



Module 5: Fire Fighting Foam Principles and Ethanol-Blended Fuel

Objective

Upon the successful completion of this module, participants will be able to develop foam use strategies for controlling / fighting fires associated with ethanol-blended fuels.



Introduction

- Production of ethanol large & likely to continue to increase
- Predominate danger from tanker trucks & rail cars carrying large amounts of ethanol, manufacturing facilities, & storage facilities
- Responders need to be prepared for large-scale emergencies & prepared with most effective techniques & extinguishing media



Basic Foam Principles

- What is foam?
 - “...an aggregate of air-filled bubbles formed from aqueous solutions which is lower in density than flammable liquids. It is used principally to form a cohesive floating blanket on flammable and combustible liquids, and prevents or extinguishes fire by excluding air and cooling the fuel. It also prevents reignition by suppressing formation of flammable vapors. It has the property of adhering to surfaces, which provides a degree of exposure protection from adjacent fires” (NFPA 11).

Basic Foam Principles

- Why use foam?
 - Only agent capable of suppressing vapors & providing visible proof of security
 - Foam blanket on unignited spill can prevent fire
 - Suppression of vapors prevents them from finding ignition source

Basic Foam Principles

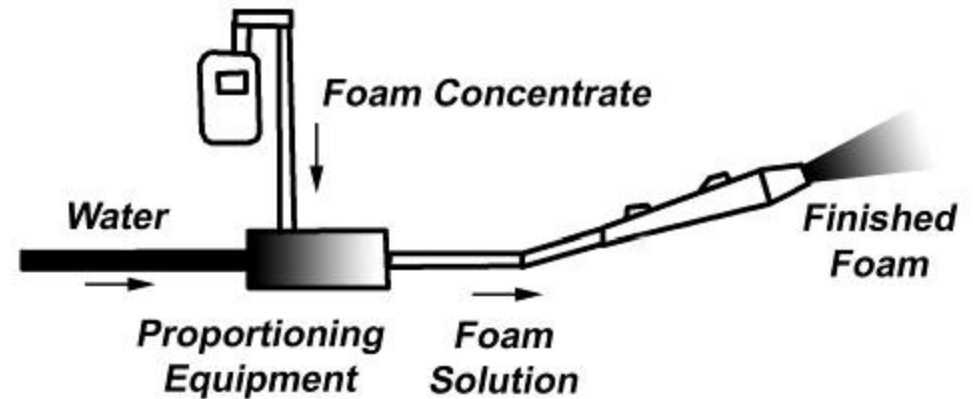
- Why use foam?
 - Can provide post-fire security by protecting hazard until it can be secured / removed
 - Can provide protection from flammable liquids for fire & rescue personnel during emergency operations

Basic Foam Principles

- How foam works:
 - Foam can:
 - Exclude oxygen from fuel vapors
 - Cool fuel surface with water content of foam
 - Prevent release of flammable vapors from fuel surface
 - Emulsify fuel

Basic Foam Principles

- How foam works:
 - Foam tetrahedron:
 - Before being used must be proportioned & aerated
 - 4 elements:
 - Foam concentrate
 - Water
 - Air
 - Aeration



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Basic Foam Principles

- What is foam not effective on?
 - Foam is not effective on Class C electrical fires:
 - Foam contains 94–97% water & water conducts electricity
 - Class C fires can be extinguished using nonconductive extinguishing agents

Basic Foam Principles

- What is foam not effective on?
 - Foam is not effective on 3-dimensional fires:
 - Recommended to first control spill fire
 - Extinguish flowing fire using dry chemical agent

Basic Foam Principles

- What is foam not effective on?
 - Foam is not effective on pressurized gases:
 - Vapor pressure too high for foam to be effective
 - Examples:
 - Propane
 - Butane
 - Vinyl chloride
 - Butadiene

Basic Foam Principles

- What is foam not effective on?
 - Foam is not effective on combustible metals:
 - Combustible metals usually react with water
 - Fires involving combustible metals require specialized techniques & extinguishing agents

Basic Foam Principles

- What is foam effective on?
 - Effective at suppressing vapors & extinguishing Class B fires
 - 2 categories of Class B products:
 - Hydrocarbons
 - Polar solvents
 - Hydrocarbons
 - Polar solvents

Basic Foam Principles

- Foam terminology:
 - Foam concentrate
 - Foam solution
 - Finished foam

Basic Foam Principles

- Types of foam:
 - Protein foam
 - Fluoroprotein foams
 - AFFF
 - FFFP
 - AR foam

Basic Foam Principles

- Foam characteristics:
 - Knockdown
 - Heat resistance
 - Fuel tolerance
 - Vapor suppression
 - Alcohol tolerance

