When did you fight your last crib fire?

The introduction of Class A foam to European firefighting raises questions about suppression standards and testing on both sides of the Atlantic.

By Holger de Vries
Fire Protection Engineer
University of Wuppertal
Wuppertal, Germany

Holger de Vries

Crib fire trials are scientific, but they date back to a time when the interiors of structures were mostly made of wood and other natural materials, so they don't represent present-day firefighting realities.

Class A foam has arrived on the European side of the pond. In Spain and France it's used to combat forest fires, and in Belgium, Scandinavia and Germany structural pumpers now carry Class A foam equipment, or will in the near future.

We Europeans have survived all sorts of American inventions so far, such as chewing gum, Coca-Cola, Coors Light, Big Macs and Disneyland, just to name some of the most visible. They've all had some influence on our lives, but actually these American spin-offs haven't changed anything dramatically. When the alarm bell sounds, we still grab our woollen coat and ride our Mercedes-based commercial pumper, squirt some water from our standard 2-inch nozzle on the fire and come back home without much thought.

Now there's this new thing that some claim will turn the tables on our fires on our continent. But its introduction raises questions about standards and testing, particularly about crib fires, that aren't so easy to answer in Europe or in America.

Class A foam isn't a stranger to us as soon as we untangle some terminology. When an American firefighter talks of Class B foam, most likely he means AFFF. While we also use AFFF, our Class B foam, the seldom-used stuff in the yellow pails on the starboard side of our trucks, will presumably be a polysynthetic foam concentrate — basically the same as most Class A foams. During our research on foams at the University of Wuppertal, we confirmed that by fingerprinting some foam concentrates with NMR spectroscopy.[1]

So now we know what Class A foam is, and that the main difference between it and other foams is the concentration of components, thus requiring a lower induction rate than Class B foams. We also know that we're supposed to use foam on solid fuels.

A question of standards

Of course, there's more to it than that. This is where standards and firefighting traditions enter the picture. Tradition does not allow for scientific quantification, so I won't pursue that issue in this article. (John Liebson of the ISFSI in his training program on Class A foam has already done marvelous work on the concept of strategic change in the fire service.[2])

Rather, I will take a close look at the standards and standardization issue. At long last Europe is trying to abolish national standards and replace them with European standards. There are two sets of standards applicable to foam-related issues: Those on foam that refer to Class B fuels, and fire extinguisher standards for Class A fires that advocate crib fires as test objects for quantifying firefighting capabilities.

The European cribs consist of 14 layers of 40mm by 40mm (about 1.6 by 1.6 inches) wooden sticks, 500mm (20 inches) long in the even-numbered layers in one direction and longer in the odd-numbered layers in the cross direction. The length of the wooden sticks in the odd-numbered layers determines the rating of the fire extinguisher. These layers are stacked onto a metal rack and ignited by a heptane-on-water fire from a tray underneath the crib. After a preburn time of eight minutes, someone takes a fire extinguisher and tries to put out the fire.

We have done this with Class A foam in the open and in trial rooms. (For a detailed report of our activities, see our article in Winter 1995–

96 Fire Professional, p. 14.) The results showed a significant superiority of Class A foam over water.

So, as proper firefighters, we should take these results, add them to a purchase proposal and ask for some Class A foam equipment during the next fiscal year. We could argue, among other things, that using this new agent might reduce man (and woman) hours and wear on apparatus.

Is life that easy? Sorry to say, but no.

Holger de Vries

Live fire demonstrations help familiarize crews with new substances, such as the Class A foam these Hannover firefighters are using, but valid comparisons between these exercises and actual fires are seldom possible.

A closer look at crib fires

Let's take a close look at the trials conducted. We fought crib fires. Crib fires are 100% wood fires. No heat accumulating in a confined room; no wallpaper, synthetic wall panels or polyurethane settee heating up to flashover in a few minutes; and no glass window waiting to crack to supply that extra amount of oxygen to the fire.

We made this important point in Fire Professional: "*Under the constraints of these trials* it can be summarized: By using [Class A foam] the time to extinguish a fire and the quantity of extinguishing agent are reduced significantly in comparison to pure water and to polysynthetic Class B foam solutions." (Italics added.)

That means exactly what it says: Under the constraints we set for the trials, including wooden fuel, its moisture contents, air humidity, air temperature, wind speed and my personal mood when I fought the fires, the crib fires were easier to put out with Class A foam. These results of course strongly suggest that Class A foam could have performed as well in a room-and-contents fire that day (and it is most likely that it would have), but there is no scientific proof for that.

