IN BRIEF

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GAS PROCESSORS ASSOCIATION EUROPE

PACKED ABSORBERS FOR DEEP CO_2 REMOVAL

By Ralph H. Weiland and Nathan A. Hatcher, Optimized Gas Treating, Inc., Houston and Buda, Texas

When an ideal stage calculation method is used to design or assess performance of an absorber in an ammonia plant, the only way for packing size (and type) to be brought into play is through a stage efficiency or a value for the height equivalent to theoretical plate (HETP). Unfortunately, there is no way to compute such values unless one has direct experience in a nearly identical, or a very similar, column under the same operating conditions.

In this article, the ProTreat® mass transfer rate-based simulator is used to show how *packing size* even within the same packing series directly affects overall absorber performance, mostly by significantly affecting temperature profiles even when all the operating conditions are kept the same. Normal temperature profiles in absorbers for deep CO_2 removal at high pressure typically exhibit a pronounced bulge or maximum somewhere within the column. Not only is the position of this temperature bulge packing-size dependent, but the size of the bulge can be, too.

There are two scenarios in which selecting the right packing size and being fully appreciative of the consequences of good and bad choices can be critical to success, namely: (a) design of a new column, and (b) revamp of an existing column. The revamp scenario is the more interesting of the two. Here, column diameter is fixed. The danger is that choosing a large diameter packing to achieve higher capacity may be contraindicated by the inability of the limited bed depth of large packing to achieve anything even close to the specified separation. This is one of the perils in any tower revamp that focuses primarily on capacity. The revamp situation is the one discussed in the context of two case studies, first in LNG production, then in an ammonia plant.

The packing series selected for the study is Intalox Metal Tower Packing (IMTP®) because it is available in several commercial sizes from #15 to #70. This makes it easier to discern and discuss the effect of packing size in a more meaningful way.

Case 1: Low CO_2 Gases Require Low L/G Ratios – LNG from Pipeline Gas

The tower to be revamped is 10ft (3m) diameter with sufficient height to hold a 40ft (12m) deep bed of random packing. Solvent and gas flow rates are constant at 1,000 USgpm (227 m^3/h) and 250 MMSCFD (280,000 Nm^3/h), respectively. Inlet gas is at 850 psig (59 barg) containing 2% CO_2. The solvent is 32 wt% MDEA promoted with 8 wt% piperazine. This pressure and solvent composition might be typical of an LNG absorber where very low residual levels of CO_2 in the treated gas are necessary. The optimal composition depends of course on the CO_2 content of the raw gas, the gas pressure, and sundry other factors. Diglycolamine (DGA®) and ADEG® are also used commercially in LNG applications. Which type of solvent is actually selected depends as much on licensing terms and the availability of process guarantees as on purely technical considerations.

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Figure 1 shows temperature profiles for these packings as predicted by ProTreat® simulation. There are two striking observations:

- Small packings have a small, sharp temperature bulge very close to the bottom of the absorber, and the bulge becomes ever broader as larger packings are used, and
- *Much* higher bulge temperatures are predicted to occur with large packings — the larger the packing, the higher the temperature

Why do the profiles broaden, and why is the bulge temperature so much hotter with very large packings when there is almost complete absorption of CO_2 (> 99.9%) and the total heat of absorption that is released is virtually identical in all cases?

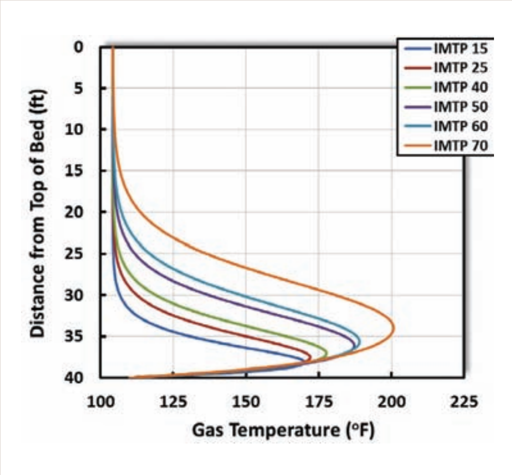

Figure 1 Revamped Absorber Temperature Profiles and Packing Size Dependence; LNG Case

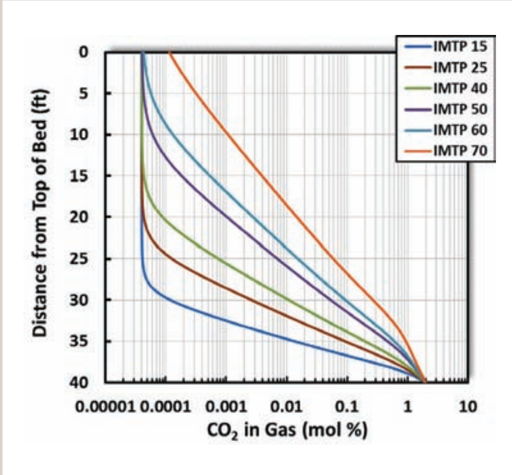

Figure 2 Revamped Absorber CO_2 Concentration Profiles and Packing Size Dependence; LNG Case

Apart from the effect of temperature, the individual-phase mass-transfer coefficients do not vary widely from one packing to another. However, as Table 1 shows, *the interfacial area varies markedly* and, of course, at the identical gas and liquid flow rates, flooding is further advanced with small packings. Under the conditions of the present case study, treating to <50 ppmv CO_2 is achieved regardless of the packing size; even IMTP #70 easily meets this specification. Note: values of the area in the table have been rounded, and it might be noted that the designated number sizes correspond roughly to packing diameter in millimeters.

The #15 packing has nearly five times the area of #70 packing. One should expect, therefore, that the CO_2 might be almost completely absorbed in a much shorter packed depth. Indeed, the CO_2 composition profiles in Figure 2 show this is exactly what happens. The treating level of 0.40 ppmv CO_2 is set by the lean loading of the solvent which, in this case, was 0.0225 moles of CO_2 per mole of total amine (set by the regenerator). Virtually complete absorption is achieved by all but the #70 packing. However, the #15 packing reaches this level of treating after the gas passes through less than the bottom 15 feet of packing. With #60 packing most of the bed is used, and with #70 packing, even using the entire bed depth leaves a residual CO_2 level in the treated gas greater than the lowest, but still more than satisfactory. The width of the temperature bulge shows a rough correspondence with the region of the bed where most of the CO_2 is being absorbed (note the logarithmic scale).

Because larger packings have smaller surface areas, they need a greater proportion of the packed bed to reach the target level of absorption – the temperature bulge is therefore broader. Of course, at the extreme ends of the absorber, phase temperatures return closer to the temperatures of the entering solvent and gas streams. Inlet stream temperatures drive those of the hot exiting streams down at each end of the bed. The remaining question is why larger packings produce hotter bulge temperatures.

Packings with small dry specific area necessarily have smaller wetted area as well as smaller total liquid holdup volume. In this Case 1, there is the same total *extent* of absorption regardless of the packing size. Thus, there is the same heat released, but now into a smaller volume of liquid holdup rather than into a larger one. Consequently, the smaller liquid volume associated with a larger packing must become hotter simply in order to absorb the heat released. This effect is not discernable in the outlet gas and solvent streams. The relative coldness of the feed gas and solvent dominate the top and bottom temperatures and confine the high temperatures to the column interior, away from the ends. However, keeping tower interior temperatures below a critical value is important in controlling what could become runaway corrosion. If one is unaware of how hot the temperature bulge can *really* become, it's impossible to account for it in the revamp, so the final revamp recommendations could easily result in a tower that experiences runaway corrosion in actual operation. Ideal stage simulators, even with efficiencies and other embellishments are incapable of predicting this aspect of packing behavior. Only the ProTreat® simulator's mass transfer rate basis allows accurate assessment.

