GERMAN CHEMICAL SOCIETY

GDCh Comments on the PFAS Restriction Proposal of ECHA

Preamble

With about 30,000 members, the German Chemical Society (Gesellschaft Deutscher Chemiker, GDCh) is one of the largest chemical societies worldwide. It has 27 divisions as well as 60 local chapters and regional forums of the Young Chemists Forum. The GDCh promotes scientific work as well as the exchange and dissemination of new scientific findings. It supports the creation of networks, transdisciplinary and international cooperation and continuous education and training in school, university and profession.

In its own areas of competence, the GDCh sees itself as an advisory learned society that cultivates a scientific, transparent approach when addressing socially relevant problems with relevance to chemistry; diversity of opinion and differentiated presentation are strived for and the concerns of chemistry from industry and science are taken into account. The work of the GDCh is primarily to be understood as a service to society: The aim is to provide facts that take account of a complex set of circumstances. In this way, a rational basis for public debate is to be created, which enables knowledge-based conclusions to be drawn and can thus support the political discussion on values and societal priorities.

On 7 February 2023, the European Chemicals Agency (ECHA) published a proposal to regulate per- and polyfluoroalkyl substances (PFAS) which aims at a far-reaching restriction and, after the expiry of time-limited exemptions for certain applications, a complete ban of this group of substances comprising at least 10,000 chemicals.[1,2] The publication of the restriction proposal is the starting point of a political process that will lead to a decision on how the European Union will deal with PFAS.

Knowledge of the persistence and consequent accumulation of PFAS in the environment has triggered socio-political and regulatory discussions not only in the EU. In various countries and regions, legislative projects are in preparation with the aim of both preventing further accumulation in the ecosphere and in organisms and contributing to the reduction of already existing burdens. The GDCh recognises this problem in principle and invites a public, scientific dialogue and a differentiated discussion and conception of the further course of action.

---

[1] ECHA – Annex XV Restriction Report: https://echa.europa.eu/documents/10162/f605d4b5-7c17-7414-8823-b49b9fd43aea

[2] PFAS definition of the European Chemicals Agency (ECHA): any substance that contains at least one fully fluorinated methyl (-CF3) or methylene (-CF2-) carbon atom; with some specific exceptions.

Contributors: Representatives of GDCh divisions from industry and academia in the GDCh ThinkTank-PFAS (GDCh Working Group Fluorochemistry (AG F), GDCh Divisions Macromolecular Chemistry (MC), Analytical Chemistry (AC), Young Economic Chemists (JuWiChem) of the Association for Chemistry and Economics): Ruth Bieringer (MC, Freudenberg, Weinheim), Maik Finze (AG F, Univ. Würzburg), Thomas Früh (MC, Arlanxeo, Dormagen), Sebastian Hasenstab-Riedel (AG F, FU Berlin), Florian Kraus (AG F, Univ. Marburg), Björn Meermann (AC, Federal Office for Materials Research and Testing, Berlin), Joachim Simon (MC, Covestro, Leverkusen), Sophia Strachotta (JuWiChem, Porsche, Weissach), Patrick Théato (MC, KIT, Karlsruhe). Further members of the GDCh ThinkTank-PFAS are: Anja Feldmann (BASF, Ludwigshafen), Gerhard Karger (GDCh, Frankfurt), Dirk Menz (Pharmpur, Königsbrunn, member of the European Economic Senate), Hendrik Wagner (BASF, Ludwigshafen).

September 2023

GDCh Theses on the PFAS Restriction Proposal

1. Maintain Proportionality - Close Knowledge Gaps

We need to rethink chemistry if we want to meet global challenges such as climate change, energy transformation and feeding more and more people. Blanket restrictions of entire substance groups, such as the planned far-reaching PFAS restriction, which lack a scientific basis, are not conducive to achieving this goal.

The GDCh is concerned about the growing politicisation of scientific contexts and the levelling in the discussion of future-relevant technological issues. The principle of proportionality must apply especially in the natural sciences. However, we see this principle violated in the proposal to restrict PFAS.

