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# Measurement of phase equilibria of supercritical ethane and paraffins

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## Abstract

This work entails the design and development of a static variable-volume cell with the aim to measure high-pressure phase equilibria of mixtures of supercritical solvents and paraffinic hydrocarbons. The cell was used to measure the ethane–*n*-alkane phase equilibria and densities near the critical point of the mixture. Experimentally determined phase equilibria are reported for the binary mixtures of supercritical ethane with *n*-C<sub>16</sub>, *n*-C<sub>24</sub> and *n*-C<sub>28</sub> in the temperature range of 313–352 K. Several equations of state (EOS) were fitted to this data, and it was found that the Soave–Redlich–Kwong equation gives a reasonable representation of the measured phase equilibria but fails in the representation of the mixture densities—a known problem of cubic EOS. The use of the Patel–Teja EOS resulted in the smallest error in the liquid phase density representation. © 2001 Elsevier Science B.V. All rights reserved.

*Keywords:* Supercritical; Phase equilibria; Equations of state; View cell; *n*-Alkanes; Ethane

## 1. Introduction

It is believed that supercritical extraction is a viable alternative to short-path distillation, fluid–fluid extraction and crystallization, as a means of producing high molecular weight *n*-alkane fractions with low polydispersities [1,2]. The ease with which the solubilities in supercritical fluids can be manipulated, as well as the relatively low operating temperatures required for supercritical extraction, makes them attractive for the fractionation

of heat labile substances, such as paraffinic hydrocarbons. There is currently, however, a very limited amount of data available on the phase equilibria of supercritical solvents and high molecular weight *n*-alkanes that are suitable for modeling a supercritical fluid alkane fractionation process [3]. Some existing data sets are often not complete in the mixture critical region [4–8,10,11,13] whilst others are unreliable.

A variable-volume cell was, therefore, designed and developed to be used in the measurement of the high-pressure phase equilibria of supercritical solvents, such as carbon dioxide, ethane, methane and propane, with paraffinic hydrocarbons, *n*-C<sub>12</sub>, *n*-C<sub>16</sub>, *n*-C<sub>20</sub>, *n*-C<sub>24</sub>, *n*-C<sub>28</sub> and *n*-C<sub>36</sub>. The mea-

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