WELCOME

RULES OF ENGAGEMENT

Safety:	**Note Fire Exits & Evac Location**
Conveniences:	**Restroom Locations**
	Cafeteria
Be Considerate:	**Smoke Free Building**
	No Cell Phones/PDA/Texting
Custodian Rules:	**No Food or Drinks in Training Room (Water Only)**

Presenter Introductions

ETHANOL

New Risks and Challenges for Public Safety and the Environment

Presented by: Massachusetts Firefighting Academy Division
Special Hazards Training Branch
Hazardous Materials & Flammable Gas Training Groups

ETHANOL

Massachusetts:

2-3 times a week 6+Million Gallons Transported by Rail-Barge-Trucks

Ethanol Trains Impact 88 Massachusetts Communities

2010 Production in the United States - 13 billion gallons

WHY ARE WE HERE ?

The sky is not falling but

IS YOUR COMMUNITY PREPARED ?

20,000,000 Gallons Stored Locally

Now the largest volume of hazardous material shipped by rail

Public Safety and Fire Control Challenges

What is Ethanol?

A colorless volatile flammable liquid C_2H_5OH that is the intoxicating agent in liquors and is also used as a solvent and in fuel —called also *ethyl alcohol, grain alcohol*

Source: Merriam-Webster.com

Alcohol as an intoxicant

What is Denatured Ethanol?

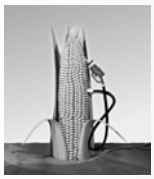
Ethanol with additives that make it unsuitable for drinking.

Used as Gasoline Additives

FLEXFUEL E85 ETHANOL

Denatured alcohol or **mentholated spirits** is ethanol that has additives to make it more poisonous or unpalatable, and thus, undrinkable.

Ethanol History & Need



It all begins at the cornfields in the Midwestern States. Other products are also used to produce Ethanol (soybeans, wood chips)

Ethanol History & Need

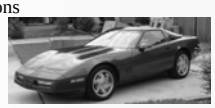
Late 1970's

- Gasoline additive since late 1970s
  - MTBE- (Methyl Tertiary Butyl Ether)
- Primary role was octane enhancer until late 1980s:
  - Viewed as environmentally sound alternative to use of lead in gasoline

Ethanol History & Need

Late 1980's

- Late 1980s:
  - Mandatory oxygenated fuel programs
  - Some states used ethanol / oxygenates to lower CO emissions



MTBE is the acronym for **methyl tertiary butyl ether**, a fairly simple molecule that is created from methanol.

It boosts octane
It is an oxygenate, meaning that it adds oxygen to the reaction when it burns.
Banned due to carcinogenic

Ethanol History & Need

Late 1980's

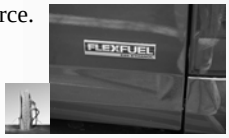
- Ethanol is currently most widely used to raise the octane:
  - Replaced MTBE banned in most states (carcinogen)
    (Methyl Tertiary Butyl Ether)

MTBE is the acronym for **methyl tertiary butyl ether**, a fairly simple molecule that is created from methanol.

It boosts octane
It is an oxygenate, meaning that it adds oxygen to the reaction when it burns.
Banned due to carcinogenic

Ethanol History & Need

- Used today in Flex Fuel E85, an alternative fuel blend based on a renewable source.



Chemical and Physical Characteristics

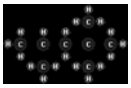
Ethanol and Hydrocarbon Fuels

What's the Difference?

Hydrocarbons & Ethanol Blends

What's the Difference?

Gasoline-IsoOctane C8 H18



Source: altfuels.org

Ethanol C2 H5 OH

Source: altfuels.org

A Carbon, Hydrogen
A Carbon, Hydrogen and Alcohol

Ethanol
(A Polar Solvent)

What is a Polar Solvent ?
Alcohol-Acetone-MEK

Simply put, it mixes with the most popular solvent:
WATER

How is Ethanol Produced ?

Chemical Properties Comparison

Gasoline	Ethanol
➢ Vapor Density: 3.0 to 4.0 • **Gasoline vapors seek low levels / remain close to ground level**	➢ Vapor Density 1.59 • **Ethanol vapors seek low levels / remain close to ground level**
➢ Specific Gravity: 0.72–0.76 • **Will float on top of water**	➢ Specific Gravity 0.79 • Lighter than water • **Thoroughly mix with water**

Auto Ignition Temperature:
is the lowest temperature at which it will spontaneously ignite in a normal atmosphere without an external source of ignition, such as a flame or spark.

This temperature is required to supply the activation energy needed for combustion. The temperature at which a chemical will ignite decreases as the pressure increases or oxygen concentration increases. It is usually applied to a combustible fuel mixture.

Chemical Properties Comparison

Gasoline	Ethanol
➢ Flammable Material ➢ Motor Fuel ➢ Hydrocarbon ➢ Flash Point • -45°F ➢ Flammable Range • 1.4% – 7.6%	➢ Flammable Material ➢ Motor Fuel ➢ Polar Solvent ➢ Flash Point • 55°F ➢ Flammable Range • 3.3% - 19%

Flash Point = Temperature is the lowest temperature at that a flammable liquid can vaporize to form an ignitable mixture in air.

Boiling Point of water=212 F

What Does Flammable Range Mean?

LFL=Lower Flammable Limit
UFL=Upper Flammable Limit

FR=Flammable Range

Also known as LEL and UEL E=Explosive range if confined

Characteristics of
Gasoline & Ethanol

Gasoline's Greatest hazard is flammability:

111,000-114,500 BTU

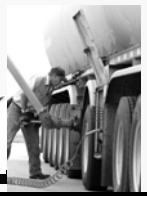
Ethanol's Greatest hazard is flammability:

81,800 BTU

1 Gallon of gasoline vs 1 Gallon of Ethanol

Ethanol
Greatest Hazards

- Its Flammability
- Transloading Operations
  - Conducts Electricity
    - Electrocution Hazards
    - Ignition Sources
    - Static Electricity



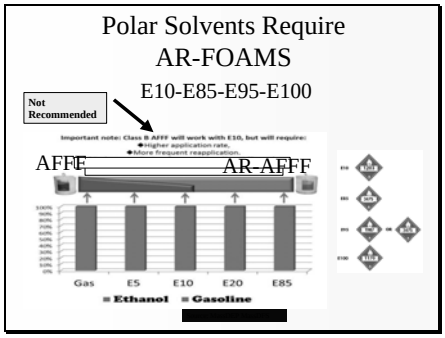
Ethanol is a good conductor of electricity.
Transloading and static electricity issues
Multiple ignition sources…

