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High pressure thermophysical properties of complex mixtures relevant to Liquefied Natural Gas (LNG) processing

Saif ZS. Al Ghafri*, Thomas Hughes, Armand Karimi, Kumarini Seneviratne, Jordan Oakley, Michael Johns and **Eric F. May**
Centre for Energy, School of Mechanical & Chemical Engineering, The University of Western Australia, Australia

Knowledge of the thermophysical properties of complex mixtures at extreme conditions have always been essential to the Liquefied Natural Gas (LNG) industry's evolution because of the tremendous technical challenges present at all stages in the supply chain from production to liquefaction to transport. In this work, we present a wide range of experimental measurements made for different binary and ternary mixtures relevant to LNG processing. For this purpose, customized and specialized apparatus were designed and validated over the temperature range (200 to 423) K at pressures to 35 MPa. The mixtures studied were (CH_4 + C_3H_8), (CH_4 + C_3H_8 + CO_2) and (CH_4 + C_3H_8 + C_7H_{16}); in the last of these the heptane contents was up to 10 mol %. Viscosity was measured using a vibrating wire apparatus, while mixture densities were obtained by means of a high-pressure magnetic-suspension densimeter and an isochoric cell apparatus. Surface tensions was measured using the capillary rise method in a visual cell, which also enabled the location of the mixture critical point to be determined from observations of critical opalescence. Mixture heat capacities were measured using a customised high-pressure differential scanning calorimeter (DSC). The extensive experimental data gathered in this work were compared with a variety of different advanced engineering models frequently used for predicting thermophysical properties of mixtures relevant to LNG processing. In many cases the discrepancies between the predictions of different engineering models for these mixtures was large, and the high quality data allowed erroneous but often widely-used models to be identified. The data enable the development of new or improved models, to be implemented in process simulation software, so that the fluid properties needed for equipment and process design can be predicted reliably which is essential for oil and gas industry. This in turn will enable reduced capital and operational expenditure by the LNG industry.

Biography:

Dr Saif Al Ghafri is a postdoctoral research fellow at UWA working in the Thermophysical properties measurements. He obtained his PhD in 2013 on Carbon Capture and Storage (CCS) from Imperial College London, focusing on measurements of the Thermophysical properties of mixtures of carbon dioxide with reservoir fluids. Dr Al Ghafri worked as a postdoctoral research associate at Imperial College for two years before joining UWA. He is currently involved in different LNG projects within the Fluid Science and Resources (FSR) group including vapor-liquid equilibrium, viscosity, solid-liquid equilibrium, density, bubble points and boil-off gas measurements.