

High Accuracy Phase Behavior and PpT Measurements via Isochoric and Isothermal Methods for Methane Natural Gas-Like Mixtures and an AGA8-DC92 EOS Validity Check

Mert Atilhan^C

Chemical Engineering Department, Qatar University, Doha, Qatar

Saquib Ejaz

ABB International, Houston, TX, U.S.A.

Prashant V. Patil

S&B Engineering, Houston, TX, U.S.A.

Jingjun Zhou

Formosa Plastics, Channelview, TX, U.S.A.

Diego Cristancho^S

Chemical Engineering Department, Texas A&M University, College Station, TX, U.S.A.

James C. Holste

Texas A&M University at Qatar, Doha, Qatar

Kenneth R. Hall

Chemical Engineering Department, Texas A&M University, College Station, TX, U.S.A.

High-accuracy density measurement data are necessary to validate equations of state (EOS) used in natural gas transport. On the other hand, accurate knowledge on phase behavior for natural gas mixtures is also very important. The American Gas Association (AGA) AGA8-DC92 EOS, currently the industry standard and several attempts have been made to develop a new EOS that can serve the gas industry because the reliability of AGA8-DC92 has been criticized over the past few years. This work reveals the ability of the AGA8-DC92 to predict the densities of natural gas like mixture which contains 94 % methane along with heavy components and the phase envelope for the same mixture. A state-of-the-art, high pressure, high temperature, compact single-sinker magnetic suspension densimeter (MSD) has been used to collect densities of simulated natural gas mixture after validating the densimeters operation by measuring densities of pure argon, nitrogen and methane in the range 270 to 340 K and 3.447 to 34.474 MPa. Temperature stability of the MSD is ± 5 mK and pressures have an uncertainty of ± 0.002 %. The total uncertainty of collected densities via MSD is calculated as ± 0.12 %. A high pressure and wide temperature range isochoric apparatus is used to determine the phase envelope points of the same mixture. Isochoric apparatus can operate up to 35 MPa within the temperature range of 100 K to 500 K. Temperature stability of the isochoric apparatus is obtained as ± 4 mK and the temperature gradient across the cell is observed as ± 2 mK through the thermopile. Pressure transducer has accuracy of 0.01 % of the full scale. A total of 36 density points were collected at 4 different isotherms and 8 phase envelope points were determined based on 95 PT points based on 10 isotherms.