9TH EUROPEAN GAS WELL DELIQUIFICATION CONFERENCE & EXHIBITION

Extend life of depleted and tight gas reservoirs

22 – 24 September 2014

Hampshire Hotel – Plaza Groningen, The Netherlands

Hosted by NAM
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Organising Committee

James Donald, +31 610949816  
Anurag Mittal, +31 620422872

Ingun Hovland, +31 622704521  
Janny Benschop-Jeuring, +31 610967871

Kees Veeken, +31 651544050  
Tony Robertson, +31 623187245
Exhibitors & Sponsors
### Booth Space Layout for the 2014 European GWD C&E

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<td>08:30</td>
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<td><em>Anurag Mittal (NAM)</em></td>
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<td>10:00</td>
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## Tuesday 23rd September

**Conference Day 1: Field Cases, Deployment Challenges & New Technology**

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<td>08:15</td>
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<td><em>Elke Rettberg (NAM Onshore Asset Manager )</em></td>
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<td>08:30</td>
<td>Challenges &amp; Successes of GWD in OMV-Petrom, Romania</td>
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<td><em>Vasile Stanculescu (OMV-Petrom)</em></td>
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<td>09:00</td>
<td>Investigating Exemption of SC-SSSV in Mature Onshore Gas Wells</td>
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<td><em>Koos Ham, Ingrid Raben (TNO)</em></td>
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<td>09:30</td>
<td>Comparison of Lift Gas Based Deliquification Methods</td>
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<td><em>Erik Nennie, Berend Brasjen, Stefan Belfroid (TNO), Kees Veeken, Frans Hollman (NAM)</em></td>
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<td>10:00</td>
<td>COFFEE BREAK</td>
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<td>10:30</td>
<td>Oil and Gas Well Revival and Deliquification Using Surface Jet Pump Technology</td>
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<td><em>Sacha Sarshar, Najam Beg (Caltec UK)</em></td>
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<td>11:00</td>
<td>Impact of Transient Simulations on Plunger Lift Operation</td>
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<td><em>Rahel Yusuf (Schlumberger Information Solutions), Kees Veeken (NAM)</em></td>
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<td>11:30</td>
<td>Velocity String with New SC-SSSV Operated via Existing Control Line</td>
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<td><em>Folkert Wessel, Michael Eisenberger (RWE Dea AG), Pamela Müller (Weatherford)</em></td>
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<td>12:00</td>
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Tuesday 23rd September
Conference Day 1: Field Cases, Deployment Challenges & New Technology

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<tr>
<th>Time</th>
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| 13:00  | Foam Application in Offshore Gas Fields Enabled by Produced Water Re-Injection  
Paula Bejarano, Linda Garming, Martin LeClercq (NAM) |
| 13:30  | Continuous Surfactant Injection to RemEDIATE Liquid Loading at Satellite Locations in SNS  
Kirsten Agnew (ConocoPhillips), Brian Marr (Weatherford) |
| 14:00  | COFFEE BREAK                                                         |
| 14:30  | Breakout: Sneak Peek (GWD Survey)  
James Donald (NAM) |
| 16:00  | Plenary: Building Bridges (GWD JIPs)  
James Donald (NAM) |
| 16:30  | DRINKS & EXHIBITION                                                  |
| 17:45  | Evening event - Coach leaves Hampshire Hotel                       |
| 22:00  | Evening event - Coach leaves Assen to return to Hampshire Hotel     |
Wednesday 24th September

Conference Day 2: Field Cases, Deployment Challenges & New Technology

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<td>Capillary Injection Tubing Anchor</td>
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<td>11:00</td>
<td>Experimental Foamer Selection JIP</td>
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<td>Pejman Shoeibi Omrani, Erik Nennie, Frank Vercauteren (TNO)</td>
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<tr>
<td>11:30</td>
<td>Development and Application of Non-Corrosive Foamer for GWD</td>
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<td>Steven Oude Heuvel, Sjoerd van der Knoop (Nalco Champion)</td>
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<td>12:00</td>
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<tr>
<td>13:00</td>
<td>Major Gas Lift Project for Depleted Annerveen Gas Field</td>
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<td>Jeroen Smith, Joris van Lith, Kees Veeken, Bert Lugtmeier (NAM)</td>
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<td>Acoustic Monitoring and Troubleshooting for Gas-Lift Wells</td>
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<td>A standardized Mobile Wellhead Compressor for a portfolio of onshore</td>
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<td>gas wells in The Netherlands</td>
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<td>James Donald (NAM)</td>
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<td>14:30</td>
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Social Event – Tuesday Evening

