"Suggested Uses of CAFS in the Rural Environment"

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In our travels across the country delivering our rural water supply seminars, we often hear a consistent theme of concerns from our rural brothers and sisters:

- Limited manpower
- Limited water supplies

Class A foam in the form of compressed air foam (CAFS) has helped some fire departments address those issues - it is not a cure-all but it does help.

(Lawrenceville KS FD - Courtesy Cafsinfo.com)

What is Class A Foam?

Foam concentrates are classified by the types of fires that they are designed to extinguish.

- Class A Foam concentrate is designed to be used on ordinary combustibles (Class A) fires.
- Class B foams are designed to be used on flammable liquid (Class B) fires.

In basic terms, a Class A Foam contains a bubbling agent, a surfactant, and a carbon-loving agent. The bubbling agent allows the water and air to mix together to form an insulating blanket composed of tiny bubbles. Tiny bubbles means more exposed water surface area and that translates into more efficient heat absorption.

The foam surfactant reduces the surface tension of water, which allows water to soak into materials instead of beading up and running off. The carbon-loving agent allows Class A Foam to bind with burnt Class A materials.

Basically, all of the ingredients of Class A Foam combine to allow water with efficient heat absorption abilities to remain in contact with the burning material for a longer period of time. This combining of ingredients allows for more efficient use of water (i.e. you will need less total water): this also means that Class A fires are much less likely to rekindle.

Making Foam

To produce any firefighting foam you need to mix three different elements; foam concentrate and water (which make foam solution) and then air. Air is added to foam solution in one of two ways:

- NAFS - or nozzle-aspirated foam - is when air is added at the nozzle.
- CAFS by contrast, adds air by means of a compressor (or compressed air supply) at the pump panel.

Pros and Cons of CAFS

The benefits of CAFS include:

- longer reach of stream due to added energy from the compressor
- lighter hose lines due to air displacing some of the water
- no special nozzles needed for air entrainment

The drawbacks of CAFS include:

- more complicated & expensive equipment
- more pump operator training
- more propensity for line kinking (this can be mitigated through more care being given to stretching and advancing hose lines)

Although there is some debate about the efficacy of CAFS for interior fire attack, there can be little dispute about its usefulness for vehicle fires, dumpster fires, and dense fuel fires such as brush or hay bales. Here are some recommendations for these usages.

> *Vehicle & dumpster fires*: An 1.75" hose flowing 120-150 gpm of 0.3% to 0.5% of Class A foam solution mixed with 60-70 cfm of air (this would be a 2:1 ratio of water to air) will allow for a standoff attack of approximately 100 to 120 feet. This should allow for the fairly rapid knockdown of a fully involved vehicle with a total use of 500 gallons or less of water. The ability to standoff from the vehicle allows for increased personal safety for the firefighting team.
>
> *Brush & hay bale fires*: A 1.5" hose flowing 95 gpm of 0.3% of Class A foam solution mixed with 45 cfm of air will allow for rapid knockdown. This can be followed with a richer mix of air to water for mop up - a 1:2 mixture of water to air should work well (from a 1.5" hose this would yield 45 gpm of foam solution mixed with 95 cfm of air).

Class A foam used on a hay bale fire. (Courtesy Singers Glen (VA) FD)

Nozzle Selection

Nozzle selection is not critical; however the best CAFS is made by flowing the stream through a shut off valve slightly smaller than the hose line. A slightly worse foam blanket, but one with more reach, is obtained by using a smooth bore nozzle. As with water, if you are trying to obtain the best trade off between reach and volume, the nozzle should be no more than half the diameter of the hose line.

Use of a fog nozzle with CAFS is possible but such a nozzle will tend to strip some of the bubbles out of the mixture, resulting in a wetter mixture. The effect of a fog nozzle is to break the fire stream into droplets, which increases the amount of water surface area available to absorb heat. CAFS essentially does the same thing when run through a smoothbore - so there really is no need for a fog nozzle in this application.

