Aeration to remove hydrogen sulfide

TASK: Determine the theoretical air volume of oxidized hydrogen sulfide in sewage. This volume of air can be estimated very accurately, thus determining the condition and type of injector to be used.

A. Chemical properties of water

The pH of the water is not as important as the oxidative deposition of iron and manganese ions. For hydrogen sulfide, a pH value of 6.8 to 7.5 is sufficient. At this pH value, hydrogen sulfide decomposes into its ionic form: $H2S \rightarrow 2H^{+}+S2^{-}$. The S- ion is then free to react with oxygen.

B. Other factors

Air oxidation of hydrogen sulfide does not occur immediately. It is therefore necessary to have a residence time, or contact tank that provides enough time for the reaction and settling to take place. Depending on the actual conditions, the contact time is 5 to 15 minutes.

C. Reaction equations

$2H2S+O2 \rightarrow 2H2O+2S0$ Note: S0 is monomeric sulfur

D. Sulfur has an atomic weight of 32.06 and one oxygen molecule reacts with 2 sulfur atoms with a molecular weight of 31.999. The reaction ratio is 31.999/32.06 = 0.9981 or 1.0, which means that 1 mg/L of oxygen can oxidize 2 mg/L of hydrogen sulfide (measured in sulfur units)

E. Residual oxygen

1. Provide a buffer against fluctuations in hydrogen sulphide.
2. Better water quality.
3. Better mixing, fuller and faster reaction of hydrogen sulfide and oxygen. Residual oxygen in the water should be 5 mg/L. If there is already initial oxygen in the water, the value of residual oxygen should be 5 mg/L-initial oxygen.

F. Theoretical oxygen demand

Theoretical oxygen demand formula for the oxidation of hydrogen sulfide:

S= Hydrogen sulfide concentration, mg/L (as sulfur)
R = final residual oxygen = (5.0 - initial oxygen) mg/L

theoretical oxygen demand = [XS·(S)] + R

phone:028-85130135 E-mail: jane1984@cd-greenwater.com

Example: (S) = 25 mg/L, initial oxygen = 0.0 mg/L
Oxygen demand = (1.0) x (25) + (5.0 - 0.0) = 25 + 5 = 30 mg/L Water flow rate

G. Theoretical air requirements

The density of air at 20°C and 1 atmosphere pressure is 1.2047g/L.
At this condition the oxygen content of the air is 20.95%, so 1 liter of air contains (1.2047g/L) x (0.2095) = 0.2524g/L = 252.4mg/L of of air. For the calculation of the theoretical amount of air required to oxidize hydrogen sulfide, it is necessary to know the flow rate of water, and if the hydrogen sulfide content level is known, it is used to calculate the amount of air required. If the hydrogen sulfide content level is known, it is more convenient to use kiloliters as the unit of measurement for water flow.
Example: The above data is an example and the water flow rate is 100 L/min.

H. Actual air requirements

Oxygen transfer efficiencies for aerators range from as low as 5% to as high as 25-35% for jets. A conservative value of 25% can be taken for GW jets. value of 25%. The actual air requirement is therefore four times the theoretical air requirement. Therefore, the actual air requirement is 47.6 L/min. Depending on the special circumstances, a certain safety factor can be taken, and the actual air requirement can be increased by 10-20% on this basis.

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email:lzx@cd-greenwater.com