USE OF CHEMICALS TO CONTROL ODORS AND CORROSION IN WASTEWATER SYSTEMS

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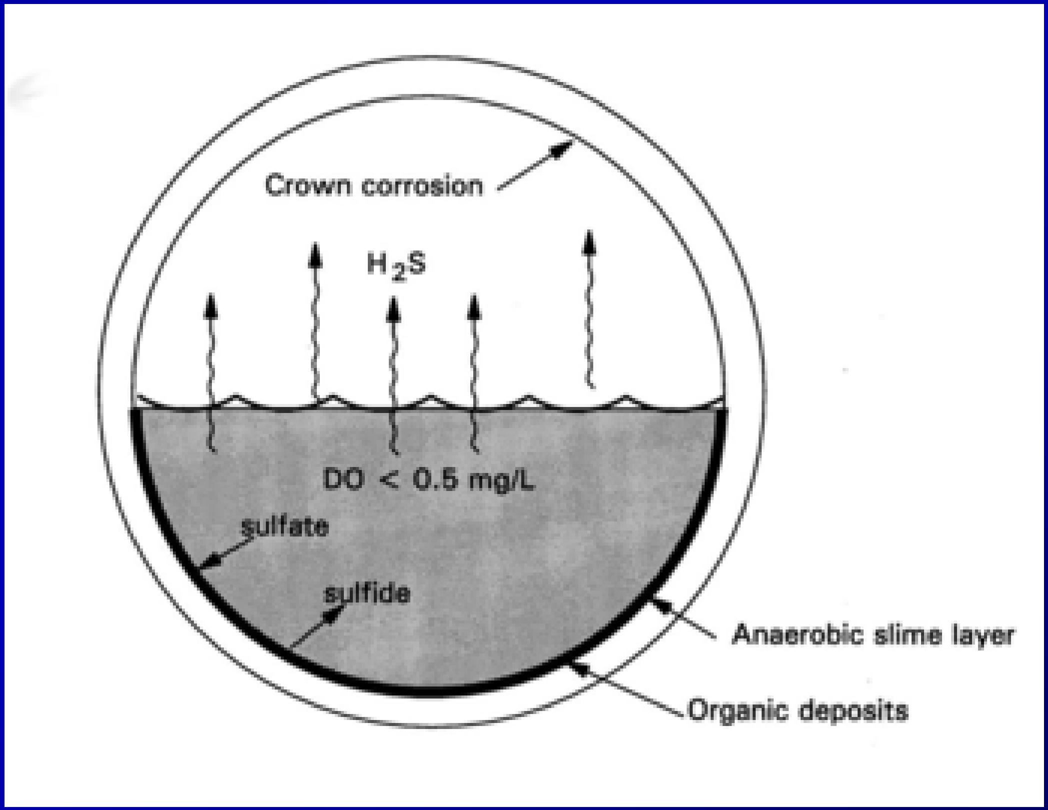
SULFIDE GENERATION IN SEWERS

- Anaerobic conditions cause sulfate → hydrogen sulfide (H_2S)
- Occurs in force mains, siphons, flat sewers, surcharged sewers
- Slow-moving sewage = deposition



ODOR AND CORROSION IN COLLECTION SYSTEMS

- Force main discharges
- Pump station wet wells
- Junction boxes, turbulent manholes
- Siphons

WHY USE CHEMICALS?

1. Easy to implement
2. Can be used for temporary control
3. Can provide reduction in both odors <u>and</u> corrosion
4. Relatively low maintenance (but high operating cost)

TYPES OF CHEMICALS

- OXIDANTS

  $S^{=} + O_2 \rightarrow SO_4^{=}$

- PRECIPITANTS

  $S^{=} + Fe \rightarrow FeS\downarrow$

- pH ADJUSTERS

  $(H_2S)_g \rightarrow HS^{-}$

- BIOCHEMICAL AGENTS

OXIDANTS

1. Sodium hypochlorite

- $HS^- + 4Cl_2 + 4H_2O \rightarrow SO_4^= + 9H^+ + 8Cl^-$
- 10-15 lb Cl_2 per lb S
- Effective for H_2S and other odorants
- Can be costly compared to other chemicals
- Safety concerns
- Fast acting

