Advisory Information for Aqueous Film Forming Foam (AFFF) Containing Per- and Polyfluorinated Alkyl Substances (PFAS) August 2021

Massachusetts Department of Environmental Protection
Massachusetts Department of Fire Services

Brief

The use of firefighting Aqueous Film Forming Foams (AFFF) containing Poly Fluorinated Alkyl Substances (PFAS) are effective for "class B" fire suppression, but also pose health and environmental concerns. The Massachusetts Department of Fire Services and Department of Environmental Protection, in coordination with our partners in Connecticut, are advising fire departments to immediately cease using AFFF older than 2003 and reserve the use of current (post-2003) AFFF only when life safety is at risk. New AFFF "Fluorine Free Foams (3F)" are available and can be used without restriction.

Background

Per- and Polyfluorinated Alkyl Substances, commonly known as "PFAS", are a family of chemicals with a similar structure, numbering in the thousands. The chemicals are known for their strong carbon-fluorine bonds, and they vary by the length and structure of a carbon-chain backbone and a terminal functional group. These compounds are very stable and impart resistance from water, oil, grease, dirt, and heat to items on which they are applied. They have wide-ranging applications, such as in grease-resistant microwave popcorn bags and pizza boxes, waterproof clothing and boots, carpets that resist stains, pipes and wires that resist corrosion, and certain firefighting foams.

Recent toxicological studies have indicated there is a health concern when people are exposed to PFAS, even to low concentrations. Because of their stability, PFAS do not readily break down in the environment or in the human body. Possible health effects associated with exposure to PFAS compounds include low infant birth weights, effects on the immune system, cancer, and thyroid hormone disruption (Ross, R.). Concerns about PFAS have focused on what are called "long-chain" versions of these compounds, typically compounds with six or more carbon atoms linked together in a chain. Two of the most studied PFAS are eight-carbon chain versions, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). As of 2015, neither PFOA nor PFOS are manufactured in the U.S., having been voluntarily phased-out of production starting in 2006. However, other PFAS, including "short-chain," have been developed as replacements for PFOA and PFOS in manufacturing, and these replacement compounds are less well studied.

The Massachusetts Department of Environmental Protection (MassDEP) has established a drinking water standard[1] of 20 ng/L (parts-per-trillion, or "ppt") for the total of six PFAS chemicals – perfluorohexane sulfonate (PFHxS), perfluoroheptanoic acid (PFHpA), PFOA, PFOS, perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA). In addition, MassDEP has established Reportable Concentrations (RCs) and cleanup standards in soil and groundwater for the same six PFAS compounds.[2]

PFAS and Firefighting Foam

Firefighting foam can be broken down into two main categories: Class A and Class B.

[1] Massachusetts Maximum Contamination Level (MMCL), 310 CMR 22.00
[2] Massachusetts Contingency Plan, 310 CMR 40.0000

Class A foams do not contain PFAS and are safe to use for their intended purpose. They are covered under NFPA 1150 (Standard on Foam Chemicals for Fires in Class A Fuels). The intended purpose is to reduce the surface tension of the water to allow for more water to burning material surface contact, which allows for faster fire extinguishment. There are no restrictions on the use of Class A foams.

Class B foams often contain PFAS, in addition to other chemical precursors. These different types of foams can be divided into numerous tactical categories with respect to expansion rates (low, medium, and high) and compatibility with different types of fuel (polar and non-polar flammable liquids). ***Importantly, all Aqueous Film Forming Foam (AFFF) products contain PFAS*** (ITRC 2018). This guidance document is focused on PFAS-containing AFFF, Alcohol Resistant AFFF (AR-AFFF), and fluoro-protein foam; the foam's potential to be a hazard to responders who use the foam; and its ability to create an adverse environmental impact if released uncontrolled to the environment. This is particularly the case if the PFAS foam solutions reach drinking water sources, groundwater, or surface waters. With regard to health and environmental concerns, the Class B foams are broken down into four categories:

