GAS TREATMENT
FOR REMOVAL OF HYDROGEN SULFIDE AND SILOXANES

Presentation to WEF R2E Group

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HYDROGEN SULFIDE (H$_2$S) Notes:

Gas Concentrations:
- Depends on feed to anaerobic digester, or wastes accepted at landfill
- Anaerobic digester concentrations from 100 - >10,000 ppmv
- Landfill 50 – 5000 ppmv

Properties:
- Heavier than air gas with low TLV/SEL
- Liquid/Gas Partitioning:
  - Present in liquid as an ion or a dissolved gas:
    - $\text{Ka}/[H^+] = [\text{HS}^-]/[\text{H}_2\text{S}]$
    - $p\text{Ka} = 7.1$ (25°C)
  - Henry’s Law:
    - $[\text{HS}^-] = K_h \times P(\text{H}_2\text{S})$
    - $K_h = 0.1$ mol/L-atm
H₂S REMOVAL TECHNOLOGIES

Technologies by H₂S Loading:

- Activated Carbon Adsorption
- Chemical Scrubbing
- Sacrificial Media
- Biological Conversion to Sulfate
- Biological Conversion to S₀
- Proprietary Gas/Liquid Contact
- Electrolysis (New)
SACRIFICIAL MEDIA SYSTEMS

Media Types:
• Iron Sponge (Varec, Shand & Jurs, ...)
• Enhanced Fe Sponge (MV Tech)
• Iron Oxide Coated Substrate (Sulfa Treat, Axens, ...)
• FeOH Media (Unison, Ferrosorp)

Modeling / Changeout Considerations:
• Gas flow, H2S concentration and effluent concentration
• Gas moisture and oxygen concentration
• Form of spent media (loose vs clumps)
• Exothermic temperature rise after media removal
H$_2$S MEDIA EXAMPLE
BIOLOGICAL TREATMENT SYSTEMS

Conversion to Sulfate:
• Range and variability of loading
• Potential polish media for high concentrations and low effluent required
• Neutralization of wastewater
• Dilution of product gas (for high inlet concentration)

Conversion to $S_0$:
• Range and variability of loading
• Potential polish media for high concentrations and low effluent required
• Larger space required
• Dewatering of waste, potential $S_0$ reuse
BIOLOGICAL H₂S TREATMENT
# Siloxane Treatment

## Degree of Treatment Based on Fuel Use:
- **Medium efficiency reciprocating engines**
- **Turbine with recuperator**
- **High efficiency reciprocating engines**
- **Microturbines**
- **CHG / RNG**
- **Emission control catalyst**

## Varying Physical Properties:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Abbreviation</th>
<th>MW</th>
<th>Vapor Pressure</th>
<th>Boiling Point</th>
<th>Melting Point</th>
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<tbody>
<tr>
<td>Trimethylsilyl fluoride</td>
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<td>92.19</td>
<td>760</td>
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<td>297</td>
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<td>Decamethyldisiloxane</td>
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<td>445</td>
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<td>31</td>
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</table>
TREATMENT OPTIONS

Non-Regenerable Systems
• Activated carbon adsorption
• Silica gel adsorption
• Refrigeration systems

• Treatment capacity can be influenced by H₂S or VOC loading

Regenerable Systems
• Temperature swing adsorption
• Requires regen flare
• Media ranges from activated alumina to molecular sieve
• Can be followed by AC or 2\textsuperscript{nd} regen system
REGENERABLE EXAMPLES