Merichem Technologies Overview

TNChE Conference

merichem technologies

Safety Moment – H_2S

- Properties of H_2S

  Highly toxic and hazardous to health
  Corrosive to certain metals and elastomers
  Heavier than air
  Colorless or transparent
  Soluble in water

Toxicity of H_2S

Concentration	Physiological Effects
0.005 - 0.13ppm	Minimal perceptible odor
5ppm	Easily detectable, moderate odor, rotten eggs
10ppm	Beginning eye irritation
27ppm	Strong unpleasant odor, but not intolerable
100ppm	Coughing, eye irritation, loss of sense of smell after 2-5mins (IDLH)
200 – 300ppm	Marked conjunctivitis and respiratory tract irritation after 1hr of exposure
500 – 700ppm	Loss of consciousness and possible death in 30 minutes
700 – 1000ppm	Rapid unconsciousness, cessation of respiration and death
1000 – 2000ppm	Unconsciousness at once, with early cessation of respiration and death in a few minutes

Response and Rescue

- Follow facility procedures

DO NOT PANIC!

Hold your breath

Move upwind or crosswind and away from the gas

Move quickly to the upwind “Safe Briefing or Assembly Area” to receive instructions

Protect yourself first. Don’t become another victim!

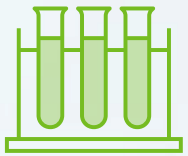
Put on appropriate breathing apparatus (if trained)

Assist anyone in distress

Merichem Technologies

Offices/Facilities
- Texas
- Alabama
- Oklahoma
- China

Representative offices worldwide



Research & Development in Houston, TX

Over 50 years serving energy, chemicals & other industry segments

Headquartered in Houston, TX

Global Presence

Merichem Technologies Include

LO-CAT®

Remove sulfur in the form of hydrogen sulfide (H_2S) from any gas stream (natural gas, CO_2, synthesis gas, etc.) & convert H_2S into elemental sulfur (S_0)

FIBER FILM®

Technologies to treat hydrocarbons with caustic, amines, or water

MERICON™ I, II, III

Treats spent refinery & petrochem caustic for proper disposal

Merichem Catalysts & Adsorbents Include

SULFURTRAP®

Fixed bed solid H_2S adsorbents

Cobalt Catalyst

Liquid-to-liquid contact product to catalyze mercaptan oxidation

LO-CAT® Catalyst

Catalyzes hydrogen sulfide (H_2S) into elemental sulfur and water

Carbon

Fixed-bed applications, catalyzing mercaptan oxidation

LO-CAT® & SULFURTRAP Applications

LO-CAT® H_2S Removal Technology

Application Experience

- Natural Gas – Oil production, gas/condensate, shale reservoirs
- Acid gas
- EOR
- Oil Sands SAGD
- FPSO/Offshore – gas production, fuel gas
- Refining – SWS, fuel gas, OVHD gas
- Carbon Capture CO2
- Gasification – coal, municipal waste, SAGD
- Landfill, other biogases
- Circular Economy & RNG
- Geothermal – non-condensable gases
- Miscellaneous – Chemical, water, odor treatment

230+ Licensed Units

LO-CAT®

Technology

merichem technologies

What is LO-CAT®?

