

Comment on Proposed Restriction of PFAS

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Refrigerants are mainly divided into inorganic compounds, fluorochloroalkanes, saturated fluorohydrocarbons and unsaturated fluorohydrocarbons according to their composition. At present, the most widely used are fluorinated hydrocarbons, such as hydrofluoroalkanes and hydrofluoroolefins. The development of modern refrigeration technology is actually the development process of iterative update of refrigerants. With the development of social productive forces and the continuous improvement of people's living standards, refrigeration technology has an increasingly profound impact on the development of modern society, and has gradually become an indispensable part of social production and life. It is ubiquitous in fields such as household refrigerators, air conditioners, commercial refrigeration and preservation, as well as medical and scientific research.

We are committed to the production, sales and promotion of fluorine refrigerants and new environmentally friendly refrigerants. We are a scientific and technological innovation enterprise integrating research and development, product production and sales. The main products are R125, R134a, R32, R410 and other traditional refrigerants as well as new environmentally friendly refrigerants. Our products involve fields such as air conditioners, refrigerators, and automotive air conditioners. With advanced production technology, strict quality control, and a service philosophy of excellence, our refrigerant products have gained widespread recognition from domestic and foreign users. We will adhere to technological innovation, focus on the fields of new energy, new environmental protection, and new materials, and be committed to the research and development of green and environmentally friendly refrigerants. At the same time, we are actively involved in the compliance work to address global climate change, contributing to protecting the global ecological environment and promoting sustainable development.

We support and agree with the EU's plan to reduce the risk of hazardous substances, and we also express our sincere admiration for this ambitious goal. Any action plan that is committed to the sustainable development of human beings and the joint construction of a beautiful earth should be advocated and encouraged. As a refrigerant production and sales enterprise in China, we have put forward our own views and opinions on the PFAS restriction measures proposed by the European Union based on our own reality.

1. The definition of PFAS is too broad and overly simplistic

We believe that the proposed PFAS limitation of grouping all PFAS into one package is unacceptable, which includes approximately 10000 substances with significantly different molecular weights, physical, chemical, and biological properties. This grouping method is too broad. This grouping is only based on its

chemical structure, not on its hazardous properties or risks, and is not applicable for the purpose of regulatory risk. It goes against the provision in Article 68 (1) that "restrictions can only be imposed when a substance poses an unacceptable risk to human health or the environment". Many of the more than 10000 substances have not been assessed for risk and have not been proved to have unacceptable risks. It can be clearly seen from the description on page 28 that **"Yet in conclusion, considering the increasing lines of evidence from modelling, laboratory and monitoring studies, there is a justified concern for a subset of PFASs being bioaccumulative while large uncertainties remain for the majority of compounds due to lack of data."**

Also, for biological toxicity, on page 47, **"Due to the high diversity of the PFASs the bioaccumulation potential and ecotoxicity/toxicity are expected to vary among the substances. Therefore, no overall conclusion on B/vB and T criteria was derived for each PFAS substance/(sub-)group (see also sections 1.1.4.6 and 1.1.4.7)".** We can see that the toxicity of different PFAS is also uncertain.

2. Overlapping with the restrictions on fluorinated refrigerants in the EU F-Gas Act, conflicting in concepts

For the currently widely used fluorine-containing refrigerants (HFCs, HFOs), most of which are fluorine-containing gases, we believe that the PFAS restriction measures proposed by the EU have overlapped with the EU F-gas regulations that took effect in 2006. From a dual regulatory perspective, we believe that fluorinated gases are more suitable for the F-gas regulation and should not be included in the PFAS restriction measures. In order to ensure the smooth implementation of the Kigali Amendment to the Montreal Protocol, the European Commission announced a new F-gas regulatory proposal in April 2022, which plans to carry out more strict control on hydrofluorocarbons (HFCs). In March 2023, the European Parliament adopted a decision on amending the EU F-Gas Act, which aims to better achieve the full phase-out of HFCs by 2050, raising the Montreal Protocol Kigali Amendment's target of an 80-85% phase-out between 2036 and 2047 to a higher level. As we all know, HFCs, as a third-generation refrigerant, is a substitute for ODS. Although it has no ozone layer destruction effect itself, HFCs is a greenhouse gas with a high GWP value. After the adoption of the Kigali Amendment, the Montreal Protocol opened a new chapter in the coordinated response to ozone layer depletion and climate warming. We believe that this step-by-step reduction and differentiated reduction in different regions with different levels of economic development are more in line with the historical process of refrigerant development and the objective laws of things' development. We believe that the inclusion of fluorinated gases in the PFAS restriction measures proposed by the alliance is unnecessary and not objective. Mainly based on the following two points to illustrate.

