TOXICOLOGICAL AND ECOTOXICOLOGICAL INFORMATION OF PFAS AND FLUOROPOLYMERS – RESPONSE TO DOSSIER CLAIMS BY CHEMOURS APM

Introduction

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 respond to and correct certain misleading information/data regarding the toxicological and ecotoxicological information of PFAS, (particularly on fluoropolymers), which are currently presented in the Dossier/Annexes. We will argue that the hazard and risks of PFAS 'sub-groups' are demonstrably different from the hazard and risks of the PFASs used to develop and evidence the 'case-by-case' concern to such an extent that 'safe use' can be demonstrated for the subgroup, despite persistence. The grouping of the entire class of substances meeting the 2021 OECD PFAS definition is therefore not justified.

The papers referenced in the body of the text correlate to the papers referenced in the Annex B. Papers referenced in footnotes have not yet been considered by the dossier submitters.

Argumentation

General Comment

The Dossier uses the term 'PFAS' very broadly and without further specification. In addition to its technical definition, the OECD (2021) characterizes PFAS as follows:

> *"PFASs are a chemical class with diverse molecular structures (e.g. neutral, anionic, cationic or zwitterionic; with or without aromatic rings; non-polymers or polymers; low molecular weight or high molecular weight) and thus diverse physical, chemical and biological properties (e.g. involatile or volatile; water soluble or water insoluble; reactive vs. inert; bioaccumulative or non-bioaccumulative)."*

As the Dossier uses the technical OECD definition of PFAS to describe the substance class and repeatedly points at the diversity within the class throughout the Annex B, Chemours argues that, in accordance with the 2021 OECD guidance, *such diversity must be properly recognized and communicated in a clear, specific and descriptive manner* when addressing a specific (group of) PFAS to allow stakeholders to correctly and precisely respond to all aspects of the Dossier.

Concrete Corrections and Comments

1. **On Grouping**

In Annex B, B.1.2, the Dossier argues that due to the diversity within the PFAS class, 'general conclusions on the physicochemical properties of all PFASs are complicated or even impossible.'

- Chemours agrees with this observation, as it underlines the significant differences between individual (types of) PFAS substances. More than that, based on the fact that even basic properties significantly differ between individual substances, we challenge the proposed grouping approach as the blanket grouping of all PFAS may lead to overregulation and subsequent unintended negative socio-economic consequences.

In Annex B, B.1.3, the Dossier argues, in summary, that the physicochemical properties of PFAS, namely their persistence, in combination with their alleged environmental and toxicological effects justify the approach of grouping all PFAS substances together to regulate the entire susbtances group.

- Chemours argues that this approach is inconsistent with the Dossier's claim above (Annex B, B.1.2), namely that general conclusions on the physicochemical properties of all PFAS are complicated or even impossible. Fluoropolymers are a point in case to underline our argument: they are proven to be neither toxic nor carcinogenic[1] [2], they are not bio-accumulative, and they do not degrade into other PFAS. As such, the Dossier's justification for the regulatory approach of grouping all PFAS together lacks scientific evidence.

In Annex B, B.1.3, the Dossier sets out to justify the grouping approach (please also see above) and in this context makes reference to the California Safer Consumer Products Program as precedent: "It is noted that the first example of regulation of PFAS as a chemical class according to the P-sufficient approach has been introduced in California,U.S.A.. Here a regulation of PFAS as a class is in place for certain consumer products under the California Safer Consumer Products Program […]" (Annex B.1.3, p. 4).

- Chemours argues that in this context it is important to account for the fact that the California Safer Consumer Products Program applies only to a subset of PFAS in specific applications, rather than to the entire group of PFAS in every possible application. In fact, the California Safer Consumer Products Program restricts only uses of PFAS in a very limited number of consumer goods, such as juvinile products and food contact materials (FCM), whereas for bake- and cookware manufacturers are only required to list intentionally added PFAS on their website. [3]

In Annex B, B.4.2.9.2., the Dossier notes that PFAS vary in their ability to bioaccumulate depending on chain length and functional groups.

