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Per- and polyfluoroalkyl substances (PFAS)

(also known as perfluorochemicals, PFCs)

Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA)

What are PFOS and PFOA?

- PFOS and PFOA belong to a family of perfluoroalkyl substances, and are human-made chemicals that do not occur naturally in the environment.
- These two perfluorochemicals were produced in the largest amounts in the U.S. and are commonly found in our environment.
- PFOS and PFOA can also be formed by environmental microbial degradation or by metabolism in larger organisms from a large group of related chemicals or precursor compounds.
- Companies have stopped production or have begun changing manufacturing practices to reduce releases and to reduce the amounts of these chemicals in their products.

What are the uses of PFOS and PFOA?

- PFOS and PFOA have been used in surface protection products, such as carpet, clothing, and cookware (Teflon®, Nonstick) treatments, and coating for paper, furniture and some food packaging materials (e.g., microwave popcorn bags, fast food containers, candy wrapper and pizza boxes), and personal products like shampoo, dental floss, nail polish, eye makeup, etc.
- Industrial uses of these chemicals are in photo imaging, metal plating, semiconductor coatings, aviation hydraulic fluids, medical devices, insect baits, printer and copy machine parts, chemically driven oil production, rubber and plastic industries.
- Both chemicals have also been present in some foam firefighting materials.

What are the environmental impacts of PFOS and PFOA?

- PFOS and PFOA can be found in air, soil, and water (ground and surface water) after release from the manufacture, use and disposal of products that contain these chemicals.

- PFAS (including PFOS and PFOA) in air are expected to settle to the ground within days to weeks.

- They breakdown very slowly in the environment and are often characterized as persistent.

How are people exposed to PFOS and PFOA?

- Exposure to PFOS, PFOA and other PFAS like perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS) are widespread and have been detected in blood samples of the general U.S. population and wildlife. These chemicals have been detected in 95-100% of samples of people's blood in the years 1999-2000 and 2003-2004. Recent monitoring data show the levels of these chemicals in people's blood appear to be declining. Based on the recent National Health and Nutrition Examination Survey data (2011-2012) the average blood levels are as follows:
    - PFOA: 2.1 ppb (95% of the general population at or below 5.7 ppb)
    - PFOS: 6.3 ppb (95% of the general population at or below 21.7 ppb)
    - PFHxS: 1.3 ppb (95% of the general population at or below 5.4 ppb)

    (ppb - parts per billion)
- People may be exposed to PFOS and PFOA from the air, indoor dust, water, food and numerous consumer products. Also, people may be exposed to these chemicals from treated carpets and upholstery; this is especially true for children.

- Food is anticipated to be the key source of exposure to these chemicals. Since these chemicals have been detected in human breast milk, infants may be exposed to these chemicals through breast milk.

- Workers in the perfluorochemical industry can be exposed to greater amounts of PFOS and PFOA than in general population.

How can PFOS and PFOA enter and leave the body?

PFOS, PFOA and other PFAS can enter your body if you breathe air, eat food or drink water containing them. It is not known how much will enter your body through your lungs or your gut.

Also, if PFAS come in contact with skin, it is possible that a small amount may enter the body through your skin.

PFAS tend to remain unchanged in the body for long periods of time. PFOA and PFOS stay in the body for many years. It takes nearly four years for the level in the body to go down by half. PFAS leave the body mainly through urine.

How can PFOS and PFOA affect people's health?

- The human health effects from exposure to low environmental levels of PFOS and PFOA are not known.

- Some of the available studies suggest that increase in blood cholesterol levels are associated with higher PFOS and PFOA blood levels.

- There is some indication that serum PFOS and PFOA may be associated with increased uric acid levels, which may be associated with an increased risk of high blood pressure.

- Exposure to PFOS and PFOA may cause liver damage. Studies in mice found that the immune system is a sensitive target for PFOS and PFOA; health effects include decreases in the size of the spleen, thymus and impaired immune system. The ingestion of PFOA contaminated water was found to cause adverse health effects on mammary gland development in mice. Also oral studies on rodents have raised concerns about potential development, reproductive and other systematic effects of PFOA and PFOS.

- Humans and rodents react differently to PFOA and PFOS and not all of the effects observed in rats and mice may occur in humans. The liver appears to be the most sensitive target in animals ingesting PFAS. The health effects include increases in liver weight, changes in liver cells, change in blood cholesterol, and triglycerides levels.

