IN BRIEF

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GAS PROCESSORS ASSOCIATION EUROPE

OASE® sulfexx™: The next generation of super selective solvents

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Introduction

The removal of hydrogen sulfide (H_2S) is an essential processing step in the production of natural gas. As new sour gas developments are being explored, gas processors need improved technologies to meet stringent sulphur dioxide (SO_2) emissions requirements. In addition, reduction of overall carbon dioxide (CO_2) emissions is now becoming an important consideration in technology selection.

One way to reduce a gas processing facility's overall carbon footprint is to reduce energy consumption and to use more sustainable technologies.

OASE® sulfexx™ is a highly energy efficient gas treating technology jointly developed by BASF and ExxonMobil to help refiners and gas processors achieve sulphur removal targets while reducing their carbon footprint. The key to the technology is a new proprietary amine that can achieve high selective removal of (H_2S) while minimising the co-absorption of CO_2. Selective treating permits full utilisation of the solvent for greater (H_2S) absorption capacity, thereby reducing circulation rate and increasing energy efficiency.

Natural gas fields with compositions that were once deemed technically challenging to develop are now being re-evaluated as potential new sources of supply. Obviously, processing gas with extremely high levels of (H_2S) would necessitate the need for higher capacity solvents. At the other end of the spectrum, processing gas streams containing low concentrations of H_2S relative to CO_2 will require advanced solvent technology to enrich the acid gas feed to the sulphur recovery unit (SRU). High quality acid gas feed enables stable operation of the SRU and reduces the fuel consumption of the process.

From a global perspective, the majority of the world's sulphur production is now being produced in the Middle East. In this geographical location, high ambient temperatures combined with a lack of available cooling and process water require a robust solvent technology able to perform under these conditions.

A common way to respond to future requirements and changing regulations is to install additional equipment. This approach is costly and may not necessarily provide the performance benefit or pass the hurdle of any economic evaluation.

Solvent technologies based on generic MDEA (Methyldiethanolamine), including promoted MDEA formulations or MDEA blended with other molecules have limitations either on capacity or on selectivity. In particular it is well known that the selectivity of MDEA-based solvents gradually decreases with increasing solvent temperatures and feed gas CO_2 partial pressures. OASE® sulfexx™ is designed to overcome all of these limitations.

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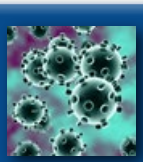

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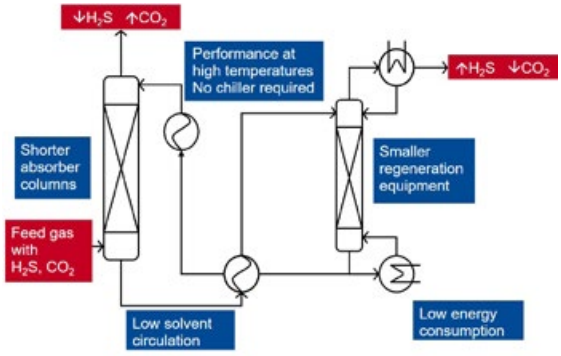
H_2S Selective Treatment

OASE® sulfexx™ provides selective removal that favours high CO_2 slip into the treated gas while H_2S is removed down to trace levels. The technology is well suited to low-pressure applications, such as Claus tail gas treatment (TGT) and acid gas enrichment (AGE), enabling high sulphur recovery. The technology may be used to achieve less than 10 vppm H_2S in the treated gas to meet stringent SO_2 emission requirements. High-pressure applications such as natural gas treatment can also benefit from the highly H_2S selective property of OASE® sulfexx™. For example, the technology may be used to treat sour gas streams with CO_2 concentrations near or equal to the required treated gas or pipeline specification. Selective treatment in natural gas requires a higher level of flexibility due to seasonal temperature variations and changes of gas quality or throughput from the wells. OASE® sulfexx™ technology is less susceptible to the effects of high temperatures and high CO_2 content of the feed gas than MDEA-based solvents. This avoids the need for over-design, and drives down the energy demand of achieving low H_2S specification.



OASE® sulfexx™ lowers specific energy demand and improves H_2S selectivity as compared to conventional selective solvents. This translates to shorter absorber columns and smaller regeneration equipment. Amine cooling with chillers are avoided in warm arid locations. Improved selectivity also lowers circulation rate and reduces carbon dioxide emissions associated with energy consumption.

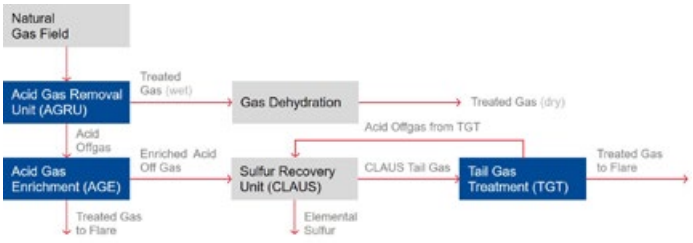


Figure 1. Selective treatment in gas processing

Key benefits

Can help improve environmental performance
- Improved selective removal of hydrogen sulfide
- Miminised co-absorption of carbon dioxide
- Can meet low sulphur emissions standards

Increases efficiency
- Lower capital investment
- Reduces size of equipment
- Reduces steam use
- Attain capacity increase with same equipment

Robust operations and technical support
- Suitable for use in hot climates
- Improves plant reliabilty
- Full technology package offered by BASF, including:
  - Process modelling
  - Onsite assistance
  - Solvent analysis
  - Reliable global supply

The OASE® sulfexx™ Development

OASE® sulfexx™ is the result of the collaboration of ExxonMobil and BASF gas treatment teams. The collaboration began in 2015 as joint research and development cooperation. The team was tasked with the development of a next generation of selective solvent technologies that exceed the performance of all other current technologies, including FLEXSORB™ SE/SE Plus. Key criteria includes: improved selectivity, lower energy demands, greater stability, and suitable for high ambient temperatures in both low pressure and high pressure applications.