- Chemours agrees with this observation and further argues that the observation underlines the fact that properties of individual PFAS significantly differ from each other, and that it is necessary to account for these diverse sets of properties to create an effective regulatory framework that minimizes risks while providing room for continuous investments and innovation.

In Annex B, B.5.1.2, the Dossier aims to address toxicokinetics/ADME (Absorption, Distribution,Metabolism and Excretion) of 'polymeric PFAS', but simultaneously states that "only a few studies with toxicokinetic/ADME information are available for this diverse group of oligomeric/polymeric PFASs. No studies are available on toxicokinetics of polymeric PFAS. All available studies on toxicokinetics/ADME studied oligomeric PCTFE (PolyChloroTriFluoroEthylene) oils and/or pure oligomers. Under the REACH regulation, oligomers are not defined and do not fall under the polymer definition according to REACH (Article 5(3))", before it further argues "Because of the lack of data, it is not possible to conclude on ADME characteristics of oligomeric or polymeric PFASs. However, considering the few available toxicity

[1] Henry et al. (2018), A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers, Integrated Environmental Assessment and Management published by Wiley Periodicals, Inc. on behalf of Society of Environmental Toxicology & Chemistry (SETAC), Volume 14, Number 3, pp. 316-334.

[2] Korzeniowski, S.H., et al. (2022), A critical review of the application of polymer of low concern regulatory criteria to fluoropolymers II: Fluoroplastics and fluoroelastomers. Integr Environ Assess Manag.

[3] Deparment of Tocix Substance Control. (N/A). About Safer Consumer Products.

data (B.5.2.1) ADME characteristics that allow interactions with biota cannot be excluded for oligomeric/polymeric PFASs" (Annex B, p. 154/155).

- Chemours argues that the conclusion drawn here lacks scientific evidence, as data is only available for oligomers and does not account for effects of polymeric PFAS. For instance, fluoropolymers are characterized by having a long or very long chain lengths (tens- or hundreds of thousands Daltons), which clearly differentiates them and their properties from oligomers.

In conclusion, the hazard and risks of PFAS 'sub-groups' is demonstrably different from the hazard and risks of the PFAS used to develop and evidence the 'case-by-case' concern to such an extent that 'safe use' can be demonstrated for the subgroup, despite persistence, The grouping of the entire class of substances meeting the 2021 OECD PFAS definition is therefore not justified.

2. On epidemiology

In Annex B, B.5.3, the Dossier provides an epidemiological overview on PFAS. Chemours would like to make a number of statements and corrections relating to this section.

For the restriction dossier, evidence from epidemiology data was based on previously reviewed reports for PFAS [Agency for Toxic Substances and Disease Registry (ATSDR) Toxicology Profile for Perfluoroalkyls (ATSDR, 2021), and two opinions from the European Food Safety Authority (EFSA) on PFAS in 2018 and 2020 (EFSA 2018, 2020)] and additional literature search for papers published after July 2019 to August 2021. ECHA concluded that results from new studies strengthen the associations between PFAS and immune outcomes, liver toxicity and metabolic disruption, cardovascular disease, reproduction and development, neurodevelopment, and cancer risk. This conclusion is too general and inconsistent with the results reported by the studies' authors.

a. For vaccination response, ECHA concluded that new evidence from 3 additional studies supported the conclusion from ATSDR and EFSA. However, the results are inconsistent among these 3 studies: (i) Timmermann et al. (2021) reported **long chain** PFAS (PFOS and PFDA) were associated with lower measles antibody concentrations at 9-months among children received a measles vaccine in Guinea-Bissau; (ii) Shih et al. (2021) reported no associations between **long chain** PFAS (PFOS, PFOA, PFHxS, PFNA, PFDA) and lower diphtheria and tentanus antibody concentrations among a cohort from the Faroe Islands in a longitudial study; and (iii) Timmermann et al (2022) reported **long chain** PFAS (PFHxS and PFOS) were associated with lower diphtheria antibody levels in childen with known vaccination record in Greenland.
b. For asthma and allergies, results from additional studies did not affect the conclusion from EFSA that there are no or inconsistent associations between long chain PFASs and asthma in children and young adults.
c. For autoimmunity, ECHA identified no study on autoimmune disease and 6 additional studies on thyroid function and disease. Five out of these 6 studies are cross-sectional, NOT 4 as stated by ECHA. The study by Li et al. (2021d) is a cross-sectional, NOT a case-control study. ECHA stated that results from these studies were not consistent but concluded that new studies strengthen the concern of PFAS exposures and thyroid disease or changes in thyroid hormones, which is different from the conclusion from EFSA