Visit Drents Museum

18.00 – 18.30 Arrival via group entrance (Brink 3)
18.00 – 18.30 Reception in Grandcafé Krul
18:30 Introduction to exhibition by Daniël Lohues
18:45 Visit exhibition by Daniël Lohues at your own convenience, museum lecturers are present to explain
Visit rest of museum at your own convenience
20.00 Buffet dinner in Abdijkerk with music on the side
22.00 Departure via group entrance (Brink 3)

Music from Jazzaholic!
Conference Abstracts
Challenges & Successes of Gas Well Deliquification in OMV-Petrom, Romania

Vasile Stanculescu (OMV- PETROM)

Abstract
The presence of liquids in gas wells is characteristic for depleted reservoirs, creating difficulties during production, the gas being unable to carry out the total quantity of liquid accumulated in well. This leads to an increasing accumulation of liquid in the well, which will have a negative effect on well production and in worst case, can even lead to a complete stop of gas flow.

In this context, OMV PETROM has been studying various modern technologies for gas wells Deliquification for many different conditions of gas wells: Foamer injection, Plunger lift, Capillary foam injection, Wellhead compression, Hydraulic piston pump and Wellhead electric compressors, in autonomous and completely automatized system, are being used in more than 300 wells in PETROM Assets.

The success of these, led to extension of applied technologies in OMV PETROM.

The results of the application of modern technologies, for gas wells Deliquification of gas wells, increased the average gas production by 21 %. This presentation will summarize the evaluation process, design, installation and results of the various applications. The challenges found during these operations and the lessons learned, along with new applications and new technologies, will greatly enhance our efforts in gas well Deliquification.
Investigating Exemption of SC-SSSV in Mature Onshore Gas Wells in the Netherlands (A Joint Industry Project)

Koos Ham, Ingrid Raben (TNO)

Abstract

The Dutch Mining Regulations (‘Mijnbouwregeling’) require the installation of a Surface-Controlled Sub-Surface Safety Valve (SC-SSSV) in each self-producing well. The SC-SSSV shall be placed at a minimum depth of 50–150 m below surface and intends to be a barrier to prevent possible uncontrolled well releases (blowouts).

The SC-SSSV can be a serious technical and/or economic barrier for applying well deliquification techniques. The Dutch regulations offer the possibility to obtain an exemption to install an SC-SSSV, provided that it is demonstrated that at least the same level of safety can be provided.

A joint industry project (JIP) has been defined to explore and clarify the criteria and requirements to obtain an SC-SSSV exemption approval from the State Supervision of Mines. The JIP was initiated by a consortium of four operating companies that are active in onshore gas production in The Netherlands. TNO was contracted for managing and conducting the project.

The project comprises at one hand supportive studies to identify the applicability of the SC-SSSV for conceivable blowout scenarios in onshore gas wells and regulatory requirements in other countries, and at the other hand the criteria and requirements to be fulfilled in order to build a credible case for exemption approval.

The presentation will give an overview of the project: the motivation, the organization and the contents. Results will be presented on different regulations and practices in several other countries, findings on blowout causes based on case histories of gas well incidents in the world and the effect of SC-SSSV to mitigate these events, and an inventory of compatibility of available GWD techniques with the presence of an SC-SSSV. We will also present the development of methods and models we use to demonstrate compliance.
Comparison of Lift Gas Gased Deliquification Methods in Dutch Gas Wells

Erik Nennie, Berend Brasjen, Stefan Belfroid (TNO), Kees Veeken, Frans Hollman (NAM)

Abstract
Many Dutch gas wells operated by the NAM suffer from liquid loading, calling for the application of deliquification methods. To this end, high pressure dry gas is made available for injection in the well. An exploratory study is conducted into a number of available deliquification methods in order to allocate this lift gas with maximum effect.

Using steady-state analyses, five deliquification methods have been evaluated for a reference well and a number of variations. The methods were: gas lift, wellhead eductor, downhole eductor, and combinations of wellhead eductor with gas lift as well as wellhead and downhole eductor.

