Enhancing Gas Lift Installations by Utilizing Two Piece Plunger Technology

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Overview

• Gas Lift Systems
• Two Piece Plunger Systems
• Hybrid GL/PL Systems
• Field Examples
• Conclusions
Gas Lift Systems

- Gas lift is the artificial lift method that most closely resembles the natural flow process of a well.
- As produced fluids travel up the tubing, formation gas comes out of solution and expands as it rises to surface.
- As the reservoir pressure depletes, the hydrostatic pressure of the fluid column increases and the well is no longer able to flow.
- By utilizing injected gas to lower the hydrostatic pressure, the required differential between the reservoir and wellbore can be reestablished.
Gas Lift Systems

- Gas lift is a method of artificial lift that uses an external source of high-pressure gas to aerate a liquid column thus reducing density and column weight.

- High-pressure gas is injected from the surface into the produced fluid through one or more gas lift valves set at predetermined depths.
Gas Lift Systems

- Gas lift has been utilized for years in assisting the production of both water & oil.
- In the past most utilization has been for offshore or other high liquid producing areas.
- Discovery of multiple shale plays has caused a renaissance in the popularity of gas lift.
- Gas lift has become the method of choice for recovering frac water as well as produced oil/water in a number of these plays.
Gas Lift Systems

- **Two Types of Gas Lift**
  - **Continuous injection** of high pressure gas from the casing into the tubing to maintain a constant flowing bottomhole pressure. The most common and flexible method of gas lift that is capable of lifting rates in excess of 20,000 bpd and as low as 50 bpd.
  
  - **Intermittent Injection** of high pressure gas from casing into tubing on an intermittent basis as fluid loads up in the tubing. Best suited for wells with GLRs between 175/200 bbls/mmcfd. Fluid slippage a big issue with intermittent.
Two Piece Plunger Systems

- Returns well to as near a flowing condition possible while utilizing plunger lift
- Designed for high rate wells (liquid & gas)
- Little or no Shut In Times required
- Lowers flowing bottom hole pressure by lifting small amounts of liquid many times/day
- Keeps liquid moving in horizontal applications
- Will operate down to around 60 degrees
Two Piece Plunger Systems

- Two Piece Plunger
  - More trips/day due to fast fall times
  - Less load per trip
  - Falls against high gas rates
  - Minimum Shut In Times
    - ~10 seconds
  - Works well with on site compression
  - No line pressure spikes
Two Piece Plunger Systems

• Two Piece Plunger Operation
  • Sleeve and ball start as one piece at the bottom of the tubing string positioned on top of the bottom hole assembly, the same as a conventional plunger
  • While the well is flowing, the sleeve and ball travel as one to the surface lifting liquid that has accumulated above the plunger. At the surface the plunger enters the lubricator and fluid and gas are produced down the flow line.
Two Piece Plunger Systems

• In the lubricator, the separator rod knocks the ball from the sleeve and the ball begins traveling back down the tubing. The sleeve is held in place on the separator rod by continued gas & liquid flow.

• The controller sends a signal to the control valve to close, briefly shutting off all flow, allowing the sleeve to fall from the separator rod and start back down hole.
Two Piece Plunger Systems

• The large bypass area of the sleeve allows the plunger to fall at a high rate of velocity against flow reducing overall cycle time

• Once the sleeve reaches the bottom, the ball seals the bottom of the sleeve and begins ascent back to the surface
Hybrid Gas Lift/Plunger Lift Systems

• Plunger assisted Gas Lift is a hybrid method of gas lift that utilizes a plunger to increase efficiency of lift gas
  • Can help eliminate common GL inefficiencies
    – Over Injection
    – Liquid Slippage

• Plunger provides an interface between gas & liquid

• Does not have negative impact on GL valves due to little or no shut in time
Hybrid Gas Lift/Plunger Lift Systems

• Candidate Selection
  • Gas lift wells producing less than 200 – 250 B/D total liquid
    – Have had success up to 500 B/D

• Continuous Injection gas lift system
  – Operating on bottom valve or orifice if possible

• Gas lift wells with paraffin issues
Hybrid Gas Lift/Plunger Lift Systems

• Advantages
  • Improves overall performance of GL system by reducing liquid fallback
  • Improved/Increased production (gas & liquid)
  • In most cases, gas injection rate can be reduced
    – Plunger doesn’t allow gas to blow through liquid as it comes to the surface
  • Helps control paraffin/wax issues
  • Plunger provides tattle-tell regarding injection
Hybrid Gas Lift/Plunger Lift Systems

- Plunger Equipment required to install Hybrid System
  - Surface Lubricator/Catcher Assembly
  - Two Piece Plunger w/Ball
  - Down Hole Bumper Spring with Holddown
  - Electronic Controller w/ Arrival Sensor
  - Motor Control Valve
Hybrid Gas Lift/Plunger Lift Systems

