DEALING WITH H$_2$S

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Origins of $\text{H}_2\text{S}$

- Sulfate reducing bacteria
- Petroleum formation process
- Volcanism
Properties of H$_2$S

- Very Toxic
- Flammable
- Odor-- Yes/no
- Heavier than air
How Toxic?

- 10 ppm; okay for 8 hour periods
- 15 ppm; okay for short term
- 50-150 ppm; smell deadened
- 500 ppm; unconscious, comma, death
Engineering Consequences

- Gas Quality
- Weight loss corrosion
- Steel Cracking
Corrosion Control

- Carbon steel plus corrosion inhibitor
- Nonmetallics
- Corrosion resistant alloys
Oilfield Corrosion

Anodic: \[ \text{Fe} \rightarrow \text{Fe}^{++} + 2e^- \]

Cathodic: \[ \text{H}^+ + e^- \rightarrow \text{H} \rightarrow \frac{1}{2} \text{H}_2 \]

In Oilfield Brine:

\[ \text{H}_2\text{S}, \text{HS}^-, \text{H}_2\text{CO}_3, \text{HCO}_3^-, \text{O}_2, \text{H}^+ \]
Uninhibited Corrosion Rate Approximation
*All Measured in Fresh Sample

For temperature below 150 degrees F, no oxygen:

\[ mpy = \frac{(\text{ppm } CO_2 + \text{ppm } H_2S/2) + \frac{1}{10} (\text{ppm } HCO_3^- + \frac{1}{2} \text{ppm } H_2S)}{K} \]

- For fresh water \( k = 50 \)
- For oilwell brine \( k = 25 \)

Pits typically grow 10-50 times the above rate;
the average oilfield ratio is 20 times
Corrosion Cracking of Steels

- Hydrogen Embrittlement
- Stepwise Cracking
- Corrosion Fatigue
Remedies for Corrosion Cracking

- Lower corrosion rate with special inhibitors
- Use less susceptible metals
- Lower stress
Removal of $\text{H}_2\text{S}$

- How much?
- Source?
- Form/phase?
Remedies for $\text{H}_2\text{S}$

- Source is SRB
- Amount is small
- Amount is medium
- Amount is large
- Use bactericide
- Use scavengers
- Use scrubber tower
- Use amine unit
Biocide Application

- Culture bottles
- Sessile/planktonic
- EPA registered process
- Usually Batch Application
- Need good contact
- Periodically alternate types
H$_2$S Scavengers

• In liquid or gas phase
• Good contact required
• Spray or tower for gas
• Disposal of spent into well
Sponge Towers

• For medium amounts

• For gas phase

• Disposal of spent sometimes difficult
Amine Units

- Expensive
- Requires energy
- For large amounts
- Disposal of $\text{H}_2\text{S}$ gas
  - Acid gas well
  - Claus unit
Conclusions

- Sources of $\text{H}_2\text{S}$
- Consequences (all bad)
- Prevention
- Removal