GAS TREATMENT FOR REMOVAL OF HYDROGEN SULFIDE AND SILOXANES

Presentation to WEF R2E Group

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HYDROGEN SULFIDE (H_2S) 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:
    - $Ka/[H^+] = [HS^-] /[H_2S]$
    - pKa = 7.1 (25C)
  - Henry's Law:
    - $[HS-] = K_h * P(H_2S)$
    - K_h = 0.1 mol/L-atm

H_2S REMOVAL TECHNOLOGIES

Technologies by H_2S Loading:

- Activated Carbon Adsorption
- Chemical Scrubbing
- Sacrificial Media
- Biological Conversion to Sulfate
- Biological Conversion to S_o
- 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_2S MEDIA EXAMPLE

BIOLOGICAL TREATMENT SYSTEMS

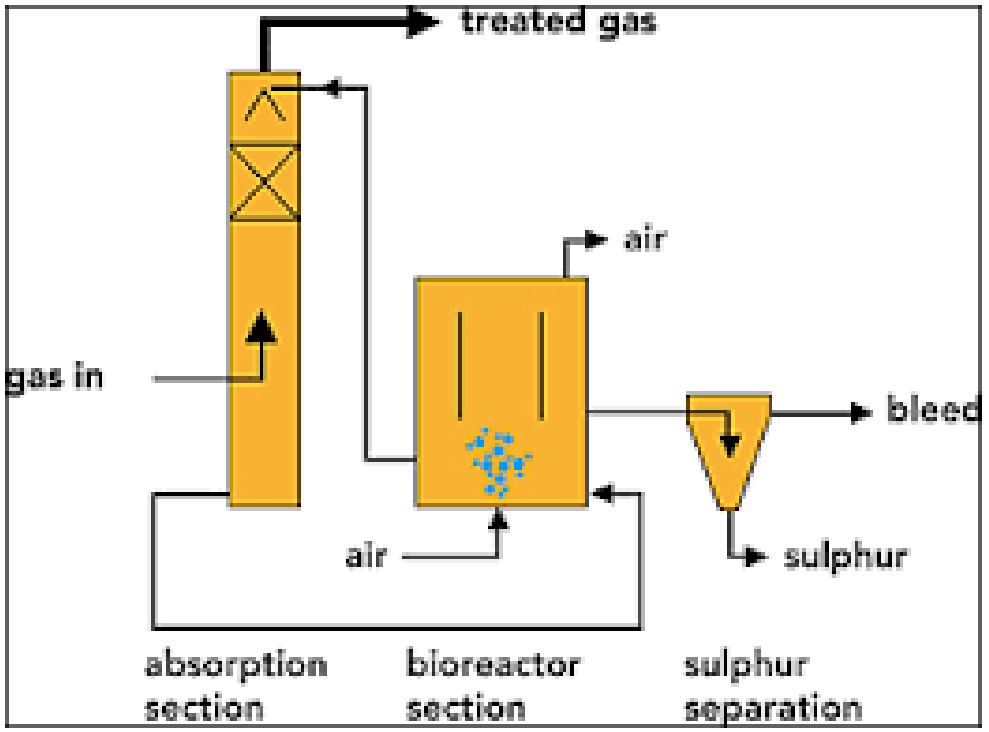
Conversion to Sulfate:

- 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_o:

- Range and variability of loading
- Potential polish media for high concentrations and low effluent required
- Larger space required
- Dewatering of waste, potential S_o reuse

BIOLOGICAL H_2S 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:

Compound	Abbreviation	MW	Vapor Pressure mmHg, 77F	Boiling Point °F	Melting Point °F
Trimethylsilyl fluoride		92.19	760	60.8	-101.2
Ethoxytrimethylsilane		118.25	400	165.2	-117.4
Isopropoxytrimethylsilane		132			
Propoxytrimethylsilane		132	40.2	214.88	32
Hexamethylcyclotrisiloxane	D3	222	10	275	147
Octamethylcyclotetrasiloxane	D4	297	1.3	348	63
Decamethylcyclopentasiloxane	D5	371	0.4	412	-47
Dodecamethylcyclotrisiloxane	D6	445	0.02	473	26.6
Hexamethyldisiloxane	L2, MM	162	31	224	-88.6
Octamethyltrisiloxane	L3, MDM	236	3.9	307	-115.6
Decamethyltetrasiloxane	L4, MD2M	310	0.55	381	-90.4
Dodecamethylpentasiloxane	L5, MD3M	384	0.07	446	-113.8
Trimethylsilanol	TMS	90	19	210	10.4
Tetramethylsilane		88.2	11.66	82	-187

TREATMENT OPTIONS

Non-Regenerable Systems

- Activated carbon adsorption
- Silica gel adsorption
- Refrigeration systems

- Treatment capacity can be influenced by H_2S 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 2nd regen system

REGENERABLE EXAMPLES

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