IN BRIEF

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GAS PROCESSORS ASSOCIATION EUROPE

USING COMPUTATIONAL FLUID DYNAMICS TO INCREASE PROFITABILITY

By Sylvain Devynck and Christian Bladanet

The last decades have seen a considerable increase in the role played by Computational Fluid Dynamics (CFD) within industrial engineering. The oil and gas industry is no exception.

Driven by both hardware and software improvements, CFD has become a key tool to improve the safety of installations, validate or optimise process equipment as well as help troubleshooting operational issues. At plant scale, the use of CFD can also contribute to the layout definition by anticipating potential problems regarding equipment performances as well as workers' safety. Being fully aware of CFD capabilities and effectiveness, project managers are giving themselves more opportunities to lower both capital and operational expenditure.

Introduction

CFD is a branch of fluid mechanics that uses computing resources, through numerical methods and mathematical modelling, to compute fluid behavior while interacting with other fluids and/or the environment. By solving the governing equations of fluid mechanics throughout a well-defined domain divided in small volumes (cells), complex flows can then be predicted which would not always be easily or rapidly feasible using experimental methods.

The history of CFD is closely related to the evolution of modern computers. CFD has grown quickly in the 1960s and 1970s when advances in computer power have allowed us to make numerical solutions possible for the developed algorithms. Through the years, driven by the interest of some industrial sectors, such as the aeronautical industry, complex developments have originated in several areas such as turbulence modelling, multiphase flow, phase change, compressible flow and counting. Associated with these considerable efforts, several commercial computational codes have emerged, giving the engineer a powerful tool set to rely on.

Introduction to CFD study

Using CFD for an oil and gas project brings added value to ensure efficiency of the design, not only at the equipment scale but also for the overall plant. Assessing complex phenomena through CFD analysis (for example temperature patterns in large piping, and flue gas plume impact on air coolers) gives the engineer an important insight on expected plant performance. This can be demonstrated through the case study of an air cooled heat exchanger (ACHE) design.

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Application to oil and gas: From the entire plant to the equipment

Whether for offshore facilities or onshore plants, a large amount of heat is generated by the process and the equipment. Dissipation of process heat is achieved in different ways but when an air-cooled based solution is considered, the impact of hot air recirculation can be very detrimental to plant performance, if not properly assessed and mitigated. CFD can provide a powerful analysis in such a case, allowing the identification of potential loss of performance, but also to test corrective solutions.

Depending on the process design requirements and the engineering sizing criteria that is used, it is becoming common to see ACHE as long as 150 meters. This is for example the case of large LNG plant refrigerant condensers which are of such a size that they can be seen even from space. Any optimisation of such massive equipment results in significant investment and operational cost savings, either by reducing the cooler size or by increasing the production.

After modelling the geometry of the entire plant to accurately define the ACHE exhaust plume, taking into account the most likely ambient conditions (wind direction and velocity, and ambient air temperature), powerful post-treatment tools allow the CFD engineer to analyse the impact of any heat source and hot air plume on air-cooled heat exchangers (ACHE), gas turbines or any other equipment sensitive to warmer temperatures. If required, adjustments can be tested before being implemented in the design, since the complex phenomena involved in air recirculation often make it difficult to predict intuitively the full consequence of a modification.

Thus, one can understand the critical need of responsiveness of CFD, especially in project early phases such as Conceptual Definition and Front-End Engineering Design when back and forth discussions between the CFD engineer and the project engineering manager can be required to determine the optimal layout configuration.

At the early stage of a design, a simplified model using a block with given porosity can provide a preliminary, but still sensible, picture of the overall hot air distribution, and will allow the identification of the potential modification of the plot to mitigate the air recirculation effect across the plant, within a time frame fitting the project stage.

As the project evolves and becomes more detailed, the model can be refined to get a close view of localised air temperature patterns.

The emergence in the last few years of new solutions based on surface wrapping technology has begun to meet this need. Rather than reconstructing from scratch the plant geometry using basic geometrical shapes, importing directly 3D CAD Model into CFD software leads to considerably lower study time. Besides saving time, this solution also increases the fidelity of the CFD model improving the accuracy of the results.

Figure 1: Large air cooled heat exchanger trains in Nigeria LNG Plant, from Google Earth

