Chemical & Material Risk Management Directorate,
Office of the Under Secretary of Defense for Acquisition, Technology & Logistics

Chemical & Material Emerging Risk Alert

Aqueous Film Forming Foam (AFFF)

Some legacy AFFF formulations contain chemicals that present human health and environmental risks and require special handling and disposal.

What is AFFF?

AFFF is a fire suppressant used to extinguish flammable liquid fires such as fuel fires. The Department of Defense (DoD) uses AFFF in shipboard and shore facility fire suppression systems, fire fighting vehicles, and at fire training facilities. AFFF is purchased as a concentrate, typically referred to as "3%" or "6%" (Type 3 or Type 6, respectively) depending on its mixture ratio with water. AFFF used by the military must satisfy Military Specification MIL-F-24385F requirements.

What are PFOS and PFOA?

Perfluorooctane sulfonate (PFOS) is a long-chain perfluorinated compound (PFC) either present in legacy stocks of AFFF or a potential breakdown product of PFOS-based AFFF. Perfluorooctanoic acid (PFOA) is also a long-chain PFC. PFOA is not an ingredient in AFFF, but long-chain fluorotelomer-based AFFFs can break down to PFOA. PFOS, PFOA, and other long-chain perfluorinated compounds are found widespread at low levels in humans and the environment, bioaccumulate in the food chain, resist degradation, show evidence of toxicity in laboratory studies, and are the subject of increasing regulation worldwide.[1] Prior to 2000, most fluorosurfactants used in the AFFF military specification (mil spec) were PFOS-based which resulted in AFFF that contained PFOS or PFOS pre-cursors. During that time, AFFFs based on long-chain fluorotelomers were also available for mil spec use. Shortly after the manufacturing phase out announcement by 3M, Inc. of PFOS-based products in 2000, mil spec PFOS-based AFFFs were no longer available. The primary supply of AFFF then became fluorotelomer-based. Over the last several years, manufacturers of fluorotelomer AFFF have been replacing long-chain fluorosurfactants with short-chain fluorosurfactants. The PFCs in current fluorotelomer-based AFFF are shorter chain molecules and tend to be less bioaccumulative and toxic. Telomer-based AFFF does not contain PFOS but may contain trace amounts of PFOA.

PFOS-Based AFFF

How do I determine if I have PFOS-based AFFF?

Due to their long shelf lives, legacy AFFF, including PFOS-based AFFF concentrate, may still be present in your inventory. Through 2001, the DoD purchased AFFF from 3M and/or Ansul Inc. 3M supplied PFOS-based AFFF under the product name, 3M Light Water AFFF. Ansul supplied a telomer-based AFFF to the DoD.[2] If the product name and/or purchase date cannot be determined, a sample can be sent to an analytical laboratory to determine the presence or absence of PFOS. Users are advised to compare sampling costs and disposal costs. It may be more cost-effective to properly dispose of limited quantities of unknown PFOS content material rather than pay for sampling and analysis.

Can stockpiles of PFOS-based AFFF continue to be used?

Yes, PFOS-based AFFF can continue to be used in the United States; however, the discharge of wastewater containing AFFF can be regulated under the Clean Water Act. The potential liability from a release during

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use of PFOS-based AFFF should be weighed against the cost of disposal and resupply in determining whether to dispose of or maintain PFOS-based AFFF in your inventory.

How can I dispose of PFOS-based AFFF?

PFOS, PFOA and other perfluorinated acids are highly stable and generally recalcitrant to low energy forms of treatment (e.g. conventional wastewater systems). Industry recommendations for disposal of AFFF concentrate is by thermal destruction at a facility capable of handling halogenated waste or the equivalent. Contact your installation's environmental or hazardous waste management office for assistance.

What environmental risks may be associated with the historic storage, use and disposal of PFOS-based AFFF?

Although not allowed for use today, DoD has used unlined earthen areas/basins at many installations to support live firefighting training activities. These activities may have resulted in soil and groundwater contamination. AFFF releases also may have occurred at AFFF storage tanks and transport lines, accident/emergency response sites, and near facilities (e.g., aircraft hangers) with AFFF fire suppression systems.