For each of the methods, the injection rate was optimized to maximize short term production and the resulting effect on ultimate recovery, production time and total injected volume was evaluated.

From the results, it has become clear that all methods have an advantage: gas lift requires comparatively small amount of injection gas, the wellhead eductor attains ultimate comparatively quickly, and the downhole eductor yields the largest ultimate recovery. Adding a wellhead eductor to the gas lift method yields an increase in ultimate recovery, production time and injection volume. Using a combination of wellhead and downhole eductor yields the same ultimate recovery as using a downhole eductor alone, but in a shorter time and with a larger injection volume required.
Oil and Gas Well Revival and Deliquification Using Surface Jet Pump Technology

Sacha Sarshar, Najam Beg (Caltec.U.K)

Abstract

A combination of factors such as the drop in reservoir pressure, a drop in the production rate of gas, and increased water-cut, result in unstable flow and produced liquids building up in the well bore, which could cause extreme flow fluctuation or complete seizure of production from these wells.

There are a number of ways to rectify this problem, some of which demand the use of a costly downhole artificial lift or boosting system. Whilst the use of downhole boosting systems is effective in reviving wells, and helps to remove the liquids built up in such wells, for many cases there is a simpler and more cost effective way to achieve the same objective, using Surface Jet Pumps (SJPs). The use of an SJP results in lowering the flowing wellhead pressure which in turn will help to de-liquefy the well and achieve stable production.

This paper raises the challenge of how to select the best solution in each case and describes how Surface Jet Pumps can be used to achieve well de-liquification effectively and increase the production life of the wells. Surface Jet Pumps can also be used in conjunction with other downhole artificial lift systems to improve their effectiveness. There is also a novel way of using the test separator and Surface Jet Pumps to revive oil and gas wells.

A number of recent successful field application examples of Surface Jet Pumps related to both oil and gas wells are presented in this paper. The applications include onshore and offshore, with potential for also subsea and downhole use of this technology. The paper also presents examples of how to cope with changes to the operating conditions during the life of the wells.
Using Transient simulations to assess the Effectiveness of Plunger Lift Operation for Gas Well Deliquification

Rahel Yusuf (Schlumberger Information Solutions), Kees Veeken (NAM)

Abstract
Reservoir pressure depletion in gas reservoirs causes gas flow reduction with time and eventually leads to liquid loading as the gas flow up the well can no longer efficiently lift the associated liquids to surface. Liquid loading has a detrimental impact on production and a suitable deliquification method is required to continue production and maximize recovery. A plunger lift operation is one such deliquification measure whereby a plunger is lowered into the wellbore and it deliquifies the well as it travels up. It is important to assess beforehand whether the operation will effectively remove the liquids and hence deliver sufficient business value.

A transient multiphase simulator has been used to simulate plunger lift operation in two onshore wells completed with 31/2” tubing. The operation starts by flowing the well for two hours and then shut-in the well for one hour during which the plunger falls to the bottom. The well is subsequently re-opened and the plunger is launched thus taking out the liquid trapped in the tubing. A total of nine plunger cycles are simulated. Sensitivities are conducted for different reservoir pressures and water gas ratios.

Simulations indicate that the plunger is able to deliquify the well and achieve cyclic flow. Further, transient multi-phase flow model produces credible results and provides insight into influence of well parameters and backpressure valve on plunger performance.

This study emphasizes the role of transient simulations in predicting the effectiveness of a deliquification measure before embarking on field deployment. The simulations provide valuable insight into flow and pressure transients inside the wellbore during plunger lift operation.
Installation of Velocity String with new Surface Controlled Subsurface Safety Valve operated through existing control line

Folkert Wessel, Michael Eisenberger, (RWE Dea AG), Pamela Müller (Weatherford)

Abstract

The presentation reviews the global 1st installation of a Weatherford Insert String Hanger – Velocity String (WISH – VS) The insert string hanger system allows a velocity string to be run under gas to optimal setting depth without losing the functionality of the original control line. The system incorporates a Surface Controlled Subsurface Safety Valve SCSSV, which is steered by the existing control line.