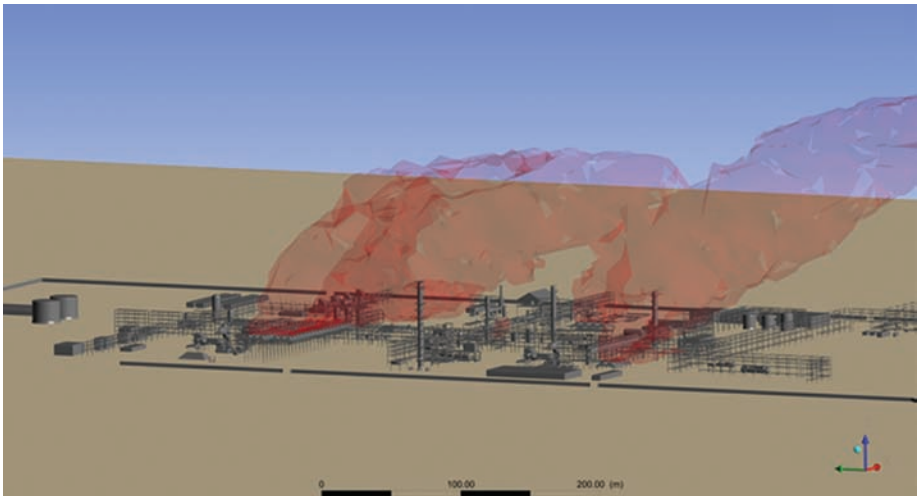
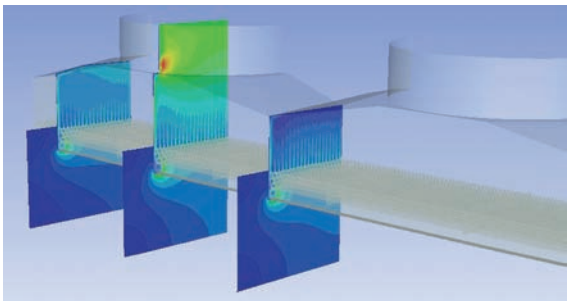


Figure 2: Hot air plume exiting ACHE – hot air recirculation CFD simulation

Working on a smaller scale, CFD can also make a difference. By developing a CFD model of complex equipment, one can have a much deeper understanding of the local phenomena happening inside or around it. In addition to the usual engineering tools, CFD can help optimise the design by reducing the margin generally applied to account for uncertainties inherent in less sophisticated tools and method.

Because of the high number of fins surrounding the tubes and the huge scale factor between the fin thickness and the tube length, building a CFD model which faithfully reproduces the full ACHE geometry is not achievable today. Such a model would require computing resources and calculation times that are totally incompatible with industrial project timeline constraints. To overcome these limitations, the CFD engineer has the possibility to customize the software almost entirely, adding in-house built models. Using that approach, Technip CFD engineers have developed a simplified ACHE model, simulating the effect of the fins (e.g. flow resistance and enhanced heat transfer) without having to include them in the geometry. This has enabled a reduction in the model size (number of cells) by a factor close to 500. Comparison between both approaches in the simulation of a small ACHE portion has shown that the use of the simplified model gives results accurately matching those of a fully detailed model but about one thousand times faster.

This simplified ACHE CFD model can determine the temperature evolution of the process fluid, the tube surface and the air flowing through the tubes in any area of the ACHE bundle, allowing computation of the expected duty. Using such a tool, the process engineer has the opportunity to explore at relatively low cost either the effect that potential external parameters would have on the equipment performance (variation of the wind velocity and direction etc) or the effect of any design modification.



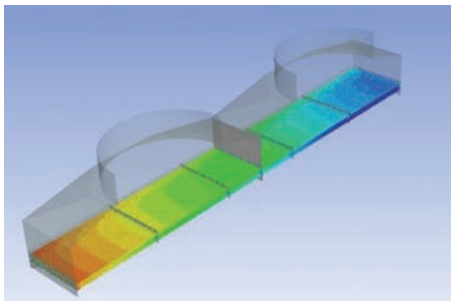


Figure 3 (left): Contours of velocity in several bundle transverse planes. Figure 4 (right): Contours of temperature at tube surfaces

As, during the course of the year the weather conditions can evolve significantly, the process engineer must find the best compromise to meet the performance criteria without having to overdesign the equipment. The flexibility and responsiveness of CFD, in addition to standard sizing criteria, could give the engineer more knowledge to provide the most optimal design. On massive equipment such as large LNG plant refrigerant condensers (Figure 1), being able to demonstrate the possibility of reducing the heat exchange surface by applying optimum design margins could save substantial cost.

Conclusion

Throughout the example of air distribution at plant scale and equipment level, CFD studies demonstrate the capability of being powerful tools to optimize the design and performance of oil and gas plants. CFD offers a great flexibility, allowing the possibility of either working at a local scale focusing on equipment performance, or at a larger scale to validate plant layout.

According to the level of accuracy required and the phase of the project taking place, the duration of the study can also be adjusted. In conceptual stage, preliminary results could be obtained within a week on a simplified model whereas in a detailed engineering phase (EPC) it could take several weeks in order to achieve an optimized solution built with a detailed and more accurate model.

Even though CFD is a powerful tool, the analysis of the problem leading to the definition of the model input data will remain the key success factor of such studies. Expertise in CFD modelling and comprehensive oil and gas engineering knowledge is paramount to take the full benefit of computing power and CFD results. As for any computational tool, nothing will replace the smartness and experience of an engineer to provide correct and fit for purpose input (in this case a model definition which is fine enough but not over-defined to optimize computing time), to analyse the results and engineering solutions that will ensure the delivery of a facility performing as per expectation and at the best cost.

