

Development of chemical engineering

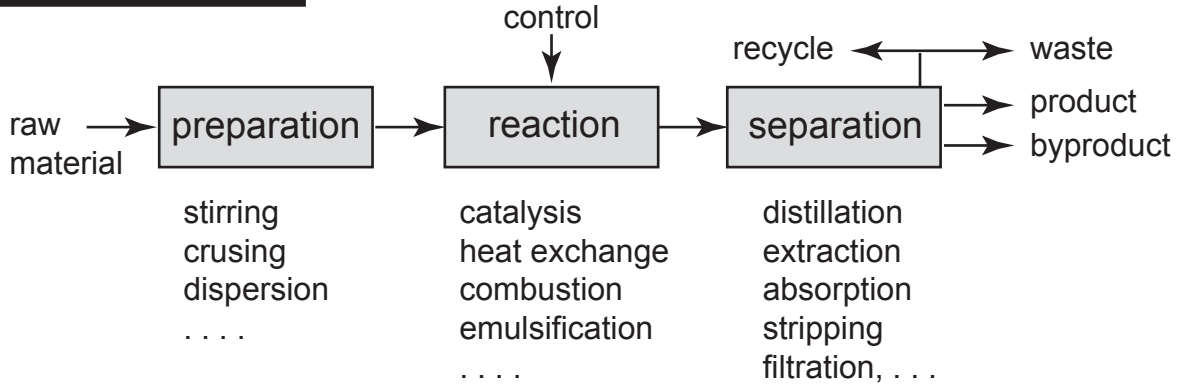
1900

a. industrial chemistry



1925

b. unit operations



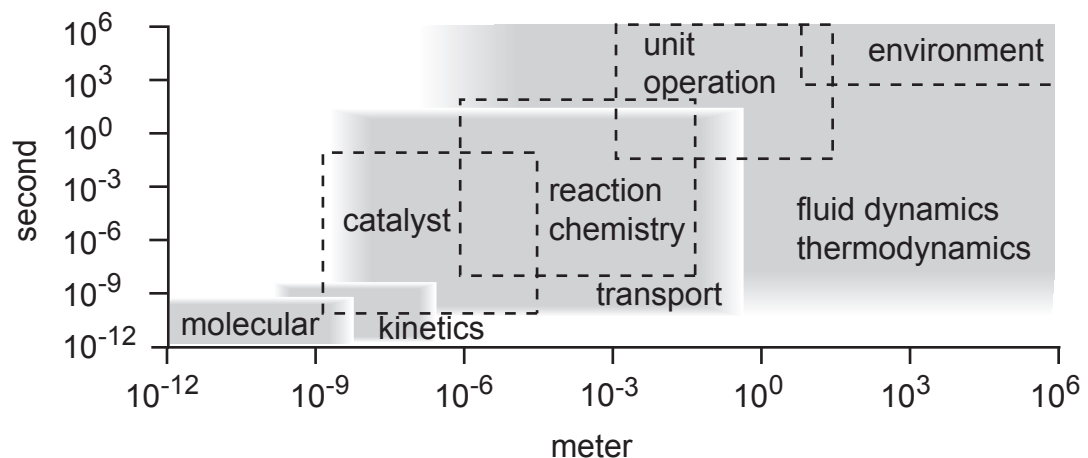
1950

c. chemical engineering science

thermodynamics	fluid dynamics	kinetics	control	computation
phase equilibria mass transfer transport coefficient microstructures	mass transport momentum tran energy transpor multiphase nonlinear dynan	catalyst reaction surface rate process	measurme feedback optimization	simulation ▶ analysis ▶ CFD ▶ CAD ▶ CIM ▶

1975

d. chemical systems engineering



2000

Evolution of chemical engineering with crude timeline: (a) Industrial chemistry treats detailed operations of individual chemical processes separately. (b) Chemical engineering considers not individual but typical processes, which is analyzed into stages, each with general types of possible units operations. (c) Engineering sciences fathom the physiochemical mechanisms that underlie unit operations. (d) Process systems engineering integrates phenomena in many scales and levels for comprehensive design of chemical processes.