

Contaminant Removal from Natural Gas Liquids



**UOP adsorbent solutions help
remove contaminants from natural
gas liquid streams**

Natural Gas Liquids

Contaminant removal from NGL streams

Natural gas liquids (NGLs) include ethane, propane and butane and other heavier hydrocarbons that make up natural gas. NGLs are valuable as separate products, and it is critical to remove contaminants from these streams, which either reduce their market value or compromise reliability of downstream catalytic processes and equipment. Gas plant operators experience new and sometimes unique challenges as they source feed gas from unconventional resources or from aging wells. Some of the concerns posed by contaminants in NGL streams are:

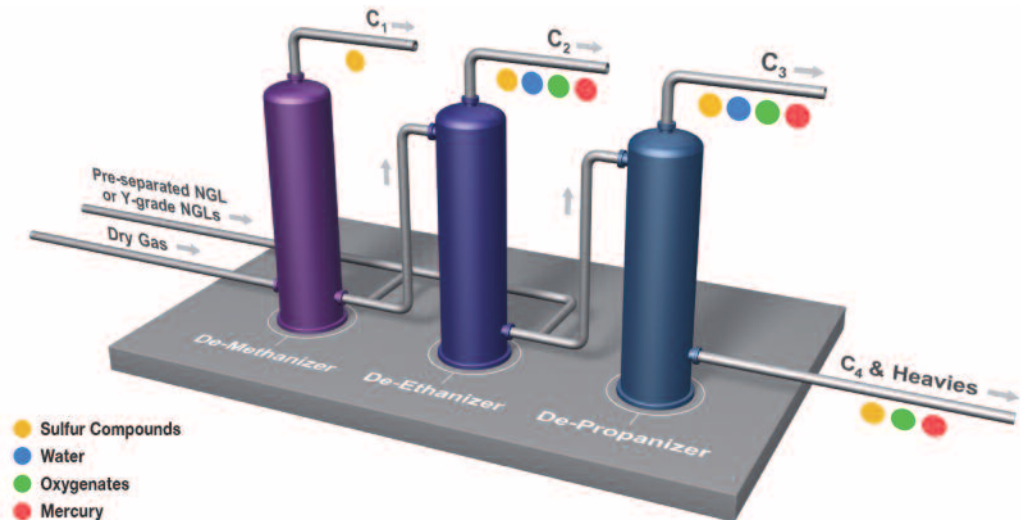
- Meeting strict specifications for NGL products
- Mitigating health, safety, and environmental hazards within the gas plant as well as in downstream pipelines and equipment
- Preventing corrosion and equipment reliability issues
- Maintaining catalyst life and activity at downstream processing facilities

Common contaminants found in NGL streams are:

- Water
- Sulfur Compounds
 - Sulfides*
 - Hydrogen Sulfide (H_2S)
 - Carbonyl Sulfide (COS)
 - Carbon Disulfide (CS_2)
 - Organic Sulfides and Di-sulfides
 - Mercaptans*
- Oxygenates
 - Alcohol (methanol and isopropanol)*
 - Other oxygenates (glycols, ethers, aldehydes and ketones)*
- Mercury



Contaminants found in NGL Streams



Adsorbents for contaminant removal from NGL

UOP has offered a variety of contaminant removal solutions to the natural gas industry for more than 60 years.

Our portfolio of regenerative and non-regenerative adsorbents specially designed and formulated for contaminant removal from NGL streams include zeolite molecular sieves, modified activated aluminas and non-regenerative metal oxide/sulfide products.

Zeolite molecular sieves are uniform microporous crystalline adsorbents which adsorb molecules based on their size and polarity. Zeolites have a strong affinity for polar molecules and demonstrate a selective preference for polar molecules relative to their degree of polarity. The combination of size and polarity-based selective removal makes zeolite molecular sieves an ideal option for removing contaminants from NGL streams. A majority of contaminants found in these streams, such as water, light mercaptans and low molecular-weight oxygenates, can be removed using molecular sieves.

Activated alumina adsorbents are synthetically-produced transitional-phase aluminas. These aluminas exhibit lower crystallinity compared to zeolites and have a non-uniform pore distribution and structure. Contaminant removal capacity of the alumina adsorbent depends on the ability of

the activated alumina to effectively chemisorb contaminants, in addition to the polarity of the contaminants. Capacity also depends on the surface activity of the alumina, which is carefully tailored using special manufacturing techniques. Contaminants like COS and H₂S are thus effectively chemisorbed and removed from the NGL stream using activated alumina adsorbents.

Guard bed adsorbents are high capacity, non-regenerative metal oxides or sulfides for removing mercury (Hg), hydrogen sulfide (H₂S) and carbonyl sulfides COS to parts per billion (ppb) levels in NGL streams. These adsorbents are carefully formulated with a pore structure designed to maximize mass transfer and enable high contaminant removal capacity while minimizing potential damage caused by liquid carry-over.



Contaminants in NGL streams

UOP's wide range of adsorbents provide contaminant removal solutions that improve the value of gas plant products and the reliability of plant equipment

Water can interact with other contaminants present in NGL streams.

