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Factsheet/Case Study "PFAS in Electrical Installation Systems”

Product(s):

- Electrical installation systems with products made of:
  - Polycarbonate with partly safety-relevant flame-retardant properties or as an additive in polymer production and chemical synthesis
  - Abrasion-resistant, permanently slippery or chemically resistant surfaces to maintain the technical properties (e.g. safety-relevant components for protection against electric shock) and service life of equipment components e.g. switching elements, sliding pairs
  - Printed circuit boards with flame retardant and durable surface protection (protective lacquer)
  - Insulation in electronic components and circuits to achieve the dielectric strength and tracking resistance required by safety and standards in combination with higher temperature resistance.
  - Durable, weather-resistant seals and surfaces
  - Electrical installation tubes for high-temperature protection in plant and machine construction
  - Various currently unknown PFAS applications in all stages of the manufacturing process
  - Based on current knowledge, almost all EIS products may be affected
  - Greases and lubricants in safety-relevant components for protection against electric shock.

- Function:
  - Electrotechnical products are indispensable for building technology (switches, sockets, protective switchgear), for energy-efficient building automation (actuators, sensors, smart home), for decentralized power generation, for storage systems, for energy management systems, and in plant and mechanical engineering for protecting cables and electrical connections at high temperatures.
  - Protection devices make an important contribution to the security of supply of electrical systems.

- Typical customer sectors:
  - Every owner, tenant, etc. of residential and commercial properties
  - Every user of a building
  - Particularly vulnerable groups of people (children, people with disabilities)
  - Industry to produce machinery and industrial equipment.

Market Information:

An estimation of PFAS-related turnover and jobs is currently not possible as actual use of currently non-regulated or notifiable PFAS substances (REACH, POP, etc.) is not known to the full extent across the entire supply chain, e.g. for PTFE and its derivatives. PFOA and PFOS, on the other hand, are already regulated under POP.
Negative indirect or direct effects on international competitiveness very likely. However, quantification not possible at present for reasons mentioned.

- Further information:
  - Durability, weathering resistance (e.g. UV resistance), normative specifications such as temperature resistance.
  - Electrical safety of installation systems
  - Worldwide purchasing of raw materials and individual parts (e.g. electronic components)
  - Disposal of these products is typically done commercially and is regulated by various European and German regulations and laws. Disposal in residual waste is not permitted.

- Linkage to policy/strategic objectives in the EU?
  - PFAS restriction projects partly conflict with EU initiatives for sustainable products, e.g. due to the lack of equivalent substitutes for the shelf life of the products or technical solutions for improving the environmental performance.

Requirements Profile

- Lifetime
  - Use of many products for more than 30 years

- Development times
  - Between 3- and 8-years including approval procedures and certifications

- Required availability time of spare parts?
  - According to EU specification min. 7 years
  - If relevant for product group/assembly more than 10 years

- Temperature resistance
  - Normal operation (at ambient temperature): - 40°C to approx. 200°C
  - Depending on intended and normative specification between 650 and 850°C (no continuous operating temperature)

- Dielectric strength
  - Up to 6000 V

- Flame retardancy
  - Up to V-0 e.g. for fire protection envelopes according to IEC EN 62368-1

- Standards, certification/approvals, market/customer requirements
  - U.a. nach Normen der Reihen: VDE 0620, EN 50491, IEC EN 60309, IEC EN 60669, EN 60670, IEC 60884, IEC 60898, IEC 60947, IEC 61008, IEC 61009, IEC 61439, IEC EN 61643, IEC EN 62368, IEC 62606; DIN EN IEC 63000, UL 94, IEEE 323, IEEE 344, ASTM E 162, ASTM E 662, EN 45545:2020, DIN EN ISO 1043-4/A1, DIN EN ISO 1043-4/A1, DIN EN 60216-1, UL 746 B, DIN 51900-2, ASTM E 1354, ASTM E 1354a, DIN EN 60068-2, EN 50125-1, DIN EN 60695

Identified PFAS Uses

Im fertigen Produkt

1. Name/Description of the use1 - Electrical insulating parts, switch parts for high voltage, wire and cable insulations - Plastics with high sliding properties and high chemical resistance - Chemically resistant surfaces (coating) - Insulating materials with high temperature resistance and flame retardancy - Thermowells for high temperature applications - - Industrial enclosures	Application - In the finished product - In machines and equipment and for production
PFAS substance/substance group:	**PTFE, PFA, ETFE**
Reason for PFAS Use/ Requirements Profile:	Electrical insulation, sliding property, temperature resistance, flame retardancy and the combination of these properties.

