Plantwide Control of Chemical Processes - Web course

COURSE OUTLINE

This course addresses the dynamic modeling, simulation and plant-wide control of complex chemical processes with material and energy recycle using commercial process simulators (Aspen Plus and Hysys).

The steps necessary in moving from steady state to dynamic simulation are presented in detail.

These include proper equipment sizing, correct plumbing, developing a basic regulatory control structure and proper tuning of the control loops.

Dynamic simulation and control of common unit operations such as reactors, distillation columns and multi-unit operations such as heterogenous azeotropic distillation is covered first followed by elaborate case-studies on complex plant-wide processes.

The material effectively complements the video counterpart of this course.

Contents:

Essentials:

Proper plumbing and equipment sizing for moving to dynamics, tuning controllers.

Single Unit Dynamic Simulations:

Tank, CSTR, cooled packed bed reactor, simple distillation. column.

Multi-unit Dynamic Simulations:

Heat integrated distillation columns, heterogenous, azeotropic distillation, reactive distillation.

Complex Plant-wide Case-studies:

Recycle process with side reaction, hydro-dealkylation process, cumene process.

COURSE DETAIL

S.No	Topics	No. of Hours
Essentials for Smooth Transition from Steady State to Dynamics		
1	Flow-driven vs pressure driven dynamic simulations. **Equipment sizing:** Surge tanks, distillation columns, heat exchangers. **Plumbing guidelines:** Liquid pumping systems, gas compression systems.Control valve and pump sizing.	2

NP-TEL

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Chemical Engineering

Pre-requisites:

UG level course on process control.

Coordinators:

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2	**PID Controllers:** Direct/reverse action, manual/automatic/cascade mode, tuning for typical flow, level and pressure loops. **Systematic tuning:** relay feedback and step test.	1
Dynamic Simulation and Control of Single Unit Systems		
1	Simple tank process.	1
2	**CSTR:** Steady state and dynamic model equations and their solution, typical control structure, Matlab case study, Aspen Plus and Hysys case study.	3
3	**Cooled packed bed reactor:** Steady state and dynamic model equations and their solution, typical control structure, Matlab case study, Aspen Plus and Hysys case study.	4
4	**Simple distillation column:** Steady state and dynamic model equations and their solution, single ended vs dual-ended temperature inferential control, control tray selection using steady state sensitivity/SVD analysis, steady state disturbance rejection evaluation using flexibility in specifications, Aspen Plus and Hysys case study.	6
Dynamic Simulation and Control of Multi-Unit Systems		
1	**Heat-integrated distillation system:** Control structure design using steady state analyses, dynamic control performance evaluation in Hysys.	2
2	**Heterogenous azeotropic distillation:** Example process, temperature inferential control structure design using steady state analyses and dynamic control performance evaluation in Aspen Plus.	3
3	**Reactive distillation:** The methyl acetate RD column, example control structure, steady state and dynamic simulation in Aspen plus.	3
Case-studies on Plant-wide Control of Complex Plants		
1	**Recycle process with side reaction:** Base case, alternative regulatory control structures,	6

	dynamic simulation in Hysys. Linking Hysys with Matlab. Steady state operating conditions for maximum operating profit using optimizer in Matlab.	
2	**Hydrodealkylation process:** Base case design, plant-wide control structure, dynamic simulation in Hysys and Aspen Plus.	6
3	**Cumene alkylation process:** Base case design, plant-wide control structure, dynamic simulation in Hysys.	4
	Total	41

References:

Luyben, W.L., Tyreus, B.D. and Luyben, M.L. (1998) Plantwide Process Control.McGraw Hill: New York.