What every Chemical Engineer needs to know

Engineering calculations, processes and process variables, process data and analysis, material and energy balances, single- and multi-phase systems, non-reactive and reactive processes, steady-state and transient processes, computational techniques, physical properties and their correlations. I learned this solely from *Elementary Principles of Chemical Processes* by Richard M. Felder and Ronald W. Rousseau. It’s at the top of the ChE’s best seller list.

Fluid statics and dynamics, laminar or turbulent flow, gravity flow, non-compressible or compressible flow, choked flow, viscosity, rheology, Newtonian or non-Newtonian fluid, power law fluids, pumps and pumping, compressors, pipe, valves, and fittings. I learned these things from several sources, namely:

* *Flow of Fluids through Valves, Fittings and Pipe*, Crane Technical Paper No. 410 by Crane Company.
* *More Solutions to Sticky Problems* by Brookfield Engineering Labs, Inc.
* *Designing for Non-Newtonian Fluids* a series of articles in Chemical Engineering magazine by M. H. Wohl dated Jan. 15, Feb. 12, March 25, April 8, May 6, and June 3, 1968.

Heat transfer, heaters, coolers, chillers, partial and total condensers, calandrias or reboilers, vaporizers, superheaters evaporators, and crystallizers. I learned most taking a graduate level course, but my most frequent reference is *Process Heat Transfer* by Donald Q. Kern.

Mass transfer and its applications, thermodynamics, phase equilibrium, distillation, leaching and extraction, gas absorption, humidification, drying, crystallization, mixing, and mechanical separations. I learned these subjects, as well as many other subjects, in *Unit Operations of Chemical Engineers* by Warren L. McCabe and Julian C. Smith.

Reaction systems, reaction kinetics, and design of reactors is what sets ChE’s apart from all the others. I learned these subjects from:

*Elements of Chemical Reaction Engineering* by H. Scott Fogler.

*Chemical Reaction Engineering* by Octave Levenspiel.

While not taught formally in college in my day, ChE’s size a lot of relief devices for equipment. Things like safety relief valves and rupture disks. Most of my training in this came from within my companies, but there are references available such as API 2000, API 520 Parts I and II, API 521, and ASME Pressure Vessel Code, and ASME B31.3 Process Piping.

Last, but not least, every ChE needs *Perry’s Chemical Engineers’ Handbook* by their side. It covers all the topics above and a lot more.