OXIDANTS

2. <u>Hydrogen Peroxide</u>

- $H_2O_2 = H_2S \rightarrow S + 2\ H_2O$
- 1.5 to 3 lb H_2O_2 per lb S
- Effective for H_2S control
- Can be economical compared to other chemicals
- Safety concerns
- Add 20 minutes upstream of control point

OXIDANTS

3. <u>Pure Oxygen</u>

- $H_2S + 2O_2 \rightarrow H_2SO_4$
- Highly effective and economical for force mains
- Maintains aerobic conditions, preventing H_2S
- O_2 uptake 10 mg/L/hr
- On-site generation vs purchased liquid

OXIDANTS

4. Permanganate and Sodium Chlorite

- Powerful oxidants
- Potassium permanganate – crystals
- Sodium permanganate and sodium chlorite – liquid
- Effective for sludge streams, e.g. belt presses
- Usually not economical for sewer applications due to high chemical cost

PRECIPITANTS

1. <u>Iron Salts</u>

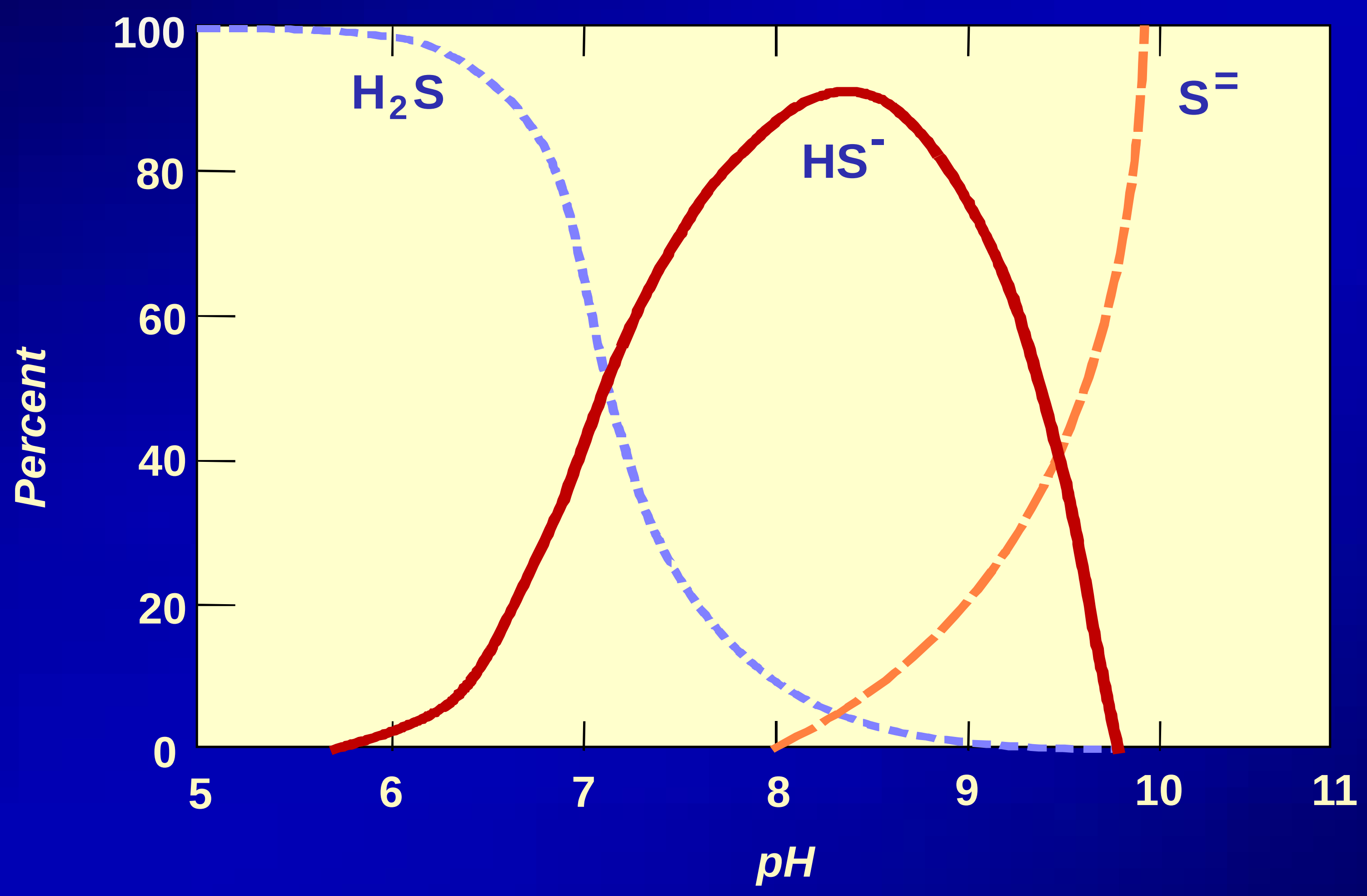
- $FeCl_2 + H_2S \rightarrow FeS + 2HCl$
- 1.6 to 3 lb Fe per lb S
- Predictable, effective
- Can be economical compared to other chemicals
- Corrosive