Ethanol's
Firefighting Issues

For Firefighters:

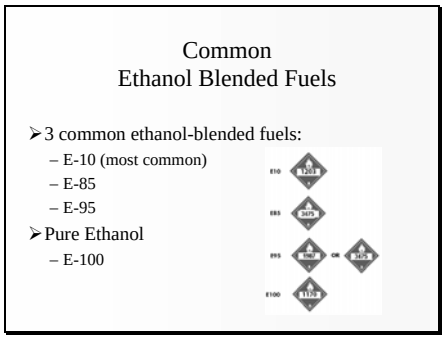
- Fire Extinguishing Agents
  - Dry Chemical Agents Supply
  - AR-AFFF Firefighting Foam Supply
  - AR-AFFF Training and Application

Ethanol is a good conductor of electricity.
Transloading and static electricity issues
Multiple ignition sources…

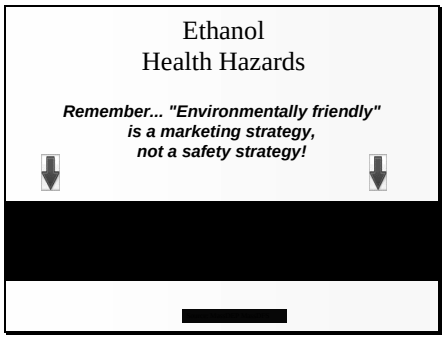


Using or restocking the wrong foam concentrate can adversely affect operations, safety of personnel, the budget, the environment or cause damage to foam system equipment.

If you are not completely familiar with your foam product, you are not completely familiar with firefighting operations!



E10=10% Ethanol + 90% Gasoline
E-85=85% Ethanol + 15% Gasoline
E95=95% Denatured Alcohol (gasoline grade)



How do we prevent exposure? SCBA PPE don't eat around job site.

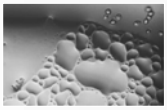
Ethanol
Health Hazards

Human Exposure

Best Defense

How do we prevent exposure? SCBA PPE don't eat around job site.

Water Solubility Gasoline



Non-Soluble in water

Water Solubility Ethanol

- Ethanol is miscible in water soluble at any concentration. www.differencebetween.net

Dilution may not be a solution

1000 gallons of ethanol needs 4000-5000 gallons of water to dilute.

Where does runoff go?

Where does burn-off go??

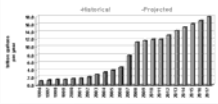
Ethanol '" is miscible in water, which means that the two substances easily combine to make a homogenous solution.
Methanol '" is soluble in water, which means that it will break down in the presence of water.

Dilution may not be the solution as:
1000 gallons of ethanol needs 4000-5000 gallons of water to dilute.

Where does the runoff go? Down stream
Where does ignited runoff go? Airborne

The Risks

- The fastest growing commodity in transportation
- Polar Flammable Liquid
- Requires unusual fire fighting equipment and tactics
- Unique environmental impacts when released



Ethanol is not a new chemical, nor does it posses extraordinary chemical risks

The problem of ethanol is that it has made a rapid and extensive arrival on the scene for transportation and storage and that it posses unusual challenges

Ethanol is a polar flammable liquid. That means that it fully and immediately mixes with water. This is completely contrary to the behavior of petroleum products which are non-polar and can be separated from water

This polar-flammable property also completely changes the fire fighting tactics required

Ethanol is flammable in a little as a 20% concentration in water. The impact of this will be discussed further

Ethanol requires a special alcohol resistant fire fighting foam. This foam cannot be used in aircraft fire fighting by FAA regulations. For decades, airports were a primary source for fire fighting foam … no more.

Ethanol also requires large volumes of dry chemical for 3-dimensional fires. Dry chemical trucks are rare, generally existing only in industrial applications, not in local fire departments.

When released into the ground, ethanol can act as a solvent to re-mobilize other pollutants. Putting chemicals that may have lied dormant for decades into the ground water.

In the ground, ethanol will decompose and release methane gas, posing a secondary fire and explosion hazards for weeks to months following a release.

In surface water, ethanol will displace oxygen immediately and until sufficiently diluted. This will cause a local fish kill.

Where it remains in surface water, a secondary oxygen displacement will occur during decomposition.

Other hazards and effects remain under investigation

Hazard & Risk Assessment

Placards & Markings

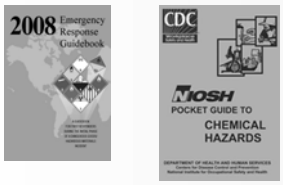
- Placards able to indicate high-concentration ethanol-blended fuels:
  - Does not distinguish between gasoline & E-10
- TRANSCAER
- http://www.transcaer.com/

Key Consideration from this program;

Does not distinguish between gasoline & E-10 gasohol
E-10 requires AR foam for emergency response

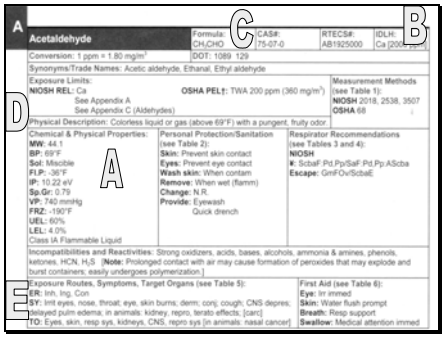
Transcaer- Good source for Emergency Response Information
http://www.transcaer.com/

DOT-ERG
NIOSH-Pocket Guide



Use ERG Look Up 1203 1987 3475 and 1170
NIOSH Look Up Gasoline Benzene Ethanol note IDLH

Key Consideration:
If there is an IDLH value in the NIOSH Book (PPE & SCBA) is a must when working in the hot zone



Ethanol Shipping &
Storage Information

- Sources of information about chemicals involved in spill / fire incidents:

TRANSPORTATION

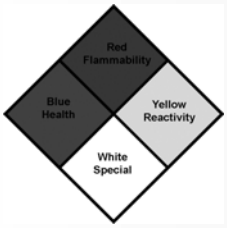
Bill Of Lading-Truck
Waybill/Consist-Train
Manifest-Marine Transport

