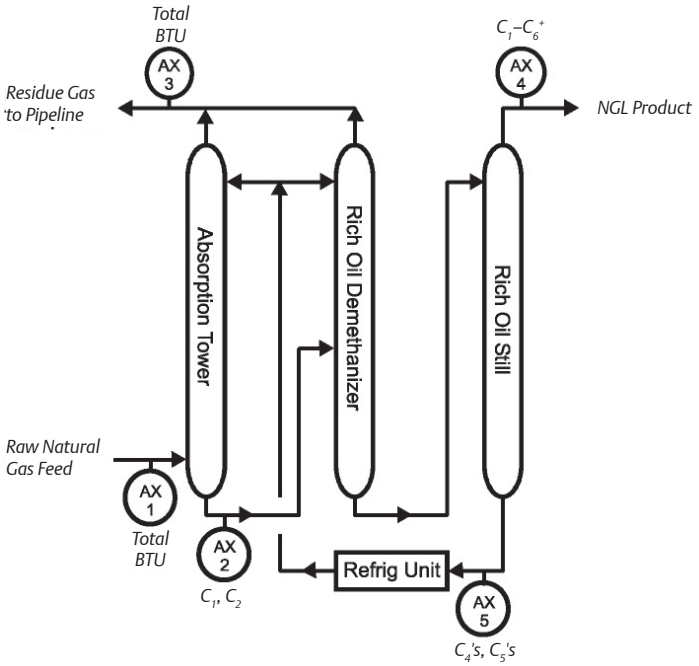
Improving Absorption Gas Plant Performance with Process Gas Chromatographs

Process gas chromatographs have been used since the 1950's 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 on-line compositional measurements. One example of how process gas chromatographs are used for improving process operations can be found in absorption 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 at the pipeline, where heavier components are extracted to sell to chemical plants. What is returned is a methane-rich residue gas that becomes the natural gas with which consumers are familiar.

One of the original methods of processing the natural gas was through an absorption – stripper column arrangement. While most new plants use the expander gas plant design due to its superior ability to remove ethane, absorption gas plants are still used when the recovery of ethane is not important.

Figure 1 - Flow Diagram of a Typical Absorption Gas Plant



The Absorption 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 enters the bottom of the main absorption tower. As the gas flows up the tower, it interacts with the stripping oil flowing down the tower. The stripping oil removes the heavier components in the gas (C_3–C_6^+). By the time the gases leave the top of the absorption tower, nearly all the heavy components from the natural gas have been removed.

To remove any entrained light gases in the oil, the oil leaving the bottom of the absorption tower passes through one or more additional towers. Any light gases leaving these demethanizer towers is added to the residue gas from the absorption tower.

The stripping oil plus any of the heavy components from the natural gas enter the rich oil still where the natural gas liquids are boiled out of the stripping oil. This natural gas liquids product stream is then sent to a natural gas liquids plant for further separation or is sold to a chemical plant as feedstock.

With the natural gas liquids removed from the stripping oil, it is recycled to the top of the absorption tower and any demethanizer towers as needed. It is also common to cool the stripping oil first through refrigeration to help the stripping oil perform better.

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 the plant's 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) measures the absorption tower bottom streams for C_1 and C_2 to get maximum recovery of the C_2 without getting too much of the C_1 as an impurity. The natural gas liquids stream may be measured (AX #4 in Figure 1) for the C_3, C_4 and C_5 content if it is being sold to a natural gas liquids plant.

On occasion, some plants have measured the stripping oil recycle stream for C_4s and C_5s compounds (AX #5 in Figure 1). Measurement of these compounds can give an early indication of the chemical decomposition of the stripper oil. 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 on-line process measurement by supplying analyzers that are both robust and capable of handling the analytical requirements.

Figure 1 - Summary of Process Gas Chromatograph Applications in a Typical Absorption Plant

Analyzer #	Stream	Components Measured	Measurement Objective
1	Raw natural gas feed	Total (BTU)	Used to calculate BTU "shrinkage" across the plant
2	Absorption tower bottoms	C_1, C_2	Optimize control of the absorption tower
3	Residue gas product	Total (BTU)	Used to calculate BTU "shrinkage" across the plant
4	Rich oil still overheads	C_1 - C_6+	NGL product purity
5	Stripper oil recycle	C_4's, C_5's	Monitor for chemical decomposition of the stripper oil

www.RosemountAnalytical.com

www.analyticexpert.com

www.twitter.com/RAIhome

Emerson Process Management
Rosemount Analytical
Gas Chromatograph Center of Excellence
10241 West Little York, Suite 200
Houston, TX 77040 USA
Toll Free 866 422 3683
T +1 713 396 8880 (North America)
T +1 713 396 8759 (Latin America)
F +1 713 466 8175
gc.csc@emerson.com
www.RosemountAnalytical.com

©2012 Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. Rosemount Analytical is a mark of one of the Emerson Process Management family of companies. All other marks are the property of their respective owners.

The contents of this publication are presented for information purposes only, and while effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

ROSEMOUNT® Analytical

EMERSON™ Process Management