pH ADJUSTERS

1. <u>Magnesium Hydroxide</u>

- Increase pH to 8.5
- Dosage ≈ 50 to 100 gal $Mg(OH)_2$ per million
- Provides alkalinity
- Slurry requires mixing and freeze protection
- Economical for high sulfide levels

SULFIDE SPECIES vs. pH



pH ADJUSTERS

2. Lime or caustic soda

- Goal is to achieve pH ≥ 8.5
- Lime slurry with polymer helps keep lime in suspension
- Caustic soda dosage may be difficult to control
- Less experience than with magnesium hydroxide

pH ADJUSTERS

3. Crown spraying with magnesium hydroxide

- Applied to crown to neutralize acid and control pH
- LACSD research: 50% $Mg(OH)_2$ slurry highly effective and economical
- Typically applied annually
- Crown pH < 4: need to re-apply
- Cost: $2 to $3/ft

BIOCHEMICAL AGENTS

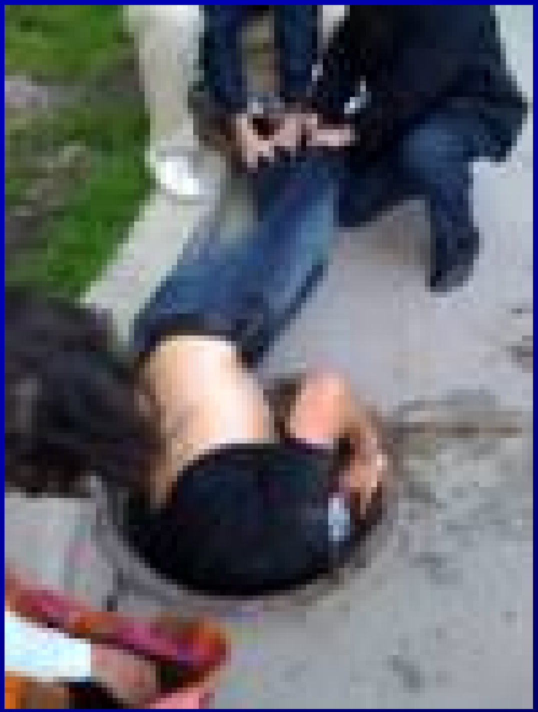
1. Nitrate

- Mechanisms:
  a. Prevention – NO_3^- serves as an oxygen source for bacteria; prevents sulfide generation
  b. Oxidation – Nitrate promotes biological oxidation of H_2S
- Prevention – 3 gal NO_3/lb S
- Oxidation – 1 gal NO_3/lb S
- Effective, safe to handle

