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Best Practice Guidance for Use of Class B Firefighting Foams

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Summary

Class B Class B firefighting foams serve a vital role in protection against flammable liquid fires. At the same time these foams contain ingredients such as fluorosurfactants that can impact the environment. Following is a list of steps that should be taken to protect the environment when using fluorinated Class B firefighting foams (AFFF, AR-AFFF, FFFP, AR-FFFP, FP, FPAR):

- Fluorinated Class B foams should only be used in situations that present a significant flammable liquid hazard, where their superior performance and unique film-forming properties are required.
- Before deciding to use fluorinated Class B foam for a specific hazard, investigate whether other non-fluorinated techniques can achieve the required extinguishment and burnback resistance. Be aware of the shortfalls of these alternative methods including no film formation, potential for longer extinguishments and reduced after-fire protection.
- Alternative techniques and agents must be evaluated well in advance of an emergency situation that requires urgent response.
- Use training foams that do not contain fluorosurfactants for training purposes.
- Use surrogate liquid test methods that do not contain fluorosurfactants for testing fixed system and vehicle foam proportioning systems.
- Provide for containment, treatment, and proper disposal of foam solution – do not release directly to the environment. Develop firewater runoff collection plans for the use of fluorinated Class B foam.
- Follow applicable industry standards for design, installation, maintenance, and testing of foam systems. Obtain and follow manufacturers' recommendations for foam concentrate and equipment. Give due consideration to products with third party approvals.
- Use foam, equipment and best practices that will safely and successfully handle the incident in the most efficient way. This includes but is not limited to education, training, preplanning and actions at an incident.
- Develop plans for dealing with unplanned releases of foam concentrate or foam solution so as to minimize the environmental impact.
- Minimize foam releases from fixed systems as a result of accidental discharges by using approved detection/control systems and proper maintenance of the system. Always close foam injection valves when the fire control panel or detection devices are being inspected and tested.
- Plan system testing so as to properly contain and dispose of foam solution effluent generated by the tests.
- With a live fire there are an unlimited number of circumstances, therefore, any and all actions should consider fire fighter and public safety first.

Introduction

Firefighting foams serve a vital role in fire protection throughout the world. Their use has proven to be essential for the control of flammable liquid fire threats. The ability of foam to rapidly extinguish flammable liquid spill fires has undoubtedly saved many lives, reduced property loss, and helped minimize the global pollution that can result from the uncontrolled burning of flammable liquids.

However, with ever-increasing environmental awareness, recent concern has focused on the potential adverse environmental impact of foam solution discharges. The primary concerns are toxicity, biodegradability, persistence, mobility, treatability in wastewater treatment plants, and nutrient loading. All of these are of concern when the end-use foam solutions reach natural or domestic water systems.

It should be emphasized that it is not the intent of this guidance document to limit or restrict the use of firefighting foam. The fire safety advantages of using foam are greater than the risks of potential environmental problems. The ultimate goal of this guidance document is to foster use of foam in an environmentally responsible manner so as to minimize risk from its use.

Scope

The information provided in this guidance document covers only foams for Class B combustible and flammable liquid fuel fires. Although other types of foams may be used for this purpose, the primary emphasis of this document relates to aqueous film-forming foam (AFFF), alcohol resistant aqueous film-forming foam (AR-AFFF), film-forming fluoroprotein foam (FFFP), alcohol resistant film-forming fluoroprotein foam (AR-FFFP), and fluoroprotein foam (FP, FPAR). The use of the term “Class B foam” will be understood to refer to all of the products listed above.

Foam Selection

Class B foams are the most effective agents currently available to fight flammable liquid fires. These foams contain fluorosurfactants that provide fuel repellency, heat stability and the required low surface tension and positive spreading coefficient that enables formation of an aqueous film on the surface of hydrocarbon fuels. It is the combination of this film formation capability and fuel repellency that gives most Class B foams their effectiveness against flammable liquid fires. Class B foams provide rapid extinguishment, burn-back resistance, and protection against vapor release, which help to prevent re-ignition and protect firefighters working in the area as part of the rescue and recovery operations.

Multipurpose AR-AFFF or AR-FFFP foams allow one agent to effectively work on both hydrocarbons and polar solvents fires. This allows a single agent to be effective on any flammable liquid fire. This attribute helps reduce foam stocks for mixed fuel facilities or response services from having two agents to only stocking a single agent for Class B fires. It also avoids the incorrect agent selection at a scene that could disperse an ineffective agent.

In order to minimize the environmental impact of Class B foams, their use should be limited to situations that present a significant flammable liquid hazard such as airport operations, storage tanks, terminals and petroleum/chemical processing, highway and rail transportation, marine and military applications, industrial facilities, and some power generating facilities.

