

LPG Processing - The Water Connection

Application Note

Following are excerpts from a paper presented by Floyd R. Thiele, Union Carbide— Sadrift Pipeline Corporation, Port Lavaca, Texas, U.S.A. and Colin Blakemore— AMETEK, Newark, Delaware, U.S.A. at the Texas A&M Symposium in College Station, Texas, U.S.A. in January.

Moisture plays an important role in the production, transportation, storage, and use of liquefied petroleum gases. Sadrift Pipeline personnel recognized this link between water and LPG and installed moisture analyzers at the custody transfer points for their suppliers and where the pipeline LPG enters Union Carbide's Sadrift, Texas Olefin Plant. Working with their equipment suppliers, they developed sample systems and maintenance programs that work.

Liquefied petroleum gas or LPG, as it is more popularly known, refers to the C3 and C4 hydrocarbons, propane, butane, propylene, butylene, and the isomers of C4 compounds and their mixtures. They can be liquefied and kept liquid under moderate pressure. Methane can be liquefied and transported as liquefied natural gas, LNG. Some cooling, along with the application of pressure is needed for this liquefaction. LPG will interact with water in ways that produce problems for the producer and end user:

- ▶ All will form hydrates.
- ▶ They are refrigerant gases.
- ▶ They can carry water to catalysts and other water sensitive parts of processes.
- ▶ Water reduces these gases' heating value.

Gas processors are generally aware of these problems and take steps to monitor and control the moisture level in their LPG processes.

Sadrift Pipeline, a large gathering system, runs a total of 1700 miles

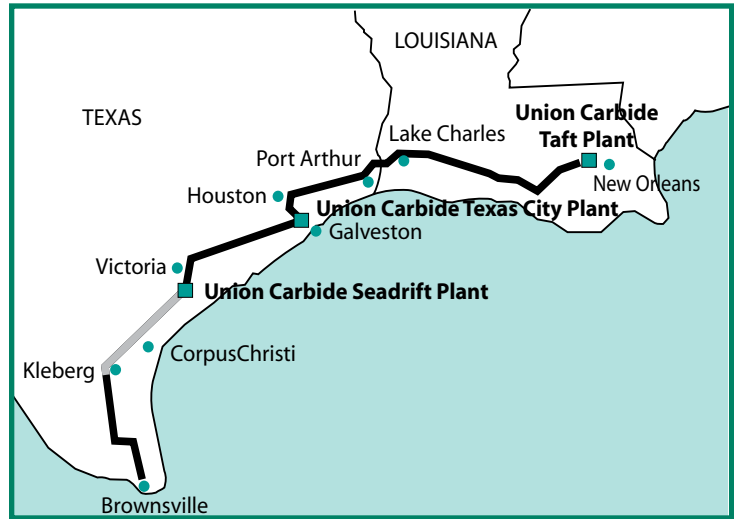


Figure 1 - Union Carbide Gulf Coast LPG Pipeline

from deep South Texas across into Louisiana. Figure 1 shows the pipeline running from Brownsville, Texas, up the coast, over nearly to New Orleans, Louisiana. The following story was developed on the section of pipeline running up from Kleberg County, Texas to the Sadrift Plant.

The pipeline carries liquefied petroleum gas to Union Carbide's Sadrift Olefin Plant located near Port Lavaca, Texas. The LPG (ethane/propane mixture) is used as a fuel gas and as the raw material for their olefin processes. There, the LPG is vaporized and cracked to ethylene which is used to manufacture polyethylene and ethylene oxide.

The Problem With Water

Pipeline pressures must be reduced as the LPG is vaporized for processing in the Olefin Plant. If moisture levels are too high as the liquid ethane and propane are vaporized, hydrates form in the pressure reduction station. These hydrates interfere with motor valve operation and the plant effectively loses control of the pressure reduction process. Once the hydrate formation begins, about all plant personnel can

do is inject inhibitors into the pressure reduction section to break up the hydrates. This leads to operations problems further downstream.

Moisture Measurement and Control

Sadrift Pipeline has no dehydration capability. So, they depend on their suppliers for dry LPG. When things go wrong, and wet LPG get into the pipeline, there are only a few things that can be done.

1. In severe cases, the pipeline can be shut in and the wet LPG producer forced to draw back the wet product.
2. If the wet LPG in the pipeline is still some distance from Sadrift, suppliers cooperate to blend in dryer than spec LPG, so the overall moisture level is reduced. This blending must be continuous because LPG tends to flow in large slugs. Mixing is minimal.
3. If, despite everyone's efforts, wet LPG gets through, all that can be done is to warn the olefin plant that it is coming.

