PTFE / ePTFE Components for Technical Applications
Essential Use of PTFE in the Scope of the PFAS Regulation Proposal

PTFE is used in many applications as critical component. In the current proposal for future PFAS regulation, it is considered to be as potentially harmful as any other short chain or low molecular weight PFA substances. Therefore, a complete ban of PTFE on the European market, is called for.

Lenzing Plastics is in favor of a stringent PFAS restriction. However, PTFE as a polymer shall be excluded, generally, as being rated as Polymers of Low Concern (PLC)[1,2]. And especially applications, we are showing here, demonstrate that use of PTFE in the described ways and areas is both: very safe and very key.

1. The Indispensable Role of PTFE Components in Sealing, Filtration and Friction Management Applications: A Case Study

1.1. Introduction

Polytetrafluoroethylene (PTFE) is a versatile material, known for its exceptional properties, making it a critical component in various industries[3]. This case study explores the safe usage of PTFE components in sealing, filtration and friction management applications. It sheds light on the unique properties of PTFE that make it irreplaceable in these fields and highlights the significance of its application in ensuring efficient, reliable and cost-effective operations. Polytetrafluoroethylene (PTFE), a synthetic fluoropolymer of tetrafluoroethylene, was discovered in 1938 by R.J. Plunkett[4]. Since then, its unique properties have found extensive use in industrial applications, particularly in sealing, filtration and friction management. This case study delves into why PTFE has become an indispensable material in these fields and analyzes the challenges associated with replacing it.[5]

1.2. PTFE in Sealing Applications

PTFE's unparalleled characteristics, such as high chemical resistance, low coefficient of friction, and exceptional temperature stability, make it ideal for sealing applications. In industries like chemical manufacturing, pharmaceuticals, food processing, oil and gas, automotive, aerospace and naval, where components are exposed to extreme conditions, PTFE seals ensure leak-free performance and extend the lifespan of equipment. The ability of PTFE seals to resist chemical attacks, moisture and corrosive substances ensures safety and reliability of the systems they are

---

[1] B. Ameduri, H. Hori, *Chem. Soc. Rev.,* **2023***, 52,* 4208

[2] B.J. Henry, J.P. Carlin, J.A. Hammerschmidt, R.C. Buck, L.W. Buxton, H. Fiedler, J. Seed, O. Hernandez, *Integr. Environ. Assess. Manag.,* **2018***, 14,* 316

[3] B. Ameduri, *J. Chem. Eur.,* **2018***, 24,* 18830

[4] R.J. Plunkett, *US Patent,* **1939***,* US 2230654

[5] J.G. Drobny, *Technology of Fluoropolymers*, **2009**, *3*

installed in. Additionally, its purity and absence of leachables makes it the perfect choice for critical sealings in food contact or even pharmaceutical processes[6].

1.3. PTFE components in Filtration Applications

Filtration processes often involve contact with aggressive chemicals and extreme temperatures. PTFE's non-reactive nature and high thermal resistance make it an excellent choice for filtration components. Additionally, its microporous structure and hydrophobic properties enable efficient filtration, preventing the passage of particles and liquids while allowing gases to pass through. In applications such as air and water purification, pharmaceutical manufacturing and chemical processing, PTFE filters provide reliable and effective results, ensuring product quality and worker safety. PTFE components are the only way to maintain the low emission level reached in many filtration processes.

1.4. PTFE components in Friction Management Applications

Friction is a common cause of wear and tear in mechanical systems, leading to reduced efficiency and increased maintenance costs. PTFE's low coefficient of friction makes it a valuable material for reducing friction and improving the performance of moving parts. In industries like automotive, aerospace, and heavy machinery, PTFE bearings significantly reduce energy consumption and prevent premature component failure. Moreover, PTFE's self-lubricating properties eliminate the need for additional lubrication, simplifying maintenance routines.

1.5. Challenges in Replacing PTFE

Despite the growing regulatory pressure, PTFE remains very challenging to replace in sealing, filtration, and friction management applications. Several factors contribute to its irreplaceability:

- Unique Chemical Inertness:
  PTFE's exceptional resistance to a wide range of chemicals, including corrosive substances and solvents, cannot be replicated by other materials.
- High Temperature Resistance:
  PTFE retains its mechanical properties at extreme temperatures, allowing it to function in environments where other materials would degrade or/and fail.
- Low Coefficient of Friction:
  PTFE's low frictional characteristics are unparalleled, reducing energy consumption, minimizing wear, and ensuring smooth operation in friction management applications. The coefficient of friction of solid PTFE is comparably low as that of 2 cubes of ice.
- Non-Stick and Self-Lubricating Properties:
  PTFE's non-stick nature and self-lubricating properties eliminate the need for external lubrication, reducing maintenance requirements and costs. In fact, PTFE is the only material with non-stick properties, good enough to resist the van-der-Waals forces of Gecko setae. I.e., PTFE is the only material a Gecko cannot stick to.
- Microporous Structure:
  PTFE's unique microporous structure is crucial for efficient filtration applications, preventing the passage of contaminants while allowing the flow of gases.[7]

---

[6] D.W. Smith Jr., S.T. Iacono, S.S. Iyer (Eds.), *Handbook of Fluoropolymer Science and Technology,* **2014**

[7] B. Ameduri, *J. Chem. Eur.,* **2018***, 24,* 18830

1.6. Case Study Conclusion

PTFE components have revolutionized the sealing, filtration and friction management industries, offering unparalleled benefits in terms of safety, reliability and efficiency. The material's exceptional chemical resistance, thermal stability, low friction and self-lubricating properties make it a challenge to replace with other materials. As technology advances, efforts to improve PTFE's environmental impact and recyclability continue, ensuring that its usage remains both, safe and sustainable in various applications. However, for the foreseeable future, PTFE's unique properties will remain the backbone of critical industries, enabling low emissions and safe operations in many manufacturing surroundings across the board.

