IN BRIEF

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A small step in gas processing, a giant leap towards the decarbonisation of energy

By Tony Wimpenny, Business Development Director, Orbital Gas Systems

In September 2018, our esteemed GPA Europe colleagues, Adrian Finn and Terry Tomlinson from Costain UK, published a fascinating article about large-scale decarbonisation by hydrogen. This article outlined the environmental and economic drivers for investing in the introduction of hydrogen into the energy mix and described numerous hydrogen-related projects in the UK that have been slated by the major gas distribution networks for implementation.

One of the projects described was the HyDeploy project at Keele University, Staffordshire, UK, which would be a first-of-its-kind project in the UK to inject hydrogen into an existing natural gas network. Given the importance this project contributes to the ongoing hydrogen-related decarbonisation of our energy infrastructure, this article describes the planning and implementation of this project in much greater detail.

Background

As mentioned in Adrian and Terry's article, the Climate Change Act 2008 sets out specific, significant targets for carbon dioxide emission reduction until 2050, and the UK government and energy sector are extremely committed to meeting or exceeding these targets by various means: looking at alternative sources of heat and power; and launching initiatives and incentives to motivate industry to innovate and improve their energy-consuming and emission-generating operations. However, decarbonising the energy mix is not a UK-specific challenge. Since global climate change legislation was passed and initiatives committed to by world leaders, governments and energy players all over the world are working hard to navigate their way to short-term compliance and long-term sustainability.

In the UK and Europe, biogas and biomethane have long been identified and employed as a more sustainable energy generation vector. Waste from various sources is used to produce biogas that can be either directly used in CHP engines for local power and heat, or the biogas can be upgraded to pipeline-quality biomethane for injection into gas distribution grids for industrial or domestic consumption. However, large scale adoption of biomethane across gas networks alone will not solve the decarbonisation challenge. Indeed, biomethane is essentially methane and carbon dioxide (along with some impurities – but that's a whole separate article!) and so will burn in a gas turbine or domestic boiler to produce carbon dioxide emissions as natural gas would. This is both an advantage and a limitation of biomethane as a decarbonisation strategy. Additional and alternative decarbonising strategies are needed to achieve the global challenge.

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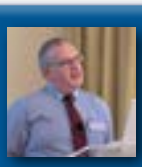
INSIDE



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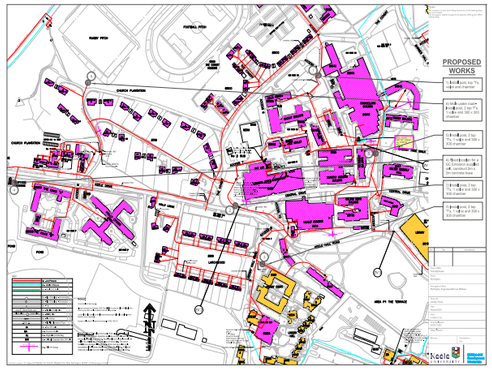
Hydrogen – Readily available, carbon-free energy

Hydrogen was quickly identified as a possible avenue to achieving greater decarbonisation, as it is readily available, can be transported as a gas using existing infrastructure and produces only water when combusted (in extremely simple terms, hydrogen + oxygen = H2O!). Hydrogen was a major component of towns gas, which was used extensively throughout domestic gas networks until the late 1960s, so its characteristics are well understood. Many other countries in Europe are also currently exploring how best to use hydrogen in their energy strategy, such as France, Germany, Italy, Belgium and Netherlands to name just a few. Further afield, countries such as USA, Canada, Japan and Australia are also undergoing hydrogen studies and trials of their own.

HyDeploy at Keele University – Local implementation leading the global charge

HyDeploy is a landmark project. By injecting up to 20% hydrogen into an existing natural gas distribution network, the total carbon dioxide emissions will be reduced, without any modification to the low-pressure gas piping or appliances. Keele University is the perfect 'live laboratory' for this as it is located at the end of a gas distribution network and already has piping suitable for low pressure blended gas containing hydrogen. The campus contains a mixture of domestic homes, teaching buildings, industrial boilers and laboratory facilities – a useful simulation of a small town for implementation and proof-of-concept for the next hydrogen injection projects on public networks.



It also wholly owns its own network, meaning the administration and costs of making infrastructure modifications on site are dramatically reduced compared to a trial on a public gas network. The campus has two independent natural gas networks which enables the injection of hydrogen into one network and continuation of the other network as traditional natural gas, which in turn affords a level of comparison of behaviour between the two…very useful for trial purposes!

Planning ahead

Despite towns gas, which contained hydrogen as one of the principal constituent components, being widespread throughout the UK gas networks last century, the premise of injecting hydrogen into the existing gas network at Keele University required a huge amount of research, documented evidence and hard work from the collaboration partners involved, in order to satisfy the requirements of the UK government's Health and Safety Executive (HSE) to approve the project. Indeed, current hydrogen limits in natural gas pipelines are set at trace levels in most European countries due to the threat of leaks and embrittlement of ageing iron-based piping.

Aside from material testing, all appliances on the Keele campus were checked for condition and compatibility, and gas behaviour studies were made by industry experts and included in the numerous project risk assessments as part of the project approval process.

On the softer side of the approval process, but an important part of making the project a success and setting a precedent for acceptance of hydrogen as a viable energy source, was the onboarding of the campus population. An educational and engaging campaign was undertaken to explain the drivers and impact of the project to the residents and students, and every opportunity was taken to invite and address concerns.

Collaboration

The project is funded under Ofgem's Network Innovation Competition and is a collaboration between Cadent Gas, Northern Gas Networks, Progressive Energy Ltd, Keele University (Keele), and Health & Safety Executive – Science Division and ITM Power. The project is also supported by KIWA, Dave Lander Consulting and Otto Simon, along with contributors of equipment and services from industry.

One of GPA Europe's member companies, Orbital Gas Systems, has set up an office on site at Keele University to support the project and develop technology and solutions relevant to the project and more generally the requirements around blending hydrogen into Natural Gas. GPA-E regular and former head of Research & Development for Orbital, Tony Wimpenny commented: "Not just in the UK, but all across the world, a change in the energy mix is required and is happening. This is set to be the biggest change for decades and it needs to be supported by all players in the gas business in order to be successful. Orbital, with its legacy of innovation and support to the UK gas networks, is well placed to support the HyDeploy project(s) and keen to collaborate with others to help the project achieve its goals and set the scene for similar projects ahead."