Moisture Measurement

Seadrift Pipeline personnel monitor moisture at pipeline entry points. These moisture monitors are aluminum oxide-type instruments. Although their readings are not absolute and their operation is somewhat affected by compressor oils and dehydrator glycol carryover, they serve to alert operators to high moisture levels. Initially, there were problems with suppliers pumping wet LPG into the pipeline. Seadrift would not accept the wet LPG and suppliers were forced to fix their problems. Today, everyone accepts the importance of moisture specifications.

At the transfer point, from pipeline to Olefins Plant, the moisture measurement is critical. Fast response and very accurate readings are essential if pipeline operators are to have time to warn Olefin Plant personnel of the impending arrival of wet LPG. Here, Seadrift uses a piezoelectric-based analyzer with a carefully designed sample system.

Moisture Analyzer Sampler System

Much has been written about the design of a sample system. Cornish, Jepson, and Smurthwaite do a particularly good job of discussing the difficulties of sample system design in their book, *Sampling Systems for Process Analyzers*. Many of their recommendations are built into the sample system for Seadrift's pipeline/plant custody transfer moisture analyzer.

Short tubing runs, vaporization close to the pipeline, heating the sample system, and minimized internal volumes are all used to speed up instrument response. Piezoelectric moisture analyzers respond extremely quickly to changing moisture levels, so the sample system is the limiting factor in measurement response.

Sample system temperature must be controlled. Not enough heat in the winter, and the sample system freezes up because of the refrigerant nature of LPG. Too much heat in the summer, and components fail.

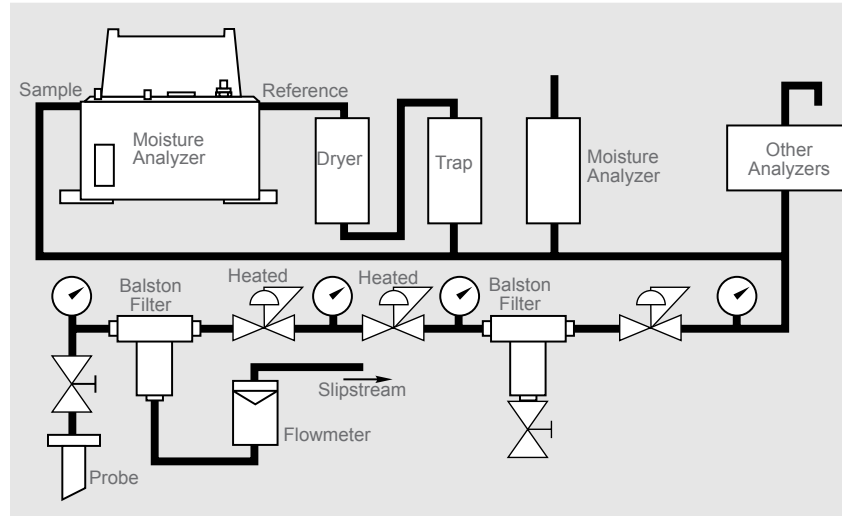


Figure 2 - Custody Transfer Point Sample System

Figure 2 shows the general component arrangement for the pipeline/olefins plant custody transfer sample system. Each component was selected to perform its function while minimizing its impact on speed of response.

Maintenance

Maintenance problems originate from three sources:

1. Compressor oil, which plugs up filters and lines, and holds up water.
2. Glycol carryover from supplier dehydrators coats lines and holds up water as moisture levels increase and gives off water as levels drop.
3. Pipeline rouge, a result of pigging, which coats everything down stream and plugs filters.

Periodically, sample systems have to be cleaned. Our experience has shown that a mix of Cascade dishwasher detergent and water, pumped through the sample system, will remove the oil, glycol, and pipeline rouge.

Conclusion

Water plays an important role in the production, transportation, storage and use of liquefied petroleum gases. All of the gases, commonly placed in the LPG group, are refrigerants. Any time pressure is reduced, there is the potential for the formation of hydrates and ice if water is present. LPG serves as the raw material for many processes which use water sensitive catalysts. Catalyst life, process yield, and end product quality are adversely affected by the presence of water. Lastly, water does not contribute in any way to the heating value of LPG being used as fuel gas.

Seadrift Pipeline recognized these potential problems and installed moisture analyzers to help them deal with water. Experience led to the design and installation of instruments and sample systems that work under pipeline conditions. Maintenance programs are in place which keep the equipment running satisfactorily.

Of course, the piezoelectric analyzer discussed in this application is the AMETEK Model 5000 with a sample system. For more information on other moisture product applications, refer to the new Moisture Product Guide. For detailed product information including features, specifications and dimensions, request specific product bulletins.

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