

Participant Guide Module

5

Storage and Dispensing Locations

Module Objective

Upon completion of this module, participants should be able to discuss common locations for storage and dispensing of ethanol-blended fuels and will provide a basic understanding of these storage/ dispensing sites.

Enabling Objectives

1. Describe the four common types of storage tanks at tank farm facilities.
2. List potential benefits and challenges associated with fixed fire suppression systems at fuel storage facilities.
3. Prepare a list of agencies that may be called upon for support during an event at a fuel storage or dispensing location.

Introduction

Often when the response community thinks of storing and dispensing ethanol-blended fuels we fail to think of the retail fueling station on the corner. As a result, we can believe that if there is no bulk storage operation or production operation in our jurisdiction, we have little to worry about. This could not be further from the truth.

Today nearly all gasoline in the U.S. is blended with some level of ethanol. Ethanol and ethanol-blended fuels are found at production facilities, bulk tank farms, rail transload facilities, construction sites and retail fueling stations within your community and throughout the country.

Depending on the size of your jurisdiction or response area, it may be impractical to pre-plan every retail facility offering ethanol-blended fuels. However, it is realistic and highly recommended that standard operating procedures or guidelines (SOP/SOG) be developed to ensure consistency in emergency response addressing life safety, incident stabilization and property conservation.

Therefore, it is important for local emergency responders to be familiar with the facilities in their locations.

Storage Tank Types

Any large volume of denatured fuel ethanol will typically be stored in conventional carbon steel storage tanks, such as those that are suitable for gasoline and other flammable fuels. Denatured fuel ethanol can also be stored in stainless steel storage tanks, although these tanks are less common. As consumption increases, larger ethanol tanks will become increasingly prevalent. These storage tanks should be identified by markings corresponding with the fuel stored.

There are several types of above ground atmospheric storage tanks typically found at bulk storage facilities. The more common bulk storage tanks for ethanol-blended fuels are noted below.

- Cone roof and dome roof tanks
- Open top floating roof tanks
- Covered floating roof tanks including geodesic domes
- Horizontal Storage Tanks

Lastly, please note that as a type of storage tank, spherical tanks do exist for bulk storage. To date this type of tank design has been limited to petrochemicals, flammable liquids or gases normally stored under pressure. Currently there are no known use of these tanks for storage of ethanol blended fuels. However, the industry is evolving at a rapid pace and the use of these tanks for ethanol-blended fuels could become a reality. It is incumbent upon any organizations and agencies that have statutory responsibilities or functional capabilities to become familiar with bulk storage and ethanol production facilities, to determine the nature and type of bulk storage tanks being used and develop detailed pre-plans.

Storage Tank Design

There are four general types of storage tanks at tank farm facilities: cone roof (closed-top) tanks, external floating roof (EFR) tanks which have an open top with a floating pan, internal floating roof (IFR) tanks (see Figure 5.1 in the Participant Guide) with a closed top and an internal floating pan, and horizontal storage tanks.

Dome roof (geodesic) retrofitting over a majority of the open floating roof tanks has been taking place within the U.S. for the past decade or more to address regulatory requirements, vapor control and product integrity. This type of bulk storage tank may contain ethanol-blended fuel.

Horizontal tanks may be found and used for ethanol-blended fuels in bulk storage facilities, retail markets, agriculture applications and private residences where regulatory codes allow.

Figure 5.1: Internal Floating Roof Storage Tank



The most common denatured fuel ethanol bulk storage tanks are internal floating roof (IFR) tanks. Key characteristics to look for on IFR tanks are a closed roof over an internal floating pan, eyebrow venting and fire protection system.

Spill Containment

Spill containment dikes are required to contain the volume of the largest tank within the contained area plus a certain proportion over tank capacity to take into consideration rainfall and ancillary spills during an incident. Specific dike containment information can be found in the *NFPA 30, Flammable and Combustible Liquids Code*.

Additional fluid from a firefighting operation could lead to overfilling/breaching of the dike. As a side note, large horizontal tanks that are elevated do not fall under the same regulatory requirements for containment. These are much more common at smaller distribution facilities and in agricultural settings.

Tank Fire Protection Systems

Some storage tanks have fixed (built-in) fire protection systems. Fixed systems are a combination of components including foam concentrate storage, proportioning valves, and delivery devices that are permanently installed to provide fire suppression protection. These same fixed systems can service multiple storage tanks, piping manifolds, and loading and unloading racks.

The systems can be activated manually or by automatic detection device. Topside application foam systems may require much higher application rates for ethanol-blended fuels than for previously stored fuels. Subsurface injection systems may not work at all with ethanol-blended fuels.

Emergency responders should work closely with terminal operators to keep abreast of changes in fuel storage at liquid product terminals.

It is important to ensure the fire protection systems are meeting current industry standards and codes. It is also important that emergency responders know how to activate the fire protective systems at a liquid product terminal.

Where the fixed fire protection systems exist, it is incumbent upon the emergency responders to establish a close working relationship with the owners and management. They must develop pre-plans of these bulk storage facilities, determine resource needs for successful mitigation of an incident and, of course, conduct functional and full-scale exercises to confirm the pre-plan and operational activities are realistic and achievable.

