PFAS-based materials used in EUROFLUOR industrial sites

Contents

Introduction

With this report, EUROFLUOR, Sector Group of Cefic, supports the request by Cefic for a full exemption for PFAS use related to industrial equipment, and we hereby provide some information and data specific to our industry branch.

The industry represented by EUROFLUOR makes use of PFAS in its industrial facilities mainly to ensure safety in the production, handling, storage and transport of Anhydrous Hydrofluoric Acid (AHF) and Hydrofluoric Acid (HF). Indeed, as described in this report, PFAS are the only currently available material having the needed resistance against the corrosive properties of AHF /HF: no other material known to date shows the same or similar resistance against AHF / HF.

This report is based on data gathered by EUROFLUOR members and it aims to show where and why PFAS-based materials are used in EUROFLUOR industrial sites.

EUROFLUOR Industry Characteristics

EUROFLUOR and its industry

EUROFLUOR is a sector group of Cefic, the European Chemical Industry Council.

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EUROFLUOR is the Association representing the major producers and users of Hydrogen Fluoride and fluoride chemicals (such as Aluminium Fluoride) in Europe. It currently counts 13 members, producing and using AHF/HF in their facilities[1].

Hydrogen Fluoride

Hydrogen fluoride, better known as hydrofluoric acid, is one of the basic raw materials for a wide variety of industrial and commercial products. It is produced by reacting a naturally occurring mineral, fluorspar, with sulphuric acid.

Anhydrous Hydrofluoric Acid (AHF) represents a concentration of 100%, normally considered at technical grade (min. 99.95%), and the diluted Hydrofluoric Acid (HF) represents all concentrations below that threshold.

AHF / HF is a strong corrosive acid which must be handled with extreme caution. Safety is therefore the primary concern of both producers and users. Indeed, since years, the industry is engaged in ensuring enhanced safety in its facilities and surrounding environment.

Hydrofluoric acid is mainly used for non-metal-surface treatment products, metal surface treatment products, washing and cleaning products, extraction agents and pH regulators, and water treatment products. It is therefore used in petroleum refining and glass treatment, in the metallurgic industry (particularly aluminium production), in the production of electronics (including semi-conductors), pharmaceuticals and agrochemicals, as well as chemical feedstock for fluorocarbons.

More on the substance is documented in ECHA website[2], including the registration dossier under REACH.

Hydrofluoric acid, when entering in contact with other materials, shows different reactions at different concentration levels. Depending on the concentration, it attacks and corrodes different materials, and the only ones which are resistant to AHF / HF are PFAS. For instance, steel can be used as construction material when AHF (or >73 % HF) is involved, even if PFAS materials show a longer resistance; however, for lower concentrations, steel's corrosion rate is rapidly accelerating, so that only PFAS materials provide sufficient resistance. In addition, in case of high purity applications steel is also not an option.

EUROFLUOR analysis of the proposed PFAS restriction proposal

Data collection: methodology

To better understand where, how and why EUROFLUOR industries use PFAS-materials in their processes, during Summer 2023 EUROFLUOR distributed to its members a questionnaire to gather the needed data. The questionnaire was developed with the support of IASP – Industrial Advisory Service Peguera UG, an external consultant.

The questionnaire was structured to identify the specific uses in EUROFLUOR industrial sites:

- Area of the plant (e.g., reactor, kiln, lab etc.)
- Activity in the area of the plant (e.g., piping, connectors etc.)
- Type of PFAS-material (e.g. gaskets, o-rings, pipecoating etc.)
- Specific PFAS-material
- Frequency of replacement

[1] More information on our web-page Eurofluor Members - Eurofluor.
[2] https://echa.europa.eu/de/substance-information/-/substanceinfo/100.028.759

- Properties of PFAS needed for this use
- Information on available existing alternative (if any)
- Information on why existing alternatives are not used (if any)
- Information on under-development alternatives (if any known)
- Known safety impact in case of no derogation for PFAS-materials

We received feedback from 6 out of 13 companies, covering 7 plants, out of which 5 producing hydrofluoric acid and 2 using it in their production processes. Therefore, this report does not contain data from of all the industries represented by EUROFLUOR, but gives an overview of what we know about the situation as it emerged from the survey.

The replies were analysed by the consultant and compiled all together, not differentiating between producers of AHF/HF and users: the safety concerns impact both producers and users.