Size Designation	Specific Area[1] (m^2/m^3)	% Flood	Temperature Peak (°F)	Treated Gas CO_2 (ppmv)
#15	290	94.6	170	0.40
#25	230	71.5	172	0.40
#40	155	65.3	178	0.40
#50	100	52.4	187	0.41
#60	85	49.7	189	0.43
#70	60	47.4	201	1.14

Table 1 Dry Area, Flood, and Absorption Performance vs. Packing Size

Case 2: High CO_2 Gases Need High L/G Ratios – Ammonia Production

The tower to be revamped from trays to packing is 15ft (4.6m) diameter with sufficient height to hold a 40ft (12m) deep bed of random packing. Solvent and gas flow rates are constant at 4,500 USgpm (1,022 m^3/h) and 250 MMSCFD (280,000 Nm^3/h), respectively. Inlet gas is at 350 psig containing 18% CO_2 in a 3:1 hydrogen, nitrogen mixture. The solvent is 40 wt% MDEA promoted with 3 wt% piperazine. Tower pressures here tend to be lower than in LNG plants and the CO_2 level in the feed gas is usually quite high, 18 mole% being typical. Primary amines such as MEA and amine-promoted hot potassium carbonate are also used commercially in ammonia applications. Again, there are often non-technical factors that determine solvent selection.

Figure 3 shows temperature profiles for these packings as predicted by ProTreat® simulation. Two observations contrast with Case 1:

- Small packings now have only a *slightly lower* temperature bulge location close to the bottom of the absorber, with the bulge becoming only moderately broader as larger packings are used, and
- Only slightly higher bulge temperatures are predicted to occur with large packings versus the *much* higher bulge temperatures seen in Case 1.

The reason for the broadening of the temperature bulge in this case is identical with Case 1 – larger packings lack the surface area of small sizes and this slows down absorption rates and spreads absorption across much more of the tower.

As expected, the CO_2 composition profiles in Figure 4 show that with large packings CO_2 absorption is spread over more of the absorber to the extent that with #70 packing the absorber cannot remove more than about 94% of the CO_2 presented to it. The width of the temperature bulge shows a rough correspondence with the most actively absorbing region of the bed.

Interestingly, in stark contrast to the LNG case, the size of the temperature bulge is almost independent from packing size. In the LNG example the relatively low CO_2 concentration in a sizeable raw gas flow needs only a small solvent flow to make on-specification gas; whereas, inlet ammonia syngas has nine times the CO_2 content. Even at the same total gas rate, this requires many times the solvent flow. The magnitude (and position) of the temperature bulge depends on how strongly the solvent flow can drive the heat of absorption down the tower or, what is equivalent, permits the gas flow to drive it upwards. As shown elsewhere, (https://www.protreat.com/files/publications/176/Contactor%20Vol_10%20No_7%20(Sensible%20Temperature%20Profiles).pdf) the Heat Transport Capacity Ratio, HTCR=$C_p^{(L)}L$ / $C_p^{(V)}V$, measures the two phases' relative ability to convey heat through the column and is a major factor determining temperature profiles. Here c_p is heat capacity and L and V are mass flow rates of the liquid and vapor phases, respectively. In the LNG example, the HTCR is about 1.4 while in the syngas case it is 12. The much larger heat carrying capacity of the solvent in the syngas case drives most of the released heat out the bottom of the column. In the LNG case, neither phase is dominant which allows the temperature bulge to spread more responsively to packing size and permits the higher bulge temperatures to manifest.

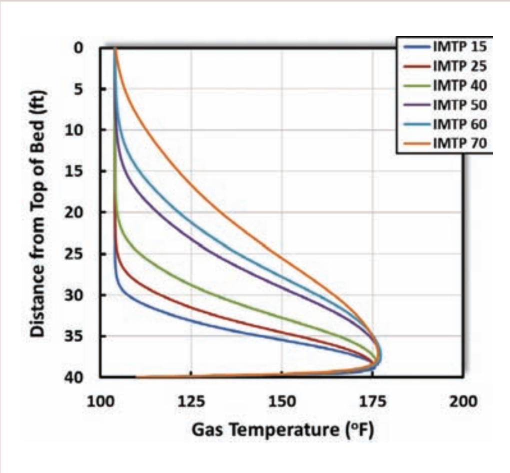

Figure 3 Revamped Absorber Temperature Profiles and Packing Size Dependence; Ammonia Syngas Case

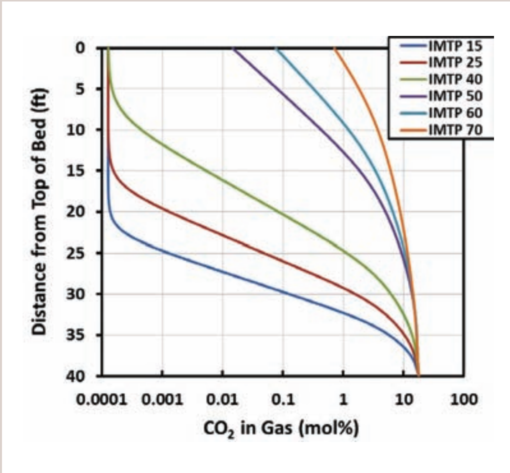

Figure 4 Revamped Absorber CO_2 Concentration Profiles and Packing Size Dependence; Ammonia Syngas Case

Summary

The inability to predict the mass transfer behaviour of packing in gas treating applications can result in less-than-robust designs and failed revamps. Furthermore, high temperature bulges in the wrong place can wreak havoc on the ability of tower shells and packing to resist corrosion. Only the ProTreat® simulator's fundamentals-based mass transfer rate model calibrated to extensive operating data is capable of reliably predicting the location and magnitude of critically important temperature bulges in packed columns, whether in revamp, troubleshooting, or design, out of the box. This allows engineers to pinpoint accurately the part of the tower most prone to hydraulic flood, the location where corrosion may first become an issue because of a combination of high temperature and high acid gas loading, and where these same factors are most likely to cause the fastest amine degradation. Armed with this information, the engineer is in a position to recommend changes to operating conditions and the best packing size (and type) to mitigate these effects. Without such information any new design, and especially any revamp, is at risk not just of failure to meet treating goals, but also of massive corrosion in the absorber and rapid solvent degradation from the extremely high temperatures possible that are not easily visible just by monitoring treated gas and rich solvent temperatures. When designing or revamping acid gas absorbers with structured or random packing, one must be very careful to ensure that the analysis correctly accounts for packing size and type on performance. There is no other way to do this save through true mass transfer rate-based simulation using a model such as ProTreat® that has been properly tuned to accurate commercial data.

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Footnotes

1 Specific area is the surface area of the dry packing per unit of packed bed volume.

THE FUTURE OF NATURAL GAS

VIEW FROM THE TOP

Steve O'Donnell, GPA Europe Chairman discusses some views on the future of natural gas

In the previous edition of *InBrief* I raised the issue as to whether GPA Europe should try to participate in some form of lobbying, to add a more balanced view and promote the benefits that we can bring to the energy balance.

I thought I would do some research on the subject of the future of our energy requirements, in an effort to identify the underlying considerations and try to understand where the future may be taking us. What follows are the views from some of the leading authorities in Europe and although I must stress, even though these are not the official views of GPA Europe, they will, I hope, encourage some lively debate amongst our members.

I will start with some issues that are affecting the UK and although these are numerous, I have identified three key decisions that impact the future. These are the closing of the UK's largest gas storage facility, additional funding for alternative fuels to replace natural gas for heating, and a cut in the payments being made to the small power suppliers who use natural gas as a fuel.