2. Manufacturing

2.1. PTFE processing

At Lenzing Plastics, we source PTFE polymer as resin from leading suppliers, globally. For many years already, free from PFOA and PFOS. Due to the PFAS campaign, 3M as one of the last remaining PTFE producing companies announced to stop PTFE polymer production in Europe and shut down the plant, completely. Consequently, in the future, import from other parts of the world will be required. Conversion of the resin into a film is performed according to two routes, depending on the targeted properties:

- Neat resin is pressed into billets that are sintered. The film is obtained by skiving the billet with blades.
- In the second route, we blend the resin with lubricant (volatile *iso*-alkanes), again press it into billets that are extruded into a rod which is, then, calendared into a film. The lubricant is fully evaporated during the process, during heating up and drying the film.

The exhaust air is treated thermally to destroy all potentially harmful substances or particulates. No generation of short-chain PFAS (e.g. perfluoroalkyl carboxyl acids or their salts) could be identified in the course of the process, so far. Next step is stretching of the film/tape, for orienting the polymer chains, thus, applying strength to the tape. And finally, it is slit and, if required, twisted into round filaments.
In summary, at Lenzing Plastics, PTFE is converted physically from a resin into a film and tape, subsequently. No other PFAS substances are added/generated during the process.

2.2. Raw material manufacturing:

Our suppliers did phase out of usage of PFOS and later PFOA already. Long before the radical restrictions legally got enforced. For selected PTFE resins (Suspension PTFE), PFAS polymerization aids are not necessary, thus not used. For fine powder resins (Emulsion PTFE) there is still no viable alternative existing[8,9]. However, R&D is in progress to work on it[10]. Introduction of a strict regulation for raw material manufacturing practice in this regard would be highly appreciated by Lenzing Plastics.

---

[8] B. Ameduri, J. Sales, M. Schlipf, *ICRL,* **2023***, 1,* 18

[9] B. Ameduri, *J. Fluorine Chem.,* **2023***, 267,* 110117

[10] R. Chauhan, G. Kumar, P.s. Rao, N. Soni, B.s. Bhattacharya, A. Dutta, A. Shukla, A.M. Patel, *PCT Application,* **2020***,* WO 2021/070159 A1

3. End of product lifecycle

PTFE is a very stable and long-lasting product[11]. In most of the applications, including sealings, filtration and friction management, it is among other reasons used, because of its longevity and durability. Therefore, products made of PTFE are less often exchanged, replaced and disposed than alternative materials. But at one point of time also the PTFE components are disposed. If incinerated in state-of-the-art facilities, no PFAS are emitted into the air[12,13]. Due to the strong carbon fluorine bond (the strongest that carbon could have to any other atom), there will be no negative impact on the environment, if placed on landfill: PTFE will not be dissolved through water, as it is not soluble therein and will not degrade to smaller particles[14]. Thermal degradation will only happen at drastically elevated temperatures and long exposure at the same time.
From technical viewpoint, also recycling is feasible. However, due to the low amounts of PTFE material, in general, it is economically challenging to organize collection of material for recycling.

[11] B. Ameduri, H. Hori, *Chem. Soc. Rev.,* **2023***, 52,* 4208
[12] K. Aleksandrov, H.J. Gehrmann, M. Hauser, H. Mätzing, D. Pigeon, D. Stapf, M. Wexler, *Chemosphere,* **2019***, 226,* 898
[13] W. Tsang, D.R. Burgess Jr., V. Babushok, Combustion Sc. and Technol., 1998,139, 1
[14] B.J. Henry,J.P. Carlin, J.A. Hammerschmidt, R.C. Buck, L.W. Buxton, H. Fiedler, J. Seed, O. Hernandez, *Integr. Environ. Assess. Manag.,* **2018***, 14,* 316

4. Summary

The described PTFE components for sealing, filtration and friction management applications are essential to keep emission and energy consumption at currently low level[15]. No replacement material is foreseeable that can combine the required characteristics. And beyond the capabilities of Lenzing Plastics there are many more usages of fluoropolymers in sealing, filtration and friction management, essential for a modern world of low emissions, low energy consumption and safe operations.[16]

Therefore, we call for a general exemption (not only extended derogation time) for the use of PTFE in all sealing, filtration and friction management applications in a future PFAS regulation.

In case of any questions, we are available to provide further details.

Lenzing Plastics GmbH & CO KG
Werkstrasse 2
4860 Lenzing, Austria
www.lenzing-plastics.com

Volker Biladt
[redacted]
[redacted]@lenzing-plastics.com

[15] Q. Guo, Y. Huang, M. Xu, Q. Huang, J. Cheng, S. Yu, Y. Zhang, C. Xiao, *J. Membr. Sc.,* **2022***, 664,* 121115

[16] European Sealing Association*; Position Statement,* **2022**