OASE® sulfexx™ is based on a new proprietary amine technology that is specifically tailored to maximise H_2S absorption in the presence of CO_2 . This property allows the solvent to achieve high H_2S cleanup and selectivity at low solvent circulation rates (Figure 2).

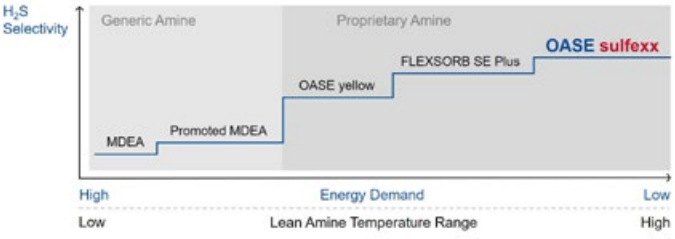


Figure 2. Comparison of selective solvents

In grassroots units, the reduction in circulation rate leads to substantial savings in investment and operating costs. Up to 30-50% regeneration steam savings over promoted MDEA can be expected. Substantial reduction in cooling water and elimination of chillers for the lean amine are possible. These results were calculated for a typical TGT unit using BASF's newly developed OASE® connect design and simulation tool [1]. Figure 3 shows the relative energy consumption of a TGT unit based on a feed gas composition of 2 vol% H_2S and 10 vol% of CO_2 . The lean amine temperature for this case study was kept at 113°F (45°C).

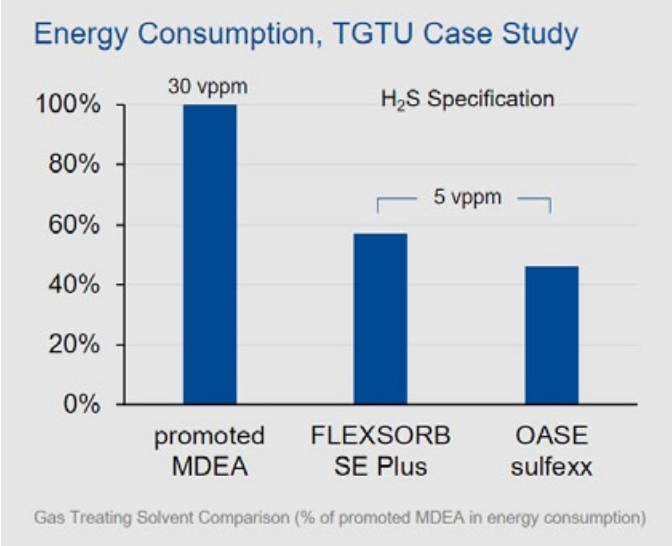


Figure 3. Comparison of energy consumption

In retrofit situations, the technology may be used to debottleneck the unit and achieve lower sulphur emission targets or allow the unit to achieve higher throughput with minimum or even no hardware modifications. In both cases, the solvent improves the quality of the acid gas. The technology has been tested in multiple pilot plants and was recently demonstrated in a commercial unit located in a North American refinery.

Commercial Demonstration

The combined tail gas streams of two Claus sulphur recovery units (SRUs) is sent to a hydrogenation step followed by a quench tower and then treated in one common TGT unit. The feed to the TGT unit contains approximately 2 vol% of H_2S and up to 7 vol% of CO_2 . The TGT unit is an original FLEXSORB™ SE design by ExxonMobil that was commissioned in 2010. With a total recovery rate of 93% in the upstream SRUs, the FLEXSORB™ SE TGT unit was designed to achieve less than 250 ppm H_2S in the absorber overhead under all operating scenarios. Just prior to the solvent swap to OASE® sulfexx™, the absorber outlet had an average of around 10 vppm of H_2S.

With the goal to improve the energy efficiency by saving regeneration reboiler steam, this field trial fits into the refinery's strategic plan to reduce the site's carbon footprint.

Within a three-day turnaround the FLEXSORB™ SE solvent was drained and the system was refilled with OASE® sulfexx™ solvent. Prior to the swap, detailed gas analysis was performed by a third party testing service. Baseline data were obtained on the feed, treated and stripper acid gas streams to confirm the material balance. The gas analysis also served to confirm online analyser measurements. The analyses were then repeated during the OASE® sulfexx™ performance test. All data obtained from the unit showed very good reproducibility and fit with the OASE® connect model.

As a part of parametric studies, the unit operated at different circulation rates and reboiler duties during the initial days of the trial. As the trial progressed, solvent circulation and steam rates were adjusted to ensure that the performance was acceptable throughout the entire operating envelop and to match the maximum H_2S level well below the 50 vppm limit as set by the test plan. These changes to the flowrates are reflected in the far left quadrant of Figures 4 and 5.

