Enhancing CSG well production through BHP control

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Problem definition

Estimation of counter-current two-phase flow pressure profiles is important in a wide range of industrial processes, including the prediction of flowing bottom-hole pressure (FBHP) for the design of coal seam gas (CSG) wells and artificial lift. The CSG industry is currently using simulators containing models which were originally developed for conventional wells (co-current flow in pipe) for their CSG developments (which are counter-current flow in annuli).

Methodology

The University of Queensland Well Simulation Flow Facilities were designed to replicate the production zone of a typical pumped CSG well in Queensland, Australia, as closely as possible:

- 7-in casing and 2¾-in tubing.
- Air and water used for safety.

Experimental results are used to:

- Validate models developed within the research team.
- Investigate flow regimes (bubble, slug, churn, and annular) and their associated holdups and pressure profiles.
- Determine the conditions for onset of counter-current flow limitation (gas carryover and "slugging").
- Conduct pressure signal analysis to identify flow regimes.

Development of flow regimes in CSG wells

Two-phase flow properties are intrinsically linked to the flow regimes that develop. The conditions at which flow regimes exist are typically predicted using superficial velocities (production rates). This is an imperfect but simplistic approach.

CCFL: onset of gas carryover & free flow

At extremely high gas or liquid flow rates, some fraction of co-current flow develops. Gas carryover is of particular interest in CSG dewatering operations.

Pressure signal analysis to identify flow regimes

Fluctuations in pressure are predominantly due to changes in holdup. Therefore, analysis of the pressure signals can reveal detailed information on the two-phase flow.

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