

UOP MOLSIV™ UI-94 Adsorbent



**Extend adsorbent bed
service life and reduce natural
gas dehydration operational costs**



Designed to overcome today's operational challenges, UOP's innovative molecular sieve adsorbent offers longer adsorbent life and higher profitability for your natural gas processing needs.

UOP pioneered the adsorbents industry with the invention of the first synthetic zeolites for use as molecular sieves in 1949. Since then, UOP has been committed to innovation with continued research and development in the adsorbents industry. With long-standing experience over a breadth of feedstock types, unit configurations and operating philosophies, UOP's technologies are designed to help facilities operate more efficiently with lower costs.

Challenges in natural gas dehydration

Molecular sieves are used to effectively dehydrate natural gas in order to meet feed gas specifications during hydrocarbon recovery. They can help achieve water dew points as low as minus 235 F (-148 C). Cryogenic units, natural gas liquids (NGL) facilities and liquefied natural gas (LNG) plants often face obstacles with natural gas dehydration that can affect their profitability. These include:

Contaminants in feed gas

Presence of contaminants – such as acid species (carbon dioxide or hydrogen sulfide), mercaptan, production chemicals and pipeline hydrate inhibitors like methanol – adversely affect adsorbent performance and result in reduced adsorbent service life.

Liquid carryover

Most natural gas dehydration systems are equipped with liquid/entrained water



separators upstream of the molecular sieve beds. Liquid carryover to adsorbent beds, however, continues to be a common

occurrence. Liquid water, glycols or other solvents affect the physical structure of the adsorbent and cause agglomeration. This results in increased pressure drop across the bed, reduced capacity and channeling leading to ineffective adsorption and regeneration.

Coke formation on adsorbent

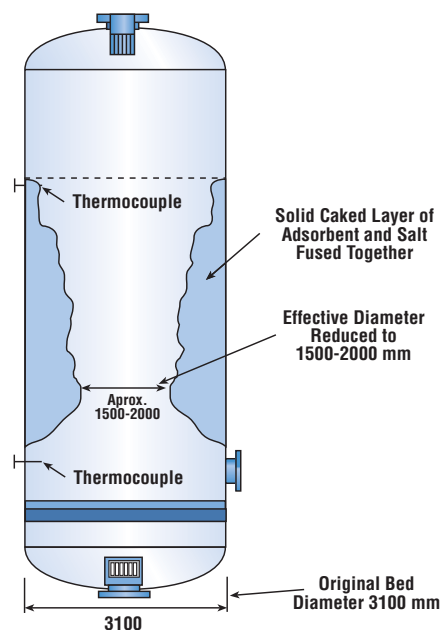
Natural gas dehydration units typically regenerate the adsorbent beds at temperatures between 450 to 550 F (230-285 C). During regeneration, heavier hydrocarbons and feed gas contaminants like methanol result in increased coke formation on adsorbent surface thereby limiting adsorbent performance.

Reflux

Counter current thermal regeneration is the most effective method for desorption of water adsorbed on the zeolite. This moisture is vaporized during regeneration of the adsorbent, and the vapor contacts the cooler vessel walls to

condense on the top and side walls of the vessel. This phenomenon is commonly termed "adsorption reflux." This phenomenon ceases once the adsorber achieves uniform regeneration temperature throughout the bed. However, the liquid water formed on the vessel wall during initial regeneration can cause agglomeration of the adsorbent material. This repeats with each successive regeneration operation and finally results in solid adsorbent material on the bed sides.

Crust formation measured on vessel walls



**In severe duty units,
standard molecular sieve
can break down and form
cake against vessel walls**



UOP MOLSIIV™ UI-94 Adsorbent

While 4A type zeolites had been the industry standard for natural gas dehydration, UOP researchers have developed a ground-breaking formulation, MOLSIIV UI-94 Adsorbent, offering improved performance under challenging operating conditions.