- There are some studies that suggest that a possible relationship between exposure to PFAS and health effects, but other studies do not show a correlation between exposure to PFAS and health effects. Because of the contradictory findings, more research is needed to understand the health effects of exposure to PFAS on humans.

Are PFOS and PFOA likely to cause cancer?

- Currently, there is no consistent scientific evidence that PFOS and PFOA cause cancer in humans. Some increases in kidney, prostate and testicular cancers have been seen in individuals exposed to higher levels, mostly occupational exposures. These results should be interpreted carefully since the effects were not found consistently across studies, there

were contradictory findings between studies, and exposure levels were much higher than generally seen in the general population.

- The International Agency for Research on Cancer and the U.S. Department of Health and Human Services have not evaluated the carcinogenicity of PFOS, PFOA and other PFAS.

- Currently, Environmental Protection Agency (EPA) is evaluating the carcinogenicity of PFOS and PFOA.

How are children more susceptible to potential exposures from PFOS and PFOA?

- Carpets treated with PFOS and PFOA can be an important source of exposure for children, because of hand-to-mouth exposure from environmental sources (carpets, dust, etc.). Children also can be exposed to higher doses of PFOS and PFOA for their body weight than an adult.

- It can also pass to a nursing infant through breast milk, since these chemicals have been detected in human breast milk.

- Possible affects in children include changes in growth, learning and behavior

- Health effects observed in children are similar to adults. A study of children exposed to high levels of PFOA in drinking water found increases in blood cholesterol.

- Some studies of the general population and people living near a PFOA manufacturing facility have found that higher levels of serum PFOA or PFOS are associated with lower infant birth weights.

- Based on animal studies, oral exposure to PFOA and PFOS has resulted in early death and delayed development of pups (mouse and rat). Also, alterations in motor activity have been observed pups (mouse) exposed to PFOA and PFOS. Scientist believe that some of the effects observed in animals exposed to PFOA and PFOS may not be relevant to humans.

- Currently, no associations between serum PFOA and birth defects were observed in children of mothers living in an area with high PFOA levels in the water, although more study is needed.

How can people reduce the risk of exposure to PFOS and PFOA?

- People may choose to use consumer products that do not contain PFOS, PFOA, and other PFAS.

- People whose well water contains these chemicals above EPA's drinking water advisory levels, may choose bottled water for drinking and cooking or install an activated carbon filtration system or reverse osmosis system.

Is there a medical test to determine whether a person has been exposed to PFOS and PFOA?

PFOS and PFOA as well as other PFAS can be measured in blood. The presence of these chemicals in your blood may indicate that you have been exposed to these chemicals. PFOA and PFOS have been measured in blood samples in 2009-2010 from a representative sample of the U.S. population; the geometric mean serum of PFOA and PFOS concentrations were 3.07 µg/L and 9.32 µg/L, respectively. Members of a community whose drinking water was contaminated with PFOA from a nearby industrial facility had a mean serum PFOA concentration of 83.6 µg/L in 2005. Workers in a PFC product facility, had mean serum PFOA and PFOS levels of 1,760 µg/L and 1320 µg/L, respectively.

However, this is not a regular blood test that can be conducted in a doctor's office. At present, it is not clear what detection of these chemicals in blood at any level means for a person's health. Also, the levels found in blood do not predict what health effects might occur.

Has the federal government made recommendations to protect human health?

- To provide Americans, including the most sensitive populations, with a margin of protection from a life-time of exposure to PFOA and PFOS from drinking water, EPA established the health advisory levels at **70 parts per trillion (ppt) or 0.07 µg/L.** When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be compared with the 70 parts per trillion health advisory level. This health advisory level offers a margin of protection for all Americans throughout their life from adverse health effects resulting from exposure to PFOA and PFOS in drinking water
- OSHA has not set any legal limits for PFAS including PFOA and PFOS in air.
- NIOSH has not set any recommended limits including PFOA and PFOS in air.

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References

Agency for Toxic Substances and Disease Registry (ATSDR), 2015. ToxFAQs™ for perfluoroalkyls.

ATSDR toxicological profile for perfluoroalkyls (draft for public comment) 2015.

ATSDR Public Health Statement for perfluoroalkyls, August 2015

ATSDR Source of Exposure to PFCs at http://www.atsdr.cdc.gov/pfc/sources_of_exposure.html

U.S. Environmental Protection Agency (EPA), 2014. Emerging contaminants – PFOS, PFOA.

National Institute of Environmental Health Sciences (NIEHS), 2012. Perfluorinated chemicals (PFCs).