H2S Treatment of Landfill Gas at the Roosevelt Landfill

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LFG Gas Treatment at Roosevelt

- Landfill Gas Blower
  - First Stage Screw Compressor
  - Aftercooler 1
    - H2S Treatment
    - Aftercooler 2
    - Dehydration
      - Siloxane Removal
      - Carbon Backup Vessels
      - Pipeline
    - Second Stage Screw Compressor
  - Aftercooler 3
    - Mars Solar Turbines
  - Existing System
    - 2013 Work
Landfill Gas Blowers/Flares
First Stage Compressors
H2S Treatment
• Glycol Pumps/Double Wall Tank
• New Chiller/Pipebridge

Dehydration System
• Heat Exchangers/ Coalescing Filter

Dehydration System
Siloxane Removal
Second Stage Compression
LFG Pipeline
Second Stage Compressor Cooler
Solar Mars 90 Turbines (2 x 10 MW) Combined Cycle
Lower Compression Area
History of H2S treatment at Roosevelt

- Old System (IC Engines 199x)
  - Iron Sponge
- Temporary New System for Turbines (2011)
  - Sulfatreat
- Final System (Summer 2013)
  - Chelated Iron Hydrogen Sulfide Treatment
• Iron Sponge
  ◦ Dry Media of Iron-Oxide on Wood chips
  ◦ Does best using warm wet gas with Oxygen

  ◦ 4000 SCFM Treating 300 ppmv H2S

Solid Scavengers – Iron Sponge
Solid Scavengers – Iron Sponge

- **Advantages**
  - Simple system
  - Can be regenerated to some extent with a small Oxygen Stream
  - Fairly low capital costs

- **Disadvantages**
  - Exothermic during media Regeneration/Removal
  - Costs for Media Replacement and Disposal of spent material
  - Inconsistent Media Shape
• Sulfatreat (iron oxide on ceramic beads)
  ◦ Does best with warm, humid landfill gas with a small amount of Oxygen

  ◦ 6000 SCFM at 50 psig with 60 ppmv H2S

Solid Scavenger – Sulfatreat
• Advantages
  ◦ Very simple system
  ◦ May be exothermic during media replacement
  ◦ Fairly low capital cost
  ◦ Uniform media shape

• Disadvantages
  ◦ Media replacement costs
  ◦ Spent media disposal costs
  ◦ Water may be required to break and flush media from bed
- LO CAT®
- SulFerox®

- Treatment at KPUD:
  - Unlicensed Iron Chelate Process

- Thanks to:
  - Dow Chemical
    - Provides chemicals and technical assistance
  - Westfield Engineering
    - Provided P&IDs
    - Provided spargers vessels and heater skid
- Unlicensed Chelated Iron Treatment System

Diagram:
- Inlet separator
- Sparger Tower
- Outlet Separator
- Regenerator
- Settling Tank
- Treated LFG
- Sulfur Cake
• Chemistry
• Treatment:
  ◦ $H_2S + Fe^{+3}L \rightarrow 2H^+ + S^0 + Fe^{+2}L$
• Regeneration:
  ◦ $1/2O_2 + 2H^+ + 2Fe^{+2}L \rightarrow H_2O + 2Fe^{+3}L$
• Chelates:
  ◦ Keep the Iron in solution
• Others: Caustic, Surfactants, degradation inhibitors

Chelated Iron Treatment
- Sparger Vessels

Chelated Iron Treatment
Pipe Bridge

Chelated Iron Treatment
- Regeneration and Settling Tanks
- Heater Skid

Chelated Iron Treatment
• Iron Chelate Pumps

Chelated Iron Treatment
Chelated Iron Treatment

- Chemical Pumps
• Sulfur Filter and Sulfur Cake

Chelated Iron Treatment
Insulated Dehydration System
Insulated Glycol Tank/Pumps
Insulated Settler Tanks
Advantages
- Low Cost of Operation
- No disposal (except sulfur cake)
- Continuous process

Disadvantages
- High Capital Costs
- Process operates warm

Performance
- Inlet: 250 ppmv H2S
- Outlet: <10 ppmv H2S
Sulfur Plugging Issues

- Heat exchanger plugging
Cake Consistency Issues
Sulfur Cake
Lessons Learned

- Very reliable system that has been treating continuously since startup in July 2013
- 0.25% Oxygen in landfill gas is sufficient for regeneration (regenerator currently is bypassed)
- 100 lbs of Sulfur made per day (no market found yet)
- Chemical use is a little higher than predicted (especially Caustic)
Questions?

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LFG H2S Treatment