BIOCHEMICAL AGENTS

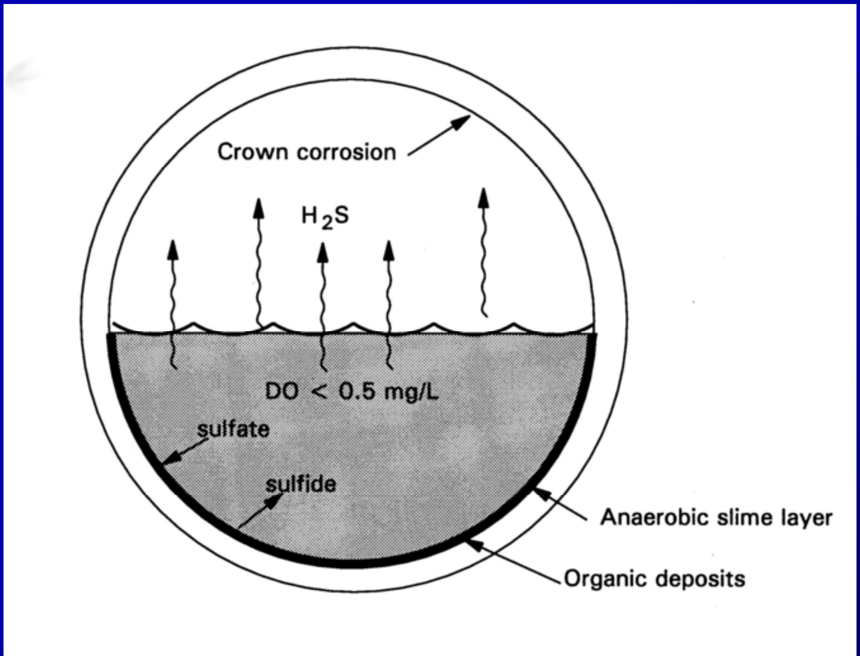
2. Bacteria, Enzymes, and “Stimulants”

- Many products available
- Some effective for grease control
- Manufacturer claims:
  - Grease removal
  - Odor reduction
  - Nutrient control
  - Sludge reduction
- Little or no documentation that these products are effective for control of hydrogen sulfide



REMOVAL OF SULFIDE-PRODUCING BIOLOGICAL SLIME LAYER IN SEWERS

- Developed in Australia
- Uses chemicals to remove biological slime that generates sulfide
- Must be repeated in 1 to 3 weeks
- Proprietary process (Cloevis BRS) marketed in the U.S. by USP Technologies



CASE HISTORIES

1. Oxygen injection – Milford, CT

- Before – sewer collapse, lift station H_2S > 50 ppm, odor complaints
- Twin force mains – 3 mgd
- Installed ECO_2 system w/Speece cone
- O_2 use ~ 1,000 lb/d
- H_2S eliminated

