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AFFF Fluorine Facts



Jim Cottrell

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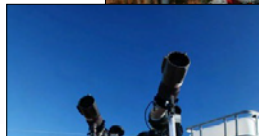
Jim Cottrell
foamguy@me.com

New England Fire Mechanics & Service Tech. Assn.
Annual Luncheon Presentation 2013

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Manufacturing

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Marine foam firefighting systems consulting



AFFF Fluorine Facts Show FTS.key - December 5, 2013

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What Make AFFF's Work

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What Make AFFF's Work

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Adding a Scotch-Guard® like chemical (fluorosurfactant) to water changes its surface tension to the point where water floats on oil base fuels (hydrocarbon). Hence the term aqueous film, or "light water®".

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Adding a foaming hydrocarbon surfactant similar to shampoo's foaming ingredient allows the agent to foam, or froth.

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Foam solution drains on contact from the foam blanket spreading a vapor suppressing film across the fuel surface. The microscopic thin water film is supported by the fuel's surface tension. The AFFF fluorosurfactant component creates a fuel shedding solution allowing forceful, plunging fire stream application and or sub-surface injection.

Aqueous film forms on contact



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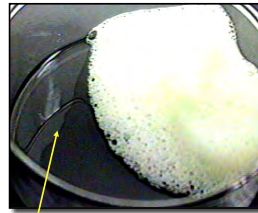


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Need Apple QuickTime Player



U.S. Navy film forming video clip. Film spread rate must be greater than eight feet per minute.



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Fluorine Makes It Happen

The 3M Company pioneered an electrochemical fluorosurfactant manufacturing process, which created Scotch Guard® type products in the early 1960's. Electrochemical fluorosurfactants for AFFF were produced till 2000 mainly by the 3M Company.

Fluorosurfactants are commonly found in printer's ink, paint, food contact paper and fabric coatings.



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In the 1990's trace byproducts of electrochemical fluorosurfactants were found on a world-wide scale as persistent contaminants in blood serum of humans, animals, soil and water. These compounds are known as perfluoro-octyl-sulfonates (PFOS and PFOAs).

No health hazards have been linked to normal background levels of these compounds. However, in the late 1990's the persistent nature of these compounds caused industry to abandon bio-persistent electrochemical fluorosurfactant compounds and replaced them with safer compounds manufactured using a telomerization process.



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U.S. EPA's Position

The U.S. EPA have had for several years a ban on producing substances containing electrochemically produced PFOS and PFOA. By end of 2013 most AFFF fire foams in the U.S. containing PFOS and PFOA surfactants should have been voluntarily removed from system inventories. National Foam's AFFF products have not contained PFOS or PFOA fluorosurfactants for many years.

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 of AFFF's containing PFOS & PROAs'



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The Fluoro-Fix: Fluorotelomer Surfactants

Fluorotelomer surfactants are not biologically persistent, but are, to some extent, environmentally persistent. Therefore U.S. firefighting foam manufacturers are following the U.S. Environmental Protection Agency's (EPA) 2010/15 PFOA Voluntary Stewardship Program by reducing the more environmentally persistent eight carbon chain (C8) telomersurfactant with a less persistent, six carbon chain (C6) telomersurfactant, which should be complete by 2015.

NOTE:
There are no state or federal regulations mandating the elimination of telomor based surfactants regardless of carbon chain lengths.



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Fluorine Free, Synthetic Firefighting Foam



Fluorine-free, Class A foam-type (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: UL 162 type III, 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.

Note: These foams do not do well under UL 162, type III, Fire Dept. application techniques where foam streams are plunged into fuel spills.



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Foam Lines - November 2013

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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 Jim Cottrell

The US EPA have initiated a voluntary program for fluorosurfactant producers, not fire foam manufacturers, to move to a less persistent "telomer" based chemistry. This voluntary program has most fluorosurfactant producers moving toward the preferred telomer chemistry by end of 2015. This does not mean the foam concentrate purchased in 2010, 2011, 2014, 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 intention to ban the manufacture and use of modern fluorotelomer based foams used to extinguish AFFF firefighting foams. They have, however, banned the manufacture and importation of fluorosurfactants for use in any products, including AFFF, that are persistent, electrochemical manufacturing processes which release and are environmentally persistent compounds. This was most applicable in the U.S. for firefighting products and the primary reason for their withdrawal from the firefighting foam market in 2000.

Fluorotelomer surfactants are synthetic firefighting foams and 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 unequalled 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.

Polysaccharides
The addition of a polysaccharide, known as xanthan gum is what makes AFFF alcohol resistant. Polysaccharides 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. Polysaccharides are not at issue in the on-going environmental dialogue surrounding AFFF and fluorosurfactants.



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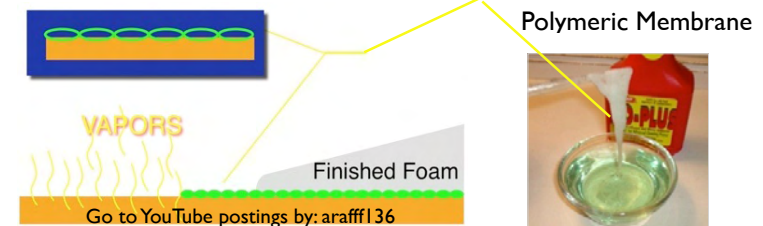
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Alcohol Resistant - Aqueous Film Forming Foam

On simple hydrocarbons AR-AFFF's release an aqueous film.

AR-AFFF's contain a polymer (sugar) in their bubbles which detect solvents and changes to a liquid Saran Wrap-like film, which blocks water in the foam blanket from being attacked by alcohol from below. AR-AFFF's tend to be longer lasting (slower draining) than regular AFFF's



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Alcohol Resistant Foam Concentrate Users

Mixing unlike foam can be system fatal...

Half cup alcohol based class A foam or regular AFFF and a shot glass of AR-AFFF can do this in minutes.

The AR-AFFF's polymer is doing what it should... in your tank, rather than on a spill...

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Foam Concentrate Tanks:

- No - aluminum
- No - mild steel
- Yes - poly & fiberglass
- Yes - stainless steel

Flooded Plumbing & Valves:

- Yes - stainless steel
- Yes - brass & copper
- Yes - threaded PVC, schedule 80
- Yes - poly & EPDM flex hose



- No - mild steel
- No - galvanized pipe
- No - PVC, schedule 40 - to brittle at low temperature.

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No - Air brake hose & component fittings (o-ring material incompatible need; buna-N)

Note: Use 3/4" (id) or larger plumbing for 95 - 125 gpm class B systems

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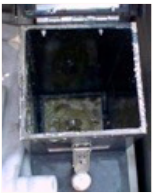

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Important to keep full tanks

Foam concentrate sloshing around will turn concentrate into a froth. The greater the air space the the worse it gets.

AR-AFFF concentrate may take weeks to calm down, if at all. This condition can cause VERY lean proportioning.

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Foam liquid in the container, before it's mixed with water.



CONCENTRATE



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Store foam as if it were latex paint.
Keeping it from evaporating is mission critical.



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