

SulfaTrap™

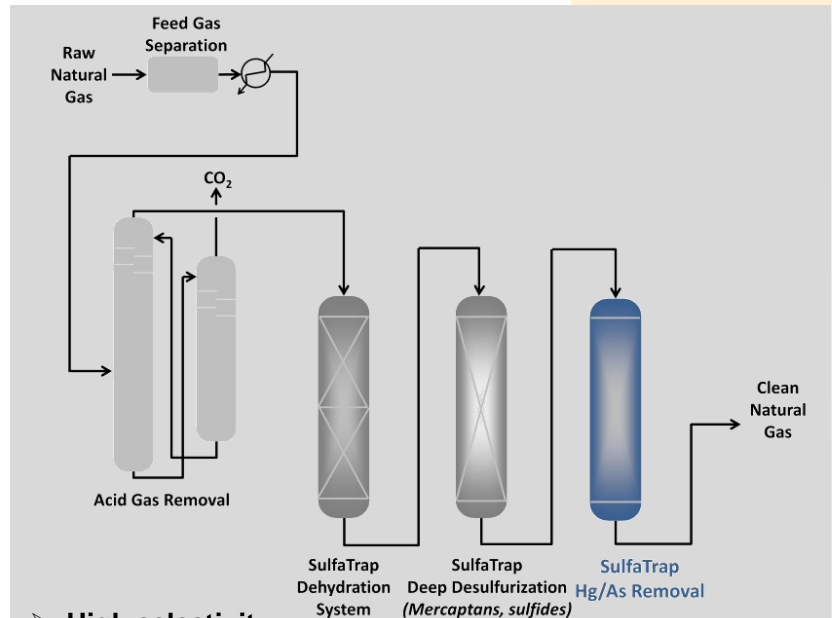
Taking Sulfur Out of the Equation

MERCURY AND ARSENIC REMOVAL

Volatile metals, such as mercury (Hg) and arsenic (As), are often present in low concentrations in natural gas, synthesis gas, petrochemical and some refinery feed streams. While their removal is important for worker safety and environmental perspectives (emissions of mercury is regulated as an air toxin under the Clean Air Amendment Act), mercury removal is particularly important in the production of Liquefied Natural Gas (LNG) as it can corrode the aluminum heat exchangers used in the liquefaction process.

SulfaTrap™-M series adsorbents offer cost-effective solution to remove mercury, arsenic and selenium to ultra low concentrations. The SulfaTrap™-M1 sorbent achieves greater than 10%wt. mercury capacity, while reducing its concentration to less than 0.01 µg/m³ (micro grams per cubic meter) to ensure maximum protection to the process equipment. The SulfaTrap™-M2 sorbent achieves over 4% wt. arsenic capacity from ambient temperature to up to 300°C, reducing the total trace metal content to sub-ppbv (parts per *billion*) levels, allowing its use on a wide range of purification applications. In addition to natural gas, these products are also effective in mercury and arsenic removal from liquids hydrocarbons.

The patented active phase can be dispersed on a range of high surface area supports (activated carbon or ceramics) which allow SulfaTrap LLC to offer tailored solutions to the operator's individual requirements or specific application.



- **High selectivity**
 - No adsorption of hydrocarbons
- **High removal efficiency**
 - All forms of Hg being removed (i.e., oxidized, metallic and organic)
 - Hg, As content reduced to <0.01 µg/m³
- **High moisture tolerance**
- **Applicable to wide range of Fuel Streams**
 - Natural gas, LPG, Synthesis Gas



Product	Application
SulfaTrap™-MT1	Universal mercury removal sorbent
SulfaTrap™-MT2	Removal of mercury and other metals, such as arsenic and selenium

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PRODUCTS FOR NATURAL GAS LIQUIDS AND LIQUIFIED PETROLEUM GAS (LPG)