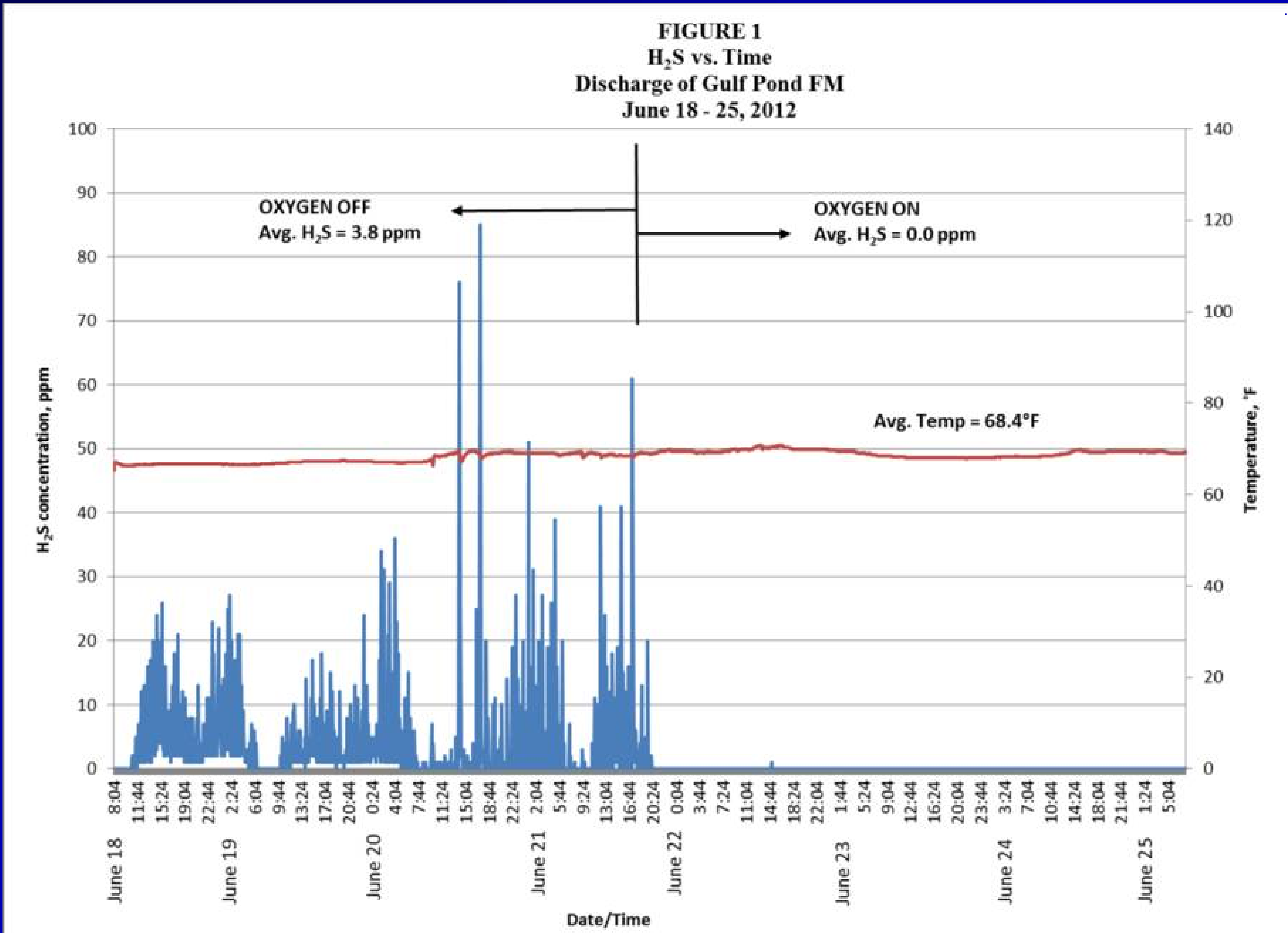


FIGURE 1
H2S vs. Time
Discharge of Gulf Pond FM
June 18 - 25, 2012
OXYGEN OFF
Avg. H2S = 3.8 ppm
OXYGEN ON
Avg. H2S = 0.0 ppm
Avg. Temp = 68.4°F
H2S concentration, ppm
Temperature, °F
Date/Time
June 18
June 19
June 20
June 21
June 22
June 23
June 24
June 25

CASE HISTORIES

2. <u>Iron salts – Macomb Co. MI</u>

- Large interceptor conveying 10 mgd
- Moderate corrosion – odor complaints
- Approx. 10 miles of interceptor, pump station, and force main
- Piloted ferrous chloride, with single upstream addition point