Sylvain Devynck – CFD Engineer, Process and Technology Division – TECHNIP FRANCE

Christian Bladanet – Gas-Syngas Department Manager, Process and Technology Division – TECHNIP FRANCE

IS ADVOCACY A VALUE?

VIEW FROM THE TOP

GPA Europe chairman Paul Openshaw asks whether we should follow GPA Midstream's lead by becoming a political influence within our industry

Paul Openshaw

GPA Midstream

Following a long and sometimes heated debate, the Gas Processors Association in the US has changed its name to GPA Midstream.

The rebranding was announced during the 95th annual convention, which was held in New Orleans in April. Here is an extract from their eBrief magazine:

GPA Midstream was selected to more clearly identify the midstream industry role that we have evolved into in recent years, while also keeping the equity of the three-letter GPA reference by which we are most popularly known...

Another key consideration in the name change decision was the fact that "GPA" has become much more visible in Washington, D.C. and in several key energy state capitols as a result of our heightened advocacy efforts over the past few years.

In 2015, GPA Midstream opened a dedicated Washington, D.C. office to maximise GPA Midstream's legislative and regulatory influence and visibility. If you visit their website you will see that most of their recent news relates to lobbying initiatives.

What about us?

There are no plans to change the name of GPA Europe. There has been no suggestion from our colleagues in the US that we should consider doing so but the direction they have chosen to take should make us think about our organisation and whether we feel we could or should be doing more to influence the industry we serve.

Which causes would be worth fighting for?

As chairman of GPAE I would like to encourage members to share their ideas and opinions on how we are set up and how we should evolve as a group. I decided to use my first "View from the Top" article (In Brief issue 6) to take the opportunity to present my views on the opportunities for shale gas development. I did receive some positive feedback and a couple of members have come forward with a desire to champion the development of fracking but this has not resulted in any move towards GPAE lobbying on this issue. Looking back, there are a few possible explanations why we did not take the debate further:

- I am not sure whether I put enough energy into the case for fracking to stimulate our group into action.
- Or perhaps fracking is not the right cause for GPAE to lobby for?
- Or maybe it's just that the membership do not wish to see GPAE take on an advocacy role.

The case for maintaining purity

It has been interesting to see the development of the GPA in the United States. Their evolution into a lobbying body has been driven by their membership, which is now dominated by the Midstream players. It could be argued there has been a shift in their focus from the internal sharing of technical know-how towards external advocacy.

The make-up of GPA Europe is very different. European Operators do play a key role within our organisation but they are smaller in number. It appears to me that the participation and support of their representatives are born from their passion and thirst for technical exchange not by the will to change our industry. Long may this continue!

So I think I have reached the conclusion that lobbying is not for GPAE. However, this is my personal perception – and does not necessarily represent the views of the Management Committee. I would welcome your views.

YOUNG PROFESSIONAL TRAINING DAY MANCHESTER, 11 FEBRUARY 2016

MORNING SESSION

After the success of the initial Young Professional Training Day in 2015, GPAE returned to the Manchester Conference Centre for a similar event in February 2016.

Pleasingly, but unfortunately, registration had to be closed two weeks beforehand because the delegate number permitted by local fire safety regulations had been reached. On the day, the lecture hall was filled by a combination of employed YP's (not to mention a few of their older generation of colleagues) and university students. In the first category, a substantial delegation from Costain was noteworthy while, appropriately for a meeting in the heart of "The Northern Powerhouse", the universities of Bradford, Durham and Manchester were well represented. For GPA Europe members, the full texts of all papers are available at - https://www.gpaeurope.com/past-papers.aspx?archive=2016 .

Colin Woodward - First chair of the day

The Challenges for the Future of Natural Gas

With Colin Woodward presiding, John Sheffield of Petroskills opened the morning session with an enthusiastic and authoritative overview of "The Challenges for the Future of Natural Gas". In the limited time allocated to him, John covered sources and compositions of natural gas, the properties of LNG from different sources, methods of gas distribution (pipeline or LNG), its markets (commercial/residential, industrial and power generation) and briefly compared natural gas with other fossil fuels and renewables for power generation, in particular its use in Combined Cycle Gas Turbine (CCGT) power stations. John then summarised the technology used in gas processing plants to convert raw natural, or associated gas, into on-specification sales gas and, where relevant, higher hydrocarbon products. John painted a bullish picture for the future of the product and our industry and handled as many questions as time allowed very informatively.