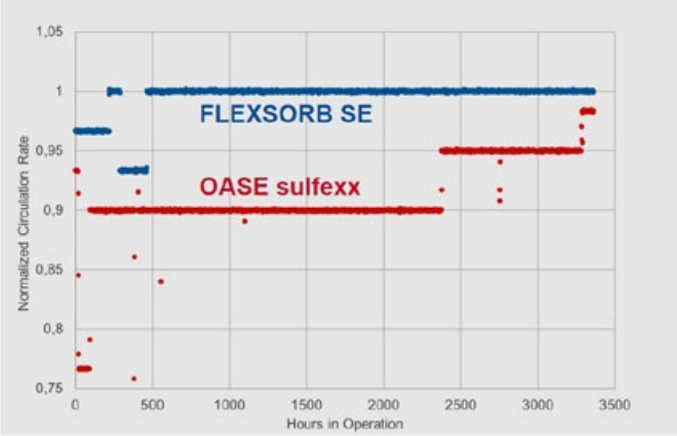


Figure 4. Normalized* solvent circulation rate

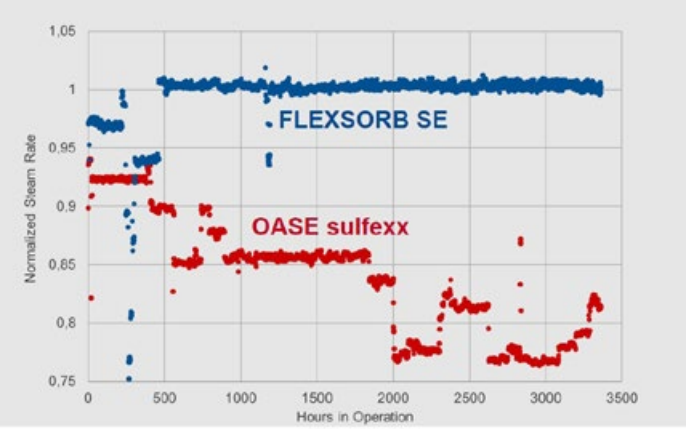


Figure 5. Normalized* reboiler steam rate

*(Normalized by dividing both FLEXSORB SE and OASE® sulfexx™ rates by typical FLEXSORB SE rate)

As a reference, performance data of FLEXSORB™ SE operating under similar feed gas conditions were overlaid in Figures 4 and 5. These figures show that OASE® sulfexx™ can operate at 90 to 95% of the circulation rate of FLEXSORB™ SE, and approximately 75 to 85% of the steam rate of FLEXSORB™ SE.

Similarly, the solvent performance in the absorber was also evaluated. The average results of the tests are summarised in Table 1. With the absorber operating at less than 10 vppm H_2S in the overhead, OASE® sulfexx™ showed improved selectivity over FLEXSORB™ SE. Tests showed CO_2 slip improvement of 6% above the baseline on average. The high selectivity also reduced the amount of CO_2 in the gas recycled back to the SRU.

	FLEXSORB SE	OASE® sulfexx™
H_2S absorber treated gas	< 10 vppm	< 10 vppm
CO_2 slip absorber treated gas	~ 85 %	~ 92 %
H_2S in stripper off gas	~ 67 %	~ 81%

Table 1. Analytical results of the gas streams

As a next step, the two companies are conducting additional tests to further improve and refine the technology.

Summary

The OASE® sulfexx™ solvent technology was jointly developed by BASF and ExxonMobil in order to efficiently remove hydrogen sulfide and meet tighter emissions regulations. The lower energy requirements may help refiners and gas processors to reduce their carbon footprint. The technology is suitable for low and high pressure applications in the field of selective H_2S gas treatment. The solvent shows superior performance characteristics over generic and promoted MDEA formulations, as well as sterically hindered amines such as FLEXSORB™ SE and SE Plus.

After extensive lab and pilot plant tests at multiple sites, OASE® sulfexx™ was deployed in a commercial TGT unit. Initial results from the commercial trial confirms the selectivity and energy advantages. BASF and ExxonMobil are continuing efforts to test and improve the technology.

References

[1] Internal BASF study using OASE® Connect design and simulation tool.

I DIDN'T SEE THAT COMING!

by Martin Copp, Chairman, GPA Europe

In the last issue of In Brief, my "View From the Top" was entitled "What will the future bring." Well I certainly didn't foresee in my wildest dreams, what challenges the world, and our industry would be facing less than three months after I wrote that article. I'm sure that 99.99% (nothing in life is 100% certain) of the world's population also couldn't have dreamed how a 125 nanometer diameter virus would turn the world as we know it upside down.

My previous article was asking questions about what the global energy market would look like in the years to come. Unless you have been living on a desert island, completely isolated from rest of the World for the last six months, then we'll all have had our lives, both private and working, affected by the global COVID-19 pandemic. And these changes have had a huge impact on the energy market already.

Pre-COVID, I would have been travelling on a weekly basis to see our customers or to one of our many production locations within EMEA. The company I work for, like almost all others, implemented measures to protect staff and the long-term future of the business. This in effect resulted in a total ban on any travel. The extent of this reduction in travel can be seen from my car fuel bills. I did not fill up my car from 15th March until 4th of July, when typically I would have been using two tanks of fuel a week.

For me, I'm in the fortunate position of being able to continue to carry out my work activities from my home office. Whilst Skype was already a regular business tool, the enforced home working has by necessity, created a business culture where virtual meetings and reliance on Microsoft Teams and SharePoint have become the new business norm. Most companies previously believed that face to face meetings were essential for carrying out business. The situation we find ourselves in has proven that businesses can continue to operate even without extensive travel and I'm sure that travel is going to get harder and harder for businesses to justify in the future. The air travel business has obviously been incredibly badly hit. At one point Lufthansa were

Martin Copp

operating less than 5% of their pre-COVID flights and the airline industry as a whole is predicting that the level of flights will not return to 2019 levels for at least three years.

At GPA Europe, we were also impacted. Our June conference, to be hosted by Total in their Paris facility, had to be cancelled. This will now be rescheduled to 2021 (COVID-19 allowing) and once details are finalised, these will be published on the website. We've not been idle though.