Built in Fire Protection Systems

See correlating slide (module 5, slide 9) for an illustration showing built-in Type I fixed or Type II semi-fixed fire protection system on a bulk storage tank containing ethanol.

In this photograph it is worth noting the biological growth on the side of the bulk storage tank. The exterior of the storage tank “sweats” more profusely when significant amounts of high concentration ethanol blends are present during warmer temperatures. This moisture captures the organic particulates in the atmosphere and ultimately leads to an algae-like growth on the sides

of the tank. There will also be biological growth around the eyebrow vents at the top of the tank in internal floating roofs (IFRs).

The graphic on the left identifies foam solution (in blue) which is foam concentrate properly proportioned and mixed with water and distributed fire protection piping at pre-determined pressures and flow rates. Once the foam solution enters the foam chamber it is agitated and aerated to allow for the foam to expand to manufacturer requirements of 8-10:1 ratio.

At this point the finished foam (as shown in the image in light green) penetrates the wall of the tank, discharged out of a specially designed nozzle which deflects the foam back onto the side wall of the tank. The finished foam sloughs down the inner wall of the tank and gently spreads across the surface of the burning ethanol-blended fuel.

These systems are designed and engineered for each specific installation. During an incident, the actual condition of the fire protection system must be assessed to determine if functional.

Ultimately, emergency responders must plan for the worst possible scenario, i.e., the fire protection system is out of service and Type III or manual foam applications will be initiated if offensive foam operations commence.

*Also note the NFPA 704 placard indicating the tank's contents.

Foam Deflector Device

The foam deflector device is attached to most Type II fixed foam chamber discharge outlets. The deflector directs foam down and over a large area of the inside of the tank wall and onto the top of the burning liquid inside of the tank.

It is important to work with bulk storage facility operators to calculate the outage or open available space in gallons above the liquid level in the tank to inform emergency responders whether the product needs to be removed from the tank before operations can begin or allowed to burn off to reduce product in the tank.

Failure to comprehend the available space inside the storage tank could lead to overfill and having ethanol-blended fuel spillage and complicate the incident drastically.

As discussed in the previous section, expansion needs to be taken into consideration. This would be the ratio of volume of foam formed to the volume of solution used to generate the foam. For example, an eight expansion means 800 gallons of foam from 100 gallons of solution. Keep in mind foam drain time will continue throughout operation.

Emergency Response Pre-planning

As discussed consistently throughout this module, pre-planning for potential incidents at liquid product terminals is extremely important. A significant piece of the pre-planning efforts must include consideration for and development of mutual aid partners.

Fire departments that help provide protection to liquid product terminals should have access to high-flow firefighting foam equipment and access to large supplies of compatible Alcohol-Resistant Aqueous Film-Forming Foam (AR-AFFF).

Emergency response agencies or organizations should also be aware they may not be able to contend with a terminal fire operation and may need to contact additional outside resources or assistance to manage an incident of scope and magnitude. Emergency responders are encouraged to establish healthy working relations with these groups and with the storage facilities in their response area prior to an emergency.

Emergency Response Planning

Fixed fire systems are currently the best protection for bulk storage tanks. Fire department personnel should be extremely familiar with these systems and pre-calculate their required flow rates and resource needs.

They should also pre-plan operations supplying these systems. Practical exercises should be scheduled at least annually to make sure emergency responders are familiar with the pre-plans and operational activities.

In some areas this has been done by establishing caches of AR-AFFF and equipment through consortiums organized among multiple terminal operations, fire departments, state and other organizations or agencies with statutory responsibilities or functional capabilities.

The consortium philosophy is a process of collaboration to develop a significant cache of AR-AFFF foam concentrates at a pre-determined geographical location properly managed and supervised and available as a regional asset for ethanol-blended fuel incidents. No one agency, department or organization bears the financial burden of buying, storing and managing such a costly resource. Lastly, all organizations should consider and apply for grant funding when available.

Key Considerations

Keep in mind that there are many different challenges involved in firefighting operations at a liquid product terminal. There may be limited access in both the terminal itself and in tank design for firefighting equipment.

At times, some locations may have inadequate water supplies to fight any type of significant fire. Personnel may have to contend with containment dikes and their systems along with miles of exposed product piping. Liquid product terminals may also have loading racks subject to fire emergencies.

Liquid product terminal operations can be very complicated and responding to a fire emergency can be very dangerous to personnel. It is also not unusual for terminals that were originally built in remote areas to now be surrounded by commercial and residential growth.

Working Relationships

We cannot over-emphasize that pre-planning is extremely important as are pre-established working relations between the fire department and the facility operators.

The absolute backbone to successfully managing an incident involving ethanol-blended fuel is ensuring an excellent working relationship with the bulk storage owners, vendors and agencies or organizations that have statutory responsibilities and/or functional capabilities.

Also, consider contracting with private flammable liquid firefighting organizations if possible.