John Sheffield - Petroskills

LNG Process Development and Design

After a welcome coffee break, Megan Jobson (Manchester University) and Xuesong Zheng (TGE Gas Engineering) then presented something completely different, their paper on "LNG Process Development and Design". This was an excellent example of academic-industrial collaboration and focussed particularly on smaller scale (< 1 MMtpa) LNG production. The authors' research had demonstrated that, while the Air Products pre-cooled propane mixed refrigerant cycle (C3MR) process is normally favoured for "worldscale" (2–7MMtpa) LNG plants, its complexity makes it less suitable for smaller facilities for which there is a trade-off between complexity and efficiency. The authors then presented their

Megan Jobson - Manchester University

Xuesong Zheng - TGE Gas Engineering

comparative study of different liquefaction processes for design of a small-scale (210 tonnes/day = 0.07 MMtpa) LNG plant with the aim of minimising compressor power consumption. They concluded that the new CryoMan-SMR™ offers improved energy efficiency over a standard SMR process for this application.

Absorption Dehydration

This presentation was followed by a second coffee break after which the chairman had some difficulty getting delegates to return to the lecture theatre for a prompt start of the next session which contained two papers describing well-established, but different, methods of dehydrating natural gas. Firstly, Gilles Elbaz, of Prosernat, discussed "Absorption Dehydration" focussing on glycol systems. He explained the reasons for gas dehydration (to avoid corrosion and ice/hydrate formation) and displayed the basic principles of a glycol (most commonly Tri-Ethylene Glycol) dehydration process. Gilles then described Prosernat's Drizo® process in some detail and followed with an overview of the practical aspects of using TEG and MEG units including their optimisation for hydrate inhibition (using the Ifpexol™ process), solvent regeneration and salt reclamation in a Mono-Ethylene Glycol (MEG) unit.

Gilles Elbaz - Prosernat

Molecular Sieves in Natural Gas Processing

Gilles was followed by Peter Hawes, representing Zeochem, who had travelled especially from Switzerland for the meeting. Drawing on several decades of experience, Peter talked authoritatively about "Molecular Sieves in Natural Gas Processing" beginning by describing the different types of molecular sieves (zeolites) and their applications, e.g. 3A or 4A for dehydration, 5A or 13X for removal of larger molecules such as mercaptans. He then covered the practical aspects of Thermal Swing Adsorption (TSA) and Pressure Swing Adsorption (PSA) systems for dehydration and sweetening of natural gas including design parameters, bed loading, optimisation of operation, and potential problems, e.g. liquids carryover, and trouble-shooting. Finally, for the mathematically-inclined, he displayed the Ergun Equation which is used for calculation of pressure drop in packed beds.

Peter Hawes - Zeochem

And so to lunch with more opportunities for networking between the students, the employed YP's and the "old timers" from the industry.

Colin Woodward

YOUNG PROFESSIONAL TRAINING DAY MANCHESTER, 11 FEBRUARY 2016

AFTERNOON SESSION

After lunch, Adam Jones of Costain took over the role of Chairperson.

Centrifugal Compressors for Natural Gas Applications - Overview

The first paper of the afternoon was presented by Federico Antonini, of GE Oil & Gas entitled "Centrifugal Compressors for Natural Gas Applications – Overview". Federico provided the delegates with a comprehensive overview of centrifugal compressors, a key piece of equipment on many gas plants.

Federico first emphasised the importance of compressors for gas applications, describing them as money machines for their customers! He then described the design process, emphasising the need for a bespoke design in each application and the variables that need to be considered to specify the compressor operating envelope. Driver selection and compressor mechanical configuration options were outlined. The main physical components of the compressor and options for physical arrangement of the package were then communicated, along with how this may differ for onshore and offshore applications.

Federico concluded by describing some of the most recent developments in compressor technology, including compact designs for offshore applications, which attracted great interest in the Q&A session.

Federico Antonini - GE Oil & Gas

Joseph Lillard - Atlas Copco

Turboexpanders for Hydrocarbon Processing and Power Recovery

The second presentation of the afternoon continued the theme of turbomachinery, with Joseph Lillard of Atlas Copco presenting on the topic of "Turboexpanders for Hydrocarbon Processing and Power Recovery".

Joseph covered the basics of expander operation and thermodynamics, before describing the key performance and sizing parameters, and how the process conditions impact the aerodynamic parameters.

He explained the elements of the turboexpander that are aerodynamically optimised and highlighted several important design concepts including power and speed balance. He demonstrated how a contour plot could be used to demonstrate the impact of off-design operation on expander efficiency.

Special concerns including process contaminants and two-phase flow, were discussed, along with availability, sparing and servicing. Joseph concluded by describing the use of turbo expanders in a power recovery context. In the Q&A, questions on failure modes and troubleshooting were addressed.

The Basics of Designing a Flare and Relief System

The final presentation of the afternoon was delivered by Wim Van Wassenhove, of Billington Process Technology. Wim tackled the topic of Flare and Relief system design - a critical safety system on any Gas Processing site.

Wim began by outlining the main components of a typical flare system, and explained how the design of these type of systems relies on the complex interaction of many parameters.