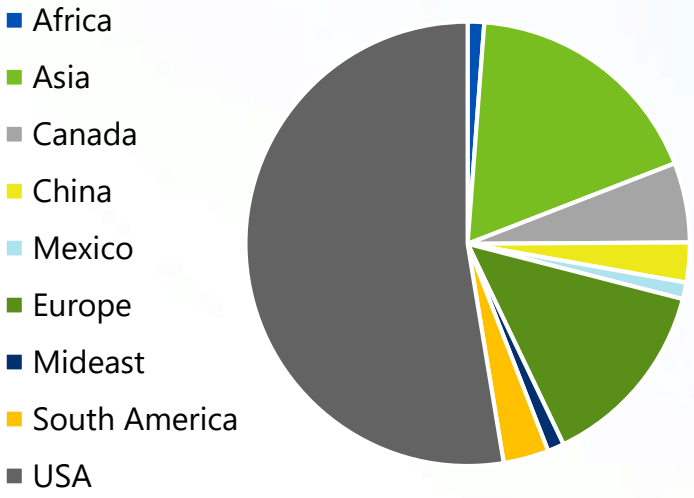
Regenerative Desulfurization Process

LO-CAT

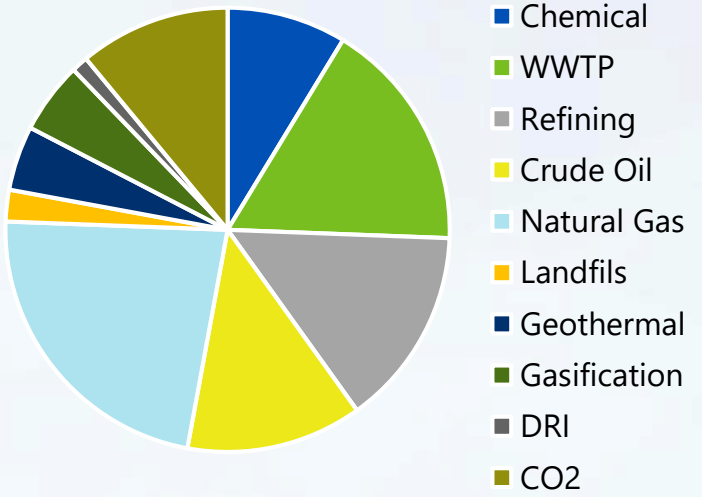
Liquid Oxidation CATalyst

LO-CAT® Demographic Info

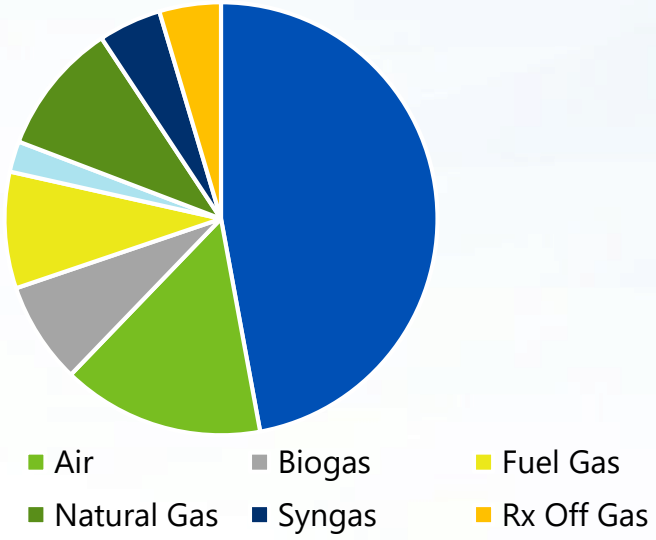
Geographic



Industry



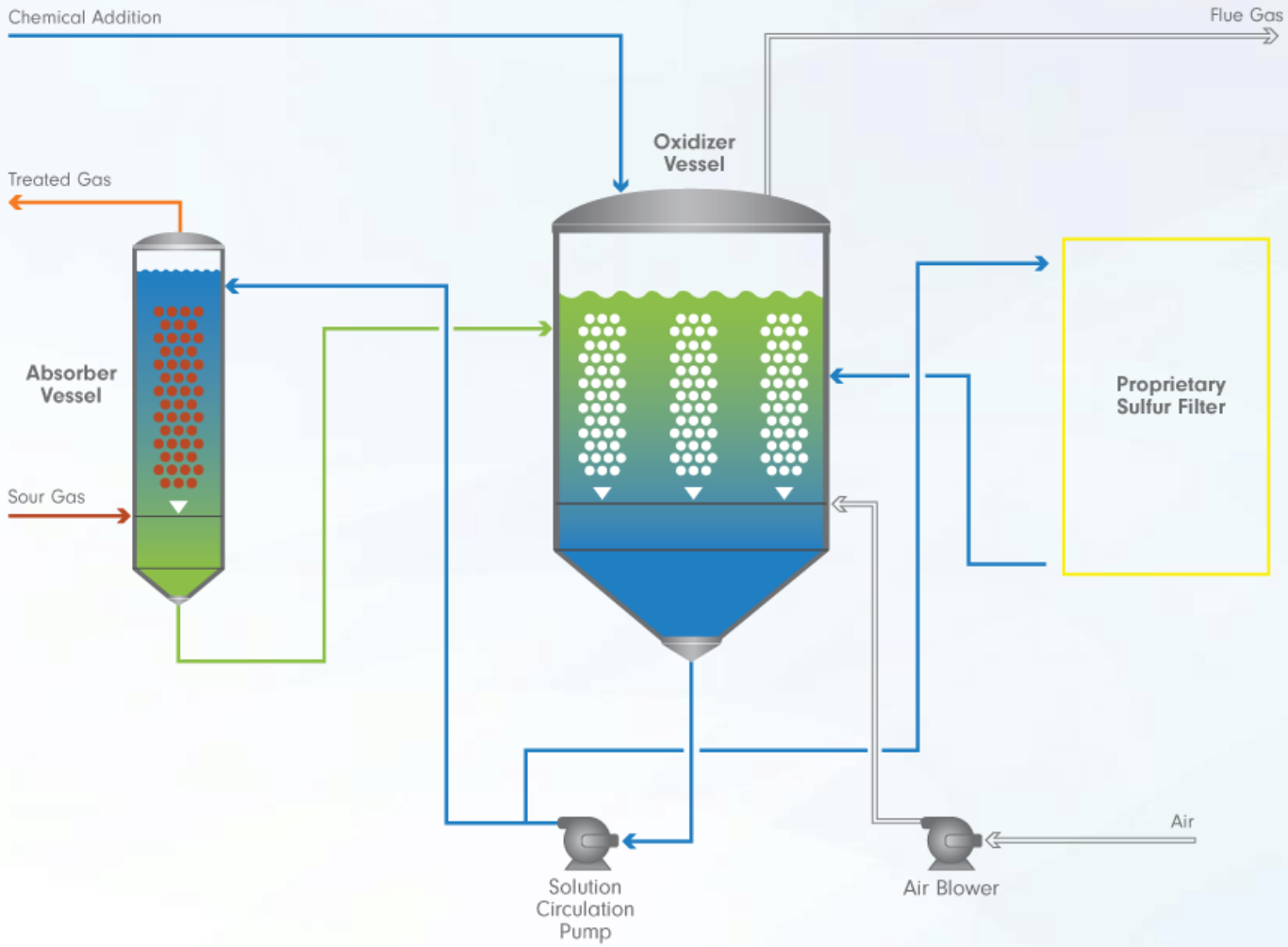
Gas Type



Merichem Gas Technologies