that there is insufficient evidence for the associations between long chain PFAS and thyroid function.

d. For liver enzymes and liver disease, ECHA identified additional 2 prospective and 2 cross-sectional studies. ECHA concluded that results from new studies are in line with the findings in EFSA and strengthen the evidence for an association between exposure to **long chain** PFAS and increased levels of the liver enzymes, mainly ALT. The conclusion from ECHA is contradicted with the results from the 2 new prospective studies. The prospective study among mother-child pairs from Boston (Mora et al., 2018) reported that higher child PFOA and PFNA were associated with lower ALT, which is **an indication of better liver function**. Although the second prospective study suggested that in utero exposure to PFAS can contribute to liver injury in childhood, the study had several limitations: (i) liver injury risk was defined as having liver enzyme concentration above the 90th percentile of a relatively healthy children population of 6 European countries (e.g., ALT>= 22.7 IU/L) instead of liver biopsy. The normal range for ALT values vary widely in children and lack sensitivity to detect nonalcoholic fatty liver disease (NAFLD) (Molleston et al., 2013)[4]; (ii) maternal exposure was modelled as a mixture of **long chain** PFAS including PFOS, PFOA, PFNA, PFHxS, and PFUnDA which are highly correlated (max value for Spearman correlation coefficient = 0.70) resulting in multicollinearity issue in the regression yeilding unstable effect estimates.
e. For blood lipid, diabetes, obesity, metabolic syndrome, kidney function and uric acid, reproductive outcomes, and developmental outcomes, ECHA concluded that new studies are either in line or supportive with opinions from EFSA.
f. For cardiovascular disease and mortality, ECHA identified additional 9 studies (2 are prospective studies) and concluded that results from new studies strengthen for an association between PFASs and increased risk of cardiovascular diseases. However, results from the 2 prospective studies have limitations in generalizability, interpretation, and potential false positive results. The study by Cardenas et al. (2019) was conducted among participants who were overweight/obese with glycemic levels in prediabetes ranges, and enrolled in a diabetes prevention program. The results from this study is not generalizable to the larger general population. The authors reported that PFOS was associated with increased risk of microvascular disease prevalence among the intervention group (with lifestyle intervention consisted of diet, exercise, and behavior modification) but NOT among the medication placebo group. Interpretation for this study results is needed to be cautious because there is no clear biological plausible pathway for the reported associations. For the other longitudinal study by Li et al. (2021b), health outcome was represented as cardiometabolic risk score based on the assumption that each individual component has equal weights/contribution to the overall cardiometabolic risk. While the study has relative small to moderate sample size (n=186), the authors conducted close to 800 models (reported in both the main paper and supplemental material); therefore, multiple comparisons is of concern where the reported associations could occur by chance alone.
g. For cacinogenicity, ECHA identified 2 additional prospective studies and concluded that the results of these 2 studies strengthen the evidence for PFOA and multiple PFAS

[4] Molleston JP, Schwimmer JB, Yates KP, Murray KF, Cummings W, Lavine JE, Brunt EM, Scheimann AO, Unalp-Arida A, NASH clinical research network. 2014. Histologic Abnormalities in Children with Nonalcoholic Fatty Liver Disease and Normal or Mildly Elevated Alanine Aminotransferase Levels. J Pedatr; 164(4):707-713.