Crib fire trials and standards date back to when wood and other natural fibers where the dominant substance of the interiors of rooms, but those days are gone. Today's firefighters are now faced with the whole periodic table of elements in everyday fires, and crib fires don't take that into account. A crib fire might to a certain extent represent traditional American wood construction, but by no means the brick-and-concrete structure of European housing.

Real-life firefighting

The problem of whether test settings represent real life firefighting isn't confined to Class A fuels and Class A extinguishing agents, either. We have a similar problem with current German DIN standards on Class B foams. Let's take low-expansion foams as an example. These foams are tested on two different fuel-on-water fires in a 4-square-meter and a 40-square-meter circular tray (about 43 and 430 square feet, respectively) .

The 4-square-meter fire uses 100 liters (26 gallons) of gasoline on a 100 mm (4-inch) layer of water. Preburn time is 60 seconds. This tray fire is extinguished with a tiny low-expansion foam nozzle flowing 23lpm (6gpm) at 5 bars (72psi). The 40-square-meter fire uses Jp-4 aircraft fuel (MIL-T 5624 T) and a standard 2-inch low-expansion nozzle at 200lpm (53gpm). Again, pre-burn time is 60 seconds.

Now, let me ask some nasty questions. Was your last tanker fire confined in a circular tray? When did you encounter a fuel-on-water fire, unless you are a naval or offshore firefighter? Is the response time of your department, including foam set-up, less than 60 seconds everywhere in your area? Did you use a ⅞-inch, 6gpm LX foam nozzle?

Instead of a circular tray, I would prefer a rectangular one. You should already object to that idea. A rectangular tray, you might say, is no more realistic than a circular one. You are right. But while a rectangular tray isn't more realistic, it is more scientific, because in a rectangular tray there's more of a difference between a well-flowing and properly sealing foam when you look at the corners of the tray, and these are realistic requirements for Class B foams. Science and real life *can* match if things are thought about properly.

Why are the currently used trays circular? Much work was done on Class B foams during and after World War II. The trials of that time were conducted on circular trays. When it came to standardization in the early '60s, the standards committee, with good intent, chose circular trays because they had already been used for a long time and because data on new foams could be compared to that on old foams.

This is also the reason for a water layer being under the fuel. What ended up as a written standard had started as a quick-and-dirty testing set-up. To be able to use a tray of thin steel, a water layer is needed to prevent the bottom from melting. But by doing this, much heat that could contribute to re-ignition in real life is being dissipated. ln other words, our German foam standard is in part governed by the material properties of the steel tray.

> It's essential to know where a standard comes from and the limits of its validity. An agent that might perform magnificently on a crib fire and thus be approved for field use might still be useless or even dangerous on the fireground.

Finally, the pre-burn time of 60 seconds is very laboratory-like. For comparison with firefighting operations including foam set-up, a pre-burn time of 15 to 20 minutes would be more realistic. But because of the environmental impact of a 15-minute Class B fire, it's unlikely that this will ever be changed.

Describing reality

Ideally, creating standards means trying to describe reality with a certain set of equations and constraints. These equations and constraints are the basic materials from which to build a model. After a model has been built, it has to be tested to determine whether the model really does represent reality. A model has to, with certain unavoidable inaccuracies, behave like the real world.

This applies not only to fire science but also to economic models, flight simulators and anything else. If the model does not behave like it should, then something has not been taken into account, and the model is not valid. This in turn means that the model has to be improved, or that model data can only be compared to other model data (e. g., two research facilities that use the same set-up can compare their findings) but does not have significance for real situations.

Furthermore, and this is a critical point, many standards weren't developed scientifically but have rather evolved from a traditional origin, like the above-mentioned Class B foam standard. Some things are done the way they're done because they've always been done that way.

It's essential to know where a standard comes from and the limits of its validity. These limits are the reason automobiles constructed on the drawing board and computer-simulated are then still subjected to crash tests and even undergo further design changes long after they have entered line production. For firefighters this means that in the worst case, an extinguishing agent that might perform magnificently on a crib fire and thus be approved for field use might still be useless or even dangerous on the fireground.

What do we do?