He went on to describe the importance of the relief scenario data as the foundation of the flare system design.

Wim Van Wassenhove - Billington Process Technology

Burner tip configurations were then discussed, and Wim explained the value of sonic tips in producing a stiffer flame, and consequently reduced radiation back to the platform in offshore scenarios.

Wim highlighted the importance of the knockout drum to prevent liquids blowing out of the flare, and highlighted other key design considerations.

And all the way from Australia...

Networking opportunities

Flare system configuration options were discussed, including the use of multiple flare stacks, and multiple flare systems of different design temperatures.

Wim followed this with a discussion on the relief sources and causes of overpressure, illustrated with some dramatic images of the consequences of plant overpressure incidents. The principles of operation and sizing of pressure safety valves (PSVs) were explained. He concluded with an explanation of the considerations required when designing emergency depressurisation systems, a section which attracted particular interest in the Q&A session which followed.

A lively networking session followed the conclusion of the afternoon's proceedings, and marked the end of another insightful and very well attended Young Professionals event. Many thanks to all of the presenters for sharing their knowledge, and to the attendees for their participation and enthusiasm.

Sandy makes University of Bradford visitors welcome

Training day speakers and chairman

GPA EUROPE SPRING CONFERENCE
PARIS, 21 APRIL 2016

TECHNICAL CONFERENCE – MORNING SESSION

Moderated by John A Sheffield

GPA Europe returned to Paris for their Spring Conference, this time in April, so the weather was markedly improved (no snow!). Once again the Conference was well attended and on the Thursday morning the delegates settled down for the introductory remarks by Paul Openshaw.

Prepare for Extinction

Malcolm Harrison, representing Petroskills, presented the first paper 'Prepare for Extinction' and he entertained the conference with a sharply focused but whimsical view of the issues facing the energy industry. The energy industry finds itself at a point of metamorphosis. On the one hand, in the midst of the largest supply and demand imbalance for a decade or more, on the other, under increasing pressure to respond to the challenge of climate change. In the short term this should lead to increased operating efficiency and a switch from oil to gas; in the longer term those who can't transform – the caterpillars – will die. The survivors will harness the brain power of their people and become the butterflies that will serve the much changed energy needs of the future world. The paper traced the intricate political path from Montreal in 1987 through to Paris in 2015, a journey that itself added to the climate change problem with all of the air miles the delegates clocked up. Gas undoubtedly offers a possibility of a short term means of reducing carbon emissions. Comparing the energy costs of different fuels at current market rates shows that gas has the ability to produce energy with 25% less CO_2 than oil and, even at current oil prices, at 40% of the price. However, at a marginal cost level as low as $3/MMBtu gas still struggles to compete with coal (at $50/tonne). The answer could be properly applied carbon taxes, but Governments lack the foresight to implement effective schemes. Malcolm concluded by stressing the need for training and development of the new cadre of engineers and stressed the value of the GPA.

Malcolm Harrison - John M Campbell

2MW Power Oxidiser generator

Waste Gas to Power

The second paper was presented by Chris van der Zande of G.I. Dynamics whose paper 'Waste Gas to Power' explored how waste gases with a low hydrocarbon content could be efficiently used for power generation. The process incorporates a 'Power Oxidizer'; a vessel containing ceramic beads which are operated at a temperature above the auto ignition temperature of methane – 600C. This lower temperature combustion process (compared to the temperature in gas turbines and gas engines) results in significantly lower emissions, specifically low NOx. The resultant hot gases are expanded through a turbine which generates power and further heat can be extracted from the exhaust gas. G.I. Dynamics have a number of units operating and believe that this technology has a real place in handling a wide range of low calorific value waste fuels such as biofuels. Currently available as either a 2MW or 250kW capacity, the process is envisaged as a complementary one that can be integrated into other operations and make a significant reduction to emissions.

Chris van der Zande - G.I. Dynamics

The Power of Tomorrow – A Hybridised Fuel Cell and Gas Engine Distributed Power Solution

Paper 3 was presented by John McGuiness of GE Fuel Cells (co – author Brandon Owens, GE Ecomagination) on the subject of "Hybridised Fuel Cells and Gas Engine Distributed Power Solution". After more than a century of technology development, market and technology forces are now converging to accelerate fuel cell adoption across the globe. These forces will work in harmony to expedite the integration of fuel cells into the global energy landscape in the decade ahead. In many ways, the adoption of fuel cells will mirror the renewable energy transition that has taken place over the last decade, which moved renewable power technologies from niche applications to mainstream power

John McGuiness - GE Fuel Cells

technologies. The three primary drivers that are moving fuel cells to the tipping point are: technology innovation; the emerging age of gas; and the rise of distributed power. The technology is based on a Solid Oxide Fuel Cell for which GE has developed an innovative new manufacturing technique which ultimately reduces the cost. Natural gas is passed through the SOFC which produces electricity, heat, water and syn gas. The development has been to use the syn gas as the fuel for a Jenbacher gas engine in a combined cycle configuration which generates power at 60-65% efficiency. The overall process efficiency can be close to 90% if the waste heat can be utilised. The FC-CC units are envisaged in capacity units up to 10MW and would fit into Distributed Power Grids and ideally could be combined with other renewable energy installations.

