S E R V I C E B U L L E T I N 1 0 3

The Use of Iron Chlorides to Control Hydrogen Sulfides

The control of hydrogen sulfide in wastewater collection and treatment systems is very important. The presence of hydrogen sulfide is a safety concern, in addition to being an odor and corrosion problem. Sulfide odor is objectionable in low concentrations and can be toxic at higher concentrations. It can cause serious and expensive damage to the crowns of concrete mains. If digester gas is used as a fuel, the hydrogen sulfide needs to be removed to protect the engines from corrosion and to meet SOx emissions regulations.

FORMATION

The main cause of hydrogen sulfide generation is the biological decomposition of organic matter containing sulfur or from the reduction of sulfur compounds in the wastewater. The hydrogen sulfide is formed during anaerobic conditions, that is, neither oxygen nor nitrate is present. If hydrogen sulfide is present and the conditions change from anaerobic to aerobic in moist conditions, bacteria will convert free hydrogen sulfide into sulfuric acid. The sulfuric acid is the major cause of corrosion problems in the system by attacking the concrete in the sewers and pumping stations.

Important factors for hydrogen sulfide formation are:

- Retention time
- Organic material (BOD, COD)
- Temperature
- pH
- Sulfate concentration

APPLICATION

Throughout the wastewater industry, iron chlorides are widely used for hydrogen sulfide control. Depending on the problem area and the desired effect, iron chlorides can be added at various points in the wastewater treatment process, including the collection system, headworks, digesters, and / or sludge dewatering system. Often hydrogen sulfide control is initiated for the sole purpose of meeting emission regulations for digester gas. However, it has been found that the addition of iron chlorides upstream to solve one problem proves to be beneficial in additional ways, such as enhanced primary settling, improved sludge thickening, and prevention of struvite formation.

HOW DO IRON CHLORIDES WORK?

Iron chlorides combine with the dissolved sulfide and form an iron sulfide precipitate. Hydrogen sulfide is a weak acid and disassociates resulting in the formation of the dissolved sulfide.

$H_2S \leftrightarrow H^+ + HS^-$ (neutral and low pH water)

$HS^{--} \leftrightarrow S^{2-} + H^+$ (high pH water)

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Ferrous chloride and ferric chloride reacts with the dissolved sulfides according to the following reactions:

$$FeCl_2 + H_2S \rightarrow FeS + 2\ HCl$$

$$2\ FeCl_3 + 3\ H_2S \rightarrow Fe_2S_3 + 6\ HCl$$

The precipitate is then removed in the primary clarifiers if the iron chloride is added at the headworks, or in digestion if added to the digesters.

SELECTION OF FERRIC OR FERROUS CHLORIDE

The choice of using ferric or ferrous chloride depends on the point of application and the desired effects.

For use in the sewer trunk system or lift stations, ferrous chloride is the product of choice since ferrous chloride doesn't form any flocs that can cause settling of sludge in the sewer system.

If the iron chlorides are to be used at the headworks, or primaries, for a benefit throughout the plant, the product of choice is ferric chloride. This product is an excellent flocculent to be added at the headworks as it will aid in TSS and BOD removal. The iron in the system is then available for hydrogen sulfide control. Depending on the limits of your operation, additional ferric chloride may be needed prior to digestion or, dewatering sludge.

DETERMINING THE DOSAGE

The required dose rate of Ferric Chloride for treatment of hydrogen sulfide can be calculated theoretically to

3.1 grams of $FeCl_3$ (as dry) / gram of H_2S

A more accurate dose rate can be determined by taking the following steps:

1. Determine the concentration of dissolved sulfide in the wastewater.
2. Select the desired post-treatment sulfide concentration.
3. Determine on a laboratory scale the iron chloride dose necessary to achieve the desired dissolved sulfide reduction.
4. Conduct a plant trial.

For more information, please, visit our website at http://www.orcawt.com or send inquiries to info@orcawt.com.