exposure are associated with renal cell carcinoma and kidney cancer. The conclusion from ECHA is contradicted with the authors of the large cancer incidence study among a Swedish cohort with high exposure to perfluoroalkyl substances in drinking water (Li et al., 2022a). The authors concluded that **no evidence** for an overall increased risk of cancer. Althought there is a moderate increased risk of kidney cancer and PFAS exposure dominated by PFOA in drinking water, all the hazard ratios included the value of 1, a null association. While the other prospective study reported an increased risk of renal cell carcinoma (Shearer et al., 2021) and PFOA, the study has several limitations: (i) the study result is not generalizable to a larger general population because the study population was consisted of predominately non-Hispanic whites (89%); (ii) exposure estimate was based on blood sample at a single point in time with unknown source which might not reflect long term exposure of the individual for developing cancer; and (iii) the study population had serum PFAS concentrations comparable with the US adults in NHANES; therefore potential residual confouding (dietry and lifestyle factors) might play a role since the same associations were not found among those with occupational or high environmental PFOA exposure (Vieira et al., 2013[5]; Steenland et al., 2012[6]; Barry et al., 2013[7]; Raleigh et al., 2014)[8].

h. For birth weight outcome, ECHA identified 7 additional studies, and concluded that new study results strengthen "the causal association between PFOS and PFOA and birth weight". This conclusion is contradicted with opinion from researchers of the C8 science panel (Steenland et al., 2018)[9] and others (Verner et al., 2015)[10]. Most of studies (including the new 7 studies identified here) on the associations between PFAS and birth weight were affected by the glomerular filtration rate (GFR), a major confounder which were not controlled for in most studies. The reported associations might be attributed to GFR or reverse causation.

Conclusions from previously reviewed reports for PFAS from ATSDR and EFSA are summarized below:

1. ATSDR (2021) concluded that available epidemiological studies **suggest associations** between **long chain** PFAS and several health outcomes; however, **the causal relationship has not been established** for these outcomes including: (i) pregnancy-induced hypertension/pre-clampsia (PFOA, PFOS); (ii) increases in serum hepatic

[5] Vieira VM, Hoffman K, Shin HM, Weinberg JM, Webster TF, Fletcher T. Perfluorooctanoic acid exposure and cancer outcomes in a contaminated community: a geographic analysis. Environ Health Perspect. 2013;121(3): 318–323.

[6] Steenland K, Woskie S. Cohort mortality study of workers exposed to per-fluorooctanoic acid. Am J Epidemiol. 2012;176(10):909–917.

[7] Barry V, Winquist A, Steenland K. Perfluorooctanoic acid (PFOA) exposures and incident cancers among adults living near a chemical plant. Environ Health Perspect. 2013;121(11-12):1313–1318.

[8] Raleigh KK, Alexander BH, Olsen GW, et al. Mortality and cancer incidence in ammonium perfluorooctanoate production workers. Occup Environ Med. 2014; 71(7):500–506.

[9] Steenland, K., Barry, V., Savitz, D., 2018. Serum perfluorooctanoic acid and birthweight: an updated meta-analysis with bias analysis. Epidemiology 29, 765–776.

[10] Verner, M.A., Loccisano, A.E., Morken, N.H., Yoon, M., Wu, H., McDougall, R., Maisonet, M., Marcus, M., Kishi, R., Miyashita, C., Chen, M.H., Hsieh, W.S., Andersen, M.E., Clewell 3rd, H.J., Longnecker, M.P., 2015. Associations of perfluoroalkyl substances (PFAS) with lower birth weight: an evaluation of potential confounding by glo-merular filtration rate using a physiologically based pharmacokinetic model (PBPK). Environ. Health Perspect. 123 (12), 1317–1324.

enzymes, particularly alanine aminotransferase (ALT), and decreases in serum bilirubin levels (PFOA, PFOS, PFHxS); (iii) increases total cholesterol and low-density lipoprotein (LDL) cholesterol (PFOA, PFOS, PFNA, PFDA); (iv) decreased antibody response to vaccines (PFOA, PFOS, PFHxS, PFDA); and (v) adverse effects on birth outcomes (small for gestational age and low birth weight) (PFOA, PFOS).