In 2011 one of the RWE Dea wells, located in Lower Saxony, suffered under liquid loading. It was decided to install a smaller string to increase the gas velocity and assure a continuous production. Due to predicted cleanout problems, when killing the well before installation, it was decided to snub in a 2 7/8” velocity string under gas using the WISH - VS in order to keep SCSSV functionality.
Maximizing Production of Mature Depleted Offshore Gas Fields through Continuous Foam Injection Enabled by Produced Water Re-injection

Paula Bejarano, Linda Garming, Kees Veeken, Martin LeClercq (NAM)

Abstract
In the Southern North Sea ONEGas offshore gas asset, Continuous Foam (CF) injection is applied to restore stable production of depleted liquid loading gas wells. There are 7 CF systems active on the K81 and Clipper offshore production platforms generating 380e3 Sm3/d capacity and 100e6 Sm3 reserves.

Onshore, CF injection has become a standard operation. However, offshore, application of foam presented operational and environmental challenges. Environmental regulations dictate maximum oil in water concentration for overboard disposal of 30 ppm which in the K81 processing platform limited the CF injection to 24 L/d, insufficient to deliquify more than 1 well. Given that CF would only be viable if all produced water was re-injected, a Produced Water Re-Injection (PWRI) well was commissioned on each K81 and Clipper to handle 50-200 m3/d. To prevent O2-induced corrosion, a gas blanketing system was implemented on K81 to maintain PWRI wellhead pressure above vacuum but this caused overpressurisation of the upstream vessels.

In terms of equipment, the offshore CF capillary string was installed utilizing the so-called REN-GATE system which provides an independent foam fluid entry point just below the LMGV and a bypass across the subsurface safety valve. This system is meant to minimize repair frequency, though it has performed below expectations and future installations may opt for the lower cost onshore system (inject via the hydraulic control line). For chemical compatibility, CF injection reduces the effectiveness of the corrosion inhibitor (CI); a higher CI dose-rate is needed to ensure the integrity of carbon steel flowlines. The default foam dosage up to 2000 ppm at a WHT of 50 °C requires doubling of the CI dosage. Daily monitoring of production performance is illustrated in Figure 1 and allows optimization of the CF injection per well, prevents excursions from environmental regulations, plus ensures the sufficient CI dosage.
Installation and Impact of Continuous Surfactant Injection to Remedi ate Liquid Loading on Gas Wells at Satellite Installations in the Southern North Sea

Kirsten Agnew (ConocoPhillips), Brian Marr (Weatherford)

Abstract
The North Valiant SP and Vulcan RD gas fields produce via satellite installations tied back to the Lincolnshire Offshore Gas Gathering Station (LOGGS) complex. The fields have been producing since 1988 and as a result of declining reservoir pressure, and the subsequent onset of liquid loading, the majority of remaining wells are produced intermittently.

Following screening, including successful surfactant trials, continuous surfactant injection was identified as the optimal method for deliquification. A total of seven retrofit capillary surfactant injection systems have since been installed in wells using a jack up vessel to support 24 hour operations. The retrofit capillary injection system has been engineered and developed for deploying chemical injection into mature wells that were not originally designed to accommodate chemical injection. The system maintains safety valve integrity and operability with the existing control line and enables the injection of the foaming agent below the WR-SCSSV. The system is deployed on slick-line and does not require rig intervention.

The redundant subsea methanol pipelines from the LOGGS complex to the satellites have been modified to deliver surfactant. In addition, a redundant chemical storage tank has been re-utilized as a means of surfactant storage thus resulting in one centralised storage and distribution centre at the LOGGS complex. It negates the need for additional satellite visits to re-fill surfactant stores and allows for cost-effective tie-ins of future satellites. Additional topsides modifications include the installation of an antifoam injection system to the inlet separators on the LOGGS complex to control separation of gas/liquid.

Overall, the project has been successful, driven by an increase in well uptime as intermittent producers are returned to continuous production.
Abstract
There are many oil and gas fields across the Globe. The barriers that exist to prevent such extended field life are many.

As oil and gas fields mature they develop problems that can make it difficult to maintain the economic viability of a field. These problems include:

• Rod and Rod Pump failures
• Corrosion
• Scale
• Paraffin, Hydrate and salt deposits

These and other conditions require the injection of chemicals into the well to treat the condition and help to extend its “operating lifetime”. Until recently this has been carried out using batch treatment of the appropriate chemicals. A batch treatment is described as Pumping comparatively large volumes of chemicals into a well followed by a “soaking” period and eventual production and clean-up of the fluids before production can continue.