Innovative Machinery Selection for LNG Plants

Sébastien Maufrais of Technip presented the fourth paper on the subject of "Innovative Machinery Selection for LNG Plants". He noted that improvements in design are allowing more flexibility in machinery selection and efficiency improvements which lead to reduced CO_2 emissions. The paper focussed on the selection of the optimum driver for various LNG liquefaction schemes. He noted that both the Heavy Duty (HD) and Aero Derivative (AD) machines can now offer improved performance with variable speed capability and efficiency up to 40% for the HD machines and AD machines up to 100MW and maintenance schedules similar to HD machines. The advantage of this selection efficiency is now allowing the reliance on HD machines for large scale configurations to be challenged and he noted that several LNG projects are now being developed with innovative driver schemes.

Don't Let Lean Keep You From Clean – Treat Lean H_2S Gas With Topsøe's WSA Technology

The final paper of the morning session was presented by Helge Rosenberg of Haldor Topsøe giving a paper on treating lean H_2S gas with Topsøe's WSA technology. Most gas processors tend to run a mile from any chemistry but the need to deal with sour gases effectively has always been one of the great challenges. The Topsøe WSA process converts H_2S streams directly to sulphuric acid and would avoid the need to use the Claus

Sebastien Maufrais - Technip

Helge Rosenberg - Haldor Topsoe

process and its various derivatives and add-ons in order to comply with sulphur emission levels. The WSA process is well proven in the refining and petrochemical industry with over 130 units world-wide, but to date has few references in gas processing facilities. But it is clear that the application of the technology could add another dimension to the problem of dealing with waste sulphur. The process is well developed and has low energy costs and low operating costs and for processing sour gases should be considered.

This paper closed a very stimulating morning session which had covered a wide range of topics and gave the members much to discuss over lunch.

The chairman awards a speaker's gift

GPA EUROPE SPRING CONFERENCE PARIS, 21 APRIL 2016

TECHNICAL CONFERENCE – AFTERNOON SESSION

Moderated by Nathalie Millot, Technip

Due to the cancellation of the last paper of this session and the rescheduling of one paper in the morning session, plenty of time for presentations and questions was available for the three afternoon presenters.

Nick Amott - Fluor

Eric Cloarec - TOTAL SA

Typical Process Challenges and configurations for Sour Gas Mega Projects

The objective of this first paper presented by Nick Amott from Fluor was to reassure that large scale sour gas projects are technically feasible and that safety issues are assessed. Knowing that 40% of remaining gas reserves are sour, new projects of this type will certainly be developed in the near future.

From a technical point of view, Nick summarized the issues that arise during the development of a sour gas project including the presence of organic sulphur and the impact on both the AGRU and SRU design.

Although AGRU, SRU & TGTU technologies are well known and demonstrated, the challenges are focused on the appropriate solvents selection to treat all sulphur compounds as well as the physical size of such units when talking about mega projects.

Certain aspects of the project, although not directly related to the sour gas treatment, will be impacted and these include the requirement in hot climates for substantial refrigeration systems and the recognition that significant steam systems are required, along with their water treatment support. The liquid products (condensates) may also require further treatment to achieve sulphur specifications. As the levels of H_2S rise, not only does organic sulphur become a problem, but potentially the deposition of elemental sulphur in the production system may need to be addressed.

From a safety point of view, the presentation showed that risks due to high pressure with highly corrosive and toxic fluids can be mitigated by implementation of different solutions such as segregation of zones, appropriate safety distances, and appropriate material selection.

HySWEET® : Improved solution for Selective Gas Processing

Eric Cloarec from TOTAL SA presented a paper, co-authored by Claire Weiss and Jing Zhao also of TOTAL SA, on the development made by TOTAL in H_2S and CO_2 removal with the HySWEET® process, which offers the advantages of higher mercaptan removal capacity while maintaining a high CO_2/H_2S selectivity for a cost effective sour gas treatment system design.

The Hysweet® process uses a hybrid solvent formulation based on a mixture of an amine and a physical compound. This process is the result of many years of development within TOTAL including laboratory measurements to develop a model validated by pilot tests and industrialization. Through these years of development, the following advantages of the HySWEET® process have been demonstrated:

- Operation is similar to the operation of the classical amine unit without (or with very limited) equipment modification, and this process is therefore appropriate for solvent swap operations.
- Mercaptan removal efficiency is significantly improved.
- Improved energy efficiency: solvent regeneration reboiling energy is reduced by up to 15% compared to more classical amine process.