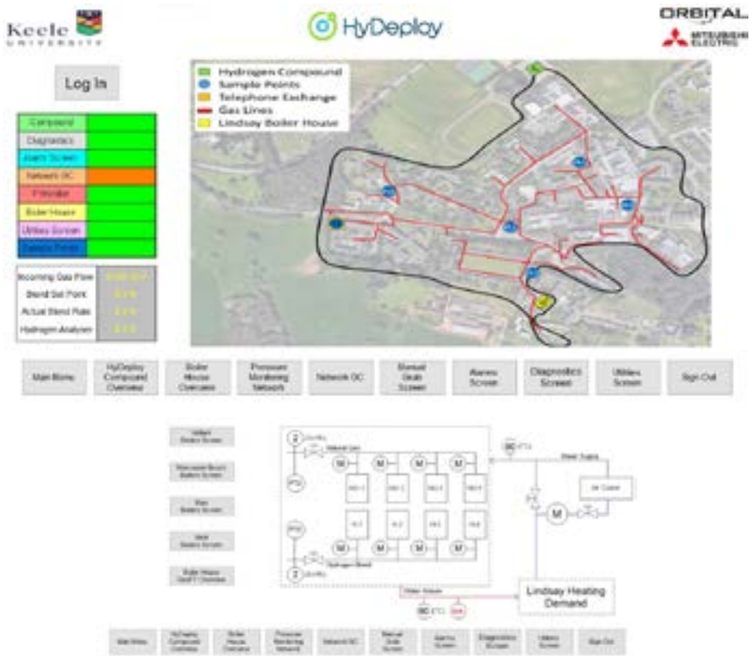
Equipment

In preparation for the project, production, mixing and validation equipment was installed on the gas network within the university campus grounds where hydrogen is to be injected. This included the equipment to:

- Generate hydrogen onsite.
- Monitor incoming gas quality before injecting a target level of hydrogen and verify that blended gas is in specification and suitable to enter the natural gas network.
- Monitor the propagation and effect of the blended gas around the network via a number of monitoring points.
- Continuously monitor gas quality and blend level at the extremity of the network.
- Collate all project-specific data into a central repository.

Knowledge is power

In order to monitor safety and performance of the equipment related to the project, a data aggregation system was developed to gather signals from all of the instrumentation across the hydrogen-blended gas network and make it available for all the project collaborators to monitor remotely, via a web browser. Data is captured from the hydrogen injection compound equipment, boilers, and instrumentation, and sent to a secure area within Keele University's existing IT infrastructure. From here, software in the data aggregation tool uses a secure web connection to pick up the data and feed the data aggregation system, which then collects, collates and displays it in a user-friendly interface for the project collaborators to access and interact with.



Trial delivery

After extensive evaluations, in-house and third-party testing, the infrastructure and equipment is now fully installed, commissioned and operational at the HyDeploy compound on campus. The programme sets out to inject hydrogen initially into the low-pressure gas distribution at a low volume percentage. Following verification that the network is operating safely, the blend level will be incrementally increased towards the maximum blend level of 20%. The project team will use the monitoring equipment around campus to establish stable, safe gas network operation at each injection level until the maximum level is reached and held successfully. The project will continue until Summer 2020, at which point a transition will occur to conclude and wrap up the project at Keele University and ramp up infrastructure building and equipping of the next phase of the project at a different location.

The next steps…leaps

The project at Keele University is just the start of a several-year programme to develop the use of hydrogen in the national gas infrastructure. The next phase immediately after the trial at Keele ceases involves re-locating and re-using the equipment, with as little modification as possible, to the next location while utilising any lessons learnt for the next phase. The idea is that the knowledge base, equipment and economic/operational performance continuously improve as the programme progresses.

The benefits of HyDeploy are clear and the industry interest is high; all stakeholders are now very excited to run the trial and watch this ground-breaking project flourish and provide information to the global gas industry on how to integrate hydrogen into domestic natural gas use.

Acknowledgements

Co-authors and collaborators: Thomas "Tommy" Isaac (Progressive Energy) for a wealth of project information, Cadent & NGN for project support and permission and willingness to share project plans and information, Keele University for open and forthcoming support.

WHAT WILL THE FUTURE BRING?

By GPA Europe Chairman, Martin Copp

Martin Copp

Amsterdam 2019 introduced a new style of conference for GPA Europe.

The feedback we've received from members and attendees has indicated that this format was well received. Thanks must go out to Helen, Malcolm, and the programme committee for envisaging this new approach. We must also extend a big thank you to the team at Shell led by Gary Bowerbank who hosted us fantastically.

Next year's conference will have a lot to live up to in order to replicate the success of Amsterdam. We have high hopes for the 2020 conference which will be hosted by Total in Paris. Helen, Myriam and the programe committee are already thinking of new innovative ways to future-proof our GPA conferences so keep your eyes open for details of this.

The workshop on the first morning of the Amsterdam conference, the panel session and a lot of the other papers were focusing on what the future energy market would look like. The world is demanding cheap, clean and reliable energy on demand and it's obvious that gas processing will have a significant part to play in achieving these goals. Natural gas is the cleanest hydrocarbon energy source currently available. Significant reductions in global CO_2 levels could be achieved by replacing other fossil fuels such as coal. Most of the major global energy players are predicting significant increases in natural gas production and consumption over the next 20-30 years. However, will natural gas provide the type of energy supply that the world appears to be demanding? That remains to be seen.

One of the reports in this copy is an update on an interesting project being undertaken in the UK. HyDeploy aims to prove that blending up to 20% hydrogen with natural gas provides a safe and greener alternative 100% natural gas. It also aims to prove that consumers will not notice any difference and will have to change their cooking or heating appliances. This last point in my opinion is something that is not discussed enough in conversations about future energy, certainly amongst my non-industry related friends. The cost to consumers of changing cooking and heating methodology is more often than not overlooked. For an average family currently using gas for cooking and heating this cost could run to thousands of pounds.

Hydrogen appears to have high potential for becoming an important part of the energy mix of the future. It can be burnt directly to produce energy or used in various types of fuel cell to produce electricity. The state of California appears to be leading the world in the use of hydrogen as a fuel, with 40 retail fuelling stations already open.

> “Hydrogen appears to have high potential for becoming an important part of the energy mix of the future. It can be burnt directly to produce energy or used in various types of fuel cell to produce electricity.”