i □ The exemption time is too short. The development of refrigerants originated in the 1930s. It took about 200 years from the first generation of natural refrigerants with low safety such as NH₃ and CO₂ to the second generation of chlorofluorocarbons (CFCs) and hydrofluorocarbons (HCFCs), to the third generation of hydrofluorocarbons (HFCs) that are still widely used, and the fourth generation of

refrigerants Hydrofluoroolefin (HFOs) that are being developed and promoted. In order to protect the ozone layer, the international community took active action, concluding the Vienna Convention for the Protection of the Ozone Layer in 1985 and the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987, which set a deadline for the restriction and replacement of CFCs substances. In order to strengthen the control of non-carbon dioxide greenhouse gases such as hydrofluoroalkanes (HFCs), the international community adopted the Kigali Amendment in 2016. The Chinese government also attaches great importance to the protection of ozone compliance work, solidly carries out compliance governance actions, and has achieved positive results. As the largest developing country, despite facing many difficulties, China still firmly joined the Kigali Amendment, making new contributions to the protection of the global ozone layer and the response to climate change. It is no exaggeration to say that refrigerant manufacturers are firm practitioners of green, environmentally friendly, and sustainable development. We feel deeply about this, from the initial mass production of R22, to the gradual popularization of R32, and then to the wide application of R134a and R125, corresponding to the continuous updating and replacement of production processes, devices and supporting facilities. In a sense, the development of refrigerants contains the development process from scratch, from imperfect to gradually perfect. The requirements of environmental sustainable development promote the research and update of refrigerants, while the replacement of refrigerants promotes the sustainable development of the environment, which is complementary to each other and spiraling organic whole. If we follow the PFAS restriction measures proposed by the European Union, the transitional period of the bill is only 18 months (1.5 years), and even if an extended exemption can be obtained, it will only be 5 or 12 years. We believe that this is likely to be far from enough, and it does not fully consider the historical facts of the development of the aforementioned refrigerants, and it is also contrary to the refrigerant-related development concepts and implementation methods agreed by the international community under UNFCCC.

As a typical representative of the fourth generation of refrigerants, Hydrofluoroolefin (HFOs), such as HFO-1234yf, CAS No. 754-12-1, have no ozone layer destruction, GWP is 4, low toxicity, good flammability, stability and compatibility. Mainly led by developed countries and industry giants, its research and development work reached its peak in 2010 and has been approved and promoted for use in the automotive markets of developed countries such as Europe, the United States, and Japan. The preparation process of the fourth generation refrigerant fluoroolefins (HFOs) is complex and has high production costs. To achieve comprehensive substitution and popularization, it still requires a long-term process. We believe that in such a historical context, if according to the PFAS restrictions proposed by the European Union, even under the premise of obtaining exemptions, it will be very challenging to find suitable non-PFAS alternative refrigerants, and complete the development, production and promotion of popularization.

ii□ Absoluteness and no difference in the way of implementation. As mentioned above, the restrictions and reductions of HCFCs, CFCs and HFCs under the Montreal

Protocol are implemented differently according to the differences in economic development levels in different regions of the world. For example, reduction schedules and specific substance control lists have been formulated for developing and developed countries, and they are constantly adjusted and updated in the implementation process. The PFAS restrictive measures proposed by the European Union do not have such differentiated implementation measures, which clearly does not take into account the economic and regional differences that may arise during the actual implementation of PFAS restrictive measures. We believe that this lacks the prior conditions for actual implementation.