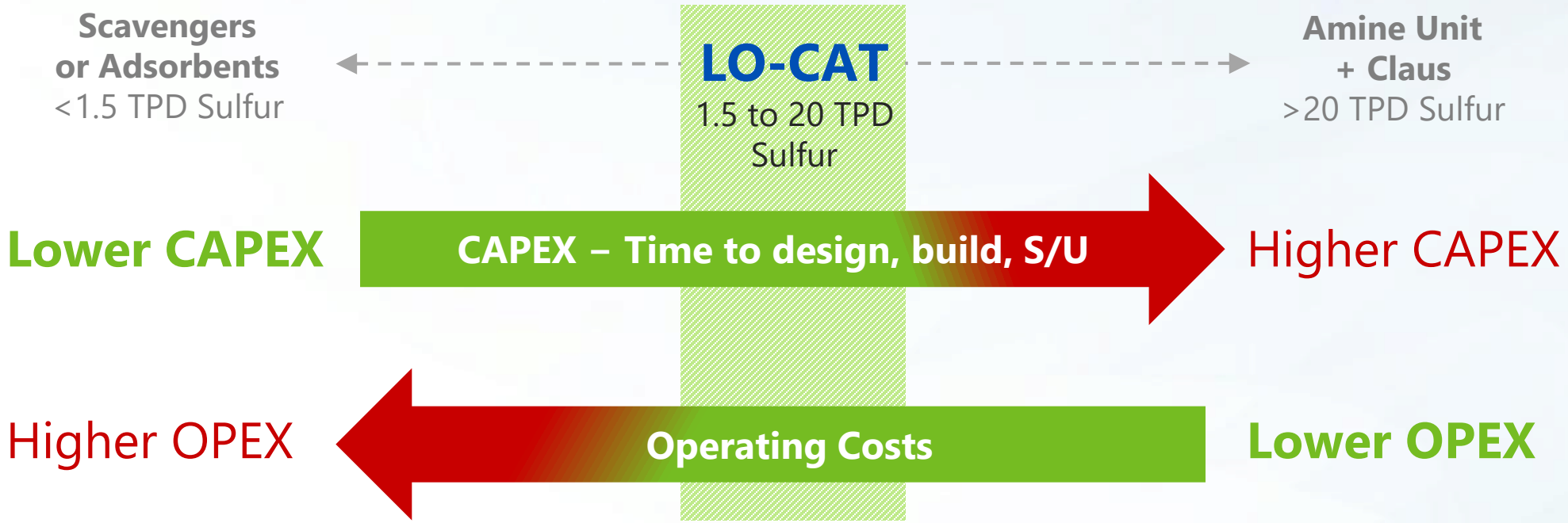
LO-CAT® Technology

- Aqueous-based, ambient temperature process
- Converts H_2S to elemental sulfur
- "Chelated-Iron" catalyst
- Removal efficiencies of 99.9+%
- 100% turndown
- Can process any gas stream containing H_2S
  (fuel gas, acid gas, SWS gas, biogas, syngas, etc.)