FIXED FACILITIES

NFPA 704
Chemtrec
Product Manufacturer
Internet

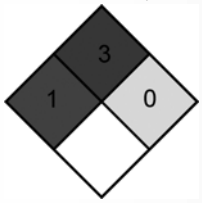
Shipping Papers
Bill of Lading-Trucking Industry-Responsibility
Driver-Found in cab
Waybill/Consist-Railroad-Responsibility
Conductor/Engineer-Found in locomotive
Manifest-Marine Industry (Barge)-Responsibility
Captain of vessel-Found in wheelhouse and on deck
MSDS
Good source of information

NFPA 704 Diamond



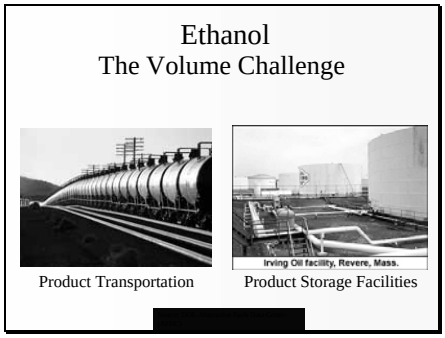
The NFPA 704 diamond should be posted at a fixed facility where hazmats are stored.

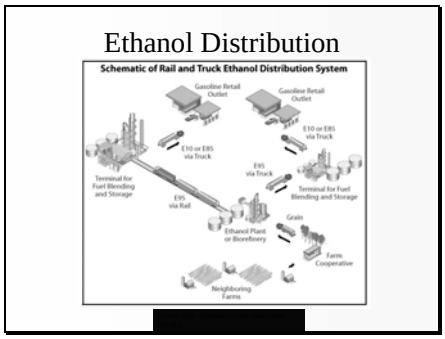
NFPA Diamond for
E-100, E-95,
E-85, and Gasoline



(1) Minor injury risk (skin irritation)
(3) Can be ignited under almost all ambient temperature conditions
(0) indicating no hazard

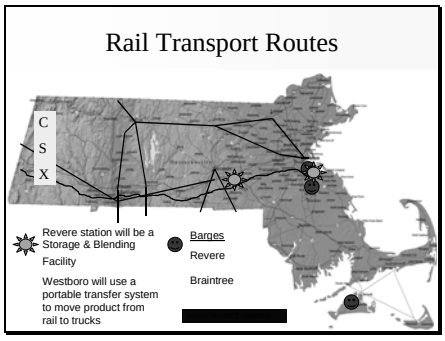
1: Blue health square: slight to moderate
irritation
0: Reactivity yellow square
3: Flammability red square: high flammability
with ignition likely under most conditions





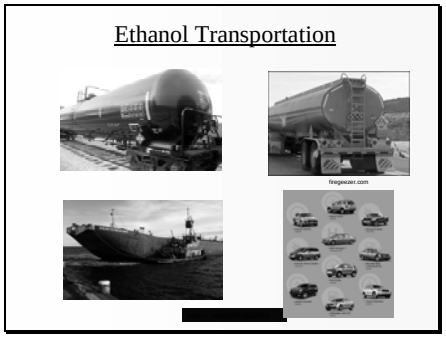
From the neighboring farms to your local gasoline stations

Cost of corn has increased 70% in the last year

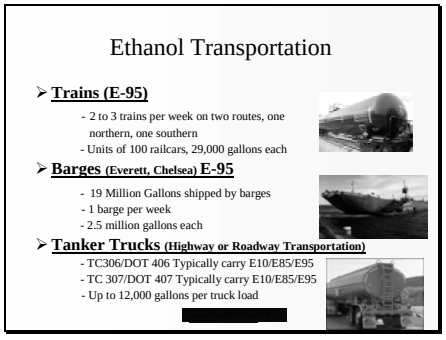


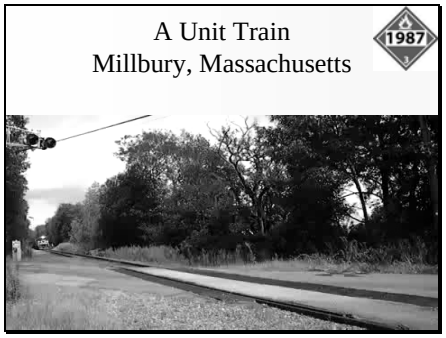
As I've pointed out, Ethanol is moving and in storage throughout Massachusetts.
It is reported that 40 tanks trucks per week of E-95 are traveling the Massachusetts Turnpike. Their destinations from the turnpike are not presently tracked.
Ethanol is moving by various rail carriers in unit trains. CSX is the largest rail company moving ethanol in Massachusetts, but not the largest mover of this product. (PanAm/Providence-Worcester/NE Central)
Short-line carriers are moving ethanol in several routes to terminal points in Massachusetts and Rhode Island, with other possible routes to New Hampshire in the works.
Rails transfer points are in development for Revere and Westboro. The Revere station will be a fixed facility, while Westboro will use a portable transfer system to move product from rail to trucks
Importantly, the recommended resolution for large ethanol fires from rail incidents has been to allow the product to burn, reducing the environmental impact and uncomplicating the fire fighting operation. While this works well in a corn field in Iowa, the rail routes in

Massachusetts will take unit trains through 88 communities, including many of our major urban areas. Allowing this volume of liquid to burn is not an option in these environments
DFS record indicate that there is currently 20,606,795 gallons of ethanol in storage in Massachusetts. Of this quantity in storage 19,811,549 is transported by barge. Again, the risk and solutions to incidents involving ethanol in barge transportation are far from resolution and require immediate research and development to address.



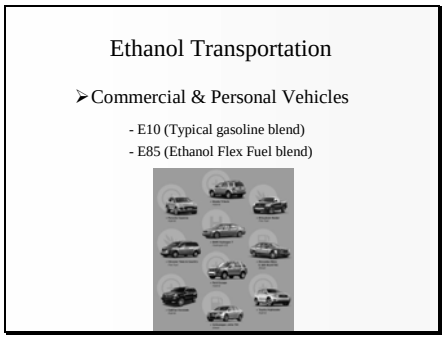
Transportation routes: Rail 30,000 gallons per rail car
Tanker Trucks DOT 306/406, 307/407, 312/412 8000 to 10,000 gallons
Barges 2 million gallons





In the last ten years, the production of ethanol has increased dramatically due to the demand for ethanol-blend fuels. Current production (2010) in the United States is 13 billion gallons. Denatured ethanol (approximately 95% ethanol, 5% gasoline) is largely shipped from production facilities by rail and is now the largest volume hazardous material shipped by rail.

