

# 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<sub>2</sub> 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<sub>2</sub>,

COS, CS<sub>2</sub>, S vapor and S liquid) are catalytically converted to H<sub>2</sub>S in a **reduction reactor**. After cooling, the H<sub>2</sub>S is selectively absorbed from the tail gas by means of an amine solvent or **absorber**. In the amine **regenerator**, the bulk of the H<sub>2</sub>S 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<sub>2</sub>S and traces of COS / CS<sub>2</sub>, is incinerated to SO<sub>2</sub>. The emission is typically limited to less than 250 ppm of SO<sub>2</sub>, but versions that reduce emissions to 50 ppm and even 10 ppm of sulfur compounds are common.

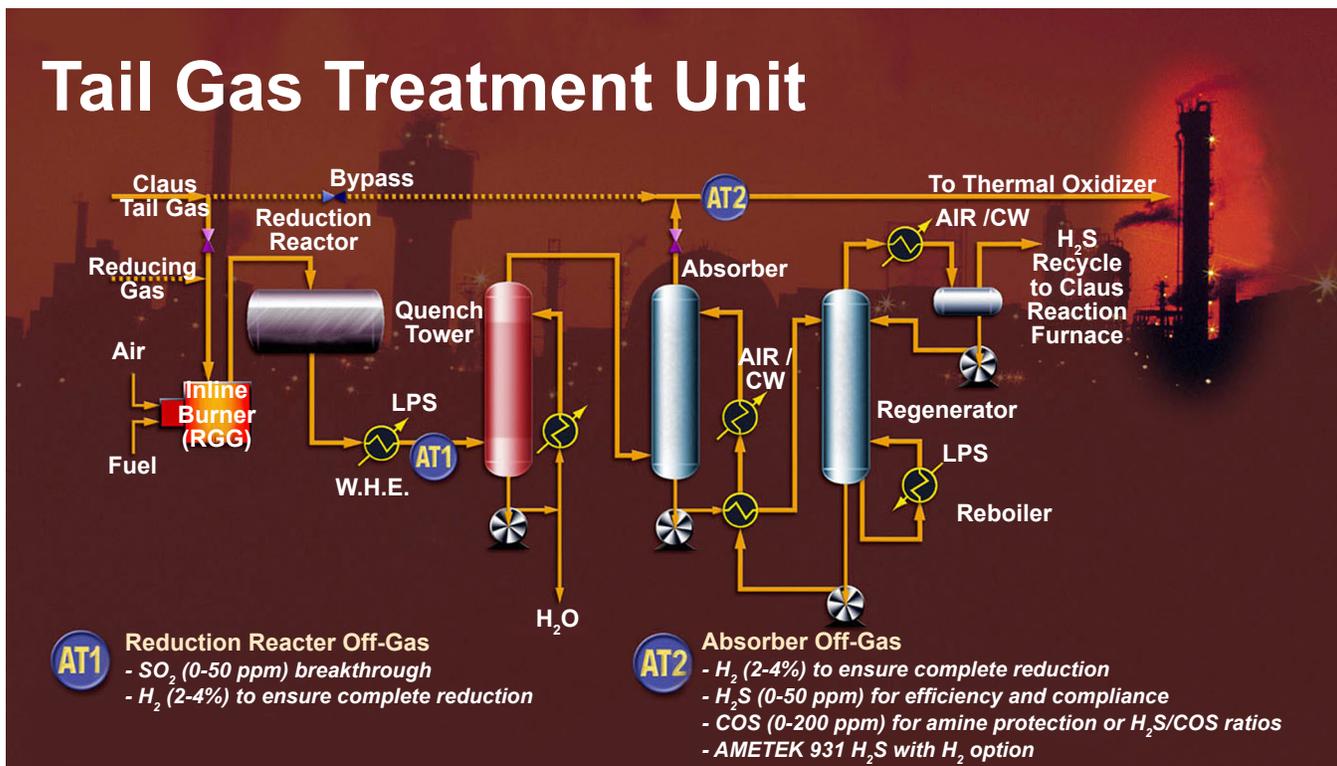
## Analytical Requirements

### Primary Measurements

The basic analyzer requirements are to measure H<sub>2</sub> at the outlet of the reduction reactor and the H<sub>2</sub>S at the

top of the absorber. Both of these measurements can be made at the top of the absorber as the H<sub>2</sub> content does not change after the reactor.

- || The H<sub>2</sub> measurement is to maintain excess H<sub>2</sub> after the reduction reactor, typically 2 – 4%, which ensures complete reduction. Insufficient H<sub>2</sub> causes SO<sub>2</sub> breakthrough to the amine solvent which will react to form heat stable salts and degrade the amine.
- || The H<sub>2</sub>S 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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## Secondary Measurements

The level of SO<sub>2</sub> 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<sub>2</sub> concentration after the reduction reactor can give faster results than using the excess H<sub>2</sub>, or the pH of the quench water, to prevent SO<sub>2</sub> breakthrough. The analyzer can be combined with H<sub>2</sub> 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<sub>2</sub>S and COS to the SO<sub>2</sub> emission. The model 932 can measure two or more sulfur gases as well as H<sub>2</sub> 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<sub>2</sub>S:** 0 - 50 ppm / 0 - 500 ppm / 0 - 5% (higher ranges available)

**H<sub>2</sub>S + H<sub>2</sub>:** H<sub>2</sub> 0 - 5% / 0 - 10%

**H<sub>2</sub>S + COS or CS<sub>2</sub>:** COS / CS<sub>2</sub> 0 - 500 ppm minimum range

**COS or CS<sub>2</sub>:** 0 - 200 ppm as primary measurement

**H<sub>2</sub>S + H<sub>2</sub> + COS or CS<sub>2</sub> or SO<sub>2</sub>:** SO<sub>2</sub> 0 - 50 ppm

**SO<sub>2</sub> + H<sub>2</sub>:** H<sub>2</sub> 0 - 5% / 0 - 10%

**H<sub>2</sub>S + NH<sub>3</sub>:** 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 spectrophotometer 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<sub>2</sub>). 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.

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