Treatment Options for Molten Sulfur Storage and Transfer Vents

Presented at the Sulfur Unit Safety Seminar
April 14-16, 2010 – League City, TX

Merichem Chemicals & Refinery Services
Tony Barnette- Technology Manager – Gas Technology Products

MERICHEM

SulfurUnit.com

Overview

- Introduction
- Reasons for Ventilating Tank/ Pit
  - Safety
  - Process/ Sulfur Quality requirements
- Methods
  - Sweep vapor space
  - Sparge molten sulfur
- Safety Considerations
  - Air vs Nitrogen
  - H_2S Concentrations Concerns
    - Personnel Safety
    - Explosive Risks
- Molten Sulfur Handling Configurations
- Vent Handling Configurations
- Case Study

Questions to Start

- What is my goal?
  - Sulfur purification
  - Safe vent handling only

- What are my limits?
  - Sulfur contaminants
  - Vent emissions limits

- What are my options?
  - Air or Nitrogen?
  - Existing equipment that can be used?
  - Recycle vs all new treatment equipment?
  - How do these affect air vs nitrogen decision?

Define Goals of Molten Sulfur Handling

- Safe Venting only
  - Sweep vapor space
- Purification of Molten Sulfur
  - Sparge and/ or liquid-phase treatment

Sweeping Options

- Balancing Safety and Process Requirements
  - Air- safe choice
  - Nitrogen- often better process choice, but presents several challenges
    - FeS formation- need procedures for maintenance to prevent auto-ignition of pyrophoric FeS when tanks open to air
    - Nitrogen blanketing results in high H2S in vapor space
  - Blowers vs. eductors for ventilating tank or pit

Sparging Options

- Pit or tank design
  - Design for pressure, or have “push-pull” configuration for sparge air
- Sparge air requirements
  - Sufficient air for stripping contaminants from sulfur
  - Balance with air requirements for H2S concentration control

Sulfur Purification Options

- Liquid Phase Treatment
  - Additive only
  - Additive + sparging
  - Additive + mechanical action
- Sparging for purification of sulfur
- Combination of both above

Sulfur Purification- A Combined Approach

- Often proprietary package systems, utilizing chemical additive, mechanical contacting, and air sweep or sparging
- Several systems available

Vent Handling

- Selection of System- Process Type
  - Destruction/ Conversion of H2S
  - H2S Recycle
  - H2S Removal
- Sizing of System
  - Flow limitations
  - H2S concentration limitations

Vent Handling

- Destruction/ Conversion of H2S
  - Thermal or Catalytic incineration
  - Flare
- Need to consider emission limits for SO_2
- Combustion equipment must be designed for corrosive service

Vent Handling

- H2S Recycle
  - Most often used where existing Claus plant present, and capacity available for additional gas flow
  - Often reason for using nitrogen as blanketing gas- to minimize air recycle

Vent Handling

- H2S Removal
  - Regenerable vs Non-regenerable (scavenger) process
    - Calculated H2S load < 200 lbs/ day- scavenger
    - > 200 lb/ day H2S load- regenerable process most economical
    - Higher capital cost of regenerable process offset by significantly lower operating costs ($0.15-0.20/ lb vs $5-10/ lb H2S removed)

H2S Removal Options

- Non-Regenerable (Scavenger) Processes
  - Solid Scavengers
    - Activated carbon, iron sponge, iron or zinc oxide-based media, or solid oxidizer media
    - Simple single or dual vessel systems
    - High temperature treatment tends to favor iron or zinc oxide medias.
    - Iron oxide most economical for H2S removal.
  - Liquid Scavengers
    - Triazine, nitrate, or amine-based products
    - Only cost effective at low (< 100 lb/ day H2S) loads.
    - Simple systems, but water-based system will require high water make up, and sulfur condensation in solution will create slurry for disposal.

H2S Removal Options

- Regenerable Processes
  - Liquid Redox
  - Direct Oxidation
  - Non-aqueous liquid systems

- Most create solid, elemental sulfur product
  - Differences lie in process chemistry and complexity

Most regenerable processes are higher capital cost than scavenger systems, with < 3 year payback on systems with > 200 lb/ day H_2S removal.

What is LO-CAT?

- **LO-CAT is a regenerative desulfurization process used to sweeten sour gas streams in a wide variety of industries**

