Reduction / Amine Tail Gas Treaters with Model 931 / 932 Analyzers

AMETEK's combined sulfur and hydrogen analyzers bring cost-effective analysis for optimal control of tail gas treaters, with the performance and reliability you have come to expect from Western Research.

Process Overview

The Claus sulfur recovery process is limited to 97-98% overall recovery efficiency because of the equilibrium nature of the reaction. In order to meet required SO_2 emission levels, many sulfur recovery units (SRUs) are followed by a tail gas treater (TGT). By far the most common TGTs are variations of the reduction/amine type, each having a proprietary feature or solvent. The most common trade names include "Resulf", SCOT, FLEXSORB SE and BSR-MDEA.

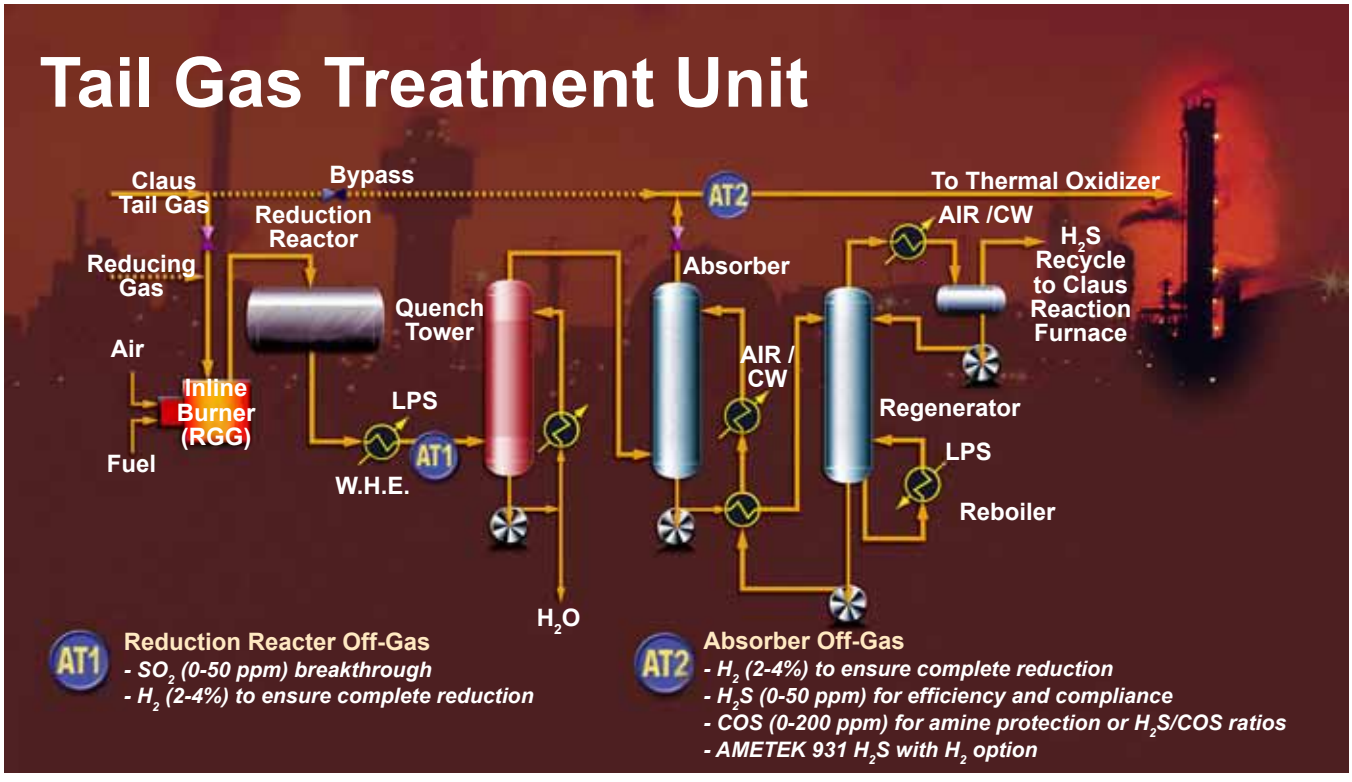
In the standard process all of the unreduced sulfur components (SO_2, COS, CS_2, S vapor and S liquid) are catalytically converted to H_2S in a **reduction reactor.** After cooling, the H_2S is selectively absorbed from the tail gas by means of an amine solvent or **absorber**. In the amine **regenerator**, the bulk of the H_2S is desorbed from the solvent and recycled back to the front end of the Claus SRU. The off-gas from the top of the absorber, containing residual H_2S and traces of COS / CS_2, is incinerated to SO_2.The emission is typically limited to less than 250 ppm of SO_2, but versions that reduce emissions to 50 ppm and even 10 ppm of sulfur compounds are common.

