Tech Science Press

*ICCES, 2024, vol.29, no.1*
DOI: 10.32604/icces.2024.011026

PROCEEDINGS

# Adaptability Study on the Equations of State for Calculating the Thermophysical Parameters of Hydrogen-Enriched Natural Gas

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**ABSTRACT**

The blending of hydrogen into natural gas provides an optimal solution for large-scale hydrogen transport, utilizing existing natural gas pipelines for mixed conveyance. The thermophysical parameters of hydrogen-enriched natural gas (HENG) significantly influence the design and operation of gas transmission networks. Therefore, accurate prediction of the thermophysical parameters of HENG is crucial. However, due to the effects of hydrogen blending, the adaptability of commonly used equations of state (EoSs) to HENG remains uncertain, especially at high hydrogen blending ratios (HBRs). In this study, the accuracy of the EoSs of PR, BWRS, AGA8-92DC, and GERG-2008 is verified using experimental data, then the performance of different EoSs is compared by predicting the Joule-Thomson (J-T) coefficient and density of HENG under the temperatures of 283.15K - 323.15K, pressures of 0.1MPa - 10MPa, and HBR of 0% - 100%. The results indicate that GERG-2008-EoS exhibits the highest stability and accuracy in predicting the J-T coefficient. The empirical formula for the J-T coefficient of natural gas exhibits small errors when calculating the J-T coefficient at low HBRs and pressures, but needs to be adjusted as the HBR increases. The PR-EoS generally exhibits large errors in calculating the J-T coefficient. In contrast, BWRS-EoS performs well when HBR below 30%, whereas the AGA8-92DC-EoS is accurate under most conditions, except for some instability at certain high pressures. In density calculations, both AGA8-92DC and GERG-2008 EoSs are accurate. However, BWRS-EoS shows significant deviations under high pressure conditions, and PR-EoS is less adaptable at higher HBRs. The comparative analysis provided in this study offers a reliable reference for predicting the J-T coefficient and density of HENG under various thermodynamic conditions. Additionally, the GERG-2008-EoS consistently demonstrates the best computational adaptability across a range of conditions, providing vital theoretical support for the application of hydrogen blending in the natural gas industry.

**KEYWORDS**

Hydrogen-enriched natural gas; thermophysical parameters; equations of state; adaptability

**Funding Statement:** This study is supported by the National Science Foundation of China (No. 52372311) and the "Open bidding for selecting the best candidates " Project of Fujian Province (No. 2023H0054).

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.