



# Foams for Fixed Systems:

## Fluorosurfactants Add Effectiveness

The negative publicity surrounding 3M's phase out of PFOS-based fire fighting foams in 2002, and the subsequent speculation that telomer-based foams might also be regulated, has contributed to a shift in recent years in the types of fixed foam systems being installed in aircraft hangars, warehouses, and other similar applications. Now that environmental authorities have decided on a voluntary stewardship approach and telomer-based foams have not been regulated, it might be time to re-evaluate what are the best agents for use in fixed foam systems.



By Tom Cortina

Fire Fighting Foam Coalition ([www.ffc.org](http://www.ffc.org))  
and

David Owen

Firemain Engineering  
([www.firemain.com](http://www.firemain.com))

### Overview of Fixed Foam Systems

From foam-enhanced sprinklers to high expansion generators, foam is used in fixed systems to deal with a bewildering variety of fire scenarios. However, one thing that they all have in common – with very few exceptions – is that flammable liquids are the fuel source. And when dealing with flammable liquids, using foam that contains fluorosurfactants usually provides the highest level of fire suppression capability.

The science simplified: foam provides a barrier against flammable liquid vapors without aggressively mixing with the product and enhancing the volatility of fire from the fuel – water alone doesn't float on hydrocarbons and only serves to make matters worse. On the other hand, foam, especially when it contains fluorosurfactants, suppresses the burning vapor by forming an aqueous film on top of lighter fuels.

How we proportion the foam concentrate with water, and to what extent we expand it, is determined by the application. It is perhaps more informative to look at the applications first to help understand what choices there are to be made.

### Foam Enhanced Sprinklers

Water is a fantastic firefighting medium, no question. However, sometimes it needs a little help when being delivered through sprinkler systems. Where a site has a large inventory of plastic material or where the storage medium itself is plastic, as in the case of

tote bins, adding foam into the sprinkler nozzles via a bladder tank gives enhanced fire control. This is classed as un aspirated foam. In other words, there is no mechanism built into the system for entraining air into the foam to give any expansion. Because the foam is only expanded to what might crudely be called a "milky effect," the foam concentrate itself needs to be aqueous film forming – AFFF.

### Foam Deluge Systems

The difference between deluge and sprinklers, whether we use foam or not, is simply that in a deluge system a whole zone will actuate and apply water or foam to the hazard. The detection line is separate and controls the opening of a deluge valve to supply foam/water to the hazard. A range of detection options are available from simple air charged lines with detector bulbs through to triple spectrum UV/IR flame detection. Because deluge systems use open nozzles we have the option to aspirate the foam so that it becomes low expansion rather than un aspirated. This is achieved with the use of nozzles that entrain air and give an expansion ratio of up to 20:1 but typically lower. A relatively gentle application of aspirated foam is to be preferred where solvents in particular are stored. Process hazards are typically where deluge systems are to be found. Because these are low-expansion systems, they usually contain fluorosurfactant foam such as AFFF or FFFP.

### Medium Expansion Pourers

Using the same methods of proportioning and foam storage, we can expand most of the commonly available foams up to 200:1. This provides a substantial foam blanket but with very limited throw from discharge devices. It's ideal where a gentle application is preferred and where spillage of flammables is contained. This is typically into bunds around tank farms and process areas where bunding is easily achieved whilst not hindering the means of escape. Medium expansion foam was particularly successful at the Buncefield incident for securing the bunds once the more volatile bund fires had been dealt with by monitors. Medium-expansion pourers can contain either non-fluorosurfactant detergent foam or fluorosurfactant foam such as AFFF or FFFP. Most of the foam used to secure the bunds during the Buncefield incident was fluorosurfactant foam.

### High Expansion Foam

Along with foam-enhanced sprinklers, this is another application where class B fires are not the only limitation to its use. Expanding foam to anything up to 1000:1 means that we have a very light and relatively dry finished foam. One of the main applications for Hi Ex systems at present is the protection of aircraft hangars and warehouses. For aircraft hangars, NFPA allows a choice of options including Hi Ex, roof level low expansion AFFF deluge, and underwing monitor protection. In recent years Hi Ex has often been chosen in preference in part because of environmental concerns about fluorosurfactant foams and also because it produces far less firewater run-off, a significant issue when considering containment.

