CONTINUOUS HYDROGEN ANALYZER

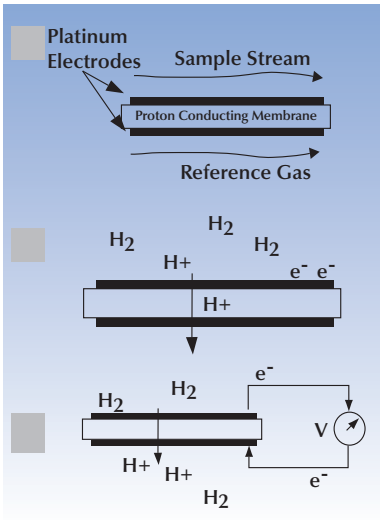
cosa+xentaur

INTRODUCTION

The COSA/Xentaur Continuous Hydrogen Analyzer (CHA), used in countless UOP Schedule A applications for many years, is built under a license to a patented UOP design. It provides petroleum refiners, petrochemical producers, and electric power generators a means to continuously and accurately monitor hydrogen concentration in gaseous streams. Utilizing a unique, patented electrochemical sensor, the CHA outputs a continuous signal corresponding directly to the hydrogen concentration. Used in conjunction with real-time controls, alarms, and shut-off mechanisms, the CHA responds immediately to changing hydrogen levels for improved operations and safety.

A UNIQUE, HYDROGEN-SPECIFIC SENSOR

Unlike thermal conductivity-based hydrogen analyzers, the CHA measures hydrogen directly and specifically. Built around a polymer membrane with proton-conducting properties, the CHA sensor detects hydrogen concentrations ranging from 400 ppm to 100% by volume in discrete ranges with ±1% accuracy or better (dependent upon sample concentration and reference gas composition).



A. The sensor's proton-conducting membrane is platinum-coated on both sides, creating two electrodes. One electrode is in contact with the sample gas stream, the other with a reference gas stream of known hydrogen concentration.

B. As hydrogen molecules dissociate, the resulting protons are conducted from the stream with higher hydrogen partial pressure through the membrane to the stream with lower hydrogen partial pressure. The resulting electrons do not pass through the membrane, creating a charge imbalance across the sensor.

C. By quantifying these electrons as voltage across the electrodes, hydrogen concentration in the sample is then determined.

APPLICATIONS

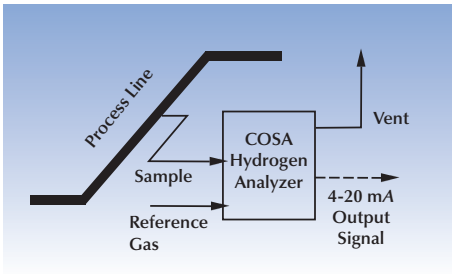
Hydrogen concentration is critical in many different refining, petrochemical, and electric power generation applications whether being monitored as a reactant, product, process "health" indicator, or coolant. COSA/Xentaur configures the CHA to match each installation's unique sample conditioning and operational needs.

CHA with optional enclosure

- Catalytic reforming – By enabling on-line control of the hydrogen/hydrocarbon ratio, the CHA allows optimization of catalyst life and minimizes utility consumption.
- Isomerization – Determining hydrogen concentration is valuable at several different points in the isomerization process. Examples include: optimizing the hydrogen/hydrocarbon ratio to assure stoichiometric balance; detecting processing upsets as they begin to occur; determining purity of recycled gas to reduce compressor utilities; monitoring makeup hydrogen purity; and detecting hydrogen-consuming side reactions caused by feed impurities, e.g., benzene saturation, which reduces the hydrogen in the offgas.
- Polyolefin production – The concentration of hydrogen in the reactor dictates the molecular weight, and thus the physical and chemical properties, of the polymer. Continuous measurement of the hydrogen concentration allows for rapid changes from one polymer grade to another with minimal off-spec material.
- Hydrogen production – By continuously monitoring hydrogen purity, the CHA immediately detects process upsets, bed poisoning, or processing deviations that lead to decreased yield and/or low product purity.
- Hydrogen-cooled power generation – Efficient and safe operation of hydrogen-cooled generators depends upon high hydrogen purity within the generator casing. The CHA enables power generation facilities to immediately detect casing air leaks which, if not corrected, can lead to windage losses and unsafe hydrogen-air mixtures.
- Hydrotreating – Continuously monitoring the hydrogen concentration of the gas stream to the reactor enables the operator to satisfy the chemical demands and control the coke rate, without causing excessive utility usage.

