ChE-340

The engineering of chemical reactions

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Cursus	Sem.	Type
Chemical Engineering	BA6	Obl.
HES - CGC	E	Obl.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course applies concepts from chemical kinetics and mass and energy balances to address chemical reaction engineering problems, with a focus on industrial applications. Students develop the ability to analyze and design chemical reactors of industrial importance.

Content

1. Introduction
Profile of Chemical Industry
Chemical Processes
Basics of Chemical Reaction Engineering
Chemical reactions, mole balance equations
Ideal chemical reactors

2. Reaction kinetics and Rate Laws
Reactant conversion in closed and open systems
Influence of expansion Basic rate laws-formal reaction kinetics
Transformation in closed and open systems
Determination of reaction kinetics
Quasi steady state assumption for complex reaction systems
Homogeneous catalysis / enzyme kinetics

3. Isothermal Reactor Design-Simple reactions
Batchwise operated stirred tank reactor (BR)
Continuous stirred tank reactor (CSTR)
Plug flow reactor (PFR)
Cascade of CSTR
Combination of PFR and CSTR
PFR with recycling
Semi batch stirred tank reactor

4. Isothermal Reactor Design-Multiple reactions
Introduction
Parallel reactions, one reactant
Parallel reactions several reactants
- semi-batch reactors
- cross flow reactors
Consecutive reactions
Consecuttive competing reactions

5. Nonisothermal Reactor Design

Batchwise operated stirred tank reactors
introduction, energy balance
adiabatic reactors
reactor with heat exchange, zero order (Semenov criteria)
- time to maximum rate
- reactor with heat exchange, isoperibolic reactors (n>0)
reactor stability, parametric sensitivity, reactor run-away (n>0)
semi-batch reactors for highly exothermic reactions
Plug-flow reactors
Continuous stirred tank reactors

Learning Prerequisites

Required courses

- Introduction to Chemical Engineering (ChE-201),
- Introduction to Transport Phenomena (ChE-204),
- Chemical Thermodynamics (CH-241),
- Chemical Kinetics (CH-342)

Learning Outcomes

By the end of the course, the student must be able to:

- Compute reactor size for required conversion
- Compute reactor space time
- Compare perforace of different reactors
- Assess / Evaluate effect of concentration and temperature on reactor performance
- Design reactors for stable operation
- Design reactors for high product yield and selectivity

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Give feedback (critique) in an appropriate fashion.
- Demonstrate a capacity for creativity.
- Access and evaluate appropriate sources of information.
- Make an oral presentation.

Teaching methods

Powerpoint lectures
Clicker questions during lecture
Example and team exercises
Practice homework problems

Assessment methods

Course Project: 25%
Mid-term: 25%
Final Exam: 50%

Resources

Bibliography

- Elements of chemical reaction engineering / Fogler
- Chemical reaction engineering / Levenspiel
- Chemical reactor design and operation / Esterterp et al.

Ressources en bibliothèque

- Elements of chemical reaction engineering / Fogler
- Chemical reactor design and operation / Westerterp
- Chemical reaction engineering / Levenspiel

Notes/Handbook

copy of the presented slides
copy of exercises and solutions

Moodle Link

- https://go.epfl.ch/ChE-340