Enforcement Section

Standard Operating Procedure: Sulfur Recovery Unit Performance Testing

Test methods and procedures for SRU Performance.

1. During the performance test, the owner or operator shall determine the minimum required reduction efficiencies (Z) of SO_2 emissions as follows:

   (a) The average sulfur feed rate (X) shall be computed as follows:

$$X = K\, Q_a\, Y$$

Where:
X = average sulfur feed rate, Mg/D (LT/D).
Qa = average volumetric flow rate of acid gas from sweetening unit, dscm/day (dscf/day).
Y = average H_2S concentration in acid gas feed from sweetening unit, percent by volume, expressed as a decimal.
K = (32 kg S/kg-mole)/((24.04 dscm/kg-mole)(1000 kg S/ Mg)) = 1.331×10^{-3} Mg/dscm, for metric units
= (32 lb S/lb-mole)/((385.36 dscf/lb-mole)(2240 lb S/long ton))

= 3.707×10^{-5} long ton/dscf, for English units.

   (b) The continuous readings from the process flowmeter shall be used to determine the average volumetric flow rate (Qa) in dscm/day (dscf/day) of the acid gas from the sweetening unit for each run.

   (c) The Tutwiler procedure following 40CFR60.648 or a chromatographic procedure following ASTM E-260 shall be used to determine the H_2S concentration in the acid gas feed from the sweetening unit. At least one sample per hour (at equally spaced intervals) shall be taken during each 4-hour run. The arithmetic mean of all samples shall be the average H_2S concentration (Y) on a dry basis for the run. By multiplying the result from the Tutwiler procedure by 1.62×10^{-3}, the units gr/100 scf are converted to volume percent.

   (d) Using the information from paragraphs 1(a) and (c), Tables 1 and 2 (attached) shall be used to determine the required initial (Zi) and continuous (Zc) reduction efficiencies of SO_2 emissions.

2. The owner or operator shall determine compliance with the SO_2 emission limits required by this permit as follows:

   (a) The emission reduction efficiency (R) achieved by the sulfur recovery technology shall be computed for each run using the following equation:

$$R=(100\ S)/(S+E)$$

   (b) The level indicators or manual soundings shall be used to measure the liquid sulfur accumulation rate in the product storage tanks. Readings taken at the beginning and end of each run, the tank geometry, sulfur density at the storage temperature, and sample duration shall be used to determine the sulfur production rate (S) in kg/hr (lb/hr) for each run.

(c) The emission rate of sulfur shall be computed for each run as follows:

$$E = C_e O_{sd} K_1$$

Where:
E = emission rate of sulfur per run, kg/hr (lb/hr).
C_e = concentration of sulfur equivalent (SO_2 + reduced sulfur), g/dscm (lb/dscf).
Q_{sd} = volumetric flow rate of effluent gas, dscm/hr (dscf/hr).
K_1 = conversion factor, 1000 g/kg (7000 gr/lb).

(d) The concentration (Ce) of sulfur equivalent shall be the sum of the SO_2 and TRS concentrations, after being converted to sulfur equivalents. For each run and each of the test methods specified in paragraph (c) of this section, the sampling time shall be at least 4 hours. Method 1 shall be used to select the sampling site. The sampling point in the duct shall be at the centroid of the cross-section if the area is less than 5 m^2 (54 ft^2) or at a point no closer to the walls than 1 m (39 in.) if the cross-sectional area is 5 m^2 or more, and the centroid is more than 1 m (39 in.) from the wall.

