AFFF & AR-AFFF Fluorine Debates

In this piece I will address the facts as I understand them surrounding the role fluorine based AFFF fluorosurfactant components play in the current U.S. fire service dialogue as they relate to bio-persistent and environmental persistent issues.

Executive Summary
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The US EPA have initiated a voluntary program for flurosurfactant producers, not fire foam manufacturers, to move to a less persistent “telomer" based chemistry. This voluntary program has most flurosurfactant producers moving toward the preferred telomer chemistry by end of 2015. This does not mean the foam concentrate purchased in 2010 - 2014 is somehow going to be banned or regulated differently going forward. In the United States, what you have you can use…

The U.S. EPA have not banned and I understand they have no intent to implement future bans on the use of modern fluorotelomer based surfactants used to formulate AFFF firefighting foams. They have, however, banned new U.S. manufacture and or importation of fluorosurfactants for use in any products, including AFFF using the dated, electrochemical manufacturing processes which produces bio-persistent and environmental persistent compounds. This was most notable in 3M’s Light Water® products and the primary reason for their withdrawal from the firefighting foam market in 2000.

Fluorosurfactants

Fluorosurfactants in synthetic firefighting foams are the components responsible for lowering water’s surface tension, allowing it to form a light aqueous film that spreads across hydrocarbon based liquid fuels, preventing flammable vapor escape. Fluorosurfactants are also responsible for fast foam spread across hydrocarbon based liquid fuels, providing unequaled knockdown, extinguishment time and burn-back security.

Hydrocarbon Surfactants

Hydrocarbon surfactants are the foaming component in the product and are not part of the recent fluorosurfactant debate. Fluorosurfactants are fuel shedding and hydrocarbon surfactants are fuel attracting. Class A foams are primarily based on hydrocarbon surfactants and is why class A foams are not a safe choice for fighting or securing liquid fuel fires. The proportional balance between the two surfactants in a water solution is what makes AFFF the agent of choice when it comes for high performance, flammable liquid fuel firefighting.

Polysachccharides

The addition of a polysachccharide, known as xanthan gum is what makes AFFF alcohol resistant. Polysachccharides contribute the self shearing (visco-elastic) property to AFFF foam concentrate, allowing the more viscous AR concentrates to flow freely when poured, vacuumed, or pumped. Not unlike tomato catsup when the bottle is lightly squeezed. AR-AFFF foams rely on the same surfactants that are found in regular, non-alcohol resistant AFFFs. Polysachccharides are not at issue in the on-going environmental dialogue surrounding AFFF and flurosurfactants.

Per-Fluoro-Octane-Sulfonate (PFOS) / Per-Fluoro-Carboxylic-octanoic Acid (PFOA)

What is at issue are per-fluoro-octane-Sulfonate (PFOS) And per-fluoro-carboxylic-octanoic acid (PFOA) These fluorocarbon surfactants are made from an electrochemical process which employ the very sturdy fluorine molecule. Their long chain carbon tails are the components responsible for water/foam solution's fuel shedding and fast spreading properties when AFFF is applied to hydrocarbon liquid fuels.

Other popular uses of the PFOS and PFOA surfactants were, among others, as water and stain repellent treatments in textiles and fast food contact paper.

PFOS and PFOA have been discovered in human and wildlife blood serum and are known to be bio-persistent. Moreover PFOS and PFOA's have been found in soil and water environments on a world-wide scale and are also known to be environmentally persistent. It is important to note that no health hazards have been linked to normal background levels of these fluorinated compounds.

The electrochemical manufacturing process which created bio-persistent PFOS and PFOA has been abandoned by all, with the exception of products produced in China.

Fluorotelomer Surfactants

Fluorotelomer surfactants are created using a telomerisation process, which create a non-bio-cumulative surfactant, however, they can still be persistent in the environment. No health hazards have been linked to normal background levels of these surfactants, however, the lower the carbon number, the less persistent they will be in the environment. The food contact paper and textile industries have also replaced the electrochemical surfactants with fluorotelomer surfactants.

In any case, the fact that they are environmentally persistent gives pause and has been at the root of the fire foam industry's ongoing, voluntary chemical component improvement initiative, causing foam product reformulation which will replace telomor-surfactants containing higher carbon chain lengths, like C8 (eight carbons) with a C6, (six carbon) telomor-surfactant by the end of 2015.

U.S. EPA Bans

The U.S. EPA have had for several years a ban on producing new products or substances containing electrochemically produced PFOS and PFOA., By end of 2013 most AFFF fire foams in the U.S. containing electrochemically produced surfactants should have been voluntarily removed from system inventories.

<u>It must be noted that the U.S. EPA have not banned the use of existing AFFF stocks, and at this time disuse is strictly voluntary in the U.S. - In Europe and Canada the ban is now mandatory, which requires disuse and disposal.</u>

Performance Issues

Since it is the fluorosurfactant's chemical structure and carbon chain that contribute to the surfactant's ability in water solution to quickly spread and resist fuel pick up, it is logical that reductions and changes in the chain length will affect performance or at minimum, create performance challenges during the reformulation process. Manufacturer's will be re-qualifying and re-certifying their products with 3rd party approval agencies which, depending on approvals and listings can take quite some time. Manufacturers must also be taking special care to make sure the new C6 generation products are compatible in storage with past acceptable mixed chain length products. Eventually passing results in firefighting performance tests of: Underwriters Laboratory (UL162), Factory Mutual Systems, U.S. Navy (mil F24385) and U.S. Coast Guard will be achieved. Each entity having slightly different test parameters and unique firefighting challenges. When it comes to firefighter safety and survivability, firefighting performance is the primary mission when formulating for the future. I am confident the industry will not back-track in this regard.

2015 Deadline

All major manufacturer's have had success with C6 AFFF and C6 AR-AFFF formulations. Currently there are limited C6 fluorsurfactant candidates that exist, more will come on line after time consuming regulatory approvals are complete; added to that are time consuming performance tests of new C6 formulations by 3rd party agencies. The result will likely see use of C6 and C8 blends through and perhaps past 2015.

Fluorine-free Firefighting Foams

Fluorine-free (hydrocarbon surfactant based) firefighting foams are now available from several manufacturers and have in some cases achieved pass results in certain performance tests. At this point I know of no synthetic, fluorine free firefighting foams which have past: U.S. Navy mil. F24385 or U.S. Coast Guard firefighting performance tests, and I know of none that will equal the burn-back or fuel pick up resistance of AFFF and AR-AFFF's using modern fluorotelomer surfactants as their backbone chemistry.

In addition, acute fish toxicity test levels of fluorine free firefighting foams which can be many times higher than C6 and or C8 AFFFs or AR-AFFFs.

Finally

As the U.S. Fire Service and its related industries continue to make greater efforts in obtaining and developing life and property saving products, be steadfast in your review and demands for high performing firefighting products which are acceptable in terms safety and survivability with a heightened sensitivity for their impact(s) on the environment.

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