Stabilisation of Gaslift Production using a Dynamic Simulator

Yvonne Roberts: Edinburgh Petroleum Services
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Contents

• Why Gaslift is important
• Why the North Sea is important
• Objectives of the Study
• Methodology
• Recommendations
• Effects of Implementation
• Summary
There are several forms of Artificial lift:

- Beam Pumps
- ESP’s, PCP’s, jet and hydraulic
- Gaslift

<table>
<thead>
<tr>
<th>Type</th>
<th>Onshore</th>
<th>Offshore</th>
<th>Oil rate (bopd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Pump</td>
<td>✓</td>
<td>✗</td>
<td>1 - 200</td>
</tr>
<tr>
<td>ESP's etc</td>
<td>✓</td>
<td>✓</td>
<td>200 - 200000</td>
</tr>
<tr>
<td>Gaslift</td>
<td>✓</td>
<td>✓</td>
<td>&lt;10 - 10000</td>
</tr>
</tbody>
</table>
The importance of Gaslift

Gaslift systems have the advantage of being:
- Relatively simple to design, install and maintain
- Systems with few moving parts
- Flexible and forgiving; gaslift almost always ‘works’

If there is sufficient gas available for gaslift, it is usually the method of choice.
US DoE/EIA figures:

- Jan-Aug 2000, oil production rates (MMbopd)
  
<table>
<thead>
<tr>
<th>North Sea</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.70 - 6.30</td>
<td>5.70 - 5.90</td>
</tr>
</tbody>
</table>

- USA production from many more wells than in the North Sea: approximately 1 million vs. several thousand.

- North Sea wells characterised by high productivity and high fluid rates with water injection to reservoir. Sufficient gas supplies in place to allow widespread gaslift.
Revenues

• Many gaslifted fields operate sub-optimally
  – Unrealised revenue
  – Lost Profit
• Within those fields some wells will be operating intermittently or will be unstable
  – Lost revenue
  – Potentially increased costs
• Those lost and unrealised revenues can generally be acquired...at a price.
  – Need to be able to make informed decisions about the best way to proceed
Cause and Effect

- Well Production is unstable under ‘normal’ gaslift conditions, but better at ‘maximum’ production
  - Gas delivery is not stable
  - Well production is inherently unstable

- Gas delivery is unstable
  - Something broke!
  - Something changed that took the operating conditions outside of the stable envelope

- Wellbore flow is inherently unstable
  - Reservoir effects: e.g. Coning
  - Wellbore effects: e.g. Flow regimes
1. Optimise the Well Production

*Optimise vb* To maximise economic efficiency, by finding the best compromise among several, often conflicting, requirements.

2. Stabilise the Well Production.

*Stabilise vb.* To render stable or steady, by establishing an equilibrium that persists even after a slight displacement.
Build steady-state Nodal Analysis model of the Well where all the equipment works as it was designed to:

- 4460 blpd for 1000 Mscf/d @ FTHP=331 psig
- 5.5 inch OD
- 24/64ths Orifice
- 7 inch OD L= 2500-ft
- 4 inch OD
- 3400 Mscf/d @ CHP = 1785 psig
- Valve performance curve for a given CHP
- Step Change in Point of gas injection
Effect of decreasing Gas injection rate at a constant FTHP

Instability if \( Q_{gi} < 1200 \) Mscf/d

@ FTHP = 100 psig
Recommended Actions

- Change orifice to 16/64ths

More stable production over a wide range of conditions
Reasons

- Effect on Unloading and Production

<table>
<thead>
<tr>
<th>Orifice Size 64ths</th>
<th>Max Unloading gas</th>
<th>Blpd @ 1200 Mcsf/d and FTHP = 100 psig</th>
<th>CHP psig</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>2000</td>
<td>6325</td>
<td>1650 - 1750</td>
</tr>
<tr>
<td>16</td>
<td>1500</td>
<td>7758 (+22%)</td>
<td>1770</td>
</tr>
</tbody>
</table>

- Much improved unloading action with smaller orifice, using less gas
- Significant improvement in Well Production
Outcome

• A staged approach to remedial works on the Well was taken and the orifice changed

• Acceptable levels of stability were achieved

• Increases in production were consistent with model predictions

<table>
<thead>
<tr>
<th>Source of data</th>
<th>Injected gas</th>
<th>Bld</th>
<th>FTHP</th>
<th>CHP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mscof/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field</td>
<td>1983</td>
<td>10934</td>
<td>87</td>
<td>1812</td>
</tr>
<tr>
<td>Model</td>
<td>1983</td>
<td>11007</td>
<td>86</td>
<td>1770</td>
</tr>
</tbody>
</table>

• No unnecessary workovers were undertaken
• Gaslift is an important form of Artificial Lift, Worldwide.

• The very flexibility of gaslift often means that it is not used to best effect.

• Tools exist for the dynamic analysis and optimisation of gaslift, both at the individual well and the field level.

• In the example shown, both stabilisation and optimisation of a single Well was achieved.

• The tools deliver financial benefit!
  – 400 bopd or ~$1000/d in this case.
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