Alternative Antiknocking Liquid Biofuels: Thermodynamic Properties of the Ternary Mixture ETBE + Toluene + Heptane at 313.15 K

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New automotive biofuels, such as ethanol (vegetal origin) and fatty acids methyl ester (vegetal or animal origin) are added up to a maximum of 5 % to conventional gasolines and Diesel oils that causes a change in the fuel properties. Development of renewable fuels needs both knowledge of new thermodynamic data and improvement of clean energy technologies. Last generation experimental high accuracy measuring techniques available in our laboratory will be used. From this, relations will be derived for a PVT-equation of state, vapour pressure and liquid and vapour compositions, and the thermodynamic functions Gibbs energy, enthalpy, entropy, and isobaric heat capacity of new binary and ternary mixtures of new renewable additives in key hydrocarbon environments of the oil derived fuels over wide pressure and temperature ranges.

Several years ago, our group undertook an extended research program on oxygenate additives in gasolines [1]. Now we focus on oxygenated additives of renewable origin: ethanol and its derived ethers ethyl terbuty ether (ETBE) and teramyl ethyl ether (TAEE). The basic gasoline, to which oxygenated additives will be added, consists of the following hydrocarbons: Paraffins: n-pentane and n-heptane; Isoparaffins: isopentane and isooctane; Cicloparaffins: cyclohexane; Oleffins: 1-hexene; Aromatics: 1,2,3 trimethyl benzene and toluene.

This work reports experimental isothermal P-x-y data for the ternary system ETBE toluene heptane and the binary systems involved at 313.15 K. An isothermal total pressure cell has been employed for measuring the vapour-liquid equilibrium of binary and ternary mixtures. Data reduction by Barker's method provides correlations for GE, using a five-parameter Margules equation for the binary systems and the Wohl expansion for the ternary. Wilson, NRTL, and UNIQUAC models have been applied successfully to both the binary and the ternary systems presented here.

[1] C.R. Chamorro, M.A. Villamañán, M.C. Martín, and J.J. Segovia, *Fluid Phase Equilib.* **220**, 105 (2004).