Module 6

Ethanol-Blended Fuel Emergencies

Terminal Objective

Upon the successful completion of this module, participants will be able to determine a method for cleaning up blended fuel spills at specific locations.

Enabling Objectives

1. Discuss the possible combinations of fuel/blended fuel spills.
2. Determine the tools/personnel/steps necessary to clean up spills of various fuels.

Instructor Note:

Module Time: *1 hour*

Materials:

- *Flip chart or white board*
- *Worksheets 6.1 and 6.2*

Introduction

Instructor Note:

The video mentioned that dilution with water was not an effective tactic for ethanol and ethanol-fuel blend fires. Why is this true?

Answer: *Ethanol diluted up to 500 percent with water will still burn.*

Understanding the properties and characteristics of both gasoline and ethanol will help emergency responders mitigate incidents involving ethanol-blended fuels.

By doing some simple tests it has been shown when ethanol is blended with gasoline, even at high mix ratios like E-85, the ethanol develops a bond to the gasoline. With this bond, the ethanol-blended fuel retains hydrocarbon/gasoline characteristics. Absorbents and booms that are designed to pick up oil-type substances will pick up the ethanol-blended fuel. As long as no water is present, the ethanol stays bonded to the gasoline and absorbs into the booms and absorbents.

However, if water is introduced, even at low quantities, it will more readily attract the ethanol and form a water/ethanol solution that drains to the bottom of the fuel mix. In this situation, an oil-type boom or absorbent will pick up the remaining gasoline on top leaving the water/ethanol solution. The water/ethanol solution can then be picked up with a water absorbing boom or absorbent. Keep in mind that depending on the water-to-ethanol ratio, the solution may still be flammable. Also remember that if foam is used to contain the ethanol-blended fuel vapor, a portion of the foam solution will absorb into the ethanol-blended fuel, forming a solution that sinks below the gasoline level. This solution again will have water/ethanol properties, which will require a water-type boom or absorbent. The ethanol-blended fuel located just below the foam membrane will require an oil-type absorbent since the ethanol/gasoline blend will still maintain hydrocarbon characteristics.

Detection and Monitoring

Detection and identification of hazardous materials using monitoring equipment is normally performed by responders at the technician level.

Monitoring equipment is a crucial resource for responders to use in the incident assessment and during mitigation. Monitoring equipment will help responders determine the concentration levels of hazardous materials and make response decisions based on these readings.

Readings will help responders determine how best to protect themselves and others from the effects of the material and how far the public should be removed from the contaminated area.

Work zones are the areas established around a hazardous materials incident and indicate the safety level and degree of hazard in that particular zone.

There are three work zones that must be established: hot, warm, and cold.

- The hot zone is located immediately around the release of a material. This area encompasses materials that are hazards. It is the area of greatest danger and contamination.
- The warm zone is located immediately outside of the hot zone and is the area where decontamination takes place.
- The cold zone begins where the warm zone ends. The command post, as well as other support functions, is located in the cold zone. Personal protective clothing in this area may be limited to safety equipment and normal working clothes.

Personal Protective Equipment (PPE)

Instructor Note:

Ask participants if they can list the health hazards of ethanol. Put them on a flip chart or white board. Typical hazards include:

- *Irritation to the eyes and skin*
- *Swallowing:*
  - *Abdominal irritation*
  - *Nausea*
  - *Vomiting*
  - *Diarrhea*
  - *Possibly death*

Instructor Note (continued):

Typical hazards include:

- *Inhalation:*
  - *Central nervous system depression*
  - *Irritation*
  - *Nausea*
  - *Vomiting*
- *Long-term exposure:*
  - *Liver damage*
  - *Kidney damage*

Ask participants what they consider the most important type of PPE when responding to ethanol emergencies including spills, releases, and fires.

Remind participants that we often think of the dangers of materials when they are involved in a fire, however, it is just as important to consider PPE and in particular respiratory protection for materials involved in spills and releases.

Instructor Note:

Remind participants that this is an awareness course on ethanol and ethanol-fuel blends. However, it is always critical to stress the importance of proper PPE. This course is not designed to provide instruction in the use or selection of PPE, but this section is presented as a reminder of its importance.

Ethanol and ethanol-fuel blends will burn somewhat similarly to gasoline fires; therefore, it is critical that all responders wear appropriate PPE. Protective clothing is designed to protect the wearer from head to toe and has proven to reduce the severity of injuries as well as save the lives of many firefighters. The following components constitute a generic set of PPE:

- a helmet with either a face shield or eye protection that meets American National Standards Institute (ANSI) Z87.1 standard,
- a protective hood,

- a turnout coat,
- turnout pants,
- gloves,
- boots, and
- respiratory protection.

Respiratory protection is especially critical since the respiratory system is the primary route of exposure into the body for hazardous chemicals. There are three types of respiratory protection:

- Air-Purifying Respirators (APR) and Powered Air-Purifying Respirators (PAPR);
- Supplied Air Respirators (SAR); and
- Self-Contained Breathing Apparatus (SCBA).

Remember that all personnel responding to a spill or fire must wear and be trained in the use of the specific PPE required for a given emergency situation (see Figure 6.1).

