Manufacturing of Fluoropolymers – An Alternative Proposal for Managing The Risk

-Public version-

Chemours | Advanced Performance Materials (APM)

July 26, 2023

Contents

Information on The Use of Fluorinated Chemistry in The Manufacturing of Fluoropolymers

In the scope of its submissions, Chemours sets out to demonstrate that as the Annex XV report does not identify and assess the complete range of potential restriction or regulatory management options, the Dossier submitters did not clearly demonstrate that the proposed restriction management option (i.e. phase-out) is the most appropriate means to regulate the potential risk of PFAS based on the Annex XV criteria of effectiveness, practicality, and monitorability.

In the scope of this submission, Chemours intends to show that this also holds true for the use of transported isolated intermediates, non-intermediate substances, and fluorinated polymerization aids in the manufacturing of fluoropolymers. Assessing alternative risk management options, the socio-economic importance of substances, and the availability and suitability of alternatives, we reiterate our perspective that a more tailored approach to the regulatory scope and conditions of the use of such fluorinated chemistry in the manufacturing of fluoropolymers is better suited to achieve the risk management objective of the Dossier submitters. At the same time, such a tailored approach would ensure that the critical function of certain PFAS in the manufacturing of fluoropolymers are not permanently lost to EU society.

Along those lines, we intend to demonstrate that, compared to a ban (i.e. phase-out), alternative restriction options are more appropriate to regulate the use of transported isolated intermediates, non-intermediate substances, and fluorinated polymerization aids in the manufacturing of fluoropolymers. We will further elaborate that this is because in the context of manufacturing of fluoropolymers, the potential concerns related to human health and the environment associated with the use of transported isolated intermediates, non-intermediate substances, and fluorinated polymerization aids can be controlled throughout their lifecycle.

To provide more detail and evidence on how potential concerns in the manufacturing of fluoropolymers can be controlled while ensuring to maintain the substances' (and their respective uses') benefits to EU society, and to correct or comment on certain concrete misleading statements made in the Dossier, this submission paper is structured in the following four chapters:

1. The Use of Transported Isolated Intermediates
2. The Use of Non-Intermediate Substances Necessary for Manufacture of Fluoropolymers
3. The Use of Fluorinated Polymerization Aids as Surfactants
4. Manufacturing of Fluoropolymers – Response to Dossier Claims

The paper then closes with a final conclusion, summarizing key arguments and reiterating the request for a more tailored and proportionate regulation of fluoropolymers and fluorinated chemistry used for their manufacture.

Please note that all sources cited are attached to this submission.

1. The Use of Fluorinated Transported Isolated Intermediates

Transported isolated intermediates are used to synthesize fluoropolymers and perfluoropolyethers. This includes the fluorinated monomers to build the polymer chain, as well as fluorinated initiators that are required to get the polymerization started.

For the use of monomers: if other monomers than fluorinated monomers would be used, it would not produce the targeted fluoropolymer. As such, there is no alternative for the use of fluorinated monomers.

Similarly, a fluorinated initiator is required for very specific polymers (please also see example in chapter 2) that are produced in a fluorinated reaction medium. In those setups the initiator needs to be compatible with the reaction medium, meaning that it must be fluorinated since a non-fluorinated initiaton system would not be compatible and would therefore not work. As such, transported isolated intermediates are required for the manufacturing of fluoropolymers and perfluoropolyethers.

Hence, in order to maintain the ability to manufacture fluoropolymers and perfluoropolyethers in the EEA, Chemours makes the argument that expanding already existing EU legislation is sufficiently stringent to control and effectively minimize potential risks associated with the use of transported isolated intermediates. For this, we are referring to the existing regulatory concept of strictly controlled conditions, as defined in REACH Art 18(4) (a) – (f), which entails a number of requirements to minimize any risks associated with the use of chemical substances in manufacturing processes:

a) *the substance is rigorously contained by technical means during its whole lifecycle including manufacture, purification, cleaning and maintenance of equipment, sampling, analysis, loading and unloading of equipment or vessels, waste disposal or purification and storage;*
b) *procedural and control technologies shall be used that minimise emission and any resulting exposure;*
c) *only properly trained and authorised personnel handle the substance;*
d) *in the case of cleaning and maintenance works, special procedures such as purging and washing are applied before the system is opened and entered;*
e) *in cases of accidents and where waste is generated, procedural and/or control technologies are used to minimise emissions and the resulting exposure during purification or cleaning and maintenance procedures;*
f) *substance-handling procedures are well documented and strictly supervised by the site operator.*

Chemours strictly adheres to these conditions. When we register substances as intermediates under strictly controlled conditions, we provide detailed documentation in line with ECHA requirements (art18(4) (a)-(f)). For those fluorinated transported isolated intermediates that are already registered under strictly controlled conditions, this information can be reviewed in their respective Registration Dossiers submitted to ECHA and, in the case of registered intermediates used by Chemours, is also available on our sites and ready for inspection by enforcement authorities.

Against this background, Chemours argues that the concept of strictly controlled conditions, as defined in REACH Art 18(4) (a) – (f), is an already existing regulatory framework that can be expanded to regulate use of fluorinated transported isolated intermediates in the manufacturing of fluoropolymers to sufficiently stringently control and effectively minimize potential risks associated with these uses.