Hydrogen powered vehicles have ranges similar to existing conventionally fuelled vehicles with the only emissions being water vapour. Whilst driving through Queensland on a family holiday, the importance of range in remote locations was immediately apparent. Current battery capacity would make trips of this nature very painful and impractical.

Hydrogen therefore has lots of potential for the future fuel, provided that safe production, transportation and storage, and just as importantly costs, can be aligned to the global requirements. This will be good news for our gas processing professionals. The knowledge and skills that we have developed whilst processing natural gas will prove invaluable in developing a hydrogen economy. I'm sure that GPA Europe will be at the forefront of this development if the energy industry follows what I believe is the best solution to our global energy needs.

I would like to finish off by thanking a few people who have made major contributions to our industry and GPA Europe.

Nick Amott and Justin Hearn are both retiring and Jon Lewis is standing down from the management committee of GPA Europe. All three of them have made significant contributions to their businesses, our industry and GPA Europe. Thank you to all of you.

Open - Retail	40
Open - Non-Retail	0
Commissioning	8
Under Construction	0
Approval to Build	4
Planning Approval	7
Permit in Process	2
Pre-Permit Application	2
Establishing Site Control	0

Courtesy of California Fuel Cell Partnership

GPA EUROPE SPRING CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

YOUNG PROFESSIONALS TRAINING DAY – MORNING SESSION 14TH MAY

Moderated by Paul Stockwell, Process Vision Ltd

Kindra Snow-McGregor - Petroskills

YP Training Day speakers and moderators

European Gas Industry: Where are we going?

Kindra Snow-McGregor of Petroskills/John M Campbell kicked off proceedings with an engaging presentation as a tribute to the work of the late John Sheffield. Setting the scene, it examined the challenges faced as we move towards a hydrocarbon-free economy. It highlighted the need and opportunities for engineers and proposed a strategy where the gas industry has a large part to play in providing the innovation and ingenuity required to overcome the technical challenges that lie ahead over the next 20 years.

The paper investigated technologies and their effectiveness in providing a cost-effective reduction of greenhouse gases (GHG). Natural gas is now becoming recognised as the best transition fuel whilst the increasing use of natural gas and LNG to replace coal can result in 50% less GHG emissions.

Three factors will be instrumental in the pace of change in the industry:

- Efforts by EU to reduce CO_2 emissions
- The falling domestic reserves and so the need to import gas
- The strategic need for a balanced energy portfolio

These factors will drive development of new technologies:

- Increase in renewables
- Hydrogenation of the gas grid
- CCS (Carbon Capture and Sequestration)
- Gas displacing coal and oil
- Strategic gas supply sourcing

Among some of the astonishing figures presented were those regarding the full life GHG emissions of vehicles. With most batteries manufactured in countries that rely heavily on coal for electricity, a battery for a sport utility vehicle will emit 74% more CO_2 than a traditional car. So, the average German car owner could drive a petrol vehicle for three and a half years before a Nissan Leaf would beat it on carbon emissions.

As steam methane reforming is a commonly applied technology could this be applied to convert natural gas to hydrogen prior to combustion in power generation to provide baseline energy requirements? A comparison of $/MWh for alternative and conventional power production was presented with some interesting results.

While renewable energy is needed and growing, it is not expected to solve the problem of CO_2 emission on its own so, for the time being, gas and renewable energy, the paper proposed, should work in a pincer movement to displace first coal in power generation and latterly oil in transport.

The UNFCCC was established in 1992. The parties have met every year since then. Despite milestones such as Kyoto in 1997, and then Paris 2015, commitments have been missed.

It was proposed that the solutions to climate change are not with politicians but with engineers and scientists. Our role has never been greater and the presentation ended with a call out to young engineers to roll up their sleeves and join the fray. This industry needs you!

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Barry Weightman - KBR

Successful Projects - a Contractor's View

Barry Weightman, now the Training and Development Manager for KBR's EMEA Engineering operations then took the floor for the second paper, giving a contractors' view of the factors that make a successful project.

Barry was keen to highlight that good communications and participation with the client is one of the main factors to create an open and trusting relationship. From conceptual design through feasibility, front end, detailed engineering studies, it was illustrated that the more robust the early design stages of a project, the better the final outcome is likely to be.

The paper also illustrated the benefits of clear project objectives and scope. A robust FEED study, integrating the operations team who are often absent, together with a clear review and decision-making process in many projects.

A Method of Predicting Transient Pipeline Holdup and Liquid Outflow

With a vast experience in the processing industry, Peter Kauders from CDE Projects started the next presentation with an explanation of the structure of cellulose and how it had influenced his early career in Courtaulds.

Peter then moved on to the topic of two-phase flows in pipelines and described the work that has been performed to model liquid holdup and transition times in pipeline networks. It was clear that much of the work in the early days was performed in small diameter test loops, and formulae created from that work did not necessarily comply with the real world. Peter highlighted the significance of Cunliffe's work in establishing the Eaton holdup correlation and its usefulness in sizing slug catchers.

Data was presented illustrating the predicted and measured condensate flow of the 20" diameter Marlin and 18" diameter Baracouda pipelines.

Peter concluded with formulae for transit time and slug catcher accumulation.


Peter Kauders - CDE Projects Ltd

Affordable Carbon Dioxide Capture in the Middle East

The last paper in the session was from Matt Mardell of Shell Global Solutions. His presentation highlighted three Shell technologies that can help to reduce capital and operational costs, and potentially cut captured CO_2 costs by 20–40%. This technology has the potential to reduce CO_2 capture costs and enable CO_2 to be used for enhanced oil recovery applications instead of natural gas. In other sites CO_2 capture technology can meet challenges and be used to debottleneck existing plants.

Matt explained that, compared with accelerated MDEA, ADIP ULTRA can help to:

- reduce capital costs by up to 30%
- lower regeneration energy requirements by up to 30%
- capture up to 25% more CO_2

The presentation moved to the development of the Shell Turbo Trays that offer up to 50% reduction in costs by enabling a reduction in size and an improvement of mass transfer rates that allow greater gas velocities. Enhanced liquid degassing also allows a smaller downcomer area.

The third technology presented was the CANSOLV CO_2 Capture System. This is a post-combustion system that uses an advanced regenerable solvent and proprietary amine technology to give up to 99% bulk CO_2 removal.

Matt then reviewed case studies that demonstrated the benefits of these technologies for high and low-pressure CO_2 capture.


