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A Unified Gas–Alkane Binary Interfacial Tension Calculation for A Broad Range of Pressure and Temperature: A Machine Learning Approach

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Gas injection is one of the most effective enhanced oil recovery (EOR) methods, in which the gas–alkane interfacial tension (IFT) is an important parameter. Thus, to accurately estimate gas–alkane mixture IFT plays an imperative role in both chemical and petroleum engineering. Various empirical correlations by fitting the experimental results have been developed in the last several decades, which are convienent to use. However, their accuracies are inconsistent over a wide range of compositions, while some of them also need inputs from the equation of state (EOS) modeling. Statistical mechanics models and molecular simulations are other popular choices for IFT prediction, whereas they can be time-consuming. Recently, the extended Connors–Wright (ex–CW) model has been proposed to accurately predict gas-alkane IFT over a wide range of pressure, temperature, and composoition. In this work, the ex–CW model is used to provide enormous IFT data to be paired with machine learning (ML) approaches to construct simple yet highly-accurate gas-alkane binary mixture IFT prediction equations (i.e. linear equations) which are functions of temperature, pressure, and molecular weight. The linear equations for gas-alkane binary mixture IFT based on ML are calibrated by comparing with experimental data, the ex–CW model, and the Parachor model. We find that the linear equations from ML approach largely outperforms the Parachor model, while they have a comparable performance with the ex–CW model. In addition, while both the Parachor model and the ex–CW model need the imputs from the EOS modeling, the linear equations from ML approach only use temperature, pressure and molecular weight. The proposed idea shows a great potential in terms of highly-efficient and highly-effective gas-alkane binary mixture IFT predictions which can be further extended to more-complicated multi-component gas-oil IFT predictions for gas injection EOR processes.

Time Block Preference

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References

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Primary authors: Mr WANG, Yingnan; Prof. JIN, Zhehui

Presenter: Mr WANG, Yingnan

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