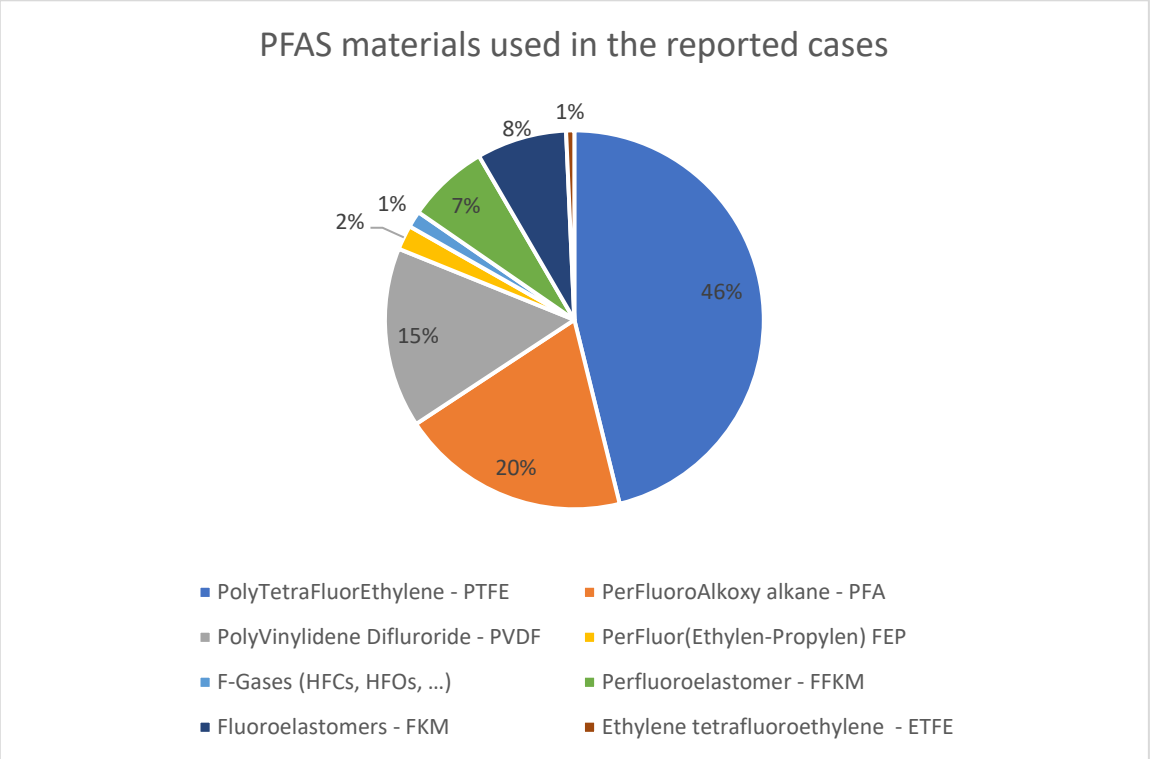
The findings are reported below.

Findings

a. PFAS materials used

From the survey it emerged that the PFAS used by EUROFLUOR members, for ensuring safety, are:

- PolyTetraFluorEthylene - PTFE
- PerFluoroAlkoxy alkane - PFA
- PolyVinylidene Difluroride - PVDF
- Perfluoroelastomer - FFKM
- Fluoroelastomers - FKM
- PerFluor(Ethylen-Propylen) - FEP
- F-Gases (e.g., R32, R 410A, R 1234…)
- Ethylene tetrafluoroethylene - ETFE



b. Application of PFAS within the plants

From the data collected, it emerged that PFAS are used in most of the parts of the plants (reactor, kiln, storage, centrifuge, loading/unloading, laboratory etc.), to ensure safety.

The abovementioned PFAS are used for the following equipment:

- PPE (Personal Protective Equipment)
- Gaskets
- O-rings
- Pall rings
- Valves
- Membranes
- Diaphragms
- Coating
- Lining
- Internals
- Pipes
- Columns
- Flexile hoses and other flexible elements
- Filters
- Sealants
- Tanks and other containers
- Heat exchangers
- Laboratory equipment (e.g. bottles for samples, vessels, syringes, valves etc.)
- Compensators
- Process refrigeration for the whole plant

The above-mentioned PFAS are the only materials which proved to be resistant against the corrosive properties of AHF/HF at different concentrations. Chemical resistance, and namely the resistance against the different concentrations of AHF / HF, is the main property of PFAS-materials for which they are used in EUROFLUOR plants to ensure a safe production, handling, storage and transport of the acid.

