About CSIR-NEERI

CSIR-NEERI is endorsed as Stockholm Convention Regional Centre (SCRC) on Persistent Organic Pollutants (POPs) for Asia Region at COP-5 meeting held during 25-29th April 2011 at Geneva. SCRC is serving different parties/countries in the Asia region to help them in their capacity building and transfer of technologies related to POPs and new POPs. Besides India, CSIR-NEERI is serving ten countries of Asia region viz. Bangladesh, Maldives, Mongolia, Myanmar, Nepal, Philippines Thailand, Sri Lanka, UAE and Vietnam. The goals of the SCRC is to provide technical assistance for building capacities of the parties of the Asia region in relation to monitoring and assessment of POPs in the environment, transfer of technologies, raise awareness and promote identification and environmentally sound management (ESM) of POPs and POPs contaminated sites in the region. The Centre is also assisting the parties of Asia region in fulfilling their obligations of the Stockholm Convention

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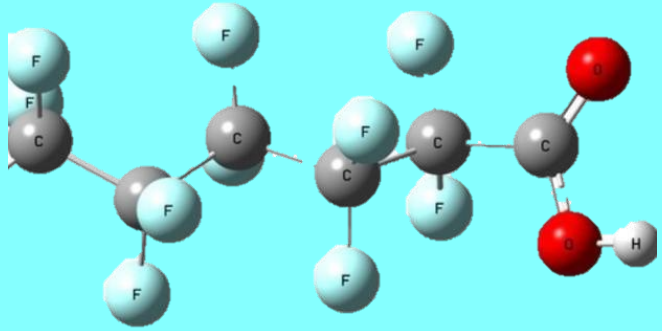
Perfluorooctane sulfonic acid (PFOS), its salts



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1. What are PFOS and its salts?

- Fully fluorinated anion.
- Commonly used as a salt or incorporated into larger polymers.
- Produced commercially from perfluorooctane sulfonyl fluoride (PFOSF) by alkaline hydrolysis.
- Formed from PFOSF in water at room temperature (Lehmler, 2005).
- Proposal to list PFOSF in Annex A of the Convention was submitted in 2005 (Decision POPRC-3/11, Stockholm Convention).
- Used in surfactants, photographic emulsifier, aviation hydraulic fluids, fire-fighting and insecticide formulations.

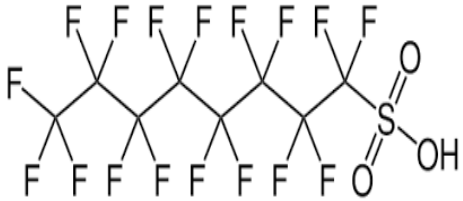


Fig. Structure of PFOS

2. What are the characteristics of PFOS?

- CAS number : 1763-23-1
- Chemical formula (general) : $C_8F_{17}SO_3H$
- Physical appearance : White powder
- Molecular mass : 500 g/mol
- Boiling point : 250-260 ºC
- Melting point : No Data available
- Solubility : 680 mg/L (24 – 25 ºC) in water
- Vapour pressure : 3.31 x 10^{-4} Pa
- pKa : <1.0
- Log Kow : 4.49
- Log Kaw : < 2 x 10^{-6} (3M, 2003a)

Its Salts

Its commercially important salts are listed below:

- Potassium salt (CAS No. 2795-39-3)
- Diethanolamine salt (CAS No. 70225-14-8)
- Ammonium salt (CAS No. 29081-56-9)
- Lithium salt (CAS No. 29457-72-5)

3. What are the applications of PFOS?

- PFOS-related substances are used as surface-active agents in different applications.
- Suitable for high temperature applications.
- Applications involving contact with strong acids or bases.
- Used in the manufacturing of aqueous film forming foam (AFFF), which is used to extinguish liquid hydrocarbon fires (ASTSWMO, 2015).
- The various applications of PFOS and its related compounds has been mentioned as follows :
  - Fire fighting foams
  - Carpets
  - Leather/apparel
  - Textiles/upholstery
  - Paper and packaging
  - Coatings and coating additives
  - Industrial and household cleaning products
  - Pesticides and insecticides