We have been organising a series of webinars between now and February 2021, which will cover many topics. We kicked off this series of webinars in September with a Panel Session featuring several people who have a big impact on our market area. We followed this with a Young Professionals Training session and the first of our Technical Session under the theme Green Energy/Energy Transition. The full programme is available on our website and is free for GPA Europe members.

During the 2019 AGM, we presented the new GPA Europe Vision, Goal and Strategy, which included four key strategic initiatives that we would launch. We requested members to volunteer to sit on the working groups that were set up to address each of these initiatives. Sixteen people volunteered their time and energy to work on these initiatives and we've now developed a road map and further actions to be carried out for all of these initiatives. I'd like to offer my personal thanks and the wider thanks of GPA Europe membership, to all of the people who volunteered to work on these objectives. The work they are doing is to the benefit of all GPA Europe membership, to ensure that we continue to provide services that create enhanced value to our members' companies. The initiatives being worked on are:

1. Develop a value proposition tool adaptable to all members
2. Develop targeted marketing strategy and support with relevant tools
3. Develop a plan to address future energy/gas markets
4. Develop a training strategy to address members development needs

Despite all the gloom that has been pervading the world as a result of COVID-19, there have been some upsides. I'm sure that you've all noticed the improvements in air quality as a result of the reduced NOx levels in most parts of the world. Will this result in the general population calling for faster change to a hydrocarbon free economy? There are signs that this is already occurring and governments are responding by promising more cuts in fossil fuel consumption; with some of them announcing significant expenditure in alternative energy technologies. I honestly believe that we are at the crossroads of some major changes in the energy and basic commodities markets and I believe that these changes will rely heavily on the gas processing skills that our industry has built up over the last 70+ years. GPA Europe will therefore continue to play an important role in safely and efficiently shaping the future, as we have been doing in the last 37 years.

GPA EUROPE AUTUMN CONFERENCE
ASCOT 13 – 14 NOVEMBER 2019

TECHNICAL CONFERENCE – MORNING SESSION 13 NOVEMBER 2019

Moderated by Samantha Nicholson, Fluor Ltd

Speakers and Moderators

After a warm welcome by the GPA Europe Vice Chairman, Gary Bowerbank, the conference commenced with the morning session, Wednesday 13th November. The conference centre of Ascot MacDonalds Berystede, is situated in beautiful gardens in a leafy suburb of Ascot just a stone's throw from the famous Royal Ascot. Opening remarks were provided by session chair, Samantha Nicholson from Fluor ltd.

The first presenter of the morning session was Paul Stockwell, Managing Director of Process Vision.

Paul's paper was titled Reducing Maintenance Costs and Improving Safety with Robotics. Paul has gained insight in the safety and cost impacts of process and their problem areas in his many years of experience and more recently has been actively developing robotic snakes optical systems which he presented. The work he is carrying out is partnered with the University of Reading and Innovate UK.

Paul explained that the use of robotics in the oil and gas industry is becoming a hot topic. The paper reported on the progress and challenges of a project to develop a robot snake. The robot snake comprises of a manoeuvrable optical system, which can monitor the internal operation of processing systems while the plant is operating. The small diameter snake provides a live video feed to

Paul Stockwell - Process Vision

provide real time operations for equipment inspection and troubleshooting. The audience heard that the snake design can be used for high pressure combustible gas systems and it is anticipated that the robot will be able to safely access systems via existing tapping points and become a versatile tool to perform a number of tasks that currently require a plant shutdown. The aim is that the tool is to have the ability to investigate the internal condition of piping and pressure vessels. Additional tools will enable operators to troubleshoot operation problems such as foaming or fouling.

The aim of the snake robot project is to: increase availability by reducing the need for inspection shutdowns; improve safety by reducing the need for confined space working; and reduce shutdown durations, as online diagnostics will help shutdown planning and logistics. Paul demonstrated the tool with a non-motorised working model.

He also explained the limits of expected operation and the size of connection required for insertion of the snake. He explained the concept behind the project including the evident safety and environmental benefits and also the reduction in costs associated with maintenance. The ideas of online robotic maintenance of trayed towers was remarkable. Using virtual reality to provide remote real-time viewing "blew the writer's mind"! The audience was invited to contact Paul with ideas on how to provide high pressure trials for the innovative equipment.

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The second paper was presented by Damien Menet of TechnipFMC.

The title was Highly Sour Gas: The Best Options to Process It. The paper discusses TechnipFMC's feasibility study for the development of a highly sour gas-condensate field for a major client. Sour gas levels are extremely high in the range of 22-28vol% hydrogen sulphide and 13-17vol% carbon dioxide, also contained organic sulphur components such as carbonyl sulphide, mercaptans and disulphides. As part of the presentation the author showed the location of various ultra-sour gas fields, the acid gas concentrations at the locations and the solvent technologies used to clean up the gas. The study addressed the evaluation of onshore technologies for gas and condensate processing (gas sweetening, gas dehydration, NGL recovery, condensate stabilisation and sweetening) for five different sets of export product: sales gas, LPGs, hydrocarbon condensates, sulphur or re-injection of the acid gases, on the basis of selecting the most attractive scheme based on economic and HSE criteria.

The presentation included a matrix of the configurations considered which enabled the focus towards the end solutions, including the latest development in sweetening technologies and acid gas reinjection, the pros and cons of each technology, and the influence of technical and economic parameters on the plant layout and technology selection. The fascinating paper will provide an excellent learning guide for aspiring process engineers in a time as ultra-sour field development becomes more and more common.