2. EFSA (2018, 2020) conducted exposure assessment of 17 PFAS (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeDa, PFBS, PFHxS, PFHpS, PFOS, PFDS, and FOSA). EFSA concluded that epidemiological studies provide clear evidence of **an association** between **long chain** PFAS (PFOS, PFOA) and: (i) increased serum levels of cholesterol; (ii) reduced antibody response to vaccination; (iii) "may well be a causal association between PFOS and PFOA and birth weight"; and (iv) and increased serum levels of the liver enzyme ALT. However, for ALT, the magnitude of the associations was small with few studies found associations with ALT outside the reference range, and there were no associations with liver disease. Associations between **long chain** PFAS (PFOA, PFOS) and other health outcomes are concluded as: (i) insufficient evidence for diabetes, obesity and metabolic syndrome; (ii) no association for fertility and reproductive outcomes in both males and females; (iii) insufficient evidence for neurodevelopment outcomes, growth in infancy or childhood, neurobehavioral, neuropsychiatric, cognitive or thyroid function; (iv) insufficient evidence for changes in kidney fuction or serum level of uric acid, and low bone mineral density or osteoporosis; and (v) insufficient support for carcinogenicity in humans.

In conclusion, the hazard and risks of PFAS 'sub-groups' is demonstrably different from the hazard and risks of the PFAS used to develop and evidence the 'case-by-case' concern to such an extent that 'safe use' can be demonstrated for the subgroup, despite persistence. The grouping of the entire class of substances meeting the 2021 PFAS OECD definition is therefore not justified.

3. <u>On Classification</u>

<u>In Annex B, B.3.1, Table B2</u> (starting page 8), the Dossier provides an overview of harmonized classifications.

- Chemours argues that the overview provided by the Table is misleading as the substances listed are generally not mutagenic, which allows for the assumption that the carcinogenicity is non-genotoxic. Non-genotoxic carcinogencity is frequently rodent-specific[11]. As such, the conclusion that certain substances are carcinogenic does not apply to all rodents and is even less valid when used to draw conclusions for human health.
- It is further noted that t the Table contains redundancies. The term 'PFOS' for instance is commonly used, not only to identify 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluorooctane-1-sulfonic acid, but also its salts (potassium, ammonium, lithium) and related substances (like PFOS diethanolamine). The same form of redundancies exist for PFOA, FPDA and PFNA.

<u>In Annex B, B.3.2 and table B.3</u>, the Dossier provides an overview of classification and self-classification of PFAS substances.

[11]Alden CL. Safety assessment for non-genotoxic rodent carcinogens: curves, low-dose extrapolations, and mecanisms in carcinogenesis. *Human & Experimental Toxicology*. 2000;19(10):557-560. doi:10.1191/096032700701546451; https://journals.sagepub.com/doi/10.1191/096032700701546451

- Chemours argues that this overview is misleading.
    - In accordance with our argumentation in the first bullet above under Annex B B.3.1, Table B2, the classifications for carcinogenic are almost entirely Cat 2. Moreover, except for approximately 9% of the substances, these classifications are based on non-genotoxic, potentially rodent specific mechanisms.
    - Also, classification as specific target organ toxicity following repeated exposure (STOT RE) is misrepresented, as in vitro toxicity studies are intentionally dosed at concentrations high enough to cause toxicity and have an impact on organs. Yet, in vivo settings such high doses do generally not occur. In fact, doses used in rodent studies are hundreds or thousands of times higher than the doses observed in humans (which are typically zero for most industrial chemicals). Hence, a classification of studies based on in vitro studies is misleading, as the presence of this apparent hazard does not indicate a risk to human health under naturally occurring conditions.