INSTALLATION, CALIBRATION, AND MAINTENANCE

Depending on the application, a sample gas stream is typically diverted to the CHA from the makeup gas line, reactor outlet, stabilizer offgas, or power generator casing. As it exits the analyzer, the sample stream can either be vented or returned to the process. Installation is easily completed by plant personnel. Qualified field service engineers are available to inspect and commission the installation.



Typical Installation

Upon installation, the analyzer is calibrated for measuring hydrogen concentration within a discrete, specified range. Using two calibration gases of known concentration and a specific, continuous flowing reference gas, a simple two-point calibration is completed in less than 30 minutes. Thereafter, calibration checks are recommended every three months, or when the reference gas cylinder is changed.

With no moving parts and extremely high stability, the CHA requires very little maintenance. Commercial uptime is reported to exceed 99%.

AVAILABLE EXCLUSIVELY THROUGH

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CONTINUOUS HYDROGEN ANALYZER SPECIFICATIONS

Performance Specifications

Display Range ..... 0.0 to 100% Hydrogen by volume (.1% H_2 display resolution).
Measurement Range..... 04 to 100% Hydrogen by volume.
Output Signal..... 4-20 mA current loop, software configurable, fail signal also software configurable.
Response Time..... 2 minutes for 10-90% of 1 to 100% H_2 step change at analyzer inlet.
Rpeatability..... Within 0.6% of original Hydrogen value with up to 99% H_2 step change, in 5 minutes at typical flow rates. Noise band is less than 0.6% H_2.
Temperature Drift..... 025% H_2/C.
Calibration Accuracy..... ±.1% H_2 in 1-100% H_2 two-point calibration range, accuracy no better than combined Calibration and Reference Gas Cylinder accuracy.
Measurement Accuracy..... ±.1% H_2 anywhere in 1-100% H_2 two-point calibration range, accuracy no better than combined Calibration and Reference Gas cylinder accuracy.

Physical Specifications

Detector Type..... Potentiometric Proton Conducting Membrane Hydrogen Sensor.
Sample Flow Rate..... 5 L/min (5000 cc/minute) (10.6 cubic ft/hr) fast loop, vent to flare. 0.5 L/min (500cc/minute)(1.1 cubic ft/hr) @20 psi across sensor cell slow loop to analyzer, atmospheric vent or vent to flare.
Sample Pressure..... 35 bar (500 psig) maximum to sample system fast loop, 30 psig maximum upstream regulator set point limit by gauge.
Sample Temperature..... Sample line must be between 0-50°C (122°F), non condensing.
Material of Construction..... All wetted parts are 300 series stainless stell, Teflon, Viton.
Ambient Temperature Range..... 0 to 50°C (32 to 122°F) limited by hydrogen sensor exposure.
Calibration..... 2-point manual calibration done periodically as needed or with a reference gas cylinder change.
Analyzer Dimensions (WxHxD)..... 20" Wide x 24" High x 12" Deep (50.8cm x 61cm x 30.5cm).
Net Weight ..... approximately 26 kg (50 lbs).
Piping Connection ..... ¼" Swagelok Tube fittings with sensor/sample system.
Enclosure Certfication ..... NEMA 4X suitable for Class I Division 1 Group B installations per US National Electrical Code (NEC) and Zone 0, EEx ia IIC T4 per CENELEC; Sensor and Transmitter is CENELEC KEMA (No. Ex-00.E.1033) approved.

Utilities

Optional Heater..... 220.120 VAC, 500 Watts.
Reference Hydrogen Consumption... 50% H_2 remainder N_2 @ 20 psig across sensor cell: 25 cc/min. typical.
100% H_2 remainder N_2 @ 20 psig across sensor cell: 30 cc/min typical.
Cal Gas Hydrogen Consumption ..... 1% H_2 remainder N_2 @ 20 psig across sensor cell: 175 cc/min typical.
100% H_2 reaminder N_2 @ 20 psig across sensor cell: 500 cc/min typical.

Contaminant Limits

Hydrogen Chloride HCL..... 150 ppm(v) maximum in 500 ppm moisture maximum.

Represented by: