Viscosity and Density Measurements of R-600a + Lubricant Oil

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Isobutane (R-600a) is widely used as a refrigerant in domestic refrigerators, because of its many advantages, such as zero Ozone Depletion Potential (ODP), low Global Warming Potential (GWP), low cost, and improved cycle performance at high condensing temperatures. Refrigeration oils can vary very widely in composition and type depending on their source. The optimum lubricant for use R-600a depends mainly on the properties of the lubricant itself and lubricant–refrigerant mixture. Among the important properties of such mixtures are the solubility, viscosity, vapor–liquid equilibria (VLE), density, and thermal conductivity as a function of temperature.[1] In the compressors, the viscosity of the lubricant is strongly affected by the presence of dissolved refrigerant, because of the large difference of viscosity between the pure oil and liquid refrigerant. Even small amounts of refrigerant dissolved in the oil may reduce compressor lubrication, giving rise to a potential breakdown in the compressor. Hence, the viscosity of refrigerant–lubricant mixtures is the important factors in determining their suitability for specific applications. Despite the abundant literature on the viscosity of pure refrigerants, there is a lack of studies dealing specifically with refrigerant–lubricant mixtures. Moreover, there is an urgent need to develop adequate correlations of the viscosity as a function of refrigerant composition and temperature. The objective of the present work is to determine experimentally the viscosity and density of a mixture of R-600a and Polyol ester (POE). A vibrating-wire instrument operated in the forced mode of oscillation was used to measure the viscosity and density simultaneously. The measurements were carried out over the temperature range from 243 to 343 K at saturated pressures, covering the entire composition range. The overall uncertainties of the present results are ±2.0 % in viscosity and ±0.2 % in density.

[1] Marsh, K. N.; Kandil, M. E. Review of thermodynamic properties of refrigerants + lubricant oils. *Fluid Phase Equilibria* **2002,** 199, 319-334.