



Moisture measurement in carbon dioxide (CO₂)

for carbon capture utilization and storage (CCUS) applications

Summary

Trace moisture (water vapor) is measured using a Tunable Diode Laser Absorption Spectroscopy (TDLAS) based analyzer in carbon dioxide (CO₂) gas that is transported through pipelines.

Application

Carbon management technologies help limit rising atmospheric CO₂ concentrations. CCUS is a key method for CO₂ management in energy and emission-intensive industries, processes and operations. This process captures CO₂ before it enters the atmosphere and stores it underground or uses it for an application like enhanced oil recovery (EOR). CCUS technologies are typically used on the largest CO₂ emitting industrial processes to reduce emissions.

EOR involves injecting CO₂ gas into a depleting oil well to force the oil to the surface and reduce its viscosity.

Transportation of CO₂ involves moving the CO₂ from capture sites to storage and/or end-use facilities. Transporting large amounts of CO₂ by road or ships is not economical. Pipelines are used to transport captured CO₂ over long distances. Normally, CO₂ pipelines are operated at higher pressure, with primary compressors located where the CO₂ is injected and booster compressors located as needed along the length of the pipeline.

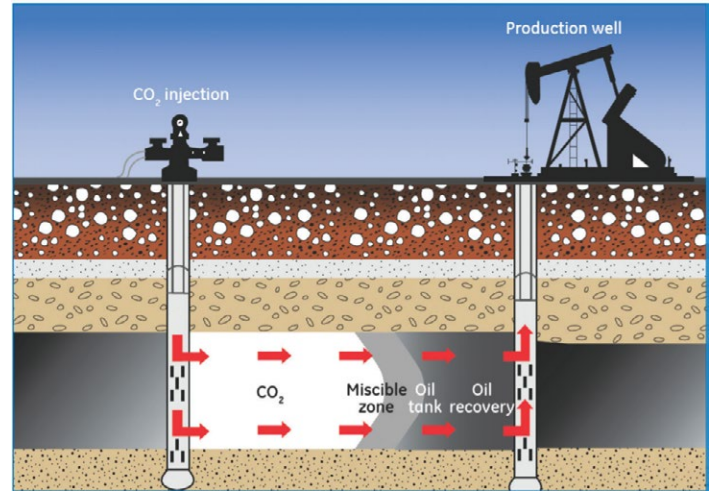
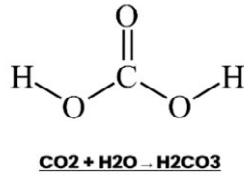
Benefits:

Laser technology has advantages over other types of sensor technologies:

- Rapid speed of response, typically in seconds, to changes in process moisture to allow for tight process control
- With no change in calibration, tunable diode laser absorption spectroscopy (TDLAS) technology does not require recalibration, resulting in lower maintenance requirements and cost
- Non-contact measurement eliminates wear and tear on a wetted sensing system due to corrosive gases and other process contaminants
- Integral sample system minimizes interference on the moisture measurement from other components in the process
- Hot permit not required with through-the-glass programming
- Analog and digital communications available
- Aurora View software enable remote service, trend graphing and diagnostics

Challenges

Protecting these CO₂ pipelines from corrosion is critical. Measurement and control of water vapor is key for the processing, transmission, and compression for injection of CO₂ used in EOR or other usage processes. Excess amounts of moisture in CO₂ gas can lead to carbonic acid (H₂CO₃) formation causing operational problems and accelerated corrosion, which damages metal infrastructure, including pipelines. High moisture levels can cause condensation at compressor stations leading to accelerated compressor corrosion. For this reason, the water content measurement is required on a continuous basis to ensure dehydration efficiency. Maintaining a low level of moisture in the transported CO₂ is achieved through drying the CO₂ gas. Dehydration of CO₂ is accomplished through different methods, including triethylene glycol (TEG) contactors, molecular sieve desiccant dryers, and membrane separators. Each of these methods consumes considerable amounts of energy and requires reliable moisture measurement to maximize its efficiency. Inadequate dehydration of CO₂ gas could result in free water condensing in the pipeline and forming corrosive compounds, reducing pipeline life.



Solutions

Traditionally, capacitance and piezoelectric technologies have been used to measure moisture in CO₂ gas streams, but these types of sensors can deteriorate over time, if not implemented properly as they are directly exposed to the process. Panametrics' experience in moisture measurement includes aluminum oxide, polymer, capacitance, chilled mirror and laser based analyzers. Panametrics Aurora TDLAS hygrometer enables EOR and carbon sequestration facilities to monitor moisture content in real time with high precision and reliability.

Application specification

The CO₂ used in this process must be dried to level of -40 °C dew point, about 130 PPMv, or lower.

- Typical moisture content range: 0 – 1000 PPMv
- Process Phase: Gas phase CO₂
- Operating Pressure: 100 – 200 barg

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