MINIMIZING ENERGY REQUIREMENTS FOR POLYMER PROCESSING BY USING SUPERCRITICAL FLUIDS

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Abstract

Supercritical fluid-based technology has been largely proposed to produce materials with nanostructural properties. Namely, classical methods that use environmentally hazardous volatile organic solvents and chlorofluorocarbons for processing and synthesis of polymers are undesired due to the enormous increment of volatile organic solvents and chlorofluorocarbons emissions and also generation of aqueous waste streams. As carbon dioxide is quite soluble in many polymers, it can be used as a solvent or plasticizer. Dissolved CO₂ causes a considerable reduction in the viscosity of the molten polymer, a very important property for the applications like polymer modification, formation of polymer composites, polymer blending, microcellular foaming, particle production and polymerization. Properties of the obtained powder product like particle size, size distribution and morphology depend on phase equilibria and thermodynamic behaviour of the system, fluid dynamics, mass transfer and nucleation-growth kinetic. Phase equilibria and reaction kinetics, verification of process steps and design of process sequences to produce a product (energy) from raw materials are the main hindrances concerning SCF applications. Detailed investigations on the basic thermodynamic and transport data like phase equilibria, density, viscosity, dielectric constant and diffusion coefficient have to be carried out to obtain the data fundamental for the design of a process in order to fulfil consumer and economic requirements. One of the main industrial challenges is the adoption of sustainable technologies, development and scaling up of processes from an approach mainly focused on the performance towards a global comprehensive approach of the production process.