Features

- Robust formulation resistant to glycol/amine carryover to adsorber beds
- Tolerance to periodic water/liquid carryover incidences with ability to regain dehydration performance following upsets

- Capability for higher regeneration temperatures, ideally between 300 to 650 F (149 to 343 C)
- Higher cycled water capacity with longer life
- Designed for difficult services and changing process conditions

Benefits

Improved service life

- Lowers risk of premature change-outs or unscheduled shutdowns
- Enables longer onstream runs
- Designed to provide enhanced performance stability and a predictable life pattern

Performance

- Ability to recover from liquid/amine carryover incidences
- Improved breakup resistance under reflux conditions
- Breakup resistance ensures stable pressure drop leading to increased liquid recovery and reduced recompression costs

Reliability

- Improved resistance to coke buildup in the presence of liquid hydrocarbons
- Withstands coke formation due to methanol coking on the adsorbent

Case Study A

Reduced downtime at an NGL plant

Situation

An American NGL plant was experiencing excessive nitrogen purging time and costs and reduced on-stream time from frequent and lengthy recharges due to an agglomerated adsorbent bed.

UOP solution

Analysis of the 4A molecular sieves showed high levels of coke formation consistent with agglomeration. On-site technical assistance determined the vessels were seeing severe reflux. UOP provided MOLSIIV UI-94 Adsorbent, offering break-up and agglomeration resistance, low-coking tendency and performance resiliency in reflux conditions.

Customer benefits

Prior to use of MOLSIIV UI-94 Adsorbent, dumping the agglomerated molecular sieve bed required six days of nitrogen purging to achieve the lower explosive limit required for vessel entry. Excessive purging was needed to purge the hydrocarbons trapped in the molecular sieve agglomerates.

Purging of the non-agglomerated MOLSIIV UI-94 Adsorbent was possible within a day, resulting in \$80,000 in nitrogen savings and avoidance of five off-line days. At full flow rates (200 MMSCFD), the lost gas and NGL revenue equaled approximately \$3 million.

Experience You Trust

UOP provides processes, technologies and equipment for gas processing, refining and petrochemical industries. With five engineering centers and 11 manufacturing facilities in 16 countries, we are close to our customers wherever they are. Since 1914, UOP has developed more than 70 licensed processes for the industries we serve. We are the world's leading supplier of catalysts and molecular sieve adsorbents and provide a full range of technical services and support.

MOLSIIV UI-94 Adsorbent has been successfully integrated in approximately 150 natural gas dehydration plants around the world.

Adsorbent technical service and support

We offer unparalleled service and support to help ensure you maximize the use and life of your UOP adsorbents.



Our highly trained and experienced staff is positioned around the world, and dedicated to meet your business needs quickly and efficiently. Some of the services we offer, include:

- Process design to determine optimal configuration and operating conditions for your application
- Start-up assistance to ensure on-time and effective product implementation
- Performance evaluations to facilitate preventative action
- Troubleshooting to diagnose problems
- Operations analysis to help improve your productivity and profitability utilizing world-class UOP laboratory, pilot plant and simulator resources

Find out more

If you are interested in learning more, please contact your UOP representative or visit us online at www.uop.com.

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Commitment to innovation

At UOP, continued innovation is paramount to the success of our current and future technology and products. Customer opinion and feedback is the cornerstone of our product development programs. We work closely with our customers to identify, review and prioritize their requirements through voice of the customer campaigns.

UOP applies a conscious effort to embark on development programs addressing the challenges, problems and improvement needs of our customers. UOP research scientists and engineers utilize state-of-the-art facilities and tools backed by sophisticated pilot plant support in the development and commercialization of real-world solutions.

Case Study B

Significant cost savings at a cryogenics plant

Situation

An Asian natural gas cryogenic separation facility was experiencing frequent adsorbent change-outs.

UOP solution

UOP's adsorbents technical service team conducted an audit of the facility, and the cause of failure was identified as liquid water carryover from the upstream separator. Proprietary modeling on operating conditions also revealed a reflux situation in the adsorber vessel. UOP provided a recharge of MOLSIV UI-94 Adsorbent, which offers break-up and agglomeration resistance.

Customer benefits

During operations with MOLSIV UI-94 Adsorbent, the plant experienced some liquid carryover instances. However, after these upsets, little or no deterioration of adsorbent performance was observed over prolonged usage. Prior to the use of MOLSIV UI-94 Adsorbent, the frequency of dumping competitive molecular sieve beds averaged nine months. At full flow rates (600 MMSCFD), the plant was able to operate 30 months with UOP MOLSIV UI-94 Adsorbent.

At these flow rates, avoiding two shutdowns resulted in savings of more than seven online days. Overall savings for the unit exceeded \$5 Million (including adsorbent replacement savings).



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OUR COMMITMENT TO SUSTAINABILITY

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