GASOLINE CONTAINING METHANOL AND COSOLVENT - MANUFACTURING, HANDLING, AND SAFETY
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I. INTRODUCTION

The use of methanol (methyl alcohol) with cosolvents (generally higher molecular weight alcohols) as blending components in the manufacture of gasoline is increasing in the U.S. marketplace. Methanol/cosolvent blends have been widely used in Europe for years. Currently, over 50 percent of the gasoline sold in Germany contains methanol with cosolvent while nearly all the gasoline sold in Austria contains these alcohols.

Methanol offers many advantages to the gasoline manufacturer and to the motorist. These include:

- Methanol is a high octane component which can economically replace lead and other methods of producing octane in the manufacture of gasoline.
- Methanol is produced from domestic natural gas and coal reserves. Therefore, it can help reduce U.S. dependence on imported crude oil and our foreign trade deficit.
- Methanol is cleaner burning than gasoline. As a component in gasoline, it can reduce automotive tailpipe emissions significantly.

There are several important regulatory and technical considerations that need to be understood with respect to the use of methanol as a component in the production of gasoline. All unleaded gasoline containing methanol sold to the public must meet applicable U.S. Environmental Protection Agency regulations. Except for low levels of methanol (below 0.3 vol. %) used as a deicing agent, EPA regulations require all unleaded gasoline containing methanol to contain a cosolvent alcohol and to meet American Society for Testing and Materials’ gasoline standards (ASTM D439). From a practical standpoint, these regulations prevent the addition of methanol to a finished specification unleaded gasoline, similar to the practice with ethanol or gasohol, without a cosolvent alcohol and other low RVP gasoline blendstocks. In addition, it is prudent practice for blenders to make certain that all gasoline containing methanol and cosolvent meet ASTM gasoline standards and comply with various state laws and regulations. It is the blender/handler’s responsibility to know and comply with all applicable federal, state, and local laws and regulations just as with any gasoline or other fuel.

There are a few important differences in the manufacturing and handling of gasolines containing methanol and cosolvent as compared to hydrocarbon-only gasoline. Blenders and handlers of the fuel must understand these differences and take them into account to produce and distribute a high-quality fuel effectively and safely. The Oxygenated Fuels Association (OFA) has developed this introductory brochure on gasolines containing methanol and cosolvent to highlight these differences. The introductory nature of the brochure must be emphasized. Detailed information should be obtained from a methanol producer or supplier before blending or distribution activities are begun.

If you have any questions about any of these topics or gasolines containing methanol and cosolvent in general, the OFA’s member companies are ready to work with you. For assistance, call or write to:

George S. Dominguez, Executive Director
Oxygenated Fuels Association (OFA)
1330 Connecticut Avenue, N.W., #300
Washington, D.C. 20036-1702
(202) 822-6750

II. OFA BLENDING GUIDELINES

In addition to the prudent blending procedures normally practiced by manufacturers of gasoline, and adherence to applicable laws and regulations, the OFA has established the following guidelines for the use of methanol and cosolvent in the production of gasoline. These are:

1. Prudent use of gasoline containing methanol suggests that limits be applied to the composition of the gasoline containing methanol.
   a. The methanol content (% volume) in gasoline containing methanol should be limited and additives used as required to assure materials compatibility in motor vehicles and in the gasoline distribution system. Data available to the Oxygenated Fuels Association indicate that five volume percent (5% volumetric) is an acceptable blend level.
   b. The oxygen content in gasoline containing methanol should be limited to levels that assure that motor vehicles will have acceptable overall performance. Data available to the Oxygenated Fuels Association indicate that three point seven percent by weight (3.7% weight) is an acceptable level.
   c. Cosolvents should be used in gasoline containing methanol to meet the applicable ASTM standards and the applicable EPA waivers and regulations.
   d. Gasoline containing methanol should be prepared and formulated for the anticipated climatic and geographical usage area. Five (5) classes of fuels are to be marketed in accordance with the phase separation temperatures listed below. ASTM geographical regions are to apply.
Class 1 Maximum Phase Separation Temperature +41°F (5°C)
Class 2 Maximum Phase Separation Temperature +32°F (0°C)
Class 3 Maximum Phase Separation Temperature +14°F (−10°C)
Class 4 Maximum Phase Separation Temperature −13°F (−25°C)
Class 5 Maximum Phase Separation Temperature −40°F (−40°C)
e. Good blending practice requires that gasoline containing methanol be tested before distribution. Records should be maintained to provide satisfactory evidence that prudent blending practices have been followed.
f. The concentration (% volume) of methanol and cosolvent should be specified on all product transfer documents to assure that misblending does not occur and to provide compositional information for proper DOT Markings.

