Development of a Novel Apparatus for the Measurement of Vapour-Liquid Equilibria at Elevated Temperatures and Moderate Pressures

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The design of novel equipment for the acquisition of highly accurate experimental vapour-liquid equilibrium data has largely been superseded in the last 20 years by an overwhelming expenditure of efforts in the correlation and prediction of phase equilibria [1]. This can be attributed to factors such as experimental difficulties, equipment design limitations, high costs and long time periods involved in the measurement of phase equilibria, all of which have plagued researchers over the course of the last century. The measurement of vapour-liquid equilibrium at the extremes of temperature and/or pressures indeed presents an even greater challenge as the design of the equipment must be exacting and able to withstand the rigours of the extreme operating conditions together with negating observed phenomena contributing to erroneous results, such as thermally-induced polymerization and decomposition reactions. In light of the above, a novel apparatus has been developed to allow for the measurement of accurate vapour-liquid equilibrium data for temperatures up to 600 K and pressures up to 1 MPa. The design of the equipment has been based on the successful design of the low pressure liquid and vapour condensate dynamic recirculating still of Raal [2]. The still is principally constructed from machined 316 stainless steel and features sight glasses to allow for observation of the fluid behavior in the Cottrell tube and in the liquid and vapour condensate sampling traps. Initial tests of the performance of the still has been achieved through a study of isobaric vapour-liquid equilibrium of the highly non-ideal cyclohexane-ethanol system at pressures of 40, 70 and 90 kPa, and measurements on a high temperature test system will also be presented. The results were correlated through the use of the Wilson, T-K Wilson, NRTL and UNIQUAC activity coefficient models; for which good agreement was obtained.

[1] V. Dohnal, D. Blahova, and R. Holub, Fluid Phase Equil., **9**, 187-200 (1982).
[2] J.D. Raal, and A.L. Muhlbauer, Phase Equilibria:Measurement and Computation, Taylor and Francis, Bristol PA (1998).