In addition, these strictly controlled conditions, requiring very high manufacturing standards and state-of-the-art emission abatement technologies, demonstrate a regulatory framework that ensures fluorinated isolated transported intermediates' critical functions in and benefits to the manufacturing of fluoropolymers are not lost. This is important to maintain the ability to competitively manufacture fluoropolymers and perfluoropolyethers in the EEA.

This specifically holds true in the PFOA restriction Commission Regulation (EU) 2017/1000), C9-C14 PFCA's (Commission Regulation (EU) 2021/1297) and PFHxA-and its related substances. Here, strictly controlled conditions, as defined in REACH Art 18(4) (a) – (f), are applied to create a derogation or exemption for transported isolated materials. We do not see justification for diverging from these guidelines for handling fluorinated transported isolated intermediates in the manufacture of fluoropolymers.

Moreover, during ECHA's webinar on how to participate in public consultations, the Dossier submitters themselves stated that derogations are meant to include all steps necessary to ensure the availability of PFAS for derogated uses.[1] [2]

Against this background, Chemours argues that the proposed risk management option (i.e. a phase-out) is not the most appropriate measure to address concerns associated with the use of fluorinated transported isolated intermediates. Given the possibility of expanding the already existing concept of strictly controlled conditions, as defined in REACH Art 18(4) (a) – (f), Chemours urges ECHA to consider an exemption from the scope of the proposed PFAS restriction for fluorinated transported isolated intermediates. The use of these substances in the manufacturing of fluoropolymers should continue under strictly controlled conditions, as it is necessary for maintaining the competitive production of fluoropolymers and perfluoropolyethers in the EEA.

2. [redacted]

[redacted].

[redacted]

[1] ECHA. (2023, April 5). *Restriction of per- and polyfluoroalkyl substances (PFAS) under REACH* [Video]. YouTube. https://www.youtube.com/live/JzZRtmaJeoQ?feature=share. 1:32:00.
[2] Chemical Watch (2023, April 25). *PFAS Global 2023* (Conference), Session 1. 1:38:00 to 1:39:10. (recording on request)

[redacted]

[redacted]

[redacted]

[redacted]

[redacted].

[redacted].

[redacted]

[redacted]

[redacted].

[redacted]

[redacted]

3. The Use of Fluorinated Surfactants as Polymerization Aids

Surfactants, also known as emulsifiers, are a class of polymerization aids, whose role is to keep the polymer in emulsion in an aqueous reaction medium. Surfactants as polymerization aids can be fully fluorinated, partially fluorinated as well as non-fluorinated, i.e. can be fluorine-based or non-fluorine-based. They can be added to the reactors, or in case of “no added surfactant” are generated in-situ.

Even though non-fluorinated polymerization aids exist, in the following, Chemours aims to demonstrate that, in comparison, fluorinated polymerization aids provide significant performance and safety benefits that must be taken into account when assessing the suitability of fluorinated and non-fluorinated polymerization aids in the manufacture of fluoropolymers.

To provide more context on the use of polymerization aids in the manufacturing of fluoropolymers: fluoropolymers are produced by a radical polymerization process. In this polymerization process, initiators generate radicals, which in turn convert the monomer into a radical, so it can react with other monomers in a chain reaction (the monomer radicals can be very reactive, from which TFE (TetraFluoroEthylene) is most reactive). The radical polymerization process stops when there is a termination radical.

To be able to build high molecular weight or complex polymer architectures, which in turn impact fluoropolymers' performance as demonstrated in examples below, there must be no interference to the radical polymerization process. To avoid such interference, the emulsifier that must keep the formed polymer dispersed in the water phase must be as inert as possible. Fluorinated emulsifiers (polymerization aids) have this stability.

In comparison, the use of a non-fluorinated polymerization aid in the radical polymerization process is at risk of initiating a reaction with the monomers, which would create two issues: (1) the reaction of the non-fluorinated polymerization aid and the monomers impacts the quality of the formed polymer, and (2) the reaction between the non-fluorinated polymerization aid and the monomers generates new unintended fluorinated substances (residues). The types of such unintended residues can vary by type of non-fluorinated polymerization aid used, by the type of monomers used, and by polymers formed.[5]

Against this background, in this chapter we outline that the substitution of fluorinated polymerization aids with non-fluorinated polymerization aids in the manufacture of fluoropolymers is not a holistic solution to address the potential risks associated with the uses of such fluorinated processing aids. Such a substitution can impact the produced fluoropolymers' performance and can create additional concerns around fluorinated residues and emissions. Therefore, we propose to consider strict manufacturing standards and state-of-the-art emission abatement and control technology as an alternative solution to effectively control and minimize potential risks associated with the use of both fluorinated as well as non-fluorinated polymerization aids in the manufacture of fluoropolymers. In addition, we argue that the performance benefits of fluorinated polymerization aids must be taken into account to ensure regulation is proportionate.