2. Gasoline containing methanol must be prepared and formulated to assure that the fuel dispensed to the motor vehicle meets all current applicable ASTM standards.
3. Gasoline containing methanol must be prepared and formulated in accordance with the applicable EPA waiver or regulation.
4. Gasoline containing methanol must be prepared and formulated in accordance with all applicable state and local laws and specifications.
5. Gasoline containing methanol must be prepared and handled in a safe workmanlike manner to assure that contamination, adulteration or misblending will not occur.

III. GASOLINES CONTAINING METHANOL AND COSOLVENT

It is important to emphasize that unlike ethanol or gasohol, methanol shouldn’t be used to “top” a finished specification gasoline without the addition of a cosolvent and a low RVP gasoline blendstock. Thus, methanol’s use as a gasoline component is easiest and likely to be most successful when it is used to manufacture a gasoline at a refinery or qualified blending facility. The blending or “topping” of methanol with finished gasoline is feasible provided other components are also added. However, topping with methanol requires a basic understanding of the essentials of gasoline blending. Both applications, manufacturing and topping, are discussed below.

A. Manufacturing a Gasoline Containing Methanol and Cosolvent

Most gasolines are manufactured at refineries or qualified blending facilities where many hydrocarbon blendstocks and components are blended together to produce a finished specification gasoline. Methanol with a cosolvent can be blended with available components to produce a specification gasoline with only a few minor changes in the blending procedure. The impact of methanol on the gasoline manufacturing process can be best described in terms of the three major characteristics that define gasoline. They are octave rating, vapor pressure and distillation.

1. Octane Rating

Standard minimum octave ratings for gasolines have been established by ASTM to promote proper and satisfactory engine performance. Generally, octave quality is increased when alcohols are added to gasoline. Methanol is a high octave blending component. There are a few points related to alcohol-induced octave improvement that are worth noting.

a. Unlike hydrocarbon gasoline blending components, an octave rating should not be run on the neat and pure methanol since it will not accurately reflect its octave blending value. Methanol’s oxygen content and heat of vaporization will significantly impact the octave rating determination.

b. The proper method to determine the octave blending value of the methanol (and cosolvent) is as follows:
   - Determine the octave (Research and Motor) of a typical gasoline blendstock.
   - Add methanol at the anticipated level of use to the typical gasoline blendstock and determine the octave of that blend.
   - Calculate by difference, the blending octave of the methanol.

An illustrative example of this is shown below for five volume percent methanol:

<table>
<thead>
<tr>
<th>Component Gasoline Blendstock</th>
<th>RON</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline blendstock</td>
<td>85</td>
<td>RON&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
<tr>
<td>Gasoline blendstock + 5 vol % MEOH</td>
<td>87</td>
<td>(RON&lt;sub&gt;50&lt;/sub&gt; + RON&lt;sub&gt;MEOH&lt;/sub&gt;)</td>
</tr>
<tr>
<td>MEOH (% GB) (RON&lt;sub&gt;50&lt;/sub&gt;) + (% MEOH) (RON&lt;sub&gt;MEOH&lt;/sub&gt;) = 1.0 (RON&lt;sub&gt;50&lt;/sub&gt;) + (.95) (85) + (.05) (RON&lt;sub&gt;MEOH&lt;/sub&gt;) = 87 RON&lt;sub&gt;MEOH&lt;/sub&gt; = 125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The MEOH Blending Research octane number (RON<sub>MEOH</sub>) equals 125.
NOTE: This procedure should be done at least in duplicate to obtain a representative value. This is necessary because of the inherent analytical errors in the octane determination method.

