

PTFE FACTS

PFAS stands for per- or polyfluoroalkyl substances. The term PFAS describes a large group of thousands of different chemicals with very different properties. Polytetrafluoroethylene (PTFE) is a member of the fluoropolymer class of per- and polyfluorinated alkyl substances (PFAS).¹

PTFE is non-toxic and safe for the end user.²

PTFE is a very large molecule that is unable to enter the human cell passively due to its size, nor does it have the appropriate chemical or structural properties that would enable it to interact with other biomolecules to actively move into the cell. In addition, PTFE doesn't bind to the cell surface receptors or signal events within the cell. Since PTFE is not subject to passive or active transport and does not bind to the surface receptors necessary for cell signaling, it is not bioavailable.³ If a molecule cannot get into the cell or bind to the cell, it cannot be toxic. Therefore, PTFE is non-toxic and safe for the end user.⁴

PTFE is an extremely stable molecule and resistant to degradation.

PTFE does not break down to be a source of non-polymer PFAS unless exposed to extremely harsh temperatures or chemicals that would themselves have a negative impact on human life.

¹ Buck RC et al., 2011, *Integr Environ Assess Manag* 7(4):513-541; OECD (2021), *Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance*, OECD Series on Risk Management, No. 61, OECD Publishing, Paris.

² Henry et al., 2018, *Integr Environ Assess Manag* 14 Supplement, pp 327-328; L.L. Radulovic, Z.W. Wojcinski, 2014, *Encyclopedia of Toxicology* (Third Edition); Bruno Ameduri, 2023, *Journal of Fluorine Chemistry*, 267, *Fluoropolymers: A Special Class of per- and polyfluoroalkyl Substances (PFASs) Essential for our Daily Life*; Gerard Puts et al., 2019, *Chemical Reviews*, 119, *Polytetrafluoroethylene: Synthesis and Characterization of the Original Extreme Polymer*, American Chemical Society: ACS Publications; Sina Ebnesajjad, 2013, *Applied Plastics Engineering Handbook: Processing and Materials*, ed. Myer Kutz (Elsevier, 2011), *Introduction to Fluoropolymers*, pp 63-89; Ebnesajjad, 2014, *Fluoroplastics, Volume 1: Non-Melt Processible Fluoroplastics*, (Second Edition) Chapter 5, *Homofluoropolymer Polymerization and Finishing*, (Plastics Design Library: Elsevier Science & Technology Books).

³ Paul Leeson, 26 January 2012, *Drug discovery: Chemical beauty contest*, *Nature* 481, pp 455-456; ECETOC Special Report No. 18, Brussels July 2014, *Information to be considered in a weight-of-evidence-based PBT/vPvB assessment of chemicals (Annex XIII of REACH)*; Ming-Qiang Zhang and Barrie Wilkinson, 2007, *Drug discovery beyond the 'rule-of-five'*, *Current Opinion in Biotechnology*, pp 18:478-488; Henry et al., 2018, *Integr Environ Assess Manag* 14 Supplement, pp 327-328.

⁴ Paul Leeson, 26 January 2012, *Drug discovery: Chemical beauty contest*, *Nature* 481, pp 455-456; ECETOC Special Report No. 18, Brussels, July 2014, *Information to be considered in a weight-of-evidence-based PBT/vPvB assessment of chemicals (Annex XIII of REACH)*; Ming-Qiang Zhang and Barrie Wilkinson, *Drug discovery beyond the 'rule-of-five'*, *Current Opinion in Biotechnology* 2007, pp 18:478-488; Henry et al., 2018, *Integr Environ Assess Manag* 14 Supplement, pp 327-328; L.L. Radulovic, Z.W. Wojcinski, 2014, *PTFE (Polytetrafluoroethylene; Teflon®) in Encyclopedia of Toxicology* (Third Edition).



A Continuous Use Temperature is the temperature at which a material can be heated and be used for an indefinite amount of time without change in its properties. For PTFE the Continuous Use Temperature is 260°C (500°F). This means a PTFE membrane can be heated and used safely until the polymer itself exceeds a temperature of 260°C. Only if the PTFE is heated above 260°C, could there be the potential for degradants or off-gases.⁵

It is only when PTFE is heated to temperatures above 400°C that time/temperature degradation begins to take place.⁶ For example, if PTFE is heated to 400°C it would need to maintain that temperature for approximately 25 hours before there was even a 1 percent loss of mass.

Non-Polymer PFAS

PFOA stands for perfluorooctanoic acid, which is a non-polymer PFAS (perfluoroalkyl substance). Historically, PFOA was used by manufacturers of PTFE fine powder as a polymerization aid to efficiently enable the TFE monomer polymerization reaction to make PTFE. PFOA appeared only as a trace residual in the PTFE raw materials from the polymerization process. Since PFOA has never been a component of the PTFE molecule, PTFE molecules do not degrade into PFOA.

Previously, PFOA residuals could be measured at trace levels in the raw material used to produce PTFE membranes. The PFOA residuals did not affect the base properties of raw materials used by Gore nor the safety and performance of our products. Nearly all the trace residuals were eliminated during our processing of the raw materials into finished products.⁷ In alignment with the EPA PFOA Stewardship program, Gore worked closely with its suppliers to remove PFOA from its global fabrics supply chain. This was successfully completed in 2013.⁸

⁵ Plastics Industry Association, *Guide to The Safe Handling of Fluoropolymer Resins, 5th Ed.*, <https://access.plasticsindustry.org/ItemDetail?iProductCode=BU201&Category=PUBLICATION>; Thomas Douglas and Ann W. Harman, November 18, 1964. *Relative Enthalpy of Polytetrafluoroethylene*.

⁶ Plastics Industry Association, *Guide to The Safe Handling of Fluoropolymer Resins, 5th Ed.*, <https://access.plasticsindustry.org/ItemDetail?iProductCode=BU201&Category=PUBLICATION>; Thomas Douglas and Ann W. Harman, November 18, 1964. *Relative Enthalpy of Polytetrafluoroethylene*; Peter R. Hondred et al., 2013, *Degradation kinetics of polytetrafluoroethylene and poly(ethylene-alt-tetrafluoroethylene)*.

⁷ Barbara Henry, 20 August 2019, *Exposure Assessment and Cancer Risk Characterization for Firefighters from Non-Polymeric PFAS Residuals in Gore Components Used in Firefighting Gear*.

⁸ W. L. Gore & Associates, Inc., 10 January 2014, *Gore Completes Elimination of PFOA from Raw Material of Its Functional Fabrics*, <https://www.gore-tex.com/pressroom/press-release/responsibility-sustainability/gore-completes-elimination-of-pfoa-from-raw-material-of-its-functional-fabrics>.