2. Name/Description of the use 2 Flame retardant additive in polycarbonates	Application - In the finished product
PFAS substance/substance group:	**PFNO**
Reason for PFAS Use/ Requirements Profile:	Temperature resistance, flame retardancy and the combination of these properties.

3. Name/Description of the use 3 - Weatherproof surfaces and foils - Tool surface protection	Application - In the process - In machines and equipment for production
PFAS substance/substance group:	**PVF**
Reason for PFAS Use/ Requirements Profile: •	

4. Name/Description of the use 3 - Production of microphones, loudspeakers and actuators - Semiconductor production - Separators in Li-ion batteries - Seals	Application - In the finished product - In machines and equipment for production
PFAS substance/substance group:	**PVDF**

5. Name/Description of the use 3 - Heat- and cold-resistant thermoplastic material - Sliding elements even in thermal-technical limit ranges	Application - In machines and equipment for production
PFAS substance/substance group:	**PCTFE**

6. Name/Description of the use 3 - Heat resistance and flame retardancy - Gas tight and flexible - Chemical resistant - High durability	Application - In spark gaps for sealing the electric arc space
PFAS substance/substance group:	**FKM**
Reason for PFAS Use/ Requirements Profile:	Seals

⇆Substitution

For specific applications / combination of applications, there are no alternative materials today that are not made of fluoropolymers, as these materials must be used under harsh operating conditions. While the search for suitable alternatives is challenging, their evaluation is straightforward as the limits of the basic material properties are often exceeded. In many cases, it is sufficient to look up material property data in standard references to determine suitability. When looking for alternatives, other fluoropolymers often come up as the best secondary and tertiary choice. For example, PCTFE is a good substitute material for PTFE and vice versa.

Several classes of materials were considered as potential alternatives for fluoropolymers, although none emerged as direct replacements. These materials were identified and evaluated using a combination of available data, publications, and extensive discussions with materials experts and consulted professionals in the general materials industry.

Non-PFFAS elastomers
Conventional elastomers such as ethylene propylene diene monomer (EPDM), hydrogenated nitrile butadiene (H-NBR), and silicone were considered as alternatives for seals but were deemed unsuitable due to their inferior chemical resistance, temperature limits, and mechanical properties. Most elastomers cannot be used at operating conditions above 150 °C. Silicone has higher temperature resistance but is inferior in terms of

mechanical properties and is also not recommended for high friction and high wear applications. The use of materials that are not suitable for the operating conditions is not recommended and would require an unrealistic number of maintenance cycles at the minimum and at best. In addition, worker and environmental safety could be compromised by an increased likelihood of failure and possible release of hazardous materials.

All the potential alternatives, metals, non-PFAS polymers, and non-PFAS elastomers, are high-performance materials that are likely to be similarly durable to fluoropolymers, resulting in the replacement of a durable material with a lower-performing one, which in turn results in an increased number of maintenance cycles and generates greater amounts of environmental waste.

Safe Use: Prevention and Reduction of Emissions and Exposure

The exact emissions of fluoropolymers are more difficult to evaluate because they occur at the end of a lifetime of more than 15 years. Both the benefits and impacts must be considered. On the positive side, fluoropolymer valve packing prevents emissions to the environment because it has higher sealing efficiency compared to competing materials. On the negative side, negligible and non-toxic emissions can be released throughout the life cycle of the fluoropolymer product. Despite the relatively low emissions in the sector, there are other mitigating factors that reduce the concern about emissions even more. The useful life of equipment and components is very long, often exceeding 15 years. This contrasts with single-use and/or limited-life consumer goods, which reach their end-of-life sooner. Due to the closed loop and sealed structure of equipment, the risk of environmental or human exposure during the use phase can be largely eliminated. In fact, equipment operators are unlikely to encounter the fluoropolymers in the system because the fluoropolymers are used in discrete, solid plastic parts that are embedded or lined in the components of the final products.