LO-CAT

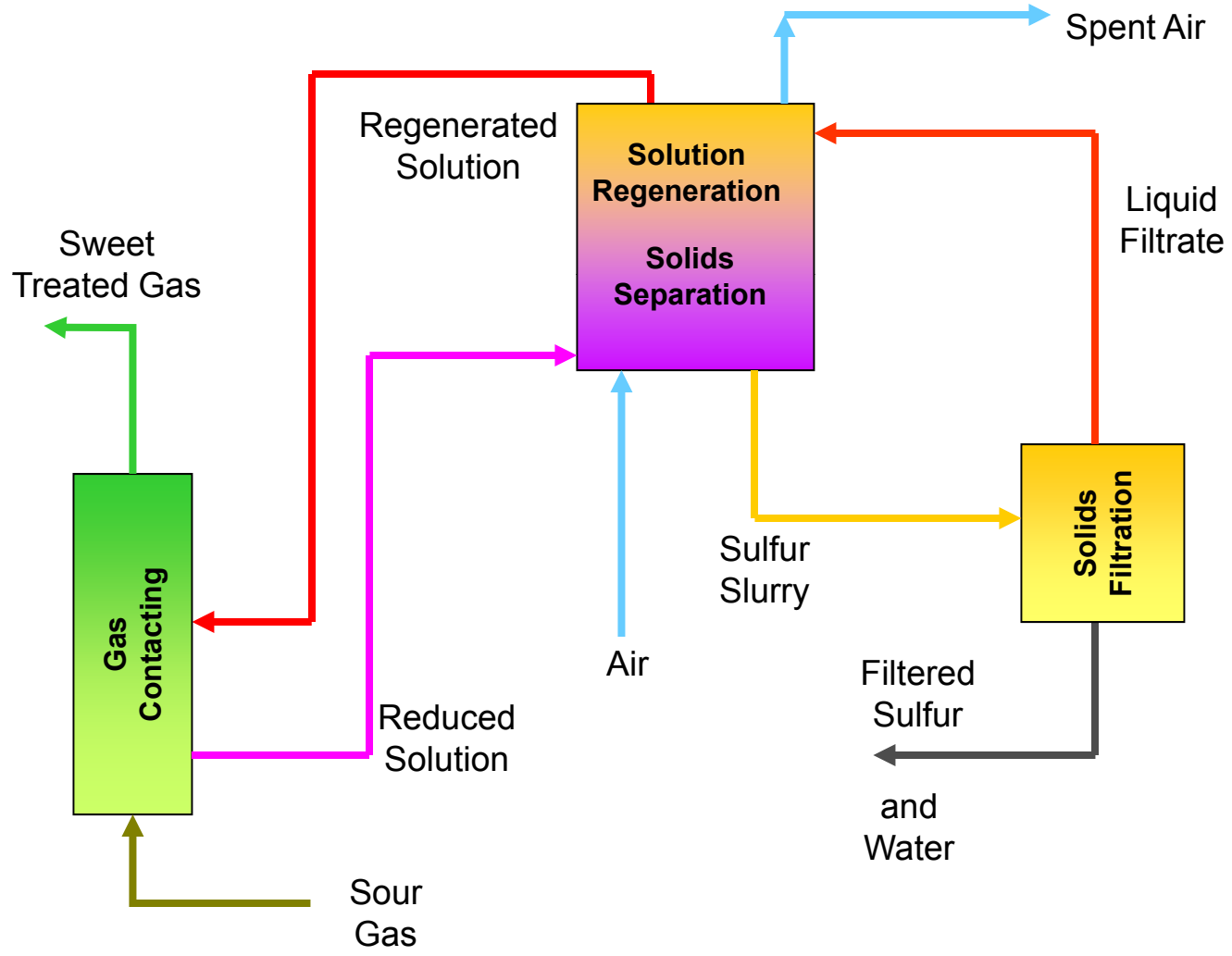
Liquid **O**xidation **Cat**alyst

How does LO-CAT Work?

- Aqueous-based, ambient temperature process
- Converts H_2S to elemental sulfur
- Employs a chelated-iron catalyst
- Reactions are not equilibrium limited
- Removal efficiencies of 99.9+% can be obtained in one step
- 100% turndown
- Operator attention requirements of 2 – 4 man hours per day
- 99% On-stream reliability
- There are no known poisons to the LO-CAT catalyst!

MERICHEM

How does LO-CAT Work?



H2S Removal Case Study

- Experience with LO-CAT Process treating 1000 TPD molten sulfur storage and transfer facility
  - Vent from storage and transfer pits sparging and sweep air
  - Significant changes in load as tanks are loaded and unloaded
  - Expansion has nearly doubled H2S load to system over last 13 years, with little change in system capacity

Industries served by LO-CAT®

LO-CAT® will treat any gas stream that requires H_2S removal.

- **Oil Refineries**
  - **Fuel Gas**
  - **Amine Acid Gas**
  - **Sour Water Stripper offgas**
  - **HDS Recycle Gas**
  - **Molten Sulfur Storage Ventilation**
- Associated Gas from oil production
- Natural Gas Processing Plants
- Syngas from gasification processes
  - Coal and waste gasification syngas feeds
  - Fuel and chemical feedstock products
- Biogas from municipal/ industrial sludge digesters
- Landfill Gas
- Non-Condensable Gas from geothermal power plants
- Coke Oven Gas
- Specialty Chemical Plants off-gases
- WWTP (digesters/odor control)
- Sour Air

MERICHEM

Thank You

- Tony Barnette- Technology Manager

  Gas Technology Products Division of Merichem Chemicals and Refinery Services LLC

  – tbarnette@merichem.com

www.gtp-merichem.com