Contribution ID: **40** Type: **not specified**

Two-Phase Gas Compressibility Factor Correlation for Gas Condensate Reservoirs

Tuesday, 22 July 2025 15:30 (15 minutes)

Accurate determination of the two-phase gas compressibility factor (Z_2ph) is crucial for reliable material balance calculations, reserve estimation, and production forecasting in rich gas condensate reservoirs. Although, experimental measurement of Z_2ph is the most accurate method, but it is expensive and time consuming. Also, existing correlations and genetic algorithm-based models often produce significant errors especially for systems containing rich condensates and non-hydrocarbon impurities. In this study, a new correlation was developed to estimate Z_2ph using datasets obtained from constant-volume retrograde gas depletion studies with C_(7+) concentration ≥2mol%.
A correlation developed based on Multiple Linear Regression (MLR) was used to calculate the pseudo-critical pressure (P_pc) and pseudo-critical temperature (T_pc) from the gas composition. These pseudo-critical properties were used to calculate the pseudo-reduced pressure (P_pr) and pseudo-reduced temperature (T_pr). Two correlations for Z_2ph were developed using linear MLR and non-linear MLR. The non-linear MLR also contains the interaction terms (P_pr,T_pr) and the quadratic terms (P_pr^2,T_pr^2) to capture complex gas behavior.
The non-linear MLR, linear MLR, Rayes et al. (1992), and GA correlations had average error and maximum deviation of 0.06% and 0.09%, 0.38% and 0.83%, 2.92% and 5.08%, and 2.51% and 3.86%, respectively. Therefore, the non-linear MLR is more accurate in determining the Z_2ph for gas condensate reservoirs compared to the GA and Rayes et al. (1992) correlations.

Keywords: Two-phase Gas Compressibility Factor, Gas Condensate Reservoirs, Correlation, Multiple Linear Regression, Pseudo-critical Properties

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Session Classification: Contributed Talk

Track Classification: Engineering: Chemical Engineering