Large volumes of ethanol are commonly shipped by unit trains, up to 3.2 million gallons, and the larger barges can transport up to 2.5 million gallons. In Massachusetts, two to three ethanol unit trains currently travel through the state per week, as well as an ethanol barge per week. The number of trains and barges transporting denatured ethanol (95% - 98% ethanol) through the state are anticipated to increase in the future, especially if the use of higher ethanol blends becomes more prevalent. The high volume of ethanol transported and the differences in the chemical properties, and the fate and transport of ethanol as compared to standard gasoline, led to the need for additional consideration of spill response actions. In particular, this document considers the assessment and response actions for rail and barge spills of denatured ethanol.



Consider an auto leaking fuel or a vehicle fire where gasoline (E10-E85) is involved. This may change your tactics.

A Challenging Auto Fire

Whitehall Engines 2,11, 12 and Rescue 8 respond to a Mercedes-Benz on fire. Chief 16 (Benner) arrives and finds the car well-involved.

The Ethanol-laced gasoline that the Mercedes-Benz was filled with posed a problem for the firefighters. 3 lines were used and one was equipped with a ProPak. It took a few extra minutes to get the fire extinguished.

Fixed Facilities

Currently 20,606,795 gallons of ethanol in storage in Massachusetts

Irving Oil facility, Revere, Mass.

Fixed Facilities

- Fixed Facility Storage Tanks
  - Some are capable of storing 1 million barrels of fuel
  - 1 barrel of fuel = 42 US Gallons
- Gasoline Stations
  - Fuel Pumps
  - Underground Storage Tanks (UST)

Note ** A “Barrel” of fuel is equal to 42 gallons.

Terminal Storage of Ethanol-Blended Fuels

- Commonly delivered via tank truck / rail car / barge:
  - Currently no common pipeline delivery method
- E-95 normally stored in IFR tanks

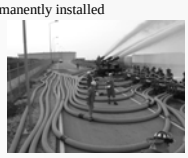
IFR-
Internal Floating Roof Tanks
May have rim fires caused by lightning strikes

Terminal Storage of Ethanol-Blended Fuels

- Pre-fire planning extremely important
- Pre-established working relations between fire department & facility operators
- Assess Foam and Equipment Needs and Compatibility
- Annual Training Exercises

Terminal Storage of Ethanol-Blended Fuels

- Built-in fire protection systems:
  - Fixed systems:
    - Combination of devices permanently installed
    - Provide fire protection
    - Can be activated manually
    - By detection device



Terminal Storage of Ethanol-Blended Fuels

- Challenges:
  - Provide limited access
  - Inadequate water supplies in area
  - Contend with containment dikes & their systems
  - Miles of exposed product piping involved
  - Unprotected loading rack facilities

Bulk Plant and Distribution Facilities

- Smaller bulk distribution storage facilities may pose greatest challenge to local fire departments
- Flammable liquid fuels stored at facilities in modest quantities

Bulk storage & Terminal Storage Facilities are regulated by OSHA 1910.160 CMR 527 and NFPA 30

Bulk Plant and Distribution Facilities

- Gasoline / Ethanol-blended fuel normally stored in underground tanks / small volume above-ground steel tanks
- Vertical / Horizontal design

Bulk Plant and Distribution Facilities

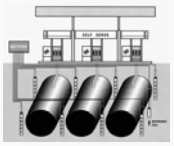
- Spill containment usually designed to contain largest tank in facility
- Incidents involving multiple tanks in facility may overtax designed containment area

Retail Dispensing (Gas Stations)

- Filled by tankers
- Early 2008: over 1,000 fueling sites handling E-85
- Most handling E-10
- Number expected to increase
- Most likely E-10 mixture

Retail Dispensing (Gas Stations)

- Stored in horizontal underground tanks:
- Fire protection systems



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Maximum pressure 0.5 psig
Tank capacities vary
Typically constructed of steel & double walled
Tank & Tank Components compatibility ?

Massachusetts
First Retail Stations

FLEXFUEL

- Massachusetts first E-85 retail gas station
  - Chelsea

D.K. Burke
410 Beachem St.
Chelsea, MA

The first of many-Chelsea

Massachusetts
Gasoline E-85 Stations

700 Memorial Dr. Cambridge
1 Rutherford Av Charlestown
100 Service Rd. E. Boston
410 Beecham St. Chelsea
54 Easthampton Rd. Northampton
683 Turnpike St. Canton
Mass Turnpike Charlton – Westborough - Natick

- Current E-85 stations in Massachusetts
- 2983 E-85 stations in U.S. in 2,018 Cities

4 Massachusetts Stations

Massachusetts
First E-85 Retail Station

Some Communities are Concerned

Recent Ethanol Incidents

July 11, 2012	Columbus, Ohio	Fire
Oct 07, 2011	Tiskilwa, Illinois	Fire
Jun 14, 2011	Menlo, Iowa	Derail
Mar 30, 2011	Lee, Massachusetts	Derail
Feb 06, 2011	Toledo, Ohio	Fire
Mar 10, 2010	Windom, Connecticut	Derail
Jun 19, 2009	Rockford, Illinois	Fire
Aug 23, 2008	Oklahoma	Fire
May 14, 2007	Baltimore, Maryland	Fire
Oct 21, 2006	New Brighton, Penn.	Fire
June 19, 2006	Missoula, Montana	Derail

Oct 7, 2011
Tiskilwa, IL , Southwest of Chicago-A train derails and causes explosions prompting evacuation of 800.
Jun 14, 2011
Someone in Menlo Iowa was very determined to *derail* a *train* carrying highly flammable *ethanol*.

Feb. 6, 2011: A *train* carrying more than 250,000 gallons of *ethanol* caught fire after it jumped the tracks near Toledo, Ohio.

Mar 30, 2011 Freight *train derails* in *LEE*, *Mass*. -- It happened around 8 p.m. on Monday night. Seven cars of a southbound freight *train derailed* in **...** "One car had *ethanol* in it. There was no release. **...**

Mar 10, 2010
Train Derailed In Windham CT, the last 4 Cars tanker *cars* carrying ethanol

Jun 19, 2009 -
Train derailment fire in Rockford / Cherry Valley, IL.

