As a largely misunderstood firefighting tactic, the use of foam has at times been confusing to the fire service. The result is that many municipal brigades/departments have just avoided the use of foam, especially Class A foam and have transitioned to using emulsifiers or wetting agents. While the end objective is to stretch valuable and at times limited water resources, it is more important to fully understand the fit for purpose of each of these technologies. This assures that these valuable tools provide maximum benefit. Foam is a very effective firefighting tool for flame knockdown, fire control, extinguishment, and burn-back resistance (Class B foam). Control, extinguishing time, and burn-back resistance are paramount to the safety of firefighters everywhere. So where do we start?

What is Foam?
Firefighting foams have been in commercial use since the early 1900’s. The National Fire Protection Association in (NFPA) 11 – Standard for Low, Medium and High Expansion Foam, Section 3.1.10, defines foam as “a stable aggregation of bubbles of lower density than oil or water.” Foam is made up by three component parts: foam concentrate + water + energy. Energy can take the form of air or mechanical agitation and when added to foam solution (foam concentrate mixed with the appropriate amount of water) finished foam is produced through means of a discharge device. The finished foam is very fluid and readily flows over liquid surfaces to extinguish fire in four ways:

- **Excludes Oxygen**
  (separates fuel from vapor)

- **Cools Fuel Surface**
  (water content of foam)

- **Prevents Release of Vapors**
  (flammable fuel)

- **Separates Flame from Fuel Surface**

Class “B” Foam
While there are many different types of foam concentrates available on the market, the two most commonly used forms are Aqueous Film Forming Foam (AFFF) and Alcohol Resistant Aqueous Film Forming Foam (AR-AFFF). NFPA Standard 11, Section 3.3.12.1 defines AR-AFFF as “a concentrate used for fighting fires on water-soluble materials and other fuels destructive to regular AFFF or FFFP foams as well as for fires involving hydrocarbons.”

Section 3.3.12.2 defines AFFF as “a concentrate based on fluorinated surfactants plus foam stabilizers to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors and usually diluted with water to a 1%, 3% or 6% solutions.”

Each Class B foam concentrate is developed for a specific application. Some firefighting foams are thick and form a heavy, heat-resistant covering over a burning liquid surface. Other types of foams are thinner and because of that, they will spread much more quickly over the fuel surface. Still, other types
of foams will generate a vapor sealing film on the surface of the fuel. Additional foam concentrate types, such as medium and high expansion foams, can be used in applications requiring large foam volumes to flood surfaces and fill cavities within a hazard.

**Class “A” Foam**

Developed in the mid-1980’s Class A foam was predominately used for wild-land fires but as their popularity grew throughout the 1990’s the use of Class A foam was expanded for use on structural fires.

Class A fires consist of ordinary combustible materials such as paper, cloth, wood, and plastics. These type fuels require the heat-absorbing effects of water (cooling) or water solutions. Class A fires consist of two types: flaming combustion involving gases which result from the thermal decomposition of the fuel. The second type is deep-seated or glowing combustion. This type represents combustion within the mass of the fuel and has a slow rate of heat loss and a slow rate of reaction between oxygen and fuel.

As a synthetic based foam concentrate, Class A foam is applied at low concentrations ranging from 0.1% to 1.0% (see proportioning rates below). Cooling and wetting are the primary extinguishing mechanisms. The use of Class A foam makes “water wetter” on average increasing the effectiveness of water tenfold.

**Typical Class “A” Foam Proportioning Rates**

- Exposure Protection: 1.0%
- Fire Brake: 0.75%
- Initial Suppression or Fire Lines: 0.5%
- Overhaul: 0.25%

These proportioning rates make the use of Class A foam a cost effective means of combating fires because smaller amounts of foam concentrate can be used to make effective foam. Class A foam is biodegradable and non-toxic, so it is environmentally sustainable. Class A foam is deployed through a variety of portable and fixed appliance devices ranging from firefighters’ backpacks, brush and fire apparatus, to rotary and fixed wing aircraft.
Using Foam Increases Operational Efficiency

Many rural and small urban fire brigades have already embraced the use of Class A foam as part of their everyday operational tactics. Their use of Class A foam, quite simply, makes good sense for them. For any brigade that has to bring their water to the scene with them and has to establish water tanker shuttles, using Class A foam can easily increase operational efficiency of fighting the fire. The reason for this is that, Class A foam, when properly deployed, allows the fire to be extinguished more quickly and with far less water than would be required if it were not being used. On average, the use of Class A foam increases water’s wetting capability 10 fold. In more simplified terms... “making water wetter.” In addition, the amount of time required post extinguishment during overhaul or mop up is greatly reduced.

“The use of firefighting foam by the fire service is not a single extinguishing solution, rather a tool (amongst many tools) that when combined with tactics create a more efficient operational scenario.

With the introduction of CAFS some brigades have taken the approach believing they could reduce water consumption (lpm) but the reality is whether using CAFS or traditional foam application appliances like line eductors or foam nozzles, water is still needed to suppress fire.

The use of foam, like other resources available to the fire service, is a force multiplier that when employed with traditional tactics stabilizes the fire hazard thus allowing fire personnel to enter the structure for overhaul. While there are efficiencies associated with the use of foam be it advancements in system hardware technology or the foam concentrate itself, the use of firefighting foam and Class A foam in particular is an asset the fire service should not overlook for structural protection.

One area frequently overlooked for the use of Class A foam is zero lot line properties or multi-family dwellings where the likelihood of multiple exposure fire scenarios is high. The ability to use foam for both internal and external exposure protection and simultaneous active fire suppression is an extremely valuable resource for those in the fire service. Another advantage in using Class A foam is that lower
nozzle flow rates are capable of being used. Fire flow rates can easily be reduced by half or more when Class A foam is deployed.