Methanol’s blending octane value is typically about 120 [(R + M)/2]. Thus, at the five percent concentration level, methanol will improve the octane rating about 1.65. Since a cosolvent is recommended for use with methanol, a similar octane blending value determination must be made for the cosolvent to determine the expected octane improvement when the methanol/cosolvent mix is blended with other gasoline components. Tables of blending values are available that can be used to calculate the octane improvement potential of most alcohols, including methanol, over a range of base gasoline octane ratings. A methanol supplier or the OFA can provide answers to questions about blending octane values.

2. Vapor Pressure

Reid vapor pressure (RVP) is an important indicator of a fuel’s volatility, which affects cold engine startability, warm-up driveability, and freedom from vapor lock (under warmed-up conditions). The vapor pressure of gasoline must meet applicable federal and state regulations. Except for methanol used at low levels (less than 0.3 % vol) as a deicer, EPA regulations require all unleaded gasoline containing MEOH to meet some vapor pressure limit as defined in ASTM D439.

Similar to octane rating, there are several aspects of methanol's vapor pressure characteristics that should be noted. These are:

a. Unlike hydrocarbon gasoline blending components, the RVP test should not be run on the neat or pure methanol since it will not accurately reflect the blending Reid vapor pressure value. Methanol's RVP blending characteristics are non-ideal and will vary with the percentage of methanol in the gasoline.

b. The proper method to determine the RVP blending value of the methanol (and cosolvent) is as follows:
   - Determine the RVP of a typical gasoline blendstock.
   - Add methanol at the anticipated level of use to the typical gasoline blendstock and determine the RVP of that blend.
   - Calculate by difference, the blending RVP of the methanol.

An illustrative example of this is shown below for 5 % vol methanol:

<table>
<thead>
<tr>
<th>Component</th>
<th>RVP (PSI)</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline blendstock</td>
<td>10</td>
<td>RVP_{g}</td>
</tr>
<tr>
<td>Gasoline blendstock + 5% MEOH</td>
<td>13</td>
<td>(RVP_{g} &amp; RVP_{MEOH})</td>
</tr>
<tr>
<td>MEOH</td>
<td>?</td>
<td>RVP_{MEOH}</td>
</tr>
</tbody>
</table>

\[(\% \text{ GB}) \cdot (RVP_{g}) + (0.05) \cdot (RVP_{MEOH}) = 1.0 \cdot 70\]

The MEOH Blending RVP number equals 70.

Note: This procedure should be done at least in duplicate to obtain a representative value. This is necessary because of the inherent analytical errors in the RVP method.

Methanol’s blending RVP is considerably above the targeted gasoline specification of 9 to 15 PSI, at the three to seven percent level of use. Also, it is extremely dependent upon its concentration in gasoline. The lower the concentration of methanol, the higher its blending RVP. Thus, economics usually dictate that the use of methanol in a gasoline be maximized within performance constraints. Also, the gasoline manufacturing process will tend to substitute methanol for high vapor pressure components such as butane and pentane in the blend recipe to meet gasoline’s RVP specifications.

Since a cosolvent is recommended for use with methanol, a similar RVP blending value determination, as illustrated earlier, should be conducted to determine the blending vapor pressure. Typically, the effective blending vapor pressure of the alcohol comprised of methanol and cosolvent is 25-40 PSI when the total alcohol content is less than ten percent. Because of this relatively high blending vapor pressure, the use of methanol and cosolvent as a gasoline blending component requires the manufacturer to modify his gasoline blending recipe. Usually, the producer will reduce his use of butane to compensate for the methanol and cosolvent.

The measurement of the RVP of a gasoline containing methanol and cosolvent is generally less precise than that of hydrocarbon-only gasoline. Currently, only the ASTM D323 RVP method has been approved for use with gasoline by ASTM. Modifications to the ASTM D323 Method are now under consideration by ASTM for instances when the RVP of a gasoline containing an alcohol is being determined. There is a concern that water present during the ASTM D323 determination may affect the RVP results. Modified versions of ASTM D323 procedures that are currently being developed exclude water from the test equipment. “Dry” methods tend to produce more consistent, yet slightly higher, results than the conventional ASTM D323 method. No data yet exists which relates the results of the “dry” method to vehicle
performance. Also, there is yet no accepted, tested method which can be performed by commercial labs. OFA recommends use of the conventional technique unless otherwise advised.