We demand that knowledge gaps be closed, that the hazard potential be considered in a differentiated manner and that substances be evaluated strictly according to their chemical-physical, toxicological and ecotoxicological properties. In this way, PFAS can unfold their benefits where they are urgently needed, such as in transformation technologies, and cannot be replaced today.

A generally applicable definition is lacking, and this leads to great uncertainty in dealing with PFAS: A central question in the scientific discussion is whether PFAS are a class of materials to which uniform regulatory criteria can be applied. The molecular size and chemical structures of different PFAS vary greatly, which is why they have very different physical, chemical and ecotoxicological properties. There are gaseous, liquid and solid PFAS; some are water soluble, some are mobile or bioaccumulative, some are toxic, some are physiologically safe and biocompatible and almost all are persistent or degrade to persistent degradation products due to the extraordinary stability of the carbon-fluorine bond.

Over the past 70 years, the unique properties of PFAS have led to applications in almost all areas of industrial production and everyday life: from speciality lubricants to additives in cosmetics; from use in electronics and semiconductors to endoscopy and catheter tubing, from tank linings in the process industry to use in medicines and pesticides, from textile coatings to high-performance gaskets, from refrigerants for heat pumps and air conditioners to fire extinguishing agents and pan coatings.[3]

Because of their wide range of uses, PFAS can enter the environment in a number of ways: during the manufacturing process of the chemicals themselves, during their further processing, during the use of the finished products and during their disposal.

PFAS have different hazard potentials. In addition, the diverse uses result in different emission probabilities and thus different risks for humans and the environment. Hazardousness per se

[3] Glüge J. et al. 2020. An overview of the uses of per- and polyfluoroalkyl substances (PFAS). Environ. Sci.: Processes Impacts, 2020, 22, 2345-2373.

cannot be a restriction criterion, it is always about the risk to humans and the environment. Otherwise chemistry is not possible.[4]

2. Progress Means Taking Risks - We Have to Endure this Conflict of Goals.

The demands of our living environment must be reconciled with the protection of people and the environment. The scientific disciplines, including chemical sciences, must actively and publicly deal with this conflict of goals.

"Wash me, but don't make me wet": according to this principle, politics and society in many places call for technological solutions as a matter of course in order to meet the growing challenges of climate change, resource scarcity and environmental protection. At the same time, actors and decision-makers shy away from addressing the material foundations and innovation requirements of the necessary technologies. We must learn again to live with the conflict of goals that progress cannot be risk-free. It is the task of the sciences to evaluate and classify these risks. The freedom of research and development is a prerequisite for being able to fulfil this social mandate.

A holistic approach must be brought more into focus. We should remember the overriding goal of all regulation: To protect people and the environment. In our case, this means stopping the global input of persistent PFAS into the environment and replacing them wherever possible. At the same time, this includes maintaining and strengthening value chains and not shifting the problem to other regions of the world, true to the motto: if we don't do it, others will.

In the discussion on the use of PFAS and a possible broad ban, the conditions, incentives and framework conditions must also be created to accelerate research and development for possible safe and sustainable alternatives. For this, we need a willingness to change - among consumers as well as producers and researchers. And we need the willingness of political decision-makers to deal with uncomfortable scientific findings.

3. We Need Clear Research Mandates for Science and Industry.

Regulation must involve science at an early stage. Regulatory requirements must not be formulated in isolation from scientific research and development work on PFAS and PFAS substitutes for relevant fields of work. In the sense of a strong science location in Germany, scientists must at the same time keep socio-political change and the resulting regulatory proposals in mind and include them in their work.

A restriction must take into account both the current state of the art and the impact on other areas. Also indispensable are method developments for the detection of PFAS, process developments for the removal and treatment of PFAS and the safe and emission-free use of PFAS.

---

[4] According to Article 68 (1) of the EU chemicals legislation REACH, a restriction of chemicals is possible if there is an unacceptable risk to human health or the environment, arising from the manufacture, use or placing on the market.

Germany may claim a leadership role for itself in many chemistry disciplines with a rich tradition and diversity. We should bring this into a responsible dialogue. For a responsible handling of PFAS materials and, if necessary, materials with a high hazard potential that have not yet been discussed, research that is open to results is necessary. Their prioritisation results from the interplay of forces between structure, properties, application / performance and release potential. A meaningful prioritisation results from the interplay of the individual factors. Without verifiable emissions, the basis for a ban would no longer apply.