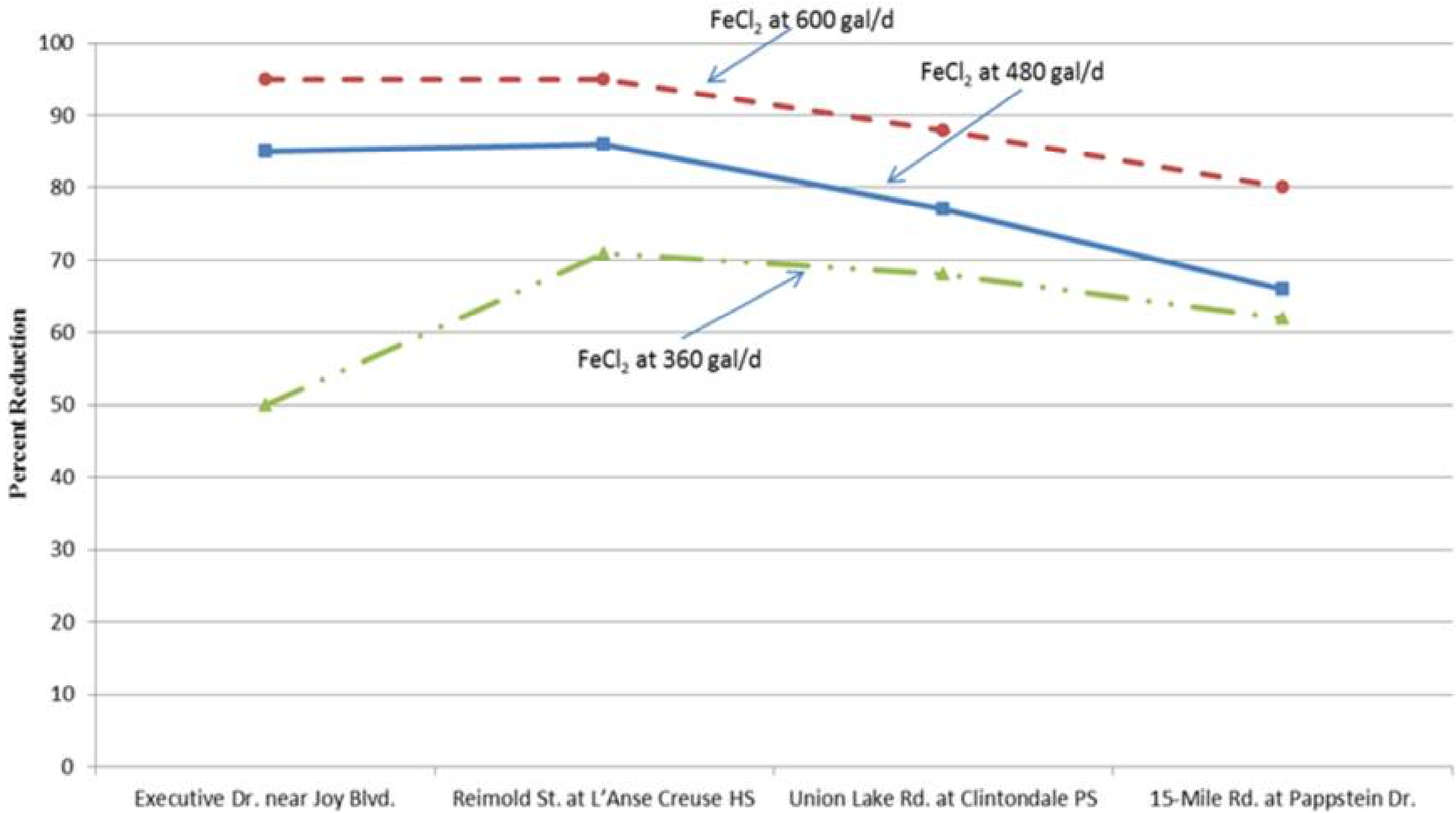
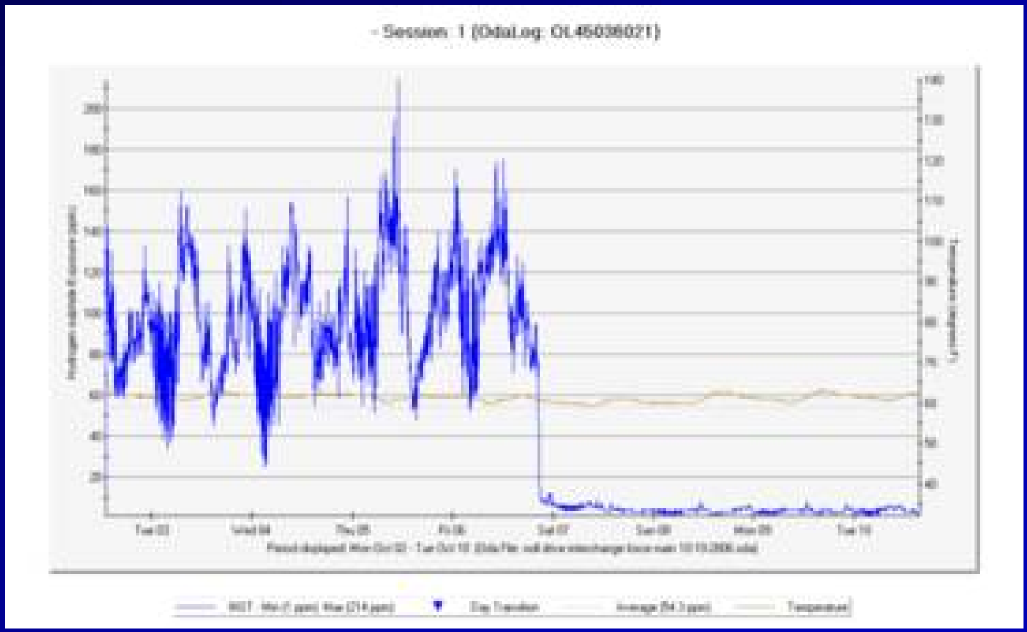