In Annex B, B.3.2, the Dossier Submitters argue, in summary, that multiple (self-)classifications for individual PFAS substances indicate that the fact "that several thousands of PFASdo not bear (self-)classifications for the endpoints of most concern (Carc., Muta., Repr., Lact. and/or STOT RE) does not mean that these PFAS do not have these properties, but most likely that study data are lacking for the majority of them to base classification on", and further argues that "the fact that the current list of PFAS with (self-)classifications already includes so many different PFAS categories suggests that PFAS currently without (self-)classifications may exhibit one or more similar properties of concern."

- Chemours argues that the conclusion that those (self-)classifications are the result of the properties of the PFAS listed is misleading. These (self-)classifications may also be the result of properties of relevant impurities. As such, the deduction that other PFAS "exhibit one or more similar properties of concern" is unsubstantiated. It is probable, that the lack of (self-)classifications are simply caused by the fact that the number of commercially relevant PFAS has shown to be in the hundreds, rather than several thousands.[12]

In conclusion, the dossier submitters do not account for interspecies differences in toxicological properties. Furthermore, the assessment, as the dossier submitters seem to imply, that the classification of many PFAS are missing, is not justified

4. Some observations on the toxicological information presented

In Annex B, B.5.2.1.5, the Dossier refers to studies on PFOS, PFHxS, PFNA, and PFOA to describe the effect of these substances on human health and potential immune effects, and then draws on animal studies to describe the immunotoxic effects for "a variety of different PFAS", including a "reduction of lymphoid organ weights" and "changes in lymphocyte counts or proliferation".

- Chemours argues that this section lacks a discussion of human relevance of these effects as it cannot be assumed that these effects observed in animals will be the same for humans. Moreover, the studies referred to potentially use significantly higher doses of the respective PFAS substances than they naturally occure.

In Annex B, B.5.5, the Dosier refers to animal studies and argues that many of the effects that PFAS have on animal health, such as damages and disfunctionalities on liver, thyroid hormone

[12] Buck et al. Identification and classification of commercially relevant per- and poly-fluoroalkyl substances (PFAS), Integrated Environmental Assessment and Management (2021)

system, and immune system, are similar for human health. It therefore concludes that such additive effects for human health resulting from the use of PFAS should be considered as realistic worst-case estimation.

- Chemours argues that there are significant differences between individual PFAS substances and their health profiles, and therefore this conclusion is too broad and lacks scientific evidence. Moreover, as noted above, a thorough, detailed, and scientific discussion is necessary to understand which effects on animal health are transferrable to human health, and if doses naturally occurring (in vivo) can cause such effects.

In Annex B, B.5 (introduction, p. 147), the Dossier, based on selected reviews, assessments, and experimental data presented, argues that exposure to PFAS can result in various health effects.

- Chemours argues that this statement is inconclusive and too vague to justify regulatory or legally binding action. In fact, in its vagueness the statement holds true for numerous, completely unrelated other groups of chemical substances. In other words, one can replace the word "PFAS" with "quaternary amines", "pesticides", "fungicides", "hydrocarbons" and still have a true statement. As such, the conclusion drawn from the reviews, assessments, and experimental data presented lacks scientific grounds.

In conclusion: the report in inconclusive and scientificly flawed as regards the demonstratebility of the human relevance of toxicological data. The dossier submitters fail to demonstrate that toxicological properties of some PFAS justify restricting all PFAS as a group.

5. On the uncertainty assessment

In the appendix to Annex F (p. 10), the Dossier makes the following statement: "*[…] applied ERCs for organic substances applied to a group of persistent substances might be too conservative and lead to emission underestimates in both article manufacturing phase, use phase and waste phase. This could for instance be caused by the fact that the ERC article/substance/mixture lifetime for organic substances is too short for persistent substances like PFAS."*