3. Distillation
A gasoline's distillation defines its boiling range and volatility characteristics. The distillation of a fuel is important since it affects a vehicle's cold starting, acceleration and hot driveability. ASTM Standard D439 prescribes gasoline distillation temperatures for various geographical and climatic regions. The standard sets specifications for temperatures at which 10%, 50% and 90% of the gasoline may be vaporized as determined by the ASTM D86 method. From a practical standpoint, only the 50% Point Specification (temperature at which 50% of the gasoline is vaporized) is worth noting. Care must be taken when manufacturing a gasoline containing methanol and cosolvent to assure that the 50% point is not below the ASTM minimum temperature (normally 170° F). The manufacturers usually accomplish this easily by modifying their gasoline recipe to exclude light, volatile hydrocarbon components when methanol is used.

It is important to note that many distillation blending correlations used to predict the distillation of the finished gasoline based on the distillation of the individual blendstocks don't predict the distillation of a gasoline containing methanol and cosolvent very well. It is recommended that manufacturers use empirical data to develop their own distillation blending correlations.

4. Water Sensitivity
Besides the characteristics mentioned, a manufacturer of a gasoline containing methanol and cosolvent must be concerned about water sensitivity. Unlike hydrocarbon-only gasoline, gasoline containing methanol and cosolvent will absorb water into the gasoline. However, when gasoline containing methanol and cosolvent contacts a significant amount of water, some of the methanol can separate from the fuel. The ability of a gasoline containing methanol and cosolvent to withstand the presence of water without separating is often referred to as water tolerance. As water tolerance increases, the likelihood of methanol separation decreases. A manufacturer should produce a (alkohol) gasoline with a water content below the fuel's water tolerance.

Several factors affect the water tolerance of a gasoline containing methanol and cosolvent. These are:
1. The volume percentage of methanol in the gasoline.
2. The type and volume percentage of cosolvent in the gasoline.
3. The temperature at which the gasoline is manufactured and distributed.
4. The composition of the other hydrocarbon-only blendstocks.
   Generally, gasolines containing methanol can be manufactured and distributed successfully if sufficient cosolvent is present and "good housekeeping" is practiced. Cosolvents significantly improve water tolerance and are essential if methanol is to be used as a gasoline blendstock. The benefit of a cosolvent in a gasoline containing methanol is illustrated below:

Many blenders follow the prudent practice of adding higher levels of cosolvent when a blend is introduced into a system to counter initial water pickup. Methanol and cosolvent suppliers should be consulted for advice on selection and use of cosolvents.

B. "Topping" or Blending Methanol With a Finished Specification Gasoline
Unlike ethanol or gasohol, methanol should not be blended with or used to "top" a finished specification gasoline without the addition of other essential components. Generally, this requires the addition of a cosolvent and a heavy boiling, low RVP hydrocarbon blending component. Without a cosolvent and a low RVP hydrocarbon blending component, the "topping" of a finished gasoline with methanol will likely:
1. Increase the RVP of the methanol/gasoline blend two to three PSI above the maximum specifications established by ASTM.
2. Decrease the 50% point of the methanol/gasoline blend below the minimum 50% point specification established by ASTM.
These effects could result in a poorly performing fuel. Also, in unleaded gasoline, it will probably result in a fuel which violates EPA regulations.

Methanol can be blended with a finished specification gasoline provided sufficient cosolvent and heavy boiling, low RVP hydrocarbon gasoline blendsstock is used to meet ASTM’s RVP and 50% point specifications. However, this requires a technical understanding and experience in the manufacture of gasoline which may not be available to a gasoline marketer, distributor or dealer. A gasoline blending consultant should be consulted for advice on this type of use of methanol.

