

Chemical Consumption

Odor Control / Sewer Gas / Hydrogen Sulfide



Design Basis – Example Odor Control at Typical Waste Water Treatment Plant

50,000 cfm @ 80°F, carrying 50 ppmv of H₂S – Single Stage packed bed Scrubber using a solution of 15% NaOCl (sodium hypochlorite or bleach) and 50% NaOH (caustic soda); operating at pH ~ 9 with ORP +600 mV; 100% destruction efficiency assumed

Overall Chemical Reaction



Determine Chemical Consumption:

Step 1: Calculate H₂S Load

(50,000 ft³/min) (50 ft³ H₂S/1,000,000 ft³) (1 lbmol H₂S/386 scf H₂S) (460+70 scf/460+80 ft³)(60m/hr)
= **0.40 lbmol H₂S/hr**

Step 2: Calculate Theoretical NaOCl Consumption

(0.40 lbmol H₂S) (4 lbmol NaOCl/lbmol H₂S) (74.45 lb NaOCl/lbmol NaOCl) = 119.12 lb NaOCl/hr
And
(119.12 lb NaOCl/hr) / [(0.15 lb NaOCl/lb)/(1.10 x 8.34 lb/gal)] = **86.6 gal/hr of 15% NaOCl**

Step 3: Calculate Theoretical NaOH Consumption

(0.40 lbmol H₂S/hr) (2 lbmol NaOH/lbmol H₂S) (40 lb NaOH/lbmol NaOCl) = 32 lb NaOH/hr
And
(32 lb NaOH/hr) / [(0.50 lbmol NaOH/lb)(1.52 x 8.34 lb/gal)] = **5.05 gal/hr of 50% NaOH**

Discussion

The above calculations yield the theoretical chemical consumption required to totally oxidize the H₂S load in the given air flow to sodium sulfate.

But!

The actual oxidation reaction takes place in several steps, so this analysis does not account for possible intermediary species formation and accumulation due to incomplete oxidation.

If the scrubber is operated below pH 7 NaOCl will partially decompose to Cl₂ gas.

If the scrubber is operated above pH 10 NaOH will also react with atmospheric CO₂.

If the scrubber is operated above pH 10 ORP control will possibly overdose NaOCl.

For more information and design assistance, please contact us at:

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