Damien Menet - TechnipFMC

The third presentation was a joint presentation between Luca del Monaco of ENI Spa and Ricardo Gonzalez from Shell Technology Centre.

Luca del Monaco - ENI Spa

Ricardo Gonzalez - Shell Technology Centre

The paper discussed the planned increase in oil and associated gas production in Val D'Agri. For the work described ENI was the operating partner and Shell Italia EP was the non-operating partner.

Associated gas production needed to be increased without altering the sulphur recovery trains so a review of the acid gas removal unit (AGRU), acid gas enrichment unit (AGEU) and the thermal oxidiser were carried out with a new design conceived. Following this there was the added complication of the associated gas containing more mercaptans than expected, causing a requirement to review the project scope. During the evaluation, further complexity was uncovered, as the proposed design could not satisfy the requirements of processing the desired gas throughput without sacrificing the sales gas specification or stack sulphur dioxide emissions specification. Further design options were evaluated to meet the specifications while minimising the existing equipment modifications and the original scope. The paper contains a detailed tabulation of possible debottlenecking options and the reason for the final choice. The chosen solution maintained the design but with additional enhancement by swapping the solvent in the AGRUs and in the installation of a CANSOLV unit downstream of the thermal oxidiser to remove sulphur dioxide produced by the combustion of additional mercaptans.

The paper detailed the challenges in options, and some of the lessons learned from a CANSOLV unit in operation. It also included operating data showing the effect of changing to CANSOLV in terms of sulphur dioxide and operating conditions. Troubleshooting of the CANSOLV plant and photographic evidence of the pipe blockage due to short-term excessive formation of elemental sulphur were included. It was fascinating to have the description of the project from initial ideas through to a candid description of operating challenges and upset on the way to the final optimised plant.

Samantha Nicholson - Fluor Ltd

The session chair made her closing remarks, and she thanked all the presenters for their insightful presentations. Questions to the presenters continued into the networking lunch.

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TECHNICAL CONFERENCE - AFTERNOON SESSION 13 NOVEMBER 2019

Moderated by Lorraine Fitzwater, Petrofac

Lorraine Fitzwater - Petrofac

Tobias Eckardt - BASF Catalysts

The afternoon session focused on LNG, but with four papers covering very different aspects of the subject.

Innovation in Materials Development for LNG Dehydration

The first paper of the afternoon session was presented by Tobias Eckardt of BASF Catalysts.

Effective dehydration of natural gas to cryogenic specification (typically <0.3ppmw) is a critical stage in pretreatment of gas for LNG production. Within existing facilities, there is a push to either increase capacity or increase process uptime to improve overall efficiency. Either option will affect the performance of the pretreatment train. Operators are looking to bring in new gas sources which may bring new or increased contaminant loadings or to increase duration between shutdowns requiring that the need for molecular sieve changeouts be increased from say three years to 4-6 years. The latter will require more durable molecular sieves.

One of the main causes of molecular sieve degradation is the presence of liquids, including condensation of water during the regeneration cycle (refluxing). This will lead to deterioration of the adsorbent strength and leaching of the clay binder – leading to "caking".

There are three main areas for reducing the impact of refluxing: 1) Improved thermal management of the regeneration cycle; 2) Improved binding mechanism of the adsorbent; 3) Redesign of the dehydrator set-up to install a more durable adsorbent. The first relies on good management of the dehydrator operation, but is limited in being able to increase capacity of the dehydrator. To improve the binder, BASF has introduced a new family of molecular sieves – Durosorb™, which results in less fines per cycle.

This presentation focused on the redesign of the dehydrator set-up. Silica-gel type materials (Sorbead) have been in use since the '90s for liquids removal from natural gas (both water and hydrocarbons).

This material has a higher capacity for water removal at high water levels (near saturated conditions) than a conventional Molecular Sieve but cannot achieve the low water specifications required for LNG production. By combining the two adsorbents in a single bed, advantages of both can be realised. Here the upper layer of robust Durasorb HD (a silica-alumina gel material) will extend the life of the molecular sieve material (Durasorb HR) by protecting it from reflux of liquids during regeneration.

This arrangement can be retrofitted into an existing dehydrator vessel to improve performance and extend bed life. BASF is also able to offer different arrangements such as beds of the different materials operated in series to provide an optimised solution for specific operational issues.

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ssLNG to Power Plants for Distributed Power Generation

The second paper of the afternoon session was presented by Robert Brannock of TGE Gas Engineering.

Robert Brannock - TGE Gas Engineering

ssLNG (<0.5MTA) can be used in remote areas, where no natural gas pipeline is in the vicinity, to generate power. Oil power plants can switch to gas firing reducing the CO_2 emissions. The power generation in remote areas is usually up to 300MW, requiring with LNG fuelling up to 0.5 MTA. The LNG supply can be from ship, barge, truck or rail cars. This can be developed as a standalone regasification facility dedicated to the adjacent power station.

Addition of a truck/ISO container loading facility allows further downstream business such as local industrial consumers or road vehicle refuelling.

The size of the power station dictates the selection of facilities, type of storage tanks and best form of construction. A number of cases were considered to illustrate the options.

For the smallest units (10-30 MW), total storage of some 500m3 would be required. This could be provided by 10-12 ISO containers. In this case storage could be 'mobile' as containers are readily transportable.

For generation of up to 50MW, vacuum insulated storage tanks (1,000m3 each) could be provided for total storage of up to 10,000m3. Plant can be fully modularised and a BOG (boil off gas) handling system would not be required. Ambient air vaporizers could be used.