LO-CAT® Market Niche

Proprietary H_2S removal from ANY type of gas stream



Competitive Landscape

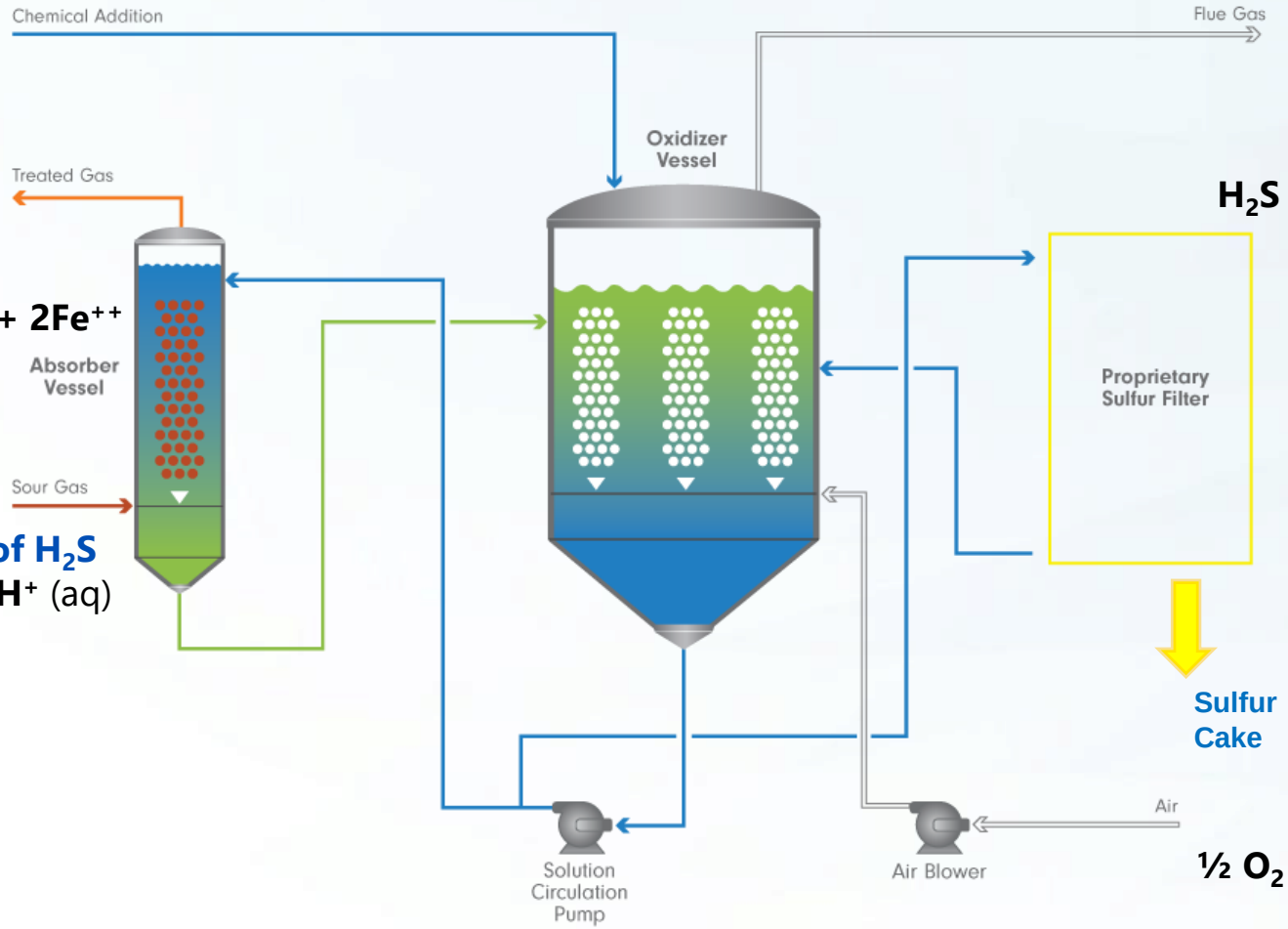
Operating Costs per lb of S

$0.40 – 0.50
LO-CAT

$5.00 – 7.00
Solid Scavengers

$9.00 – 12.00
Liquid Scavengers

Direct Treat Scheme



Overall Reaction

$$H_2S\ (g) + \tfrac{1}{2}\ O_2\ (g) \xrightarrow{Fe} H_2O + S^o$$

Sulfide Oxidation

$$HS^- + 2Fe^{+++} \longrightarrow S^\circ + H^+ + 2Fe^{++}$$

Absorption & Ionization of H_2S

$$H_2S\ (g) + H_2O \longleftrightarrow HS^- + H^+\ (aq)$$

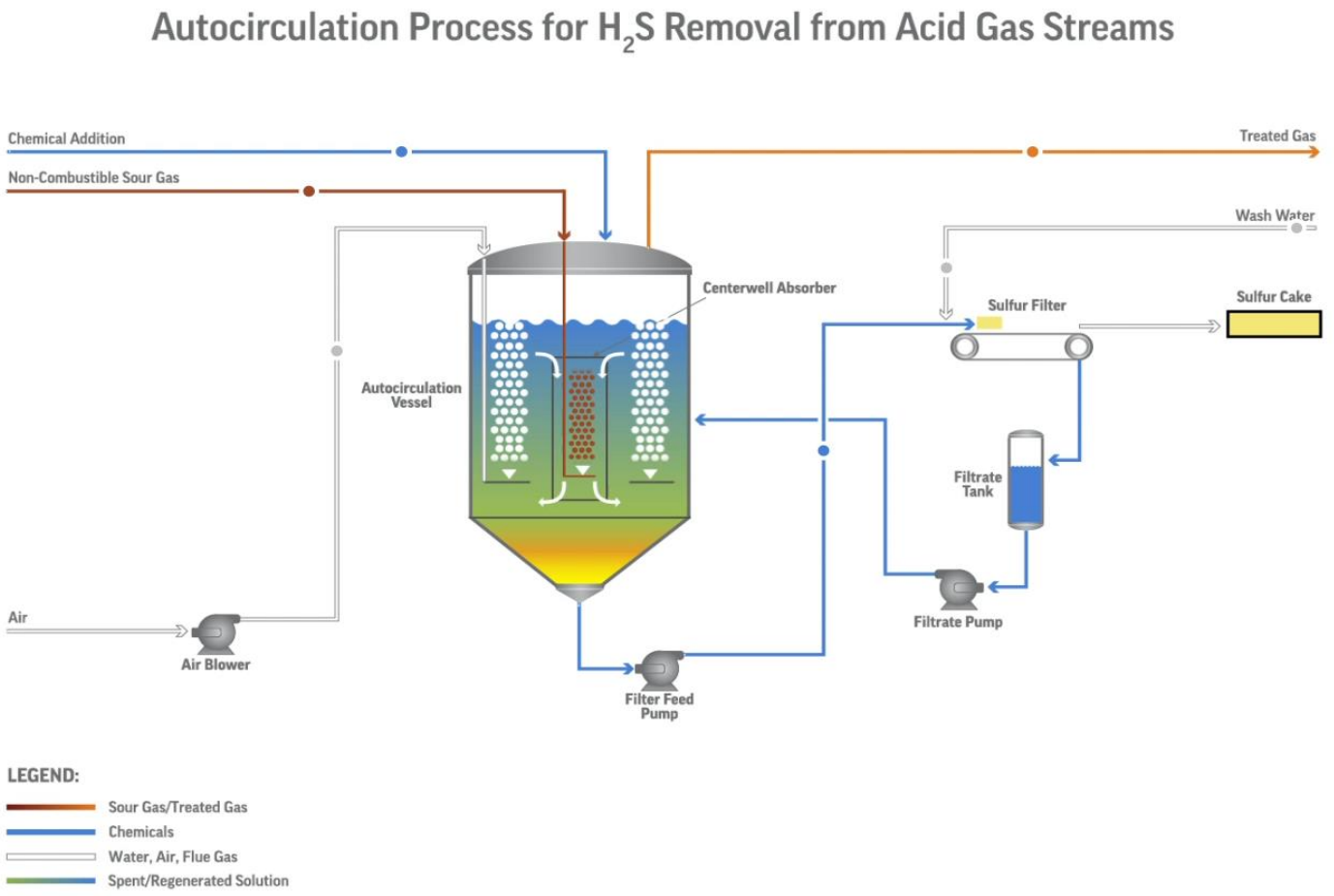
Oxygen Absorption

$$\tfrac{1}{2}\ O_2\ (g) + H_2O \longleftrightarrow \tfrac{1}{2}\ O_2\ (aq)$$

Catalyst Oxidation

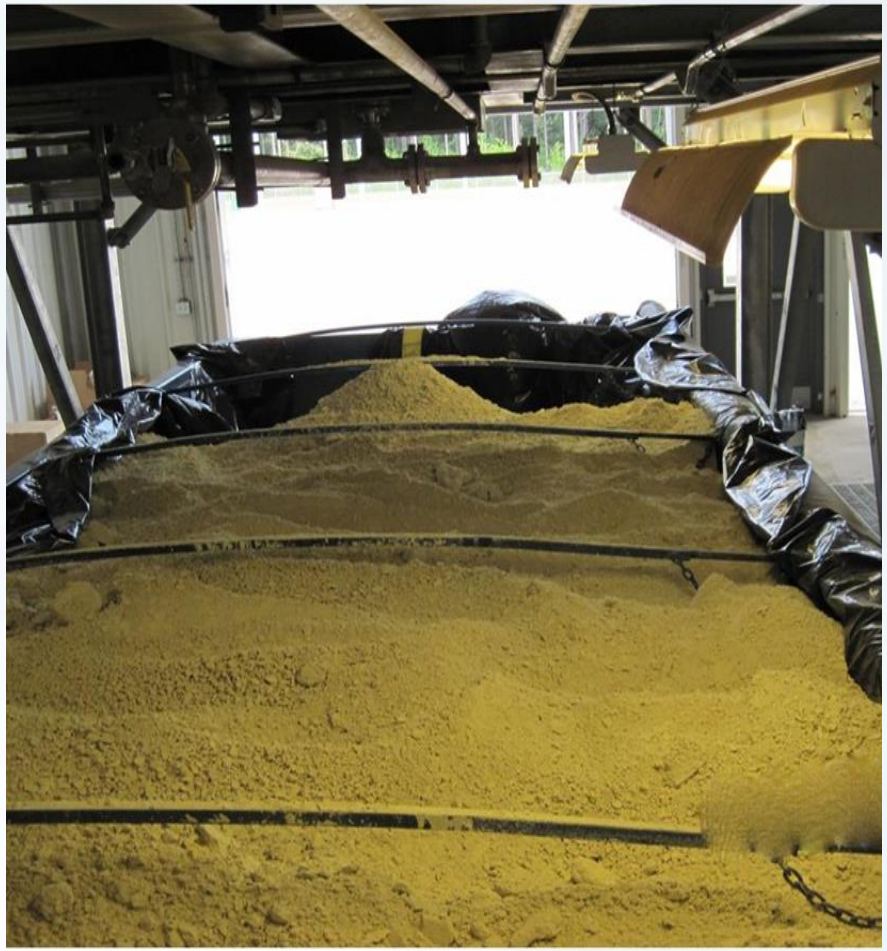
$$\tfrac{1}{2}\ O_2\ (aq) + 2Fe^{++} + H_2O \longrightarrow 2Fe^{+++} + 2OH^-$$

Auto-circulation Scheme



Sulfur from Pressure Filter

- 99.9 % Sulfur removal
- Sulfur contains 65% solids
- Use as fertilizer
- Safe disposal at landfill



Major Midstream Operator – Haynesville Shale, USA

Source: Amine acid gas

Capacity: 10.5 LTPD (5 Trains)

Gas Flow Rate: 14 MMSCFD (each)

Inlet H_2S: 0.4% H_2S

Outlet H_2S: 4 ppm

Operational: Since 2025

10 LTPD Sulfur

Largest Landfill Desulfurization Project – Waste to RNG, USA

Source: Landfill gas