As PFOS is subject to restrictions under certain international treaties, restrictions on the use and/or disposal exist in some countries. The European Union requires the removal of all PFOS-based AFFF from service by 27 June 2011.[3] In Europe, some Services may have specific policy on the management and disposal of PFOS-based AFFF and resupply of conforming AFFF.[4]

The U.S. Environmental Protection Agency (EPA) has developed Provisional Health Advisories (PHA) for PFOS (0.2 micrograms per liter [µg/L]) and PFOA (0.4 µg/L) to protect against potential risk from exposure to these chemicals in drinking water.[5] PHAs reflect reasonable, health-based hazard concentrations above which action should be taken to reduce exposure. State regulatory agencies (e.g., Minnesota, New Jersey, and North Carolina) also have established guidance or action levels for several PFCs in drinking water, groundwater, and soil.[6]

Very limited environmental sampling data exist for PFCs as they were not typically sampled for during site characterization. However, analytical results from sampling conducted at three DoD firefighting training areas showed concentrations of PFOS and PFOA in groundwater several orders of magnitude greater than the EPA PHA values.[2]

If records indicate your facility may have experienced AFFF leaks, spills or releases to the environment, refer to DoD Instruction 4517.18 for principles to follow in determining what site specific characterization, assessment, and risk management actions you should take.[7]

Currently, there are no *in situ* technologies and very limited *ex situ* options to treat soil or groundwater contaminated with PFCs. Thermal treatment is typically used for contaminated solids while granular activated carbon is the most effective water treatment method.[8] The DoD Strategic Environmental Research and Development Program is funding research to develop innovative treatment technologies for PFCs.[9]

Telomer-based AFFF

Do telomer-based AFFF concentrates meet DoD military specification requirements?

Current fluorotelomer-based AFFF concentrates that satisfy the requirements of Mil Spec MIL-F-24385F are listed in the DoD Qualified Products Database (QPD) (https://assist.daps.dla.mil/online/start/). In order to ensure that the AFFF you purchase meets MIL-F-24385F specifications, it must be listed in the DoD QPD. Because the QPD is updated periodically, the QPD should be checked before each AFFF purchase.

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Do telomer-based AFFF concentrates meet current EPA standards? Will releases trigger cleanup requirements?

Manufacturers have developed new short-chain telomer-based AFFF formulations in coordination with EPA. EPA has approved over 100 pre-manufacture notices for new products that are based on C_6 telomer chemistry.[1] EPA considers the shorter chain compounds to have lower bioaccumulation potential and toxicity than the longer chain PFCs used in legacy AFFF. Fluorotelomer manufacturers can be contacted for advice on how best to distinguish the legacy long-chain telomer-based AFFF products from the newer short-chain telomer-based formulations.

A one-time release of telomer-based AFFF for emergency fire suppression would not be expected to result in levels of contamination requiring cleanup. However, uncontrolled repeated applications of AFFF at firefighting training areas could be expected to contaminate soil and groundwater and thus these activities need to be managed.

How can I control releases of AFFF in the future?

Follow applicable DoD and industry standards on the design, installation, and maintenance of foam systems, extinguishers, and firefighting training areas. DoD Unified Facilities Criteria (UFC), DoD Unified Facilities Guide Specifications, and Component-specific design documents contain relevant guidance. Provide for containment, treatment, and proper disposal of foam discharges through actions such as the use of double lined fire training pits and improved wastewater collection systems.

Minimize false discharges from fixed foam systems by using approved detection, actuation, and control systems as required by industry standards. Whenever operational situations allow, use non-fluorosurfactant training foams.

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Footnotes

[1] USEPA Long-Chain Perfluorinated Chemicals (PFCs) Action Plan. 30 December 2009. http://www.epa.gov/opptintr/existingchemicals/pubs/pfcs_action_plan1230_09.pdf.

[2] Schultz MM, Barofsky DF, Field JA. 2004. Quantitative Determination of Fluorotelomer Sulfonates in Groundwater by LC MS/MS (*and references herein*) 38:1828-1835.

[3] European Union Directive 2006/122/ECOF amending Annex 1 to Council Directive 76/769/EEC related to restrictions on the marketing and use of certain dangerous substances and preparations (perfluorooctane sulfonates). 12 December 2006.

[4] Headquarters United States Air Forces in Europe (USAFE) Policy for Management/Elimination of Aqueous Film Forming Foam containing Perfluorooctane Sulfonate (PFOS AFFF). October 2007.

[5] See USEPA–Perfluorooctanoic Acid (PFOA) and Fluorinated Telomers. http://www.epa.gov/opptintr/pfoa/pubs/pfoainfo.html#provisional.

[6] See http://www.pca.state.mn.us/index.php/waste/waste-and-cleanup/cleanup-programs-and-topics/topics/risk-based-site-evaluation-process-guidance-documents.html for SRV Spreadsheets; http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html; http://www.state.nj.us/dep/watersupply/pfoa_dwguidance.pdf; http://h2o.enr.state.nc.us/csu/documents/15A2L-TANBOOK-1jan2010.pdf.

[7] DoD Instruction 4715.18. Emerging Contaminants (ECs). USD(AT&L). 11 June 2009.

[8] Water Treatment for PFOA and PFOS. Presented by Andrew S. Hartten, DuPont Corporate Remediation Group, at the PFOS and PFOA Science Presentation for EPA Office of Water. 16 October 2009. http://www.epa.gov/opptintr/pfoa/pubs/activities.html.

[9] See http://www.serdp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Emerging-Issues.

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