For power generation units >50 MW and up to 300MW, required storage capacity would be >10,000m3, requiring atmospheric storage tanks, built in situ to API620/EN14620. These tanks could be full containment, double containment or single containment depending on local regulations. This requires a BOG handling system with the gas compressed to the power generation fuel system.

Short installation time and a minimum cost solution are usually important for these customers. To achieve this, a modular design approach combined with a high level of standardisation for the LNG infrastructure are essential. Depending on the individual project the standardised and modular design approach allows optimised execution by selection of either prefabrication or in-situ construction. This design approach brings clear advantages in plant expandability while providing fast track project delivery and optimised return on investment.

Synergies during planning, construction and operation of the total installation comprising LNG terminal and power station can be maximised to reduce both capital and operating costs.

Guillaume Breysse - TechnipFMC

Damien Jenn - TechnipFMC

Benefits of an Integrated Approach to Enhance F&G Detection on FLNG

Guillaume Breysse and Damien Jenn, of TechnipFMC presented the third paper of the afternoon.

The duo continued the LNG theme, this time FLNG, and some safety aspects. The aim of F&G systems is to detect a fire or a flammable gas leak sufficiently early to alert and initiate appropriate actions before a catastrophic event. F&G detectors were once located by prescriptive rules and safety engineer experience. Assessment of the F&G Detector coverage is now possible with the 3-D plant model and consideration of a performance-based approach. Software has been developed for F&G Mapping, which is becoming an effective way to achieve coverage performance targets.

In 2017, an in-house F&G Mapping study was carried on a FLNG EPC project with more than 1,000 detectors. One of the main challenges in a F&G Mapping Study is co-ordination between engineering disciplines and potential sub-contractors. The study involved many stakeholders and a robust work-process enabled TechnipFMC to effectively optimize the design, the CAPEX, the planning and to maintain accurate knowledge of the study.

Based on a geographic approach, defining flammable gas cloud size generating an overpressure greater than 150 mbar was a key step. As the overpressure developed by the explosion is a complex mechanism involving numerous parameters, Computational Fluid Dynamics (CFD) calculations were performed to model explosions and subsequently retrieve relevant gas cloud sizes. Building on TechnipFMC expertise in flame leak physical properties and fire mapping practices resulted in optimized detectors locations.

The full speaking team from the conference

FLNG to Subsea – are you following me?

The final paper of the afternoon was presented by Andrew Loose of KBR.

Andrew followed the FLNG theme, this time looking at control aspects. In common with other LNG plants

In common with other LNG plants, the overall control of an FLNG facility is required to fulfil the following objectives: (a) maintain the system within a safe design envelope; (b) maintain stable control of the system to avoid upset and flaring; (c) maintain the maximum LNG production rate through the diurnal and seasonal ambient temperature variations.

Onshore LNG and at-shore floating LNG barge facilities are generally fed from extensive gas pipeline networks providing a large gas inventory buffer such that any upsets to supply or in the LNG plant are easily managed by the control systems. However, with most offshore FLNG, there is little inventory between the wells and the inlet of the gas pre-treatment unit. Thus the design and control of the subsea system and topsides process must be considered together.

The liquefaction capacity of the FLNG facility at any time is dependent on the refrigeration compressors. As these are gas turbine driven, the power and hence capacity is subject to the ambient temperature. With the diurnal temperature swing, the actual throughput will vary throughout the day. With the relatively short production flowlines, and without active control of the sub-sea chokes, this variation will appear as pressure swings at the top of the riser as the flowlines and risers pack and unpack.

Andrew Loose - KBR

A further impact of the fluctuating inlet pressure is the risk of hydrate formation. Hydrates in the system are prevented by injection of MEG upstream of the sub-sea chokes. With the JT effects in the riser and across the topsides chokes, the pressure swings may take the arrival pressures outside of the 'safe' range and hydrate formation may occur.

In addition to the diurnal swings, other more dramatic transient effects include a trip causing 50% loss of capacity; controlled ramp-down to 50% and restart; and trip of a well. To develop and test the overall sub-sea and topsides control philosophy, a dynamic model of the system from wellhead to LNG rundown was created using UniSim software, with the multiphase subsea sections verified using OLGA software.

The subsea control was implemented using slow-acting chokes with a large number (130) of small steps from open to closed. The dynamic simulations were run for a series of cases and control system responses generated.

The study concluded that the active control of the sub-sea chokes could be used to maintain stable operating conditions in the FLNG topsides.

This study emphasised the importance of treating the subsea and topsides process as an integrated system and not in isolation when designing a complex FLNG facility and also highlighted the importance of attention to detail to ensure successful long-term, reliable operations. It was noted that the control system should be optimised for project specific conditions.

The papers were all well received, and our thanks go to all the presenters for their work in preparing the papers and presentations.

GPA EUROPE AUTUMN CONFERENCE
ASCOT, 13 - 14 NOVEMBER 2019

TECHNICAL CONFERENCE - MORNING SESSION 14 NOVEMBER 2019

Moderated by Sandy Dunlop, Dunlop Presentations Ltd.

Sandy Dunlop

Verena Kramer - Linde

Tobias Eckardt - BASF Catalysts

On the morning of 14 November, delegates assembled to hear three fascinating and different papers, before breaking for lunch and the subsequent Annual General Meeting.

Novel and efficient process to recover valuable by-products from natural gas

Verena Kramer of Linde together with Tobias Eckhardt of BASF gave an interesting paper on their investigations of a hybrid process using conventional adsorption systems with membranes and Pressure Swing Adsorption (PSA) to recover helium for natural gases. The conventional approach to this process is to use cryogenic separation techniques which entail considerable energy as impurities are removed at temperatures approaching absolute zero. By utilising the new concept, processing occurs at much more benign temperatures, albeit still requiring compressor power.