The closure of the UK's largest gas storage plant which provides 70% of the current storage capacity has prompted warnings that the country is becoming too dependent on energy imports and will face more volatile winter gas prices. British Gas' owner, Centrica, said it was permanently closing the Rough facility off the Yorkshire coast because it had become unsafe and uneconomic to reopen the facility, which had been temporarily shut over safety fears. The loss comes on top of the diplomatic crisis in Qatar, which supplies a third of UK gas imports and has highlighted the UK's increasing reliance on hydrocarbon imports.

Centrica said Rough, which opened in 1985 and could hold about nine days' gas supply, will cease to be a storage facility once its remaining gas reserves have been sold over the next four to five years. The company said tests of the wells at the facility showed it had come to the end of its design life. Rebuilding or refurbishing Rough would not be economical, the firm added, though the cost of closure is expected to be broadly neutral because of the value of the remaining gas.

Other experts said it was no surprise Centrica had decided to shutter the depot, because liquefied natural gas (LNG) imports from Qatar had significantly reduced the economic viability for this kind of facility. Analysts said the closure would increase the volatility of winter gas prices, a view shared by other industry-watchers. Energy consultancy Inenco, said: "We anticipate that the decision to close Rough will create uncertainty in terms of energy pricing. Though we haven't seen a material impact on prices yet, most probably because there is still a significant amount of recoverable gas in the field which could last for years, the pressure would come in the winter months, especially if we experience very cold conditions."

Alternative energy (wind and solar) is getting cheaper, but it is very new, so we don't know the reliability or future maintenance cost profile yet, and this only provides a small proportion of the total energy supply required and will do so until we have sufficient coverage both onshore and offshore. The only practical way forward to fill the gap is gas, but we are doing our very best to make ourselves entirely dependent on foreign supplies when we have sufficient gas below our feet in our shale deposits. This will provide an adequate and secure supply until such times as the other infrastructures are sufficiently developed.

Steve O'Donnell

The fracking industry said the closure would increase the UK's reliance on Qatari LNG imports, which it said had proved to be politically risky, although there is no evidence yet that the diplomatic crisis engulfing the Gulf state, whose neighbours have severed diplomatic ties, has interrupted UK supplies. The solution for the UK in the medium term cannot be to transport gas across oceans and continents. The UK needs to ensure that whatever gas replaces that from Rough comes from sources that can deliver the same high levels of environmental and regulatory standards.

Gas has become increasingly important in the UK's power mix as coal plants close and renewables grow, and also provides heating for about 80% of UK homes. It would appear however that the UK government is resolute in its determination to reduce the use of natural gas. We are already cutting our carbon emission by backing coal out with gas because every kW of electricity made from coal will produce twice the amount of CO_2 as from a CCGT plant.

While simply replacing coal with natural gas in the electricity sector would not be an effective long-term climate strategy, natural gas does offer some important advantages in the near- to medium-term. Low natural gas prices and recent increases in the cost of generating electricity from coal have resulted in a significant shift from coal to natural gas over the past few years. With sufficient regulatory oversight, burning natural gas instead of coal could help reduce air pollution, providing immediate public health and environmental benefits. The ability of natural gas generators to be ramped up and down quickly, could support the integration of wind and solar, provide increased flexibility to the electricity system, and continue to be used to meet peak demand.

Whilst natural gas can play an important role in meeting peak electricity demand it is also used to fuel cogeneration plants that generate both heat and power. These plants are up to twice as efficient as plants that only generate electricity. These highly efficient technologies provide both heat and power in the commercial and industrial sectors.

The UK government announced funding for two projects which it states could help wean the UK off its reliance on natural gas for heating. The Department for Business, Energy and Industrial Strategy said £25m would be made available to test using hydrogen to cut greenhouse gas emissions from heat. The money will fund research into whether existing gas pipes can be used for hydrogen, and what impact having a hydrogen boiler would have for consumers. A further £10m is being invested in "smart heating".

Unlike gas, hydrogen produces no emissions when burned, although it is only considered a green fuel if produced with renewable power. The newly appointed energy minister, Claire Perry, said: "The UK government is committed to leading the world in delivering clean energy technology and today's investment shows that we are prepared to support innovation in this critical area." However, if we go for hydrogen as an alternate energy we are talking about huge investments in electrolytic plants which will use a significant amount of the electricity we are able to produce from wind and solar, and as new nuclear is at least ten to fifteen years away, how will the additional electricity be generated?

The UK energy regulator has drastically cut £370m of payments for small power producers, in a blow to smaller gas plants. This is in direct contrast with both wind and solar where subsidies are paid even when they are not producing. The decision by Ofgem sparked strong criticism, with claims the move would fail to achieve its aim of saving consumers about £20 a year on their energy bills. However, the Flexible Generation Group, which represents small generators – mostly gas plants – said the decision would inevitably push up costs to consumers by making prices spikier at times of high demand.

The following is the conclusion from a report issued by The Oxford Institute for Energy Studies in January this year:

"For the period 2015-30, projections from both the IEA and the European Commission are that, with the policies that governments have said they will introduce, natural gas demand will be relatively stable and declining only modestly even with more aggressive decarbonisation policies. Post-2030, that outlook changes potentially dramatically, particularly if decarbonisation policies become more aggressive; this initially impacts power generation and progressively the heat sector. This may seem to suggest that the European gas community has another decade to engage seriously with decarbonisation, but that would be a wrong conclusion.

Natural gas has always been a long term business because of large scale investments, long asset lives and long term contracts. Decarbonisation poses different long term challenges and potentially an existential threat. Continuing with current business models and arguments may result in a situation where, by the time the gas community agrees a solution to decarbonisation which is commercially viable and acceptable to governments, a combination of renewables and electricity storage will have taken over much of its market in both the power and heat sectors. The gas community needs to engage now with proposed government policies and targets for decarbonisation in a 2030–50 time frame, even if those policies and targets seem unrealistic and to ignore short term, low cost gains which can be achieved by switching from coal to gas in power generation.

The aim is to focus the attention of the European (and potentially wider geographical) gas community on the need for a different approach to a decarbonised energy future. Specifically the gas community needs to devise, and start putting into practice, a strategy for decarbonisation of methane as soon as possible but certainly within the next five years. The alternative is to accept a future of decline, albeit on a scale of decades, and the risk that by the time the community is ready for serious engagement, non-gas options will have been chosen which will make that decline irreversible."

In my opinion the policy makers do not always fully understand the impact of their decisions and these are often made for short term political or financial gains and not necessarily for the good of the community, the environment and especially not for the good of our industry.

So I ask again is it time for us to step up or are the problems too immense for an organisation like ours to have any real influence? We have an abundance of phrases and sayings but two very important ones spring to mind:

- Actions speak louder than words.
- If you want something done right, you have to do it yourself.

With the future of the gas processing industry in doubt anything that we can do would in my opinion, be a welcome step in the right direction.

YOUNG PROFESSIONAL TRAINING DAY
PARIS, 16 MARCH 2017

MORNING SESSION

Chaired by Gauthier Perdu, Prosernat

Following the success of GPA Europe's first two well-attended Young Professional Training Days held in Manchester in 2015 and 2016, it was decided to move on to Paris this year to replicate the event for a new audience. The 3rd Young Professional Training Day took place in Rueil-Malmaison, France. It was hosted by IFP Energies Nouvelles and IFP School, who welcomed the audience to their facilities. The delegates had the opportunity to appreciate the great premises of IFP Energies Nouvelles, located in the town of residence of Joséphine de Beauharnais. Joséphine was Napoléon's unfortunate first spouse. The town and IFP Energies Nouvelles offices are in fact built in the former park of Joséphine's castle. It is located just 10 km west of Paris.