3.1 Key Functional Requirements

As outlined in numerous submissions from other stakeholders in response to the Dossier (e.g. RECHARGE (Batteries): Part 2 # 3925; Hydrogen Europe: part 9 #4144; ACEA (Automotive): part 13, #4276; SEMI Europe (Semicon): part 13 #4304; EUROMOT (Automotive): part 16 #4370; ESIA (Semicon): part 18 #4449; ASD (Aerospace): part 17 #4419; EFPIA (Pharmaceutical): part 19 #4455), fluoropolymers are used in a variety of sectors which enable the green and sustainable transformation of the EU economy, as fluoropolymers provide a unique set of properties (high temperature resistance, chemical resistance, excellent electrical insulation, weather/UV stability, low friction, low/no flammability).

However, given that fluoropolymers are comparatively expensive materials, they are typically only selected for applications that require a combination of two or more of their properties, as

[5] See submitted publication (Chemosphere) for detailed description of reaction mechanism (attached to this submission)

downstream users have an economic incentive to otherwise use comparatively cheaper alternative materials that are able to provide the same properties. Those applications for which fluoropolymers are often chosen include, but are not limited to, wire & cables, tubings, films, machined parts, injection molded parts, coatings, seals and gaskets.

In addition, the context in which these fluoropolymer-based applications are used within their respective sector further defines very specific performance requirements that the fluoropolymer used must meet.

Finally, the fluoropolymer's end use performance attributes, the fluoropolymer resin, must be transformed in the right form factor for the final product / application.

This combination of application (requirements of combination of properties), performance requirements and form factor requires a wide variety of fluoropolymer families, and within each family specific grades exist that provide specific benefits to their respective uses. Each of these fluoropolymer families have specific manufacturing processes, and their respective grades are produced with specific ingredients, using specific recipes, process conditions, and machine configurations.

In this context of producing the different fluoropolymer families and grades, choosing the correct polymerization process and associated polymerization aid is crucial to achieve the desired outcome, i.e. fluoropolymers that meet the performance requirements of a respective application.

Chemours conducted extensive research and gathered comprehensive experience that ultimately shows that for certain families and grades of high quality and high purity fluoropolymers (specifically PTFE Fine Powder, PTFE Dispersion, PTFE Micropowder, FEP (Fluorinated Ethylene Propylene) , PFA (PerFluoroAlkoxy), and FFKM (Fluorinated Fluorine Kautschuk Material)), the use of a fluorinated polymerization aid is necessary, and currently cannot be substituted with non-fluorinated polymerization aids, to meet the respective performance requirements. In other words, Chemours argues, and further exemplifies below, that the assumption, that all fluoropolymers that the society requires can be produced without fluorinated polymerization aids, is not correct.[6]

The following two examples provide additional detail on how the use of non-fluorinated polymerization aids impacts fluoropolymers' properties compared to the use of fluorinated polymerization aids:

> When using PTFE fine powder, the molecular weight is a key indicator for the PTFE fine powder's ability to generate the required porosity and pore size of membranes. One way to determine the molecular weight is by using Differential Scanning Calorimetry (DSC). The higher the melting point, the higher the molecular weight, the better the PTFE fine powder's ability to increase the membranes' porosity and pore size. The graph below demonstrates how the use of a non-fluorinated polymerization aid reduces the peak temperature, as such the molecular weight. The lower molecular weight, in turn, impacts the expanded PTFE's ability to achieve the targeted porosity and pore size (please also see example below).

[6] See for F-PA/HFPO-DA and impact on properties, Chemours (2023). Impact FPA and NFPA in Manufacturing Fluoropolymers (attached to this submission).

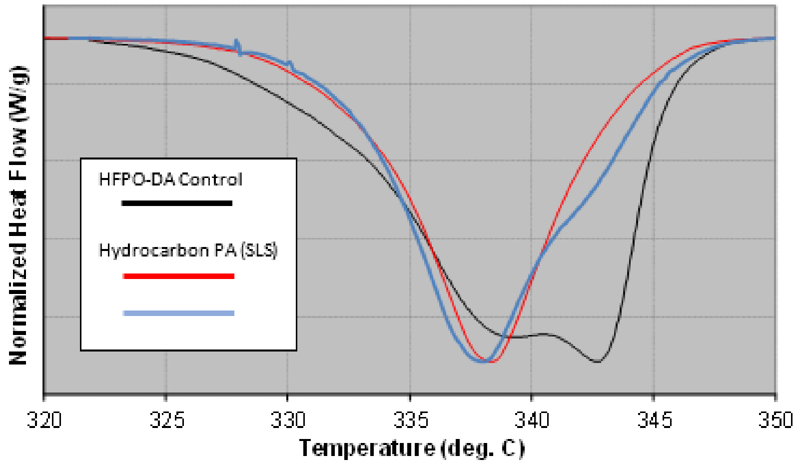

Figure 1: Impact molecular weight][7]

For wiring in harsh conditions, a key aspect is to achieve a high “MIT Flexlife” per ASTM D2176 standard of the wiring installations.[8] The flexlife directly correlates with chemical, thermal cycling and mechanical cycling performance. As demonstrated in the picture below, however, the achieved MIT flexlife is significantly lower when non-fluorinated polymerization aids are used compared to fluorinated polymerization aids, which directly means insufficient chemical, thermal cycling and mechanical performance for the required applications.

