Density Measurements of n-Pentane and n-Decane and Solubility Measurements of Propane in n-Pentane and n-Decane

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Oil-injected rotary-type positive displacement compressors are mainly used for the compression of refrigerants in heating, ventilation, and air conditioning systems. The efficiency of such machines is primarily determined by the inevitable two-phase surge and gap flows in these types of compressors. The complexity of simulating the two-phase flow in the narrow gaps with moving boundaries and the need for accurate models for the thermophysical properties of the highly asymmetric fluid mixtures of oil and refrigerant limit further development. For most of these mixtures, there is virtually no experimental data available in the literature, as reliable measurements are highly demanding. The few existing experimental studies are usually unsystematic, uncomprehensive, and often associated with incomplete or missing uncertainty statements. However, a reliable data basis is needed to accurately model the thermophysical properties of oil-refrigerant mixtures. Against this background, we present density of two surrogate oils, *n*-pentane and *n*-decane, and solubility measurements of the natural refrigerant propane in the given alkanes. These only slightly asymmetric mixtures build the starting point of a comprehensive study towards more asymmetric mixtures. Density measurements cover a temperature range from 273 K to 423 K with pressures up to 100 MPa utilizing commercially available vibrating tube densimetry in combination with advanced data analysis models. The expanded combined uncertainty ($k = 2$) is estimated to be 1.5 kg/m³ in density. The solubility of propane in the two oil surrogates was measured over a temperature range of 273 K to 373 K at pressures up to 8 MPa. The measurements were carried out using a custom-made Raman spectroscopy setup with a novel postprocessing routine to determine the solubility data from the optical measurements. The data will be used within the DFG-funded Research Unit "Archimedes" for thermodynamic property modeling.