The use of Class B foam is not recommended for Class A (wood) or Class C (electrical) hazards where there is minimal or no flammable liquid threat. If a flammable liquid threat exists, Class C applications must be de-energized since foam contains water that can conduct electricity. Examples of situations where Class B foams are not required include but are not limited to forest fires, residential and structural fires, computer rooms and telecommunications facilities, restaurants and commercial kitchens, and general facilities protection. In addition Class B foams may not be necessary for small flammable liquid threats such as automobile fires without a significant fuel spill where a large water application rate or dry chemical extinguisher can be used.

Eliminating Foam Discharge

Class B foams contain fluorosurfactants that are persistent in the environment and are not removed by passage through a wastewater treatment plant. As a result the only way to ensure that fluorosurfactants from Class B foams are not released to the environment is to eliminate foam discharge altogether. Obviously this is not possible or desirable in the case of emergency firefighting or fixed system fire suppression, and may not be possible in other scenarios such as accidental release. Fortunately there are alternative fluids and methods currently available that make it possible in many cases to eliminate the use of Class B foam for training and testing of foam systems and equipment, which represent the majority of foam use.

Training

There are specially designed training foams available from most foam manufacturers that simulate Class B foam during live training and do not contain fluorosurfactants. These foams are normally biodegradable and usually with advanced approval can be safely sent for treatment to the local wastewater treatment plant. Because they do not contain fluorosurfactants, training foams produce no film thereby allowing for more repeat fire training sessions and a more challenging training environment. During training evolutions fire fighters must be aware of the trade off in performance with training foams resulting in longer extinguishments and little burnback protection compared with Class B foams. Firefighters and other foam users should work with the Authority Having Jurisdiction (AHJ) to ensure that the use of training foams meets all local and application-specific live training requirements. In some cases training foams can also be used as a substitute for Class B foams in vehicle and equipment testing.

Training should be conducted under conditions conducive to the collection of spent foam. Training facility design should include a containment system. Some fire training facilities have elaborate systems designed and constructed to collect foam solution, separate it from the fuel, treat it, and in some cases re-use the treated water. In general, advanced training and education on the products, hazards and applications are critical. This alone will significantly contribute to the most efficient and safe use of Class B firefighting foams.

Foam System Testing

Many AHJs and third-party approval organizations require periodic testing of installed foam fire protection systems to assure reliable performance in an actual fire event. Typically these tests involve full discharge of the system usually through fire hose lines connected to test outlets that are part of the system installation. Testing primarily involves engineered, fixed foam fire-extinguishing systems. Two types of tests are conducted on foam systems: acceptance tests, conducted pursuant to installation of the system; and maintenance tests, usually conducted annually to ensure the operability of the system.

Surrogate Liquid Test Methods

The major focus when evaluating foam system performance is to confirm proper function of the foam proportioning system. This is done by conducting a foam injection rate test. This testing can now be done using surrogate non-foaming environmentally acceptable test liquids in lieu of Class B foam if the AHJ permits such substitutions. The surrogate test liquids are specifically formulated to simulate the flow behavior (viscosity characteristics) and approximate conductivity or refractive index of the foam concentrate used in the system. If these alternatives are used, users must put in place proper procedures to guarantee the systems can be returned to emergency ready status without issue. A common mistake can be not opening the main foam supply valve after testing.

When foam must be used for acceptance or maintenance tests, only a small amount of foam concentrate should be discharged to verify the correct concentration of foam in the foam water solution. Designated foam solution (foam and water mixture) test outlets should be designed into the piping system so that the discharge of foam solution can be directed to a controlled location. The controlled location can consist of a portable tank that would be transported to an approved disposal site by a licensed contractor. Containment, transportation, and disposal of the foam solution as well as foam concentrate replacement can be costly. Portions of the acceptance and ongoing maintenance testing do not require the proportioning system to operate and those parts can be accomplished by discharging only water.

Water Equivalency Method

In some cases water can be used as a surrogate liquid in place of foam. This is generally called the "water equivalency method" since a correction factor (to account for viscosity differences between foam and water) is applied to the water flow rate to make it equivalent to the foam concentrate flow rate. When using this method, flow meter measurements on the water and foam concentrate sides of the system are compared to determine the injection rate. The simulated foam concentrate (using water in place of foam) flow rate is multiplied by a correction factor to account for the flow rate difference between foam concentrate and water. This corrected flow rate is divided by the total system flow rate to determine the foam injection rate percentage. While this practice may work on some systems, water equivalency is not accurate when representing the viscosity characteristics of most alcohol resistant (AR) foam concentrates due to their thixotropic nature. Users should consult with the foam manufacturer to determine if they have appropriate test data to support the water equivalency testing method.