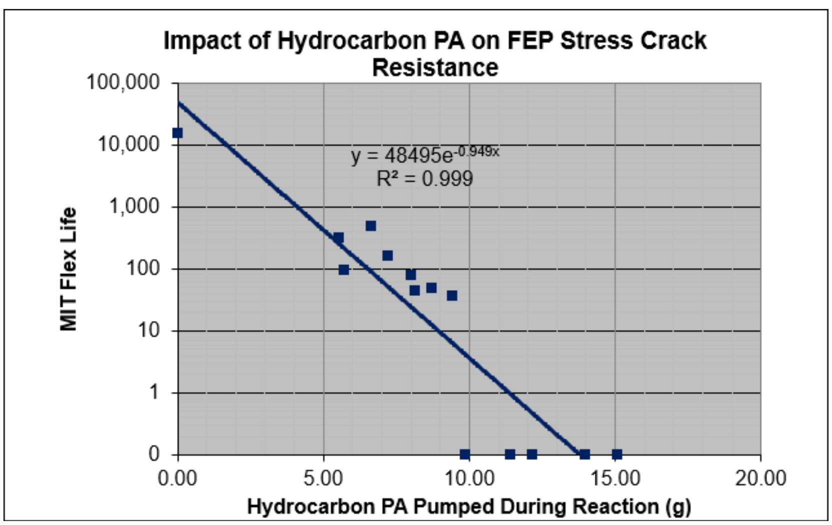

Figure 2: Impact MIT FLexlife[9]

[7] Chemours (2023). Impact FPA and NFPA in Manufacturing Fluoropolymers. (attached to this submission)
[8] Please also see *Test Method for Folding Endurance of Paper and Plastics Film by the M.I.T. Tester*. (2021). https://doi.org/10.1520/d2176-16r21.
[9] Chemours (2023). Impact FPA and NFPA in Manufacturing Fluoropolymers. (attached to this submission)

Based on this impact of polymerization aids on the performance of different fluoropolymer families and grades, in the following we lay out concrete examples of applications with specific Chemours grades[10] where certain performance requirements for fluoropolymers can only be met by using fluorinated polymerization aids:

Semiconductor industry: high purity PFA for semiconductor fluid handling
To achieve high yields in the manufacturing process of integrated circuit, the semiconductor industry uses aggressive and high purity chemicals for etching and cleaning steps throughout the manufacturing process. In this example, PFA fluoropolymer provides a combination of chemical resistance, high purity and form factor that makes it the best available solution to use. First, to transport the aggressive fluid chemicals, e.g. HydroFluoric Acid and Sulfuric Acid, the fluid handling system contains PFA-based tubing made through an extrusion process, as well as PFA-based valves and fittings made through injection molding. Second, PFA fluoropolymers are melt extrudable, which allows it to be transformed to meet the form factor. Third, the PFA fluoropolymer is also a pure material, without any additives, and combined with the specific finishing step of the manufacturing process it gives a high purity polymer meeting the requirements from the semicon industry. The specific grades from Chemours that are used in this context are typically PFA451HP and 951HP for tubing extrusion because their viscosity meets the requirements for a tubing extrusion process, and PFA 440 HP for injection molding, as this grade has the viscosity required for injection molding.

Chemical industry: high chemical and temperature resistant PFA for chemical process industry
The chemical industry uses and produces many aggressive chemicals as for example described in the book "*Fluoropolymers Applications in the Chemical Processing Industries* by Sina Ebnesajjad and Pradip R. Khaladkar, 2004". In the context of handling these chemicals, it is highly important to prevent corrosion of equipment, which can lead not only to high operating costs but also to hazardous leakages. Therefore, in the chemical industry, many valves, pumps, pipes are lined with PFA fluoropolymers. To obtain the key properties, like chemical resistance and high temperature resistance, as well as convert in the right form factor through extrusion or injection molding, PFA fluoropolymers require in the polymerization the use of fluorinated processing aids.
The specific grade from Chemours that is typically used in this application is PFA450HP because it has the right chemical and temperature resistance and the viscosity is such that it can be used in tubing and transfer molding conversion processes.

Semiconductor, electronics, automotive & chemical industry: high molecular weight fine powder for expanded membranes
Expanded PTFE is used for many applications, from vents in automotive headlight and mobile phones, to filters in the chemical and semiconductor industries. Pending the application there are different types and grades of fine powder to assure it can generate the required porosoity and pore size of membranes. Chemours 's grades that are typically used in this context are for example PTFE fine powder 605XT X and PTFE fine powder 601X.

Chemical industry, transportation & energy sector: high stress crack resistant PTFE fine powder for critical tubing applications

[10] Chemours (2020). *Product Information FEP 9494 / FEP 9898 / FPA 440HPA / PFA 450HP / PTFE 601X / PTFE 605XT X / PTFE 62 X / PTFE 62N X.* (attached to this submission)

In the chemical industry as well as the transportation and energy sector, manufacturing equipment and machinery is often subject to extreme conditions and therefore requires high chemical and temperature resistance as well as mechanical flex stability. In this context, different types and grades PTFE fine powder are often used to provide exactly this combination of properties specifically to heat exchangers of coal fired power plants, tubing for potassium hydroxide used in alkaline electrolyzers, or fuel tubing in airplanes and cars. Chemours has designed specific grades for these applications like PTFE fine powder 62N X and PTFE Fine Powder 62XTX.