The impetus for this research has been the increasing price of helium caused by reduction of 20% in helium production in Qatar. Given the importance of helium particularly for medical use, superconductors and the aerospace industry, it was felt that a new process concept was opportune.

The process considers the use of adsorption to remove heavy hydrocarbons and water from the natural gas as would be typical on a cryogenic process, but then differs in the separation stages. Initially a separation through a membrane takes place with a helium rich permeate, while the bulk remaining gas goes to the methane rich product gas.

The permeate is then compressed and sent to an absorption system for removal of acid gases. The sweet gas is then passed to a second membrane process to concentrate the helium permeate, whilst remaining methane rich gas passes to the product stream. Finally, the low-pressure helium permeate from the second membrane is compressed and sent to a PSA unit to produce specification helium gas for sale. The reject gas from the PSA unit is recycled to the AGRU compressor to increase helium recovery.

Verena and Tobias presented a case study in which gas containing 0.4% helium together with 4% CO_2 , 83% methane, with a balance of ethane plus was analysed to produce a product gas with maximum 2% CO_2 , 4lbs/MMSCF water content and -10oC HHC dewpoint. A comparison with using the process with or without the helium purification step was performed which showed that an expected 95% helium recovery (99.999%) would increase revenue potential by a factor of seven, making the process economically attractive. Unfortunately, at this stage no direct comparison with the cryogenic approach has been carried out, it is thought that the higher operating temperature and possible lower complexity may also make the process attractive over conventional approaches. The process has not yet been commercially proven, but we await, with interest, future developments.

Here's the feed composition. Let's go!

Brian Moffatt of Petrophase gave us the benefit of his years of experience in problems that arise due to misinterpretation of the basis of feed definition in design. In particular, he concentrated on well fluid analysis and presented three examples where it as necessary for the recipient of the information needs to act like a detective to determine the correct basis for design.

Brian emphasised the benefits of applying phase equilibrium analysis. A composition was provided with a statement that the design conditions for the sample were 615 psia and 27°C. However, an analysis of the equilibrium conditions of the given composition would not match the straight-line correlation of the equilibrium plot. A correlation could be achieved with a separator temperature of 49°C suggesting that the actual liquid composition proposed was wrong for the actual design conditions.

In the case of lean condensates, C7+ components concentrated in the surface separator provides a more accurate measurement, but care must be taken to consider the flowrate. At higher flowrate condensation occurs in the reservoir providing a leaner actual well stream.

A further example given was for the measurement of contaminants such as H_2S, which can be absorbed in mud filtrate downhole and thus may not appear at operational levels during testing, and mercury, whose weight means that its concentration will increase with depth in the well.

Brian concluded his discussion by pointing out that the different disciplines working with data may not be fully aware of the implications of the information they are handling. Different perspectives result in differing results and it is therefore important to understand the source of information and validate it against modelling methods. His paper contains a useful checklist of items to consider in data quality control.

Brian Moffatt - Petrophase

Paul Garlick - Fluor Ltd

A Matter of Time: Why is Process Safety Time Important?

The final presentation of the session was provided by Paul Garlick of Fluor who discussed a little understood issue of the effect of Process Safety Time (PST) in the design of Safety Instrumented Systems (SIS) for safeguarding process plant. The Safety Integrity Level (SIL) determines the necessary SIS, but little consideration has tended to be given to the system response time in the event of activation.

Paul argued that traditional definition of Process Safety Time, the period between the initiating event and the hazardous scenario, could be too long and that a less risky definition would be the time from the activation of the SIS to the hazard occurrence – a much shorter period which takes into account the time taken to actually initiate the SIS. Calculation of this time requires a detailed knowledge of the real plant design, which may not be available until late in the design process.

A methodology of the Process Safety Time calculation is detailed in the paper. It considers cases where actual process conditions and equipment response times may result in the SIS not operating sufficiently quickly to achieve the desired level of protection.

The presentation draws our attention to an important aspect of SIS design which may not always be considered, but which nevertheless can be critical to provide assurance of the integrity of the design.

All three papers provided some introspection and thought, and delegates will have returned to work with ideas which will improve design capability.

GPA Europe Chairman's Annual Report - 2019

Written for the GPA Europe 2019 AGM held on 14 November 2019

By Martin Copp, Chairman, GPA Europe

Ladies and Gentlemen, friends and colleagues, welcome to the 2019 Annual General Meeting of GPA Europe Ltd.

Our event year started with another cooperative event between GPA GCC and GPA Europe Chapters, held in The Regency Hotel Kuwait. These co-hosted events provide a valuable opportunity for GPA Europe's engineering contractors, technology providers and consultants to access key decision makers from the regions NOC's.

GPA-GCC events last for four days with the first two days consisting of technology workshops. In 2019, four of the workshops were presented by GPA Europe members. This is a reflection of the importance that the GCC Chapter places on the capabilities of our European Chapter membership.

GPA Europe members were able to book the event through our chapter. Thirteen attendees booked in this way but there were considerably more members from our chapter who attended than booked through us. We will again be co-sponsoring the 2020 GCC Annual Technical Conference which will again be in Kuwait and would encourage members to attend. This event really does give access to many customers that our members can potentially do business with. Of course, if you are wishing to attend, booking through GPA Europe, adds much valuable income to our organisation.

2019 had the highest attendance ever with over 600 delegates attending the two days of workshops and two days of papers.