Even if it is the task of the legislator to involve relevant societal actors, it is also up to the scientific community itself to contribute validated scientific findings to the public dialogue. The controversy surrounding PFAS regulation shows that scientists need to move out of their comfort zone when it comes to the fundamentals and future viability of their subjects.

4. Basic Research and Innovation Ensure Future Viability

Regulation always brings with it the opportunity to innovate. However, the opposite is the case when unrealistic timelines are formulated. A legal restriction on PFAS must take into account a realistic state of the art, because innovations from chemistry need time. The development of safe and sustainable alternatives must also be promoted through incentives.

Basic research provides new insights into structure-property relationships and enables the development of new materials and active substances. In this context, fluorine chemistry is an important and vibrant field of research that should be brought to the attention of young scientists and explored in depth. Fluorine chemistry must therefore remain an integral part of basic academic research and chemistry education.

The substitution of PFAS - if possible - requires significant research and development work depending on the field of application. Realistic timelines need to be developed together with all stakeholders based on empirical knowledge. A broad ban without adequate substitutes can lead to disproportionate damage. One example is climate-neutral mobility: the use of PFAS is essential for current and future vehicle technologies, not least for batteries in electric vehicles. A scalable substitute does not exist today.

Where alternatives are already available, their use should be promoted. This also involves educating all stakeholders.

5. Closing Knowledge Gaps and Creating Solutions

The need for research on PFAS can be divided into three areas: In addition to the described substitute materials and alternatives, analytical methods must be developed, and recycling and waste management must be advanced. This can only be achieved through **the cooperation of all actors** - authorities, companies as well as research.

*5.1 Develop **new** analytical methods for the detection and quantification of PFAS in a timely manner.*

In order to assess potential PFAS hazards and effectively protect humans and the environment, these compounds must be detected, differentiated and quantified. Only then can regulatory authorities and environmental protection organisations monitor compliance with limits and bans and take appropriate measures to limit emissions. Against the background of the large number of PFAS compounds, suitable analytical methods are needed to measure the exposure of PFAS in different environmental compartments such as water, soil and air and to better understand potential risks.

As reliable, validated analytical methods are only available for a few PFAS so far, an expansion of the existing methods to further application areas and product categories, such as monitoring of packaging materials of food or complex electronic products, is necessary. In addition, the focus must also be placed on process monitoring in the future - e.g. in the area of waste incineration.

In general, a harmonised catalogue of methods for PFAS analysis is needed: this is the only way to make chemical analysis results comparable and to give small companies and private individuals access to reliable analytical procedures by specialised laboratories. Analytical methods should also be categorised and standardised in such a way that PFAS can not only be detected and quantified, but also assigned to groups with different properties: toxic compounds, environmentally toxic compounds, non-toxic compounds, persistent compounds.

Basically, a distinction is made between "target" analytical approaches and sum parameter methods - "target methods" aim at a small number of known compounds - sum parameter methods aim at carbon bound fluorine as a whole. Studies show that "target" substance lists must be expanded; the spectrum of PFAS has shifted in environmental compartments. Mass balances cannot usually be concluded on this. Therefore, complementary sum parameter methods are necessary - but since the PFAS spectrum is very broad, sample preparation strategies urgently need to be further optimised and standardised.

The pollutant entry from point sources can usually be detected well using "target" methods - however, the diffuse input of chemical substances as well as the input of a broad PFAS spectrum poses a great challenge to analytical chemistry and can only be detected using sum parameter methods. Sum parameter methods are well suited for "pre-screening" - if future limit values are exceeded, "target" screening should follow.

The currently discussed low limit values are difficult or impossible to detect and quantify with the available analytical methods, especially in complex matrices. In view of the risk potential of individual PFAS, a reassessment of the limit values and the method portfolio is absolutely necessary. Furthermore, limit values should always be set individually for individual PFAS on the basis of their risk potential for humans and the environment.

