

Improving expander gas plant performance with process gas chromatographs

Process gas chromatographs have been used since the 1950s to provide real-time compositional data to process control systems. Today, there are tens of thousands of process gas chromatographs in use throughout the process industry making the gas chromatograph the analytical workhorse for online compositional measurements. One example of how process gas chromatographs are used for improving process operations can be found in expander gas plants.

Natural gas supplies nearly one-fifth of all the energy consumed in the U.S. During its journey from the natural gas fields to consumers' homes and businesses, it travels through an intricate network of transmission and distribution pipelines that crisscross the countryside. One of the first steps in the journey of natural gas through a gas plant is through a gas plant that straddles the pipeline extracting the heavier components for sale to chemical plants and returning a methane-rich residue gas that becomes the natural gas with which consumers are familiar.

There are several different designs of natural gas plants in the world today but the most common design is the expander gas plant. Developed in the mid-1960s, it efficiently removes the ethane and heavier components from natural gas, which is often used as feedstock to chemical plants such as ethylene plants.

The Expander Gas Plant

Before the raw natural gas is processed by the gas plant, it is treated to reduce H_2S and H_2O levels. This treated gas then enters the gas plant where it is often compressed to a higher pressure (see Figure 1). After compression, some of the heavier components will liquefy and are separated in a liquid/vapor separator. The liquids then continue on

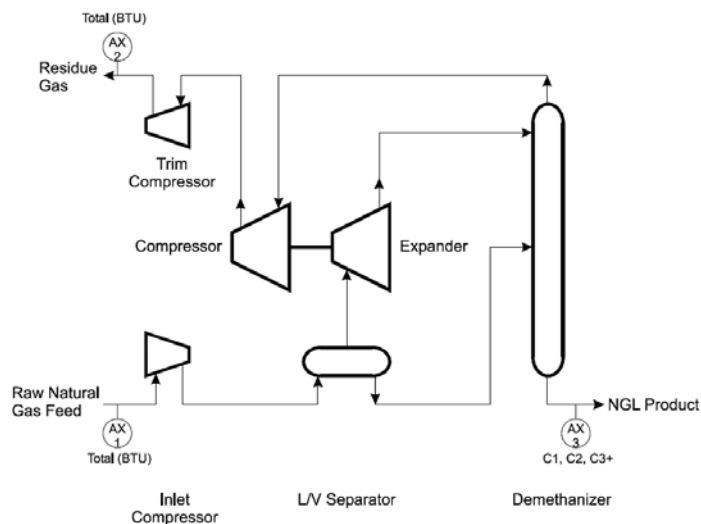


Figure 1 - Flow Diagram of a Typical Absorption Gas Plant

to the demethanizer while the remaining vapors enter the expander.

In the expander, the pressure of the vapors is dropped dramatically resulting in a huge drop in the stream's temperature (to less than $-100^{\circ}F$). At these low temperatures, 90-95% of the ethane and heavier components will liquefy. Furthermore, the energy released during this expansion is used to recompress the final natural gas product by connecting the expander shaft to the compressor shaft.

The stream from the expander enters a cryogenic demethanizer tower that separates the liquefied heavier compounds

from the methane. The methane-rich stream leaves overhead and is recompressed to a pressure appropriate for the pipeline before leaving the plant. The natural gas liquids will leave the bottom of the demethanizer as natural gas liquids product.

Improving Unit Performance With Process Gas Chromatographs

The first two analysis points for process gas chromatographs (AX #1 and #2 in Figure 1), are a good example of using gas chromatographs for providing information on plant material balance. Part of the economics of the gas plant is to determine the BTU shrinkage across the plant. Measuring the BTU of the feed stream and then the residue product stream allows the BTU shrinkage to be calculated.

The third analysis point (AX #3 in Figure 1) is to measure the demethanizer bottom streams for the C₁/C₂ ratio to get maximum recovery of the C₂ without getting too much of the C₁ as an impurity. If the stream is being sold as a product to a natural gas liquid plant, the stream may also measure the C₃, C₄ and C₅ content. A summary of these applications can be seen in Figure 2.

The Emerson Solution

Emerson has a long history of providing process gas chromatographs for the natural gas industry. Emerson's process gas chromatographs set the standard for online process measurement by supplying analyzers that are both robust and capable of handling the analytical requirements.

| Analyzer # | Stream | Components Measured | Measurement Objective |
|------------|----------------------|---------------------------------|--|
| 1 | Raw natural gas feed | Total (BTU) | Used to calculate BTU "shrinkage" across the plant |
| 2 | Residue gas product | Total (BTU) | Used to calculate BTU "shrinkage" across the plant |
| 3 | Demethanizer bottoms | C ₁ , C ₂ | Optimize control of the demethanizer tower |

Figure 2 - Summary of Process Gas Chromatograph Applications in a Typical Expander Gas Plant

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