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Phase Equilibrium Engineering: Chapter 11. Phase Equilibrium Engineering Principles in Reactive Systems (Supercritical Fluid Science and Technology)

Esteban Brignole, Selva Pereda

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The benefits of using SCF as reaction media have promoted an intense research and development activity in this field. In this chapter, several case studies demonstrate the advantages of working under supercritical conditions. In particular, gas–liquid catalyzed reactions are one of the areas where the use of supercritical fluids is very attractive. In general, these reactions are diffusion-controlled and the use of supercritical fluids increases the reaction rate by eliminating the gas–liquid interface. In this chapter also, the interesting properties of operation under near-critical conditions are analyzed: higher solubility of reactants and products in the supercritical phase, reduced deposition of reacting components on the catalyst pores, diffusion coefficients higher than in liquids, independent control of the concentration of permanent gases like H2, O2, or CO in the reaction mixture, higher thermal capacity, and low interfacial tension The hydrogenation of low volatile liquids, using solid–fluid heterogeneous catalysts, is presented to show the advantages of working under supercritical conditions. In this case study, the selection of the process conditions that guarantees operation under a supercritical single-phase state is discussed as a typical phase equilibrium engineering problem. Finally, for reactions in which the SCF plays a role not only as solvent but also as a reactant, the problem of phase condition design and cosolvent selection is addressed.

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