Using Methanol in Propane

Choosing the right amount under the right conditions maximizes antifreeze benefits

The presence of water in propane can interfere with usage, particularly when ambient temperatures fall below 40°F (5°C). As the temperature of the fuel approaches freezing temperatures, water can come out of the solution, forming a separate layer in the tank that can freeze. This can also lead to potential ice formation in valves and regulators.

The addition of methanol to propane can reduce and even eliminate freezing problems. Methanol, a simple alcohol, prevents whatever water may be present from freezing. While the use of methanol may not affect the burners used by most residential, commercial, industrial, or agricultural customers, excessive amounts have the potential to cause operational problems with some newer applications that are more sensitive to fuel composition.

Excessive methanol use has the potential to cause problems with engine calibration when propane is used as a fuel for internal combustion engines, resulting in increased emissions. Moreover, if there is enough water and methanol in the propane, a separate and often corrosive water-methanol layer may form at the bottom of fuel storage tanks.

Although the practice of adding methanol as an antifreeze has been in place for a long time, there is no guidance on exactly how much to add, largely because no reliable methods currently exist for measuring how much water or methanol is present in propane (see sidebar). Guidelines are needed to allow propane producers, distributors, and users to ascertain the amount of methanol that is actually needed. Attention to this issue can prevent potential operational problems and improve customer satisfaction.

Project Description

The Propane Education & Research Council (PERC) worked with Battelle on the study, Recommended Proper Use of Methanol in Controlling Water Freezing in LP Gas (**Docket 11992**), which set out to accomplish the following objectives

- Identify ways of using methanol to maximum advantage in order to prevent customer problems with water freezing in propane.
- Minimize the issues related to the use of too much methanol, such as phase separation and corrosion.
- Determine the benefits of alternatives to methanol, if any.
- Identify methods to best determine water content in propane and determine a quantitative test method.

Photo courtesy of the Office of Pipeline Safety, U.S. Department of Transportation

Methanol acts as an antifreeze for water in propane when cold weather causes ice to form.

Determining Water Content in Propane

Currently, three methods are used to determine the presence of water in propane.

- The Valve Freeze Test, the most common of the three, simulates freezing conditions. If water is present, ice will form.
- The Cobalt Bromide Test uses a green sea salt that changes color when water is present.
- Length-of-Stain Detector Tubes contain a reagent that changes colors when it comes in contact with water.

These tests, however, are not completely controlled and are not always repeatable. Also, their pass/fail nature does not offer enough information to allow a decision on how much methanol to add. Thus, alternative water content tests must be developed.

Example of a Valve Freeze Test Apparatus

Project Implementation

The project was conducted by Battelle and completed in June 2007. To develop guidelines for methanol use, Battelle analyzed the

- Chemistry and physics of propane, water, and methanol;
- Freeze valve and water determination test options;
- Water and methanol determination options;
- Alternatives to methanol addition;
- Efficacy of stain tubes to detect the presence of water in propane; and
- Impact of methanol use on materials and vaporization rate.

Project Completion: Conclusions

The results of the study were summarized in a guideline of recommended practices intended for use by propane marketers and distributors. Conclusions include:

- Developing a reasonably accurate equation of state for the propane-methanol-water system is now feasible.
- None of the existing methods for measuring water and methanol are sufficiently accurate, free from interferences, or usable in the field.
- Within recommended guidelines, methanol did not impact fuel vaporization and presented no significant operational problems.
- No significant material problems were found using methanol (within recommended guidelines).
- No alternatives to methanol were identified that would be able to match methanol's combination of effectiveness, relative lack of operational problems, and low cost.

Key Conclusion: **Methanol dosage rate is directly related to the liquid content of propane.**

Researchers recommend a methanol addition rate of 600 parts per million (ppm), which is equivalent to 4.9 liquid ounces of methanol per 100 gallons of propane.

Equivalent rates using other units of measure are:

Tank Size (Gallon)	Methanol to be Added		
	Liquid Ounces	Liquid Pints	Pounds
250	12	¾	0.63
500	24	1½	1.25
1,000	49	3	2.5

Next Steps

To further expand on the results of this study, Battelle recommends additional key actions including:

- Developing an optical water and methanol meter.
- Obtaining K-ratio data for methanol in propane.
- Obtaining data on the effect of water on methanol solubility in appropriate concentration ranges.
- Quantifying the effects of methanol on the stain-tube readings for water vapor.
- Developing an accurate equation of state for the propane-water-methanol system.

Guide for Use of Methanol in Propane

Treatment with methanol is indicated if the following conditions apply:

① Fuel Conditions
- Water content analysis shows the fuel has high water content (greater than 35 to 50 mass ppm)
- The fuel fails the valve freeze test
- Fuel from this supplier has a history of freezing problems
- Presence of water bottoms in transport or storage tanks is known

and

② Ambient Conditions
- Ambient temperatures below 35° F (1.7° C) are expected

or

③ No Fuel-Related Issues, But
- Very cold temperatures (lower than -20° F [-30° C]) are expected
- A large drop in ambient temperature is expected

! Treatment with methanol is not indicated if these conditions apply:
- The fuel is known to have been treated with methanol already
- Ambient temperatures are not expected to be below 40° F (5° C)

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