



Perfluorinated and Polyfluorinated Chemicals

Other Names: Perfluorooctane sulfonate (PFOS)
Various perfluorooctanoic acid (PFOA)
and its salts and esters Perfluorinated
tensides

CAS Number	Substance
2795-39-3	Perfluorooctane sulfonate (PFOS)
3825-26-1	Perfluorooctanoic acid (PFOA) and its salts and esters

May Be Found In:

- Textile or leather finishes for water, oil, or stain repellency
- Paper protection (e.g. oil resistant)
- Performance chemicals (fire-fighting foams, mining/oil well surfactants, floor polishes, insecticides)
- Mould release (injection moulding process)
- Food contact materials (cups, containers)
- Used to increase colour fastness properties for a.o. wet rub

Perfluorinated and Polyfluorinated Chemicals (PFCs) are also known as Perfluorinated Tensides (PFTs). They belong to the perfluoroalkyl family of substances. These have carbon chains of various lengths where hydrogen atoms are either completely replaced with fluorine atoms (perfluorinated chemicals) or partially replaced (polyfluorinated chemicals). PFCs do not occur naturally in the environment.**1** Bacteria, light, water or air do not contribute to the decomposition of PFCs, so they remain in the environment for a very long time. PFCs are ubiquitous, found all over the globe. A high degree of thermal and chemical stability gives these substances special properties, including fire resistance and repellency against oil, stains, grease and water. They therefore have hundreds of important manufacturing and industrial applications.**2,3** No proper disposal system is available for PFCs. They must be incinerated, with the resulting flue gas purified.

Uses in the Supply Chain

Since the 1960's this group of chemicals has been widely used for many applications including repellent finishes for fabrics, garments, leather, inks, lacquers, lubricants, paper, and others. The fluorinated finishes provide a highly durable repellent effect against water, soil, and oil. Durable water, oil and stain repellent finishes based on long-chain PFC's are banned from intentional use. There are two ways to manufacture PFCs, electrofluorination and telemerisation.

PFC's made by electrofluorination have by-products associated with them called perfluoroalkyl sulphonates (the most common being the C8 species Perfluorooctane sulfonate, PFOS). The deliberate use of any PFCs made by electrofluorination with a chain length of C6 or above is not permitted. These PFC types are typically used in home textiles.=

PFC's made by telemerisation have by-products associated with them called perfluorocarboxylic acids (the most common being the C8 species perfluorooctanoic acid, PFOA). The deliberate use of any PFCs made by telemerisation with a chain length of C8 or above is not permitted. These PFC types are typically used in clothing and footwear.

Why Perfluorinated and Polyfluorinated Chemicals are Restricted

- Due to the ubiquitous distribution of these substances and their persistent, bioaccumulative and toxic potential, the Stockholm convention added PFCs to the list of persistent organic pollutants (POPs) in 2009. PFCs have been proven to form bonds with proteins in the human body. Animal studies also indicate a potential to promote cancer and affect reproduction. Various laws and regulations are in place to protect public health and the environment from PFCs.
- Legislation in major markets around the world restricts production of these substances and their presence in finished products. In 2006, the EU declared a ban on producing, trading and using PFOS. Some North American states (eg Washington, Maine, Vermont) have implemented reporting requirements for PFOS in children's products.
- PFOA and PFOS are very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment.
- PFOA and PFOS are very persistent in the environment and have the potential to bioaccumulate in humans and other mammals.
- Above certain exposure levels, PFOA and PFOS primarily affect the liver. They may also impair human fertility or cause harm to unborn children.^{2,3}
- Perfluoroalkyl (C_nF_{2n+1}) substances are highly persistent under natural conditions. Although some PFCs may partially degrade in the environment, they will ultimately transform into highly stable end products, usually the highly persistent perfluoroalkyl or perfluoroalkyl (poly) ether.⁴
- PFOA and PFOS may result in the development of cancer above certain exposure levels.^{1,5}
- Many brands and retailers already phased out the use of C-8 compounds as part of phasing out other PFCs.

Sourcing Compliant Materials from Your Suppliers

- Explain that you require materials to be compliant with current AFIRM RSL limits.⁶
- Request suppliers to submit a confirmation of material compliance and/or a test report from a third-party laboratory. When materials are received, consider performing random, risk-based testing to ensure current AFIRM RSL limits are met.
- Implement a management system for material compliance to ensure materials are tested at point of production and before delivery.
- Share this guidance sheet with your material suppliers. Using the guidance in the next section, instruct them to work with their chemical suppliers to source chemical formulations that comply with these requirements. If needed, highlight the existence of harmful substances in materials via chemical management trainings from the ZDHC Academy, existing guidelines, and laws.
- Make sure all your suppliers have a solid chemical management system in place.

Sourcing Compliant Formulations from Your Chemical Formulators

- Explain to chemicals suppliers that you require chemical formulations to comply with current ZDHC MRSL limits.
 - Search for formulations on the ZDHC Gateway Chemical Module. If your preferred formulations are not listed, encourage providers to register their formulations.
 - Ask for a ZDHC ChemCheck report.
- For all formulations, request SDS documentation to ensure none of the CAS Numbers above are listed as ingredients.
- Other questions that will help to substitute a new repellent:
 - Is the level of performance requested applicable to the usage of the specific material or product?
 - Is the chemistry based on long-chain (C-8) or short chain (C-4, C-6) fluorinated chemistry?
 - Does the chemical formulation have an accepted MRSL Conformance Certificate?

Safer Alternatives

- Due to the harmful potential of PCFs, the chemical industry has developed several alternatives. Less harmful chemical formulations, Less harmful chemical formulations are now available for most apparel and footwear applications.
- Fluorinated polymer finishes based on short-chain fluorinated chemistries are also available, which cannot chemically degrade into PFOA or PFOS. Even short chain fluorinated substances could however pose a threat. Their chemistry and potential negative effects on the environment and human health are not yet evaluated in detail.
- Other alternatives (depending on performance needs) include PFC-free applications such as waxes, silicones, acrylic polymers, polyurethanes, dendrimers, and more.
- Additionally, materials exist that are naturally repellent due to other chemical or mechanical properties.
- Any alternative choices must be carefully vetted to prevent making a regrettable substitution.
- Please note that any chosen alternative must comply with the ZDHC MRSL chemical formulation limits and AFIRM RSL limits for materials.

Additional Information

References

- 1 Agency for Toxic Substances and Disease Registry. (2015) Toxicological Profile for Perfluoroalkyls. Retrieved August 9, 2017, from <https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf>.
- 2 Hohenstein Institute & Textile Exchange. (2017). Chemical Snapshots – Perfluorooctanesulfonic acid or Perfluorooctane sulfonate (PFOS). Revision 0.2. Retrieved March 17, 2017.
- 3 Hohenstein Institute & Textile Exchange. (2017). Chemical Snapshots – Perfluorooctanoic Acid (PFOA). Revision 0.2. Retrieved March 17, 2017.
- 4 Zhanyun Wang, Jamie D. DeWitt, Christopher P. Higgins and Ian T. Cousins, Environmental Science & Technology, 2017,51,2508-2518, - A never-Ending Story of Per- and Perfluoroalkyl Substances (PFAS).
- 5 OECD/UNEP (2013): Synthesis Paper on Per- and Polyfluorinated Chemicals (PFCs). https://www.oecd.org/env/ehs/risk-management/PFC_FINAL-Web.pdf.
- 6 Apparel and Footwear International RSL Management Group (Ed.). (2018, January 31). Restricted Substances List (Rep.). Retrieved <http://afirm-group.com/afirm-rsl/>.

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