Despite these concerns, a recent report for the Canadian Department of National Defence recommended the use of overhead, closed head water sprinklers with low level, low expansion AFFF foam as the fire protection system of choice for aircraft hangars. According to the report, the proposed AFFF system scored the highest in both technical and cost evaluations, is very effective in asset fire protection with the AFFF agent utilized, has the ability to achieve rapid delivery and fire control, and is relatively simple to install and maintain as all foam components are located at low level.

### Environmental Update

Telomer-based foams do not contain or degrade into PFOS. They are not made with PFOA (perfluorooctane sulfonate), but may contain trace levels as a contaminant of the manufacturing process. Rather than regulate telomer-based products, environmental authorities such as the United States Environmental Protection Agency (EPA) have decided on a voluntary stewardship approach. Under the EPA's PFOA global stewardship program, telomer producers have committed to 95% reductions of PFOA, PFOA precursors, and related higher homologue chemicals by year-end 2010 and are working toward the elimination of these chemicals from both plant emissions and finished products by year-end 2015.

Members of the Fire Fighting Foam Coalition that make telomer-based fluorosurfactants and AFFF agents are in position to meet the goals of the global stewardship program before the 2015 target date with a family of all C6-based fluorosurfactants that provide the same fire protection characteristics with reduced environmental impacts. Incorporating these new fluorosurfactants will require some reformulation and likely some type of re-approval of most current AFFF, FFFP, and fluoroprotein foam products between 2010 and 2015.

A new study published recently by SFT related to fluorochemicals found at fire training facilities in Norway has drawn interest within the foam industry. The

SFT study confirms the findings of previous studies that the likely ultimate biodegradation products of the fluorosurfactants used in currently manufactured AFFF agents are persistent, but are not considered to be significant environmental toxins. The low bioaccumulation values developed in this study reinforce previous assertions of the general safety of these products. Because these studies were done at fire training areas where foams were released uncontrolled numerous times over many years, the findings should not be used to assess the impact of a one-time use of a fire-fighting foam to extinguish a fire, which would result in significantly smaller contaminant concentrations. Current accepted practice is to use fluorine-free training foams whenever possible as well as to collect and treat foam discharges when fluorine-containing foams are used for training or testing.

### Conclusions

There are a number of different types of fixed foam systems that use both fluorosurfactant and non-fluorosurfactant foams. Although there has been a small but discernable trend in recent years towards the use of non-fluorosurfactant foams, this trend has been fueled in part by speculation that telomer-based fluorosurfactant foams would be regulated. Now that environmental authorities have decided on a voluntary stewardship approach and telomer-based foams have not been regulated, it might be time to be far less anxious about telomer based foams and to continue to use the AFFF agents that have provided such proven fire performance in fixed and mobile fire protection.

### Fire Fighting Foam Coalition

The Fire Fighting Foam Coalition, Inc. (FFFC) is a not-for-profit trade association whose members are manufacturers, distributors and users of aqueous film-forming foam (AFFF) fire fighting agents and their chemical components. The Coalition represents members' interests on all issues related to the environmental acceptability of fire fighting foams. FFFC also helps to ensure that accurate information about PFOS alternatives, including telomer-based products, is disseminated to appropriate audiences. The Coalition is a clearinghouse for information, supports the development of industry positions, and interacts on behalf of members with relevant government organizations.

FFFC has provided extensive information on AFFF to environmental agencies in the United States, Europe, and Canada that includes the following:

- Amount of fluorosurfactant actives used in the manufacture of AFFF in the United States
- Chemical structure of the fluorosurfactants used in major fluorotelomer-based AFFF formulations
- Mechanics of film formation
- Groundwater monitoring data from US military fire training areas
- US Inventory of PFOS-based and fluorotelomer-based AFFF
- Overview of the different types of foams, the market channel for their distribution, and the environmental fate once they are used
- Aquatic toxicity of fire fighting foams

The following companies are represented on the Board of Directors of FFFC: Ansul (Tyco), Chemguard, DuPont, Dynax, and Kidde (UTC). All of us believe strongly in the value of our products and their potential for fighting fires quickly and safely. Our products have been proven to provide knock-down, resist burnback and secure the enflamed area in flammable liquid – or class B – fires. From aircraft fires to major flammable liquid spills, our products have provided quicker, more effective results with less risk to firefighters, less property damage and reduced environmental impact.