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The Effect of Development of Two-Phase Flow Regimes on the Stability of Gas Lift Systems

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Abstract : Flow instability during gas lift operation is caused by three major phenomena – the density wave oscillation, the casing heading pressure and the flow perturbation within the two-phase flow region. This paper focuses on the causes and the effect of flow instability during gas lift operation and suggests ways to control it in order to maximise productivity during gas lift operations. A laboratory-scale two-phase flow system to study the effects of flow perturbation was designed and built. The apparatus is comprised of a 2 m long by 66 mm ID transparent PVC pipe with air injection point situated at 0.1 m above the base of the pipe. This is the point where stabilised bubbles were visibly clear after injection. Air is injected into the water filled transparent pipe at different flow rates and pressures. The behavior of the different sizes of the bubbles generated within the two-phase region was captured using a digital camera and the images were analysed using the advanced image processing package. It was observed that the average maximum bubbles sizes increased with the increase in the length of the vertical pipe column from 29.72 to 47 mm. The increase in air injection pressure from 0.5 to 3 bars increased the bubble sizes from 29.72 mm to 44.17 mm and then decreasing when the pressure reaches 4 bars. It was observed that at higher bubble velocity of 6.7 m/s, larger diameter bubbles coalesce and burst due to high agitation and collision with each other. This collapse of the bubbles causes pressure drop and reverse flow within two phase flow and is the main cause of the flow instability phenomena.

Keywords : gas lift instability, bubbles forming, bubbles collapsing, image processing
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