FIGURE 2. Summary of H_2S Reduction at Three $FeCl_2$ Dosages

CASE HISTORIES

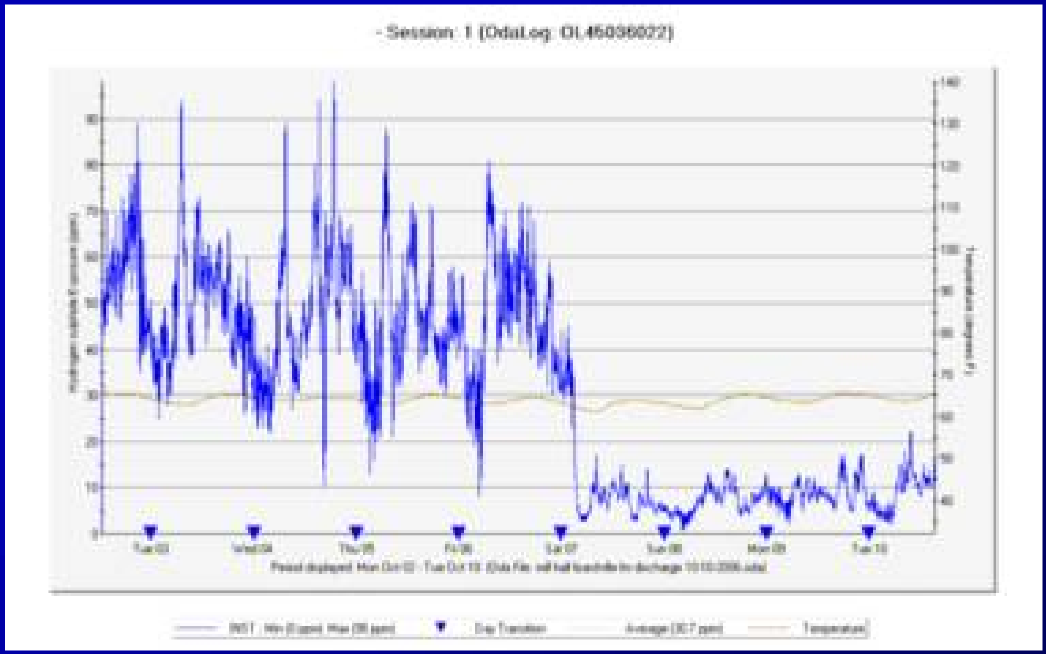
3. pH Adjustment; Nittany Valley, PA

- New collection system consisting of multiple small pump stations and force mains
- Severe corrosion within two years of start-up
- Tried biochemical agents – not successful
- Demonstrated successful application of $Mg(OH)_2$ for two pump stations in series – single dosage point



H_2S at Interchange FM discharge

H_2S at Lizardville FM discharge



SELECTING A CHEMICAL TO CONTROL ODORS AND CORROSION

1. Establish objectives
   odor control, corrosion control, or both?
2. Temporary or permanent system?
3. Where is control desired?
4. Review chemicals and estimate dosages from literature, jar tests
5. Compare costs of alternative chemicals
6. Conduct trials – dosage vs. performance
7. Select chemical based on performance, cost, safety

QUESTIONS?


CAUTION:
Vehicle may be Transporting
Political Promises!
POOPMPR

ANSWERS?