FEATURE ARTICLE

FIRE PREVENTION
& FIRE ENGINEERS JOURNAL

(HIGH-EXPANSION FOAM SUPPRESSION ARTICLE)

WHEN THE STAKES ARE HIGH

Peter Kristenson looks at high-expansion foam and its role in fighting fires in high risk environments.

Before we start looking at high-expansion foam in particular, perhaps we should start by answering the question: what is firefighting foam?

Originally developed in the late 1800s as a method of extinguishing flammable liquid fires, firefighting foam is basically a stable mass of small, air-filled bubbles that has a lower density than oil, petrol, or water. When it is discharged as a fire suppression agent, it comprises three essential elements: the foam concentrate, water and air. The foam concentrate is injected into the water by means of a foam concentrate proportioning unit, and the resulting blend is fed to a foam generator. In most cases this is located at the end of the pipe or hose that is used to deliver the mixture. The foam generator sucks-in air, which combines with the liquid mixture to create the firefighting foam.

Because of the agent's low density, the foam readily floats on a fire's fuel surface or, in what are called "total volume filling" applications, completely fills the enclosed protected area to extinguish the fire by separating the fuel from the oxygen that is essential for combustion to continue. Effectively, the foam completely smothers the fire, while its high water content provides effective cooling to reduce the fire's heat energy. Well-formulated foam, correctly applied, displays a number of important firefighting characteristics that ensure a fire is extinguished efficiently and securely to prevent re-ignition. These include: stability; cohesion; rapid fire-knockdown; heat resistance; and vapour suppression.

There have, in recent years, been many advances in the field of foam concentrates, and there is no doubt that a number of suppliers have been somewhat over-enthusiastic when promoting their own type of generic product, the formulation of which has been dependent upon the company's manufacturing capability.

However, it is important to be aware of the wide range of foam formulations that are available today. These range from the low cost but highly stable protein foams, through to the latest leading-edge synthetic products. Briefly though, the types of foam currently on the market can be categorised as: protein foams; fluoroprotein foams; aqueous film forming foams (AFFF); film forming fluoroprotein foams; and alcohol-resistant concentrates.

In essence, there are three categories of foam, which are characterised by the volume

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of foam that is created by a given amount of water. These are: low-expansion or Low-Ex foam; medium-expansion or Med-Ex foam; and high-expansion or Hi-Ex foam. Low-expansion foam has an expansion factor of up to 20, while medium-expansion has a factor between 20 and 200. High-expansion foam has a factor higher than 200, and may be as high as 1100.

In the UK, total volume filling application of Hi-Ex foam is covered by BS 5306-6.2:1989 [Fire extinguishing installations and equipment on premises. Foam systems. Specification for medium and high expansion foam systems], which covers both fixed and semi-fixed systems and application rates for high expansion foam on liquid and solid fires. The equivalent standard for the surface application of Hi-Ex foam is BS EN 1568-2:2000 [Fire extinguishing media. Foam concentrates. Specification for high expansion foam concentrates for surface application to water-immiscible liquids].

A high-expansion foam generator is used to create the Hi-Ex foam, and this usually incorporates a fan that ensures the required amount of fresh air is available for the foam production. This fan can be driven by a petrol or diesel engine, or by a water turbine, but electricity is the most common power source for conventional fixed installations in enclosed areas.

HIGH RISK ENVIRONMENTS.

Naturally, it is the petrochemicals industry that first springs to mind when mention is made of high risk environments. However, this belies many other hazardous environments where fire can have a catastrophic impact on life preservation and asset continuity. These include: aircraft hangars – both civil and military; hazardous waste storage facilities; flammable liquid stores and flammable material production facilities; cable tunnels; turbine generators; paper product and tyre warehouses; engine test cells; ship's holds and engine rooms; and transformer rooms.

All of these enclosed areas represent a significant potential fire risk and foam systems are increasingly being seen as the most suitable firefighting solution, in preference to CO_2 [Carbon Dioxide] total flooding systems that are safe to use only for unoccupied locations.

For these enclosed applications, high-expansion foam is the ideal choice, owing to its use of the minimum amount of water. A characteristic of a Hi-Ex system is that the total amount of water required to extinguish a fire is, in relative terms, small, so likewise the total quantity of extinguishing media to be cleaned up once the fire has been extinguished is also minimised. For each litre of water used in a high-expansion foam application, between 600 litres and 1000 litres of foam bubbles are generated.

Hi-Ex foam can be put into two very broad types: Class A foams and Class B foams. This is very important distinction, as a Class A foam is not designed to put out Class B fires. Using a Class A foam – suitable for freely burning materials such as wood, paper, textiles and other carbonaceous materials – on Class B flammable liquids might extinguish the fire, but might also lead to catastrophic results because of its inability to secure the liquid's explosive vapours. Class B fuels can be subdivided into two more subclasses: non-polar solvents – hydrocarbons like high-octane petrol, aviation fuel and naphtha that will not mix with water; and

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polar solvents, such as acetone, methanol and methyl ethyl ketone that will mix with water.

Hi-Ex foam will rapidly – within minutes of its release – completely fill and engulf the area in which the fire has occurred, and so extinguish the blaze. The USA's NFPA [National Fire Protection Association] stipulates that the installation should be designed for this to take place in between two and eight minutes. However, the performance of a high-expansion foam system is hugely dependent on the quality of the foam concentrate that is used. All too frequently, foam is considered as a commodity product where price is the sole deciding factor. Quality, continuity of supply, technical support, engineering know-how, manufacturing resources and industry expertise should all also be seriously considered factors influencing the buying decision.

In these applications, Hi-Ex foam has what is often termed as a "mass effect", effectively isolating the entire fire area and extinguishing a fire in several ways. The water within the foam is turned into steam and contributes towards a rapid cooling of the fire; the steam also acts as an inerting agent and reduces the oxygen content of the air; the isolating characteristic of high-expansion foam prevents heat from spreading and setting other objects alight; and the foam also prevents flammable gases from spreading and igniting.

HOTFOAM PROTECTION.

Hi-Ex foam's proven suitability for fighting fires in enclosed spaces led to the development of a high expansion foam that utilises smoke-contaminated air in the late 1980s and early 1990s.

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This was inspired by the Sandoz Schweizerhalle warehouse fire in Basil, Switzerland, which led to what was described at the time as: “the worst ever case of contamination in a large European river". Firefighting water swept tons of agricultural chemicals, chlorinated organics, organic mercury compounds, and dyestuffs into the river, causing pollution throughout Germany and the Netherlands.

This was followed by tests that proved that the introduction of smoke gases in the air supply to conventional high-expansion generators reduced, or completely eliminated, the need for foam production by a generator. The same result was found to be true if the air supply, in addition to containing smoke, gas and particles, is also very hot. These trials led to the introduction of the first contaminated hot air high-expansion, or “inside air” product, called HotFoam™, which was approved for industrial us in 1992. It was subsequently approved for use in marine applications in 1994.

HotFoam operates on very different principles to conventional Hi-Ex foam systems, as the foam generators – which do not require power in any form - are positioned inside the protected space, using the air and smoke from the fire itself to generate the foam bubbles. This does away with the need for an external fresh air supply for the foam production, and provides the flexibility and effectiveness invariably required for, say, warehouse protection. In addition, the rapid knock-down of the flames and heat helps to minimise damage to both the building structure and its often high value contents.

It can be effectively used on hydrocarbon and polar solvent liquids, as well as solid

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Class A combustibles. Installation is much simpler and less costly than a comparable conventional Hi-Ex foam installation

END

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EDITOR'S NOTE

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