Source: (*UNEP-POPS-POPRC.2-17-Add.5.English.PDF*)

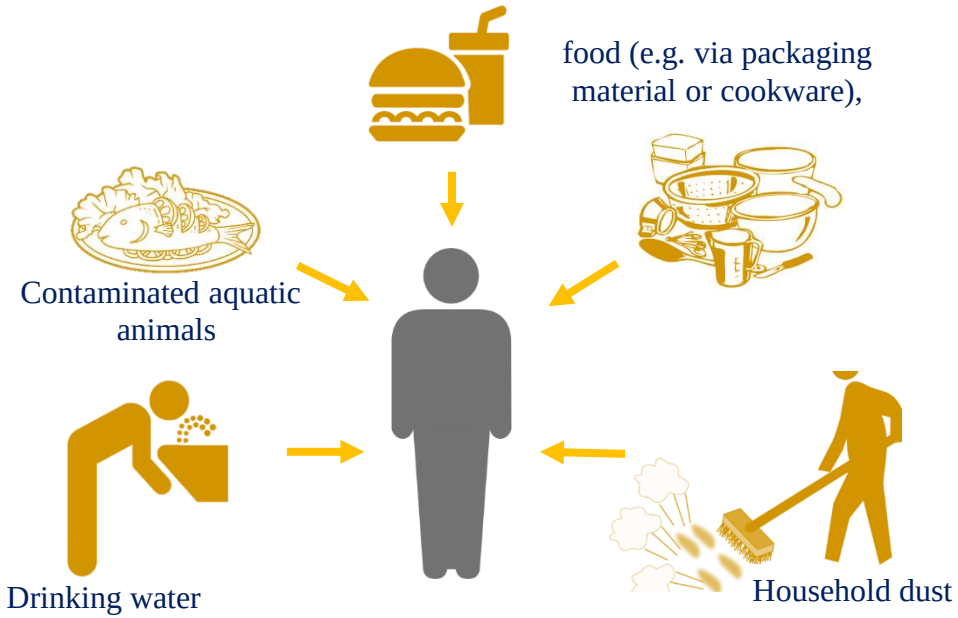
4. What are the sources for release in the environment?

- No natural source available.
- The occurrence of PFOS in the environment is a result of anthropogenic manufacturing and use.
- Very limited information regarding the emissions and pathways in the environment.
- Release likely to occur throughout life cycle such as at the time of production, assembly, distribution, consumer uses as well as via landfills and sewage treatment plants after the use of the products.

Manufacturing processes constitute a major source of PFOS to the local environment. During these processes, volatile PFOS-related substances may be released to the atmosphere. PFOS and PFOS related substances could also be released via sewage effluents as depicted in figure

5. What are the modes of exposure to humans?

- The occurrence of PFOS is almost everywhere i.e. air, water, soil, sediment and aquatic organism (e.g. Fishes). The significant concentrations of PFOS were not only limited to matrices but also in human blood and wildlife samples.
- There are several possible modes of exposures to humans such as drinking water, contaminated aquatic animals, food (e.g. via packaging material or cookware), household dust etc.



Possible mode of exposure to Humans

6. Why PFOS is a chemical of concern ?

- Extremely persistent.
- Do not hydrolyse, photolyse or biodegrade. (OECD, 2002
- Occurrence in all environmental matrices.
- Detected in environmental media and biota in many parts of the world, including oceans and Arctic.
- Long-range transport potential (ATSDR, 2015).
- Toxic to laboratory animals causing reproductive, developmental and systemic effects (EPA 2016d).
- US-EPA found suggestive evidence to cause cancer (EPA 2016d, 2016e).
- In 2009, the Stockholm Convention on Persistent Organic Pollutants added PFOS to Annex B, restricting its production and use.

7. Evidences in Support of Prevalence of PFOS in environment

- Occurrence reported in all environment matrices as well as biota (Chang et al., 2016).
- Detected in surface water and sediments downstream of production facilities and in wastewater treatment plant effluents, sewage sludge and landfill leachate in cities of United States (OECD 2002).
- Long-range atmospheric transport may be the most possible cause of the presence of PFOS in different remote regions of Northern hemisphere.
- Concentrations observed in predators from remote regions; e.g. the polar bears.

