professional and industrial printing equipment is much longer than that of consumer printers and is usually more than five years.

It would be reasonable that the new PFAS restriction, as far as the printing industry is concerned, takes an approach similar to the ban on the sale of gasoline-powered cars in the EU from 2035. The authorities will prohibit the marketing of new cars, but will not ban those already on the road. After all, customers have made significant investments in a product designed to be used for a long life. In the case of printers, it would make sense to prohibit the installation of new printers that use PFAS, but not block the use of those that were already installed in the market by banning the needed toners containing a fluoropolymer (FP).

The demand

A transitional period that is extended to 5 years after entry into force of the restriction for the use of fluoropolymers in toner, carrier and developer

The request for an extended transition period would allow the continued use of printers on the market that depend on a toner-carrier formulation containing a fluoropolymer.
It would also give time to continue research efforts, which may in the coming years still lead to the development of PFAS-free toner for printers installed in the market with equivalent performance to toners based on FP.

There are within the industry companies (typically with a large installed base) that continue to seek modifications to toner to make it still usable in installed base hardware (printers) and thus have PFAS free toner in all of their systems. They need up to 5 years to do this and costs are high. Within the sector, there are also companies (typically with a smaller installed base hardware) for which it is NOT economically feasible to develop a dedicated PFAS free toner for existing printers on the market and which need at least 5 to 7 years as the age of the majority of the installed base of printers so that they can remain on the market with the original toner containing PFAS, which is steadily decreasing in quantity.

Both cases lead to the same conclusion, i.e. a transition time of at least 5 to 7 years is needed.

A transitional period that is extended to 5 years after entry into force of the restriction is perhaps a reasonable compromise, limiting unnecessary electronic waste and taking into account the expected timeline between the publication of the Annex XV dossier and the entry into force of a possible restriction on the use of PFAS in toners.

As noted before, in the case of toners for the printing industry, we specifically deal with fluoropolymers, which is only a limited subgroup within the broad general PFAS definition. These fluoropolymers have the fluorine atoms attached to the main carbon chain, i.e. they are not side-chain fluorinated polymers. These fluoropolymers are much less problematic in terms of health and environment and can even be considered polymers of low concern.
For these reasons, an extended transition period for the use of fluoropolymers is already a solution as far as the printing industry is concerned, and perhaps such a more limited derogation may be considered.

Information on impact on human health or on the environment

As noted before, in the case of toners for the printing industry, we specifically deal with fluoropolymers (FP), which is only a limited subgroup within the broad general PFAS definition. These fluoropolymers are much less problematic in terms of health and environment and can even be considered polymers of low concern.

Moreover, it can be argued that the amount of fluoropolymers ending up in the environment at the end of the toner use is small:

- The toner market in terms of volume is small. Moreover, the content of FP in a toner formulation is in the range of 0.1-0.3%
- The main exposure pathway of PFAS may come from landfilling of not-recycled printed paper products. Considering that printed paper in Europe is 74% recycled (data from 2020- European Paper Recycling Council June 2021), and that 6% of the wastes are incinerated in the EU (Eurostat, Sept 2021), only 24% of the toner could be landfilled. The maximum typical amount of PFAS in toners is 0.3%. This means that only “0.00072kg of PFAS/kg of toner placed on the market” have the potential to be released into the environment.

During the recycling process the waste paper will be washed out and foamed. Due to the physical and chemical characteristics of the toner it can almost completely be pealed off the paper fibers and the toner particles are swimming on the surface. The foam and mud will be skimmed, dried (squeezed) and thermal utilized for energy production. The cleaned waste paper goes into the process of production for recycled paper and packaging paper (cartons).

Cost effectiveness of abatement PFAS emissions from toners in remaining installed base printers

A cost/kg of PFAS emission for toners in the remaining installed base printers was determined for comparison with the acceptability of restriction measures or cost-effectiveness criteria also applied in other REACH restriction dossiers.

The confidential section of this document provides detailed information, including actual toner volumes, PFAS emissions and economic impacts. Depending on the specific member company, data are provided for the period 2023 through 2029 or for the period 2025-2029.
The results for the associated loss of profit/kg PFAS emission for the different companies range from 62 000€/kg (period 2023-2029) and 51 000 €/kg (period 2025-2029) to 66 000 €/kg (2025-2029 data only).

The REACH restriction for microplastics is comparable to PFAS in the sense that a very broad group of substances is in scope and the justification for unacceptable risk is only "persistence ".

In the final RAC-SEAC combined opinion on an Annex XV dossier proposing restrictions on intentionally-added microplastics dd 10-12-2020, it is stated on p 147-148 that the "*Dossier Submitter concluded that the costs associated with the proposed restriction can be viewed as acceptable for society to reduce microplastic emissions to the environment*" based on an estimated **cost-effectiveness** of the proposed restriction on the placing on the market ranging from < €1/kg to €2 200/kg and comparing that with the conclusion of a 2017 study by Oosterhuis et al. Which indicated that "*measures costing less than €1 000 per kilogram of emission reduction would usually not be rejected for reasons of disproportionately high costs, whereas for measures with costs above €50 000 per kilogram PBT such a rejection is likely*" (Oosterhuis et al., 2017).

