PFAS legislation and its impact on fluoropolymer materials for sealing devices

Following from our previous issues, the topic of PFAS is still very prominent. In this article Sandy Van den Broeck and Ralf Vogel from the ESA discuss the issues of PFAS and the evolving regulations that could significantly impact the use of fluoropolymers in critical industrial applications.

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Per- and polyfluoroalkyl substances (PFAS), often referred to as "forever chemicals," have been at the centre of growing regulatory scrutiny worldwide due to their persistence in the environment, potential health risks, and widespread presence in various consumer products. PFAS, a class of over 9,000 synthetic chemicals, are used in a range of applications such as non-stick cookware, water-resistant clothing, firefighting foams and industrial processes. Fluoropolymers, a subset of PFAS, have become crucial in high-performance valve applications, particularly due to their chemical resistance, thermal stability, low friction and durability.

With increasing global concern over PFAS contamination in water sources and the health risks associated with exposure, governments and regulatory bodies are imposing stricter regulations. However, as regulatory frameworks evolve, there is growing debate on how these regulations impact fluoropolymers materials considered vital to numerous industries but are often lumped together with the broader category of PFAS.

Countries and regions around the world are responding to PFAS concerns with new legislation aimed at controlling and eventually phasing out these chemicals. The United States, Canada, the European Union and several other countries have taken steps to regulate PFAS in drinking water, food packaging, textiles and other sectors.

United States: In 2023, the US Environmental Protection Agency (EPA) introduced new rules under the Toxic Substances Control Act (TSCA) that impose limits on PFAS in drinking water and mandate comprehensive reporting on PFAS manufacturing, usage and disposal. The EPA's roadmap also proposes designating certain PFAS chemicals as hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which could accelerate efforts to clean up contaminated sites.

Canada: On 5th March 2025, the Canadian government published the State of Per- and Polyfluoroalkyl Substances (PFAS) Report, marking a significant milestone in the country's efforts to address chemical substances that pose risks to human health and the environment. The report concludes that the class of PFAS—excluding fluoropolymers—poses potential harm to both people and ecosystems. Fluoropolymers, a subgroup within PFAS, will not be included in this assessment and will be considered separately at a later date. In response to the findings, the government is proposing to list PFAS (excluding fluoropolymers) as a class under Part 2 of Schedule 1 to the Canadian Environmental Protection Act, 1999 (CEPA).

To manage the risks associated with PFAS, the government is rolling out a two-phase plan:

Phase1, starting in 2025, the initial focus will be on reducing and eventually eliminating the use of PFAS in firefighting foams, a major source of environmental contamination.

Phase 2 will target non-essential uses of PFAS in consumer products that do not contribute to health, safety or environmental protection. This includes items such as cosmetics, food packaging and textiles.

European Union: The European Chemicals Agency (ECHA) has been pursuing a restriction proposal to regulate the use of PFAS across member states. The European Union's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) framework is also driving efforts to restrict the production and use of PFAS in products like firefighting foams, textiles and food packaging. The ESA as a trade organisation for sealing device manufacturers has submitted an extensive response to the current PFAS consultation process by ECHA including a detailed socio-economic study for the sealing industry. As a result, ECHA recently acknowledged the importance of sealing devices as a product group which is affected by the upcoming legislation.

Global landscape

Countries like Canada, Australia and Japan are similarly adopting stricter PFAS regulations, focusing primarily on monitoring, reporting and restricting PFAS in sensitive applications such as drinking water and consumer goods.

Amidst these regulatory developments, fluoropolymers, a class of high-performance materials that includes polytetrafluoroethylene (PTFE), ethylene tetrafluoroethylene (ETFE), and perfluoroalkoxy (PFA), face uncertain prospects. Fluoropolymers are widely used in critical industries such as aerospace, automotive, electronics and healthcare, where their exceptional chemical resistance, high-temperature tolerance and inertness make them indispensable. Some of the key applications include sealing materials in pumps, valves and chemical processing equipment.

However, the broad regulatory categorisation of PFAS has created concern that fluoropolymers could be swept into the same restrictions as more hazardous and persistent PFAS, despite evidence suggesting that they behave differently in terms of environmental persistence and human toxicity. Fluoropolymers, due to their larger molecular size and low solubility, are considered less bio accumulative and less likely to degrade into harmful byproducts, compared to other PFAS compounds such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), which are already regulated by ECHA.

Challenges of regulation

Industry stakeholders, including the manufacturers of fluoropolymers and the sealing industry, are pushing for a more nuanced approach in PFAS legislation. Their argument is that fluoropolymers should be treated separately from smaller, more mobile PFAS chemicals, which pose a higher risk of contamination. The industry cites key differences in the environmental and health profiles of fluoropolymers, highlighting their stability and non-reactive properties, which significantly reduce their likelihood of leaching into the environment or accumulating in human tissues.

The European Chemicals Agency (ECHA) has acknowledged these differences, and some fluoropolymers are under review for possible exemptions from a broad PFAS ban during the current review process. Nonetheless, there is concern that overzealous regulation could disrupt supply chains, stifle innovation and compromise the availability of materials that are essential to many industries.

One of the biggest challenges is balancing the environmental and health risks associated with PFAS with the legitimate need for high-performance materials like fluoropolymers. On one hand, there is undeniable pressure from environmental groups and the public to eliminate all PFAS from consumer products and industrial applications due to their potential for water contamination and health effects such as cancer, liver damage and reproductive issues. On the other hand, industries that rely on fluoropolymers argue that outright bans on these materials could have unintended consequences, such as reduced efficiency, safety risks and loss of competitiveness in high-tech fields.

A middle ground could involve stricter control over the use of smaller PFAS molecules, such as is already the case for PFOS and PFOA, while allowing the continued use of fluoropolymers in highly regulated and essential applications. This would entail setting clear criteria that differentiate harmful, mobile PFAS from stable, non-toxic fluoropolymers, thus allowing industries to continue benefiting from their unique properties while minimising environmental and health impacts.

The evolving landscape of PFAS legislation presents significant challenges and opportunities for the sealing industry reliant on fluoropolymer materials. As regulators in the US, Canada, Europe and beyond refine their approaches to PFAS regulation, it is crucial that they adopt a science-based, risk-oriented perspective that acknowledges the diverse nature of PFAS compounds. Differentiating fluoropolymers from other, more hazardous PFAS substances is essential to ensuring that these valuable materials remain available for critical applications while protecting public health and the environment. ■