Liquid–Liquid Equilibrium for Ternary Systems Containing Ethyl Esters, Ethanol and glycerol at 323.15 and 353.15 K

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Ethanolysis (transesterification) is the chemical reaction between triglycerides and ethanol in the presence of a catalyst to produce as final products fatty acid ethyl esters (FAEEs) and glycerol. The final products can be considered as pseudo-ternary mixture of FAEEs, glycerol, and ethanol, which form two liquid phases after the completion of the reaction: the glycerin–rich–phase and ethyl esters–rich–phase. The ethanol in excess is distributed between both phases that then can be separated by decantation. The knowledge of the phase behavior of this system is required in order to explore the operating conditions for optimizing the purification process during the production of biodiesel. The objective of this work was to measure and to correlate the liquid–liquid equilibrium for systems containing: ethyl linoleate/ethyl oleate/ethyl palmitate/ethyl laurate + ethanol + glycerol at 323.15 and 333.15 K. The experimental setup includes an equilibrium cell kept at the desired temperature (uncertainty of 0.1K). Equilibrium compositions were determined by HPLC. The type A standard uncertainties of the equilibrium compositions ranged from (0.05 to 0.88) % by mass for ethyl esters, (0.03 to 0.37) % for ethanol and (0.02 to 0.33) % for glycerol, with the lowest figures associated with the lowest mass fractions within the composition range investigated. The experimental data was successfully modeled with the Cubic–Plus–Association Equation of State (CPA–EoS), with global average deviations of 3 % for all the systems here considered, using temperature independent interaction parameters correlated from binary data. Hence, it can be applied to explore the operating conditions and design of equipments in the separation processes used for biodiesel purification.

Supported by FAPESP (08/56258–8), CNPq (304495/2010-7+480992/2009–6), CAPES and Fundação para a Ciência e a Tecnologia (SFRH/BD/29062/2006).