When the same criteria are applied to assess the cost-effectiveness of a restriction on the placing on the market of PFAS-containing toners for remaining installed base printers, the conclusion is clearly that the (very high) costs/kg emission in this case is disproportionately high and far outweigh the cited criteria to reduce the associated (very small volumes of) emissions to the environment.

The cost-effectiveness values for a restriction on the placing on the market of PFAS-containing toners for remaining installed base printers would NOT be within the range of cost-effectiveness estimates for adopted REACH restrictions on substances posing a risk to the environment, e.g. PBT/vPvB(-like) substances.

Supporting technical information

The fluoropolymers play a key role in the development process, that is why they are used in the composition of the toner and carrier particles.
The electrophotographic development system is a complex technology that works when there is a perfect balance with the carrier that feeds the toner to the photoconductor.
The toner and carrier are mixed and permanently agitated in the developer station to keep the toner particles with the precise electrical charge needed for their development process. This toner and carrier blend is named developer.
The toner is composed by a thermoplastic polymer of 6-13 μm particle size, usually a polyester or an styrene-acrylic resin. About 7-15% of its composition are pigments, waxes, silica and other minor additives such as fluoropolymers.
The carrier are bigger particles, usually 200-300 μm in average particle diameter, composed by an iron or a ferrite core, and a coating. The coating is usually a fluoropolymer, a silicone or an styrene acrylate.
Due to the mixing, there is friction between toner and carrier particles which give electrical charge to the toner particles. But also this friction, causes and erosion in the toner particles that progressively creates a fine layer of toner around the carrier particles. This phenomenon is named scumming. Eventually, the toner layer is so thick that the carrier particles are not able to charge the toner particles by friction. If this happens, printing quality defects will appear. At that moment, the developer mixture has reached its end of life and has to be replaced by a new one.
In this process, the fluoropolymer play an essential role. Fluoropolymers have unique properties such as high temperature and mechanical resistance and they are positive charge donor. These properties are a perfect match for the development system.
Additionally fluoropolymers have excellent lubricity and release properties becoming a flowability enhancer.
Thanks to the FP coating in the carrier particles, and the FP use as toner surface additive, the friction between toner and carrier is reduced, the toner particles are protected from erosion and the carrier particles are protected from scumming. As a result, the developer life is stablished in 2 million pages, which is an impressive number. Without the FP coating the developer life could be reduced to only 20%.
Additionally, its electrical charging properties guarantee a stable positive tribocharge to the toner particles during all the developer life.

Additionally, the use of Fluoropolymers is critical as an ingredient in toner formulation due to its ability to reduce friction. Toners including fluoropolymers achieve an increased durability meanwhile printing. This means that any part or component where there is friction between toner or printed paper and metal such as printer rollers, drums, blades, etc in the printer or in the postprocessing equipment will be protected and achieve a longer life thanks to the use of fluoropolymer.
In small and medium size printers for home and office, the damage of unreplaceable components, means a shorter life-time of the printer and an increase of electronic waste generation. In case of large size and production printers, without the aid of fluoropolymers, parts and components of rollers and postprocessing units will need to be fixed or replaced earlier with the consequent effect of maintenance cost increase and productivity loss.

As mentioned, fluoropolymers are currently used in two components of the development system: as a toner ingredient and as a carrier coating.
The restriction of PFAS will require the replacement of the fluoropolymers in the two components in order to enable the industrial printers to have continued use in the field. Otherwise, the printers will have to be disposed of well before the end of their useful life.

Information on R&D – time needed including market evaluation and introduction

Topic	Carrier manufacturer	Toner manufacturer	Evaluation	Testing by printer manufacturer	Time
PFAS substitution on Carrier Coating	· Production & Tests of new coatings · Production & Tests of new cores (back up)		Measurement of physical properties	· Tests of performance · Tests of developer life	Each iteration takes min 6 months
PFAS substitution in toner		· Production of toner samples with new additives	Measurement of physical properties	. Tests of performance · Tests of developer life	Each iteration takes 4-6 months
New carrier and new toner integration	· Production of carrier with new coating	· Production of final toner sample	Measurement of physical properties	· Tests of performance · Tests of developer life · Field Tests	Life Test + Field test will take up to 1 year

Information on R&D – results (confidential section)

This section contains confidential business information and is added as a separate confidential attachment.

Information on R&D – results (confidential section – member 2)

This section contains confidential business information and is added as a separate confidential attachment.

Information on estimated related PFAS amounts (confidential section)

This section contains confidential business information and is added as a separate confidential attachment.

Economic impact (confidential section)

This section contains confidential business information and is added as a separate confidential attachment.

Cost/kg of PFAS emission for toners in remaining installed base printers (confidential section)

Information on marketing statement (confidential section – member 2)

This section contains confidential business information and is added as a separate confidential attachment.