(1) Method 6 shall be used to determine the SO_2 concentration. Eight samples of 20 minutes each shall be taken at 30-minute intervals. The arithmetic average shall be the concentration for the run. The concentration shall be multiplied by 0.5×10^{-3} to convert the results to sulfur equivalent.
(2) Method 15 shall be used to determine the TRS concentration from reduction-type devices or where the oxygen content of the effluent gas is less than 1.0 percent by volume. The sampling rate shall be at least 3 liters/min (0.1 ft^3/min) to insure minimum residence time in the sample line. Sixteen samples shall be taken at 15-minute intervals. The arithmetic average of all the samples shall be the concentration for the run. The concentration in ppm reduced sulfur as sulfur shall be multiplied by 1.333×10^{-3} to convert the results to sulfur equivalent.
(3) Method 16A or 15 shall be used to determine the reduced sulfur concentration from oxidation-type devices or where the oxygen content of the effluent gas is greater than 1.0 percent by volume. Eight samples of 20 minutes each shall be taken at 30-minute intervals. The arithmetic average shall be the concentration for the run. The concentration in ppm reduced sulfur as sulfur shall be multiplied by 1.333×10^{-3} to convert the results to sulfur equivalent.
(4) Method 2 shall be used to determine the volumetric flow rate of the effluent gas. A velocity traverse shall be conducted at the beginning and end of each run. The arithmetic average of the two measurements shall be used to calculate the volumetric flow rate (Qsd) for the run. For the determination of the effluent gas molecular weight, a single integrated sample over the 4-hour period may be taken and analyzed or grab samples at 1-hour intervals may be taken, analyzed, and averaged. For the moisture content, two samples of at least 0.10 dscm (3.5 dscf) and 10 minutes shall be taken at the beginning of the 4-hour run and near the end of the time period. The arithmetic average of the two runs shall be the moisture content for the run.

3. The owner or operator shall obtain the information required by using the monitoring devices, an oxidation or reduction control system followed by incineration, or a reduction control system not followed by a continually operated incineration device. The average sulfur emission reduction efficiency achieved (R) shall be calculated for each 24-hour clock interval. The 24-hour interval may begin and end at any selected clock time, but must be consistent. The 24-hour average reduction efficiency (R) shall be computed based on the 24-hour average sulfur production rate (S) and sulfur emission rate (E), using the equation in section 2.a above.

(a) Data obtained from the sulfur production rate monitoring devices or measurements specified in this SOP shall be used to determine S.

(b) Data obtained from the sulfur emission rate monitoring systems specified in paragraph 3 above shall be used to calculate a 24-hour average for the sulfur emission rate (E). The monitoring system must provide at least one data point in each successive 15-minute interval. At least two data points must be used to calculate each 1-hour average. A minimum of 18 1-hour averages must be used to compute each 24-hour average.

Table 1. REQUIRED MINIMUM INITIAL SO_2 EMISSION REDUCTION EFFICIENCY (Z_i)

H_2S content of acid gas (Y), %	Sulfur feed rate (X), LT/D			
	2.0≤X≤5.0	5.0<X≤15.0	15.0<X≤300.0	X>300.0
Y≥50	79.0	$88.51X^{0.0101}Y^{0.0125}$ or 99.8, whichever is smaller		
20≤Y<50	79.0	$88.51X^{0.0101}Y^{0.0125}$ or 97.9, whichever is smaller		97.9
10≤Y<20	79.0	$88.51X^{0.0101}Y^{0.0125}$ or 93.5, whichever is smaller	93.5	93.5
Y<10	79.0	79.0	79.0	79.0

Table 2. REQUIRED MINIMUM SO_2 EMISSION REDUCTION EFFICIENCY (Z_c)

H_2S content of acid gas (Y), %	Sulfur feed rate (X), LT/D			
	2.0≤X≤5.0	5.0<X≤15.0	15.0<X≤300.0	X>300.0
Y≥50	74.0	$85.35X^{0.0144}Y^{0.0128}$ or 99.8, whichever is smaller		
20≤Y<50	74.0	$85.35X^{0.0144}Y^{0.0128}$ or 97.5, whichever is smaller		97.5
10≤Y<20	74.0	$85.35X^{0.0144}Y^{0.0128}$ or 90.8, whichever is smaller	90.8	90.8
Y<10	74.0	74.0	74.0	74.0