

MEASURING WATER IN HYDROGEN RECYCLE GAS USING TUNABLE DIODE LASER ABSORPTION SPECTROSCOPY

Catalytic reforming is a chemical process used to convert refinery heavy naphthas, typically having low octane value, into high-octane liquid products called reformates. The process rearranges the hydrocarbon molecules in the naphtha feed as well as breaking some of the larger molecules into smaller molecules. The overall effect is that the product reformat contains hydrocarbons with more branching and higher-octane value than the hydrocarbons in the naphtha feedstock, and water being a by-product of the reforming process.

WATER IN THE CATALYTIC REFORMING PROCESS

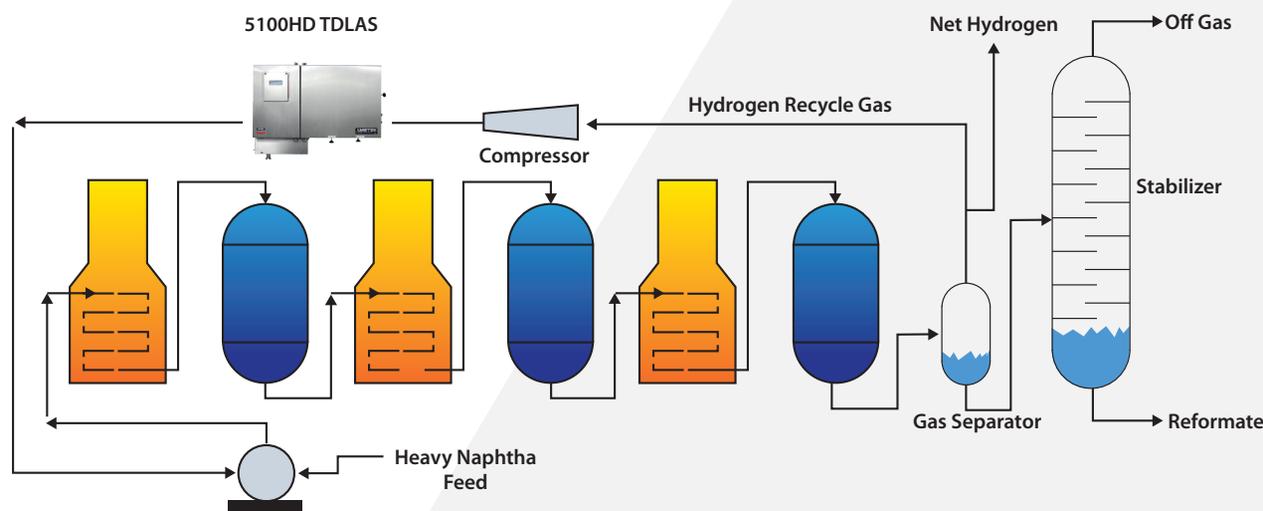


Figure 1. Diagram of a three-bed catalytic reformer

Hydrogen is captured and reused in many processes in a refinery, but water – created when hydrogen reacts with free oxygen – can also be present. Unfortunately, the surface area of the catalyst used in the reforming process can be negatively impacted by excess water. Excess water will wash off the chlorine ions (from perchloroethylene) that are introduced to maintain the high reaction surface area of the catalyst.

Monitoring the water concentration in the catalytic reforming process (Figure 1) is important to manage the chlorine and water balance. Excess chlorine can lead to the formation of

chlorine salts and corrosion of metals in the processing unit, which can lead to reactions that generate undesired lighter hydrocarbons.

Typically, the maximum allowable water content is around 50 parts per million (ppm), although during the catalyst regeneration process the level can be much higher. Historically, electrochemical detectors have been used to monitor the water level in the hydrogen recycle gas, but this type of sensor degrades over time as it is exposed to heavy hydrocarbons and low levels of hydrogen chloride present in the process. Exposed electrochemical cells can fail several times a year.

ANALYZING WATER IN HYDROGEN RECYCLE GAS

Tunable diode laser absorption spectroscopy (TDLAS) based analyzers, such as the AMETEK 5100HD, are less likely to experience failures caused by the presence of heavy hydrocarbons and hydrogen chloride in the reforming process. The light source does not come into contact with the process gas, and the sensor is not degraded by process constituents.

WHY AMETEK?

The 5100HD TDLAS analyzer is a highly reliable and low-maintenance solution for this application. The 5100HD provides an integrated heated sample compartment (up to 100°C is typical for this application) containing one or two stainless steel gas cells and the sample conditioning system (membrane filter). When configured with two cells, multiple streams can be simultaneously, and continuously, analyzed for water concentrations.

Unlike other manufacturers' analyzers, the 5100HD continuously verifies optical system performance, using a

sealed reference cell. If required, the laser module can be changed in the field. Products from other TDLAS suppliers must be returned to the factory for this type of repair.

The 5100HD analyzer can also be installed outside of a temperature-controlled shelter, further reducing installation and operational costs. Designed to meet IP65 and NEMA 4X requirements, the 5100HD is also certified to meet North America, ATEX and IECEx safety requirements.

5100HD ANALYZER FEATURES

- Field-proven in refinery applications
- Integrated and continuous optical bench verification assures the optical system is performing accurately
- No expensive sample system requirements – hot/wet analysis
- A true process TDLAS analyzer with liquid separator and horizontal cell built into 0 to 150°C (32 to 302°F) oven
- Low maintenance: no consumables – no carrier gas, no columns, no column valves, no sample wetted detector
- IP65 design; walk-in shelter not required
- Suitable for an ambient temperature range of -20 to 50°C (-4 to 122°F)



AMETEK 5100HD TDLAS ANALYZER for water in hydrogen recycle gas

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