Matt Mardell - Shell Global Solutions International BV

GPA EUROPE SPRING CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

YOUNG PROFESSIONALS TRAINING DAY – AFTERNOON SESSION 14TH MAY

Moderated by Myrian Schenk, KBR

Carbon Capture Utilisation and Storage, is it the Holy Grail Toward a Sustainable Energy System?

The afternoon of the YP training day started by welcoming Professor Nick Amott from Fluor Ltd UK and Dr Javier de la Fuente from Fluor Amsterdam.

They jointly presented a paper entitled: Carbon Capture Utilisation and Storage, is it the Holy Grail toward a Sustainable Energy System? As they had anticipated in their abstract, indeed it turned out to be a very interesting millennial talk with the views and perspectives of a baby-boomer!

The authors highlighted that Carbon Capture and Storage (CCS) is good as a short-term solution, however, Carbon Capture Utilisation and Storage (CCUS) in the long-term are perhaps the most relevant strategies worldwide


Javier Fernandez de la Fuente and Nick Amott

to reverse the increasing emissions of CO_2 into the atmosphere.

The paper described their views to reverse the CO_2 emissions, by focusing in Carbon Capture Utilisation and Storage. They presented and compared a number of promising utilisation projects, such as: (a) utilisation of CO_2 to produce liquid hydrocarbons (e.g. methanol), water and electricity; (b) utilising feedstock CO_2 to make polyurethanes, polyols and polycarbonates; and (c) utilisation of CO_2 to produce construction materials by accelerating the carbonation of waste residues.

However, some of these projects have only been successful at small (demonstration) scale. Javier and Nick discussed that one of the key components for any of these technologies to become industrially scalable and economically feasible is the capacity to capture and purify CO_2 at a competitive cost.

In an attempt to demonstrate this point, the paper compared the existing carbon capture technologies, such as amine plants, membranes and physical solvents and their applications to the technologies that are currently under development. These include the concept of air to fuels and the use of enzymes as a catalyst to absorb carbon dioxide.

Low Temperature Process Design (2019)

The second paper in the afternoon was presented by Adrian Finn, Process and Technology Manager at Costain, UK. He has been involved in nearly one hundred studies; pre-FEED and FEED work in his career. He holds more than 20 granted patents and 50 technical papers.

During his presentation, Adrian told us about low temperature consideration in design, which is a major subject in natural gas processing. Using "low temperature design" enables us to meet the natural gas specification, which will vary depending on the market destination: fuel or chemicals feedstock; natural gas for sale (pipeline); and/or to produce liquefied natural gas (LNG) for transportation.

By carefully examining some of the fundamentals of thermodynamic and process evaluation techniques (especially for multicomponent distillation), an optimal process design can be obtained.

Low temperature processes are likely to have large power requirements. Most of this power is used to generate the refrigerants. A cost-effective production of refrigeration depends on the understanding of the relation


Adrian Finn - Costain

between energy and power (or work). Here, the application of process integration techniques for energy efficiency and optimisation are key.

Adrian also presented some industrial examples that help to demonstrate how important in these processes are key equipment: distillation columns, turbo-expanders and plate-fin heat exchangers in the design of optimal low temperature processes. The types of cryogenic processing plants are: Air Separation, Ethylene; Hydrogen and LPG Recovery; Carbon Capture; and for Natural Gas Processing: LNG, Nitrogen Removal; NGL; LPG Extraction; and Removal of CO_2 (for high CO_2 content).

The paper also demonstrated that there is a nested optimisation required to finalise the process design. First is the optimisation of each flowsheet developed with the hardware and machine selection. In addition, each process should be as close as possible to reversibility (small changes, close to equilibrium, minimum driving forces) as this will minimise the work (power) consumption. Adrian also recommended the incorporation of real issues into a flowsheet simulation, such as operability, control, layout, required safety distances, etc. to obtain a better picture and help with the optimisation of the plant.

Adrian not only reminded us of the "rules of thumb" for distillation but also highlighted the importance of their use in low temperature process design. In addition, for the most efficient cryogenic distillation: double-effect; multiple-columns; side condenser/reboiler usage and thermal coupling all offer advantages when searching for the optimal process design. We also heard about the incorporation of plate-fin type exchangers (multi-stream aluminum), which offer tight temperature approach and stream integration, and the use of turbo-expanders to recover the work of the expansion during process design optimisation.

A paper I will have close to me next time I am designing a cryogenic or low temperature plant!

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Bart Beuckels - UOP

The Importance of Trace Components in the Development of Natural Gas Processing Schemes. What if you Overlook an Impurity During your Design?

After a nice coffee break with the usual GPA networking opportunities, Bart Beuckels, a Technical Lead for the Gas Processing Technologies for the EMEA+FSU region (Europe, Middle East, Africa and FSU) of UOP-Antwerp, Belgium, offered his contribution to the Young Professionals audience.

He presented his paper: The importance of trace components in the development of natural gas processing schemes. What if you overlook an impurity during your design? In the initial steps of a natural gas processing facility design/development, it is not uncommon that feed gases are poorly specified either due to unknown well head compositions or due to the inaccuracy in analytical measurements. Bart's presentation focused on the impact that a component that was not accounted for during design will have on the process performance, as sometimes, this may even require changes to the process design or the selection of a different technology all together at later stages of the development. Bart also highlighted the importance of the balance between the impact of 'unknown components' and an unrealistic design basis. Some of Bart's considerations were:

- **Methanol** - not present in natural gas but added by the operator. Issues will be in the NGL products and interference in the water specification. MeOH can be removed in the dehydration unit and/or in the C3/LPG stream by a wash-section.
- **COS** - zero COS is unlikely in a gas composition when H_2S and CO_2 are present, or it might be formed in the dehydration unit. Issues are off-spec Ethane, Propane and/ or LPG. Dealing with COS might require a different gas plant configuration.
- **Mercaptans** - not often identified as the earlier focus is on H_2S and total sulfur and also the RSH distribution is not fully understood or it might be changing with processing. To deal with this it will require the addition of a Mercaptans removal technology (Selexol, Gas/LPG Merox, etc.)
- **Oxygen** - O_2 is not normally present in natural gas, however it can ingress as air in low pressure gas. O_2 will give issues in the molecular sieve and in the amine unit. These issues can be resolved by adding an O_2 scavenger or customised regeneration schemes and a solvent reclaiming unit (permanent or mobile unit) respectively.