Electronics sector: high speed FEP for advanced electronics cables
In the electronics industry, excellent electrical insulation of wires is needed to assure high speed data transfer. These insulations are particularly important for very fine wire wiring within for example data center server cables. In this context, FEP is used as insulation material as it combines excellent electrical properties with the ability to extrude over very fine copper wire. Grades from Chemours that are typically used for such wires include FEP 9494 and FEP 9898.

3.2 Residues and By-Products of Non-Fluorinated Polymerization Aids

In addition to concerns that the use of non-fluorinated polymerization aids do not allow many fluoropolymers to achieve the required technical performance, their use can also create high levels of a wider spectrum fluorinated by-products. In other words, regardless as to whether a fluoropolymer is made with a fluorinated or non-fluorinated polymerization aid, fluorinated emissions can be created during the manufacturing process. **The formation and type of such fluorinated by-products depends on the specific polymerization type, the recipe used and the manufacturing process.**

Comprehensive research has shown that non-fluorinated polymerization aids can generate significantly more and a wider spectrum of by-products than fluorinated polymerization aids in for example PTFE fine powder polymers. Given the higher amount and wider spectrum of by-products generated when using non-fluorinated polymerization aids, they may not be as effectively captured and controlled as when using a fluorinated polymerization aid.[11] This comparison also includes the manufacturing process of fluorinated polymerization aids themselves under strictly controlled conditions. The formation of residues from non fluorinated polymerization aids is also supported by research by the U.S. Environmental Protection Agency (EPA), which shows that the use of non-fluorinated polymerization aids, in comparison to the use of fluorinated polymerization aids, yields more by-products with varying compositions, whose impact on the environment cannot immediately be known.[12]

In order to adequately assess the by-products (and their emission levels) generated when using non-fluorinated polymerization aids, a non-targeted analysis is required in addition to standard commercial testing (targeted analysis). Only with such a non-targeted analysis it is possible to fully understand the impurity profiles from the manufacturing processes.

[11] See for F-PA/HFPO-DA and impact on properties, Chemours (2023). *Impact FPA and NFPA in Manufacturing Fluoropolymers*. (attached to this submission)
[12] McCord, J. and Strynar, M. (2022, May 22-26). *Environmental forensic investigation of chemical manufacturing and use of PFAS by nontargeted analysis*. SETAC Focus Topic Meeting: Nontarget Analysis for Environmental Risk Assessment, Durham, NC. (attached to this submission)

To provide a concrete example underlining the importance of fully assessing residues created during the manufacture of fluoropolymers: in 2009, DuPont, the predecessor of Chemours, started research on the use of non-fluorinated polymerization aids for the manufacture of PTFE.[13] After extensive research, DuPont was able to produce the required PTFE with non-fluorinated polymerization aids, and Chemours, by then a spin-off from DuPont, launched the product commercially in 2016.[14] At that time, the analytical techniques Chemours applied did not include the non-targeted analysis. However, when the technology became available to Chemours and was applied to the manufacturing process of the new PTFE, it became clear that very high levels of residues were present. As a result, Chemours decided to withdraw its product from the market, since levels of residues generated throughout the manufacturing process were significantly higher compared to producing the same product with a fluorinated polymerization aid.[15]
Using a non-fluorinated polymerization aid can generate a wide variety of unknown fluorinated residues, while the use of fluorinated polymerization aid has as possible residue the polymerization aid that was used in the process and its properties are well understood. Consequently, fluorinated residues and emissions can be much more effectively captured and controlled when producing PTFE with a fluorinated polymerization aid.

Such experiences with the creation of non-intended fluorinated materials are not unique to DuPont / Chemours. In the U.S., the EPA published a poster on this topic and ChemService provided a Risk Management Option Analysis particularly for this issue.[16] [17]

What the research and example outlined above demonstrate is that (A) fluorinated residues and emissions are created in the manufacturing of fluoropolymers regardless of whether a fluorinated or non-fluorinated polymerization aid is used, or if no surfactant is added at all (in-situ generated fluorosurfactants), and (B) only with a full understanding of the impurity profiles from the manufacturing process it is possible to design effective emission controls. [18] [19]

In line with this observation, we point back to our argument from the beginning of this chapter 3, namely that a substitution of fluorinated polymerization aids with non-fluorinated polymerization aids in the manufacture of fluoropolymers is not a holistic solution. Such a substitution does not comprehensively and stringently address potential risks associated with these uses. Much more, controlling fluorinated emissions generated during the manufacturing of fluoropolymers to the best extent possible is key to minimize potential risks.