Capacity: 5 trains of 4.5 LTPD (each)

Gas Flow Rate: 6.8 MMSCFD (each)

Inlet H_2S: up to 4% H_2S

Outlet H_2S: <400 ppm
(or 1% of Inlet H_2S)

Operational: Since 2023

5 Trains of 4.5 LTPD Sulfur

Acid Gas – Canada

Source: Amine Acid Gas

Capacity: 1.26 MTPD

Gas Flow Rate: 81 Nm3/hr

Inlet H_2S : 45.7% H_2S

Outlet H_2S : </=100 ppm

Operational: Since 2018

3 LTPD Sulfur

Renewable Bio-Fuels

Source: Amine Acid Gas

Capacity: 3.9 MTPD

Gas Flow Rate: 3.1 MMscfd

Inlet H_2S: 3.1 - 6% H_2S

Outlet H_2S: <20 ppm

Operational: Since 2019

3.9 MTPD Sulfur

Associated Gas - EOR , USA

Source: Associated gas from EOR

Capacity: 3.38 LTPD

Gas Flow Rate: 6 MMscfd

Inlet H_2S: 1.5% H_2S

Outlet H_2S : 12 ppm

Operational: Since 2009

3.4 LTPD Sulfur

Acid Gas – USA


Amine Unit
Settler
Box Type Autocirculation Vessel
Filter Building
3 LTPD Sulfur

The Green Solution to Sulfur Recovery

- Exceptional efficiency (>99.9%), proven reliability, 100% turndown capability for small as well as large applications
- 50 years global experience with over 60 units
- Very low operating costs
- No liquid waste streams requiring treatment & disposal
- Sulfur cake has no dissolved H_2S

SULFURTRAP®

Fixed Bed Solid H_2S Adsorbents

merichem technologies

What is SULFURTRAP®?