Aug 23, 2008
In Oklahoma, 8 cars on the 110 car *train derailed* most of which were carrying either crude oil or *ethanol*. A major explosion ensued

October 7, 2011 Tiskilwa, IL

Unit Train Crash & Fire

June 19, 2009 Rockford, IL

May 14, 2007 Baltimore Maryland

Note the deluge of Purple K extinguishing from the ARFF (Aircraft Rescue Fire Fighting) unit

October 21, 2006 New Brighton, PA

October
2006, 23 cars of an 86-car **train** derailed in **New Brighton**, **PA**

JUNE 19, 2006 Missoula, MT

Train derails in downtown Missoula, spilling fuel
09:55 AM PDT on Monday, June 19, 2006- Associated Press

MISSOULA, Mont. - Five railroad cars bound for Washington state derailed on a Montana Rail Link track and leaked fuel near downtown Missoula, Montana.
It happened at about 5:30 a.m. Company spokeswoman Lynda Frost says the derailment was caused by a broken track.

Two of the cars were carrying ethanol fuel, and one car leaked nearly ten-thousand gallons of fuel on the company's rail yard. Fire, police and hazardous materials teams responded, and covered the spill with foam to keep it from igniting.

Frost says crews will likely have to remove the soil.

Several homes in the area were temporarily evacuated.

o one was injured. The train originated in Laurel, Montana, and was headed to Pasco, Washington

Past Ethanol Incidents
Insight & Fate

Significant fires involving multiple rail cars

Local first responders focused on evacuations, containing the fire, protecting nearby structures and tanks

In most cases, fires were allowed to burn in rural areas

Ethanol impacts to surface water are a significant concern

Run-off to nearby streams-dam for removal

AR-Foam had limited use due to limited foam supplies on hand

Consideration of past ethanol incidents provides some insight into fate and transport in a spill situation, as well as response activities that have been effective. Consideration of these incidents, as well as conducted and possible response actions leads to the following conclusions:

In some cases, ethanol rail incidents result in fire. In many cases, these fires have been significant, involving multiple rail cars and large volumes of ethanol;

First responders generally have been local fire fighters that have focused on necessary evacuations, containing the fire, and protecting nearby structures and/or tanks;

In most cases, if not all, ethanol fires have been allowed to burn, although most have not occurred in highly populated areas. Cooling water has been used

to protect structures, tanks, and uninvolved rail cars;
In some cases, where large amounts of water usage were necessary, run-off to nearby streams occurred. In one case, the stream was subsequently dammed, and 500,000 gallons of impacted water were removed for disposal;
Alcohol resistant foam (AR-AFFF) has had limited use in these large spill and fire situations, probably due to the limited volume generally available to local fire-fighters and concerns with migration and/or recovery of the foam/ethanol. Most use has been to extinguish specific breached and burning cars that were blocking passage, or to extinguish fires inside tankers prior to removal of the contents and movement of the tanker. The use of AR-AFFF has been effective in these circumstances;
The fires have consumed large volumes of ethanol, thus limiting impacts to environmental media;
The most significant impacts related to ethanol spills have been to surface water. In some cases, surface water impacts have resulted in fish kills several days after the spill as a result of oxygen depletion. These impacts have occurred some distance from the site of the original spill;

Due to concerns of surface water impacts, response activities have more recently involved efforts to prevent discharge to surface water through damming. Aeration of small creeks and large rivers has also been used to improve dissolved oxygen content; and
Migration of spilled ethanol from the surface through soil to groundwater is also of concern, due to possible groundwater contamination and discharge to surface water, as well as methane generation. Where possible, spilled material has been recovered by pumping. In some cases, spilled material was not identified, and migration to groundwater and surface water occurred. In cases where groundwater impacts have occurred, ethanol has degraded relatively rapidly, although gasoline constituents have been more persistent.

As a result of the above observations, the following recommendations can be made:
Contained burning is an effective response to an

ethanol spill incident. It has been used in numerous spill incidents, albeit they have not generally occurred in highly populated areas;

The use of cooling water may be necessary to protect structures, tanks, or uninvolved rail cars. Runoff from water use should be contained and/or recovered to the extent possible to prevent infiltration to groundwater and impacts to surface water;

The local fire department stocks of alcohol resistant foam could be increased, as its use is effective. When used where the ethanol/foam can be recovered, environmental impacts will be limited. Foam not recovered and reaching surface water can increase the biochemical oxygen demand loading to streams. In addition, foam use on unpaved surfaces does not limit the migration of ethanol to groundwater;

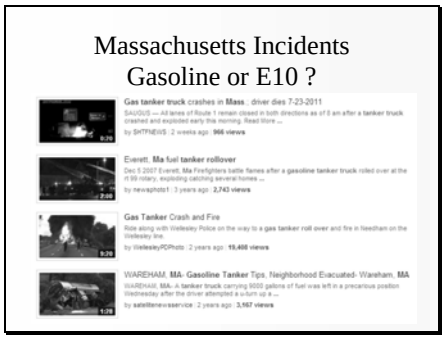
Ethanol pools or impacts to soils should be identified as quickly as possible to prevent infiltration to groundwater and runoff to surface water. The high solubility of ethanol can result in rapid transport in these media. Recovery and excavation have largely been used to address such situations. Controlled burn has not been used, but could be considered in some situations;

Ethanol impacts to surface water are a significant concern. Ethanol spills reaching ditches or small creeks can be addressed by damming, thus allowing time for biodegradation and preventing releases to larger water bodies. Aeration of these smaller water bodies can be used to improve their dissolved oxygen content and enhance biodegradation, but these actions may not reduce ethanol content sufficiently prior to discharge to a large water body;

Once ethanol is discharged to a larger river, response options are limited. Monitoring of both dissolved oxygen and ethanol should be conducted in order to determine whether concentrations are approaching anoxic or toxic levels. Barge aerators can be used to improve dissolved oxygen levels; and

Ethanol incidents in the marine environment have been rare, with none of a significant volume occurring in harbors or near-shore areas. Response options in such cases are similarly limited to the use of aeration to improve dissolved oxygen levels,

although this would only be effective in smaller areas, such as inlets.



Massachusetts incidents, were they gasoline or a Gasoline Blended Fuel E-10?

Common Challenges For All Agencies

- Life Safety
  - Immediate
  - Short & Long Term Community Health
- Exposures
  - Structures & Critical Infrastructure
  - Environment (waterways, water supplies, aquifers)
- Access to scene (RR-Highway-Fixed Facilities)
- First Responder Capabilities & Resources
- Community Resiliency

[redacted]

Common Challenges For All Agencies

- Resources
  - Manpower (evacuations, fire protection, scene control)
  - Equipment (AR-Foam, DC, Nozzles, Eductors)
  - Shelter (Staffing, Food, Water, Clothing)
- Scope/Size of Incident
  - Better Plan For A Large Event
- Multi – Agency Response
  - Unified ICS

Time To Swap Business Cards Is Now

[redacted]

Preplanning and Preparedness

What Is Strategy ?