**IV. PREPARATION**

Because gasolines containing methanol and cosolvent have some differing characteristics from hydrocarbon-only gasoline, some necessary prior to use to manufacture, distribute and market the fuel. These are:
- Water-free the distribution system.
- Install filters at service station dispensers.
- Check for incompatible materials.

**A. “Water-Freeing” the Distribution System**

Prior to use of methanol and cosolvent, the manufacturing, distribution and marketing system which the gasoline containing methanol and cosolvent will come into contact should be “water-freeed.” All free-standing water at the bottom of tanks at the refinery, the terminal and service stations should be removed. Usually, this requires removal by normal operating practice but with special attention to “good housekeeping.” Experience indicates that only in unusual circumstances does a tank have to be taken out of service to effectively remove free water.

Generally, it is recommended that at the refinery or terminal, methanol and cosolvent or the gasoline containing the alcohols be stored in external floating roof tanks with double seals or a covered tank. Experience indicates that external floating roof tanks with double seals will provide adequate protection from rain water if the drains and seals are maintained in good operating order. At service stations, fill pipes, well caps and vapor systems should be checked for problems that may allow water to enter the tanks.

Immediately after introduction of the gasoline containing methanol and cosolvent, all tanks should be checked regularly for the presence of water bottoms (i.e., water or an alcohol/water mix at the bottom of a tank). New water-indicating pastes formulated specifically for detecting alcohol/water bottoms are available. Their use is strongly recommended. The old-type conventional water-finder pastes do not work well with gasolines containing methanol and cosolvent and should not be used. Methanol suppliers of QFA may be contacted for more information on the new pastes.

During the introduction phase of using a gasoline containing methanol and cosolvent, it is not unusual to encounter some water bottoms. This occurs because the “water freeing” process is not fully effective. If water bottoms are detected, the following procedures are recommended:

1. Measure the height of the water bottoms and estimate its volume based on the tank’s strapping garage.
2. If the water bottoms are a small amount and unlikely to interfere with normal operations, it should be carefully monitored, but not removed. Note: The existing gasoline distribution and marketing system is designed for some water.
3. The closest monitoring of water bottoms should take place at service stations. Generally, water bottoms of one or two inches in a service station tank won’t interfere with operations. However, water bottoms will normally be dispensed into a motorist’s vehicle if they are about four inches in height. These water bottoms will behave like water in a hydrocarbon gasoline and will stall a car.
4. To insure trouble-free performance at the service station, it is recommended that water bottoms be removed if they exceed two inches in the bottom of the tank. (See the Safety section for proper disposal of water bottoms.)
5. The fuel quality should be checked if significant amounts of water bottoms are identified and continue.

After the introductory phase, gasolines containing methanol and cosolvent will absorb small amounts of water that are routinely experienced in a gasoline distribution system. In fact, the gasoline containing alcohol will keep the entire distribution system dry when used on an ongoing basis. The water absorbed into the gasoline containing methanol and cosolvent will not adversely impact the fuel’s performance.

Note: A motorist’s fuel system which may contain small amounts of water, due to condensation, will be dried out by the routine use of gasoline containing methanol and cosolvent. Therefore, a motorist will only experience a performance problem if alcohol/water bottoms are dispensed into the vehicle or if the vehicle fuel tank contains an unusually large amount of water which has been dispensed along with hydrocarbon-only gasoline prior to alcohol-gasoline use.
B. Install Filters at Service Station Dispensers

When gasoline containing methanol and cosolvent has been introduced into a distribution system that has been historically used in hydrocarbon-only gasoline service, the (alcohol) gasoline will have a tendency to clean out dirt and rust that has accumulated in the system over many years. Experience indicates that the installation and maintenance of standard ten micron filters at service station dispensers is usually sufficient to maintain product quality and trouble-free performance of the distribution system. The use of filters at service stations, while practiced widely with hydrocarbon-only gasoline, is essential when using a gasoline containing methanol and cosolvent. Without a filter, rust and dirt from the distribution system may be dispensed into a motorist’s vehicle. This could eventually lead to blockage of the vehicle fuel line filter.