**Wetting Agents and Emulsifiers – Alternative Products?**

The use of firefighting wetting (mid 1960’s) and emulsifying (early 1990’s) agents were introduced to the firefighting community claiming use on Class A and B fires. The goal of these alternative agents is similar to foam agents in that they aim to reduce the surface tension of water. However, instead of forming a “foam blanket” on a Class B fuel surface, the solution is “vigorously” mixed with the fuel to form a non-flammable emulsion. Emulsifiers have limited foaming capabilities. Emulsifiers must be mixed with water at a given percentage and “forcefully applied” onto the entire surface of the burning fuel source. The resulting solution then mixes with the fuel, breaking it into very small droplets (the definition of an emulsifier). These droplets of fuel are surrounded or encapsulated by the emulsifier/water mixture to extinguish the fire.

The Underwriters Laboratories Inc. (UL) Directory defines wetting agents as “liquid concentrates which, when added to plain water in proper quantities, materially reduce the surface tension of plain water and increases its penetration and spreading ability.” Water to which a wetting agent has been added to is sometimes referred to as “wet water” because of its increased ability to wet surfaces it is applied to. Wetting agents improve the efficiency of water in extinguishing Class A fuel fires. Use on Class B combustibles require much higher application rates than those requiring foam agents and is limited to non-water soluble flammable liquids (hydrocarbons only). Little if any burn-back resistance is present on Class B fires extinguished with “emulsifiers or wetting agents.”

The NFPA Glossary of Terms defines an emulsifier as “a chemical or mixture of chemicals that along with some energy input promotes the formation of an emulsion.” Use of emulsifiers or wetting agents does not afford use as a “fire brake or passive structural protection” (i.e. exposure protection). In contract to Class A foam the use of wetting agents and emulsifiers does not provide adequate exposure protection against radiant heat or an advancing fire. A note of caution here that Class A foam, wetting agents or emulsifiers should never be used on Class E (energized electrical) Class D (combustable metals), or Class F (cooking oils) fires as the water content in these products is not compatible with the fuel hazard.

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>UL Requirements NFPA 18</th>
<th>UL 162 Requirements NFPA 11</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Test</td>
<td>Class A Wetting Agent (GOHR)</td>
<td>Class B Foam Liquid Concentrate (GFGV) [also suitable for Class A use]</td>
<td>Not comparable agents as indicated by separate listing and test criteria</td>
</tr>
<tr>
<td></td>
<td>1.5&quot; depth n-heptane floated on water 50 sq. ft. (4.65m²) 1 minute pre-burn</td>
<td>2.0&quot; depth n-heptane floated on water 50 sq. ft. (4.65m²) 1 minute pre-burn</td>
<td>55 US Gallons (208 liters) fuel on each test</td>
</tr>
<tr>
<td>Application Rate</td>
<td>0.2 gpm ft² (10 gpm nozzle) (8.15L/min/m²)</td>
<td>0.04 gpm ft² (2 gpm nozzle) (1.63L/min/m²)</td>
<td>Application rate for wetting agent test is 5 times higher with less fuel</td>
</tr>
<tr>
<td>Extinction Time</td>
<td>No time limit - pan must not overflow before extinction</td>
<td>3 minutes or less for full extinguishment</td>
<td>Unlimited dilution (emulsion) of foam providing pan does not overflow</td>
</tr>
<tr>
<td>Water Type Used for Test</td>
<td>Fresh water only (no salt water test)</td>
<td>Fresh water and salt water test performed</td>
<td>Wetting agent (emulsifiers) perform much better with fresh water compared to salt water</td>
</tr>
<tr>
<td>Test Type</td>
<td>Performance Criteria</td>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>Vapor Seal Tests</td>
<td>NONE</td>
<td>2 seal tests conducted during 9 minute waiting period</td>
<td></td>
</tr>
<tr>
<td>Burn-back Test</td>
<td>None</td>
<td>Foam blanket must resist breakdown from flame for 5 minutes after foam blanket has rested for 9 minutes post fire extinguishment</td>
<td>Critical for post fire security</td>
</tr>
<tr>
<td>Polar Solvent Fuel Test</td>
<td>None</td>
<td>AR type foam tested for use on alcohols and other polar solvent fuels</td>
<td>Fuel containing greater than 10% Ethanol considered polar solvent fuels. AR type foam for extinguishment</td>
</tr>
</tbody>
</table>

Shown above is the UL test performance criteria for wetting agents. It should be noted that there are distinct differences in the criteria for wetting agents vs. foams. All too often questions arise from not only the the fire service but industrial fire brigades, engineering firms and consultants as to “how does foam and wetting agents compare to one another.” There certainly is an argument that both are firefighting agents in much the same way that apples and pears are both fruits, but that’s where it ends. Ultimately selection of any firefighting tool should be governed by product(s) being "fit for purpose" and having the appropriate third party certifications for the intended application.

In conclusion, the use of Class A foam just makes smart sense. It enhances a fire brigade’s ability to suppress fires more rapidly – improves water’s wetting capability thereby providing faster penetration and greater fire control, increases protection of personnel and maximizes operational efficiency through the use of variable proportioning rates thus minimizing post fire clean up time, and conserving valuable water resources.

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**Author Bio**

Dave Pelton is Vice President, Global Marketing for The Solberg Company. Dave entered the fire protection industry in 1984 and has served on several trade association boards and industry technical committees on both a domestic and international level including Fire Equipment Manufacturers Association (FEMA), Fire Suppression Systems Association (FSSA), National Fire Protection Association (NFPA), and International Standards Organization (ISO).