- A Strategy Is A Plan For Managing Resources
- Begins with
  - Preplanning
  - Preparedness
  - Training
  - Annual Exercises

Pre-Incident Planning (Strategy)

- Who Are The Players ? (What are their needs)
  - Fire Rescue
  - HazMat Response
  - Law Enforcement
  - EMS
  - Public Works
  - Utility Companies
  - Local Business Community

Pre-Incident Planning (Strategy)

- Who Are The Players ? (What are their needs?)
  - DOT
  - EPA
  - DEP
  - MEMA & LEPC
  - CSX – Pan Am – Providence & Worcester Railways

Pre-Incident Planning (Strategy)

- Transportation Incident Resources-
- Access-Highway & Railway
- Water Supply
- Fixed Facility
- Foam & Dry Chemical
- Mutual Aid Plan
- Regional Response
  - HazMat
  - DEP
  - EPA
- Training-Full Scale Exercises

What Is Your Strategy ?

- Examples Of Common Strategies For All Agencies
  - Life Safety and Community Health
  - Public Protective Actions
  - Spill Control (Confinement)
  - Leak Control (Containment)
  - Fire Control
  - Recovery/Resiliency

Common Strategies For All Agencies

- Recognize size and scope of incident
  - Limited resources, life safety first priority
  - Request additional resources
- Evacuations
  - May require the use of all available manpower
  - Weather conditions
  - Where will they go?

Common Strategies For HazMat Operations

- HazMat Operations
  - Rescue
  - Environmental Protection
  - Survey Metering (Local & Area Monitoring)
  - Product Confinement/Containment
  - Public Protective Actions
  - Technical Decon
  - Mitigation
  - Recovery Efforts

Common Strategies For Law Enforcement

- Law Enforcement
  - Evacuate
  - Crime Scene
    - Evidence
  - Perimeter Control
    - Scene
    - Traffic

Common Strategies For EMS

- Fire Rescue-EMS & Trauma Centers
  - Triage
    - Possible MCI
  - Treatment
    - Burn Protocols
    - Assessment of Burn Suppli

"Mass" Decon Unit

EFORE

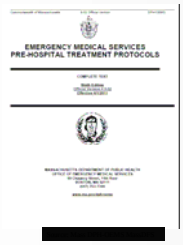
LOADING

Common Strategies For EMS

- Fire Rescue-EMS & Trauma Centers

  - Transport
    - Trauma Centers /Burn Units
    - Hospital Surge
  - Trauma Centers/Burn Centers
    - ICU Beds/Ventilators/Burn

Always perform EMS care according to appropriate standards



EMS Issues

- Scene safety is the primary concern for emergency responders
- Depending on location
  Multi or mass casualty incident (MCI)

EMS Issues

- Not all injuries will be readily apparent
- Rapid triage, treatment and transportation is critical

83

Not all injuries will be readily apparent
Rapid triage, treatment and transportation is critical
EMS responders may be working side by side with other rescuers
Post incident issues
may need to be addressed

Respiratory Hazards

- Asphyxiation
  - Vapors mix readily with CO_2 in the lungs, signaling the body to stop breathing
  - Large quantities of Dry Chemical (Monomonium Phosphate) may cause pulmonary edema

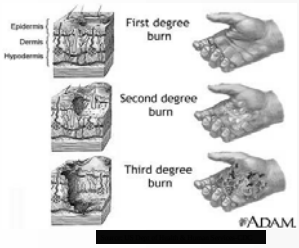
Burns

- There are several ways thermal burn injuries can occur

Direct flame contact
Radiant heat
Steam burns

Steam burns often caused by perspiration trapped under firefighting PPE

Burn Classifications



First Degree

Is superficial and causes local inflammation of the skin. Sunburns often are categorized as first degree burns. Characterized by pain, redness, and a mild amount of swelling. The skin may be very tender to touch

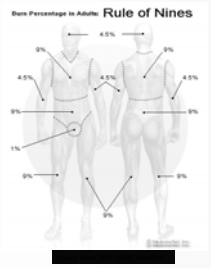
Second Degree

Deeper into the tissue and includes blistering of the skin in addition to the pain, redness and inflammation

Third Degree

The deepest burn involving all layers of the skin, in effect killing that area of skin. Because the nerves and blood vessels are damaged, third degree burns appear white and leathery and tend to be relatively painless

Determining Extent of Injury

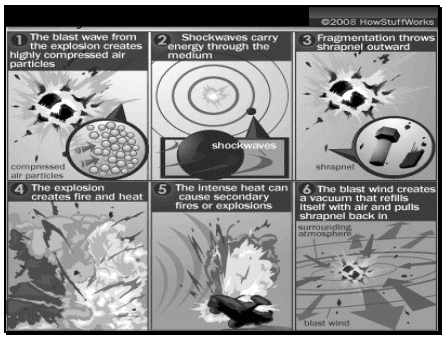


Blast Injuries

Explosions may result in both blunt force trauma and penetrating injuries

May cause hearing loss

Communications to those effected by the blast may be difficult as victims may experience loss of hearing



Because Ethanol has a LEL & UEL-if confined it can explode.
The fire itself may heat nearby containers of other products thereby creating explosions or BLEVES

Common Strategies For Environmental Agencies

- Environmental Impacts
  - Historically the product was allowed to burn
  - Exposed soil must be monitored, possibly removed
  - Open water impacts in research

Common Strategies For Environmental Agencies

- Ethanol's secondary explosive hazard
  - Biodegrades to methane
  - 24 months after spill at a depth of 4 Feet concentrations above the LEL were found
- Methane Generation
  - Monitor
  - Mitigate

Time frame up to 15 months after spill
3-8 months concentrations increased
24 months after spill at a depth of 4 Feet concentrations above the LEL were found

Common Strategies For Environmental Agencies

- Ethanol to Methane
  LEL 5% UEL 15%
  - Can be explosive if:
    - There is methane gas generation
    - It finds a pathway through utility pipes, drains or conduits and
    - Collects in a confined space
      - Manhole
      - Subsurface space
      - Utility Room
      - Basement

92

Time frame up to 15 months after spill
3-8 months concentrations increased
24 months after spill at a depth of 4 Feet concentrations above the LEL were found

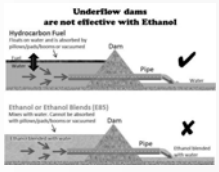
Environmental Impacts

- Waterways
  - Ground Water
  - Aquatic Life
  - Vegetation

Ethanol lowers the oxygen supply in water

Minimize Environmental Impact

- Confinement
  - Dike
  - Damming
  - Booming
- Where do these resources come from?
- How are they restocked?



