

# Improving Absorption 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 on-line compositional measurements. One example of how process gas chromatographs are used for improving process operations can be found in absorption gas plants.

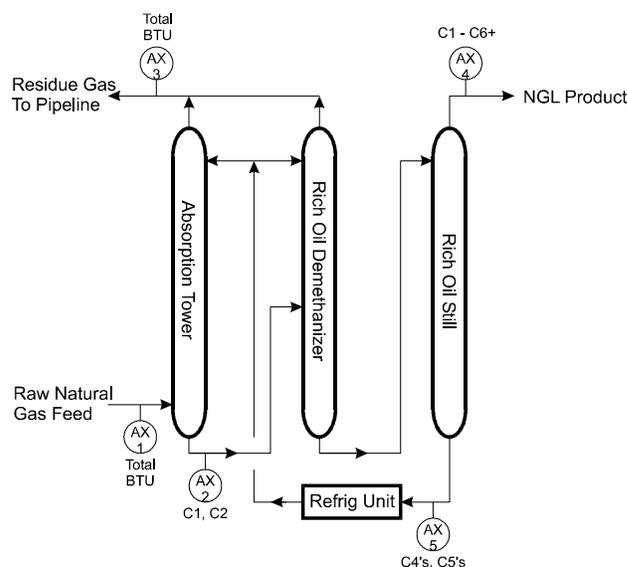
Natural gas supplies nearly one-fifth of all the energy consumed in the U.S. During its journey from the natural gas fields to consumers' homes and businesses, it travels through an intricate network of transmission and distribution pipelines that crisscross the countryside. One of the first steps in the natural gas' journey is through a gas plant that straddles the pipeline extracting out 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.

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.

## 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.



**Figure 1 - Flow Diagram of a Typical Absorption Gas Plant**

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 line product stream is then sent to a natural gas line 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<sub>1</sub> and C<sub>2</sub> to get maximum recovery of the C<sub>2</sub> without getting too much of the C<sub>1</sub> as an impurity. The natural gas liquids stream may be measured (AX #4 in Figure 1) for the C<sub>3</sub>, C<sub>4</sub> and C<sub>5</sub> content if it is being sold to a natural gas line plant.

On occasion, some plants have measured the stripping oil recycle stream for C<sub>4</sub>'s and C<sub>5</sub>'s 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.

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	Absorption tower bottoms	C <sub>1</sub> , C <sub>2</sub>	Optimize control of the absorption tower
4	Rich oil still overheads	C <sub>1</sub> - C <sub>6</sub> +	NGL product purity
5	Stripper oil recycle	C <sub>4</sub> 's, C <sub>5</sub> 's	Monitor for chemical decomposition of the stripper oil

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

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