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SULFUR RECOVERY UNITS
Performance Test Arrangements
(Operating Manuals)

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SCOPE

This Typical Operating Manual outlines the performance test arrangements for a sulfur recovery unit.

DESIGN CAPACITY AND SULFUR RECOVERY

1. ACCURACY

The overall error in the calculation of the Process Guarantees is a result of errors, which are inevitably present in the measurements contributing to the calculation. The errors incorporated in the following determinations represent the errors at 95 percent probability level, called here accuracy.

2. AVERAGE VALUES

To determine whether the Process Guarantees are met, the final result is the calculated average value of all analyses taken.

3. DEFINITION OF DESIGN CAPACITY & SULFUR RECOVERY EFFICIENCY (SRE)

The Sulfur Recovery Efficiency (SRE) of the PLANT is defined as:

$$SRE = \frac{SFG - SCT}{SFG}$$

in which

SFG (lb/h) = Sulfur present in the acid feed gas streams to the PLANT.
SCT (lb/h) = Sulfur present as H_2S, SO_2, COS, CS_2 and sulfur vapor in the tail gas from the coalescer of the PLANT.

4. DETERMINATION OF SULFUR IN FEED GASES (SFG)

The determination of sulfur present in the feed gases (SFG) is performed through measurement of H_2S in the feed gases. Samples are taken from the feed gas lines of the PLANT and are analyzed by a gas chromatograph or by alternative methods to be agreed between COMPANY and LICENSEE/CONTRACTOR,.

The sampling method can be agreed between COMPANY and LICENSEE/ CONTRACTOR.

The amine acid gas feed flow rate shall be measured; while the SWS gas feed flow rate shall be measured. The flow rates are corrected for the operating pressure and temperature.

As the gas chromatographic analyses are on dry basis, corrections for water content and compressibility factors shall be applied by hand calculations.

Inaccuracy on the determination of the dry amine acid gas feed flow rate shall be a maximum of 2.4%. Inaccuracy on the determination of the dry SWS gas feed flow rate shall be a maximum of 4.2%.

The sulfur present in the acid gas feeds to the PLANT (SFG) is calculated from the following equation:

$$SFG = 32 \times SH2S$$

in which

SFG	= Sulfur in the feed gas (lb/h)
S_{H2S}	= Total molar flow of H_2S in the feed gas (lbmol/h)
32	= Molecular weight of sulfur

The total molar flow of sulfur present in the form of H_2S in the acid gas feeds, SH2S, can be calculated from the following formula:

S_{H2S} lbmol/h = (vol.% H_2S in sample of dried amine gas) x (molar flow of dry amine gas) +
(vol.% H_2S in sample of dried SWS gas) x (molar flow of dry SWS gas)

The determination of the sulfur quantity (SFG) in the feed gas of the PLANT shall have a maximum inaccuracy of 2.3% or better at the FEEDSTOCK.

5. DETERMINATION OF SULFUR IN TAIL GAS (SCT)

5.1 Determination of H_2S, SO_2, COS and CS_2 in tail gas

The first part of the determination of sulfur present in the tail gas is performed through determination of H_2S, SO_2, COS and CS_2 in the tail gas from the coalescer on basis of a nitrogen balance. Samples are taken and are analyzed by a gas chromatograph or by alternative methods to be agreed between COMPANY and LICENSEE/ CONTRACTOR. The sampling method can be agreed between COMPANY and LICENSEE/CONTRACTOR.

The molar flow rates of H_2S, SO_2, COS and CS_2 are determined in relation to the N2 flow rate. The calculated N2 concentration in the tail gas, based on the FEEDSTOCK of the plant, varies between min. 48.43 vol.% (0_2 enrichment-summer case) and max. 59.44 vol.% (air-winter case) upon the operation case (wet basis). The amount of nitrogen in the tail gas shall be calculated by measuring the air inputs to the Acid Gas Burner and the reactor, plus the input to the PLANT in the feed gas. The amount of N2 that originates from the air shall be corrected for the relative humidity of air.

The inaccuracy on the concentration measurement of H_2S, SO_2, COS, CS_2 and N2 percentages in the tail gas shall be a maximum of 2.0%.

The resulting inaccuracy on the molar flow rate determination of nitrogen in tail gas shall be less than 2.0% when processing the FEEDSTOCK.

The molar flow of the sulfur present in the form of H_2S, SO_2, COS and CS_2 in the tail gas can be calculated from the following formula:

$$Sc = \frac{\text{(mol.\% sulfur components in sample of tail gas) x (molar flow of } N_2 \text{ in tail gas)}}{\text{moi.\% nitrogen in sample of tail gas (on dry basis)}}$$

in which

Sc = Molar flow of sulfur expressed as S_i (lbmol/h)

Remark:

Dry ambient air is assumed to consist of 20.95 vol.% 0_2, 78.09 vol.% N2 and 0.96 vol.% other components (CO_2 and Ar).