- A product suite of adsorbents for fixed bed H_2S removal applications
- Available as pellets, spheres or granules
- Removes H_2S by chemical adsorption
  - Some can remove light mercaptans
- Easily achieve <1 ppm outlet H_2S
- Classified as environmentally non-hazardous waste in both fresh & spent forms

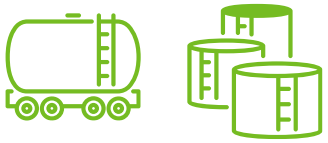
Sectors – SULFURTRAP®

SULFURTRAP® can treat H_2S in any of these sectors (<1.5 TPD of sulfur removed)

Upstream

Extracts feedstocks used to produce fuels & petrochemicals

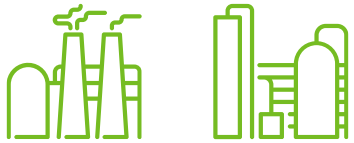
- Offshore Production
- Onshore Oil Production
- Wellhead Processing



Midstream

Moves and stores feedstocks like crude oil & natural gas

- Natural Gas processing
- Transportation
- Storage



Downstream

Refines/processes crude oil and gas into into finished products

- Petrochemical
- Refining
- Syngas
- CCUS

Renewables

Biogas upgraded for use in place of fossil natural gas

- Anaerobic digesters
- Agriculture
- Landfill
- Utilities & WWTP

SULFURTRAP® Adsorbents

Product	Applications		Type	Sulfur Capacity	Particle Shape	Dry Gas	Water Saturated Gas
SULFURTRAP® UHC Ultra High Sulfur Capacity H_2S Adsorbent	• Offshore gas • Landfill gas (LFG) • Amine off gas	• Acid gas (CO_2) • RNG	Iron oxide/ hydroxide	High	Pellet: 4-5 mm x 10-15 mm	✓	✓
SULFURTRAP® HTD High Temperature Hydrogen Sulfide (H_2S) Adsorbent	• Coke oven gas • Blast furnace gas • Biogas-RNG • Natural gas	• Acid Gas (CO_2) • Syngas • Landfill gas	Iron oxide/ hydroxide	Mid	Pellet: 4-5 mm x 10-15 mm	✓	✓
SULFURTRAP® ST1 Economical Hydrogen Sulfide (H_2S) Adsorbent	• Biogas-RNG • Natural gas • Acid Gas (CO_2)	• Syngas • Landfill gas	Iron oxide/ hydroxide	Low	Pellet: 4-5 mm x 10-15 mm	✓	✓
SULFURTRAP® EX Extended Life Hydrogen Sulfide (H_2S) & Light Mercaptan (RSH) Adsorbent	• Natural gas • Acid Gas (CO_2) • Biogas-RNG	• Syngas • H_2	Iron oxide	Mid	Pellet: 4-5 mm x 10-15 mm	>70% RH	
SULFURTRAP® LH Hydrogen Sulfide (H_2S) & Light Mercaptan (RSH) Adsorbent	• Liquid hydrocarbons up to gasoline range	• LPG • NGL • Condensates	Iron oxide	Low	Sphere: 4x12 mesh	N/A	

SULFURTRAP® Benefits

Long Life

- High sulfur loading capacity wt%

Low pressure drop (dP)