It is expected that the PFAS emission concerns associated with fluoropolymer manufacturing can be addressed and managed within a reasonable and defined timeframe. The implementation of various emission mitigation technologies/emission control methods to reduce the environmental footprint is necessary and we intend to continue to maintain a responsible supply chain.

Socio-economic Impact

Consequences of the Proposed Restriction

The exclusion of electrical installation systems (EIS) as a sector of use and the enforcement of a ban on all EIS products will have a significant socio-economic impact on the European economy. In addition to this impact, it must be noted that the number of services coming from the installation of EIS products is orders of magnitude larger. If the REACH proposal to restrict PFASs is enacted in its current form, EIS equipment will be eliminated for all use sectors, resulting in devastating cuts and a direct reduction in the European economy.
In addition, the potential elimination of fluoropolymers could put the EU behind other countries in terms of technological competitiveness, particularly in the chemical processing sector.
The materials used in EIS systems are used in the electrotechnical infrastructure in buildings and are therefore the basis for digitalization, the integration of renewable energy generation and thus for decentralized energy supply.
In addition, materials constraints will continue to limit the scope of technology-related activities that can be undertaken, including those that are critical to Europe's future, namely alternative energy, transportation and battery manufacturing. Materials are critical to these technologies, and an exemption for fluoropolymers will allow Europe to maintain a level playing field and increase the likelihood of a successful outcome.

Number of companies affected by a PFAS ban:
All companies that manufacture devices will be affected by the restriction. In addition, there are customers worldwide who will be affected given the large installed base and lack of viable replacement options.

Burden of Proof and Analytical Aspects

Fluoropolymers are clearly different from other materials in this very broad group of PFAS chemicals. These materials are not known to cause problems for human health or the environment in EIS products.

Fluoropolymers are known to offer many beneficial properties simultaneously (combined in individual products) that allow for the continued development of applications that are critical to society, not only in terms of technological advancement, but especially in terms of public safety and the development of clean energy alternatives.

Required Transition Period and/or Derogations

Qualification and approval of alternative materials require a very large amount of time:

- Development of the alternative material at the material manufacturers.
- Approval / listing of these materials
- Equipment development for conversion to alternative materials
- Approval of the corresponding devices

These steps can essentially only be processed sequentially. Depending on the extent to which even completely new material compositions must be researched, time periods in the order of 10 years may well come into play for this.

a) approx. 3 years for known substitutes
b) For substitutes not yet ready for industrial use, approx. 5-10 years
c) For drop-in substitutes with market maturity approx. 5 years

Our sector offers:

EIS equipment can be dismantled and separated at the end of life for processing or reuse as part of a circular economy. The end-of-life fate of fluoropolymers in this business can be controlled and may include the following options:

Recovery and recycling.
Fluoropolymers can be chemically recycled back into their basic building blocks and rebuilt without compromising their properties. Melt-processable fluoropolymers, which do not include PTFE, can be recycled using conventional mechanical methods. The challenge with non-melt-processable fluoropolymers such as PTFE is finding ways to get the materials to a facility that can perform chemical recycling. This is a difficult problem, but not an insurmountable one.

Better control for PFAS
Label all semi-finished parts in a production facility with the ingredients. This measure can prevent or avoid the release of materials containing PFAs into the environment at any stage of development and production. Inclusion of PFAs also in the SVHC-Reach list to allow better traceability of PFA-containing material. These two points are necessary to better understand where we use PFAs. Then it is possible to avoid reusing this material in new projects or at least take certain measures in our process when we use this type of material.

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