75 delegates attended this year, mainly young professionals, since French universities did not send many participants. On the other hand, delegates from engineering and construction companies were present in numbers including representatives from Bechtel, KBR, Fluor and TechnipFMC. The audience took the opportunity to raise searching questions, and the comments received during sessions were much appreciated.

The training day also benefited from some very interesting papers. The morning session, moderated by Gauthier Perdu from Prosernat, focused on gas processing technologies, but the afternoon session made way for papers about more innovative topics. The afternoon session was chaired by Adrien Martel from TechnipFMC.

Glycol Gas Dehydration – An Introduction

The GPA Europe Chairman Steve O'Donnell opened the meeting at 9.00 am sharp, following which came the first paper of the day, explaining the principles of gas dehydration units using regenerative TEG. Jan Lambrichts (co-authored by Eric Klinker) from Dow Oil, Gas & Mining delivered a very comprehensive lecture about the design and operational aspects of TEG dehydration units. He started from the fundamentals of simple units; then he presented an overview of more sophisticated technologies like TEG regeneration with stripping gas, Drizo® and ColdFinger® technologies. Then, the paper

Jan Lambrichts – Dow

moved onto the key aspects of operation, especially the needs and the advantages of keeping the glycol solvent in good condition. Jan was able to explain, based on his experience, how glycol units are often neglected by operators, with consequences of corrosion, having heavy TEG losses or being plagued by underperformance. He demonstrated that a more careful management of the solvent can secure the reliable operation of TEG units and keep them in good condition, significantly lowering the maintenance costs. As such, Dow Gas & Mining can provide technical support for the analyzing and troubleshooting of TEG plants and TEG solvents.

Sulphur Recovery

The second paper focused on the conversion of H_2S into Sulphur. Thibaut Heim of Prosernat clarified the fundamentals of the Claus Reaction in a general presentation of Claus Sulphur Recovery units. By considering the process and technologies proposed by Prosernat, including the conventional Claus unit with two thermal and catalytic stages (95-98%), or Sultimate (99.9 %+) or SmartSulfTM option (99.5 %+), he authoritatively demonstrated how the reduction of sulphur emissions from the stack, imposed by local regulations, dramatically increases the installed and operated costs of sulphur plants. At the end, but only if accepted by the customer, it can be more attractive to limit the sulphur recovery to 99.2–99.5% and use less expensive units like SmartSulfTM (proposed by Prosernat) or like SuperClaus (technology proposed by Jacobs). Thibault explained in particular the aspects of a SmartSulfTM SRU, which uses only two isothermal catalytic reactors operating in tandem. The reactors are directly installed downstream of the thermal stage of SRU to achieve 99.5% sulfur recovery.

The session broke off for the morning break, and delegates had time to network or meet friends from their recent university years.

Mercaptans: A Challenge in Production of Sour Gas to Deal With More and More Stringent Specifications

The third paper of the morning looked at gas sweetening. Claire Weiss, who leads the Acid Gas group of the process engineering team at TOTAL EP, described a rigorous process study performed for the development of a gas/condensate production plant including the treatment of natural gas containing H_2S, CO_2, COS and mercaptans. It arose again that the cost of removal of contaminants like COS and mercaptans happens to be exponential compared to simple cases where there is only H_2S, and CO_2 in the feed gas. The paper presented the optional schemes based on various technologies, including HySWEET®. HySWEET® is a technology developed by TOTAL to improve significantly the pick-up of mercaptans achieved by a conventional amine unit using DEA or MDEA. Even if it is a hybrid solvent, the co-absorption of hydrocarbons is remarkably low. Claire showed which scheme TOTAL had finally selected for the sweetening

Thibaut Heim – Prosernat

Claire Weiss – Total

Colin Avis – KBR

Adam James – KBR

of gas: they kept the removal of COS by a conventional formulated MDEA AGRU, and achieved the mercaptans treatment by regenerative caustic wash located in downstream NGL recovery units. The project takes advantage here of the possible disposal of disulfide oils produced by the caustic based LPG sweetening unit in the crude oil. It simplifies the design of the SRU and avoids partial release of mercaptans to atmosphere, as SO_2. This was unavoidable for any cases where mercaptans had been removed by HySWEET® AGRU and transferred in low H_2S acid gas to SRU.

Vendor Selection for Ideal Technical and Commercial Outcomes

The last paper of the session left aspects of the process design to concentrate on the management of EPC Projects. The conception and delivery of oil and gas projects have become more and more complex over the years. The recent slowdown of our industry has increased the pressure on the need to work with a high level of efficiency and productivity to save – or keep – profits. The paper explained the organization of engineering activities, selection of suppliers, procurement, fabrication and follow-up in an industrial project. The co-speakers Colin Avis and Adam James from KBR were very convincing. Based on the organization of their company, they presented the project management chain and the interfaces involved in any EPC Project. They described how a rigorous procedure of selection of suppliers, as well as the documented qualification of new suppliers can bring substantial benefits.

Gauthier Perdu, Prosernat

YOUNG PROFESSIONAL TRAINING DAY
PARIS, 16 MARCH 2017

AFTERNOON SESSION

Chaired by Adrien Martel, TechnipFMC

Estimation – What is its "Job Ticket"

After an excellent networking lunch, the afternoon started with a presentation delivered by Nancy Rabeau, Estimating Engineer from TechnipFMC, on the subject of Estimation - What is its "Job Ticket". The presentation began with an explanation of the key role of Estimating Engineer during the early phase of any project, in terms of project price definition as well as during the project as assurance of project cost control. Usually this job is not well known at the start of a young person's career, as is the case for the majority of the attendees. Then, the certification as Estimating Professional by

Nancy Rabeau – TechnipFMC

AACE® International (Association for the Advancement of Cost Engineering) was presented, in particular the different methods (conceptual vs deterministic) to find an accurate project cost definition depending on criteria allowing to the assessment of the maturity level of each project. According to the definition of AACE® International,

Bruno Lequime – TechnipFMC

"Estimation is a compilation of all the probable costs of the elements of a project or effort included within an agreed upon scope". Therefore estimation is a key job, responsible for the working out and the validation of all project prices, but also a central one, interacting with all activities.

Nancy then moved on to a theoretical case study about the Equipment Factor Conceptual Method used for low maturity projects, illustrating how the final selling price of installed equipment can be estimating taking into account the equipment environment such as raw equipment, subcontract, labor and bulk costs plus an additional contingency.

Work Process and a Focus on Floating LNG Layout and Cryogenic Protection Optimisation

Mathieu Rivot and Bruno Lequime from TechnipFMC presented the second paper on Work Process and a Focus on Floating LNG Layout and Cryogenic Protection Optimisation, which has been implemented on recent FLNG projects. After a brief introduction regarding the importance of the safety in any design and the implications for the many engineering disciplines involved at all stages of a project development, Bruno started to introduce the different safety issues related to a Floating