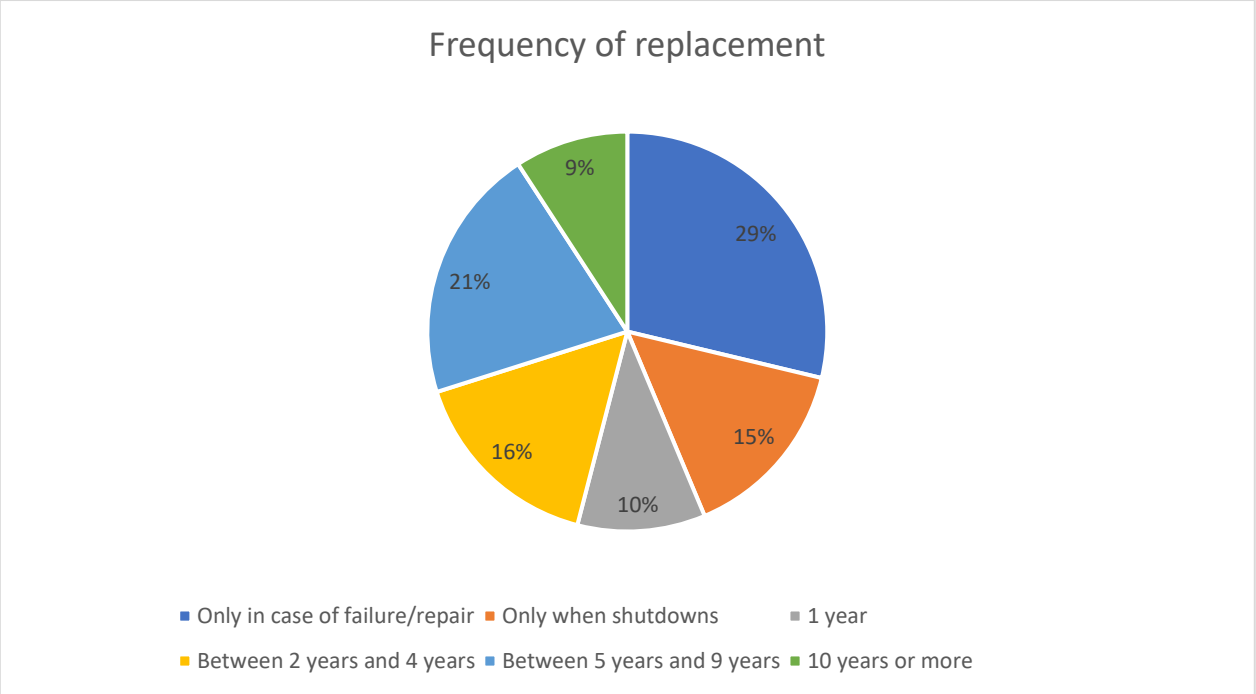
For instance, PFAS-materials are needed in the different PPE to be used in facilities where AHF/HF is produced, handled, stored, transported, in order to ensure the adequate safety levels for workers. This applies not only to PPE Risk Category III (as per Regulation EU 2016/425), but to all PPE risk categories as soon as AHF/HF is involved.

Combined with chemical resistance, also thermal resistance is a property largely sought by the industry and guaranteed by PFAS.

c. Frequency of replacement of PFAS materials

The frequency of replacement depends on several aspects such as the complexity of the product portfolio, the specificities of the use of PFAS and the amount of AHF / HF to be produced or handled.

Replacement is in most cases reported to be needed only in case of failure/repair. The most occurrent frequency in the reported cases is in between 5 and 9 years, as showed in the chart below (21% or reported cases).



d. Available alternatives

Today, for most cases there is no other material available or known, showing the same resistance against AHF/HF, the same resistance to high temperatures, and the same lifespan as the above mentioned PFAS.

There are some materials that show some resistance against AHF / HF, but they are not mechanically easy to handle. In most cases, these materials cannot be used as the danger of a breakthrough or leakage is too high. Two examples are Carbon and Silicon Carbide. The first could be used as a lining, but it is very susceptible to fracture; furthermore, there are no suitable seals for this material to connect different parts. The second could be used as construction material (e.g. for heat exchangers), but, again, it is highly susceptible to fracture. Therefore, in both cases their use would not always guarantee the needed safety levels.

The only reported case where an alternative to PFAS could be available is for a specific gas treatment facility, where it could be possible to use Alloy 59 for the Quencher (tank). The downside of it is the costs, much higher than PFAS. Also, no data was reported on the lifespan of such an alloy when used in constant contact with AHF/HF.

Due to the strength of the carbon fluorine bond, PFAS-materials show unique properties in terms of chemical, mechanical and thermal resistance, unlike any other known material. From a pure scientific point of view no equal alternative is to be expected in the near future.

The industry is constantly working to increase plant safety. To achieve this, EUROFLUOR members are in constant contact with suppliers of materials aimed at all the uses above-mentioned. At present, no information has reached the industry indicating the development and availability of improved materials without PFAS.

Conclusions

The loss of the PFAS-based materials would increase the risk of leakage and the resulting release of hazardous substances, which the industry is already successfully handling.

Equivalent substitute materials are currently not available. Some materials that show some resistance against AHF / HF have been identified but many pose danger of a breakthrough and would have to be replaced very often due to their lower chemical resistance, so that a continuous production or handling of AHF / HF would not be possible. Due to the additional economic effort and the significant loss of plant safety, production would most likely have to be stopped.