MINIMUM LIFT CALCULATIONS FOR GAS WELLS

Curtis H. Whitson

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Turner et al. (SPE 2198) gives the following equation to calculate the minimum lift velocity v_{min} of a gas well necessary to avoid liquid loading in gas wells,

$$v_{min} = 2\frac{(\sigma\Delta\rho)^{0.25}}{\rho_g^{1/2}} \quad \textbf{(1)}$$

with v_{min} in ft/s, gas-liquid interfacial tension (IFT) σ in dynes/cm, and density in lb/ft^3. This relation is usually applied at wellhead conditions of p_{wh} and T_{wh}.

For water-gas (and water-oil) systems, the IFT (σ_{wg}) can be estimated from the relation

$$\sigma_{wg} = 15 + 0.91\,\Delta\rho_{wg}$$

or

$$(\sigma_{wg}\,\Delta\rho_{wg})^{0.25} = [(15 + 0.91\,\Delta\rho_{wg})\Delta\rho_{wg}]^{0.25} \quad \textbf{(2)}$$

with $\Delta\rho_{wg}=\rho_w-\rho_g$ in lb/ft^3. This relation was developed from experimental data and the graphical correlation of Ramey (SPE 4429).

For oil/condensate-gas systems, the IFT (σ_{og}) can be estimated from the general correlation,

$$\sigma_{og} = 1.79(10^{-6})(\Delta\rho_{og})^{4.24}$$

or

$$(\sigma_{og}\Delta\rho_{og})^{0.25} = 0.0366(\Delta\rho_{og})^{1.31} \quad \textbf{(3)}$$

with $\Delta\rho_{og}=\rho_o-\rho_g$ in lb/ft^3. This correlation was developed using the Peng-Robinson EOS (equation of state) and the parachor method for calculating gas-oil IFTs. A suite of gas condensate fluids, ranging in composition from lean to rich systems were used to generate IFT and density "data" covering a range of expected wellhead pressures and temperatures (100 to 5000 psia and 100 to 250^{o}F); IFTs ranged from 10^{-8} to 22 dynes/cm. Fig. 2 shows the quality of the correlation for estimating the quantity $(\sigma_{og}\Delta\rho_{og})^{0.25}$, where deviations are generally less than a few percent.

Fig. 1 shows the two correlations for the quantity $(\sigma\Delta\rho)^{0.25}$ for both water-gas and oil/condensate-gas systems. The two correlations are consistent

as they approach an IFT of about 70 for a density difference of 62.4 lb/ft^3 (air-water system at standard conditions).

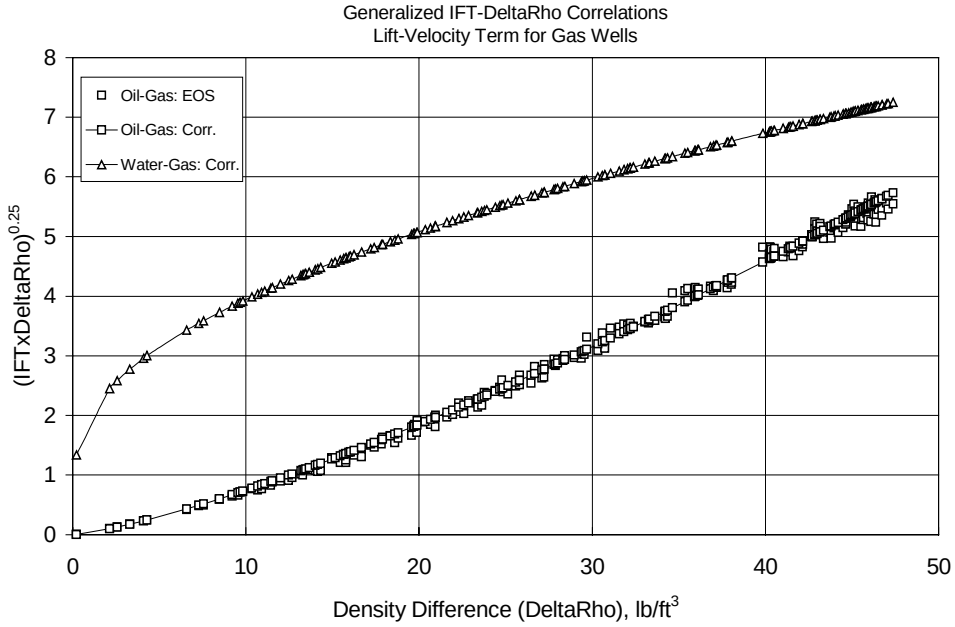

Figure 1

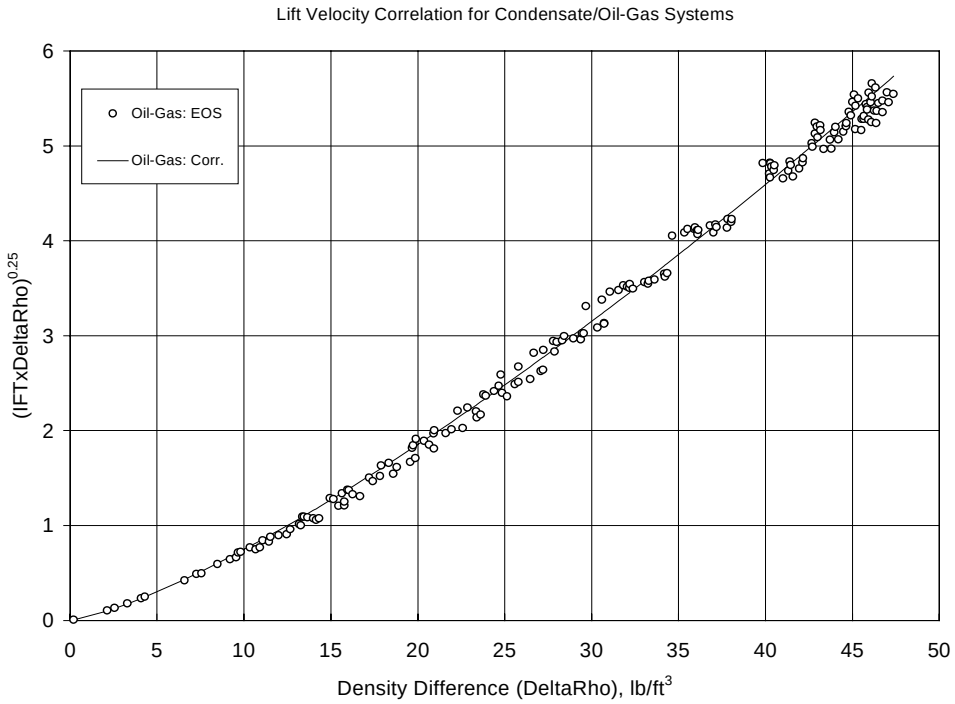

Figure 2