Sulphur Plants, The Seven Deadly Sins

The last presentation of the YP Event was by Jan Kiebert, Manager Europe, and Middle East & Asia for Sulphur Experts. Jan is involved in all aspects of the operations support and process engineering consulting work conducted by Sulphur Experts, Amine Experts and Dehydration Experts. Jan's paper is entitled Sulphur Plants, the Seven Deadly Sins. These are, as presented in detail by Jan:

Sin #1: Poor Reaction Stoichiometry

Sin #2: Catalyst Deactivation

Sin #3: Operating the First Converter too Cold

Sin #4: Operating the Second and Third Converters too Hot

Sin #5: Bypassing Gases around Conversion Stages

Sin #6: High Final Condenser Temperature

Sin #7: Liquid Sulphur Entrainment.

Jan Kiebert - Sulphur Experts

These are the key items that reduce any Sulphur plant efficiency and, to be able to meet the tighter emissions, the Claus Sulphur Recovery Units should be operated optimally. The paper gave us an insight on the recovery efficiencies of the Claus Process: over 99% for an ideal capability of a four-stage plant and ~96.5% for practical recovery with a two-stage plant.

In addition, if the plant suffers any of the named 'sins' then their efficiency will reduce, but still these processes offer a very high efficiency compared with other plants in the industry. Jan also recommended that the plants are checked for their performance, and that the deviations between typical and potential recovery are determined.

This paper can be used as a check-list for an operator to check or troubleshoot the operation of a Claus Plant.

General Chair Remarks

What an afternoon for the Young Professionals Training. Four great presentations.

I highly recommend that you fully read all the papers - I am sure you will be soon referring to them.
Please visit the GPA Website and download a copy of each one of these papers!

GPA EUROPE AUTUMN CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

TECHNICAL CONFERENCE – AFTERNOON SESSION 15TH MAY

Moderated by Gary Bowerbank, Shell

Technical Conference speakers and moderators

Adrienne Blume -Gulf Energy Information

A Low Carbon Technology Workshop was held on the morning of 15th May, where participants took part in a round table discussion to share views on the Low Carbon technologies that will influence the future of GPA Europe members. The workshop was facilitated by Malcolm Harrison, Instructor at Petroskills/John M Cambell, Erik Puik, Senior Energy Advisor at Shell, and Devin Shaw, Commercial Director CO_2 Capture and CSS also of Shell. The facilitation team did an excellent job of describing the desired outcomes, keeping the participants on track as the conversations and opinions flowed.

A very thought-provoking session.

Keynote Address and Opening

After the Workshop, we opened this year's conference with a keynote address by Yuri Sebregts (Executive Vice President Technology and Chief Technology Officer at Shell), who emphasised the challenges we (as an industry) have, to provide more and cleaner energy as the demand doubles towards 2050. He also discussed how important gas was as part of the energy transition, and that new developments in gas processing technologies will be required in the future.

David Torres (VP Integrated Gas and CO_2 Abatement Technologies, Shell) then went on to give a little bit of the history behind Shell's Technology Centre in Amsterdam, including discussing some of the more recent technology developments in gas processing (e.g. Shell Turbo Trays). He also stated that Shell owns/or is involved with more than 30% of the global LNG capacity and that being the biggest player in LNG has been key to Shell's success and Shell continues to grow LNG capacity, with projects such as LNG Canada.

Large Capital Project Execution

Under the umbrella of "Large Capital Project Execution" three very different papers were presented, which perfectly set the scene for the rest of the conference. The session discussed the current and future supply and demand of gas within Europe, gave a different view on local content, and shared experience from a monumentally challenging LNG project in the frozen world of Siberia.

The Insoluble Equation: How to Balance Europe's Natural Gas Supply and Demand

Adrienne Blume, from Gulf Energy Information, made the first presentation and with her background in the media was able to see the energy challenge in Europe from different perspectives. In the presentation Adrienne gave a comprehensive overview of the current and future energy balance for Europe clearly showing that, even as renewables increase, the need for gas remains strong.

And although North Sea production is still very active, supply continues to decline, and production of the giant Groningen field continues to be reduced following earthquakes induced by the depleted reservoir. On the other side of the equation, Europe's gas demand continues to increase in line with GDP growth. On top of this there is also the climate change aspect. Many governments have agreed to phase out coal for power generation; gas is the obvious alternative. Countering this is the unachievable goal of reducing CO_2 emissions by 20% of 1990 levels per decade and energy-efficiency initiatives in the industrial sector.

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This imbalance will increase Europe's demand on either gas from Russia or LNG imports. There may be political justification to limit reliance on Russian imports, and indeed Russia is looking to diversify into more LNG export, which indicates there will be an increase in LNG import and Regas terminals – many of which will be floating.

One alternative to this could perhaps be to exploit the large (estimated) reserves of shale gas. However, developing shale gas in Europe has not taken off due to a wide range of factors (population density, government restrictions, public opinion and high development costs). Perhaps this needs to be revisited.

The paper provides a wide range of data to demonstrate the various aspects of the equation and discusses the choices available to the governments of Europe, along with their relative merits and potential consequences, and paints a picture of just one of several futures for European gas.

David Simmonds - Simmonds Energy Ltd

Pursing Local Content Sustainably

David Simmonds, from Simmonds Energy Ltd, has had an interesting career from working in the oil and gas industry as a contractor and for both Shell and BG, before taking the unusual step after retiring to volunteer with VSO Tanzania, working as an advisor assessing jobs and business opportunities.

It is with this unique view point, he presented a different approach to Pursing Local Content Sustainably in large scale capital projects. Traditionally our industry has tried to meet local government requests on local content, which vary widely from country to country, but maximising construction activities onsite giving onshore and stick-built concepts preference in the development process. This has often led to more cost-effective solutions such as modularisation and floating options (i.e. FLNG) being deselected. He presented several cases where, due to the drive for local content, projects became less attractive and as such remain on the shelf. These projects not going ahead means these countries, who would greatly benefit from their development, do not see the revenue coming in, nor do they see the anticipated local jobs being created.

David suggests that we as an industry should look more broadly at local content and through the lens of Corporate & Social Responsibility (CSR). By doing this it may be far better for the country to invest in education and local business that can enable the oil or gas project, rather than focus on the direct jobs. For example, it could develop farming industry to provide food for the large contractor workforce during construct but such that the crops can then also become a cash crop in the future. In the paper David presents several examples of this, and how by investing relatively little in these areas it can make a large impact on the local region. These Corporate & Social Responsibility investments can be used to decouple the desire for "local content" from the actual project development and execution. This would put lower cost options such as modularisation and FLNG back on the table, increasing the likelihood that a project may be developed.

