Gas Processors Association – Europe

promoting technical and operational excellence throughout the European Gas Industry

February Conference 2010

Technical Meeting
ADVANCES IN PROCESS EQUIPMENT

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Knowledge Session
MASS TRANSFER

Wednesday 24th - Friday 26th February 2010

Venue:	**Marriott Rive Gauche, Paris, France** **17 Boulevard St Jacques, 75014 Paris**
Registration:	**Wednesday 24th at 18:00 hrs**
Welcome Reception:	**Wednesday 24th at 18:30 hrs**

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ADVANCES IN PROCESS EQUIPMENT - PROGRAMME

Thursday 25th February 2010

08:50	**WELCOME: Morning Session: Moderator – David Healey, Air Products, UK**
09:00	**Application of Nitrogen Refrigeration Turboexpander/Compressors to Large Scale LNG Trains** *Joseph Kugler, Air Products Air Products and Chemicals, Inc, USA* The desire to increase single train LNG production while staying within the constraints of proven and available equipment has led to the development of the AP-X® process cycle. This cycle uses multiple large scale turbo-expander/compressors (companders) in a nitrogen refrigeration loop for the final stage of LNG sub-cooling. Four 7-MW companders operate in parallel in each of six process trains. Dry gas face seals are used to minimize loss of the nitrogen refrigerant to atmosphere. High capacity oil thrust bearings allow application of a simple, intrinsically safe, passive thrust balance arrangement. A common lube oil system is used for all 4 companders. A CCC control system manages load sharing and surge protection. Challenges and achievements throughout the design, installation, commissioning and final on-stream operation will be reviewed.
09:30	**Thermo-Fluid Dynamics and Design of Liquid-Vapour Two-Phase LNG Expanders** *Simon Cathery, Costain Oil, Gas & Process Ltd, UK & Dr Hans Kimmel, Ebara International, USA* Modern process plants for the liquefaction of natural gas operate at high pressure to improve the overall efficiency of the cryogenic process. Following the condensation of the refrigerated gas the pressurized Liquefied Natural Gas (LNG) is expanded across a liquid-vapour two-phase expander to a lower pressure suitable for storage and transportation. The near-isentropic expansion process generates some vapour and the remaining liquid is cooled down. The aim of using an expander rather than a Joule-Thomson valve is to increase the amount of liquid and to decrease the amount of vapour at the outlet of the two-phase expander. By employing a two-phase draft tube at the exit of the two-phase expander, an increased amount of liquid is produced. The fluid dynamic operation and the thermodynamic performance of two-phase LNG expanders is presented and analyzed
10:00	**A Reliable Criterion for the Selection of Flashing Liquid Expanders** *Roger Dambach, Cryostar SAS, France* Turbines that remove enthalpy from a liquid and convert it into shaft power go back to the ancient Greco-Roman civilization. Today liquid turbines are applied to many applications. Even though the fundamentals of hydraulics have not changed a number of novel turbine concepts have appeared on the market such as the multistage reverse pump, the Euler turbine and the Variable Phase turbine. The specific speed constitutes a reliable criterion for the selection of the most suitable liquid turbine for a given application. When this criterion is applied to the expansion of liquid hydrocarbon fluids such as LNG or Mixed Refrigerant it is shown that a radial inflow turbine has the wider range of applications than a radial outflow (Euler) or Pelton (Variable Phase) turbine. This is especially true when considering an expansion below the saturated liquid line because a two-phase flow will always yield higher specific speeds than a fully liquid phase at turbine discharge.
10:30	**Coffee Break**
11:00	**High-Efficiency CO2 Compressors** *Peter Baldwin, Ramgen Power Systems, USA* Ramgen Power Systems is developing a unique shockwave compression technology for use on high molecular weight gases like CO_2. The primary goal is a low-cost, high-efficiency CO_2 compressor that will significantly reduce the overall capital and operating costs of Carbon Capture and Storage (CCS). CO_2 compressors represent approximately 1/3 of the significant capital and operating cost of a post-combustion, amine-based CCS system. The CO_2 compressor power required for a pulverized coal power plant is 8-12% of the plant rating, depending largely on the suction pressure. A 1,000 MW PC plant would require 100 MW, or 134,000 hp for CO2 compression at an estimated $150 million equipment cost for today's 3 x 50% configuration. Installation costs at $75-100 million would be in addition.
11:30	**An Overview of compression options for FLNG** *Tom Fuggle, Dresser-Rand, UK* This paper will review the various influences in the development of an FLNG project on determining the ultimate compression solution. The initial influence of the potential gas field(s) and environment on the compression trains will be considered together with managing fluctuations of production. The configuration of the compression trains, both motor and gas turbine drives, will be discussed and how this is matched to the optimum "size" of vessel. Areas of consideration include the compressor map, ambient performance effects, potential power ranges, selection of optimum power, power enhancement, waste heat recovery and remote condition monitoring. The paper includes benefits of matching the compression equipment to the process; optimisation of the equipment to improve efficiency, flexibility and availability to maximise LNG production and fiscal revenues; and considerations of CAPEX and OPEX costs.
12:00	**Optimisation of Large Gas Compression Systems for Gas & Condensate Fields using "Integrated Asset Models"** *Dr Sib Akhtar, MSE (Consultants) Ltd, UK* The design of compressors for large gas fields, normally centrifugal type, proves a challenge. Once reservoir pressures decline, production rates are constrained by the design of compressor facilities and cannot be easily changed. Compressor operating conditions, pressures and flows, constantly change with time due to reservoir depletion. This makes it difficult to specify the "compressor basis of design" at the early design stage and late changes have major detrimental impact on its cost and schedule. The paper examines different strategies adopted by operating companies, contractors and vendors for designing compression systems. The paper demonstrates the use of "Integrated Asset Model" of the gas field in which reservoir and sub-surface elements are integrated with different compressor designs thus enabling alternative compressor designs to be tested over field life. The Integrated Asset Modelling approach provides an optimised and robust compressor design with reduced risk of late design changes.
12:30	**Networking Lunch**

