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 ppm_v of H_2S – 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

$H_2S + 4\ NaOCl + 2\ NaOH \longrightarrow Na_2SO4 + 4\ NaCl + 2\ H_2O$

Determine Chemical Consumption:

Step 1: Calculate H_2S Load

(50,000 ft3/min) (50 ft3 H_2S/1,000,000 ft3) (1 lbmol H_2S/386 scf H2S) (460+70 scf/460+80 ft3)(60m/hr)
= ***0.40 lbmol H_2S/hr***

Step 2: Calculate Theoretical NaOCl Consumption

(0.40 lbmol H_2S) (4 lbmol NaOCl/lbmol H_2S) (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 H_2S/hr) (2 lbmol NaOH/lbmol H_2S) (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 H_2S 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 Cl_2 gas.
If the scrubber is operated above pH 10 NaOH will also react with atmospheric CO_2.
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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