Christian Bladanet Technip - FMC

Yamal LNG – A Project Beyond Limits

Christian Bladanet of TechnipFMC, who was the process manager for the Yamal LNG project, shared a wide number of learnings and experience from the development of Yamal LNG. After four years of development, which includes a number of unique challenges, the Yamal LNG plant is producing at full capacity.

Christian provided an introduction to the project and shared numerous photos over the four years, focusing on the interesting challenges associated with designing and constructing an LNG plant in Western Siberia, where access is limited due to frozen seas and where the average annual temperature is -10°C (and as low as -57°C in winter).

In the design phase special focus was required to manage the low temperature due to the risk of going below the minimum design temperature of low temperature carbon steel, but also to avoid the permafrost being melted due to the presence of the LNG plant, especially the flare. To manage this risk thermosyphons were used. The thermosyphons are naturally circulating heat pipes, which self-regulate the ground to ensure the permafrost remains frozen.

The project used some of the largest modules ever constructed, transported via several routes through the frozen Arctic Ocean and using specially dedicated ships to be able to deliver frozen seas (up to 2m depth).

He shared information regarding the safety performance, including how this was incentivised for such a large workforce, and how they optimised the commissioning and start-up to enable the second and third train start-ups to significantly beat the plan with respect to timing. These learnings allowed the third train to go from gas in to LNG rundown in less than one week.

With the facility up and running, the focus has now moved to maximising production, especially during the colder periods – of which there are many.

After a fascinating opening afternoon, Conference delegates were invited to the Exhibitors Evening, where there was excellent opportunity to talk to the companies exhibiting during the Conference. Many thanks from GPA Europe to all those involved.

GPA EUROPE AUTUMN CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

TECHNICAL CONFERENCE – MORNING SESSION 16TH MAY

Moderated by Kindra Snow - McGregor Petroskills/John M Campbell

Bill Howe - GasConsult

Zero Refrigerant Liquefaction – Developments in the ZR LNG Technology

After the engaging and fascinating executive panel was completed, chaired by Nick Amott of Fluor Ltd UK, the first paper of the morning was delivered by Bill Howe, of Gasconsult Ltd (co-author Geoff Skinner). The focus of the presentation was on the furthering developments in their zero refrigerant LNG process. This patented ZR-LNG process requires no external gaseous or liquid refrigerants, no refrigeration extraction, nor associated equipment. The technology utilises a dual methane expander configuration, with other process enhancements.

The recent award of a grant from the UK Government's Innovate fund allowed the design development of the process to quantify the benefits of the system. The design development work was completed by CB&I (now McDermott) for a standardised FLNG liquefaction module based on the previous work completed by Gasconsult.

The standard module capacity considered was 1.5 mtpa.

Bill presented a summary of the process performance of the design and how it could handle changing inlet compositions and ambient temperatures, including sea water temperatures. He also highlighted the operability and reliability issues as well as the key safety benefits provided by the ZR-LNG technology. Given that all external hydrocarbon refrigerants are eliminated, ZR-LNG is inherently safer than other options for FLNG applications.

Bill clearly presented that this methane expander liquefaction process offers a number of advantages in project returns, operability, safety and plant complexity as compared to other liquefaction technologies that may be considered for FLNG applications. The supporting work and data that was recently completed and gathered by CB&I has moved the technology towards commercial readiness which can be applied to the detailed assessment of ZR-LNG for future project opportunities.

Lars Ødeskaug - Front Energy

CeFront – Improved Hull Design Leads to Greater Stability and Better Economics for FLNG

Our second speaker for the morning was Lars Odeskaug, of Front Energy, with a presentation on "Improved hull designs for FLNG". Lars provided an engaging presentation with videos demonstrating their new hull concept, stability as tested in an ocean test basin at MARINTEK. Vessel motion due to wind and waves is a key limiting factor in deploying floating LNG facilities in harsh environments. Once a FLNG facility is in operation, moving decks will likely present major challenges in process operability and process efficiency when two-phase flow is involved. In addition, wave motion can cause sloshing in partially filled membrane tanks

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which can be a safety concern. Not to mention the safety concerns of offloading LNG to visiting carriers under harsh sea environments which require more robust mooring and loading technologies.

The goal of the new hull design was to minimise these concerns. The focus of this work has been on a hull design that does not require a turret, and that is as stable as the axisymmetric hull regardless of wind, waves, and current direction. In addition, consideration was given to the Asian yard's fabrication facilities capabilities in the design.

The new hull design with storage capacities ranging from 150 000 m^3 to 300 000 m^3 (LNG and condensate) has undergone extensive testing in the ocean test basin at MARINTEK, Trondheim, Norway, which verified its stability in sea states up to significant wave heights of 17m. The study demonstrated that the new hull design is extremely stable as compared to a Very Large Crude Carrier (VLCC) based hull. Some of the advantages include: low pitch and roll motions; reducing sloshing and providing stable platform for the gas processing and liquefaction facilities; elimination of the turret and swivel, among other structural and fabrication advantages.

Lars provided a fascinating conclusion highlighting the Gato Negro FLNG project that is being considered off the pacific coast of Mexico to process natural gas from the Permian basin in the U.S. The developer of the project has already chosen the Cefront hull as the basis for the development.

> "The unit will have an export capacity of 3 mtpa. The Cefront hull design provides significant cost reduction as a result of eliminating the turret and can be tailored to a wide range of applications due to the vessels superior motion characteristics."

Cinzu Czenn - Sulzer

Re-thinking Boil-off Gas Condensation with the In-line, Compact and Lightweight Solution

The last, but not least, speaker for our session was Cinzu Czenn from Sulzer. She presented a paper on Sulzer's new technology for a boil-off gas (BOG) recondenser for Floating Storage and Regasification Units (FSRUs) and LNG carriers where space saving footprint is critical.

Conventional BOG recondensers use gas as the continuous phase. As a result, they are relatively large columns equipped with packing where the BOG is contacted with sub-cooled LNG to promote heat and mass transfer, resulting in the condensation of the BOG. This conventional method does work but comes at a high cost due to the large and heavy equipment required.