Recently a new method has been implemented for such treatments using a new downhole injection design. This approach uses a small diameter string, usually ¼’ or 3/8” diameter, strapped to the outside of the production tubing string which accesses the tubing at a chosen point in the well. This provides for a much more effective and economic way of treating the problems while maintaining continuous production.

Chemical injection techniques have improved and become more efficient over the years and now the use of a ¼ turn Tubing Anchor will provide for optimal injection of chemicals in a rod pump well to ensure maximum protection for the whole completion. This will provide for a considerable improvement in run life, reduced failure rate, and improved well profit margins.
Joint Industry Project: Experimental foamer selection

Pejman Shoeibi Omrani, Erik Nennie, Frank Vercauteren (TNO)

Abstract
Foamers are widely applied worldwide to deliquify gas wells. In order to be effective, the surfactant chemical should form a stable foamer when combined with field water and condensate under field conditions. To ensure good foamer performance in the field, lab testing is conducted beforehand to test foamer performance. A wide variety of test methods is currently being used to perform these tests. In discussions with various operators, a clear demand was identified for a standardized test method. The fact that all chemical vendors use somewhat different test procedures to qualify their products makes it very difficult to objectively compare foamers.

A Joint Industry Project was set up in order to arrive at a standardized test method which will be made available to all parties involved in foamer testing. The central concern is that none of the current test methods are representative of field conditions, which may lead to incorrect or incomplete foamer selection.

In the first phases of the project, the effectiveness of foamers under the effect of several parameters was investigated in a desktop scale setup. A new desktop scale setup was designed to incorporate the currently available foam testing methods into a single setup. The designed setup can be pressurized up to 15 bars and heated up to 150 °C and can handle brine and condensates. This setup will enable us to evaluate the foamer behavior at more representative conditions.

The foam behavior is characterized by measuring three parameters; foam buildup time, collapse time and liquid carryover. The results of measurements gave an insight to the effect of each parameter and the combination of parameters on the foam behavior. The initial results show that foamer concentration, gas superficial velocity and hydrocarbon fraction are among the most influential parameters on the foam behavior.
Development and Application of a non-corrosive foamer for gas well deliquification

Steven Oude Heuvel, Sjoerd van der Knoop (Nalco Champion)

Abstract

Work has previously been presented in this forum on the development of a non-corrosive foamer for gas well deliquification. That work focused on the laboratory development to meet pre-defined performance and physical properties of the desired product.

This presentation will demonstrate the process typically followed during the selection and recommendation stage as well as presenting field data on performance for the developed non-corrosive foamer.

In order to assess if a well would benefit from application of a chemical foaming agent an assessment is performed to determine if the well is producing above or below the critical rate. Proprietary software is used to model the well based on data collected. If the well is producing at below the critical rate, laboratory testing is performed to assess the suitability of different chemical foaming agents.

The laboratory test results, together with the output of the model are combined to provide a recommended product, concentration and application method. The resulting impact on gas production rate and monitored parameters will be presented and conclusions drawn.
Abstract
The onshore Annerveen gas field; developed through 15 wells in 3 clusters, has produced 70.3 Bcm of the 73.3 Bcm OGIP. Without additional compression or deliquification projects, to address liquid loading of the wells, predicted end of system life is 2020.

Reservoir modeling indicates 0.25 Bcm additional gas can be recovered for every 1 bara reduction in abandonment pressure below the 8 bara currently forecast. Previous continuous foam injection did not deliver notable benefits, while velocity strings will not reduce abandonment pressure in the Annerveen field due to their prolific nature of the reservoir.

The existing depletion compressors and treatment plant have excess capacity that can be exploited to provide high pressure gas. This would support either the implementation of a gas lift project or installation of a wellhead eductor.

The already low surface pressure of 2.15 bara would limit further reduction in abandonment pressure through use of an eductor to approximately 1.0 bara. In contrast, outflow modeling indicates a 4 bara reduction would be possible by applying gaslift; equating to a total incremental recovery of approximately 1 Bcm, sufficient to justify a major gas lift project. The lift gas will be injected via the A-annulus and an existing side-pocket mandrel. This requires altering the corrosion inhibition and well integrity strategy.