Only under exceptional circumstances should preparation beyond that already discussed be necessary.

Note: Motorist’s fuel tanks are usually coated with terne and don’t rust or contain dirt unless it’s been picked up from the gasoline distribution system. Therefore, a fuel containing methanol and cosolvent dispensed from a properly prepared system won’t affect a motorist’s fuel system unless a motorist has been dispensed an unusually large amount of dirt and rust along with the hydrocarbon-only gasoline prior to alcohol-gasoline use.

C. Check for Incompatible Materials

Gasolines containing methanol and cosolvent that comply with the OFA guidelines (on page three) have been successfully used in complex gasoline distribution systems that contain a wide variety of materials. This includes many types of metals, elastomers and plastics. However, due to the wide range of materials used in distribution systems, some care should be taken to assure that all system components are compatible.

The equipment manufacturer or supplier should be contacted for their recommendations on the compatibility of their materials and components with gasolines containing methanol and cosolvent.

Generally, most tanks and piping used in the gasoline distribution blends are compatible with alcohol-gasolines. Steel tanks should be expected to provide trouble-free performance. Many service station tanks are constructed out of glass-fiber-reinforced plastics, often referred to as fiberglass. These tanks are also generally acceptable. However, the supplier of the tank should be consulted.

Some gasoline marketers coat or “line” the inside of a steel tank with an “epoxy-type” coating, especially as a means to repair a leaking tank. Some linings have definitely been determined to be incompatible with gasoline containing methanol and cosolvent. These linings should be replaced prior to use of the alcohol-gasoline. The manufacturer of the lining material should be contacted for his recommendation.

Experience indicates that a material that is incompatible with gasohol, gasoline containing ten percent ethanol, is likely to be incompatible with a gasoline containing methanol that conforms to the OFA guidelines.

Due to the possibility of a material compatibility problem, all transporters, distributors and marketers of the gasoline containing methanol and cosolvent should be notified before the gasoline is introduced. This also helps ensure proper handling with respect to water sensitivity.

Gasolines containing methanol and cosolvent, just like hydrocarbon-only gasolines, should be formulated with proper additives such as corrosion inhibitors, antioxidants, etc. Generally, gasolines containing methanol and cosolvent require additives and treatment levels similar to hydrocarbon-only gasoline. An additive manufacturer should be contacted for their recommendations.

V. SAFETY

Safety preparations and procedures for storing and handling gasoline containing methanol and cosolvent, and hydrocarbon-only are very similar. Pure methanol, on the other hand, requires different preparations and procedures because of its flammability characteristics.

Blenders/handlers should carefully review the safety of methanol and gasoline containing methanol and cosolvent with methanol and equipment suppliers and medical advisors. The checklist below, while not comprehensive, provides useful information concerning the safety of methanol and gasoline containing the alcohol.

General
• Establish safety rules, checklists and regular inspection schedules.
• Train employees to handle methanol and gasoline containing the alcohol properly, to identify hazards and to use protective equipment.
• Properly label containers/receptacles that contain methanol or gasoline containing methanol.

Fire Prevention
• Store and handle methanol and gasoline containing methanol only in areas protected from flames, sparks and excessive heat.
• Absolutely no smoking should be allowed.
• Conform to all applicable federal, state and local codes for handling and storage of flammable liquids.
• Consult with methanol suppliers for specific fire prevention and firefighting techniques.
• Make sure that correct firefighting equipment is available.

A. Health Precautions
OFA strongly recommends that blenders/handlers carefully review the procedures for the safe handling of methanol and gasoline containing methanol with menthol and equipment suppliers and with medical advisors. Generally speaking, both gasoline and methanol are toxic when taken orally. However, medical treatment may vary. Protective, impermeable clothing, including gloves, should be used whenever other-than- incidental skin contact should occur with gasoline either with or without methanol. Neither fuel should ever be used to wash the hands or the skin. OFA has established a Health and Environmental Safety Committee that is reviewing health and safety-related information about methanol and methanol/gasoline blends.