Firefighting Vehicle Tests

Aircraft rescue and firefighting (ARFF) and municipal fire fighting vehicles are required to go through periodic foam nozzle discharge tests to ensure proper function of their foam proportioning system. Traditionally, these tests have been done by discharging foam solution with all of the associated issues involved in containment and disposal. Technology is available to enable testing these vehicles using water or a water-based surrogate liquid containing an environmentally benign biodegradable dye. The dye in the surrogate test liquid can be detected in the proportioned solution stream by means of colorimeter instrumentation. When water is used as the surrogate test liquid a flow meter system measures the water injection rate (with correction factors applied).

Since firefighting vehicles are mobile foam systems, the previously discussed surrogate foam liquids, training foams and water equivalency options can also be employed. The same appropriate care and control instructions would apply. Additional consideration should be given to the total emergency vehicle out of service time, ease of placement back to ready status and any required back up coverage.

Containing Foam Discharge

Fires, fuel spills and evolving emergencies occur in many types of locations and under many different circumstances, often at unpredictable times. In some cases it is possible to collect the firewater runoff and in others it is not. However, for sites where there is a significant flammable liquid hazard such as fuel farms and petroleum/chemical processing, airport operations, specific rail transportation, marine and military storages, and industrial facilities, it is recommended that a firewater runoff collection plan be developed. This plan aims at listing and making available the required (permanent or temporary) equipment that will capture the runoff water and place this water in a contained area or tank allowing later treatment. The goal of the plan is to minimize the volume of non-collected runoff firewater. From this preparation work, in the case of a full-scale fire, intervention teams will install the firewater runoff collection equipment at the same time as they install and activate the foam extinguishment equipment. Spill and containment equipment should be on-site and additional resources identified in any plan. Education and training should include expected and unpredicted runoff containment.

The total foam water solution that has been used in firefighting operations will probably be heavily contaminated with the fuel or fuels involved in the fire as well as solids and other residues. It is also likely to have been diluted with water discharged for cooling purposes. The finished foam solution will usually contain about 1- 6% foam concentrate depending on the type of foam used.

Manual Firefighting Operations

In some cases, the foam solution used during fire department operations can be collected or minimized. However, it is not always possible to control or contain the foam due to the hazards presented during an emergency operation. This can be a consequence of the location of the incident or the circumstances surrounding it. Event-initiated conservation efforts and manual containment measures are usually executed by the responding fire department to reduce and/or contain the flow of foam water solution when conditions and manpower permit. These operations include the following measures:

- Blocking sewer drains - This is a common practice used to prevent contaminated runoff firewater from entering the sewer system unchecked. It is then diverted to an area suitable for containment.
- Portable dikes - These are generally used for land-based operations. They can be set up by the fire department personnel during or after extinguishment to collect run-off.

Fixed System Releases

This type of release is generally uncontrolled, whether the result of a fire incident or accidental release. The foam solution discharge in this type of scenario can be dealt with by event-initiated operations or by engineered containment systems. Event-initiated operations encompass the same temporary measures that would be taken during fire department operations: portable dikes, floating booms, etc. Engineered containment would be based mainly on the location and type of facility, and would consist of holding tanks, dykes/bunds or areas where the contaminated foam water solution would be collected, treated, and sent to an appropriate disposal facility.

It is recommended that the design of new fixed systems based on Class B foams also integrate the collection of runoff water.

Firewater Disposal

As explained above, runoff firewater is a complex fluid to handle after its collection. It potentially contains residual hydrocarbons or polar solvents from the burning fuel, combustion products, hydrocarbon surfactants, water-soluble polymers, hydrolyzed proteins, co-solvents, anti-freezing agents and fluorinated surfactants. This type of runoff firewater can also potentially foam. Incineration in appropriate equipment is a recognized way to dispose of this type of effluent. Other techniques that have proven effective include a combination of coagulation, flocculation, electro-flocculation, reverse osmosis, and adsorption on granular activated carbon (GAC).

Foam Concentrate Disposal

Class B foam concentrates do not carry an expiration date and generally have a 10 to 25-year shelf life, so the need to dispose of spent or expired concentrate should be infrequent. Most foam manufacturers and some independent contractors offer a service of testing foam concentrate samples on a regular basis to determine if the concentrate still meets the original specification. When disposal of Class B foam concentrate is required, it is recommended that it be sent for thermal destruction (high temperature incineration) to a facility capable of handling halogenated waste or the equivalent.