Analytical Requirements

Primary Measurements

The basic analyzer requirements are to measure H_2 at the outlet of the reduction reactor and the H_2S at the top of the absorber. Both of these measurements can be made at the top of the absorber as the H_2 content does not change after the reactor.

- The H_2 measurement is to maintain excess H_2 after the reduction reactor, typically 2 – 4%, which ensures complete reduction. Insufficient H_2 causes SO_2 breakthrough to the amine solvent which will react to form heat stable salts and degrade the amine.
- The H_2S measurement is to ensure the process is operating efficiently and the emission limit is being met. Historically, these measurements required two analyzers, or a gas chromatograph with three-minute cycle time. The AMETEK model 931 analyzer can do both measurements on a continuous basis.



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WESTERN RESEARCH®
Application Note

Secondary Measurements

The level of SO_2 breakthrough in the reduction reactor off-gas along with the COS concentration in the absorber outlet are also important measurements for optimum control.

- Directly measuring the SO_2 concentration after the reduction reactor can give faster results than using the excess H_2, or the pH of the quench water, to prevent SO_2 breakthrough. The analyzer can be combined with H_2 in the 931 analyzer so both components can be measured after the reduction reactor.
- The COS concentration at the outlet of the absorber is of interest because the selective amines used in the TGT have a limited absorptivity for COS. It can be very useful to know the contribution of H_2S and COS to the SO_2 emission. The model 932 can measure two or more sulfur gases as well as H_2 from any one sample point.

Analytical Capability of the Model 931 / 932 Analyzer

The model 931 / 932 is based on the 900 series ultraviolet (UV) photometer that is extensively used in SRU tail gas, feed gas, and stack gas applications. A thermal conductivity (TC) detector is integrated into the UV sample cell for the continuous measurement of hydrogen. The no-moving-parts UV light bench is used for single gas measurement or the multi-wavelength analyzer for a combination of sulfur gases.

Possible Combinations

H_2S: 0 - 50 ppm / 0 - 500 ppm / 0 - 5% (higher ranges available)

H_2S + H_2: H_2 0 - 5% / 0 - 10%

H_2S + COS or CS_2: COS / CS_2 0 - 500 ppm minimum range

COS or CS_2: 0 - 200 ppm as primary measurement

H_2S + H_2 + COS or CS_2 or SO_2: SO_2 0 - 50 ppm

SO_2 + H_2: H_2 0 - 5% / 0 - 10%

H_2S + NH_3: for sour water stripper (SWS) feed gas

Benefits

- Fast response; both detection principles (UV, TC) are continuous and instantaneous. Response time <30 seconds compared to three minutes or more for gas chromatographs.
- Single sample point and one sample system for multiple measurements
- Safety; the unique “HAG” (heated acid gas) probe containing the pipe-mounted sample system components, can be completely isolated from the process on both the sample and vent legs of the analyzer. This allows the entire sample system to be back-purged before maintenance.
- No consumables, no carrier gas
- Combined spares and maintenance with other series 900 analyzer used in the SRU

Summary

The 900 series light bench is the most precise UV spectro-photometer used in process analytics. Recent developments allow for single digit ppm measurement of multiple sulfur gases and the addition of a second detection principle (in this case, thermal conductivity for H_2). No one knows sulfur recovery as well as AMETEK Western Research; and this addition to the family allows for a single source of feed gas, tail gas, TGT tail gas and sulfur train emission analyzers all from one manufacturer.

AMETEK®
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One of a family of innovative process analyzer solutions from AMETEK Process Instruments.
Specifications subject to change without notice.