Mathieu Rivot – TechnipFMC

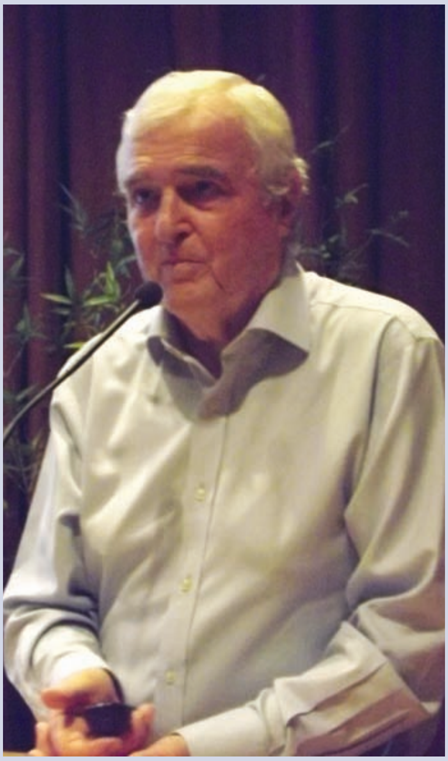
LNG project. These included constrained conditions and the absence of industry guidelines leading to an internal development of design standards between contractor and client. The first issue presented was regarding layout, in order to protect personnel, minimise escalation and allow safe escape. These considerations result in the optimisation of parameters such as the living quarter location, implementation of safety gaps or fire and blast walls as well as a raft of the ISO 20257 (Design of Floating LNG installations). Then, Mathieu presented initiatives to improve knowledge of cryogenic spill hazards on FLNG and to optimise the Cryogenic Spill Protection (CSP) requirement. Due to the high cost of this requirement, optimisation was needed and a plan was launched to better understand and simulate the physics of cryogenic leaks in FLNG topsides within an extensive multi-sponsors program. More than 120 tests have been done using more than 150 tons of LNG to have a more comprehensive approach to carbon steel plates' thermal response when confronted with jet and pool LNG spillage and to obtain an experimental validation of a 3D/CFD software (EOLE®) developed to simulate the thermal effects of such cryogenic spillage. After the presentation of some test results completed in 2015, evaluation of cryogenic protection has been improved and software validated, leading to possible optimisation of future (F)LNG projects in an ever more constrained economic environment.

A Gas Industry Overview as of Spring 2017

After the afternoon break, the day finished with an open presentation giving a global Gas Industry Overview as of Spring 2017 presented by Pierre-René Bauquis of IFP School. A fascinating aspect of the gas industry is that there is never anything totally new, whilst there are constant changes in the gas supply sources and gas utilization, which significantly modify the perspectives of this industry. Long term views about natural gas must constantly refer to economics, ie costs, prices, taxation and competitivity. These issues now become significantly influenced by concerns related to anthropogenic climate changes, raising the question will these concerns favour natural gas in the future or limit its future expansion? Pierre-René presented a global market evolution based on figures showing that gas production will become a key indicator. Natural gas is expected to be the only "fossil fuel" to continue to grow during the next 30 years and as a result, gas processing will grow accordingly. Following that change, NGLs from gas processing will represent an increasing percentage of world "crude oil" supplies. In the meantime, the presentation explained that the LNG market will increase as a result of new growing markets like replacement of coal for power generation, small import terminals development, mainly FSRU and major market change for trucks and marine transport.

At 5pm, after the closing remarks given by Chairman Steve O'Donnell, the assembly had the opportunity to walk towards "Café Leffe" in the center of Rueil Malmaison. The delegates appreciated not only the famous Belgium beer, but also French wines, all served alongside many plates of charcuteries, tapas and fries. The complimentary "apéritif" offered by GPA Europe was again cheered!

Adrien Martel, TechnipFMC



Pierre-René Baquis – IFP School

Speakers and Moderators

GPA EUROPE SPRING CONFERENCE
MILAN, 18 MAY 2017

TECHNICAL MEETING – MORNING SESSION

Chaired by Steve O'Donnell, Oil and Gas Systems Ltd

Panel Session: The Impact of Non – Process Issues on Design

After a very enjoyable Welcome Reception on Wednesday evening where delegates relished the opportunity to chat with contacts old and new, the official proceedings of the Spring meeting in Milan commenced with a panel discussion on the Impact of Non-Process Issues on Design. Although this format has not been implemented for some time it was decided to trial it here to gauge the response from the audience.

The session commenced with two brief presentations, the first from Lorraine Fitzwater who is a Senior Study Manager for Petrofac entitled: Reservoirs, Location and Infrastructure. The second presentation was provided by Peter Kauders the founder of CDE Projects entitled: The Process is just the Beginning.

Reservoirs, Location and Infrastructure

Lorraine's presentation provided an insight into the start of the design process during feasibility studies, where there is a high level of uncertainty, particularly with the reservoir information. The presentation focused on three key areas: reservoirs; location; and cost.

It was seen how extensive the information provided for the reservoir can become and this included examples of production profiles, compositions and presences of impurities in the fluids. The importance to firm up the information as the project moves through the design phases was demonstrated with working examples. It was also shown how not taking into account some of

Coffee al fresco

Lorraine Fitzwater – Petrofac

the impurities and dealing with them in the process design can lead to catastrophic failures in the plant. The impact of changes in the reservoir information and the effect of the overall development costs were shown.

It was also seen how the location has a significant impact on the costs with examples of how the local infrastructure and transportation to market all affect the costs. The range of locations is very wide and goes from the extremes of hot and cold and the issues associated with installing, commissioning and maintaining the plant in theses harsh environments. This presentation looked at the impact these 'non-process' issues have in the overall project costs and therefore the viability of the project to get financial approval.

The Process is Just Beginning

Peter's presentation looked at the more complex projects where the block flow diagram showed the type, number and capacity of process units, and their interrelation. It explained how the requirements for operation and maintenance may affect the scheme. It showed that the product specifications, which may be driven by regulatory as well as market requirements, determine the processing that is needed. How logistic factors may set the maximum equipment size, and hence the processing train capacity, and may also be a determining factor on the extent of processing that is sensible and how minimising the size of the facilities applies to remote onshore projects, just as it does to offshore platforms was also discussed.

Since process evaluation, selection and optimisation depend upon economic analysis, an understanding of cost estimating methods and their limitations shows how important this understanding is in ensuring an economic solution. In the feasibility study, the cost estimate is factored from equipment costs. Utilities and off-sites have to be equally well defined, including wells and pipelines, if the project cost estimate and economic analysis are to be realistic. Unfortunately, equipment costs alone do not show whether one process would be cheaper to build than another, and infrastructure costs may be not be fully understood.

It was seen how overruns in project costs are commonplace, and that these may be the result of poor decisions at the feasibility study stage, sometimes compounded by inadequate project definition and/or weaknesses in cost estimating practice, such as factoring methods. It showed that by using mathematics, it is now possible to emulate the work of an engineering team. The equipment and materials needed for many processes can be modelled at the feasibility stage with an accuracy typically only achieved in a year's conceptual engineering and providing a means to identify and correct poor design decisions early on, and to improve the design optimisation and project cost control.

Peter Kauders - CDE Projects

Panel Discussion

At the end of the two presentations we moved into the panel session. The panel consisted of; Peter Kauders of CDE Projects, Lorraine Fitzwater of Petrofac, Sigbjorn Svenes of Statoil and Nick Amot of Fluor Ltd. A lively question and answer session followed with several very good questions from the delegates which were equally well answered by the panel. There was a wide range of questions dealing with the uncertainty of the reservoir information, the complications derived from transport and logistics issues, language barriers, country codes and standards and how individuals or companies experiences influence the outcome of a project. The session closed with the panel and the delegates heading to a well-earned coffee break.

Bart Bueckels - Honeywell UOP

Tom Knop - Honeywell UOP

The Importance of Trace Components in the Development of Natural Gas Processing Schemes

Following on from coffee a short knowledge session on the Importance of Trace Components in the Development of Natural Gas Processing Schemes was given. This knowledge session was jointly presented by Tom Cnop and Bart Bueckels of Honeywell UOP. Tom is a Senior Manager, Gas Processing & Treating Technologies, and has been working for UOP for the past 16 years. Bart is a Senior Process Engineer, Gas Processing & Treating Technologies, and has been working for UOP for the last seven years.

This proved to be a very interesting session and provided an in-depth view of the issues that arise if you fail to take into account the trace elements found in natural gas. The session started with an overview of a natural gas flow scheme from extraction to the pipeline.