The compact Sulzer BOG recondenser utilises LNG as the continuous phase. The BOG enters the high efficiency mixer through distribution orifices on its inner pipe. Cinzu presented both pilot testing results, and feedback from commercial operations validating the performance of the new recondenser design. They noted not only system stability, but operational simplicity and condensation efficiency. In conclusion, the result of the new design results in a smaller, lighter recondenser which offers many advantages over the current traditional designs available.

GPA EUROPE SPRING CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

TECHNICAL CONFERENCE – AFTERNOON SESSION 16TH MAY

Moderated by Tony Wimpenny - Orbital Gas Systems

The Thursday afternoon session, chaired by Tony Wimpenny, was a journey back to the operational real world. Four interesting talks were given to share the experiences and lessons learned along the journey from operational issue to operational success.

Why Sulphur Plants Plug

Jan Kiebert - Sulphur Experts

Firstly, Jan Kiebert from Sulphur Experts gave a very detailed account of the mechanisms of sulphur plant plugging, covering the different route causes of plugging issues, mitigation and avoidance strategies and finally some reversal techniques, where applicable. The presentation was packed with real-world experiences, photos and videos that really brought to life some of the issues that were described in the presentation.

Coverage of the topics was extremely comprehensive and was a challenge to fit what could have been a two-day training course into just 30 minutes, but Jan raced through the different case studies at lightning pace, despite having to present on crutches! He presented some valuable lessons for all to take away.

Stabiliser Reboilers Fouling Preventive, Mitigation and Enhancement Efforts

Next up was Abdulrahman Al-Methn from Saudi Aramco (co–authors Paul Mishar K, Taib Abang, and Mohammed Saati, also of Saudi Aramco). Abdulrahman gave a detailed account of some reboiler fouling issues, which had caused significant and repeated disruption for unplanned maintenance and rectification. A project was undertaken to understand the cause of the issues and huge volumes of data were collected to identify and mitigate the problems. Through this detailed assessment and resolution exercise, which in total took around six months to complete, the issue that previously required maintenance attention every 3-4 weeks was dramatically improved to a maintenance cycle of around once every five months.

Abdulrahman Al-Methn - Saudi Aramco

After a coffee break held in the Shell Technology Centre atrium, where a number of exhibitors and sponsors were showcasing their solutions to the delegates and passing 'resident' Shell employees, the afternoon session continued with a couple of presentations from Petroleum Development Oman (PDO).

Operational Reliability and Improvement Through Root Cause Analysis of Plant Trips

The first of these two presentations was delivered by Ahmed Al-Harrasi, and explained the trip reduction programme undertaken by PDO to reduce the number of plant trips caused (unnecessarily in some cases) by various transient instrument signals or alarms. One example was given where a simple re-compressor discharge (high) temperature signal was capable of shutting down the entire facility. In this case, the fault in the design logic was identified and rectified. Furthermore, we learned during the extremely active proceeding Q&A session that subsequently a complete alarm rationalisation exercise was undertaken across a number of facilities to avoid a repeat of such a fault. In the case of the trip reduction programme a multi-disciplined team had come together with a common goal and realised great success in reducing plant trips; an interesting story with a happy ending.

Ahmed Al-Harrasi - PDO

Improved Availability and Reduction of Losses on the Kauther Gas Plant TEG Unit

Last, but certainly not least, Marwa Al-Harrasi of PDO (co–author Muhammad Akiel Anwar, also of PDO) described to the audience an issue related to issues found with the triethylene glycol (TEG) unit of the Kauther Gas Plant in Oman. Marwa eloquently described the scavenger chemicals and process used to remove H_2S from the feed gas at the plant inlet, but how there was evidence of this scavenger being carried over to the TEG unit – manifested as contaminated TEG which was no longer capable of performing as it should. In fact, what was clear from the presentation was that a holistic approach was required to really understand all the factors at play that led up to the resultant and evident issue. A number of remedial actions were undertaken to comprehensively address the issue, including overhead vapour combustion (OVC) burners replaced with electrical heating, upgraded wet gas separator, improved filtration systems and others. It was a fascinating story with plenty of detail, analytical evidence and another positive outcome; and was much appreciated by the audience.

Marwa Al-Harrasi - PDO

That concluded the Thursday afternoon session and left the audience with plenty of ideas and experiences to discuss as all headed to the Shell atrium for an obligatory team GPA photo and then onwards to the gala dinner.

GPA EUROPE SPRING CONFERENCE
AMSTERDAM, 14 –17 MAY 2019

TECHNICAL CONFERENCE – MORNING SESSION 17TH MAY

Moderated by Peter Martin - Johnson Matthey


Marcus England - KBR

After yet another fantastic conference dinner where delegates were serenaded by the Cats Collective jazz group while they tucked into delicious bitterballen and other Dutch specialities, everyone was keen to tune in to the final morning papers focussed on advanced modelling techniques and equipment advances.

Prevention of Flare Overload During Emergency Depressurisation

First up was Marcus England, a Process Leader at KBR with experience across all project design phases and a subject matter expert for steady state simulation.

His paper set the scene regarding common practice for emergency depressurisation (EDP) systems in which, for larger plants, the flare system is typically sized to accommodate EDP of specific sections of the plant individually. As a result, there is a need to incorporate a system that will prevent uncontrolled, simultaneous EDP of multiple sections of the plant to ensure the flare is not overloaded.

Marcus then went on to discuss some of the issues and implications of current practices in which an operator may be required to make quick choices based on limited information if multiple plant sections require EDP; which sections should be depressurised first and at what point can additional sections be depressurised while preventing flare overload? Whilst very rare, the impact of such an event could be high. Relying on an operator's ability under pressure to follow procedure and evaluate a complex issue in a short space of time is not the safest option. By using logic and modelling techniques, some decisions can be taken away from the operator by developing a system that automates EDP and ensures safeguards against flare overload are embedded.

Marcus used a multi-train LNG Plant case study to describe the approach taken, assumptions used and analysis of the results during design and implementation. Graphs were shown to visualise the release of pressure over time for different scenarios to demonstrate the time required between depressurisation of different plant sections to ensure the flare capacity was not reached.

Application of Artificial Intelligence to Optimize Pipeline Network Design

The second paper was presented by Andrew Lewis from Augmented Engineering Ltd. Andrew is a keen advocate of digitalisation in the oil and gas industry and demonstrated his passion in his paper.

