Supercritical carbon dioxide extraction processes development

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In supercritical CO₂ extraction process, there are two essential steps: the extraction step in the extractor where the SC-CO₂ allows the solvent removal from product structure and the separation step which consists of the separation of CO₂-solvents in a cascade of cyclone separators downstream the extractor. Cyclone separators are separation devices that use the centrifugal and gravity forces to remove liquid phase from flue gases. Two supercritical extraction processes are studied here: organogels supercritical drying for aerogels production and supercritical extraction of polar compounds from natural products. Concerning the first process, the organogel is prepared by an aminoacid-type organogelator with aromatic solvents such as tetralin or toluene. The experimental results showed a good solvent recovery rate in the case of tetralin, exceeding 90% but an unsatisfactory separation for toluene with a yield below 65%. In order to understand the experimental results, a thermodynamic study and a hydrodynamic study (CFD) of the mixture separation in the cyclones are carried out. Supercritical extraction of polar compounds from natural products using a CO₂ + aqueous ethanol mixture as solvent requires a reliable knowledge of vapor-liquid equilibria of the carbon dioxide + ethanol + water system in order to size and optimize the extraction process. The purpose of this study is to select an appropriate thermodynamic model among the ones available in commercial process simulators for representing the phase behaviour of the system of interest. This study highlighted that the optimal thermodynamic models for the application of interest have to be chosen among the VTPR, PSRK and MHV2-UNIFAC EoS. Once identified a suitable thermodynamic model for the CO₂ + ethanol + water ternary system, it has been possible then to simulate the extraction process of polar compounds from natural products and to discuss how water influences the process efficiency.

![Figure 1: Simplified scheme of supercritical extraction](image)

Biography

Danielle Barth contributes to develop Supercritical carbon dioxide processes (continuous and batch extraction, prep-scale supercritical fluid chromatography, drying, dying, VOC desorption, Chemical reactions (like Staudinger Aza-Wittig), Enzymatic reactions (with lipase) at pilot-scale and laboratory-scale since thirty years.

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