- Water hydrolyzes carbonyl sulfide in a reversible reaction to form hydrogen sulfide and carbon dioxide. Elevated carbonyl sulfide content in an NGL stream results in high hydrogen sulfide formation, which could be corrosive.
- Water in NGL streams could also pose operating challenges for downstream catalytic processes.

UOP solutions: MOLSIV™ 4A-DG, MOLSIV UI-94, COSMIN 105A Adsorbents

Oxygenates are added during natural gas processing as components of hydrate inhibitors, corrosion inhibitors injected in gas pipelines, or other chemicals used in gas production. Common oxygenate contaminants include glycols and methanol.

When oxygenates are not separated during natural gas drying, they will likely concentrate into the NGL product stream. Oxygenates are considered poisons for some downstream petrochemical processes involving C₃ and C₄ streams.

UOP solutions:

Regenerative options:
UOP UI-755, UOP UI-750 and
UOP UI-710 Adsorbents

Mercury is commonly found in natural gas in varying concentrations. Many NGL plants require mercury removal upstream of cryogenic processing to avoid corrosion damage to aluminum metallurgy in the cryogenic section of the plant and the potential for catastrophic failure.

Various NGL fractionation facilities source their feedstocks from "Y grade" NGL pipelines that collect NGL products from multiple gas plants and condensate units. This common stream is then separated into C₂, C₃, C₄ and heavier fractions at the fractionation plant. Insufficient upstream mercury removal (in feeder gas plants) leads to mercury contamination of the C₂, C₃, C₄ and heavier streams. Mercury-contaminated NGL streams:

- Adsorb or form amalgams with equipment metallurgy, copper and aluminum internals
- Are a known poison for noble metal catalysts and thus limit the use of contaminated NGL streams in downstream processes



- Are traded at a discount thereby reducing profitability

UOP solutions:

Regenerative options:

UOP HgSIV™ 3 or UOP HgSIV 1

Non-regenerative options: UOP GB-346, UOP-346HP, UOP GB-346S, UOP GB-346HPS and UOP GB-347S Adsorbents

Sulfur compounds naturally occur in natural gas as sulfides, disulfides or mercaptans. Given the various types of sulfur compounds and their chemical characteristics, customized removal techniques are needed, since no one treatment technique is sufficient for all types of sulfur compounds in NGL streams.

Sulfur compounds pose operational, corrosion, environmental and marketing challenges for NGL plants. Sulfur contaminants found in NGL streams include:

- **Mercaptans** pose not only corrosion concerns but also specification challenges for NGL producers. High mercaptan content increases the total sulfur in the stream which is commonly limited by a sale specification.

UOP solutions:

UOP RK-29HP, UOP RK-29 II and UOP RK-33F Adsorbents

- **Hydrogen sulfide (H₂S)** is usually treated upstream in natural gas treatment processes using liquid amine based scrubbing systems. Natural gas plants limit H₂S content to below 1ppm in the dry gas feed to NGL recovery. However, H₂S can sometimes be found in NGL streams which can cause corrosion issues and failure to meet established NGL product standards.

A common test method for H₂S corrosivity is ASTM D 1838 (12-A), for copper corrosion potential of the stream. Copper corrosion test results of >1a are considered off-spec.

Liquid hydrogen sulfide scavengers are sometimes used to remove H₂S from NGL streams. These are liquid tertiary or quaternary amines which react with H₂S to form a thermally-stable salt. These salts travel with the NGL streams and pose contamination risk for downstream processing.

UOP solutions:

Regenerative options: UOP RK-29, UOP RK-29HP

Non-regenerative options: UOP GB-417 and UOP GB-420 Adsorbents

- **Carbonyl Sulfide (COS)** can be present in the feed natural gas or could be formed on the molecular sieve surface due to the catalytic activity of the zeolite.

UOP offers liquid solvent technology for selective removal of COS from natural gas, upstream of natural gas drying. UOP also offers its COSMIN series of molecular sieves to reduce COS formation on the molecular sieve surface.

COS that is not removed upstream fractionates with the cryogenically-separated C₃ NGL stream. COS gets hydrolyzed on contact with trace water contamination in pipelines, leading to the formation of H₂S and CO₂, which pose operational and marketing challenges for the NGL streams.

UOP solutions:

Regenerative options: UOP RK-29 II, UOP RK-29 and UOP RK-29HP Adsorbents



Service and support for your adsorbent needs

UOP is a leader in developing and implementing adsorbent solutions for contaminant removal in the oil and gas industry. UOP developed the first commercialized zeolite molecular sieve application and continues to commercialize a range of innovative and advanced adsorbent removal technologies. With more than 2,100 total active patents worldwide, our research and development efforts continue to drive important advances in the oil and gas industry.

Backed by strong research and development support, UOP's adsorbent Sales Technical Support (STS) team provides experienced advisors supported by a troubleshooting team. UOP's STS team supports 1,000 customers in nearly 100 countries around the globe. We maintain this reach through our regional service centers in Houston (USA), Antwerp (Belgium), Dubai (UAE), Kuala Lumpur (Malaysia), Dhahran (Kingdom of Saudi Arabia), Moscow (Russia) and Shanghai (China).