Departments wishing to investigate CAFS further should look into the various manufacturers and what they have to offer as well as speak with departments that have used CAFS. Any time fire departments are using firefighting foams the product information sheet from the foam

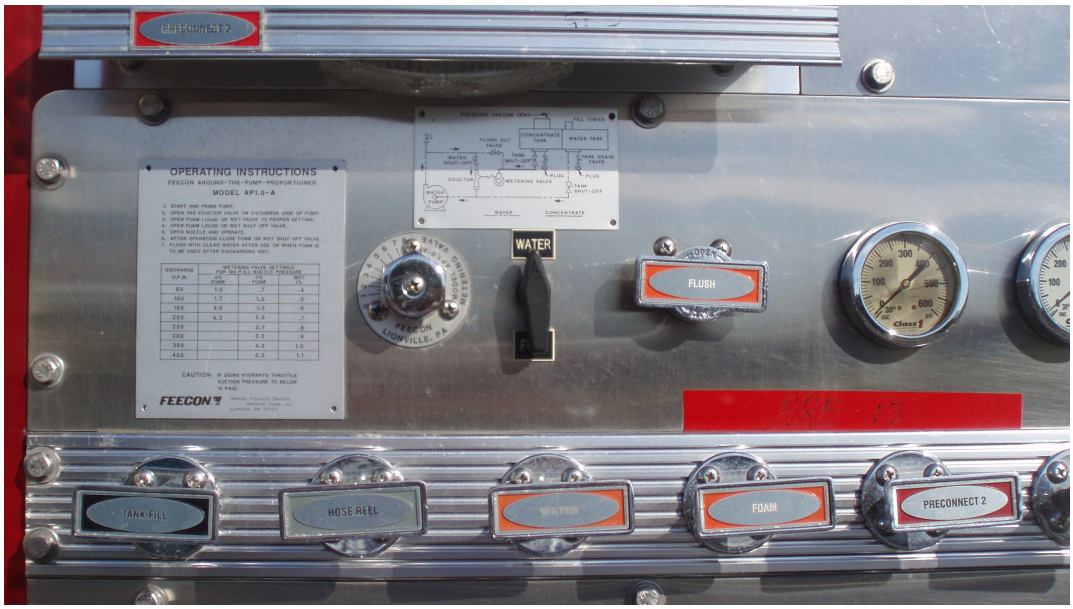
manufacturer should be consulted and followed. Most manufacturers are very specific about proportioning rates for specific firefighting uses.

Inexpensive Strategies for Using Class A Foam

So you are a rural fire department and you can't afford a CAFS system on your pumper, but you want to realize the enhanced firefighting abilities of Class A foam? There are some other alternatives that are available.

Accessory foam systems:

Around the pump foam system - this system can be added behind the pump panel or in the case of the Feecon FoaMidget, can be carried in a compartment and added when needed. Basically a small line is run from the pump discharge into a foam eductor. From the eductor, a line is run into an auxiliary intake on the fire pump and foam solution is then taken into your pump and available from any discharge. Most of these systems require a low intake pressure and therefore you can only run the system at draft or off of your booster tank. Departments which install these systems on their engines usually add some kind of direct tank fill valve to their rigs to allow for replenishment of their water supply. Drawbacks of this system include the necessity to thoroughly flush your pump after every use.



Typical around the pump foam system controls. *(A. Butsch)*

A FoaMidget set-up on a traditional pumper. *(Baltimore County (MD) Fire Department)*

Foam pump:
Manufacturers such as Hale, Pierce and Darley offer a positive displacement, foam concentrate pump which supplies a metered dose of concentrate directly to the discharge manifold of your fire pump. This makes foam solution available from every discharge. However, since most of these systems include a check valve before the point of foam addition, there is no need for extensive flushing of your entire system - simply flushing the hose line used is all that is usually necessary. The main drawback of this system is the necessity of adding a flow meter to your discharge manifold. This flow meter requires yearly calibration and has to be plumbed on a straight run of pipe. Also the foam pump itself will need to be checked periodically to ensure that it is calibrated.

Batch mixing:
Batch mixing is probably the cheapest way of adding Class A foam capabilities to your arsenal. One simply adds Class A foam concentrate ahead of time to the booster tank. A typical 750 gallon booster tank would require 3.75 gallons of Class A concentrate to make a 0.5% Class A solution. The drawback of batch mixing is that you will need to obtain your water supply solely off of your booster tank - and use up the tank's entire contents before refilling and remixing. You will also need to consider whether your foam has any shelf life limitations when it is pre-mixed - this information should be readily available from the manufacturer's specifications.

Batch mixing can also be done by setting up a folding tank and adding concentrate as needed. A typical 3000-gallon tank will require 15 gallons of foam concentrate for a 0.5% Class A solution. (A 0.1% solution will only require 3 gallons of concentrate). As water is dumped into the tank, further additions of concentrate will be needed - and you will need to have a pretty good idea of how much water was dumped in to make a reasonable guess as to how much concentrate to add.

