Volumetric Behavior of a Liquid Mixture of Pentaerythritol Tetrapentanoate and Pentaerythritol Tetra(2-Ethylhexanoate) for Broad Ranges of Temperatures and Pressures

O. Fandiño, M.J.P. Comuñas, L. Lugo, E.R. López and J. Fernández[C, S]
Laboratorio de Propiedades Termofísicas, Departamento de Física Aplicada, Facultad de Física, Universidad de Santiago de Compostela, Santiago de Compostela, Spain
fajferna@usc.es

Ester based synthetic lubricants such as phthalates, adipates, sebacates, neopentylpolyol esters and pentaerythritol tetraesters are widely used due to their excellent properties. Most of these uses are performed at medium and high pressures, but in the case of viscosity and density, the existing studies are carried out mainly at atmospheric pressure. Lubricants are normally non-pure compounds such as refrigeration oils. Hence, it is interesting to know how the pressure and the temperature affect to the volumetric properties of mixed polyol esters (POE). Several commercial POEs used in refrigeration are described as mixtures of linear- or/and branched-acid pentaerythritol esters. From this kind of commercial oils there is special interest in lubricant with viscosities around 32 cSt at 313.15 K and 0.1 MPa (ISO32). In previous works three pure pentaerythritol esters with linear chains and other with branched chains [1-3] have been studied. These compounds can be considered precursors of the commercial polyolester oils (POE). Subsequently, we have studied two mixtures of 34 cSt at 313.15 K and 0.1 MPa: one commercial POE containing several pentaerythritol esters and a mixture of pentaerythritol tetraheptanoate, PEC7, and pentaerythritol tetra(2-ethylhexanoate), PEB8 [4]. To complete these studies, in this work, the density of a mixture of pentaerythritol tetrapentanoate, PEC5, and PEB8 has been measured under pressure using a vibrating tube densimeter. The composition of the mixture was chosen in order to its viscosity was around 34 cSt (ISO 32). The measurements have been performed at nine temperatures in the range 278.15 K to 353.15 K and eleven isobars up to 45 MPa. A correction factor, due to the viscosity of the sample, was applied to the density experimental values [1-3]. The uncertainty in the measured densities is estimated to be 0.14 $kg \times m^{-3}$. The measured data have been used to study the behavior and influence of temperature, pressure and composition on the isothermal compressibility, the isobaric thermal expansion coefficient, internal pressure and the excess molar volume.

This work was carried out under the Research Projects PPQ2002-03262 and PGIDIT03PXIC20608PN.

[1] O. Fandiño, A.S. Pensado, L. Lugo, M.J.P. Comuñas, and J. Fernández, *J. Chem. Eng. Data* **50**, 939 (2005)
[2] O. Fandiño, A. S. Pensado, L. Lugo, E.R. López, and J. Fernández, *Green Chem*. **7**, 7759 (2005).
[3] O. Fandiño, J. García, M.J.P. Comuñas, E.R. López, and J. Fernández, *Ind.Eng.Chem. Res.* **45**, 1172 (2006).
[4] O. Fandiño, M.J.P. Comuñas, L. Lugo, and J. Fernández, *Proceedings of the European Symposium of Applied Thermodynamic*, Jurata, Poland, June 2005.