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	Afternoon Session: Moderator – Justin Hearn, BASF SE, Germany
14:00	**Challenges Related to Optimized Membrane Modules for Natural Gas Sweetening** *May-Britt Hägg, Department of Chemical Engineering, NTNU. Norway* Commercial membrane modules for natural gas sweetening are either made as spiral-wound membranes (Cellulose acetate and derivatives) or hollow fibres (polyimides). New materials with optimised separation properties for CO2 removal from natural gas are continuously in focus for research. For several materials such as Nan composites, facilitated transport membranes, carbon membranes both high selectivities and high permeance for CO2 are documented on laboratory scale. Increased separation properties will reduce membrane area and loss of methane. The challenge is to upscale the membrane from laboratory to pilot scale due to the lack of facilities and funds. The preferred configuration for membrane modules are hollow fibre due to their high packing density (permeation area). If the optimised separation properties are obtained in laboratory on flat sheet membranes, the challenge to convert to hollow fibres is significant – even with the same type of material. Durability of the membrane material towards components like H2S and higher hydrocarbons may easily be tested out on lab-scale, but life time has to be tested on pilot scale. Last but not least, high pressure test rigs are usually restricted with respect to where they can be placed.
14:30	**Separex™ Membranes for Natural Gas Treating - A Novel Design to Reduce Footprint and Weight.** *Tom Cnop, UOP N.V., Belgium* Membrane technology has been widely used for separating acid gases such as CO2 and H2S from natural gas due to cost effectiveness, reliability, ease of operation and suitability for remote installation (land-based or offshore). Some recent projects will be reviewed. Membrane elements are installed in series in a membrane tube and multiple membrane tubes are installed in parallel to form membrane skids. The size of such skids is controlled by the height and shipping limitations of the project. For large systems the amount of pipe work, as well as the structural steel to support the membrane modules, adds footprint and weight to the overall membrane system. UOP has developed a novel system for the membrane assembly called MultiTube. The MultiTube is based on a compact design with a pressure vessel containing a plurality of membrane tubes and flow adapters simplifying the process stream connections; thus increasing membrane packing density; and reducing the footprint and weight. UOP has developed this system from concept to commercial site demonstration. A 7-tube unit has been successfully demonstrated at a commercial natural gas plant. The MultiTube system will allow membrane systems to become even more attractive for large projects, whether onshore or offshore.
15:00	**Ensuring the Reliability of Aluminium Plate-Fin Heat Exchangers** *David Averous, Florian Picard and Gilles Aubert, Fives Cryogenie, France* Aluminium Brazed Plate Fin Heat Exchangers have been frequently used in cryogenics industry, in particular in gas processing applications such as LNG plants. The complex technology of Plate-Fin Heat Exchanger (PFHE) offers a high-level heat transfer capacity and a large range of allowable pressures, but requires highly skilled design. Optimal design leads to some difficulties because any hydraulic or thermal perturbation on a stream is directly propagated to the others through the aluminium core matrix, and could directly impact on the mechanical integrity of the exchanger. This is particularly applicable to off-design and non-steady state conditions. The paper focuses on the implementation of technical resources in order to provide accurate expertise for the operation of PFHEs, including thermo-hydraulic analysis and mechanical stresses studies. Some in-house computational tools are used to highlight the physical phenomena which are inherent to the behaviour of PFHEs. The reliability of PFHE is directly based on such calculations in order to define and continuously improve the standard design rules.
15:30	**Coffee Break**
16:00	**Design and Verification of Internals Used for High Pressure Gas Scrubbing** *Dag Kvamsdal, Cameron Process Systems, Norway* High pressure gas scrubbing has proven to be challenging. The future high pressure scrubber designs should be compact, robust and use scrubber internals that are verified at real flow conditions. Internals used in high pressure gas scrubbing are often verified at low pressure with model fluids or air water test set ups. This will discuss why air water test setups and low pressure testing using model fluids are not appropriate for internals operating at high pressure. It will emphasize the importance of doing tests in real fluid systems at high pressure and which physical effects will affect the separation performance at high pressure. The paper will discuss the use of CFD for designing high pressure internals for gas scrubbing; the possibilities and limitations of using CFD in the design of gas scrubbers.
16:30	**Experimental Efficiency Determination of a Solid Separator Device: Wringing Separator** *Liberato Ciccarelli, Eni, Italy* The paper compares designs of separation devices for removal of iron oxides from gas streams and will provide a ccomparison between separator with single internal device and multiple inlet devices
	Conference continues with Knowledge Session on Friday 26th at 09:30

