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Scrubbing Hydrogen Sulfide with Hydrogen Peroxide

Problem

Air pollution control is one of the problems facing plant operators and designers today. Hydrogen peroxide has been shown to be a convenient way to eliminating oxidizable pollutants from air or other gases. This data sheet describes a scrubbing system using hydrogen peroxide, a simple means of completely eliminating such obnoxious materials as hydrogen sulfide.

Chemistry

The scrubbing solution consists of dilute sodium hydroxide to which enough hydrogen peroxide is added to react with the hydrogen sulfide according to the equation:

$$4H_2O_2 + H_2S \rightarrow H_2SO_4 + 4H_2O$$

The equation shows that 4 parts of hydrogen peroxide by weight are needed for each part of H2S present in the gas to be cleaned. Enough sodium hydroxide must be present to neutralize the sulfuric acid formed according to the equation:

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

This indicates that for each weight part of hydrogen sulfide, approximately 2-1/2 weight parts of sodium hydroxide are needed.

To accelerate the oxidation reaction small amounts of iron salts may be added, but they are not essential. The recommended quantities are 10-100 mg/l of Fe, added either as $FeSO_4$ or the EDTA complex.

Equipment

The simplest and most reliable type of scrubber for this purpose is a packed-bed tower operated counter-currently, the gas is moved upwards and liquid flows downward.

Conventional scrubber design can be used. The packing is loaded by wet dumping on a support plate. A distributor is used for even distribution of liquid. Because of the short column length no redistributors are needed. A collecting reservoir at the bottom of the

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scrubber is recommended. Here the reaction can go to completion within a few minutes.

For all the equipment alkali and hydrogen peroxide resistant materials of construction must be used, i.e., 316 stainless steel, ceramic, glass. For service below boiling point of water, polypropylene is acceptable.

Operation

Approximate size and performance parameters for such a tower are shown here. The example describes a scrubber which can handle a gas flow of 50 m3/min (1800 cu ft/min). Several choices of tower diameter and height combinations are given in the table. The packing chosen is 1" Intalox saddles (Norton Company). Two sets of values are given: One for removal of H_2S originally present in an amount of 200 ppm, the other for treatment of gas originally containing 20 ppm H_2S.

				Height of Column and Minimum Blower HP					
Diameter of Column		Liquid Flow		200 ppm H_2S			20 ppm H_2S		
m	inches	L/min.	gal/min.	m	inches	HP	m	inches	HP
.782	30	86	23	1.27	50	2.4	.84	33	1.7
.798	31	120	32	1.06	42	2.1	.70	28	1.4
.824	32	158	42	.93	37	1.8	.62	24	1.2
.924	36	400	106	.52	21	1.1	.35	14	0.8
1.128	44	1200	318	.35	14	0.8	.23	9	0.6

The hydrogen peroxide consumption for gas containing 200 ppm H_2S will be 56 g/min (7.5 lbs/hr) calculated as 100% material). The consumption of NaOH will be 35 g/min (4.5 lbs/hour).

For other gas flow rates the height of packing will remain the same. The column diameter will change proportionally to the square root of the gas flow. The liquid flow and needed HP for blowers will change in direct proportion to the gas flow. It should be noted, that the HP values refer to what is needed to overcome scrubber pressure drop when the blower is working at maximum efficiency.

The controls necessary for the most effective and efficient operation are a pH controller to keep the liquid at the bottom of the column at a pH of 9 or higher. A sulfide monitor is desirable to make certain that the effluent is free from sulfide, an indication that enough hydrogen peroxide has been added to complete the oxidation. Although a continuous potentiometric monitor (i.e., Orion 1000) is preferred, periodic tests with field kits (i.e., Hach kits or Drager tubes) may be used.

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SCHEMATIC OF A HYDROGEN SULFIDE SCRUBBER