The drawback is hydrocarbons co-absorption which is increased; however, compared to the

other existing hybrid solvent it is significantly reduced and concentration of HC including BTEX in acid gas is acceptable for the downstream SRU unit.

As of today this process records seven years of operation with no operational issues with two units having swapped original solvent to Hysweet, and one grassroots plant.

Reducing LNG plant CO_2 footprint by improving the efficiency of the C_3/MR pre-cooling cycle.

The afternoon session ended by proving that there is still room for improvement in the efficiency of a Carnot refrigerant cycle.

Aline Buffet from Technip focused her presentation on the efficiency improvement of the Propane Refrigerant cycle used in a C_3/MR liquefaction process with enhanced heat transfer solutions. Her paper was co-authored by Jeremy Provost and Laurent Brussol, also of Technip.

Propane condensers and propane evaporators are the two main functions with heat exchange in this cycle.

Aline Buffet - Technip

Since the early 2010s, dual enhanced tubes such as the GEWA-PB tubes manufactured by Wieland Thermal Solution allows the reduction of the temperature approach of the propane evaporators from the traditional 3°C with low fin tubes down to 2°C while maintaining an identical footprint of the heat exchangers; this reduction allows an increase in the LNG production at identical compression power of the refrigerant cycle.

A similar approach is now available for the propane condenser which is the largest air cooler in air-cooled LNG plants, dictating usually the footprint of the LNG train. Technip, Wieland Thermal Solution and Kelvion developed a Dual Internally and Externally Structured Tube for Air coolers called DIESTA. This tube allows the reduction in footprint of an LNG train down to 10 to 20% at a given LNG production or an increase of the LNG production by reducing the temperature approach of the exchanger.

By combining both above mentioned solutions in a Propane pre-cooling cycle which represents 30 to 40% of the total refrigeration power of the C_3/MR liquefaction process, this allows to better balance power and adapt compressor arrangement of the liquefaction process and increase LNG production with an improved liquefaction efficiency, hence reducing CO_2 emissions.

The session was brought to a close with instructions for joining the highly anticipated Conference Dinner on the Seine that evening.

Time for a break and a catch up

Questions from the floor

GPA EUROPE SPRING CONFERENCE DINNER

Paris, 21 April 2016

GPA Administrator, Sandy Dunlop, surpassed all expectations once more by organising a stunning evening's entertainment. Delegates were transported from the Marriot Rive Gauche by coach to the banks of the River Seine, where they embarked for an evening's cruise on a privately booked vessel courtesy of Bateux Mouches.

The lucky conference-goers were treated to a first rate three course dinner whilst viewing some of the most famous sites in Paris including The Eiffel Tower, Notre Dame and The Louvre.

Paul Openshaw, GPA Europe chairman, brought the evening to a close with a toast to the British monarch on her 90th birthday. Far less importantly, the In Brief editor, Claire Haycock, received a similar toast as she had also celebrated a birthday the week of the conference (although not quite so aged!). Claire was absolutely thrilled and honoured when the waiters served her a special dessert complete with candle and sparklers.

Then it was time for the diners to step up to the deck to see the magical sights of Paris lit up by night on the return journey.

A very special evening was enjoyed by all!

Claire Haycock - In Brief Editor

Notre Dame

GPA EUROPE SPRING CONFERENCE
PARIS, 22 APRIL 2016

TECHNICAL MEETING – MORNING SESSION

Moderated by Malcolm Harrison of John M Campbell

Technology Screening Study of Offshore CO_2 Removal from Natural Gas for the Purpose of CO_2 Use and Storage

Mark Sankey of BP (representing CCP, the CO_2 Capture Project) set a theme of Carbon Capture and Storage. Removing CO_2 to meet specifications for transportation and use is an established practice for natural gas processing: however projects are now being asked to meet

Mark Sankey - BP

specification requirements for the CO_2 where geological storage, perhaps with CO_2 EOR is contemplated. Mark's paper provided a description of some excellent work that CCP has commissioned: a technical screening study for offshore CO_2 removal from natural gas with the aims of determining state-of-the-art, identifying emerging and potentially breakthrough technologies, and evaluating their cost and performance. CCP is currently assessing possible technology development or demonstration projects that it could support.

Key Role of Membrane Gas Separations in the Utilisation of an Underground Natural Gas Reservoir for the Renewable Energy Storage

Aleksander Makaruk then presented some work that Axiom and Rohöl-Aufsuchungs AG have completed in collaboration. The paper was co-authored by Johannes Szivacz, also of Axiom

Aleksander Makaruk - Axiom

Angewandte Prozesstechnik, and Stephan Bauer and Lukas Schlegl of RAG Rohöl-Aufsuchungs AG. This was a wonderfully innovative piece of work that demonstrated how surplus power generated from renewable sources could be 'converted' to natural gas taking advantage of existing gas storage infrastructure. In particular, the presented technology involves the injection of hydrogen along with natural gas into an underground reservoir for the surplus energy storage, whereas membranes are used to adjust the hydrogen content during the gas withdrawal phase.