B. Firefighting
In case of fire, immediately call the fire department. In general, techniques for fighting fires involving methanol, cosolvent or gasoline containing the alcohols are the same as for hydrocarbon-only gasoline fires. A major exception is that alcohol-resistant foams should be used in fixed extinguishing systems to fight methanol or methanol/gasoline tank fires. Another important distinction is that since methanol flames are colorless and are practically invisible in daylight, personnel should always approach a spill or a leak of methanol as if a fire were present. Signs of methanol fires are “heat waves,” blistering paint, charred wood, etc. Firefighting foam and equipment manufacturers/suppliers should be consulted for specific recommendations.

Fires at spills or leaks can be extinguished with dry chemicals, carbon dioxide (CO2) or aqueous-film-forming foams (AFFF’s). Water can be used in some cases (e.g., for very small fires) but is likely to be ineffective due to the great dilution that would be necessary. These extinguishing agents are not effective against tank fires.

Tank fires demand different foams. For large methanol tanks with fixed fire extinguishing foam systems (such as those commonly found at gasoline storage tanks), alcohol-resistant, aqueous-film-forming foams (AR-AFFF’s) are required. For gasoline containing methanol, AR-AFFF’s are recommended. The AR-AFFF’s are designed for use with water-soluble, polar solvent materials. For tank fires involving methanol, cosolvent or gasoline containing the alcohols, topside application must be used (subsurface application will not work). Applied correctly, AR-AFFF’s will generally work at standard rates (relative to gasoline) with no equipment modifications.

While AR-AFFF’s are recommended for alcohol-gasoline storage tank fixed foam systems, conventional (non-alcohol-resistant fluoroprotein) foams may be effective if the necessary equipment modifications are made and higher application rates are used. The table below is a summary of fire extinguishing methods and their applications for methanol and gasoline containing methanol.

C. Disposal of Alcohol/Water Bottoms
As mentioned earlier, an alcohol/water phase referred to as “water bottoms” or “alcohol/water bottoms” may develop in the bottom of tanks in the distribution system and service stations on occasion. This is most likely to occur during the introduction of a gasoline containing methanol and cosolvent. Generally, it is recommended that the alcohol/water bottoms not be removed unless it may interfere with the operation of the distribution system or the service station. Routine usage of gasoline containing methanol and cosolvent will eventually absorb the alcohol/water bottom into the gasoline and “dry” up the system. (See Page 12 for additional information.)

If alcohol/water bottoms must be removed, there are several safety and regulatory aspects which need to be understood.
1. Alcohol/water bottoms are flammable. Although it is often referred to as a “water bottom,” it is usually only 10 or 20% water. The other 80 or 90% of the bottom is an alcohol or hydrocarbon which is ignitable.
2. EPA regulations define a waste alcohol mixture with a flash point of less than 140°F and greater than 24% alcohol as a hazardous waste. As such, disposal of alcohol/water bottoms is regulated in accordance with the Resource Conservation and Recovery Act (RCRA). Manufacturers and distributors of gasoline containing methanol and cosolvent should familiarize themselves with these and other applicable state and local regulations. In general, regulations under RCRA require disposal of the alcohol/water bottoms at an EPA approved waste site.
<table>
<thead>
<tr>
<th>FIRE SITE</th>
<th>FIRE TYPE</th>
<th>EXTINGUISHER TYPE</th>
<th>APPLICATION METHOD/RATE</th>
<th>EQUIPMENT MODIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spills or Leaks</td>
<td>Methanol or Gasoline containing methanol</td>
<td>AFFF</td>
<td>Topside via Extinguisher as Needed</td>
<td>Not Applicable</td>
</tr>
<tr>
<td></td>
<td>Methanol or Gasoline containing methanol</td>
<td>AR-AFFF</td>
<td>Topside Only/ Required/ Standard Rate</td>
<td>None</td>
</tr>
<tr>
<td>Storage Tanks</td>
<td>Gasoline containing methanol</td>
<td>Conventional Nonalcohol-Resistant Fluoroprotein</td>
<td>Topside Only/ Higher Rates Required</td>
<td>Probably Required</td>
</tr>
</tbody>
</table>

* Relative to gasoline.
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