Enhancing CSG well production through BHP control

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Problem definition

The 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.

Leaders of the CSG industry are currently using simulators containing models that were originally developed for conventional wells (co-current flow in pipe) for their CSG developments (counter-current flow in annuli).

Experimental setup

To produce a system model for predicting the FBHP in CSG wells.
1. Develop mathematical models for the pressure gradient of each unique flow regime
2. Design an experimental rig resembling a typical CSG well
3. Conduct lab tests for identification of flow regimes and measurement of associated pressure drops and hold-ups
4. Determine the conditions for onset of slugging and free flow
5. Validate/modify our mathematical models for the FBHP

Results

A transition to the annular flow regime, gas continuous phase, was observed when water flow rate was increased. Shifting from a liquid continuous phase to a gas continuous phase has the most significant impact on the pressure data.

Experimental measurements:
1. Flow regimes
   • Visual observation
   • Videography
2. Differential pressure and FBHP
   • Pressure transducers
3. Holdup
   • Image analysis
   • Photo diode
   • Distributed Acoustic Sensing (DAS)
4. Effect of liquid properties
   • Test formation water
5. Maximum dewatering rate
   • Detect gas carry over

Models have shown that in counter-current two-phase flows, water flow contributes to increased void fraction by decreasing bubble rise velocity and increasing gas retention time. Void fraction, or hold-up, is a key criteria in the description of flow regimes.