Implementing a “dip stick” design places the gas injection point as deep as possible; ensuring maximum benefit. The retrofit design minimizes the time required for changing out the gas lift valve, while use of the largest available 1” gas lift valve achieves the required 40,000 Sm3/d lift gas rate at the available 35 bara surface pressure.
This will be the first time Shell has used gas lift to achieve such low abandonment pressures; boosting the bottom line by expanding the envelope of existing technical solutions.
Techniques to Acoustically Monitor and Troubleshoot Gas-Lift Wells

*Lynn Rowlan (Echometer)*

**Abstract**

The distance to the fluid level provides beneficial information throughout the life of a gas-lift well. From the initial unloading of the well, to maintaining production, and even into troubleshooting the well, the location of the fluid level plays a crucial role in understanding the well’s performance.

Fluid levels can be used to help determine whether a problem is occurring within the wellbore or due to equipment malfunction. A quick surface measurement determines valves below the fluid level are not injecting gas. Finding holes in the tubing string and location of any restrictions in the tubing or casing help identify problems impacting production. During a workover, monitoring the fluid levels of a well filled with kill fluid ensures sufficient hydrostatic pressure is maintained against the formation. In gas-lift wells without a packer, producing bottomhole pressures can be accurately measured using an acoustic fluid level instrument.

Examples of fluid level shots on gas-lifted wells will be used to demonstrate these concepts. Acoustic fluid levels acquired on gas-lift wells provide a low cost, direct method to observe the well and benefit the operator through knowledge of the well’s producing conditions.
A standardized Mobile Wellhead Compressor for a portfolio of onshore gas wells in The Netherlands

James Donald (NAM)

Abstract

Mobile Wellhead Compression (MWHC) can extend the uptime of gas wells and postpone liquid loading. Due to cost, equipment and plant change lead times it is often disregarded in the pursuit of alternative methods that can cure clear and present liquid loading issues. However, with its ability to produce a well down to 2 bar and maintain wellbore access it’s a desirable method to maximize well recovery. We identified that developing a standardized MWHC was key to reducing the lead times and making MWHC an economically attractive deliquification technique.

This presentation first describes analysis of our portfolio of 150 producing wells in Onshore Netherlands to understand where MWHC is technically and economically attractive as a deliquification method. We also analyse the potential for gas lift integrated with the compressor. The second part describes how we used field data to derive the design parameters for a MWHC that could serve as many of those candidates as possible while still being cost effective. A screw type compressor with capacity of 300k sm3/d was arrived at. Key considerations were slug size, gas specification and choice to design for formation water (or not).
Abstract

• Since its introduction in 2003 foam assisted lift (FAL) has been applied in NAM onshore operations batch mode in about 150 wells and continuous mode in about 50 wells. Historic FAL performance was evaluated to establish the success rate of foam, the reduction of the critical rate achieved with foam and the dependency of foam performance on reservoir, well and foam application parameters.

• The findings of the review include the following:
  • Continuous foam showed a higher success rate (90%) than batch foam (50%), highlighting the specific technical challenges involved in batch foam application.
  • The continuous foam-in-water concentrations were on average (5x) too high, indicating significant scope to decrease foam consumption.
  • The observed reduction of the critical rate was up to 65%, supporting the assumption of 50% reduction for candidate selection.
  • None of the reservoir and well parameters evaluated proved to be a show-stopper for applying FAL.
Participants

Aubin Ltd
Aimilia Neroutsou
Alistair Watson

Baker Hughes
Bjoern Lause
David Welboren
Marc Lücke
Marcus Adrians
Sam Tousis
Valery Tchomne Kouontchou

Baker Hughes
Bjoern Lause
David Welboren
Marc Lücke
Marcus Adrians
Sam Tousis
Valery Tchomne Kouontchou