In line with this assessment, at our manufacturing site in Dordrecht, where Chemours applies state-of-the-art emission control and abatement technologies, more that 99.99% of fluorinated polymerization aids are being captured, and remaining emissions of the fluorinated processing

[13] Chemours. (2015, December 5). *Chemours to Introduce Innovative Technology for Teflon™ Nonstick Coatings at Ambiente 2016* [Press release]. (attached to this submission)
[14] Chemours. (2017, October 25). *Customer letter regarding LX transition* Letter. (attached to this submission)
[15] Chemours. (2017, October 14). *Customer talking points regarding LX impurities* (attached to this submission).
[16] McCord, J. and Strynar, M. (2022, May 22-26). *Environmental forensic investigation of chemical manufacturing and use of PFAS by nontargeted analysis*. SETAC Focus Topic Meeting: Nontarget Analysis for Environmental Risk Assessment, Durham, NC. (attached to this submission)
[17] Chemservice. (2021, November 4). *Regulatory Management Option Analysis for Fluorpolymers*. Retrieved from https://fluoropolymers.plasticseurope.org/application/files/5416/5104/8333/20211104_FP_RMOA_Final_3.pdf. Page 44: However, the possibility that certain PFAS by-products may be generated due to unintended reactions between non-PFAS polymerisation aids and fluorinated monomers in the reaction process should be taken into account. Nevertheless, it is worth noting that these companies have also implemented occupational health and safety management systems to monitor and control the manufacturing steps.
[18] Boyle J. et al. (2023, June). *Nontarget LC/QToF Interrogation of Fluorinated Residues in a Fluoropolymer Dispersion Prepared with a Hydrocarbon based Processing Aid* [Conference presentation abstract]. American Chemical Society, Denver, Colorado, United States. (attached to this submission)
[19] See submitted publication (Chemosphere) (attached to this submission)

aid used in manufacturing (HFPO-DA) are less than 0.01% or 6kg per year. To provide additional detail, these state-of-the-art emission control and abatement technologies are composed of a multi-step filtration system (also called “abatement train”), including nano-filtration, reversed osmosis, settling tanks, sand filters, deep bed filters, ion-exchange, and activated carbon filtration.[20] [21] [22]

3.3 Non-fluorinated polymerization aids do not provide a solution

In summary, fluorinated polymerization aids play a crucial role in the production of high-performance fluoropolymers, as they enable these fluoropolymers to meet the requirements for high-performance applications. In addition, applying state-of-the-art emission control and abatement technologies allows to minimize and control potential risks associated with their use in fluoropolymer manufacturing throughout their lifecycle. In comparison, using a non-fluorinated polymerization aid instead could lead to more and a wider spectrum of by-products, which can make them more difficult to measure and to capture and as such their impact on the environment cannot immediately be known.

Chemours has been conducting R&D for more than 10 years in using non-fluorinated polymerization aids for its PTFE, FEP and PFA product lines, and up to now, did not find a solution that does generate a lower level of fluorinated residues and achieves the polymer performance requirements.

Yet, the Dossier currently proposes a phase-out of fluorinated polymerization aids: “By way of derogation, paragraphs 1 and 2 shall not apply to: a. polymerization aids in the production of polymeric PFASs until 6.5 years after EIF. This derogation does not apply to the production of PTFE, PVDF and FKM.” (Annex XV, p. 5, column 2, item 5a).

Based on our reasoning above, Chemours argues that currently there is no viable alternative for the use of fluorinated polymerization aids in fluoropolymers (for instance, but not limited to, PTFE and FEP) that have specific technical requirements, for example, in semiconductor, chemical, electronics, automotive/transportation, and energy industries. In addition, releases can be minimized using state-of-the-art emission control and abatement technologies.

Hence, the proposed risk management option (i.e. a phase-out) is not the most appropriate measure to address the potential risks associated with the use of fluorinated polymerization aids in the manufacture of fluoropolymers. Moreover, the currently proposed risk management objective (i.e. a phase-out) would result in disproportionate impacts on society unless the proposed restriction is modified (sufficient transitional arrangements / modified scope).

Therefore, Chemours urges ECHA to consider an exemption for the use of fluorinated processing aids in the manufacture of fluoropolymers. If a phase-out is eventually considered by the Scientific opinions to be a more appropriate measure, then Chemours

[20] Chemours in Dordrecht: Responsible Manufacturing [One-Pager] – showing emission controls and level capture/use recycle vs emission (attached to this submission)

[21] DCMR Environmental Protection Agency (2022, October 31). *Publicatie beschikking revisie omgevingsvergunning Chemours*. [Letter regarding DW permit and performance]. (attached to this submission) https://pzh.notubiz.nl/document/11990703/1/Brief++gedeputeerdenZevenbergen+en+Stolk+Publicatie+revisievergunning+Chemours.

[22] For demonstration surface water changes with installation emission controls please see Jonker, M.T.O. (2021). *Poly-en perfluoralkylstoffen (PFAS) in de Rijkswateren.* Utrecht. pp 85-87. Retrieved from: https://edepot.wur.nl/548355.

urges ECHA to consider a derogation of at least 12 years with a review prior to its entry into force, as this will be necessary to avoid disproportionate socio-economic impact.

