

# 2008 Adsorbents & Gas Processing Technology Conference



*Advancing Technology to Meet the Challenges Ahead*

**December 1, 2008  
Abu Dhabi, UAE**

**Conference Topics:**

- Integrated Gas Complexes – Mercaptan Removal
- CO<sub>2</sub> Removal from Natural Gas
- Natural Gas Liquid Recovery – Ortloff
- Improved Dehydration Adsorbents
- Mercury Removal Solutions
- UOP R&D Vision

We are pleased to invite you to UOP's 2008 Middle East Adsorbents & Gas Processing Technology Conference. Gather with industry specialists, regional colleagues and UOP experts to discuss key technology challenges and potential solutions. We'll share ideas on issues that impact the gas processing business in the Middle East every day. Please join us!

**To register for the conference, please contact**

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## 2008 UOP Middle East Adsorbents and Gas Processing Technology Conference

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### Agenda

#### REGISTRATION

08:00 – 09:00

Continental Breakfast Served

<b>Keynote Opening Address: <i>Advancing Technology to Meet the Challenges Ahead</i></b>	<b>Mark Lewis</b> Director – Separations, Additives & Specialties Catalysts, Adsorbents & Specialties UOP LLC
<b><i>World Scale LNG Feed Pretreatment Technology – The Advantages of Integrated Approach</i></b>	<b>Steven Struyf</b> Account Manager – Continuing Services Gas Processing UOP Middle East
<b><i>Overview of UOP Membrane Technology for Acid Gas Removal</i></b>	<b>Tom Cnop</b> Group Leader Gas Processing UOP NV
<b><i>Advancements in NGL/LPG Recovery Technologies from Natural Gas and LNG – Presentation by Ortloff</i></b>	Ortloff speaker to be announced
<b><i>Extending Molecular Sieve Life in Natural Gas Dehydration Units</i></b>	<b>Hank Rastelli</b> Research & Development Associate Gas Processing UOP LLC
<b><i>Mercury Removal Solutions for Gas Processing Plants</i></b>	<b>Neil Eckersley</b> Principal Project Management Specialist UOP Ltd
<b>Question &amp; Answer Session</b>	Facilitator



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### **Presentation Abstracts**

#### ***World Scale LNG Feed Pretreatment Technology – The Advantages of Integrated Approach***

Natural gas streams are typically treated for control and removal of multiple acid gas contaminants (CO<sub>2</sub>, H<sub>2</sub>S and mercaptans) and in most cases these compounds cannot be removed cost-effectively by a single technology. The number of technology units, determined by the types and quantities of the different acid gas components, and how they are integrated will significantly impact overall project economics and success.

UOP has designed and implemented a unique flow-scheme which is being utilized to effectively remove and control all acid gas components prior to liquids recovery. The flow-scheme takes advantage of each technology's strength, while maximizing integration to minimize capital and operating costs. The flow-scheme minimizes the number of required units and optimized integration results in a very cost effective and technically comprehensive complex.

- Specific end product requirements will determine the most cost effective Integrated Pretreatment block configuration.
- Integrated Pretreatment block technologies are each by itself commercially proven.
- Specific UOP design features on each of the technologies help to minimize overall project and operating costs.
- The Integrated Approach has been commercially proven in the current world scale natural gas processing plants and further designs are ongoing with total operating installed pretreatment capacity by 2009 around 14 BSCFD

#### ***Overview of UOP Membrane Technology for Acid Gas Removal***

Membranes have become an established technology for carbon dioxide removal since their first use in this application in 1981. This technology is widely practiced for the treating of pipeline gas, enhanced oil recovery (EOR), bulk removal of CO<sub>2</sub> on offshore platforms or in remote desert sites, and for upgrading of biogas for commercial sale. Membranes are used for the co-removal of CO<sub>2</sub> and H<sub>2</sub>S, but only when the sulfur levels are relatively low. The multiple benefits of membrane technology promised by early innovators have since been proven in a wide variety of installations in many locations around the world, and vendors of traditional CO<sub>2</sub> removal technologies have been quick to acquire or develop membrane-based processes to supplement their older processing routes. In some cases, the most-economical approach is to combine membranes with existing technologies. Membranes are also used to debottleneck existing solvent-based plants.



