Multicomponent Vapor–Liquid Equilibrium Measurement and Modeling of Ethylene Glycol, Water, and Natural Gas Mixtures at 6 and 12.5 MPa - DTU Orbit (25/11/2018)

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High pressure subsea natural gas dehydration (NGD) units using ethylene glycol (MEG) absorption have been proposed. To expand the experimental database and assist design qualification, new vapor–liquid equilibrium (VLE) experimental data have been measured for a 20-component glycol–water–natural gas mixture at $T = (288–323)$ K, $p = (6.0, 12.5)$ MPa, and $w_{\text{MEG, feed}} = (90, >99.8)$ %. MEG, H$_2$O, CO$_2$, N$_2$, and alkane (methane to n- and i-pentane) phase distributions have been quantified. Experimental uncertainty ranges from ±2–42%, with the greatest uncertainty for the quantification of trace components. Experimental results are modeled using the Cubic-Plus-Association (CPA) equation of state. Overpredictions (∼9%) are observed for the water content of the vapor phase. CO$_2$ is shown to have a large effect on $y$ MEG, leading to modeling deviations in the order of 65%. A relatively accurate prediction of the natural gas partition coefficients was observed for major components C$_1$–C$_3$ and CO$_2$, with modeling errors ranging from 5% for methane to 10% for CO$_2$. More significant deviations were observed for trace components, with the largest deviation of 73% N$_2$. The CPA model provides both satisfactory and conservative results suitable for use in NGD process designs. On the basis of this work, operation at subsea conditions would significantly improve dehydration capability.