The development of a natural gas processing facility involved the careful selection of a series of separation and treating technologies. It was seen that is was not uncommon that feed gases were poorly specified either due to unknown well head compositions or due to the inaccuracy in analytical measurements. The presence of a component that was not accounted for during design can impact the process performance of the unit and may require changes to the process design or the selection of a different technology all together. That is why it is important that the process engineer understands the impact of components that are often not identified in the early phases of the project. It is equally important that the process engineer recognises an unrealistic design basis.

The trace components that needed careful consideration were mercury, metals, sulphur compounds including COS and mercaptans, heavy hydrocarbons, methanol, oxygen, helium as well as the possible presence of solids and liquids. The following series of case studies were discussed:

- Solids
- Water
- Mercury
- H_2S
- Mercaptans
- C5+ and BTEX
- Nitrogen
- Helium
- Liquids
- Methanol
- CO_2
- COS
- CS_2
- Olefins
- Oxygen

Although in comparison to the time allocated to previous knowledge sessions this was quite short at only 45 minutes long, Tom and Bart managed to cover a significant amount of impurities in their session. The delegates were very appreciative of their comprehensive overview and we now all appreciate the importance of identifying the trace elements and dealing with them in the design of the plant.

GPA EUROPE SPRING CONFERENCE

MILAN, 18 MAY 2017

TECHNICAL MEETING – AFTERNOON SESSION

Chaired by Nick Amott, Fluor

After the joys of an Italian lunch and the stimulation of both the panel discussion and excellent introduction to removal of trace impurities by Tom and Bart in the morning, we reconvened.

The afternoon held great promise with some strong technical papers and as you will see, we were not disappointed.

(More) Effective Contaminant Measurement in LNG Processing

Tony Wimpenny of Orbital Gas Systems kicked off with a great primer on the topic of gas sampling with his paper titled (More) Effective Contaminant Measurement in LNG Processing. Safe and efficient gas processing requires a detailed understanding of the characteristics of the gas prior to treatment, and verification that the treatment has been completed to the required specification. Tony's paper investigated the challenges measurement imposes on a sampling system and a number of techniques that can be employed to mitigate problems.

Tony Wimpenny - Orbital Gas Systems

This presentation and paper is a great reference for the importance of the detailed topic of sampling system design and the impact it can have on correctly (...or incorrectly) identifying contaminants by good or poor sample system design and the consequent impact on analyser function and performance. Clearly Tony's company has done some great R&D in this area especially with the use of CFD. Whilst the results may seem obvious, it takes a specialist to actually work the issues through. There was some intelligent and informed discussion after the paper which is well worth a look. My take-away, analysers are not psychic and I well remember the example provided using the hotel wash basin principle (a private joke for all attendees).

Nitrogen Rejection Using Proven Adsorbent Shows Groundbreaking Cost and Process Efficiency

The next paper was presented by Jasper Klapwijk of Zechstein Midstream Partners. Jasper was standing in for Paul Bieniawski and although Jasper has a commercial background, he did not need me to wish him luck with the technical questions because he handled the whole topic with aplomb and clear depth of knowledge and understanding. The other co-authors of the paper titled Nitrogen Rejection using Proven Adsorbent shows Ground breaking Cost and Process Efficiency were Carlos Flores also of Zechstein and Hiva Goudarzi of Engie E&P Deutchland. The first interesting information was the origin of the word "Zechstein" which relates to the geological formation that is so closely linked to the

Jasper Klapwijk - Zechstein Midstream Partners

Danny Thierens – Sulzer

Michiel van Acken - Osomo Projects

company's business. There is a growing European "problem" of ever increasing levels of nitrogen in gas fields, particularly Poland but also in Holland and Germany. The technology being put forward is a development of the well known PSA process which promises nitrogen rejection from a methane gas stream of better than 99% in a single pass. Jasper presented the results of pilot plant work undertaken in the USA and left us tantalised with the potential of the process whilst the team look for commercial partners to take the technology forward. My take-away is that the use of specially developed PSA resin beads can lead to a good solution for small to mid range capacity gas processing where there is a high nitrogen content up to 50%, whilst noting that for large capacity applications, cryogenic processing is still likely to be the strongest contender for a cost effective solution.

Although the weather was a bit chilly, we were able to break for freshly made Italian coffee and pastries in the open air as we discussed the papers so far and caught up with business contacts.

Strong Synergies by Integrating Membrane Separation, Gas Expansion – Liquefaction and Contaminant Freeze-out Processes

We reconvened to hear a paper that challenged our preconceived ideas about LNG processing configurations. Michiel van Aken of Osomo Projects and on behalf of co-author Geoff Skinner of Gasconsult, presented Strong Synergies by Integrating Membrane Separation, Gas Expansion-Liquefaction and Contaminant freeze-out Processes. Michiel took us on a journey into some novel LNG process configurations advocating that we should "never assume that something (a technology) is mature". We were encouraged to continually challenge the premise (paradigm) as has been done by the authors. If your capacity requirement for LNG is small scale, is the answer to simply reduce the size of equipment but stay within a traditional configuration? Michiel presented a strong case to say that the answer is an emphatic NO! The process scheme presented showed three departures from the norm by combining membrane separation, dense phase liquefaction and contaminant freeze out. Yes there was some lively discussion in the Q&A but both Micheil and Geoff, who was also present, were able to strongly support their case.

cMIST™: Novel, Compact Dehydration System for Reducing Size and Weight

The final paper of the day gave Danny Thierens of Sulzer the chance to present cMIST™: Novel, Compact Dehydration System for Reducing Size and Weight. No, this was not a novel approach to dieting but a really interesting introduction to the new technology developed by ExxonMobil in partnership with Sulzer as Licensor. The natural gas industry is increasingly pursuing compact and lower weight processing technology to meet the technological and economic demands of offshore, onshore, remote and challenging gas processing, resulting in the innovative solution presented by Danny.

I had seen an equally professional presentation on this technology by Shwetha Ramkumar at Gastech and was really looking forward to the audience reaction to this brand new technology approach to gas dehydration. Please review the presentation material to not only get into the subject but see how strong the technical calibre of this and many other papers presented at GPAE can be. The questions that you would expect for a new technology were handled professionally such as the level of turndown that can be handled. Of course the "teaser" that was left by Danny with the audience was the logical extension of the technology to amine treating using this mass transfer contact device. We look forward to developments in this area in the future.

Well satisfied from an afternoon of intellectual stimulation, the audience dispersed to prepare for the evening's gastronomical stimulation. Delegates were transported by coach through Milan to the beautiful Navigali district, where they sauntered through picturesque cobbled streets packed with locals and tourists alike all enjoying a warm evening, sitting outside the districts many bars and restaurants, to the restaurant. A wonderful feast of traditional Italian cuisine was enjoyed by all.

Nick Amott; Fluor

Editor's Note re cobbled streets: Lesson learned – it's a good idea not to wear stiletto heels on a GPA Conference Dinner night unless you wish to walk barefoot back to the coach!

GPA EUROPE SPRING CONFERENCE
MILAN, 19 MAY 2017

TECHNICAL MEETING – MORNING SESSION

Chaired by Ligia Pana, Saipem

Following the delights of the Conference Dinner, the last session of the Conference was opened by Ligia Pan of Saipem.

Gas Cloud Imager vs. Point Detectors in Gas Leak Monitoring and Quantification

Allison Sawyer of Rebellion Photonics was first to present, on the advantages of Gas Cloud Imaging (CGI) technology for gas leak detection.

Rebellion's CGI camera is fully autonomous and continuously images and quantifies explosive vapor clouds. The camera can detect all hydrocarbon gases, such as methane, and other dangerous gases, such as ammonia and it can differentiate between 20 gases at the same time at every pixel, instantly.