At least 12 years with a review period would be needed to develop an alternative technology, scale it up as well as complete customer and value chain qualification through their required test protocols. In particular, developing a commercial new process requires multiple steps:

1) The invention to develop a non-fluorinated polymerization aid that has an acceptable toxicological profile, does not generate unwanted levels of fluorinated residues, can produce the polymers targeted properties, can be used in a commercially viable way (time for an invention is undefined, for Chemours it is already more than 10 years).
2) The new polymerization aid must be scaled-up to a commercial manufacturing process; pending the solution this may require the construction of a new plant. This phase can vary between 1-2 years.
3) The new polymerization aid needs to pass multiple toxicity tests, meeting requirements for regulatory agencies around the world, and must pass several end use approvals (e.g. food contacts). This process alone can take up to 3-4 years.
4) The new polymerization aid must be used in commercial scale manufacturing of fluoropolymers, which include a wide range of different grades that need to be produced in test conditions multiple times to assure reproducibility. Before customer qualification can start). To work through the full portfolio of grades, and conduct evaluation after each test can be between 2-3 years.
5) When the new process is repeatable and reproducible, customers need to qualify the polymer made with the new process in their conversion process and by their downstream users. Some sectors and applications can qualify a new product very fast (less then 1 year), other sectors like aerospace, military , medical need much longer time, this can get up to 5 or even 10 years due to their specific protocols. Therefore, pending the market sector and application, qualification can vary from 1-10 years.

4. Manufacturing of Fluoropolymers – Response to Dossier Claims

After thoroughly and carefully reviewing the PFAS Restriction Dossier and its Annexes, in this chapter we would like to take the opportunity of this consultation to correct certain misleading information / data regarding manufacturing and processing of fluoropolymers currently presented in the Dossier / Annexes. The correction of these concrete statements made in the Dossier further underlines Chemours' reasoning that the proposed risk management option (i.e. a phase-out) is not the most appropriate measure to address the identified risks associated with the manufacturing and processing of fluoropolymers.

4.1 Statements concerning the Chemours Dordrecht Works

Certain information in the Dossier that addresses the Chemours Dordrecht Works' environmental emissions and the ratio of emissions to waste is misleading or outdated. Please find newer data and additional insights on these sections below, and please refer to references cited for additional, more detailed information.

In 1.1.5.2 of Annex XV, the Dossier makes the following misleading statement:

"It must be noted that indirect emissions via waste from manufacturing could be a significant source of environmental emissions as was shown at the Chemours site in the Netherlands where indirect PFAS emissions via waste were 11 times higher than emissions via water (ILT, 2018; Tweede Kamer, 2019)."

We would like to correct:
This statement is a misinterpretation as it assumes that all PFAS in waste is emitted. However, waste streams are incinerated and not emitted.[23] [24] [25]

In B.4.2.7.6. of Annex B, the Dossier makes the following misleading statement:

"*The occurrence of HFPO-DA has also been studied in the vicinity of fluorochemical production plants in Europe. For example, HFPO-DA was detected in all samples downstream from a fluorochemical production plant in Dordrecht, the Netherlands, with the highest level (812 ng/l) being 13 times higher than the sum of PFAAs. In contrast, the levels were below the reporting limit at the control sites and in two out of three samples taken upstream from the plant. HFPO-DA was also found in tap water within 50 km from the fluoropolymer manufacturing plant (Brandsma et al., 2019; Gebbink et al., 2017)."*

We would like to correct:
This information is outdated and does not take into account the robust emission control techniques that have been installed in recent years using the best available techniques. For comparison, monitoring data from 2021 show that HFPO-DA in the Meuse estuary is in the range of 0.01-2.2 ng/l.[26]

In B.9.2.2 of Annex B, the Dossier makes the following misleading statement:

In the past (2013), "Chemours Dordrecht in the Netherlands, the main production site in Europe for fluoropolymers such as Teflon™ and Viton™, was allowed to emit 7 t Hexafluoropropylene oxide dimer acid (HFPO-DA) per year. Currently, these numbers are lower."

We would like to correct:
The above statement, referring to a publication by the Dordrecht municipality, is an understatement, as it does not capture the very significant reduction in permitted emissions in recent years.[27] Chemours has an operations permit by DCMR which includes a permit for 2 kg/year for indirect discharge to water (via Aquarius) and 4 kg/year to air. Next to that we have a permit by RWS for direct discharge into the river for 5 kg/year which is mainly rainwater and discharge of the groundwater remediation system. This represents a 99.97% reduction in

[23] Inspectie Leefomgeving en Transport. (2020, August 28). *Inspectierapport* [Inspection report]. (attached to this submission)
[24] Tweede Kamer der Staten-Generaal. (2019, December 4). *Verslag van een schriftelijk overleg*. Retrieved from https://zoek.officielebekendmakingen.nl/kst-28089-152.pdf. https://zoek.officielebekendmakingen.nl/kst-28089-152.pdf.
[25] Inspectie Leefomgeving en Transport. (2018, June 26). *Afvalstromen van Chemours*. Retrieved from https://www.ilent.nl/documenten/rapporten/2018/06/08/afvalstromen-van-chemours.
[26] Jonker, M.T.O. (2021, April). *Poly- en perfluoralkylstoffen (PFAS) in de Rijkswateren*. Utrecht. Retrieved from: https://edepot.wur.nl/548355 https://edepot.wur.nl/548355.
[27] Dordrecht Municipality. (2022). *Nieuwe vergunningen Chemours gepubliceerd*. Retrieved from: https://cms.dordrecht.nl/Inwoners/Overzicht_Inwoners/Dossier_Chemours_en_DuPont/Nieuws/Nieuwe_vergunningen_Chemours_gepubliceerd.

permitted levels over a 10-year period.[28] [29] [30] [31] [32] [33] [34] [35] Operating responsibly and sustainably, Chemours Dordrecht has worked within the limits of this permit. No recorded incident or incident at the factory has resulted in an exceptional release or contamination.
Moreover, we would like to emphasize that we have no visibility on the size of all production sites for fluoropolymers in Europe and cannot verify but rather question the statement on production size included in the Dossier.