Terminal Size Considerations

Smaller bulk distribution storage facilities may pose unique challenges to local fire departments. These facilities are located throughout communities to better distribute fuel to end-users. Storage tanks in these facilities can be a multitude of styles and layouts depending on age and location. Storage tanks may be vertical, horizontal, or a combination of both.

Normally flammable liquid fuels, including gasoline and ethanol-blended fuel, are stored at these facilities in modest quantities. Most of these facilities do not have built-in fire protection systems. These facilities are normally designed with limited fuel spillage containment structures or dikes and are typically unstaffed.

Large bulk distribution storage facilities also pose unique challenges to local fire departments. Storage tanks in these facilities have high-capacity storage and high product transfer capabilities.

A variety of different storage tanks may be present: vertical, horizontal, above-ground or below-ground, or a combination of all of these. Flammable liquids including gasoline and ethanol-blended fuel are stored at these facilities in significant quantities. These facilities have detailed emergency response plans due to the sheer volumes stored on-site.

Pre-established working relations between the emergency responders and the facility operators is extremely important. Pre-planning cannot be over-emphasized.

Depending on the age of the bulk storage facility and geographic location, fixed or semi-fixed foam fire protection systems may be found. The capabilities and limitations of these systems can only be determined through extensive familiarization and functional training.

Storage at a Production Facility

Both denatured and undenatured or neat ethanol can be stored at a production facility although the most common is denatured fuel ethanol (E95-E98). Ethanol-blended fuels found at retail fuel stations are not generally found at a production facility.

There will be denaturant such as natural gasoline or unleaded gasoline stored at a production facility. Denaturants are added to ethanol through inline blending systems prior to the final product storage tanks.

A typical example is shown in this photo. In this tank configuration (module 5, slide 18) ethanol would be stored in the tanks identified as 1 & 2. The denaturant would be stored in the tank identified as 3.

Retail Dispensing Stations

Currently, there are approximately 115,000 retail fueling stations throughout the U.S. Geography, throughput volume or sales, fire code and many other variables impact whether an above-ground or below-ground storage tank is used.

Above-ground storage tanks can be either vertical or horizontal in design. Nearly all underground storage tanks are horizontal. Inventory is brought to the retail station by cargo tank trucks and transferred directly into the underground storage tanks.

Some jurisdictions have hundreds of retail fueling stations selling ethanol-blended fuel. Pre-planning each retail facility would be extremely time-consuming and labor-intensive. Since these facilities must be constructed and maintained to nationally recognized standards, development of standard operating procedures (SOP) or standard operating guidelines (SOG) may be more practical to ensure consistent operational practices and increase emergency responders and community safety if an ethanol-blended fuel incident were to occur.

Retail Tank Configuration

At retail sites, the most common tank configuration is horizontal underground tanks. The maximum pressure that any underground tank can hold is 0.5 pounds per square inch gauge (psig).

Tank capacities range from a few thousand gallons up to 20,000 gallons. These tanks are typically constructed of steel or double walled fiberglass. Emergency shut-off valves will vary for each container due to design and construction differences.

Loading and unloading points will vary due to design and construction. Risers for multiple tanks will be color-coded or marked to identify the product.

Summary

In this module we learned that denatured fuel ethanol (E95-E98) is most commonly stored in storage tanks made of carbon steel. Denatured fuel ethanol can also be stored in stainless steel storage tanks, although these tanks are less common.

Pre-planning for potential events at liquid product terminals is extremely important. Emergency responders should develop good working relationships with the terminal operators and should be very familiar with their operations.

Liquid product terminals will likely be equipped with fixed fire suppression systems, it is important to remember that these systems could be rendered inoperable at the onset of an incident.

From the liquid product terminals, the ethanol-blended fuel arrives at local retail fueling stations mostly by cargo tank trucks. These stations will use underground and above-ground storage tanks.

Although the amount of fuel stored at each retail fueling station is small, especially when compared to liquid product terminals, the sheer number of retail fueling stations requires that an SOP or SOG be established to ensure safe and consistent operational activities during incidents. If possible, developing a pre-plan would be most advantageous.

Activity 5.1: Ethanol in Your Jurisdiction

Purpose

To allow participants to determine the potential for an ethanol emergency in their jurisdictions.

Participant Directions

1. For this activity you will work individually or in groups of two.
2. Read the items in Worksheet 5.1 and write down your answers.
3. Be prepared to discuss with the class.

Worksheet 5.1: Ethanol in Your Jurisdiction

1. Approximately how many people live in your jurisdiction? _____
2. How many retail fuel stations in your jurisdiction have been pre-planned?

3. Do you have any industries that would use or store large quantities of ethanol or ethanol-blended fuels? _____
4. If so, how many are there? _____
5. What are the likely routes ethanol will be transported to or through your jurisdiction?

6. Compile a list of agencies in your jurisdiction that you can call upon during an emergency at a fuel storage or dispensing location.

7. Based on all the information discussed in this class, what do you think would be the major concerns (logistical, mitigation, environmental, mutual aid, etc.) at an ethanol emergency at a retail fuel station in your jurisdiction? At a storage facility in your jurisdiction?

