

Solubility of Carbon Dioxide in Pentaerythritol Ester Oils

O. Fandiño, E. R. López, L. Lugo 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*

For environmental reasons, carbon dioxide is an attractive substitute to replace the conventional refrigerants. However, the reliability and energy performances of refrigerating units require a suitable choice of lubricant. Lubricant solubility in the refrigerant is important to ensure that its circulation through the system does not deplete the lubricant in the compressor. Lack of solubility tends to deposit the lubricant permanently in other locations in the system, especially in the evaporator. Moreover, the viscosity of the oil in the compressor can be considerably reduced due the presence of dissolved refrigerant, which results in a lowered lubricity. Hence, the solubilities of CO₂ in pure oils, such as polyol esters, are needed in order to develop suitable formulations of lubricants leading optimal global efficiency of the refrigeration cycles.

In this work, the solubilities of CO₂ in pentaerythritol tetrapentanoate, PEC5, and pentaerythritol tetra(2-ethylhexanoate), PEB8, in the temperature range 283-333 K and up to 6 MPa were measured in a high-pressure gas solubility apparatus. The experimental technique is isochoric-type and it is similar to that designed by Wahlstrom and Vamling [1]. The measurement cell, made in stainless steel, is located in a liquid bath thermostat, which controls the temperature with fluctuations lower than 0.01 K. The temperature of the cell is measured using a calibrated Pt-100 resistance thermometer with an accuracy of 0.02 K. All the apparatus, which consists mainly of the measurement cell and a gas bottle of calibrated volume along with the valves and tubing, was located in a temperature chamber. The temperature is kept constant in 0.3 K inside the chamber. A digital Heise pressure transducer was used to measure the pressure of the system. The estimated accuracy of the digital pressure gauge is 0.0004 MPa.

Carbon dioxide presents high solubilities in both pentaerythritol esters in all the temperature range. The solubilities of CO₂ at 283 K in the pentaerythritol ester with branched chains, PEB8, are very similar to those found by Bobbo et al. [2] in the isomeric pentaerythritol ester of linear chains pentaerythritol octanoate, PEC8.

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

[1] A. Wahlstrom, and L. Vamling, *J. Chem. Eng. Data* **44**, 823 (1999).

[2] S. Bobbo, M. Scattolini, R. Camporese, L. Fedele, and R. Stryjek, *Proceedings of the IIR International Conference on Thermophysical Properties and Transfer Processes of Refrigerants*, Vicenza, Italy, 2005.