Application Note

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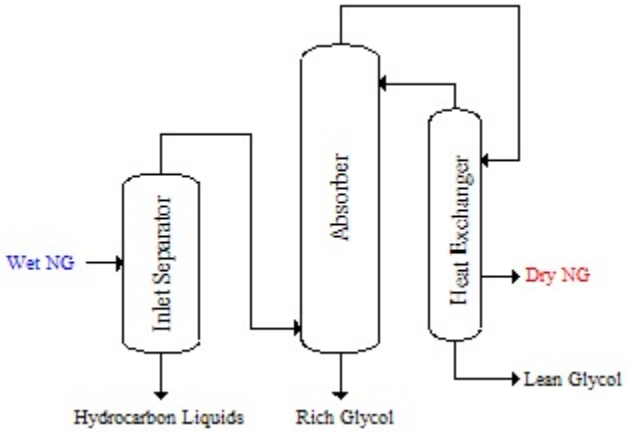
Aurora TDLAS in Glycol-Dehydration of Natural Gas

Provides rapid response in natural gas without cross-sensitivity to glycol

When a natural gas processing facility near Edson, Alberta needed a robust, reliable on-line moisture analyzer to contend with excessive contaminants (including glycol) that hindered the successful use of Al_2O_3 based moisture sensors, the GE Sensing Aurora TDLAS moisture analyzer proved itself admirably.

PROBLEM:

Raw natural gas can be saturated with liquid water and heavy hydrocarbons. As such, it must be processed in several stages, including dehydration to remove the excess water. One of the most common techniques used is glycol-dehydration.



The figure below shows a basic glycol flow loop where glycol is used to absorb the water present in the natural gas. Unfortunately, some of the glycol and other contaminants may be carried along with the natural gas.

If this carry over becomes excessive such that sample conditioning efforts are not able to adequately remove it, traditional moisture measurement technologies - like Al_2O_3 based impedance sensors - can be compromised with resultant measurement uncertainty. When this occurs, these sensors and the sample system must be cleaned and purged to re-establish acceptable measurement. In addition, dry-down times for these technologies can be a few hours or longer, depending on the moisture concentration.

SOLUTION:

The Aurora moisture analyzer uses Tunable Diode Laser Absorption Spectroscopy (TDLAS) to measure moisture concentration in a natural gas stream. When light energy at certain wavelengths specific to water is transmitted through a gas medium, some of the light is absorbed by the water. At other wavelengths that are not specific to water, practically no light energy is absorbed. By measuring this light absorption vs the reference, the Aurora quantifies the partial pressure of water in natural gas. This partial pressure of water divided by the total pressure and multiplied by 10^6 yields ppmv (parts per million by volume) moisture content.

The Aurora TDLAS takes full advantage of this phenomenon, to provide a stable moisture measurement that is independent of the other components of the gas.

The Beer-Lambert Law below describes this

$$A = \ln(I_o/I) = S \times L \times N$$

where A is the absorption, I is the beam intensity tuned to the absorbing wavelength of moisture, I_o is the reference beam intensity when tuned away from the absorbing wavelength, S is the absorption line strength (fixed constant), L is the measurement path length through the sample, N is the number of water molecules contained in the beam path, and ln is the natural log.

Three times per second, the Aurora TDLAS scans across a narrow band of frequencies to compare the absorbing frequency to the non-absorbing frequency. Since a new reference (I_o) is established with each scan, the Aurora provides a stable, drift-free measurement. As a result of this, and other innovative design features, the standard recommended factory verification/service period is once every 5 years.

Further, since the measurement path being the gas stream itself (the beam path through which the laser passes), dry-down is rapid, typically less than two seconds.

In an effort to confirm response time in the field prior to an actual upset event, the customer decided to simulate an upset by temporarily shutting down their glycol pumps. The contactor rapidly lost it's ability to dry resulting in a flow-through of wet sales gas into the Aurora analyzer with was immediately indicated. After a few minutes, the pumps were restarted, the contactor began regaining it's drying ability and, in a matter of less than 10 minutes, dry gas was again being indicated by the Aurora. The test confirmed an overall system response time measured in minutes as expected.

Because of the ability of the Aurora TDLAS to measure the water in the natural gas independent of contaminants in the gas, and because the laser based measurement system provides an optical response time of just a few seconds, it provides a very good solution for many difficult moisture measurement applications.

For more information, please contact:

Procon Systems Inc.
6025 - 99 Street NW
Edmonton, AB, T6E 3P1
Canada
Phone: (780) 437-0244
Fax: (780) 438-2893
Website: www.proconsystems.com

PROCON SYSTEMS INC.