- Field Results
  - Niobrara
  - Barnett Shale
  - Granite Wash – Texas Panhandle
• Niobrara Shale (Codell)
  • Majority 2-7/8” Tubing w/ Stop set at ~30 degrees
  • Typical oil increase of 10 – 20 B/D per well
  • 40 – 80 B/D of oil increase per 4 well pad
  • Total oil 70 – 100 B/D per well
  • Total liquid 100 – 150 B/D per well
  • Reduced injection volumes 10 – 20%
  • Reduced paraffin issues
Hybrid Gas Lift/Plunger Lift Systems

Barnett Shale

Two Piece plunger installed

Net Gas Increase

Injection Gas Decrease

Liquid Increase
Hybrid Gas Lift/Plunger Lift Systems

- Samson Resources
  - Granite Wash Area – Texas Panhandle
  - Target Zones – GW Red, Cottage Grove & Hogshooter Formations ~10,500’-11,500’ TVD
  - Well Design – 7” Intermediate Casing X 4.5” Liner, 2-7/8” Tubing w/ Packer and GL valves to TOL
  - Tubing w/ Stop & BHS Set 1 jt. Above GL Valve #1
  - Average Gas Uplift of 67 MCFD
  - Average Oil Uplift of 3.5 BOPD
Hybrid Gas Lift/Plunger Lift Systems

Ivestor 4 H57

Two Piece plunger Installed

Graph showing the performance of hybrid gas lift/plunger lift systems with data for Gas Sales, Pressure (CSG), Oil Prod, and Water Prod from 6/1/2014 to 8/30/2014.
Hybrid Gas Lift/Plunger Lift Systems

Ivestor 7 H57

Two Piece plunger Installed

- Gas Sales
- Pressure (CSG)
- Oil Prod
- Water Prod
Hybrid Gas Lift/Plunger Lift Systems

Davis G 806 1H

Two Piece plunger Installed

Graph showing the comparison of Gas Sales, Pressure (CSG), Oil Prod, and Water Prod over time.
Hybrid Gas Lift/Plunger Lift Systems

Ivestor 6 H57

Two Piece plunger Installed
### Field Results

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<th></th>
<th>Before</th>
<th>After</th>
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<tbody>
<tr>
<td><strong>Ivestor 4 H57</strong></td>
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<tr>
<td>Net Gas</td>
<td>149 mcf/d</td>
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<tr>
<td>Oil B/D</td>
<td>20 B/D</td>
<td>25 B/D</td>
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<tr>
<td>Water B/D</td>
<td>20 B/D</td>
<td>44 B/D</td>
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<td>Casing Pressure</td>
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<td><strong>Ivestor 7 H57</strong></td>
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<tr>
<td>Net Gas</td>
<td>95 mcf/d</td>
<td>273 mcf/d</td>
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<tr>
<td>Oil B/D</td>
<td>43 B/D</td>
<td>47 B/D</td>
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<tr>
<td>Water B/D</td>
<td>14 B/D</td>
<td>30 B/D</td>
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<tr>
<td>Casing Pressure</td>
<td>517</td>
<td>378</td>
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## Hybrid Gas Lift/Plunger Lift Systems

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<tr>
<th>Field Results</th>
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<tbody>
<tr>
<td><strong>Davis G806 1H</strong></td>
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<tr>
<td>Net Gas</td>
<td>225 mcf/d</td>
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<td>Oil B/D</td>
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<td>Water B/D</td>
<td>11 B/D</td>
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<td>Casing Pressure</td>
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<td><strong>Ivestor 6 H57</strong></td>
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<tr>
<td>Net Gas</td>
<td>223 mcf/d</td>
<td>275 mcf/d</td>
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<tr>
<td>Oil B/D</td>
<td>27 B/D</td>
<td>31 B/D</td>
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<tr>
<td>Water B/D</td>
<td>9 B/D</td>
<td>20 B/D</td>
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<tr>
<td>Casing Pressure</td>
<td>501</td>
<td>348</td>
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</tbody>
</table>
Hybrid Gas Lift/Plunger Lift Systems

Began PL Installations
Hybrid Gas Lift/Plunger Lift Systems

GL Assisted PL

Began Installation of Gas Lift Assisted PL

PSI

Pressure(CSG) - Pressure(TBG)

Clear Selections
Hybrid Gas Lift/Plunger Lift Systems

• Conclusions
  • Production increases (Gas & Liquid)
  • Lower Flowing Bottom Hole Pressure
  • Paraffin Control
  • Increased efficiency of GL system
  • Stabilized Flow
  • Reduced Casing Pressures
  • Low Cost Initial Investment
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