- From SOR to EOR

Easy cleanout

Lowest $/lb sulfur removed

Supply chain excellence

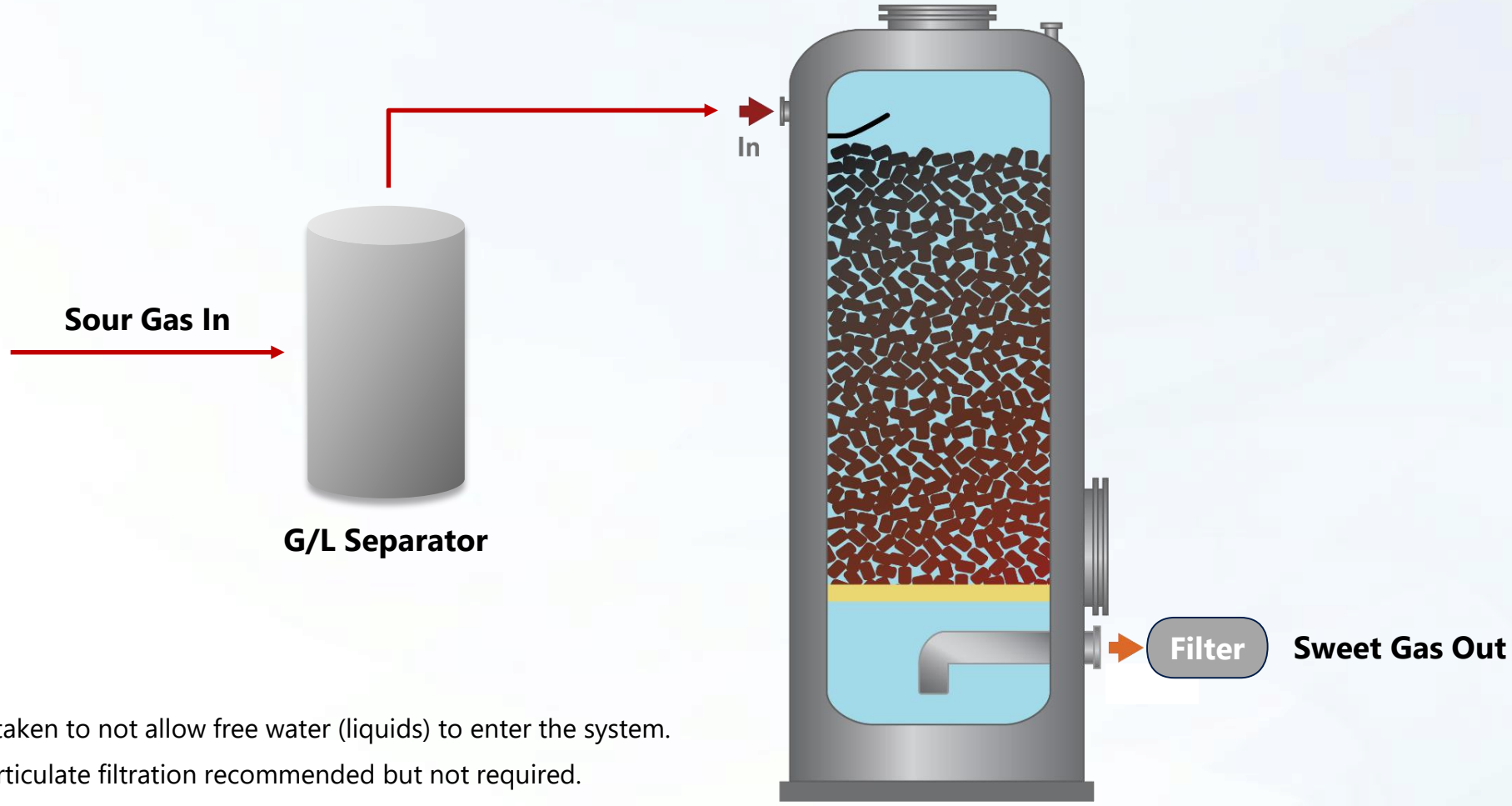
- Large inventory hold
- Short lead times
- Logistics support

SULFURTRAP® Benefits

Sulfur removal from gas and liquid streams is needed to:

- Meet required specifications
- Increase revenue
- Reduce equipment corrosion
- Prevent poisoning of downstream processes

SULFURTRAP® Basic PFD



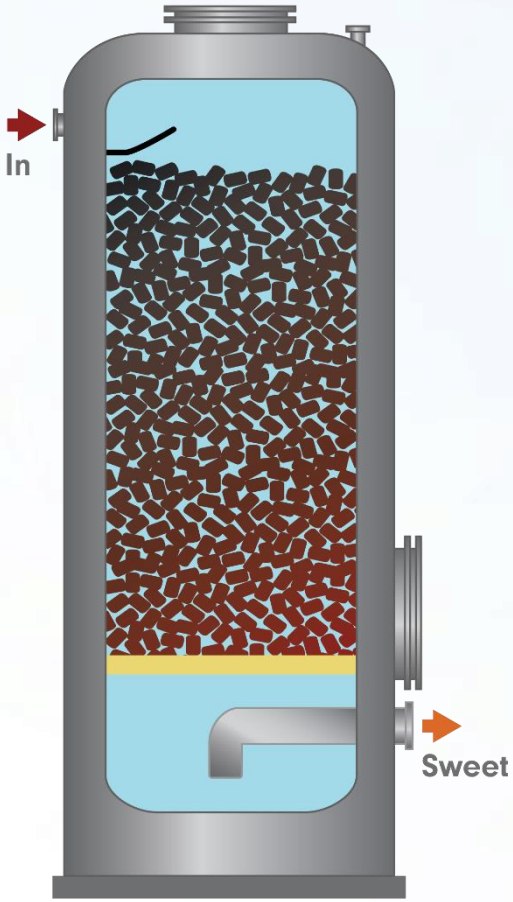
- Care should be taken to not allow free water (liquids) to enter the system.
- Downstream particulate filtration recommended but not required.

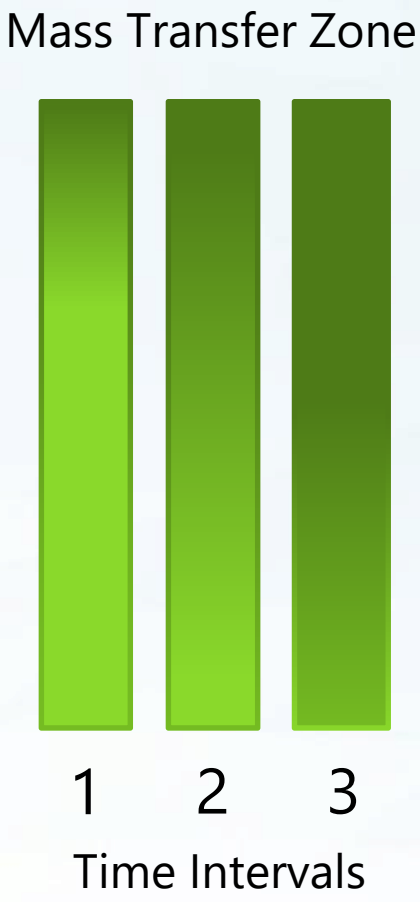
SULFURTRAP® Single Vessel

Pellets deactivate gradually from inlet to outlet through a packed bed, leaving behind a free-flowing, non-hazardous by-product.

