Liquid Phase Collection System Odor Control 101

Presented by

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Presentation Outline

- General System Considerations
- Treatment Technologies
  - Air and Pure Oxygen Injection
  - Oxidants
    - Chlorine and Hypochlorite
    - Hydrogen Peroxide
    - Ozone
  - Iron Salts

Presentation Outline (Cont.)

- Treatment Technologies (cont.)
  - Caustic Dosing
    - Continuous
    - Shock Dosing
  - Nitrate Salts
  - Anthraquinone
  - Enzymes and Bacterial Augmentation
- Summary

General System Considerations

- Think System Wide
  - There may be people working in the collection system downstream of chemical addition
  - Chemical doses (and their effects) end up at the treatment plant
  - Evaluate cost-effectiveness based on actual performance at your site
  - Conduct thorough monitoring to evaluate performance of chemicals

Air and Pure Oxygen Injection

- Direct Injection to Forcemains
- Injection into High Pressure Side Streams or Inverted Siphons for Gravity Systems
- Introduction of Oxygen can:
  - Inhibit the growth of sulfate reducing bacteria
  - Chemically oxidize sulfide
  - Promote biological oxidation of sulfide

Air and Pure Oxygen Injection (Cont)

- Air Injection
  - Need to Consider Forcemain Profile
  - Need to Consider Forcemain Composition
  - Best for Pressure Systems (forcemains)
  - Need to Know Oxygen Uptake Rate (4-20 mg/l/hr)
  - Effective Treatment Duration is a Function of Uptake Rate.
  - Most Effective at Inhibiting Sulfide Generation
  - Can be Relatively Inexpensive

Air and Pure Oxygen Injection (Cont)

- Pure Oxygen Injection
  - Can Dissolve 5X More Oxygen Than with Air
  - Does Not Introduce Nitrogen, Thus Less Potential for Gas Accumulation at High Points
  - Can Usually Lease Storage/Vaporization Equipment.
  - Will Need Booster Blower at Pressures > 40 psi

Oxidants

- Chlorine and Hypochlorite
  - Chlorine is Being Phased Out in Favor of Hypochlorite
  - Mixes Rapidly with Wastewater
  - Rapidly Reacts with Inorganics (<1 min)
  - Dosage Rate in Range of 8 lb Chlorine per lb Sulfide
  - Treatment Effective for About 4 Hours
  - Reasonably Simple to Implement

Oxidants (Cont)

- Hydrogen Peroxide
  - Oxidizes Sulfide to Sulfate and Sulfur
  - Dosage in the Range of 4-8 pounds H_2O_2 per Pound Sulfide
  - Requires 15-30 Minutes for Complete Reaction
  - Can Also Serve as a Source of Oxygen to Inhibit Sulfate Reduction.
  - Requires Special Equipment, Which Can Be Leased from Vendor
  - Provides About 4 Hours Control

Hydrogen Peroxide Storage

Oxidants (Cont)

- Ozone
  - Most Often Used in Pump Stations to Treat Air
  - Strong Oxidant, Which is Not Selective for Sulfide
  - Normally Too Expensive for Liquid Stream Treatment

Iron Salts

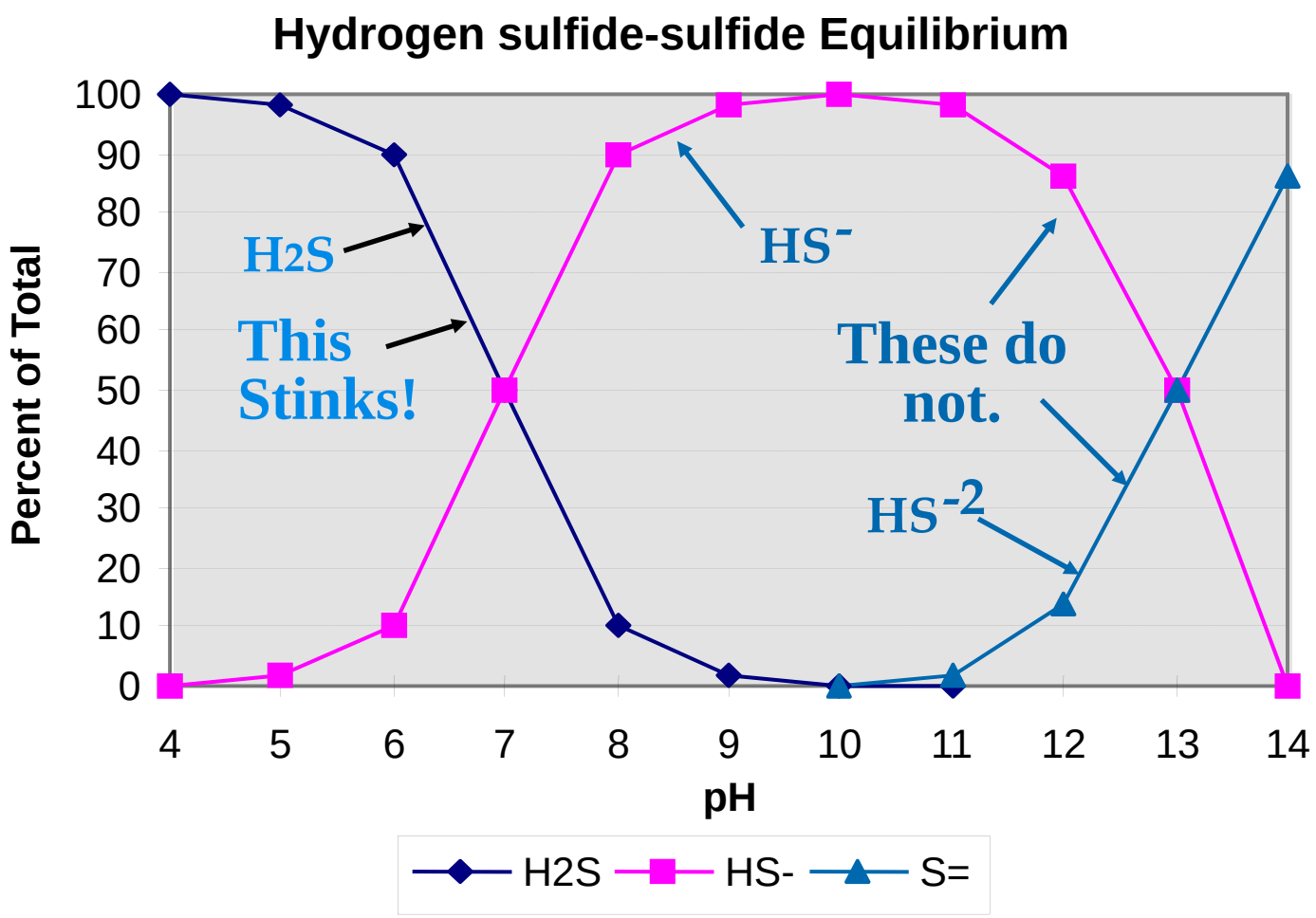
- Includes Ferrous/Ferric Chloride and Ferrous Sulfate
  - Sulfide is Removed by Precipitation with the Iron
  - Dosage is not Stoichiometric and Varies as a Function of the Level of Control Required
  - Dosage in the Range of 1.5 – 2 Pounds Iron per Pound Sulfide with Limit of ~0.5 mg/l S
  - Organic Acids Can Interfere with Reaction
  - Can Also Help Control Sulfides in Digesters
  - Can be Cost Effective
  - Are Classified as Hazardous Chemicals