It's one thing to say that standards are not a great help. To offer an alternative is more challenging. In our job we expose ourselves voluntarily to far more risks than most industrial workers. We need something to quantify our tools, not just because of financial and environmental issues, but because we need to be confident in what we use on the fireground to save others and their property. This is even more important now than only a few years ago, since suddenly Class A foam experts and wonder agents are surfacing everywhere.

Since starting our research project on Class A foam at Wuppertal University two years ago, we've been trying to use any and all agents available. We have sustained that and limited our activities to the agents that are approved by the U.S. Department of Agriculture/National Wildfire Co-ordinating Group, because the environmental impact of extinguishing agents has to be part of the risk-benefit analysis of the whole issue. *NFPA 298, Foam Chemicals for Wildland Fire,* and USDA 5100-304a, which covers similar ground, are not performance-based standards but cover only physical, chemical and toxicological aspects.

There is also some question about running trials at all because of the problem of statistical reliability. To run one trial with a certain agent proves nothing. There is some debate about the minimum number of trials necessary on a specific item to allow for statistical interpretation. Some say as few as four, others as many as 13.

Let's assume that seven trials on one item are enough. This means we require seven trials on each agent before we can be somewhat sure of having reliable data. Seven crib fire trials per agent represent a major financial and labor effort. Wouldn't it be more sensible to invest a little more money and run realistic trials instead?

From our experience let me suggest an outline for future research on Class A foam and any other extinguishing agent that might be developed:

1) Non-performance standardization is necessary. Generally, there has to be mandatory standardization or approval for man-made extinguishing agents of any kind to try to prevent the use of possibly risk-increasing and/or health-endangering substances on the fireground, which might have adverse environmental effects as well. In standardization or approval committees, not only firefighters and manufacturers, but biologists, chemists and toxicologists need to have a vote.

Much work has been done on the

environmental impact of commercial detergents and much data is available. The same could be done for suppression agents. The fire service should challenge scientists who are looking for a rewarding field of research to come forward with their ideas on research along these lines to benefit the fire service and ultimately the communities we serve.

2) Non-realistic trials do have a limited use. There will always be a need for some crib fires, and manufacturers will always like to demonstrate their products by burning down a barn. That's fine as long as we keep in mind that crib fires are isolated from the real world.

If we do run this type of trial, we should try to gain as much from it as possible. The next time you burn down a barn, call the electrical engineering department of your nearest college or university and ask if some students want to run a research project and are willing to instrument the room with thermocouples, or ask the chemistry department to collect run-off water samples and make a toxicological assessment. This instrumentation won't convert anecdotal evidence into scientific data, but it will contribute to a pool of information from which the whole fire community can benefit.


Sonja Noje-Knollmann

A good trial should be as realistic as possible. In this trial, the author is knocking down a fire in a burn room used for 1:1 scale fire simulations and investigations.

3) Hold realistic trials. If we really feel uncomfortable about some extinguishing agent technology, everyone involved should join forces for a mutual research project instead of burning a forest of crib fires. This research project should aim at running realistic room-and-contents fires or whatever else might be suitable for the problem. These trials should be announced months ahead so that any interested parties have the opportunity to contribute their ideas to the project team. Anything and everything that can be measured should be measured in order to gain the most from the whole project.

Having said that, I confess that I'm currently preparing more crib fires. Class A foam is just beginning to be used in Europe, and we still need some time to familiarize ourselves and our fellow firefighters with its use and performance. We are aware that while a dozen crib fires might help us, a hundred wouldn't do much better. In the United States, you already have hands-on experience with Class A foam, and you have the resources to run realistic testing. Use them. FC

Holger de Vries is a fire protection engineer at Wuppertal University in Germany, holding a master's in safety engineering and fire and explosion protection from that institution. He is currently a volunteer leading firefighter and safety officer with the Wuppertal Fire Department and has been a member of the German fire service for 15 years.

1. NMR spectroscopy: Nuclear magnetic resonance spectroscopy. Some atoms' nuclei absorb electromagnetic radiation of a specific frequency when they're placed in a strong magnetic field. The spectrum of absorption varies depending on the structure of the molecule containing the absorbing atom. While this result isn't characteristic enough to determine the exact molecule, e. g., in a Class A foam concentrate, it can be used to "fingerprint" similar molecules in different concentrates.

2. Liebson, John, "Implementation and Utilization of Class A Foam Technology for the Structural Fire Service" (Student Manual/ Instructor Manual). The Alliance for Fire and Emergency Management: Ashland, Mass., 1994.