4.2 PFAS emissions in soil

The Dossier points towards a supposed lack of information regarding PFAS emissions to soil, even though there is no evidence of direct emissions to soil, as explained below. Also, please refer to references cited for additional, more detailed information.

In B.9.2.1 of Annex B, the Dossier makes the misleading statement:

> *"Information on emissions of PFASs to water, soil and air during production and processing activities was asked from stakeholders. Even though information was provided by some of the major producers and processors of PFASs present in the EEA, not all emissions were captured. For instance, emission to soil was not presented although the situation at 3M Zwijndrecht suggest that PFAS soil emission for PFAS manufacturing cannot be neglected."*

We would like to correct:
In most cases, the detection of compounds in soil (and groundwater) can be attributed to legacy operations prior to the widespread application (and in some cases availability) of treatment options to reduce emissions. Moreover, such compounds in soil occur through indirect emissions through waste discard or emissions to air, the latter have historically known to result in deposition onto soil.[36] Therefore, presence in soil is already accounted for by these emissions. In this context, it is also important to note that soil emissions do not occur out of a well maintained sewer system. In rare cases where incidents have occurred, they are remediated and pollution is kept within the boundaries of the industrial site. To provide a concrete example: At the Chemours Dordrecht Works in the Netherlands, we have significantly reduced emissions compared to 2018 (please also refer to the information provided under *1. Statements concerning the Chemours Dordrecht Works* above). Here, the occurrence of PFAS compounds in soil in the region is the result of past manufacturing with legacy PFAS compounds (PFOA).

[28] Provincie Zuid-Holland. (2022, October 31): *Publicatie revisievergunning Chemours* [Letter]. Retrieved from: https://pzh.notubiz.nl/document/11990703/1/Brief++gedeputeerdenZevenbergen+en+Stolk+Publicatie+revisievergunning+Chemours
DCMR milieudienst Rijnmond. (2022, April 1). *Ontwerpbeschikking* [Letter]. Retrieved from: http://dcmr.gisinternet.nl/downloads/pdf/55/99991208455.PDF
[29] Provincie Zuid-Holland. (2022, October 31): *Publicatie revisievergunning Chemours* [Letter]. Retrieved from: https://pzh.notubiz.nl/document/11990703/1/Brief++gedeputeerdenZevenbergen+en+Stolk+Publicatie+revisievergunning+Chemours
[30] DCMR milieudienst Rijnmond. (2022, April 1). *Ontwerpbeschikking* [Letter]. Retrieved from: http://dcmr.gisinternet.nl/downloads/pdf/55/99991208455.PDF
[31] Chemours. *Rapport eMJV Emissies 2018 – 2021.* (attached to this submission)
[32] Chemours (2023, March 20). *Chemours Dordrecht verwelkomt Drinkwaterbedrijf Evides Industriewater* [Presentation]. including indicative mass balance slide 18 and emission reduction slide 17 (attached to this submission).
[33] Chemours (2023, March 3). *Ministerie Infrastructuur & Waterstaat. Welkom bij Chemours* [Presentation]. see slides 12 to 14 on HFPO-DA emission reduction (attached to this submission).
[34] Inspectie Leefomgeving en Transport. (2018, June 26). *Afvalstromen van Chemours*. Retrieved from: https://www.ilent.nl/documenten/rapporten/2018/06/08/afvalstromen-van-chemours
[35] Inspectie Leefomgeving en Transport. (2018, June 26). *Afvalstromen van Chemours*. Retrieved from: https://www.ilent.nl/documenten/rapporten/2018/06/08/afvalstromen-van-chemours
[36] Schroeder et. al. (2021). PFAS soil and groundwater contamination via industrial airborne emission and land deposition in SW Vermont and Eastern New York State, USA. *Environmental Science: Processes & Impacts* 2, 291-301. https://doi.org/10.1039/D0EM00427H.

Conclusion

As demonstrated in this paper, fluorinated transported isolated intermediates, [redacted], and fluorinated polymerization aids are required in the manufacturing of fluoropolymers. We further outlined that the concept of strictly controlled conditions as defined under REACH Art 18(4) (a) – (f), providing strict emission control and abatement technologies, is adequate to effectively control and minimize any potential risks associated with these uses. In addition, we showed that performance aspects associated with the use of fluorinated chemistry, particularly fluorinated polymerization aids, in the manufacturing of fluoropolymers must be taken into account to design proportionate regulation.

Therefore, in summary, Chemours asks for:

- **an exemption for the use of transported isolated intermediates in the manufacture of fluoropolymers and fluoropolyethers under strictly controlled conditions**
- [redacted]
- **an exemption for the use of fluorinated processing aids in the manufacture of fluoropolymers. If a phase-out is eventually considered by the Scientific opinions to be a more appropriate measure, then Chemours urges ECHA to consider a derogation of at least 12 years with a review prior to its entry into force, which will be necessary to avoid disproportionate socio-economic impact.**