The next event for us was the GPA Europe Spring Conference which this year was held in Amsterdam. In a new development for GPA Europe, Shell kindly offered to co-host this event within their Technology Centre. Given that the combined attendance for the YP event and the main conference had over 180 attendees, I'm sure that many of you in this room were present and would agree that this event was one of the most successful that GPA Europe has hosted over the last several years.

A special thanks go to the Technical Committee headed by Myrian Schenk and Gary Bowerbank from Shell for organising such a great event which we are hoping will become a successful model for future GPA Europe conferences.

Christian Bladanet receives the Best Paper Award from Martin Copp

The week started off with the YP event. This event provides free training for university students and young engineers in the gas processing sphere. The sessions are prepared around topics that our Young Professionals team identify from amongst themselves and are presented by subject matter experts in the required fields. Our thanks go out to these experts who gladly give up their time to pass on their knowledge and experience to the future experts in our field. We will again be hosting a YP conference in 2020 and would encourage member companies to put forward candidates for attending. This event really goes a long way in the development process of the future leaders of our businesses.

The first of several new ideas for GPA Europe conferences that were trialled at Amsterdam was the Low Carbon Technology Workshop. This workshop was extremely well organised by our own Malcolm Harrison, alongside Eric Puik and Devin Shaw of Shell Global Solutions. The goal of the workshop was to identify from within our industry, potential solutions to de-carbonisation of the global energy market. After an initial introduction into the goal of the workshop, the group was split into smaller groups which were then given a range of different scenarios to discuss, agree solutions and actions and then report out to the other groups and organisers. Given the participation in this workshop of operators, engineering contractors, technology licensors, equipment providers and consultants, the solutions created encompassed a view from almost all the different stakeholders in our industry. The results of this workshop are being collated and will be reported out in the future. We are planning to host similar events at upcoming events. Any members that would like to table industry challenges that could be a potential topic for future workshops are encouraged to send these to the GPA E admin office.

Another new addition, at least in recent years, was a keynote address by Yuri Sebregts, VP Technology and Chief Technology Officer of Shell. Whilst Yuri could not physically attend himself, his keynote address was presented via video. The importance that he places on organisations like ours was evident in the take home message that our conferences were very important for the future of the world.

To complete a hat-trick of new ideas, the technical committee also organised an Executive panel session which was admirably facilitated by Nick Amott. The three panellists Ed Daniels, Special Adviser to Shell's Executive Committee, Andy Lane, Head of Business Development – Gas Value Chains, BP and Alain Poincheval, Managing Director, TechnipFMC are all influential people from within our industry. They provided a high-level perspective on how major companies in our market are addressing sustainability, affordable energy supplies for a growing population, low carbon economy and the future of LNG. I'm sure many people found these insightful comments interesting and valuable and provided guidance for what we need to do to develop our industry going forward.

We would like to thank our sponsors and exhibitors whose participation allows our members to keep abreast of developments within the marketplace and for people to actually see some of the equipment we hear about in our technical conferences.

The attendance at the conference by Adrienne Blume who is the Editor of Gas Processing and LNG and Executive Editor of Hydrocarbon Processing really put our organisation in the news. She was constantly writing and uploading articles onto the relevant publication website. This gave exposure to our events that we have never previously experienced. GPA Europe is trying to identify ways to generate similar levels of exposure for our 2020 conference.

Spring Conference attendees

I'd like to make you aware of the upcoming events for 2020. The first event of the year will be the GPA GCC chapter, 28th Annual Technical Conference from 17-18 March in Kuwait. GPA Europe will again be co-promoting and if you are looking for an opportunity to get access to a wide number of users for your products and services, I would encourage you to attend.

Executive panel discussion

The GPA Midstream Convention will take place in New Orleans between 19-22 April. This is the parent of our organisation and they always put on a great event.

The GPA Europe Spring Conference and Young Professional conference will take place 2-4 June in Paris with TOTAL – a very exciting event for us and we will be communicating details soon. Finally, we will hold our AGM in November in London.

I would like to thank you all for your continued support of our organisation. Without your membership and attendance at our conferences, the organisation would not exist, and the industry and our world would be worse off for this.

At this time, we also remember John Sheffield who passed away at the beginning of the year. John was a long-standing member of GPA Europe who worked tirelessly for the industry and our organisation. He will be forever in our thoughts.

My final thanks goes to the Management Committee of GPA Europe. All of these people are volunteers and willingly give up their time so that the organisation exists, In Brief gets produced, events happen, newsletters get issued, etc. It's not easy to fit all of the work required to do this in with a day job, family time and personal time. Thank you ManCom.

FORTHCOMING EVENTS

BE PART OF OUR DIGITAL JOURNEY WHICH BEGAN ON 24 SEPTEMBER 2020.

DATE:	SESSION
24 September 2020	Panel Discussion
8 October 2020	Young Professional Session: "Carbon Capture, Utilisation and Storage"
22 October 2020	Technical Session: "Green Energy/ Energy Transition"
19 November 2020	Technical Meeting & AGM

If you have missed any sessions, recordings are available free of charge for members to view.

Our next session is **10 December 2020** followed by monthly online sessions and content.

Registration is now open! Free of charge for our GPA Europe members.

We'll bring sessions of substance with live Q&A. We will also have dedicated sessions for our Young Professionals.

DATE:	SESSION
10 December 2020	Technical Session: "Future Energy"
14 January 2021	Young Professional Session: "Digitalisation"
21 January 2021	Technical Session: "Troubleshooting poorly performing filters/ coalescers"
19 February 2021	Technical Session: "Gas Sweetening Technologies"

More sessions for 2021 will be announced soon.

If you are interested in sponsoring an individual session, or the event series, please get in touch with us today for more information.

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