3. Degradation of fluorine containing gases and low temperature mineralization of trifluoroacetic acid (TFA)

The fluorine containing gases related to the refrigerant, fluoro-alkanes (HFCs) and fluoro-alkenes (HFOs), are degraded to produce trifluoroacetic acid (TFA) by combining with hydroxyl radical (OH) under ultraviolet irradiation in the atmosphere. The fluorinated gas itself is not the persistent substance proposed in the PFAS restriction case, but merely a precursor to TFA.

On page 1 of the proposed restriction plan, it is mentioned that “When these substances and their degradation products continue to be released to the environment, the concentration in the environment will increase as mineralization under natural conditions does not take place for the PFASs in the scope of this restriction proposal. Once present in the environment, the removal of PFASs from surface water, groundwater, soil, sediment and biota is technically extremely difficult and very costly, if at all possible.”

But through the report of Reference 1, it is mentioned that TFA is formed as an acid in the atmosphere, and when it reaches the surface (soil or water), low-temperature mineralization with alkali metals (such as sodium, potassium, calcium, etc.) can occur to form salts. TFA salts lack reactivity and are relatively persistent in the environment, with an estimated half-life ranging from hundreds to thousands of years. Therefore, fluorinated gases as TFA precursors should not be included in PFAS. Meanwhile, through reference 1, we can learn that PFCAs can be mineralized at low temperatures to generate corresponding salts, which can be extended from PFCAs to other perfluorinated and polyfluoroalkyl substances. The degradation rate is fast, and the reaction conditions are mild, providing a new pathway for the degradation of perfluorinated or polyfluoroalkyl substances. Through reference 2, we can gain a deeper understanding of the thermal decomposition mechanisms of perfluoroalkyl ether carboxylic acids and short chain perfluoroalkyl carboxylic acids, and obtain new pathways for the thermal degradation of perfluoroalkyl substances.

TFA salts do not react with biomolecules, so this persistence is not important. TFA and its salt are easy to be excreted by animals, and no Bioaccumulation occurs in the food chain. It has the characteristics of low toxicity of animals and plants, so the risk is very small. The reports submitted by the German and Norwegian environmental agencies demonstrate that TFA poses low toxicity to organisms and humans, as detailed in References 3 and 4.

In summary, we believe that fluorinated gases should not be regulated like PFOA and PFOS, and PFAS regulations should not include them.

4. Application for refrigerants exemption from REACH PFAS control

We sincerely propose the above views and suggestions regarding the PFAS limitation measures proposed by the European Union, all of which are based on the actual production situation in the industry. We apply for refrigerants exemption from REACH PFAS control, and the relevant refrigerant information is shown in the table below.

Related refrigerants

Classification	Refrigerant	Name	CAS Number	Chemical formula
HFCs	HFC-134a	1,1,1,2-tetrafluoroethane	811-97-2	CF ₃ CH ₂ F
	HFC-125	1,1,1,2,2-pentafluoroethane	354-33-6	CF ₃ CHF ₂
	HFC-143a	1,1,1-trifluoroethane	420-46-2	CF ₃ CH ₃
HFOs	HFO-1234yf	2,3,3,3-tetrafluoropropene	754-12-1	CF ₃ CF=CH ₂
	HFO-1234ze	1,3,3,3-tetrafluoropropene	29118-25-0	CF ₃ CH=CHF
	HCFO-1233zd	1-Chloro-3,3,3-trifluoropropene	460-71-9	CF ₃ CH=CClH

Reference

1. Trang B, Li Y, Xue X S, et al. Low-temperature mineralization of perfluorocarboxylic acids[J]. Science, 2022, 377(6608): 839-845.
2. Alinezhad A, Shao H, Litvanova K, et al. Mechanistic Investigations of Thermal Decomposition of Perfluoroalkyl Ether Carboxylic Acids and Short-Chain Perfluoroalkyl Carboxylic Acids[J]. Environmental Science & Technology, 2023.
3. German Environment Agency, Reduce chemical input to water - trifluoroacetate (TFA) as a

persistent and mobile substance from multiple sources, 2021.

4. Norwegian Environment Agency, Research on the Environmental and Health Effects of HFO Refrigerant, 2017.