The ESP Group - Dewatering Gas Well Using Submersible Electrical Motor

Peter O. Oyewole (Artificial Lift Production Engineer)

BP America Inc
What are we going to talk about?

- Introduction
- Centrifugal ESP (Conventional ESP)
- Electric Submersible Progressing Cavity Pump – ESPCP (TTC option)
- Hydraulic Diaphragm Electric Submersible Pump – HDESP
- Electric Submersible Twin Screw Multiphase Pump (ESP-TSMP)
- San Juan CBM ESP Group Field Trial
- Conclusion & Summary
Introduction

- ESP – Traditionally reserved for HIGH LIQUID RATE wells
- Application Extending to LOW LIQUID RATE gas wells
- Why?
  - Recent Technology Advancement & new products/package
  - Completing More Complex Wellbore
    (Deviated, S-shaped, Horizontal, HST, M’laterals)
  - Environmental
  - Regulation & Spacing
  - Reserve Access
  - Accelerate production

➔ Rod Problem – Wear, Rod fall etc get bigger
Introduction

- **Gain**
  - Rodless (No rod problem)
  - Install & run in complex wellbore geometry
  - Low Profile – Visibility & Under Irrigation System
  - Can handle some solid (may need desander, screen…… if applicable)

- **Limitation**
  - Electricity (Utility or Generator)
  - Prime Mover is DH (Rig work to repair motor & some pump)
Centrifugal ESP (As low as ~40BLPD)

- Low Liquid Rate Gas Well (Concerns)
  
  (1) Gas Interference
  - Gas locking, Cavitation
  
  (2) Downthrust wear - Pump
  (Low liquid rate = operating in downthrust)
  
  (3) Heat damage - Motor
  (Reduced conductive cooling)
Gas Interference

(1) Gas Separation
(2) Gas Handling
(3) Tapered Pump (not common)

- Require some liquid production to work
- Some gas handler may require a lot more liquid mix to work
- Gas Separator & Gas Handler Combo is possible in an application.
Gas Separation

(1) Sump Pump – Best gas separator
- (w/out Shroud@ shallow/low BHT, w/shroud on deeper/high BHT)

(2) Static Gas Separator
- (Bottom Intake Feeder for Horizontal wells)

(3) Rotary Gas Separator
- (U got the speed/RPM)

(4) Vortex Gas Separator
- (Diffuser is added)
Gas Separation

Static GS

XGS & Rotary GS

Rotary GS

Poseidon™ (SLB)

Bottom Intake Feeder

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Gas Handling

- Before the main pump. Btw the gas separator/intake and the main pump
  
  (1) Advanced Gas Handler (AGH)™ – Schlumberger
  (2) Multi Vane Pump (MVP)™ – Centrilift
  (3) XGC™ – Wood Group ESP
  (4) Poseidon™ – Schlumberger
Gas Handler

- Increase Pressure & reduce gas volume – (Gas law)
- Recirculation path or split vane design - keep gas bubble from accumulating
- Homogenize the gas liquid mixture – for pump stages to handle
- Reduces/break gas bubble
- Impact high momentum energy to the fluid by design
- Compression chamber - Compress free gas back in solution – gas in water solubility ???
- Axial flow by design
Downthrust wear - Pump

- Stabilizers sleeves
- Balance Circulation ring
- Shimming (compression pump are not Low Flow rate)
- Thrust Washer materials
Heat damage-Motor

- Shroud Motor landed @ or below perf
- Derated Motor & Variable Rated Motor - (↓ temp rise & ↑ rated temp)
- Motor Temp Control Cut-off – With DH sensor w/thermocouple - monitor motor winding temperature
- Recirculation Pump
- Surface water injection through cap string
Electric Submersible Progressing Cavity Pump – ESPCP (TTC option)

- PCP + Gear Reducer + Submersible Motor
- PCP
  - Handle lower liquid rate than centrifugal
    (As low as ~20BLPD)
  - Additional solid handling capability
Three run was required.
Through Tubing Conveyed

- Motor, Gear reducer, Seal w/Tubing & Intake X-over
- Base coupling locator, flex shaft, PCP, tubing Pack-off and Anchor - installed & removed
- w/slickline, E-line, CT, Jointed rod, Corod
- Why?
- PCP the weak link due elastomer limitation can be easily removed when failed without a full rig workover
- Adequate Motor Protection is required w/motor temp rise cut out.
Hydraulic Diaphragm Electric Submersible Pump (HDESP) - SmithLift

- Hydraulic Diaphragm + Electric Motor
- Designed specifically for low liquid volume gas wells (as low as ....motor cooling)
- One Rotor & Stator –highly efficient system @ low liquid rate
- Positive displacement: double acting diaphragm with check valves
- Handle gas better…
- Can operate @ pump off ….Required very low NPSH
- Current Application - <2500’ ;<200BLPD
Electric Submersible Twin Screw Multiphase Pump (ESP-TSMP)
Electric Submersible Twin Screw Multiphase Pump (ESP-TSMP)

- Rotary +ve displacement type pump as PCP
- Capable of handling large gas vol.
- Sensitive to Solid (especially in low viscosity fluid)
- Opposing flights of screws creates double axes
- Screw matches: Rotation advances trapped fluid
- Trans-axial flow and forces (less shear force)
- Appropriate clearance design is essential to prevent reverse slip flow, head & efficiency loss
San Juan CBM field trial

ESPCP/ESPCP TTC

- 8 wells/12 installations since 11/05 – Le Platt #1
- **TTC- 836** days run life & still running.
- Others not as successful – Stuck rotor/inadequate HP
- First install ever- New TTC design with mechanical locks & One slickline run in 2 7/8”
- Running ESPCP TTC no ESPCP

- **ESP** – Two installs by Q2
San Juan CBM field trial

HDESP

- 4 wells/11 installation since 12/05 – Poff Forest & Sitton well - had over 200 days run life before failure
- Electrical Integrity was a biggest issue
- Quit new HDESP installs and considering HDI w/out electrical

- ESP-TSMP - BP Wytch Farm install
Conclusion

- Some of the ESP Group are becoming a viable method to dewater gas well.

- Smaller throw-away ESP’s with Franklin motors is been around but not favorable…depend on the biz model

- More work is still required for more adaptation of the tech to gas well
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