Gas Well Deliquification Workshop
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Gas Well Deliquification Utilizing Electrical Submersible Pumping (ESP) Systems

Emee Ermel – Petroleum Engineer, Chevron
Brian Dugan – GWD Sales Manager, Centrilift
Les Reid – GWD Professional Engineer, Centrilift
Overview

• History and Theory
• Gas Handling Technology Advancements
• Methodology and Production Techniques
• Future
History of ESPs in GWD

- De-liquefying individual gas wells of nuisance water is an emerging area of focus worldwide.
- Formation dewatering is primary focus in Oklahoma - long thought to be cost prohibitive due to high water content, now viable with ESPs.
Centurion P3 Pump Curve
Gas Well Deliquification with ESPs

- Chevron – Midland ESP testing
  - P-3 Centrilift ESP
  - Initially, well did not have sufficient BHP to lift fluid
  - Too early to have conclusive results
  - Testing still ongoing

- Opportunities in other assets for additional field testing in 2008
Gas Well Deliquification with ESPs

Deliquification opportunities for Chevron’s international business units (>1200 wells)

Active Producer Type (excluding IndoAsia)

Active Producer Type (IndoAsia)

*2006 Data
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Typical dewatering well utilizing an ESP: Note the increase in well performance over time, primarily due to the synergistic interaction of additional wells as they were added and lowered reservoir pressure.

Source: World Oil Sept. 2000: Major reserve increase obtained by dewatering high-water-saturation reservoirs, David Chernicky, New Dominion, L.L.C., Tulsa, OK.
Gas Well Deliquification with ESPs

Six Crucial Factors for Success

• Correct geological assessment of the reservoir
• Abundant supply of 3-phase electrical power
• Sufficient gas processing infrastructure
• Adequate water disposal system
• Commitment to large front-end capital investment: drill sufficient number of wells
• Effective use of ESP technology
Gas Well Deliquification with ESPs

Centrilift Produced – Gas Dewatering Wells

- 1998
- 2000
- 2002
- 2004
- 2006
Gas Well Deliquification with ESPs

Why is gas a problem for ESPs?

Gas grows until:
- The impeller gas locks or
- Secondary pumping phenomena develops
Gas Well Deliquification with ESPs

Methodology and Production Techniques

• Avoid, Expel, Handle the gas
• Manage changing well conditions
Gas Well Deliquification with ESPs

Technology Advancements for Gas

SHROUDS
EARLY 60’s
REVERSE FLOW
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LATE 60’s
TAPERED STAGES

MID 70’s
FIRST ROTARY

1978
FIRST ROTARY SEP INSTALLED
2008 Gas Well Deliquification Workshop
Denver, Colorado

1979
DRIVES

1986 - TURPIN

EARLY 80’s
TANDEM SEPARATORS

1989
HIGH PIP TEST

2001
GAS LOOP

2003
GAS HANDLING STAGE

2005
HIGH VOLUME GAS SEPARATOR

2005
HIGH VOLUME GAS SEPARATOR

2005
HIGH VOLUME GAS SEPARATOR
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Avoid the Gas - Shrouded ESP in a Sump

Advantage: Takes advantage of natural separation
Disadvantage: Motor cooling
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Trapped Gas Forms Slugs

Vertical

74-81°

ESP Set Position

Trapped Gas
Inverted Shroud to Minimize Gas Slug Effect

While gas slug passes by unit, pump is drawing fluid from the inverted shroud.

Inverted shroud fills with fluid during normal operation
Gas Well Deliquification with ESPs

While gas Slug passes by unit, pump is drawing fluid from the inverted shroud.

Inverted Shroud fills with fluid during normal operation
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Avoid the Gas

RECIRCULATION PUMPING SYSTEM*

PUMP
• Size like a normal installation
• Standard options can be used

RECIRCULATION SYSTEM
• Intake for both pumps

SEAL - conventional

MOTOR

RECIRCULATION TUBE

TUBING CLAMP

*PATENTED
Gas Well Deliquification with ESPs

Gas Handling/Expelling

- Plan for future when sizing ESPs
- Extended flow range pump designs
  - abrasion resistant and hydraulic technology
- Gas handling charge pumps
- High volume gas separators
- Downhole sensors and VSD
- Remote well monitoring and automation
- Lead sheath electrical cable
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Methodology and Production Techniques

• Typical GWD wells require ESPs ranging from 1,500 to 4,000 bfpd and 100 to 400 HP in size

• ESP systems for dewatering purposes regularly utilize many of the following items:
  – gas separators, charge pumps, downhole sensors, shrouds, recirculation pump, lead cable, variable speed drives, and corrosion resistant coating
Gas Well Deliquification with ESPs

Summary

• Gas well deliquification via ESP systems is a viable option in today’s market
• Success has been achieved by dewatering entire fields versus individual wells
• Variety of methods can be employed to handle gas with ESPs
• Dynamic well conditions can be handled with appropriate commitment to proper ESP use.
Gas Well Deliquification with ESPs

Cutting Edge…

• Field optimization via remote well monitoring and automation

• Exploring higher water content producing zones
  – Arbuckle
  – Simpson

• Utilization of high HP systems (1200 HP +) capable of producing as much as 20,000 bfpd
  – Wells drilled in these zones are producing in excess of 1.0 mmcfpd
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