Massachusetts DEP Boom Resources-Spill Control

BOOMS

Each trailer is equiped with 800 feet of 18" boom in eight 100' sections and 200 feet of 12" boom in four 50' sections. May not be helpful with E-95 but could be beneficial with E-10 and E-85 fuel blends.

Common Strategies For Fire Rescue Agencies

- Fire Rescue Operations
  - Offensive
    - Rescue Mode-Protect Egress-Protect Exposures
    - Stabilize when manpower, water supply, foam supply permit
  - Defensive
    - "Line in the sand" What can/can't be saved (including us)
    - Dike/Dam/Diversion/Vapor Suppression

Site Management

"Command Presence"

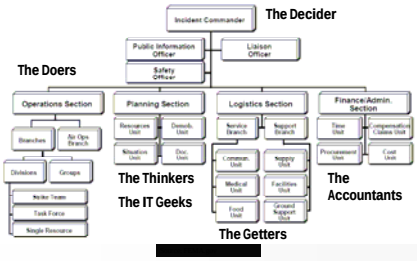
Site Management

Don't Become Overwhelmed

Establish and Maintain a STRONG Incident Management System (early)

USE A UNIFIED ICS STRUCTURE

ICS-Structure-EOC/FOC



ICS-Structure
Unified Command
Works Best !

"Tactics"
Implementing Response
Objectives

What Are Your Tactics ?

- Extinguish or Let It Burn
- Cooling Containers & Exposures
  - Storage Tanks/Railcars/Tankers
  - Structures
- Product Control
  - Diking / Damming / Diversion

Product Identification

- What is burning?
  - Read the smoke
    - Gasoline
    - Gasoline Blend
    - Ethanol Blend
  - Read the placard

Heavy Black smoke = Hydrocarbon
Light to smokeless = Ethanol

What is your GPS ?

- URBAN
  - Life Safety
    - Density
  - Exposures
    - Buildings
    - Vehicle Traffic
    - Environment
- RURAL
  - Life Safety
    - Acreage
  - Wildland/Terrain
  - Access

Fire Control & Vapor Suppression

- AR-AFFF
  - Alcohol Resistant Aqueous Film Forming Foams
- Dry Chemical
  - Foam Compatibility

You'll need a lot of it !

Fire Control/Vapor Suppression

Discuss importance of keeping the containers intact. This keeps fuel confined. Aluminum melts at 1200' F.

Bill Hand
Training Coordinator
Hazardous Materials Response Team
Harris County, Texas

Fire Control/Vapor Suppression

Fire Control/Vapor Suppression

Fire Control/Vapor Suppression

That is 100 gpm <u>foam solution</u> per line

Fire Control/Vapor Suppression

Firefighting Foam

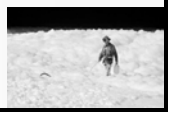
Basic Foam Principles

What is foam?

Break it down			
Aqueous	Film	Forming	Foam
watery: containing, dissolved in, or consisting of water	it forms a film on top of the fuel to assist in suppressing vapors		Thick frothy blanket which also helps suppress vapors, insulate etc.

Alcohol Resistant foams have a Polymer that acts like a gel

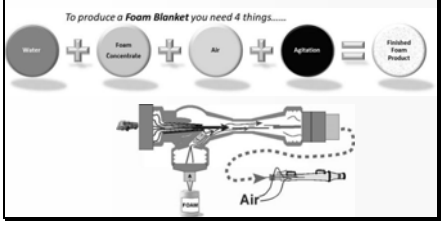
Walking through foam blanket will disturb the blanket



Walking through foam blanket will disturb the blanket

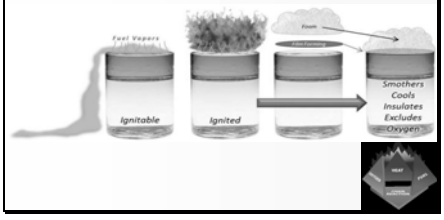
Basic Foam Principles

- What you need to generate foam:



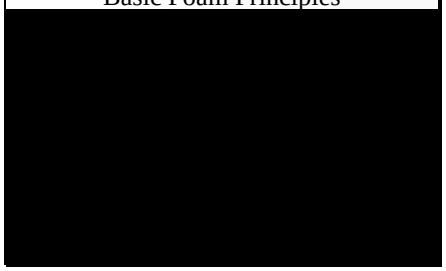
Basic Foam Principles

- How foam works:



FOAM REMOVES THE O2
DRY CHEM INHIBITS THE CHEM CHAIN REACTION

Basic Foam Principles



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

Foam Resources

1% x 3% 3% x 3% 3% x 6%

What is the difference?

1% x 3% = 1% Hydrocarbon & 3% Polar Solvent
3% x 3% = 3% on either
3% x 6% = 3% Hydrocarbon & 6% Polar Solvent

Foam Resources

- How much AR-AFFF foam is required ?
  - NFPA 11
    - Enough to flow .10 to .20 gpm / FT^2 / 15 minutes
  - Depends on foam concentrate 1x3-3x3-3x6
  - Nozzles and Eductors must be a matched set

DO NOT USE A NOZZLE WITH LOWER GPM FLOW THAN THE EDUCTOR'S RATED GPM!

