Application Note

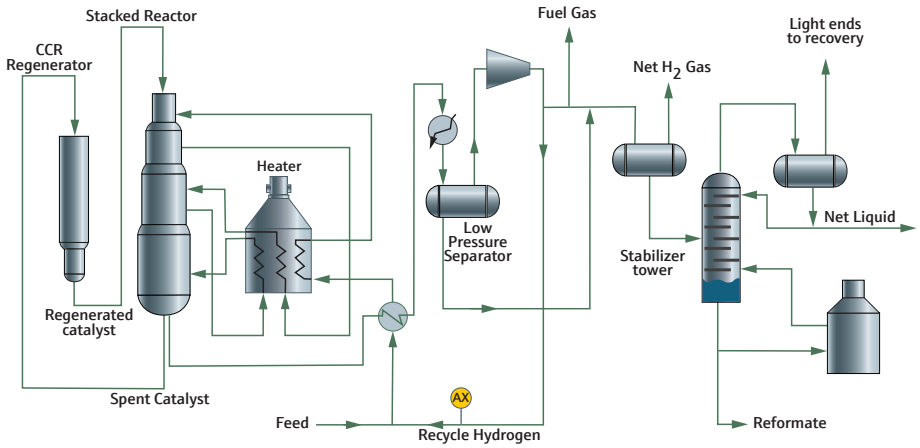
Water in continuous catalytic reformer hydrogen recycle

Industry:
Refining
Application Note 23201

Key Points

- Fast response to H_2O concentration changes for process monitoring and control
- Non-contact laser measurement avoids detector contact, corrosion and damage from HCl
- Laser-based measurement is highly selective and accurate for H_2O in catalytic reformer hydrogen recycle streams

Catalytic reforming A catalytic reformer unit converts naphtha into high-octane compounds termed reformates used in gasoline blending, and yields large quantities of hydrogen, which is recycled and used in other processes. A continuous catalytic reformer (CCR) unit has a 3-stage stacked reactor employing a platinum/rhenium catalyst on a chloride alumina support. Water and a chloride compound are continuously injected to chlorinate the alumina and maintain acid sites needed to perform the conversion reactions. The catalyst is continuously extracted from the bottom of the reactor stack and transferred to a separate, external catalyst regenerator. Inside the regenerator, coke deposits on the catalyst are burned off and the catalyst is oxy-chlorinated and dried sequentially in separate zones. Following reactivation with hydrogen the catalyst is returned to the top reactor in the CCR stack.



Continuous Catalytic Reformer

On-line H_2O monitoring On-line monitoring of the H_2O concentration in CCR hydrogen recycle streams enables refineries to control the chloride level required for optimum catalyst activity and helps minimize HCl formation which causes corrosion damage. Maintaining an H_2O concentration of 15 - 30 ppm in a CCR hydrogen recycle stream helps maintain chloride levels (typically 1.0 - 1.3 wt%) on the catalyst by regulating injection of H_2O and the chloriding agent.

SpectraSensors' solution SpectraSensors tunable diode laser absorption spectroscopy (TDLAS) analyzers have proven highly effective for this important measurement. TDLAS analyzers have an exceptionally fast response to changes in H_2O concentration, an important performance characteristic for monitoring and controlling H_2O levels in refinery CCR units. Laser and detector components of a TDLAS analyzer are isolated and protected from HCl in the process gas stream that leads to corrosion and frequent replacement of devices using direct contact sensors.

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Application Data	
Target Component (Analyte)	Water in Continuous Catalytic Reformer Hydrogen Recycle Gas
Typical Measurement Ranges	0-50 ppm*
Typical Repeatability	±1 ppm (control) and ±10% of reading (trend)*
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Non-Differential Tunable Diode Laser Absorption Spectroscopy
Validation	Certified blend of H_2O in pure N_2 or integrated permeation system

*Consult factory for alternate ranges.

Typical Stream Composition

Component	Minimum (Mol%)	Typical (Mol%)	Maximum (Mol%)
Hydrogen (H_2)	70	80	90
Methane (C_1)	8	12	20
Ethane (C_2)	3	5	10
Propane (C_3)	0	2	5
i-Butane (C_4H_{10})	0	1	2
n-Butane (C_4H_{10})	0	<1	2
C_5+	+0	0	1

The background stream composition must be specified for proper assessment, calibration and measurement performance. Specify the normal composition, along with the minimum expected values for each component, especially H_2O, the measured component. Other stream components may be allowable with approval from SpectraSensors.