Design of processes using supercritical fluids

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There is an essential need for processes intensification due to the design of new products with special characteristics or to design new processes, which are environmentally friendly and sustainable.
Data on the operating parameters such as the type and quantity of the solvent, the recirculation rate and energy consumption should be considered in order to design a feasible process. Literature provides these information, which can be obtained from phase equilibrium and mass transfer measurements, mostly for the processes and reactions performed at ambient pressures. Since the trend is shifted towards applications performed at elevated pressures, several parameters influencing solubility, mass transfer of target compounds in the SCF, and consequently extraction yield have to be considered prior to choosing the suitable processing solvent and process parameters should be determined at conditions pertinent to the process. Extract quality depends on processing pressure and temperature which can seriously influence the composition of the final extracts. In addition, pressure drop effect has to be evaluated and taken into account when optimizing parameters to obtain the best ratio between yield and solvent amount and extraction time. There is an additional requirement, namely, highest possible loading of SC solvent should be achieved in extraction step of the processes, while in separation step of the process the solubility of solute in solvent should be the lowest.
The practical analyses shall verify if extraction using supercritical fluid is the suitable technique for the isolation of the target compound thus high solubility of compound of interest in the supercritical solvent is essential for the economy of extraction process.
When in a certain reaction system SCFs are applied as a reaction media, the particular thermodynamic and transport data have to be considered. Investigations of basic thermodynamic and transport data like phase equilibria, density, viscosity, dielectric constant and diffusion coefficients are fundamental for process design. These parameters should be determined experimentally in order to fit the model to experimental data. Data on behavior of multicomponent systems at elevated pressures and temperatures are still relatively scarce and comprise methods that are either expensive either time consuming.
Specific interest should be dedicated to the fact that thermodynamic and transport properties are associated with heat and fluid flow characteristics. Consequently, the thermodynamic properties of multicomponent mixtures and their analysis in terms of interpretative models constitute a very interesting subject, essential for design and set up of industrial processes which continue to drive research in the study of multicomponent systems. Viscosity and interfacial tension of systems containing supercritical fluid are among the most influential parameters on fluid behavior.
The lecture is focused on thermodynamic and mass transfer fundamentals of some processes using sub or supercritical fluids with different gasses like propane, argon, chlorinated hydrocarbons, sulfur hexafluoride and carbon dioxide.