



# Phase Equilibrium Engineering: Chapter 6. Phase Equilibrium Engineering Principles (Supercritical Fluid Science and Technology)

*Esteban Brignole, Selva Pereda*

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In this chapter, the basic methodologies of phase equilibrium engineering are introduced through the systematic analysis of several case studies. Some of the thermodynamic tools that have been presented in the previous chapters are applied to illustrate how the phase and conceptual process design of complex engineering problems can be tackled from a phase equilibrium engineering approach. In all the case studies, the first step is to consider in great detail the properties of the process feed, the components, their physical properties, concentrations, and molecular interactions. This information is then used for the selection of thermodynamic models, a suitable technology, pressure, temperature, and compositional operating boundaries. It is shown how the mixture composition and the process goals and specifications determine the process scheme and the unit thermodynamic sensitivity. In addition, the importance of the mixture composition is highlighted in combination with the energy and material balance in the case study for the selection of the desirable natural gas cryogenic technologies. The use of a pressure versus temperature drawing board is used to plot the process trajectory and the mixture phase envelopes from the initial conditions to the key phase engineering design problem. Moreover, the phase design provides also a sound basis for the process initial specification and computer simulation. As another example of phase equilibrium engineering, the heat integration in a complex process is solved by the application of the Gibbs phase rule to the LLV equilibria of a ternary mixture.

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