Rigorous Process Safety Management programs have reduced the probability of major and catastrophic accidents; the CGI system is proposed as a new technology to achieve zero catastrophic accidents. Traditional point detectors are only detecting 1/1000 of the leaks. The GCI system often captures leaks of two orders of magnitude more than traditional point or line detectors.

Continuous monitoring is defined as a system that can autonomously run 24/7 without an operator interpreting the image. The CGI system provides autonomous alarming similar to the common DCS.

With the GCI, the maintenance process is made easier as the leaks are immediately identified.

The CGI system can be used also for the following: flare surveillance, to discover unknown hot and cold spots, to monitor pipes that should have a specific temperature, and to verify that repairs are successful.

The CGI system is in line with the future trend for optical imaging, and is in particular useful to comply with the upcoming methane emissions regulations.

A New Generation of Integrated AGRU and SRU Saves Energy and Costs

For the second paper, Gauthier Perdu of Prosernat (co-authors Géraldine Laborie, Laurent Normand and Benoît Marès) presented the advantages of an integrated acid gas removal (AGR), tail gas treatment (TGT) and acid gas enrichment (AGE) process, in a new plant successfully started up in Qatar in the frame of the Plateau Maintenance Project (PMP) for Qatargas.

The development of new fields (e.g. in Middle East, Central Asia or Iran) frequently presents difficult acid gas treatment: the acid gas from the AGR regeneration is frequently poor (i.e. H_2S content lower than 50%) with high presence of contaminants, since the feedstock to the facilities is rich in CO_2, H_2S, mercaptans, COS, sometimes associated to low H_2S/CO_2 ratios.

Gauthier Perdu - Prosernat

The new patented integrated scheme was presented and compared with other more conventional options, with an outlook on economics. The new integrated system is based on the Prosernat Advamine™ preflash low BTX process with acid gas recycle. In the concept selection phase of the project, the following four process schemes were compared: independent AGRU + SRU/TGTU (considered as the base case); initial integrated scheme with common regeneration for AGRU and TGTU; conventional acid gas enrichment scheme in TGTU; and preflash low BTX process.

When acid gas has less than 50% H_2S, the design of SRU needs to be intensified (acid gas enrichment increases H_2S and reduces the content of aromatics).

The following solutions can be considered in these cases: traditional acid gas enrichment between AGRU and TGTU, sulfur recovery with co-firing; sulfur recovery with oxygen enrichment of the combustion air; integrated scheme including AGRU, TGTU and AGEU. The integration of AGRU + TGTU + AGEU brings evident benefits. Nevertheless, the risks caused by TGTU to the integrated unit should be considered in the design.

The preflash low BTX process is characterized as follows: addition of a low-pressure column upstream of the regenerator (solvent to preflash column is preheated in amine/amine exchanger, LP flash gas bypasses regeneration and SRU); acid gas enrichment occurs in two steps (selective CO_2 desorption in preflash column which liberates CO_2 and allows BTX and HC slipping to TGTU, selective H2S reabsorption in TGTU column); recycle of acid gas from regenerator overhead to LP flash column is available as an option; it is a patented process.

The main advantages of the preflash low BTX process are as follows: it is suitable for very lean cases; it significantly improves the quality of the acid gas to the SRU (achieving high H2S concentration in acid gas); it is less expensive than conventional enrichment; the operation with acid gas recycle makes the unit very versatile and flexible (it manages big upsets such as shutdown of SRU or TGTU maintaining the H2S content); it enables a reduced circulation rate of solvent (a lower amount of CO_2 is reabsorbed compared to a traditional enrichment scheme, the reuse of semi-lean solvent is maximized); it allows designing SRU without co-firing (which is still a competing solution but which needs fuel gas, produces steam not always usable, requires experienced suppliers and operators to avoid risk of poor combustion).

The preflash low BTX process has been implemented and successfully tested in the new project for Qatargas.

Maximising Value through Compressor Selection

Next, Michael Rimmer of Costain (co-author Grant Johnson) presented a discussion on gas compressor selection, to identify cost-effective compression solutions throughout the natural gas value chain.

It was discussed how the choice of compression technology depends not only on the required capacity and head, but is also influenced by the gas being handled, capital and operating cost, energy efficiency, maintainability, environmental performance, required flexibility and other factors.

Michael presented the following examples: gas-turbine driven centrifugal field gas compressors; gas-engine driven reciprocating compressors at remote gas production sites; hermetically-sealed compressors with active magnetic bearings and high-speed motors in underground gas storage; integrally-geared compressors handling multiple streams in gas processing; and dry screw compressors in flare gas recovery.

Michael Rimmer - Costain

Proper specification and selection of compression equipment can have a major impact on life-cycle costs including capital cost, and the operating cost for fuel/power and maintenance. Design of facilities around machinery capability, focusing on full life-cycle requirements and operating range, rather than maximizing peak efficiency at a single operating point at which the machine will operate for a limited time, leads to robust selection.

It is important to understand how the compressor fits into the overall facilities and all the conditions under which it will be required to operate (i.e. how the reservoir, machinery, pipelines and processing plant will work together).

The increasing choice of compressor technologies, offering improved efficiency, lower maintenance, and reduced life-cycle cost, and continued focus on environmental performance, should be taken into account, as it can influence the project viability, in particular in a low energy price environment.

Selecting Process Technologies for Deep CO_2 Removal from Natural Gas

Giorgia De Guido of Politecnico di Milano (co-authored by Laura A Pellegrini, and Stefano Langé also of Politecnico di Milano, and Saeid Mokhatab, Consultant) presented some alternative technologies developed to decrease treatment costs for high CO_2 content natural gas, and provided useful guidelines for a preliminary screening of reliable technologies that will result in the lowest energy and operating costs. An overview of the alternative process technologies as well as their level of maturity and commercial readiness was discussed.

The CO_2 removal processes can be classified into four main categories: solvent-based processes; adsorption on solid beds; membranes; low-temperature separations.

For absorption-based processes, gas solubility into liquid solvents is typically favored at low temperatures and high pressures, while the solvent regeneration is favored at low pressures and high temperatures. Chemical and physical absorption processes were presented.

Giorgia De Guido - Politecnico de Milano

For chemical absorption processes, those by means of aqueous amine solutions allow the selective or unselective separation of CO_2 and H_2S from a gas stream, by means of chemical reactions in the aqueous phase between acid compounds and a specific alkaline solvent (typically amine). Due to the low solubility of hydrocarbons in water, compared to organic solvents, the hydrocarbon losses due to co-absorption are practically negligible.

For physical absorption processes, when high acid gas partial pressures are present in the feed gas stream, chemical absorption may be too expensive and physical solvents can be used instead. Typically, solvents used for physical absorption units are organic molecules that must remain chemically stable with temperature, and have a good capacity to the solubility of acid gases. Selexol™, Rectisol® and Fluor Solvent™ processes were presented.

For low-temperature processes, the problem of CO_2 freeze-out has to be considered. Distillation-based and CO_2 frosting-based processes were presented.

Distillation is the most widely used process for separation and it seems a good option also for removing CO_2 and H_2S from natural gas, due to the difference in the vapor pressure of the main components. Ryan-Holmes, CFZ™ (Exxon Mobil) and dual-pressure low-temperature processes were presented.

CO_2 Frosting-Based Processes are based on the concept of frosting and defrosting CO_2.

Cryocell®, antisublimation over heat exchangers and cryogenic packed beds processes were presented.

Finally, hybrid processes are claimed by the authors to benefit from the advantages of each of the technologies combined in the hybrid system. Sprex® (Total and IFPEN) Cryocap™ (Air Liquide) and mechanical turboexpansion processes were presented.