Technical Meeting kindly sponsored by Technip

Conference Dinner at 19:30 hours kindly sponsored by Total

Knowledge Session

Date: **Friday 26th February 2010 09:30 – 12.00 hrs**

Venue: **Marriott Rive Gauche, Paris**

MASS TRANSFER TECHNOLOGY

Presented by : KOCH-GLITSCH

Mass transfer internals in one form or another are used in most industries. They are extremely important to the hydrocarbon processing industries where they are used in distillation columns, absorption columns and stripping columns. Due to the many different conditions under which internals can operate, it is essential that the correct mass transfer internal is selected to ensure that the most cost effective solution is realised. This session looks at the main considerations for selecting the appropriate internal for any mass transfer application and focuses on the importance that column internals (distributors, supports, collectors etc.) have on the efficient operation of packed mass transfer columns.

The following is a brief overview of the content of the session.

- Differences in mass transfer mechanisms of trays, random packings and structured packings
- Generalised internals/ application guidelines
- Overview of hydraulic models for high performance packings
- The effects on column efficiency of the internals

Finally, there will be a Question and Answer Session for all participants.

Presenters will be:

Martin Copp: Koch-Glitsch Global Technology Management, Packed Tower Products.

Claire Haycock: Koch-Glitsch Senior Process Engineer.

*The Knowledge Session is **free** to all GPA Members, Individual and Corporate.*

Numbers are limited so please register early!

The Charge for non members will be £100.00 GBP / €120.00 EUR

GPA reserves the right to alter the timings of the papers presented or to substitute alternatives should circumstances so dictate.