- **Legacy PFOS Foams**, which contain long-carbon-chain fluorinated compounds (C8), specifically PFOS and PFOA, manufactured prior to 2003 by 3M and sold under the brand name "Lightwater" (ITRC 2018).
- **Legacy Fluorotelomer Foams** (contain some long-chain PFAS) manufactured from the 1970s until 2016 and include all other brands of AFFF. These foams contain polyfluorinated precursors that may chemically transform to PFOA and other PFAS in the environment, and contain PFOA as a by-product of manufacturing (ITRC 2018).
- **Modern Fluorotelomer Foams** which were manufactured from around 2010 to present, contain almost exclusively short-chain (C6) fluorotelomers or short-carbon-chain fluorinated compounds that may still have trace levels of PFOA and PFOA precursors as a byproduct of manufacturing (ITRC 2018).
- **Fluorine-Free Foams**, which do not contain fluorinated compounds.

Recommendations from DFS and MassDEP are:

- **Discontinue the use of legacy PFOS and legacy fluorotelomer foams (pre-2003)**.
- **Use modern fluorinated foams only when absolutely tactically necessary**. Some examples include, but are not limited to:
    - For vapor suppression of unignited flammable liquids at an incident with a life safety hazard, such as a motor vehicle accident with patient entrapment with a gasoline spill.
    - For vapor suppression of unignited or burning flammable and combustible liquids to protect significant property.
    - For vapor suppression of unignited flammable liquids at an incident where ignition sources cannot be controlled.
    - For vapor suppression of highly evaporative toxic liquids where the vapor plume may cause health issues to the public and/or responders.
    - Extinguishment of ignited flammable liquids. Note: AFFF and AR-AFFF (ATC-AFFF) foams are NOT intended for use on three-dimensional fires (those that are sprayed as a mist/droplet or flowing liquids). As such, the use of foam in this application will prove to be ineffective.
    - If there is no life hazard or significant property at risk and ignition sources can be controlled, do not use firefighting foam.
    - At a fire where the fuel is burning plastics rather than the flammable or combustible liquid, such as a car fire, the use of straight water or water with a fluorine free additive that meets NFPA 1150 or NFPA 18A (Water Additives for Fire Control and Vapor Mitigation) additive is recommended.
- **Discontinue the use of modern fluorinated foam for training.**
    - There are fluorine free training foam concentrates available.

- **Notification**
  - When PFAS firefighting foam is used, please make a courtesy call to MassDEP Emergency Response 24/7 at 888-304-1133
- **Replace current PFAS foams with Fluorine Free Foam (3F)**
  - A committee has been formed to address the need to find a replacement Class B foam that is fluorine-free and meets UL-162, the Standard for Foam Equipment and Liquid Concentrates. This committee is comprised of members from the Massachusetts Department of Fire Services, Massachusetts Department of Environmental Protection, Connecticut Commission on Fire Prevention and Control, the Connecticut Department of Energy and Environmental Protection (CT DEEP), the Petroleum Industry, and Fire Service leaders. In partnership, several 3F foams were tested and confirmed to be fluorine-free.[3] In addition, the committee recommends review of the independent GreenScreen certification of fluorine free foams.[4]
- **Decontamination**
  - MassDEP and CT DEEP have also formed a workgroup to evaluate the decontamination of firefighting equipment (concentrate storage trailers, tanks, piping, etc.) used for legacy and current PFAS-containing foams. This is an ongoing project and results should be available shortly.
- **Funding**
  - MassDEP will continue to fund the "legacy foam" (pre-2003) takeback and disposal program.
  - MassDEP, DFS, and the Fire Chiefs Association of Massachusetts (FCAM) are working together to seek funding to include the collection and proper disposal of current PFAS foams and possibly to purchase replacement foam.

For additional information regarding this Advisory please contact any of the following:

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References:

- Ross, Racheal (April 30, 2019 02:57 pm ET). https://www.livescience.com/65364-pfas.html May 3, 2019
- Interstate Technology and Regulatory Council (ITRC) Firefighting Foam web page https://pfas-1.itrcweb.org/3-firefighting-foams/#3_7

[3] Future PFAS-related information from MassDEP will be available through the MassDEP PFAS web page at https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas

[4] GreenScreen Certified ™ for Firefighting Foams https://www.greenscreenchemicals.org/certified/fff-standard