Ferric Chloride

Caustic Dosing

Availability of Hydrogen Sulfide for Release to the Atmosphere is a Function of pH

Effect of pH on Hydrogen Sulfide -Sulfide Equilibrium



Caustic Dosing (cont)

- Available Chemicals include
  - Sodium Hydroxide (25 and 50%)
  - Lime
  - Magnesium Oxide/Hydroxide
- Sodium Hydroxide is Most Commonly Used
- Classified as a Hazardous Chemical, so Significant Storage/Handling Issues
- If Stored On-site, Need Heat Tracing

Caustic Dosing (cont)

- Continuous Dosing
  - Raising pH to Between 8 and 9 Prevents Available Sulfide from Being Released to Atmosphere
  - Can Require a Significant Quantity of Caustic Over Time
  - Dosage Rate is Unrelated to Sulfide Concentration, but Depends on Wastewater Alkalinity
  - Not Commonly Used Because of Cost and Potential Treatment Plant Impacts

Caustic Dosing (cont)

- Slug Dosing
  - Goal is to Raise pH to 12.5 or Above for at Least 20 Minutes
  - Inhibits Sulfide Generation by Stripping Slime Layer
  - Effect Lasts from 4 Days to Several Weeks, so Requires Periodic Dosing During the Odor Season
  - Works on Both Forcemains and Gravity Sewers

Caustic Dosing (cont)

- Slug Dosing (cont)
  - Dosage is Dependent on the Wastewater Alkalinity
  - Significant Risk to Collection System Personnel and Downstream Facilities
  - Best Used On Sub-systems with Flows Not Exceeding 10% of Total System Flow
  - Dosing Can be Done Using Tank Truck, Thus Avoiding Fixed Facilities
  - Can Be Cost Effective in Some Applications

Caustic Storage Tank

Nitrate Salts

- Most Common Sources are Calcium and Sodium Nitrate.
- May be Considered Proprietary Products
- Serve as an Oxygen Source, so Can Both Inhibit Sulfide Generation and Oxidize Existing Sulfide
- Generally Require a Period of Dosing to Achieve Full Effect
- Dosage Varies Based on Several Factor, so Needs to be Adjusted Based on System Monitoring

Nitrate Salts (cont)

- Dosages in the Range of 1-3 Pounds Nitrate Oxygen per Pound of Sulfide are Common
- Proprietary Combinations are Available That Combine Nitrate Salts with Caustic or Other Chemicals That Inhibit Sulfate Reduction or Sulfide Release
- Products are Not Classified as Hazardous
- Can Often Be a Cost Effective Solution
- Avoid Calcium Nitrate When Waste Stream Contains High FOG Concentrations

Nitrate Feed System

Nitrate Feed System

Anthriquinone

- Inhibits the Ability of Organisms to Reduce Sulfate
- Requires Periodic Dosing as Effect Wears Off
- Has Not Worked in Some Applications
- Available in Combination with Nitrate Products (Proprietary Product)
- Cost Effectiveness Needs to be Evaluated On-site

Enzymes and Bacterial Augmentation

- Focus is on Changing the System Ecology
- Limited Data on Effectiveness

Discussion

- Many Technologies/Approaches Available
- Applications are Often Site Specific Due to Both System Characteristics and Local Chemical Price Variability
- Systems Should Be Tested Prior To Implementation
- Systems Should Be Re-evaluated Periodically
- Spend 1% to 10% of Annual Chemical Cost Tracking Performance

Discussion

Evaluation Criteria For Choosing an Odor Control Method

- Characteristics of the wastewater
- Type of odor being controlled
- Cost Effectiveness
- Safety
- Regulatory compliance
- Operability
- Maintainability
- Environmental issues
- Site space available
- Aesthetics