- The Dossier's reasoning is based on misleading assumptions and the estimate of emissions must be considered accurate for several reasons:
  - ERCs are conservative by default compared to measured data, resulting in higher release rates, not lower ones.
  - The ERC is based on contributing activities of uses, regardless of whether or not the substance is persistent. There is no evidence that the environmental release is underestimated because ERC was used for persistent substances.
  - To imply that all registered substances related to PFAS are persistent substances is not correct. Most of the substances registered by Chemours (F-gases) are gaseous at ambient temperature. Upon release to the environment, they disperse rapidly in the atmosphere where they react with hydroxyl radicals from the troposphere. Currently, there are no established persistence criteria for the air compartment, the most important compartment to which the substance would partition after emission under normal, foreseeable conditions of use. The physicochemical properties of these substances with low boiling point, high vapor pressure, high Henry's Law coefficient and low log Know indicate that these substances will not be absorbed to any significant extent in soils or sediments, will readily volatilize from water, soil and sewage treatment plants and therefore will not persist in aquatic or terrestrial compartments. According to Technical Guidance Document R.7.9.5.1, substances that are gaseous under ambient conditions can be expected to be removed from the aquatic

compartment by volatilization. Therefore, water, soil and sediment are not environmentally relevant compartments for these substances. As a result, these registered substances do not meet the persistent (or very persistent) criterion as specified in Annex XIII of Regulation (EC) No 1907/2006.

- By design of the REACH registration, total releases into the environment (air, water, soil) from all life cycle stages is assessed per year, regardless of whether the substance is persistent or not.

In conclusion, no evidence exists to back the claim by the dossier submitters that emissions are underestimated.

6. Additional comments

In Annex XV, 1.1.5.7, the Dossier states that "the ban of PFOS and PFOA has resulted in a transition to other PFAS, such as shorter chain PFAAs and PFAEs. For example, HFPO-DA is widely detected in the European environment, whereas 6:2 Cl-PFESA is found in high levels in China, but currently not in Europe (Heydebreck et al., 2015; Joerss et al., 2019; Pan et al., 2018). Besides these most studied PFAEs, studies have clearly shown the presence of other, sometimes even more abundant PFAEs in the vicinity of fluorochemical industries (Song et al., 2018; Strynar et al., 2015; Sun et al., 2016)."

- Chemours argues that partly due to continuously decreasing detection limits, HFPO-DA is indeed still found in Dutch waters. Yet, the figures presented by Heydebreck et al. (2015), for example, refer to measurements that were made before 2015 in a.o. the Netherlands. More recent measurement data for HFPO-DA from 2020 indicates that HFPO-DA is present in waters only in the range of 0.01-2.2 ng/l, and, compared to the numbers found by for instance Heydebreck et al., has thus significantly reduced over time.[13]

In conclusion: the presence of HFPO-DA in (Dutch) water is grossly overstated.

In Annex B, B.4.1.2.5, the Dossier claims that current concern over microplastics present in the oceans is also related to fluoropolymers, as microplastic PTFE has been found in biota and sediments, which led to the conclusion that there is sufficient evidence that that microplastic PFTA constitute an intrinsic hazard because of their long-term persistence in the environment in combination with their particulate form and potential to cause adverse effects.

- Chemours argues that this statement is too general and therefore misleading. Currently available information on fluoropolymers in microplastics in the environment is limited to the detection of PTFE microparticles in Mediterranean fish and remote Arctic Ocean sediment samples. Such PTFE microplastics represent only a very small fraction of all detected microplastics, according to a meta-analysis by Lohmann et al. (2020). In fact, from table 2 in the study from Bergmann et al. (2017), Chemours derives that only 0.01%-4.7% (all sampling stations) of all microplastics found in sediment are fluoropolymer microplastic particles. In addition, it is noted that, except for one sampling station (designated by Bergmann et al, (2017) as HG-IX), the relative presence of fluuoropolymers is less than 0.3 %. Another study by Capillo et al. (2020) looks at microplastic particles found in several demersal species in the Mediterranean. These species contained very little microplastics (depending on the species up to one

[13] Jonker, M.T.O. (April 2021). Poly- en perfluoralkylstoffen (PFAS) in de Rijkswateren. https://edepot.wur.nl/548355

microplastic particle per individual fish on average). Additionally, it should be noted that of the six microplastics identified, PTFE makes up 25%.

In conclusion, while PTFE microplastics have been identified in sediment. its relative presence is extremely low, compared to other types of microplastics.