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Density and viscosity of glycerol acetates + CO_2 mixtures at high pressure

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ABSTRACT

Glycerol acetates are high-added value glycerol derived biosurfactants that find applications in different industrial sectors. Previous studies show the supercritical CO_2 technology has a great potential for the fractionation of these highly viscous and non-volatile products (mono, di, and triacetyl glycerol) according to the quality standards of the food and cosmeceutical sectors. A proper design of fractionation columns requires a robust thermodynamic model for phase equilibrium and PVT predictions, as well as of proper correlations for physical properties like viscosity to carry out a good assessment of the mass transfer problems to estimate the height of theoretical stages. Physiochemical properties of these multicomponent mixtures are difficult to predict due to the complex nature of the system. Thus, in this work, we determine experimentally the density and viscosity of CO_2 saturated glycerol acetates mixtures at different pressures (30 bar to 150 bar), temperatures (25 °C to 50 °C) and CO_2 concentrations (30 mol % to 70 mol %). Operating conditions were selected based on phase equilibrium predictions with the GCA-EOS of a high-pressure fractionation column. First, a variable volume equilibrium cell is used to measure bubble points and saturated liquid molar volumes of glycerol acetates + CO_2 mixtures. Thereafter, a high-pressure falling ball type viscometer is used to determine the dynamic viscosity of saturated liquid mixtures in the same range of pressure, temperature and CO_2 concentrations. As expected, temperature and CO_2 concentration has a significant effect on both density and viscosity measurements. The measured molar volumes are between 70 cm^3/mol and 130 cm^3/mol, while the viscosities are between 5 mPa.s and 20 mPa.S, according to CO_2 concentration and temperature.

Keywords: glycerol acetates, fractionation, CO_2, density, viscosity, biosurfactants