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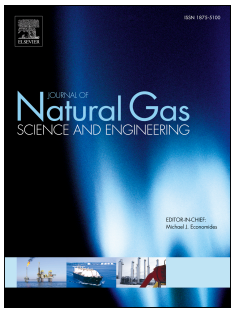

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Transient liquid leakage during plunger lifting process in gas wells

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Abstract

Plunger lift is an economical method to solve the liquid loading problem in wells. Following our previous research (Zhao et al., 2018), which focused on the steady-state process of liquid leakage during lifting, the transient variations of plunger velocity, liquid leakage and stress conditions during plunger lifting process are investigated theoretically and experimentally in this paper. Based on the force analysis and finite difference method, the transient physical model for the mass and gas volume fraction of gas-liquid column above plunger is proposed. Combining the similarity experiments and infrared measuring technology, the proposed transient model is verified quantitatively with the relative deviation less than ±10%. The results show that both the liquid leakage and the gas volume fraction of gas-liquid column above plunger cannot be neglected during plunger lifting. The transient change rules of lifting differential pressure, plunger velocity, gas volume fraction of gas-liquid column and liquid leakage flow rate during lifting process are obtained. The influences of liquid loading condition and gas production rate on transient plunger lifting process are discussed. Through the dimensionless analysis, a dimensionless correlation for transient gas volume fraction of gas-liquid column is developed.

Key words: plunger lift; transient process; liquid leakage; gas volume fraction;