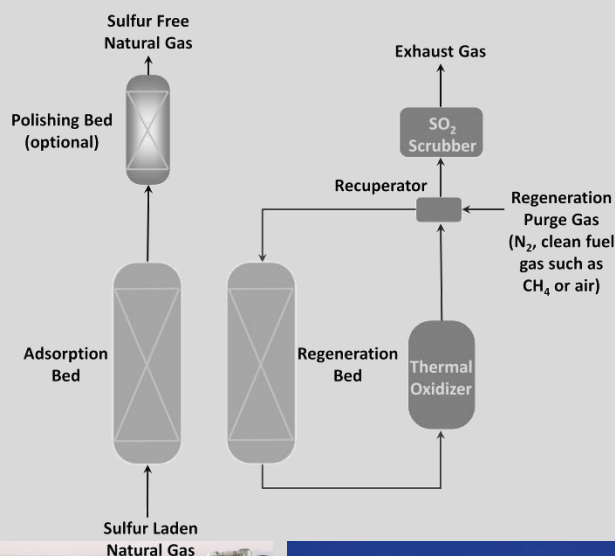
SulfaTrap™ desulfurization technology is a new treatment option for LPG and NGL fractions. With the capability of reducing the sulfur concentration in these light hydrocarbon fractions to sub ppm concentrations, SulfaTrap™ polishers integrated to the bulk acid gas removal and desulfurization process, could provide cost-effective option to meet the most stringent sulfur specs for salable and feedstock grade LPG and NGL products.

SulfaTrap™ sorbents remove all sulfur compounds (e.g., H₂S, COS, mercaptans, disulfides and thiophenes) to sub ppmw levels.

The regenerable bulk sulfur removal sorbents could treat raw NGL, while a wide range of polishers could provide solutions to meet the most stringent specs.

The polishers could effectively desulfurize LPG for “odorless LPG” applications and successfully treat propylene, butane and isobutene feedstocks.

Regenerable LPG/NGL Desulfurization



- **High capacity and removal efficiency for all sulfur species**
 - Reducing sulfur concentration to less than 10 ppbw
- **Easy disposal** - No flammability, toxicity or pyrophorocity
- **Regenerable or expendable operation**

Product	Application
SulfaTrap™-R2	Regenerable desulfurization sorbent
SulfaTrap™-R5	COS removal
SulfaTrap™-R7	H ₂ S, mercaptan removal
SulfaTrap™-R8	General desulfurization

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PRODUCTS FOR NATURAL GAS

SulfaTrap offers a wide range of products for desulfurization of natural gas. Sulfur is an acid gas that corrodes the pipelines and the process equipment. It is also a potent poison for any catalysts used in the synthesis processes that uses natural gas as a feedstock. In addition to the naturally occurring sulfur, organic sulfur compounds are also added as an odorant. Sulfur speciation in the gas can change from pipeline to pipeline, locale to locale and season to season. Other compositional changes in heavy hydrocarbons and moisture further complicate the problem.

SulfaTrap™ sorbents remove all naturally occurring sulfur compounds (e.g., H₂S, COS, methyl mercaptan and organo-sulfur odorants, including complex sulfides (e.g. dimethyl sulfide, DMS and disulfides) complex mercaptans (e.g., tertiary butyl mercaptan, TBM), and thiophenes (e.g., tetrahydrothiophene, THT), Our sorbents reduce the sulfur concentration to ppbv levels to ensure maximum protection.

We work closely with you to engineer the best solution for your application!



- **Ambient temperature operation**
 - -40°C to 80°C
- **High capacity and removal efficiency for all sulfur species**
 - Reducing sulfur concentration to less than 5 ppbv
- **Tolerant to heavy hydrocarbons and moisture**
 - 0 ppmv H₂O to fully saturated gas streams
- **Easy disposal** - No flammability, toxicity or pyrophorocity
- **Regenerable or expendable operation**

Product	Application
SulfaTrap™-R2	Moisture-tolerant desulfurization
SulfaTrap™-R5	COS removal
SulfaTrap™-R6	General desulfurization (pipeline NG)
SulfaTrap™-R7	Bulk H ₂ S removal
SulfaTrap™-R8	General desulfurization

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PRODUCTS FOR BIOGAS

Biogas is produced as a byproduct of anaerobic digestion or decomposition of organic wastes into methane and carbon dioxide (CO₂). Effective utilization of biogas in fuel cell applications requires the removal of impurities such as sulfur (e.g., hydrogen sulfide, mercaptans, and disulfides) and siloxanes to prevent degradation of cell stacks and poisoning of the catalysts used in the fuel processor.