8. What are the health effects of PFOS?

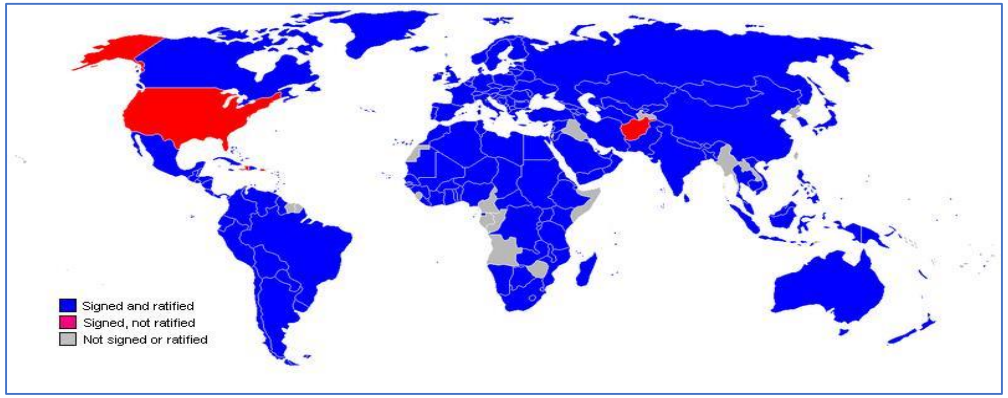
- Found in human blood, tissue even breast milk samples of general population.
- Health effects of PFOS have been more widely studied than other per- and polyfluoroalkyl substances (PFAS).
- Based on limited evidence from studies on exposed people, the potential health effects includes:
  - ❖ Increased cholesterol levels
  - ❖ Immune system changes
  - ❖ Decreased fertility
  - ❖ Altered thyroid function
  - ❖ Increased risk of certain types of cancer
  - ❖ Changes in growth, learning and behaviour of developing foetus and child
- Animals subjected to high doses exhibit developmental, reproductive and liver effects, along with increased rates of cancer.

9. What is the Indian scenario of PFOS?

- Reported in Indian environment.
- Currently India doesn't have any specific regulation and policy .
- PFOS has been found in the Cooum River (3.91 ppt) (Yeung et al., 2009) and in untreated sewage (12 ppt). Another study found that the Noyyal River contains significant levels of PFOS at 29 ppt (Sunanth and Vasudevan 2016).
- Found in women breast milk from Chidambaram, Kolkata, and Chennai. Overall, average PFOS levels in Indian breast milk (Tao et al., 2008).
- Found in almost all of the fish samples from the Ganges River (Yeung et al., 2009).
- Found in the livers of pigs feeding on municipal waste dump site in Perungudi near Chennai. Female pigs contained substantially higher levels of PFOS (71 ng/g wet weight) than male pigs (9 ng/g wet weight) (Watanabe et al., 2010).

10. Stockholm Convention

- Stockholm Convention on POPs is a global treaty adopted on 22 May 2001 in Sweden and entered into force in 2004, with the aim to protect human health and environment from chemicals that remain intact in the environment for more extended period, become widely distributed geographically, accumulates in fatty tissues of humans and wildlife and have harmful effects on human health or on the environment.
- India ratified and became a member of this Convention on 13 January 2006. India is one among the nations which ratified the Stockholm Convention and took various important steps in the progress of the prohibition of POPs. (http://pib.nic.in/newsite/PrintRelease.aspx?relid=161203)
- The Government of India, with financial and technical support from the Global Environment Facility (GEF), initiated the NIP development process which involved the ground-level assessment of situation of POPs through inventorization, samples collection, analysis and interpretations (Government of India, 2011).



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Disclamation :-

The above mentioned data was taken from authentic sources and it is cited well wherever needed. CSIR-NEERI is not taking any responsibility of data cited in this document. The data pertaining to Indian climatic condition is still very limited. The main objective behind compiling information on this particular chemical is for public awareness only.

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