Simulation of Liquid Loading in a Tight Horizontal Gas Well

Donald Jackson, Principal Consultant
SPT Group

Co-authored by Claudio Virués and Dave Sask, Encana
The Problem

- Liquid loading in horizontal wells
- Intermittent production
- Field-testing solutions is costly
Resources

- Horizontal wells previously analyzed with downhole video-logging
- Measured well data
- Transient multiphase flow simulator
Wellbore Profile & RWD
History Match

- 11-day period starting shortly after video logging
- Wellhead pressures specified as constraint
- Measured gas rates used to validate match
- Liquid holdup compared against video logs
Gas Rate History Match

---

![Graph showing gas rate history match with measured and calculated data points.](image)
Observed Holdup Comparison

![Graph showing observed holdup comparison between calculated and video log observation depths.](image)
Liquid Holdup Behaviour
Wellbore Trajectories

![Graph showing wellbore trajectories]

- **True Vertical Depth, m**
- **Measured Depth, m**
- **Original**
- **Toe Up**
- **Toe Down**
- **Complex**
- **Undulating**

Feb. 19 – 22, 2012

2012 Gas Well Deliquification Workshop
Denver, Colorado
Forecasting

- Model runs too slowly for multi-year forecasting
- Model a 2-day period for each year
- With enough years, errors should average out
Cumulative Gas Production

Tubing Depth Variations

<table>
<thead>
<tr>
<th>Year</th>
<th>Pseudo-Cumulative Gas Production, e³sm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>1881.9 mKB</td>
</tr>
<tr>
<td>2010</td>
<td>1719 mKB</td>
</tr>
<tr>
<td>2008</td>
<td>1665.26 mKB</td>
</tr>
<tr>
<td>2006</td>
<td>1636 mKB</td>
</tr>
<tr>
<td>2004</td>
<td>1581 mKB</td>
</tr>
</tbody>
</table>
Cumulative Gas Production

Trajectory Variations

- Original
- Toe Up
- Toe Down
- Complex
- Undulating
Liquid Holdup Snapshots

Flowing

Shut In

Toe Up

Undulating
Pressure Trend at Toe

![Pressure Trend Graph]

- **Pressure, kPa**
- **Time, d**

- **Toe up**
- **Undulating**
Conclusions

• Transient multiphase flow modelling can match observed field conditions

• Modelling verifies that liquid holdup can severely impact production from horizontal wells
  – Wellbore trajectory is major contributor to liquid holdup
  – Tubing landing depth contributes to holdup to a lesser degree
Ongoing Work

- Wellbore model coupled with a near-wellbore reservoir module
- Automated history matching
- Application to other wells/areas
More Information?

- Refer to SPE Paper 149477
  - Authors can provide copies
- Email dja@sptgroup.com
- Ask questions now!
Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Gas Well Deliquification Workshop, they grant to the Workshop, the Artificial Lift Research and Development Council (ALRDC), and the Southwestern Petroleum Short Course (SWPSC), rights to:

- Display the presentation at the Workshop.
- Place it on the www.alrdc.com web site, with access to the site to be as directed by the Workshop Steering Committee.
- Place it on a CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other use of this presentation is prohibited without the expressed written permission of the author(s). The owner company(ies) and/or author(s) may publish this material in other journals or magazines if they refer to the Gas Well Deliquification Workshop where it was first presented.
Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the front page of the Gas Well Deliquification Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the Gas Well Deliquification Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Training Course and their company(ies), provide this presentation and/or training material at the Gas Well Deliquification Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warranties of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.