Configurations

- Single vessel
- Lead-lag
- Parallel





SULFURTRAP® Vessel Configurations

Single Vessel

Double vessels in parallel configuration can be used as well

Small Lead-lag

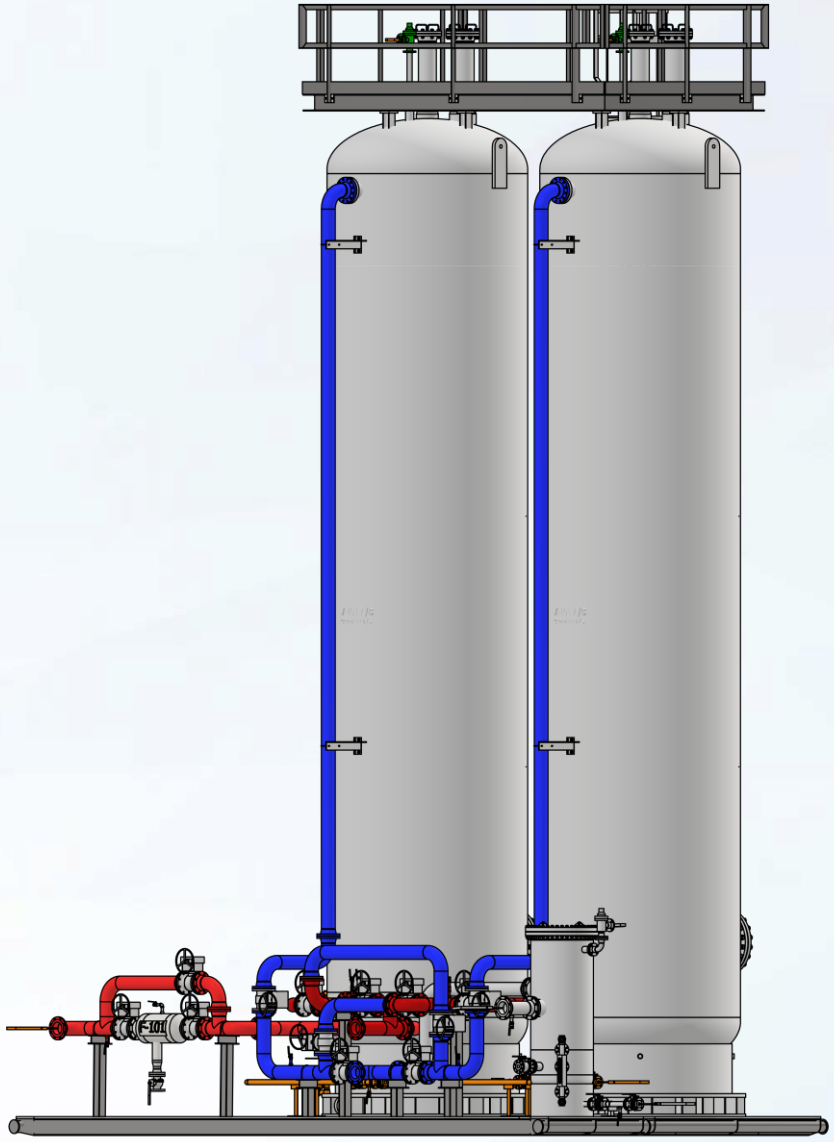
Large Lead-lag

Lead/lag vessel configuration eliminates process down-time and allows greater process reliability.

SULFURTRAP® Lead-lag System

Normal Operation

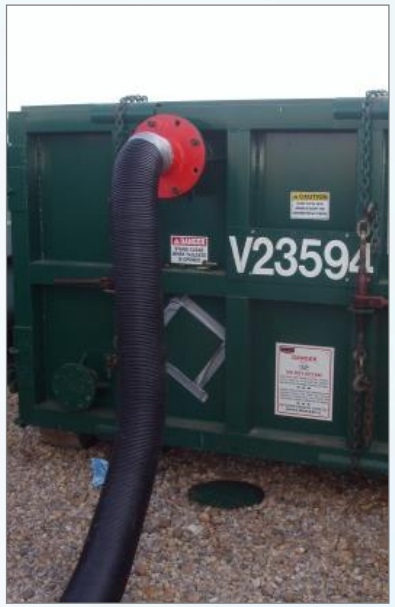
- Gas stream is fed to the lead vessel from top to bottom
- H_2S in contact with iron adsorbent chemically reacts forming a stable iron sulfide compound
- H_2S is completely removed by the lead bed until the sulfur loading capacity is reached
- Lead vessel is set offline for media changeout while the gas is redirected to the lag vessel



SULFURTRAP® Changeout & Disposal

Changeout procedure

- Review SULFURTRAP SDS, Operations Manual/Changeout Procedure prior to handling or service work
- Purge hydrocarbons from vessel
- Water quench spent adsorbent. Fill/drain 1-3 times as needed
- Remove moistened/spent adsorbent into hoppers or containers
- Send to landfill or waste area according to local practice



Value Proposition - SULFURTRAP®

Proposals

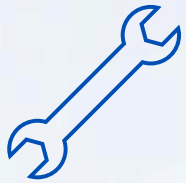
- Product selection
- Performance estimates
- Performance guarantee

Process Optimization

- Drop-in replacement
- Revamp / Retrofit
- Rental / Lease capabilities

Operational Support

- Startup
- Cleanout/disposal
- Performance review



Accessories
(spare parts)

- Ceramic bed support and hold down media
- Foam and felt pads
- S/S wire mesh screens
- Proprietary cleaners and surfactants

LO-CAT® vs SULFURTRAP®

Product Selection

SULFURTRAP® **LO-CAT®**

0 1.5 20

Long Tons of Sulfur Removed per Day (TPD)