Process Integration - Video course

COURSE OUTLINE

Process integration, a part of Process Intensification, is a fairly new term that emerged in 80's and has been extensively used in the 90's to describe certain systems oriented activities related primarily to process design.

It has incorrectly been interpreted as Heat Integration by a lot of people, probably caused by the fact that Heat Recovery studies inspired by Pinch Concept initiated the field and is still core elements of Process Integration.

It appears to be a rather dynamic field, with new method and application areas emerging constantly.

The Process Integration is defined as "systematic and general methods for designing integrated production systems, ranging from individual processes to total sites, with special emphasis on the efficient use of energy and reducing environmental effects".

This definition brings Process Integration very close to Process Synthesis, which is another systems oriented technology. Process Integration and synthesis belongs to process systems engineering.

Process Integration has evolved from a heat recovery methodology in the 80's to become what a number of leading industrial companies in 90's regarded as a "major strategic design and planning technology".

With this technology, it is possible to significantly reduce the operating cost of existing plants, while new processes often can be designed with reduction in both investment cost and operating cost.

Contents:

Introduction to process integration, role of thermodynamics in process design, targeting of energy, area, number of units, and cost, super targeting, concept of pinch technology and its application.

Heat exchanger networks analysis, Maximum Energy Recovery (MER) networks for multiple utilities and multiple

NP-TEL

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Chemical Engineering

Pre-requisites:

Knowledge of basic process design of process equipment.

Coordinators:

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pinches, design of heat exchanger network.

Heat integrated distillation columns, evaporators, dryers, and reactors.

Waste and waste water minimisation, flue gas emission targeting, heat and power integration. Case studies.

COURSE DETAIL

S.No	Topics	No. of Hours
1	Introduction to process Intensification and Process Integration(PI). Areas of application and techniques available for PI, onion diagram.	2
2	**Pinch Technology-an overview:** Introduction, Basic concepts, How it is different from energy auditing, Roles of thermodynamic laws, problems addressed by Pinch Technology.	2
3	**Key steps of Pinch Technology:** Concept of ΔT_{min} , Data Extraction, Targeting, Designing, Optimization-Supertargeting	1
4	**Basic Elements of Pinch Technology:** Grid Diagram, Composite curve, Problem Table Algorithm, Grand Composite Curve.	2
5	**Targeting of Heat Exchanger Network:** Energy Targeting, Area Targeting, Number of units targeting, Shell Targeting and Cost targeting.	4
6	**Designing of HEN:** 1. Pinch Design Methods, Heuristic	10

	rules, stream splitting, design of maximum energy recovery(MER). 2. Use of multiple utilities and concept of utility pinches, Design for multiple utilities pinches, Concept of threshold problems and design strategy. 3. Network evolution and evaluation-identification of loops and paths, loop breaking and path relaxation.	
7	Design tools to achieve targets, Driving force plot, remaining problem analysis, diverse pinch concepts, MCp ratio heuristics.	2
8	Targeting and designing of HENs with different ΔTmin values, Variation of cost of utility, fixed cost, TAC, number of shells and total area with ΔTmin Capital-Energy trade-offs.	3
	1. Process modifications-Plus/Minus principles, Heat Engines and appropriate placement of heat engines relative to pinch. 2. Heat pumps, Appropriate placement of heat pumps relative to pinch. 3. Steam Rankin Cycle design, Gas turbine cycle design, Integration of Steam and Gas turbine with process. 4. Refrigeration systems, Stand alone and integrated evaporators. 5. Heat integrations and proper placement of Reactors for batch Processes as well as continuous processes.	9
9	Retrofit of distillation systems.	3
10	Case studies	2
	Total	40

References:

1. Shenoy U. V.; "Heat Exchanger Network Synthesis", Gulf Publishing company.

2. Smith R.; "Chemical Process Design", McGraw-Hill .

3. Linnhoff B., Townsend D. W., Boland D, Hewitt G. F., Thomas B. E. A., Guy A. R., and Marsland R. H.; "A User Guide on Process Integration for the Efficient Uses of Energy", Inst. Of Chemical Engineers .