Andrew introduced Augmented Engineering Ltd's technology, Pipetimize, for optimising pipeline network design which eliminates the huge quantity of manual workflow iterations that would be required without the benefit of this technology. When considering the complex nature of pipeline network design, optimisation requires detailed consideration of pipeline sizing, route selection, geographic location of the tees and any compression/pumping stations, ensuring all flow and pressure-loss requirements are adhered to. Therefore, there is huge benefit to introduce automation to this process to ensure pipeline networks can be designed optimally in short timeframes with fewer resources. This can result in significant cost reduction early in the project.

Andrew explained key parameters that can be modelled to reduce the project cost. E.g, the cost of the pipe is affected by the length, diameter and wall thickness. However, the cost of pressure boosting including the degree, frequency and location of this boosting will also have a large impact on cost and are determined by the pipeline routing.

He described how Pipetimize draws upon a range of tools and machine learning techniques to optimise output accuracy whilst also minimising computing time.

Finally we were presented with the consideration that this tool could be applied to optimisation of other project scopes outside of just pipeline CAPEX, for example: processing facility locations, drill centre locations and even minimisation of project NPV.

Process Intensification: Hydrogen Sulfide and Hydrate Control for Subsea Application

The third presentation of the day followed the morning networking coffee break. Eirini Skylogianni took to the floor to present her work on "Process intensification: Hydrogen sulfide and hydrate control for subsea application" through the Norwegian University of Science and Technology.

Eirini introduced us to the basics of H_2S removal and dehydration offshore, discussing motivations for removal of these components and the existing technologies used in these applications. The issues associated with the current approach were highlighted noting the space and weight limitations of multiple treatment systems offshore whilst also accommodating the desire to remove H_2S as early in the process as possible due to HSE concerns.

Eirini went on to present a process intensification concept, whereby the acid gas removal process is integrated with the hydrate inhibition process, resulting in injection of the H_2S removal solvent and the hydrate inhibitor together into the pipeline which acts as the contact tower. This allows for subsea processing and eliminates the need for multiple topside processing units. It was noted that regeneration would still be needed topside in this scenario.

We were then taken through the bulk of the research which centred around characterisation of a solvent mix which was presented as MDEA + glycol. The characterisation focussed on assessment of three key themes: contaminant removal efficiency, trouble-free operation and the impact to the environment. This covered detailed assessments of a broad range of criteria including absorption capacity, mass transfer properties, viscosity, foaming potential, corrosion, biodegradability, and emissions control. To adequately assess the overall performance of the solvent mix, each of these criteria was given an importance level to which this solvent and others could be critically compared. It was shown that the MDEA + MEG mix could provide a satisfactory solvent for this application.


Eirini Skylogianni - Norweigian University of Science and Technology

Increasing the Efficiency and Capacity of Two-Phase Separators

Next up was Bart Prast of Twister BV (co-author Tijmen Ton also of Twister). In this paper, Bart discussed the principals behind the SwirlValve – a type of cyclonic valve – and the benefits that this technology brings when utilised upstream of two-phase separators.

Firstly, some background information was provided regarding the common issue of poor performance in two-phase separators, primarily as a result of pushing the equipment past its design capacity and also quite simply improper design. Whilst common practice in cases such like this involves modifying the separator internals or simply installing a downstream filter coalescer to 'mop up the stranglers', Bart introduced the idea of installing their SwirlValve upstream of the separator instead. This valve effectively improves coalescence of the droplets – both in gas-liquid and liquid-liquid applications, improving downstream separation efficiency; larger droplet size equals greater separation efficiency.

Bart demonstrated these effects qualitatively, taking us through the relevant equations to demonstrate droplet size as a result of the forces trying to break them up and the forces trying to coalesce them. CFD models were presented to demonstrate the practical effects that his equations were explaining.

Then we were taken through two case studies, for NAM and Petrobras. The NAM study was a test of a gas-liquid application in which the SwirlValve cage was compared against a labyrinth cage in a traditional JT value. The purpose was to debottleneck the Low Temperature Separator downstream to allow an increase in plant capacity. In multiple flow rate scenarios, the SwirlValve improved the LTS efficiency, allowing NAM to meet its hydrocarbon dewpoint specs at higher flows. Positive results were also seen with Petrobras – this time on a liquid-liquid (oil-water) application. Testing was performed to analyse efficiency of an oil-water separating tank downstream of a SwirlValve and a globe valve. Multiple test conditions were applied and the SwirlValve showed equal or improved performance in all scenarios. Clear photos of liquid samples post-separation were used to demonstrate the improved separation.

Conceptual Design Emulation and Its Uses in Project Planning, Cost Estimating and Plant Optimisation

Last up was Peter Kauders of CDE Projects Ltd. Conceptual Design Emulation (CDE) is a logic-based mathematical system that can be used to predict the outcome of the work of a project design team. All outputs are in mathematical form, without producing drawings. The system can carry out all necessary engineering tasks in order to design many processing units – so far the focus has been on gas treating units, hydrotreaters, distillate hydrocrackers and crude and vacuum distillation units.

We were shown how the model works with a live demonstration with the inputs required – often nothing complicated e.g. for a pump; the suction pressure, liquid flow and density are typically all that is needed – and the outputs that the model can provide including equipment sizing, layout, material costs etc. Complications arising within design teams, where coordination of work between groups and reliance on drawings and datasheets to convey information is a huge time hinderance, are eliminated and rapid results are obtained and gathered in a single source. Peter clearly described the multiple benefits of this including creation of cost estimates earlier in the project, ability to quickly evaluate and compare novel processes to existing ones, process optimisation and many others.

FORTHCOMING EVENTS

2020 GPA GCC CHAPTER'S 28TH ANNUAL TECHNICAL CONFERENCE

17-19 March 2020

The Regency Hotel, State of Kuwait

Hosted by the GPA-GCC chapter, providing Workshops, Conference and Exhibition under the theme of "Natural Gas Value Chain – Opportunities and Challenges".

2020 YOUNG PROFESSIONAL TRAINING DAY

June 2020

This free training day has been designed by the GPA Europe Young Professional Committee for those new to the industry.

A great introduction to the world of gas processing and an opportunity to meet influential figures in the industry.

Full details to be communicated shortly.

2020 SPRING CONFERENCE

June 2020

A conference and networking event organised by GPA Europe. Full details to be communicated shortly.

What's on?

- Technical Conference
- Workshop
- Keynote Address
- Executive Panel
- Demonstrations
- Social Activities

2020 GPA EUROPE AGM

19 November 2020

London Hilton Paddington, London, UK

Our company's AGM.

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