As with around the pump systems, batch mixing allows foam solution to run into every part of your pump - so thorough flushing of your pump is needed after each use.

A Class A foam batch-mixing operation in Winfield, MD. *(AC Tim Legore)*

Keep in mind that none of methods just discussed allow for air to be added to the foam solution at any point other than the nozzle. Using a "foam tube" to aerate the foam solution will tend to dissipate some of the energy of the hose stream and will diminish its reach. An adequate foam blanket can be produced by using a fog nozzle and if bubble production is less of a concern, then any nozzle can be used. However, it is important to realize with less bubbles the solution will not absorb heat as efficiently.

Class A Foams, Wetting Agents, and Emulsifiers

On occasions, there is confusion between Class A Foam concentrates, wetting agents, and emulsifiers. To make things worse, some common foams can be considered to be all three! So…what do these common terms mean?

In general, foam concentrates are classified by the types of fires that they are designed to extinguish. A Class A foam concentrate is designed to be used on ordinary combustibles (Class A) fires. Class B foam concentrates are designed to be used on flammable liquid (Class B) fires. Wetting agents and emulsifiers are distinguished by their mechanism of action and can sometimes be used on both Class A and Class B fires.

In basic terms, a Class A foam contains a bubbling agent, a surfactant, and a carbon-loving agent (an emulsifier). The bubbling agent allows the water and air to mix together to form an insulating blanket composed of tiny bubbles. Tiny bubbles means more exposed water surface area - which means more efficient heat absorption.

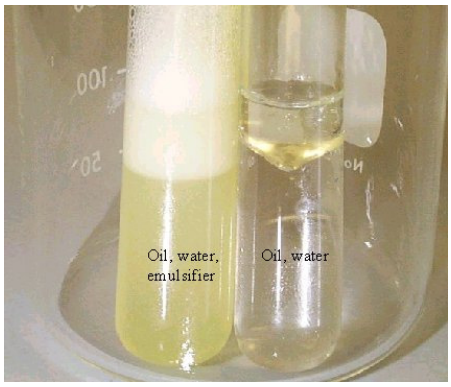
The surfactant reduces the surface tension of water and allows water to soak into burning materials instead of beading up and running off. The carbon-loving agent allows Class A foam to bind with burnt Class A materials. Basically, all of the ingredients of Class A foam combine to allow water with efficient heat absorption abilities to remain in contact with the burning material for a longer period of time. This allows for more efficient use of water (i.e. you will need less total water).

Wetting agents are usually simple surfactants - they work to reduce the surface tension of the water to which they were added. However, wetting agents do not have the foaming qualities of Class A foam and thus lack the insulating and added heat absorption capabilities that foam offers. Most common wetting agents are proportioned at very low rates (0.3% or less) and are quite economical as a result. Suggested uses for these agents are brush and wildland firefighting, mop-up and overhaul etc.

Class A foam used for exterior attack and overhaul. *(Courtesy of Phos-Chek Corp.)*

Emulsifiers are oleophillic (hydro-carbon loving) molecules that tend to bind and mix with hydrocarbons. Most Class A foams contain emulsifiers to one degree or another. An

emulsifying agent by itself would lack the foaming action of a true foam. Some emulsifiers are designed for use on shallow, Class B fires. Instead of floating on top of the Class B fire they mix and encapsulate the fuel so that the fuel becomes inflammable. If the pool of Class B material is too deep, the emulsifier may not mix with all of the fuel. An important point to note is that emulsifiers - due to their chemical structure - may not be able to mix with polar solvents such as ethanol.



Example of emulsification at work. *(Courtesy State University of New York)*

In review, most Class A foams contain both wetting agents and emulsifiers. Careful reading of the manufacturer information will yield good information on what proportioning rates are necessary to realize the most benefits of a specific ingredient. For example, Angus Hi-Combat Class A Foam is marketed as being a wetting agent and/or emulsifier at 0.3%, but requires proportioning at 0.5% for a full, Class A structural firefighting foam. Conversely, there are emulsifiers on the market that have surfactants in them allowing their use as a wetting agent at a low concentration. They can also be used as emulsifiers at higher concentrations - but can never be used as true foams.

The take home lesson here is that Class A can make a real difference in fire attack operations – especially in the rural and small town settings. More importantly, when considering the purchase of a CAFS or Class A foam capable unit, be sure to “do your homework first” and know what you are buying!