Figure 6.1: Firefighter Wearing Full Set of Protective Clothing

This is the end of the section that is the property of TEEX.

Activity 6.1—Incident Procedures

Purpose

To become familiar with the correct order of steps in the following procedures and the rationales behind them.

Instructor Note:

Time: *15 minutes*

Materials: *Worksheets 6.1 and 6.2*

Instructor Directions:

1. *Have participants attempt to properly order the steps in the following procedures.*
2. *Participants can work individually or in groups.*
3. *Use Worksheets 6.1 and 6.2.*
4. *After participants have put the procedures in order, go over the correct order and then discuss the rationales behind each.*

Participant Directions

1. Use Worksheets 6.1 and 6.2 to properly order the steps in the procedures.
2. You can work individually or in groups.
3. Be prepared to discuss the correct order and the rationales behind each step.

Worksheet 6.1: Non-Fire Spill and Leak Procedures

A. Establish a safety zone using conventional detection devices. Normal gas detection meters will still detect the Lower Explosive Limit (LEL) of the gasoline component since the gasoline has a lower LEL than ethanol. Since both the gasoline component and the ethanol component are heavier than air, predict the vapor travel to be down and to lower levels of elevation.

B. Determine which approach to use:

   — If the ethanol-blended fuel is spilled on dry surface, “oil only” absorbents, pads, and booms will contain the product. Plugging containers or over-packing may also be considerations.

   — If the ethanol-blended fuel is spilled into waterway, the ethanol will precipitate out of the fuel mixture and blend with the water. Depending on water to ethanol quantities, the water/ethanol solution will become non-flammable at high water ratios. The ethanol will become essentially inseparable from the water in field conditions. The remaining gasoline components will remain on the surface of the water and can be contained with normal “oil only” booms or underflow dam systems.

   — If vapors present a problem at the spill location, covering the spill with foam should be a consideration. Foam, however, can make remediation and cleanup more difficult.

C. Cleanup and remediation can be accomplished with standard booms, absorbents, and pads keeping in mind that if water or foam is present, it will take a two-step process.

D. Attempt to identify the product by placards, labels, shipping documents, and other identifying factors, staying upwind and uphill and using appropriate PPE. Physical properties will also aid in identification. High concentrations of ethanol will give the fuel a lighter color and a “sweeter” odor.

Answer:

D

A

B

C

Worksheet 6.2: Fire Incident Procedures With Ethanol-Blended Fuel Spills

Instructor Note:

Using the video Responding to Ethanol Incidents*, show the segment from 10:50 to 13:53. After the clip ask the following questions:*

- *In the table-top demonstration, why were most of the foams ineffective on polar solvent fuels?*
  - ***Answer:*** *Because ethyl alcohol and water mix together and foam bubbles are mostly water.*
- *What was in the two Alcohol-Resistant (AR) foams that allowed them to create the foam blanket?*
  - ***Answer:*** *Polymers*
- *Why is dilution with water not an effective mitigation technique for polar solvent fires?*
  - ***Answer:*** *Even at 500 percent ethanol will still burn.*

A. Monitor and contain run-off from foam application.

B. Attempt to identify the burning product by placards, labels, shipping documents, and other identifying factors, staying upwind and uphill using appropriate PPE. The absence of black smoke and reduced visible flames will give visual indicators of the presence of ethanol. Heat intensity may appear greater than normal gasoline as a result of the presence of ethanol.

C. Apply foam from upwind and uphill, banking or deflecting foam off tanks, objects, structures, or ground ahead of the spill to accomplish gentle application with Alcohol-Resistant (AR) type foam. Backup lines should be in place to protect personnel operating hoselines. When possible, application by unmanned devices and Airport Rescue Fire Fighting (ARFF) type vehicles should be considered. Make sure only AR foam is used and there is no application of water in the foam area.

D. Attempt to provide containment of any flowing fuel. Protect exposures as needed depending on location and situation, and use extreme caution around any exposed containers or pressure vessels.

E. Evaluate the burning fuel area to determine appropriate flow or application rate for the foam solution. Minimal rate of application should be 0.2 gallons per minute (gpm)/square foot (example: 1,000 square feet of burning ethanol-blended fuel will require 0.2 × 1,000 = 200 gpm foam solution). Before beginning foam application, adequate supply of foam concentrate and water should be secured and on site. At least a 10-minute supply of foam and water should be available for suppression operations and an additional 10 minutes reserve for maintaining scene.

F. Maintain stable conditions until full cleanup and remediation can be completed.

G. Maintain a good blanket of foam on the spilled fuel, and monitor vapor release after the fire has been extinguished. When using the foam blanket to maintain vapor suppression, a full visible blanket should be kept on the fuel surface at all times. Do not rely on film formation or membrane formation.

Answer:

B
D
E
C
A
G
F

Instructor Note:

Ask participants what emergency personnel, in addition to cleanup personnel, they would like to have on stand-by as they conduct their cleanups. Why?

Summary

Regardless whether you are confronted with a spill or a fire, there are certain procedures that must be followed in order to ensure safe incident management. Knowing the type of fuel that has spilled or is burning is essential to the success of your operation. In addition, you should take steps to contain the event and appropriately distribute the proper foam.