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UOP has developed polymeric membranes that can be used for bulk removal of H<sub>2</sub>S from natural gas even at very high H<sub>2</sub>S concentrations and at high operating pressures. This approach allows for more sustainable development of new sour gas fields or for retrofitting into existing applications. The membrane system can be used to make a large bulk cut of the acid gases, typically in the 70-90% reduction range, then final pipeline specifications can be met in a traditional amine process. The permeate gas from the membrane system can ideally be re-injected, as opposed to being converted to elemental sulfur and stored onsite. Significant reductions in capital and operating costs, as well as sulfur production costs, can be achieved through this new approach.

This paper summarizes the principles involved in CO<sub>2</sub> and bulk H<sub>2</sub>S removal by membranes, design considerations, UOP's experiences in large natural gas processing plants on offshore platforms and in remote desert sites, and the recent innovations by UOP's Gas Processing group on H<sub>2</sub>S removal in natural gas sweetening.

- Separex Membrane systems are a solid and proven technology for the removal of acid gases.
- Separex membrane systems are ideally suited to installation in remote regions: offshore platforms, FPSO's or remote desert locations
- With correct UOP pretreatment design, membrane systems are extremely reliable and efficient
- Application of Separex membrane systems at higher levels of H<sub>2</sub>S removal: UOP has completed pilot plant testing at conditions up to 1400psia (100 bar) and 20% H<sub>2</sub>S.

## ***Advancements in NGL/LPG Recovery Technologies from Natural Gas and LNG***

The current state of the art in process technology for the efficient recovery of hydrocarbon liquids from natural gas and LNG streams will be reviewed. This presentation will address issues such as operating efficiency, stability and flexibility; CO<sub>2</sub> tolerance; and LNG integration and fractionation.

## ***Extending Molecular Sieve Life in Natural Gas Dehydration Units***

Today's natural gas plant designs and operating conditions have led to an increased severity of regeneration conditions for the molecular sieve inlet gas dehydrators. High moisture concentrations, large temperature gradients, high pressure regeneration gas, and dehydrator vessel design practices promote the formation and refluxing of free liquid water. Hot regeneration gas that is saturated with hydrocarbons and water comes into contact with the cooler top vessel head and upper section of the molecular sieve bed, causing condensation to occur both in the bed and on the vessel walls. The intimate contact of molecular sieve with the rapidly vaporizing liquid water and hydrocarbons in this liquid reflux zone results in accelerated



particle break-up; leading to (non-uniform) pressure drop build-up through the molecular sieve bed, and, ultimately channeling and premature water breakthrough.

To resolve this problem, UOP has developed UI-94 MOLSIV™ Adsorbent:

- Overcomes the problems of rapid break-up
- Resists pressure drop increase caused by refluxing
- Increases operational life in severe service NG units by at least double

## ***Mercury Removal Solutions for Gas Processing Plants***

Mercury is present in many of the world's natural gas fields. Process plants with brazed aluminum heat exchangers, including LNG facilities and nitrogen rejection units, are particularly susceptible to corrosive attack by mercury. There is an increased awareness on the part of gas processors to better protect their assets and address environmental concerns by removing mercury from their facilities. In recent years, mercury levels have increased from typical highs of 30 or 40 ug/NM<sup>3</sup>, to levels exceeding 1,000 ug/NM<sup>3</sup> in the Pacific Rim area.

In supplying purification solutions to the gas processing industry, UOP has developed a number of approaches for mercury removal. Several process options using both regenerative and non-regenerative fixed-bed technologies are now available. The protection of aluminum heat exchangers can be accomplished using a layer of silver-containing molecular sieve, inside the dehydration vessels. The active silver forms an amalgam with any mercury present and its zeolitic substrate adsorbs moisture in the gas to be treated. This approach offers flexibility in being regenerable, as the mercury-containing gas is by-passed around any cryogenic equipment. If necessary, condensed mercury can be collected and the mercury-entrained gas, treated with a small non-regenerative guard bed. Another approach uses non-regenerative metal sulphides to remove mercury from the raw gas, upstream of the dryers and the amine unit. Utilizing larger vessels, this approach also protects the brazed aluminum heat exchanger and ensures less mercury contamination in and around the process plant.

A comparison of the mercury removal processes described above is made and several case histories are presented, examining the relative merits of regenerative zeolitic and non-regenerative metal sulphide-based solutions. The plant-specific drivers leading to the adoption of these technologies are discussed and the efficacy of each approach is critically assessed.

- UOP has recently been selected to supply products for several interesting mercury removal projects
- UOP is in the process of commercializing new non-regenerable products within the gas processing sector
- UOP can now contribute to a range of solutions to treat, remove and recycle mercury from a wide range of gas processing plant flow-schemes