The pros and cons of the presented technologies were discussed, obtaining the following main conclusions: chemical absorption is profitable for low acid gases contents in the raw feed gas; low-temperature processes are suitable at high CO_2 contents in the raw feed gas (also physical solvents could be applied, but their use requires further study mainly for recovering C2+ components from the physical solvent); low-temperature distillation-based acid gas removal processes are typically attractive for high natural gas flow rates, though they can be also usefully applied to biogas upgrading; low-temperature frosting-based processes can be suitable for low gas flow rates and low-pressure applications such as for the case of biogas upgrading; supersonic expansion may be attractive for low-medium gas flow rates and when size constraints matter; hybrid processes may be attractive since they combine bulk removal and final treatment with classical technologies, but they typically require more equipment and they consume both heat and cooling duties. Among low-temperature distillation-based processes, the Ryan-Holmes requires additional heat for solvent regeneration, while the CFZ™ and the dual-pressure low-temperature distillation processes require only cooling duties since no entrainer is used. The CFZ™ process requires an ad-hoc designed distillation column, while the dual-pressure low-temperature distillation process consists of standard equipment. Only a few of the

Speakers and Moderators

proposed low-temperature technologies are already commercially available and most of them are nowadays at a pre-commercial level (small scale pilot testing). When considering the offshore removal of acid gases from natural gas, systems based on the use of membranes may become of interest, because they allow to meet the important requirements related to offshore applications, such as light weight, small footprint, and operational simplicity.

Case studies showing a quantitative comparison among removal processes for different CO_2 contents in natural gas were finally presented.

Replacing a Shell-and-Tube Bundle with a Round Welded Plate Pack to Increase Heat Recovery in Existing Shell

Robert Broad of GESMEX presented the advantages of plate-and-shell exchangers in debottlenecking projects.

The plate-and-shell exchanger is a fully welded

Robert Broad - GESMEX

plate pack in which the plates are round and the heat transfer is counter-current, which removes the discontinuities where thermal stress concentrates, resulting in a much more robust unit. The pressure drop can be better utilized for heat transfer, with fewer passes, meaning less parasitic pressure required for turning the fluid; this also results in a higher wall shear stress, which is a major factor in fouling. The round shell is also much stronger than the flat panels of the block type exchanger, which greatly reduces the material required, giving a lower capital expense and also reduced steelwork for installation.

In debottlenecking projects, it is possible to replace tube bundles with round plate packs, utilizing the existing shell and pipe work with no modifications. The advantages of this are: lower capital costs; faster turnaround of the upgrade; increased and more efficient heat transfer area in the existing shell; robust and gasket-free solutions; less contractors on site, with no hot work, thus reducing risk of incidents.

In a heat exchanger upgrading the following key factors should be discussed and agreed on: surface area that can be inserted into the existing shell; required additional heat recovery; available pressure drop and shear stress that can be achieved; and required payback for the project.

The upgrading of an acid gas removal unit (AGRU) involving its heat exchangers (lean/rich interchanger, regenerator reboiler, regenerator condenser, lean cooler), was presented as an example of the use of the plate-and-shell exchanger, with an outlook on economics.

GPA MIDSTREAM ANNUAL CONVENTION – SAN ANTONIO

10 – 13 APRIL 2017

Contributed by Sandy Dunlop - GPA EUROPE Administrator

The Management Committee of GPA Europe asked me to attend the GPA Convention from 10–13 April 2017 and, as I had not attended the convention since 2005, I was very happy to go along to represent GPA Europe and take my wife Anne with me.

If you have not been to a GPA Midstream Annual Convention then you really have missed out on one of the great events in the gas processing year. Over 2000 delegates attend representing the vast membership of GPA Midstream as well as many representatives from the GPSA member companies offering not only 65 technical papers, but a wide array of hospitality events with each trying to outdo the other for attendance. The buoyancy of the US gas processing business as a consequence of the shale gas boom was clear to see.

It was good to see a lot of friends from GPA Europe and also many of the American delegates we see at our annual meetings – it just goes to show what a relatively small family is the Gas Processing business.

I felt that, with retirement this year, the likelihood of coming again to the Convention would be slim, so I decided to take in all the events, including playing golf at the San Antonio Quarry Golf Course – our team did not win, but it did not come last!

The chairman of GPA Midstream, Wouter van Kempen of DCP Midstream was kind enough to invite Anne and I to a very pleasant Dinner on Sunday evening and then, on Tuesday lunchtime, to the Chairman's Lunch where awards were presented to a number of people. As a member of the Editorial Board of the GPSA Engineering Databook, and on the occasion of the launch of the 14th Edition, Adrian Finn of Costain was amongst the team all recognised for their hard work with an individual plaque, and GPA Midstream was kind enough to present me with a Citation of Service plaque recognising my involvement in the gas processing industry for over twenty years. Chris Lindenberg of Wester Filter Co. was similarly recognised. I know it is a cliché, but it is really quite humbling after all this time to be recognised in this way as a thank you for my efforts – so I return my sincere thanks to GPA Midstream.

In the enforced absence of Steve O'Donnell on business, I presented the report of the GPA Europe activities in 2016 at the International Committee meeting which was strongly attended, not just by international representatives, but also by GPA Midstream delegates which I think shows a keen interest by our American cousins in the international scene. Our efforts at increasing links with other Chapters was warmly welcomed.

Sandy Dunlop receives his citation

Sandy and Adrian - proud award recipients

GPSA Engineering Databook Editorial Board

The social highlight of the event in San Antonio this year was a concert from World Class Rockers where some legendary (and, it is fair to say, quite doddery!), rock musicians got together to produce a fantastic noise (some said cacophony – but they were few in number) reminiscent of the great days of rock and roll.

Adrian, Greg Bury of GPA Canada and I co-chaired the Worldwide Developments Forum where the best papers presented at GPA Canada, Europe and GCC were presented and although the session was right at the end of the convention, I am pleased to say that we had up to 100 delegates attending the meetings to hear what is happening outside the USA in Natural Gas Processing.

It was a very enjoyable occasion, thanks to the GPA Europe for asking me to attend, and if you get the chance of attending future conventions, do so – you will learn a lot, meet a lot of people and have a fantastic time.

FORTHCOMING EVENTS

2017 ANNUAL CONFERENCE

13 - 15 September 2017

Sofitel Chain Bridge, Budapest

- Knowledge Session on use of GPSA Engineering Databook
- Technical Papers
- Conference Dinner
- Companions' Tour

AGM & TECHNICAL MEETING

23 November, 2017

Hilton London Paddington Hotel

JOINT CO-OPERATION MEETING WITH GPA GCC CHAPTER

4 - 8 March 2018

Shangri-La Hotel, Oman

EXHIBITION AND CONFERENCE

Presentation and Sponsorship Opportunities available

2018 YONG PROFESSIONAL TRAINING

15 March, 2018

IFP en Offices, Rueil Malmaison, France

Five Sessions on various aspects of Natural Gas Processing

2018 ANNUAL CONFERENCE

16 - 18 May, 2018

NH Vittorio Veneto Hotel, Rome, Italy

- Technical Papers
- Conference Dinner
- Companions Tour

2018 TECHNICAL MEETING

19- 21 September 2018

Barcelona

Why not join GPA Europe after attending the GasTech Exhibition?

2018 AGM & TECHNICAL MEETING

22 November, 2018

Hilton London Paddington Hotel

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This listing of current Corporate Members represents the status as at 13 March 2017.

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In Brief editor:
Claire Haycock
01925 741111
07718 185963

GPA Admin Office
GPA Europe,
132 Chantry Road,
Disley, Stockport,
Cheshire SK12 2DN,
United Kingdom
T: +44 (0)1252 625542
F: +44 (0)1252 786260
E: admin@gpaeurope.com
W: www.gpaeurope.com

Contacts:
Sandy and Anne Dunlop

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