Eco-Design of an Offshore Project Using Life Cycle Assessment (LCA)

Christophe Héraud of Technip then presented a paper (co-author Pierre – Michel Letanneux) entitled "Eco-Design of an Offshore Project Using Life Cycle Assessment (LCA)". Life Cycle Assessment is a recognised methodology to address the facility environmental impacts: climate change; resource depletion; eutrophication; toxicity; acidification etc.

The paper illustrated an analytical approach to assessing the life cycle cost of different designs based on their environmental attributes. A methodology that could become increasingly important as the new technologies to address climate change are commercialised the Eco-design study can also present convincing arguments for project stakeholders such as authorities, local communities and financiers.

CO_2 from Gas Treating Facilities for Enhanced Oil Recovery

After the coffee break, René Elms, from Bryan Research and Engineering presented an overview of the benefits of CO_2 in Tertiary Enhanced Oil Recovery. The paper was co-authored by Mahmoud El – Halwagi also of Bryan Research and Engineering.

Gas treating facilities have the potential to be sources of miscible injectant for enhanced oil recovery (EOR) projects given a sufficiently high raw gas feed rate and CO_2 concentration. Facilities employing acid gas enrichment (AGE) to enrich H_2S for sulphur recovery also have the potential to supply CO_2 for EOR projects. Furthermore injection of AGE contactor overheads would provide a reduction in the facility CO_2 footprint.

Rene Elms - Bryan Research and Engineering

In particular the paper focused on some economic mapping of a proposal to recover CO_2 from an Acid Gas Enrichment Unit. Finding a means of generating revenue from CO_2 is a key element of the CCS triangle comprising revenue generating, government subsidy and technological innovation.

Drying of CO_2 in Process Applications Using Molecular Sieves

Finally, in the last session of the conference, Howard Secker of Grace GmbH & Co (co-authors KG and E. Bergene, Statoil ASA) provided an overview of the use of molecular sieves for both the removal of CO_2 and water.

Paris speakers and moderators

The removal of CO_2 from process gas may be required for example to meet heating value specifications, avoid corrosion issues, and to prevent freezing in low temperature processes. Nowadays for environmental reasons, after removal, the CO_2 cannot be released directly to the atmosphere. It is therefore often used for commercial applications, enhanced oil recovery, or sequestration. In all of these applications, the CO_2 has to be dried before processing. With the right product selection and optimized operation, molecular sieve dryers can provide a solution for dehydration of CO_2 to low product specifications, to avoid hydrate formation, freezing, or corrosion issues.

The paper concluded that molecular sieves can provide a solution for drying CO_2 as long as the correct grade is chosen to minimize damage from carbonic acid attack. In addition, steps should be taken within the regeneration method to minimise reflux condensation.

Howard Secker - Grace GmbH & Co.

AUNGIER AWARD 2015

GPA Europe is delighted to announce that the Aungier Award for 2015 has been awarded to Fabio Brignoli of Tecnimont for his presentation at the Annual Conference in Florence in September 2015 entitled "An Innovative Technology for Natural Gas Sweetening by means of Cryogenic Distillation" which was prepared by Laura A. Pellegrini & Stefano Langé, Politecnico di Milano, Oldrich Mikus, Stamicarbon, and Barbara Picutti, Paolo Vergani, Guido Franzoni, Marco Lo Savio & Fabio Brignoli, Tecnimont. The award will be presented to Fabio at a forthcoming meeting.

The Aungier Award is made to the best presentation by a Young Engineer (student or less than five years out of college) and consists of a plaque and £1000 payment directly to the individual.

Winner of the Aungier Award - Fabio Brignoli - Tecnimont

FORTHCOMING EVENTS

ANNUAL CONFERENCE
21 - 23 September, 2016

Divani Apollon Palace Hotel, Athens, Greece

Joint Conference between GPA Europe and GPA Gulf Chapter

- 2 days of conference
- Conference Dinner
- Companions Tour
- Sponsor's Exhibition

AGM & TECHNICAL MEETING
24 November 2016

Hilton London Paddington, London, UK

- Knowledge Session - Production Water Handling
- Technical Meeting - Water Handling in Gas Wells and Production Plants

YOUNG PROFESSIONAL TRAINING DAY
16 March 2017

IFP School, Rueil Malmaison, Paris, France

SPRING MEETING
17 - 19 May 2017

Hilton Garden City, Milan, Italy

- Exploitation of Low Price Natural Gas
- Knowledge Session
- Technical Presentations
- Conference Dinner

ANNUAL MEETING
13 - 15 September 2017

Sofitel Hotel, Budapest, Hungary

- 1½ days of conference
- Conference Dinner
- Companions Tour

AGM & TECHNICAL MEETING
23 November 2017

Hilton London Paddington, London, UK

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