5.2 PFAS recycling is feasible.

Existing PFAS recycling technologies need to be further developed and new strategies devised - taking into account their potential environmental impact and economic viability. The possibilities of recycling PFAS depend strongly on the substance and the application.

The example of fluoropolymers (FP) demonstrates that recycling is possible in principle. In addition to ways of material recycling (mechanical recycling), processes for depolymerisation and thus chemical recycling (upcycling) of FP are currently being developed in pilot plants.[5,6] In comparison, about 9% of the annual plastic production of more than 460 million tons[7] is recycled today. Although the recycling of clean FP such as PTFE, FEP, PFA and PVDF waste generated during production is already possible today, the recycling of FP in consumer products still poses problems because they are typically contaminated by fillers and other substances.[8]

Various studies have shown on a small scale up to pilot scale that the ability to recycle FP back to their monomers and reuse them in (co-)polymerisations works. It therefore seems possible to establish a circular economy for fluorinated polymers as well.

Similar scenarios seem reasonable for e.g. fluorinated gases, which remain in their chemical structure and only require distillative purification steps.

Products containing PFAS for which material recycling is not technically or economically feasible must be sent to orderly waste incineration. Carbon-fluorine bonds can be completely mineralised to hydrogen fluoride (HF) under suitable conditions, so that no measurable emissions of PFAS to the environment occur.[9]

Specifically, medicinal products and PFAS-based medical devices should be prepared for disposal in such a way that they can be safely converted into harmless degradation products or landfillable materials using standard medical waste disposal processes. A prerequisite for this is, in particular, knowledge of their thermal behaviour or their reaction with aggregates during the usual disposal processes.

With regard to the development of a circular economy, it must be taken into account that very low PFAS limit values (possibly in the range of the natural background, which can only be measured with considerable effort) do not make the use of recycled raw material flows impossible from the outset. Therefore, limit values need to be established that on the one hand realistically reflect the risk potentials of the substance class, but on the other hand balance the risk of corresponding PFAS traces in recycled raw materials with the need for decarbonisation and circularity.

---

[5] Bruno Améduri, Fluoropolymers as Unique and Irreplaceable Materials: Challenges and Future Trends of These Specific Perfluoroalkyl Substances, 2023, doi:10.20944/preprints202309.0512.v1

[6] The overall recycling rate (including PTFE and FP recyclates) is currently 3.4 % (based on an annual FP production of 330,300 tons) Lohman, R.; Letcher, R.J.; The universe of fluorinated polymers and polymeric substances and potential environmental impacts and concerns. *Curr. Opinion Green Sustain. Chem.* 2023**,** *41*, 100795.

[7] Li, H.; Aguirre-Villegas, H.A.; Allen, R.D.; Bai, X.; Benson, C. H.; Beckham, G. T.; Bradshaw, L.S.; Brown, J.L.; Brown, R. C.; Cecon, V.S.; Curley, J.B.; Curtzwiler, G.W.; Dong, S.; Gaddameedi, S.; García, J.E.;Hermans, I.; Kim, M.S.; Ma, J.; Mark, L.O.; Mavrikakis, M.; Expanding plastics recycling technologies: chemical aspects, technology status and challenges; *Green Chem*. 2022, *24*, 8899-9002.

[8] Conversio, 2022: Fluorpolymer waste in Europe 2022 - End-of-life analysis of fluoropolymer applications, products and associated waste streams.

[9] Gehrmann, H.-J., 2023: Pilot-Scale Fluoropolymer Incineration Study: Thermal Treatment of a Mixture of Fluoropolymers under Representative European Municipal Waste Combustor Conditions.

Conclusion:

- **The present proposal for a comprehensive PFAS restriction seems disproportionate in the light of abatement options.**
- **Progress means taking risks - assessing them and defining measures to deal with them. We will continue to need hazardous substances for existing and new technologies. At the same time, this means replacing them wherever they are not essential.**
- **We need clear research mandates for science and industry.**
- **Basic research and innovation must be promoted to replace PFAS, prevent emissions and manage waste.**
- **To do this, we need to close knowledge gaps - through new analytical and recycling methods.**