BP
Abbas Delavarmoghaddam

Brilliant Water Solutions
Michiel Arnoldy
Schouten Paul

Brilliant Water Solutions
Michiel Arnoldy
Schouten Paul

Brunei Shell Petroleum
Jim Hall

Caltec Limited
Syed Peeran
Tony Joynston

Centrica Energy
Leif Kristian Tveiterå
Majid Masood
Sivajeev Jeyakumar

Chimc
Abdelaziz Madouri
Alessandro Allegrucci
Raul Antonio Di Toto

ConocoPhillips
David McLaughlin
Iain Brown
Mark Oatey

ConocoPhillips
David McLaughlin
Iain Brown
Mark Oatey

Cormorant Engineering
Ken Newman

DAJAN srl
Gianfranco Protano
Miguel Gil

DEEP. Underground Engineering GmbH
Hagen Küchler

Definitive Optimization
Bobbi Jo Endersby-Lyren
Clint Mason
David Lyren

Delft University of Technology
Dries van Nimwegen

EBN
Ferhat Yavuz
Thijs Huiskes

Echometer
Lynn Rowlan

Emerson
Arjan van Ginkel

ExxonMobil
Dark Mill
Uwe Beier

Fangmann Energy Services GmbH & Co. KG
Fangmann Steffan Gerdes
Kerstin Kogler
Lummer Frank
Nils Recalde
Omair Rauf

Fangmann Energy Services GmbH & Co. KG
Fangmann Steffan Gerdes
Kerstin Kogler
Lummer Frank
Nils Recalde
Omair Rauf
Participants

**GDF-Suez**
Angela Viejo Garcia
Christophe Jeancenel
Ed Beringer
Gerald Breimer
Paulina Grunwald
Stéphanie Lafage

**Geveke Werktuigbouw**
Eric Wijnen

**Hoerbiger Ventilwerke GmbH & Co KG**
Rudolf Navratil

**KBB Underground Technologies GmbH**
Jürgen Kepplinger

**Maersk Oil**
Mohd Awallizam Kairan
Roberto Orenes

**M-I SWACO**
Marc Watt
Roger Walters

**Multi-Chem, a Halliburton Service**
Pieter Vijn
Richard Thomas Hornsby Hornsby
Thomas Hagen

**MÜNZING International Sàrl**
Johan Oudesluys

**Nalco Champion**
Angela Tosh
Annette Perales
Christopher Paradise
Fabian Lugthart
Gerrit van Dijk
Julia Zinina
Lesley Andrew
Mark Zijlstra
Marwa Neanaa
Razvan Oprescu
Richard de Vetter
Sjoerd van der Knoop
Slaven Piljic
Steven Oude Heuvel

**NAM/Shell**
Ahmed Farag
Aleksei Anokhin
Alexandru Cosmin Ciufu
Andrea Montero
Anurag Mittal
Barry Labrecque
Chandran Peringod
David Ashby
Dina Holzapfel
Dolapo Balogun
Dolapo Balogun
Edwin Gort
Esther Briggs
Gert de Vries
Grigorescu
Ingun Hovland
Jaclyn McFadzean
Participants

NAM/Shell
James Donald
Janny Benschop
Jeroen Smith
Kees Veeken
Martijn de Vries
Natalia Zhidkova
Nienke Wiersma
Paula Bejarano
Rafael Islamov
Ramona Cristina
Richard Vietje
Stanislav Kurbanov
Stephen Ozanne
Tony Robertson
Vincent Beijer

PGNiG SA w Warszawie Oddzial w Sanoku
Erwin Szwart
Tomasz Kociuba

Resato
Hendrik Sijtsma

RWE Dea AG
Folkert Wessel
Marc Kurella
Michael Eisenberger

Schlumberger
Rahel Yusuf

Siemens
Bob Okhuijsen
Peter Postma

Solvay Novecare Oil & Gas
Kevan Hatchman

OMV AUSTRIA
Mihai Leitoiu

OMV-PETROM ROMANIA
Adrian Popescu
Iulian Giura
Laurentiu Niculeanu
Vasile Stanculescu

Perenco
Matthew Weatherley
Uzochukwu Ayobami Morah

PSE Kinsale Energy
Jennifer Ryan

TETRA TECHNOLOGIES INC. / COMPRESSCO
Ugo Ormezzano
Participants

**TNO**
Erik Nennie
Ingrid Raben
Jos van t Westende
Koos Ham
Maarten Bijl
Shoeibi Omrani Pejman

**TOTAL E&P**
Amelie Decousse Frangel
John van Miert
Mohamed Khater

**Tri-Ocean Energy**
Hassan Meselhy

**Vermilion Energy**
Sven Tummers

**Weatherford**
Alasdair Fergusson
Bogdan Iordanescu
Colin Rae
Martin Oliphant
Michael Taylor
Pamela Müller
Serge Martin
Silviu Ungureanu

**Welltec**
Lambert Dilling

**Wintershall Noordzee B.V.**
Emanuel Mawa-Isaac
Harry Segeren
Leif Blidegn