@ Eductor Intake	Dial Setting	Percent foam actually applied	What's happening?
250psi	6%	5.5%	Backpressure created from nozzle, diminishing foam pickup
200psi	6%	6%	Correct, 6% of the total flow is foam concentrate
150psi	6%	6.9%	Not enough back pressure, higher concentration
100psi	6%	8.4%	Not enough back pressure, far higher concentration

Foam Resources

Ethanol Spill 1000 FT^2 (20 x 50)

Must be AR Foam

1% x 3%	3% x 6%
.20 gpm-fs x 1000=200 gpm-fs	.20 gpm-fs x 1000=200 gpm-fs
.03% x 200 gpm-fs = 6 gal fc	.06% x 200 gpm-fs = 12 gal fc
6 gal x 15 min = 90 gal fc (18) 5 gallon buckets needed	12 gal x 15 min = 180 gal fc (36) 5 gallon buckets needed

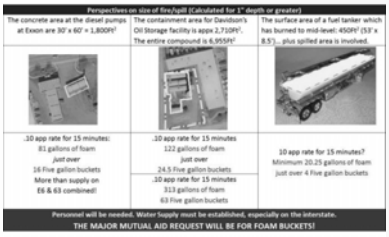
fs= foam solution fc= foam concentrate

Rule of Thumb

For a 20 x 50 or 1000 sqft 1x3 = (9) 5 gallon buckets or 45 gallons fc (foam concentrate) needed

For a 100 x 100 or 10,000 sqft 1x3 = (90) 5 gallon buckets or 450 gallons fc (foam concentrate) needed (1 AFT-Attack Foam Trailer)

Foam Resources



Calculating potential Square footage by fuel volume-NON-Polar Solvent

The larger a fuel container the exponentially larger surface area of fuel when spilled. Gasoline tanker trucks range from 5-9,000 gallons, railcars may hold roughly 30,000 gallons and storage tanks vary depending on size.

1 gallon [US, liquid] = 231 cubic inches

1 gallon [US, liquid] = 0.13368055556 cubic foot

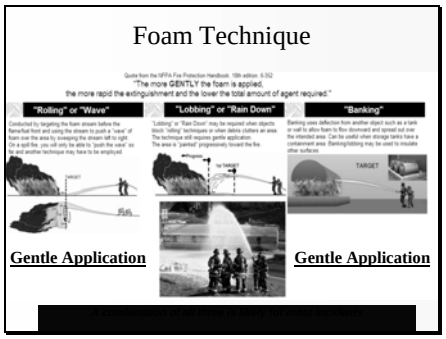
8 500 gallon [US, liquid] = 1,963,500 cubic inches

An 8,500 gallon gasoline tanker could produce 13,635 Ft2 (Square feet) of fluid 1" deep.

An 8,500 gallon gasoline tanker could produce 27,270 Ft2 (Square feet) of fluid 1/2" deep.

An 8,500 gallon gasoline tanker could produce

54,540 Ft2 (Square feet) of fluid 1/4" deep.
An 8,500 gallon gasoline tanker could produce 109,080 Ft2 (Square feet) of fluid 1/8" deep.
Using Application rate formulas, these larger fuel volumes can easily exceed our capabilities without massive mutual aid of foam concentrate, personnel & equipment



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Foam Resources

- First Responder & Mutual Aid Apparatus
  - Small Quantities
  - May not be AR-AFFF
  - May not be compatible
  - Nozzles and Eductors mix-matched
- Aircraft Rescue and Fire Fighting Apparatus
  - Typically do not use AR-AFFF
  - Do have Dry Chemical in quantity
    - 750 Pounds
- Regional Foam Trailers

First Responder & Mutual Aid Apparatus
Small Quantities
May not be AR-AFFF
May not be compatible
Nozzles and Eductors mix
Aircraft Rescue and Fire Fighting Apparatus (ARFF)
Typically do not use AR-AFFF
Do have Dry Chemical in quantity
Regional Foam Trailers

Massachusetts Regional
Foam Resources

United Plastic Fabricating Inc. is delivering 15 foam trailers for response to fuel or chemical spills and fires occurring in the south east and western sections of Massachusetts. The foam trailers were purchased thru a Homeland Security grant. The trailers carry 500 gallons of Universal Gold 1-3% AR-AFFF foam concentrate which is suitable for use on hydrocarbon or polar solvent type flammable liquid incidents. One trailer is also equipped with an Angus Hi-EXpansion foam generator and 100 gallons of concentrate. Each trailer has two 200' 120 gpm 1.75" foam handlines, a 300' 250 gpm 2.5" foam handline. All handlines are equipped with Elkhart low pressure nozzles with clip on expansion tubes. The trailers also have Elkhart Stinger demountable monitors equipped with a Williams Fire and Hazard Control 500 gpm Hydrofoam foam nozzle device with remote proportioning device and a ground base. Each trailer has an Edwards gas powered 35 gpm rotary gear concentrate pump for on loading or off loading concentrate. The pump has a preconnected 100' transfer hose. Each trailer is equipped with a Honda 2000 watt generator with two Fire Research 500 watt preconnected floodlights. The trailers are available as mutual assets with the requesting department responsible for supplying the trailer with an adequate water supply. The trailers are to be deployed two at a time to evolving incidents.

Massachusetts Regional
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Where Are They ?

Current Massachusetts Efforts

- SERC Ethanol Committee
- Tri-State Ethanol Exercise
- Coordination of alcohol resistant foam resources by Fire Chiefs Assn. Fire Mobilization Committee
- Department of Environmental Protection "White Paper"
- Department of Environmental Protection on-going Research with CG and NOAA

It has taken a bit of time to garner attention to this problem. We are told that the current efforts to address Ethanol in Massachusetts are not matched elsewhere.
Ultimately, the State emergency Response Commission has taken a leadership role in developing and delivering consistent and comprehensive information to communities to become aware of Ethanol and its risk and to plan for the potential of a release and/or fire.
Several concurrent efforts are underway as listed here *(describe each)

The Future

- No end in sight
- Flex Fuel Vehicles will increase the risk
- Pre-eminence of Ethanol will require changes in basic Fire Fighting equipment and training in all communities
- Large environmental incidents will occur.

Ultimately, ethanol is yet another new reality. Its presence promises to increase and the inherent risks extend to all communities as flex-fuel vehicles and the filling stations that serve them become the norm.
The Department of Fire Services continues to evaluate the risks and to prepare, with our partners in emergency management and environmental protection to address this new reality.

Best Practices

- Community Awareness and Conduct Pre-Incident Response Pre-Planning
- Life Safety
- Identify AR-Foam & Dry Chemical Needs
- Evacuate (ERG) and Shelter
- Protect Exposures
  - Structural (Building & Bridges)
  - Wildland
- Protect Environment
  - Contain Runoff, Suppress Vapors & Extinguish burning fuel remaining in containers

PREPARE PLAN STAY INFORMED !!

National Foam
Division of Kidde Firefighting

Foam Tech Level I
Ethanol & BioFuel Awareness
Seven Hours

Presented by:
Combat Support Products Division - Cottrell Associates, Inc.

Demonstration

Regional Foam Trailers

AR-AFFF Live Fire Demonstration