

High Temperature Vapour-Liquid Equilibrium Measurements of Water Alcohol Mixtures

Ana Cristino and S. Rosa

Faculdade de Ciências da Universidade de Lisboa, Departamento de Química e Bioquímica, Lisboa, Portugal

P. Morgado

Instituto Superior Técnico, Departamento de Engenharia Química e Biológica, Lisboa, Portugal

Amparo Galindo

Imperial College London, Department of Chemical Engineering, London, United Kingdom

Eduardo Filipe and António Palavra

Instituto Superior Técnico, Departamento de Engenharia Química e Biológica, Lisboa, Portugal

Carlos A. Nieto de Castro^{C, S}

Faculdade de Ciências da Universidade de Lisboa, Departamento de Química e Bioquímica, Lisboa, Portugal
cacastro@fc.ul.pt

The design of industrial processing equipment of linear alcohols, an important alternative source of energy, needs accurate VLE measurements of binary mixtures of these compounds with water at high temperatures. A flow apparatus was built to carry out these measurements at temperatures and pressures up to 573 K and 20 MPa, respectively. A flow method was chosen to avoid the thermal degradation of alcohols at high temperatures. The VLE equilibrium is achieved inside a high pressure cell made of 316SS with a sapphire window, sealed with gold O-rings. Inside this cell the temperature is measured using a calibrated Pt100 resistance thermometer with accuracy better than 0.1 K. The pressure was measured with two pressure transducers, operating up to 5 and 20 MPa, with accuracy better than $\pm 0.2\%$ FS. Furthermore, the equilibrium compositions were determined using a new method for accurately converting vibrating tube periods of oscillation in density values developed by the authors Lampreia and Nieto de Castro (2011) using an Anton Paar vibrating tube densimeter [2], with an accuracy better than 0.1%. VLE measurements for the system water-ethanol were carried out to test the quality of the data obtained with the apparatus, as accurate data are available [3, 4]. Measurements with water + n-propanol mixtures are also presented. The Statistical Associating Fluid Theory for potentials of Variable Range (SAFT-VR) [5, 6] was used to correlate the data. The molecular parameters used were taken from the work of Mac Dowell et al. [7]. The phase equilibria, has proved to be accurately described with this approach, especially considering that the parameters are being applied to a larger region of the phase diagram.

- [1]. S.C.S. Rosa, C.A. Nieto de Castro, A.M.F. Palavra, Proceedings of 4th Asian Thermophysical Properties Conference, (1995), 467-470
- [2]. I.M.S. Lampreia, C.A. Nieto de Castro, J. Chem. Thermodynamics, (2011), 43 537–545
- [3]. V. Niesen, A.M.F. Palavra, A.J. Kidnay, V.F. Yesavage, Fluid Phase Equilibria, (1986), 31, 283-298
- [4]. B. Kolbe, J. Gmehling, Fluid Phase Equilibria, (1985), 23, 213-226
- [5]. A. Gil-Villegas, A. Galindo, P.J. Whitehead, S. Mills, G. Jackson, A.N. Burgess, J. Chem. Phys., (1997), 106, 4168-4186
- [6]. A. Galindo, L. Davies, A. Gil-Villegas, G. Jackson, Mol. Phys., (1998), 93, 241-252
- [7]. N. Mac Dowell, F. Llovel, C.S. Adjiman, G. Jackson, A. Galindo, Ind. Eng. Chem. Res., (2010), 49, 1883-1899.