Foam Characteristics

Property	Protein	Fluoroprotein	AFFF	FFFP	AR-AFFF
Knockdown	Fair	Good	Excellent	Good	Excellent
Heat Resistance	Excellent	Excellent	Fair	Good	Good
Fuel Tolerance	Fair	Excellent	Moderate	Good	Good
Vapor Suppression	Excellent	Excellent	Good	Good	Good
Alcohol Tolerance	None	None	None	Good	Excellent
Source: National Foam					

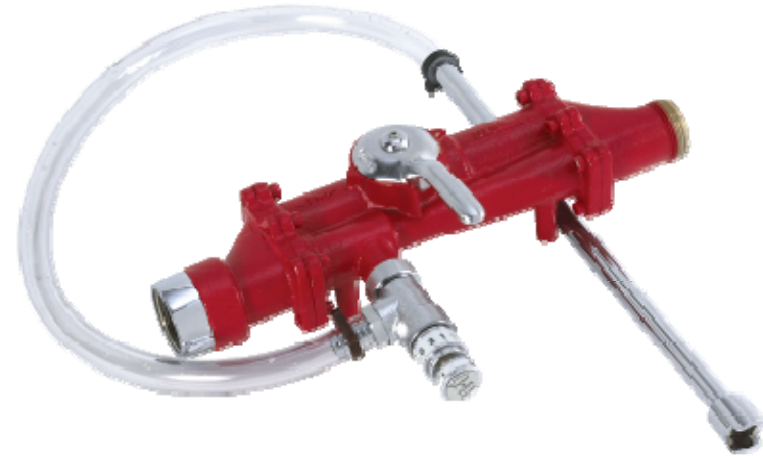
Basic Foam Principles

- Foam proportioning & delivery systems:
 - Concentration levels:
 - Hydrocarbons: 3%
 - Polar solvents: 6%
 - Foam proportioning systems:
 - Eductors:
 - In-line
eductors:
Advantages



Basic Foam Principles

- Foam proportioning & delivery systems:
 - Foam proportioning systems:
 - Eductors:
 - Bypass eductors
 - Common eductor failures



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Basic Foam Principles

- Foam proportioning & delivery systems:
 - Foam proportioning systems:
 - Foam nozzles:
 - Foam proportioning nozzles:
 - Advantages



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Basic Foam Principles

- Foam proportioning & delivery systems:
 - Foam proportioning systems:
 - Air aspirating nozzles
 - Non-air aspirating nozzles



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Basic Foam Principles

- Application techniques:
 - Never plunge foam directly into the fuel
 - Bounce-off:
 - Effective if there is an object in / behind spill area
 - Bank-in:
 - Particularly effective with non-air aspirating fog nozzles

Basic Foam Principles

- Application techniques:
 - Rain-down:
 - Nozzle elevated & foam allowed to fall over spill as gently as possible

Foam and Ethanol and Ethanol-Fuel Blends

- Foams not developed for application on alcohol- / ethanol-blended fuels:
 - Ineffective on fuels containing alcohols / ethanol:
 - Alcohol / Ethanol attacks & absorbs foam solution

Foam and Ethanol and Ethanol-Fuel Blends

- AR foams:
 - Forms tough membrane between foam blanket & alcohol-type fuel
 - Crucial to use in combating ethanol-blended fuel fires
 - Apply gently to surface of alcohol- / ethanol-blended fuels

Foam and Ethanol and Ethanol-Fuel Blends

- AR foams:
 - Use Type II application techniques:
 - Apply indirectly to fire
 - Type III application:
 - Effective only when deflected off surfaces
 - Best option may be to protect surrounding exposures

Foam and Ethanol and Ethanol-Fuel Blends

- Require higher flow rate of foam to extinguish fires:
 - AFFF-type: 1 gpm foam / 10 ft² burning surface on hydrocarbon-type fuel
 - Ethanol-blended fuels: 2 gpm foam / 10 ft² of AR type foam

Foam Recommendations for Fire Departments

- Consider converting to AR foam concentrates
- Develop means of having cache of AR foam readily available

Foam Recommendations for Fire Departments

- AR foams effective on both alcohol & hydrocarbon fires:
 - Some have quicker knockdown abilities & longer foam retention times than protein-based hydrocarbon foams

Foam Recommendations for Fire Departments



UN ID number



UN ID number



NA ID number

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Foam Recommendations for Fire Departments

- AR foams effective on both alcohol & hydrocarbon fires:
 - Uncertain if fire is alcohol- / ethanol-blended:
 - Consider doubling application rate
 - Foam of choice

Summary

- AR foam best choice for incidents
- AR foam recommended choice for all fuel fires involving gasoline- / ethanol-blended fuels
- AR foam performs on hydrocarbon fires as well:
 - Preferred choice from response standpoint if nature of burning fuel is unclear