Temperature and Pressure Effect on PEG 1500-Supercritical CO_2 Phase Equilibria

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Polyethyleneglycols (PEGs) are water-soluble polymers widely used in cosmetics and pharmaceutics.

Solubility measurements of PEG 1500 in supercritical carbon dioxide were performed by means of a laboratory scale SCF extractor operating under dynamic conditions at low flux ($4.5\ 10^{-3}$ mol/min). After gas expansion, dissolved PEG 1500 was collected in water and quantified by RI-HPLC.

A gravimetric method was used to measure the solubility of supercritical carbon dioxide in PEG 1500. The polymer was placed in a magnetically stirred vessel and the carbon dioxide was pumped in at the fixed temperature and pressure. Once the equilibrium was reached, the amount of carbon dioxide dissolved in the polymer was calculated from the weight gain of the sealed vessel taking into account the volume of the vessel, the carbon dioxide density at the selected pressure/temperature and the polymer true density.

Solubility values were measured at two temperatures (308 and 328 K) and in a 10-30 MPa pressure range.

At 308 K PEG 1500 solubility data were in the range of $2.5\ 10^{-8}$ and $8.5\ 10^{-6}$ mole fraction, while at 328 K the solubility values were between 10^{-9} and $3.8\ 10^{-6}$. The solubility increased with the pressure and decreased with temperature due to the different values of carbon dioxide density. This last was calculated according to Peng-Robinson EOS [1]. For each carbon dioxide density the relevant solubility parameter was calculated according to the approach proposed by Giddings and Coworkers [2]. The log of PEG 1500 mole fraction dissolved in supercritical carbon dioxide was reported vs. the carbon dioxide solubility parameter. The obtained data were satisfactory fitted with the parabolic expression reported by Giddings et al. [3].

The concentration of the carbon dioxide in the polymeric phase was within 10-30 percent w/w, indicating high affinity of carbon dioxide for PEG 1500.

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[3] J.J. Czubryt, M.N. Myers and J.C. Giddings, *J. Phys. Chem.* **74**, 24 (1970).