The sulfur concentration in biogas can be very high (400 - 15,000 ppmv) and the gas is saturated with water (~5-8% vol. H₂O). SulfaTrap™-R8 is formulated as a moisture tolerant sorbent; it can achieve high sulfur capacity not only for hydrogen sulfide (H₂S) but also for all mercaptans, organic di-sulfides and tri-sulfides. SulfaTrap™-R8 can reduce the sulfur concentration in the biogas to low ppbv levels in one step. SulfaTrap™-R7 is offered as a low-cost sorbent designed for bulk removal of H₂S.

Siloxanes are a family of man-made organic compounds that contain silicon, oxygen and methyl groups used in personal hygiene, health-care and industrial products. At the wastewater treatment plants and landfills the low molecular weight siloxane species volatilize and contaminate the digester gas. SulfaTrap™-Si and modified SulfaTrap™-R8 sorbents remove siloxanes from biogas without using refrigeration.



- **High selectivity** and removal efficiency to all sulfur species
 - Reducing sulfur concentration to less than 5 ppbv
- **High capacity** for mercaptans, disulfides and H₂S
- **High Sulfur capacity** (in excess of 30% wt.)
- **Operates at high levels of moisture and CO₂**
- **Easy disposal**
 - No flammability, toxicity or pyrophorocity
- **Expendable operation**

Product	Application
SulfaTrap™-R7	Biogas desulfurization, bulk H ₂ S
SulfaTrap™-R8	Biogas desulfurization, polishing bed
SulfaTrap™-Si	Siloxane removal from biogas

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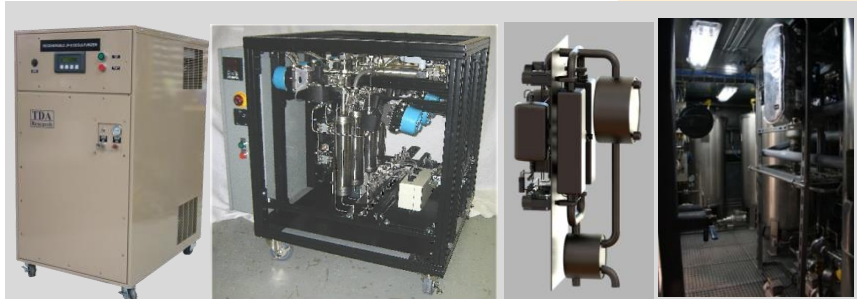
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PRODUCTS FOR LIQUID FUELS

SulfaTrap™ offers a number of sorbents for desulfurization of liquid hydrocarbon fuels, such as logistics fuel (e.g., JP-8, JP-5), diesel fuel, bioethanol and natural gas liquids. These sorbents remove sulfur directly from the liquid stream to sub ppmv levels.

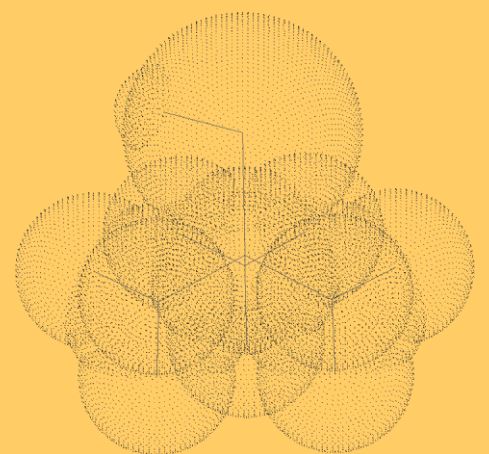
SulfaTrap™-D1 can be operated as an expendable bed for low sulfur fuels (e.g., ultra low sulfur road diesel), or as part of a regenerable system (regenerated by applying a mild temperature swing).

SulfaTrap™-WG and SulfaTrap™-HRG sorbents are capable of removing sulfur components from the vaporized fuel or any reformat gas generated from the liquids.



- **High selectivity** and removal efficiency to all sulfur species
- **SulfaTrap™-D1** reduce sulfur levels to **less than 40 ppbv** in liquid fuels
- **SulfaTrap™-WG** and **SulfaTrap™-HRG** reduce sulfur levels to **less than 5 ppbv** in the reformat gas
- **High capacity**
- **Regenerable operation** - oxidizing, reducing, or inert gases can be used for regeneration

Product	Application
SulfaTrap™-D1	Liquid-phase desulfurization sorbent
SulfaTrap™-WG	Warm gas desulfurization, 200-650°C
SulfaTrap™-HRG	Hot reformat gas desulfurization, 500-800°C



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