FREQUENTLY ASKED QUESTIONS ABOUT AQUEOUS FILM FORMING FOAM

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What are the chemicals of concern in firefighting foam?

Aqueous film forming foam (AFFF) is used to extinguish Class B flammable liquid fires. They work by forming a foam and film coating around the liquid, which acts like a thermal and evaporation barrier to stop the combustion process. Up until recently, this was accomplished by using a fluorocarbon surfactant called perfluorooctane sulfonic acid (PFOS). In 2002, production of PFOS was banned in the United State and manufacturers switched to AFFF formulas that contain other fluorocarbon surfactants made through a process called telomerization. While these foams do not contain PFOS, they break down and form a hazardous byproduct called perfluorooctanoic acid (PFOA).[1]

PFOS and PFOA are part of a large family of compounds known as perfluoroalkyls. PFOS and PFOA are long-chain carbon (also referred to as C_8) man-made chemicals that do not occur naturally in the environment. PFOS and PFOA were made in large quantities and widely used for their ability to repel stains, grease, water, and oil. They were used to manufacture coatings and treatments for upholstery, carpets, packaging, clothing, and cookware, including the production of common household products such as Teflon and Scotchgard.

Why should we be concerned about PFOS and PFOA?

Perfluoroalkyls are released into the air, water, and soil around areas where they are manufactured or stored. PFOS, PFOA and other perfluoroalkyls are stable and do not break down naturally in the environment, so once they are released they remain in the water, air, or soil. Perfluoroalkyls can be transported to new areas through windy conditions, movement of groundwater, flooding, or food production. Because of their persistence in the environment, concentrations of PFOS and PFOA accumulate in people, wildlife, food sources, soil, and drinking water in locations across the globe.[2]

How are people exposed to PFOS and PFOA?

People can be exposed to PFOS and PFOA by inhaling contaminated airborne particulates, eating contaminated food, drinking contaminated water, or working with PFOS or PFOA containing materials such as AFFF. PFOS and PFOA can also be absorbed through the skin. Fire fighters working with AFFF can contaminate their clothing and PPE and potentially expose other people, including their family members.

Because of their widespread use and environmental persistence, most people in the U.S. have been exposed to perfluoroalkyls. PFOS or PFOA have been detected at low levels in blood serum samples of the general U.S. population. Higher blood serum concentrations have been detected in people that live near production facilitates or work with PFOS and PFOA.[3]

What are the health effects of exposure?

Once an exposure has occurred, PFOS and PFOA remains in the human body for a long time even if there are no more additional exposures. The half-life, which is the amount of time it takes for the concentration in the body to decrease by half, ranges from 2-9 years. This long half-life means that the chemicals remain the body where they can build up to concentrations that may cause health effects.

There is evidence suggesting that perfluoroalkyls can cause tumors in lab animals exposed to very high doses, particularly in the liver, reproductive organs, and pancreas. However, there is limited evidence that they cause cancer studies in humans. Studies among highly exposed populations have shown a small but insignificant risk of testicular, kidney, bladder and thyroid cancer related to PFOA and PFOS exposure.[3,4] The International Agency for Research on Cancer (IARC) classifies PFOA as a Group 2B carcinogen, meaning it is "possible carcinogenic to humans" based on limited evidence of carcinogenicity in humans and limited evidence in lab animals.[5] IARC has not evaluated the carcinogenicity of PFOS.

Studies on non-cancer health effects are also limited due to small study populations and inconsistent results; however research suggests that high exposures to perfluoroalkyls are associated developmental effects during pregnancy or breastfeeding, thyroid damage, increases in blood cholesterol levels, and liver damage.[6] Both PFOS and PFOA are corrosive and can cause damage to the skin and eyes.[7,8]

Are PFOS and PFOA regulated?

In 2000, the United States Environmental Protection Agency (EPA) and 3M, the manufacturer of PFOS, agreed to a voluntary phase out of production, which was completed in 2002. AFFF containing PFOS is no longer made in the U.S.

In 2006, the EPA and the eight major companies that manufacturer PFOA launched the 2010/15 PFOA Stewardship Program, in which companies agree to reduce emissions of PFOA by 95% by 2010 and phase out production by 2015.[9]

These voluntary phase outs do not affect existing products containing PFOS and PFOA. AFFFs that contain these chemicals may still be in use and are sources of potential harmful exposures to IAFF members and to the surrounding environment and community.

In May 2016, the EPA updated the PFOA and PFOS Drinking Water Health Advisory, which is a non-enforceable concentration established to provide the general U.S. population with a margin of protection from health effects related to drinking water contaminants. The health advisory for both PFOA and PFOS is 70 parts per trillion (ppt), or 0.07 parts per billion (ppb).[10] These are much lower than the older 2009 EPA Health Advisories, which were 0.4 ppb for PFOA and 0.2 ppb for PFOS.

What can be substituted for PFOS and PFOA in firefighting foams?

A suitable substitute for PFOS and PFOA in firefighting foams not only has to meet health and environmental standards, but it also must be effective at extinguishing Class B flammable liquid fires. The AFFF used in the U.S. military and in most civilian applications must meet specific requirements for surface tension established in Military Specification MIL-F-24385F to ensure its effectiveness against a wide variety of flammable liquid threats.

The EPA is currently reviewing safer substitutes for PFOS and PFOA as part of the 2010/15 PFOA Stewardship Program and the New Chemical Program as the manufactures phase out production of PFOA. One suitable substitute is AFFF that contains certain fluorocarbon surfactants with fewer than six carbons (also referred to as C_6 or fluorotelomer foam) made through telomerization. These foams do not form PFOA when they degrade and are generally less toxic and less persistent in the environment compared to the longer chain PFOA.[11]

Another option is to develop an effective AFFF that is free of fluorocarbon surfactants altogether, which eliminates the environmental and health hazards associated with PFOS and PFOA. A number of these foams are currently on the market; however they may pose more severe short term health effects and higher aquatic toxicity compared to foams with fluorocarbon surfactants due to the increased detergent additives needed to improve the performance of the foam.[12] While available for commercial and civilian uses, these foams may not meet the more stringent U.S. military performance standards.[13,14]

What can I do to reduce my risk of exposure?

Until a safer, non-toxic alternative AFFF that meets the standards necessary to flight Class B fires is made available, there are several work practice controls that should be put in place to avoid exposures.

- When possible, replace older AFFF stocks, or those labeled "C_8 AFFF," with a safer alternative. If appropriate, fluorine free foams can be used, but for certain military operations, C_6 formulas of fluorotelomer foam may be used.
- Avoid the use of AFFF containing fluorocarbon surfactants for training exercises to limit fire fighter exposure and environmental contamination
- Discharged foam and water run-off of AFFF must be managed and contained so that it is not released into the environment. Prevent run off from entering sewers, storm drains, soil, or bodies of water.
- Dispose of old or spent foam per manufacturer's guidelines.
- Wear PPE whenever handling AFFF
- Any PPE that comes into contact with AFFF should be washed per manufacturer's instructions immediate following the incident.

- See you physician in case of exposure. Perfluoroalkyls can be detected in the blood, but this is not a routine test. The average concentration of PFOA and PFOS detected in the blood samples from the U.S. population from 2009-2010 were 3.07 and 9.32 μg/L, respectively. Exposures are much higher for people living or working near productive facilities. For example, average concentrations from employees working at one facility with PFOA and PFOS were 1,780 and 1,320 μg/L, respectively.[2]

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