UOP's STS team is committed to providing service designed to advise you about pre-startup problems, get you on-stream faster and keep your operation running at peak performance.

Call your UOP representative to assist you in: Pre-Application Support

- Adsorption process design
- Review existing unit designs for improved operation with UOP adsorbents
- Vessel inspection, loading and start-up assistance

Performance Evaluations

- Contaminant analysis in feed and product streams
- Adsorption cycle and regeneration optimization
- Performance life projection
- Spent adsorbent analysis

Troubleshooting

- Simulation studies on operating plants
- Troubleshooting operating issues with unit surveys, performance evaluations and shutdown experience

Find out more

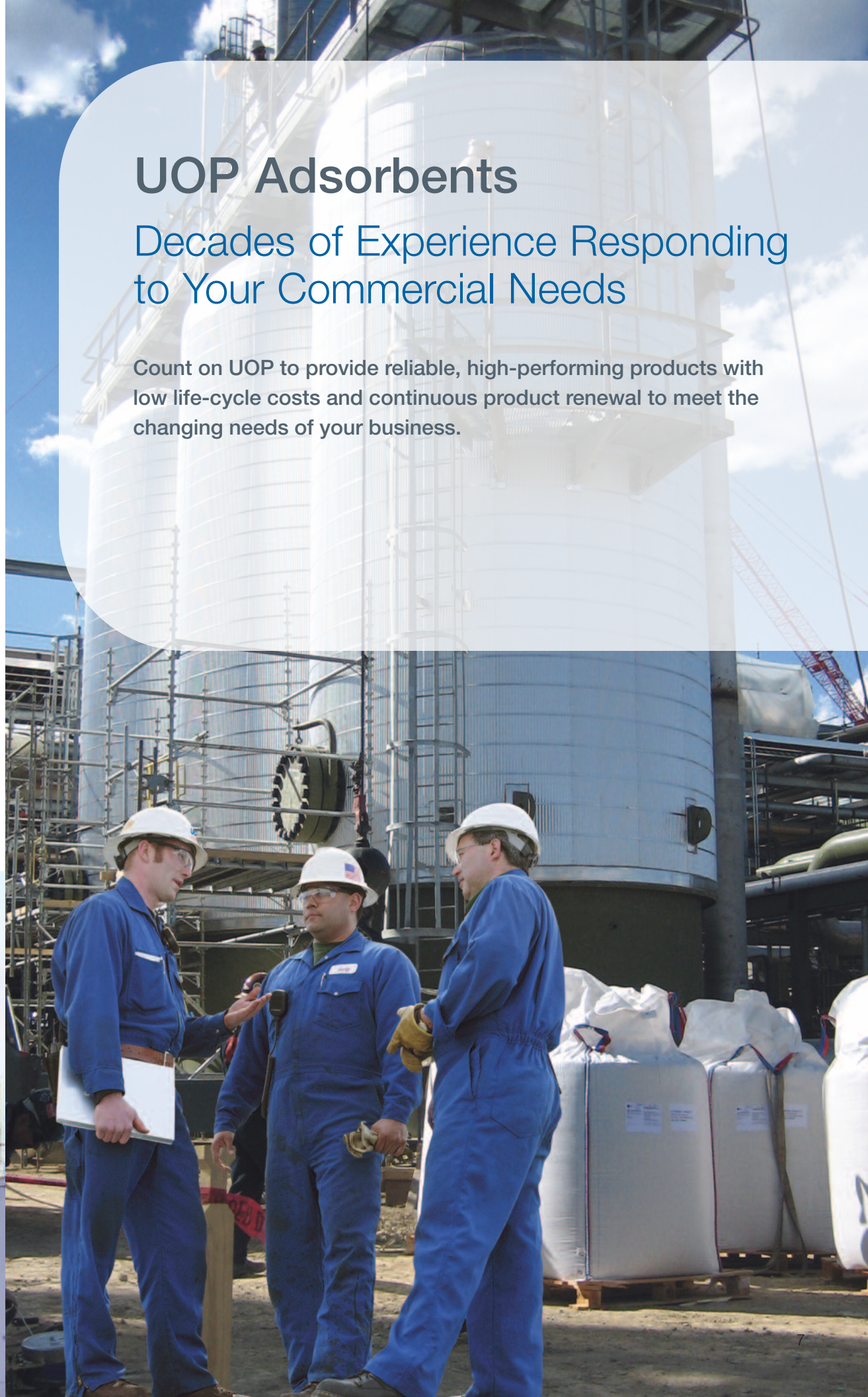
To learn more about UOP gas processing, please contact your UOP representative or visit us online at www.uop.com.



UOP Adsorbents

Decades of Experience Responding to Your Commercial Needs

Count on UOP to provide reliable, high-performing products with low life-cycle costs and continuous product renewal to meet the changing needs of your business.





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