Elective Lecture

Module number	**Credits**	**Workload**	**Term**	**Frequency**	**Duration**
	5 CP	180 h	1. Sem.	only WS	1 Semester
Courses			**Contact hours**	**Self-Study**	**Group size**
Industrial Chemistry II: Chemical Reaction Engineering			a) 2 SWS b) 1 SWS	105 h	All students choosing Industrial Chemistry

Prerequisites

Solid knowledge of basics in Industrial Chemistry and Physical Chemistry

Learning outcomes

- Students acquire advanced knowledge about reactors used in chemical industry. They can apply mathematical models to describe ideal reactors und will know reasons of deviations from ideal behavior and know basic models for description of non-ideal reactors. In addition, students can apply thermodynamic and kinetic tools in the analysis of reactions and are able to evaluate consequences of transport limitations on overall reaction rates and are able to select appropriate counteractive measures.
- Soft skills: interactive presentation in front of an audience, notetaking during lectures, unsolicited post-preparation of module contents, unsolicited consultation of the relevant literature

Content

1. Basics of chemical reaction engineering: terms and definitions
2. Stoichiometry and thermodynamics: stoichiometric balance and chemical conversion, calculation of reaction enthalpy under reaction conditions, chemical equilibrium, definition of equilibrium constants in diluted and concentrated systems, Michaelis-Menten-Kinetik
3. Kinetics of chemical reactions: volume-constant reactions in ideal reactors, kinetics of multiple homogeneous reactions (first Damköhler number, polymerization, Michaelis-Menten-kinetics), kinetics of heterogeneous reactions (catalysis, steps, Langmuir isotherm, competitive adsorption, monomolecular and bimolecular reactions, Langmuir-Hinshelwood-, Eley-Rideal-, Hougen-Watson rate laws, Bodenstein principle, rate-limiting step, most abundant surface intermediate, mass transport in heterogeneous reactions
4. Combination of mass and heat transfer: kinetics of heterogeneous reactions limited by surface reaction or transfer processes, reaction through liquid/liquid interface, effectiveness factors, consecutive model in heterogeneous catalysis (second Damköhler number) and in reaction through liquid/liquid interface, parallel approach in heterogeneous reactions (Thiele modulus) and in reactions through liquid/liquid interface (Hatta number), especially for catalytic reactions (generalized Thiele modulus, criteria for limitation of mass transfer - Weisz modulus, mass transfer and overall kinetics, combining of reaction and heat transfer - Prater number)
5. Reactors in chemical industry (overview): ideal reactors (types, calculation of conversion, residence time distribution, cascade of CSTRs, complex reactions in CSTR, PFR, selectivity, non-isothermal reactions, instability), non-ideal reactors (residence time distribution, dispersion model, CSTRs-in-series model, segregation, time of mixing, influence of segregation on kinetics)
6. Modelling of real reactors, selectivity in parallel and consecutive reaction networks
7. Non-steady state reactor operation: transition behavior of a CSTR, transient experiments

Teaching methods

a) Lecture; b) Exercises

Mode of assessment

30 min end-of-term oral exam

Requirement for the award of credit points

Passing the oral exam

Module applicability Master of Chemistry, focal point Industrial Chemistry
Weight of the mark for the final score Weighted according to CPs
Module coordinator and lecturer(s) M. Muhler, B. Mei
Further information All documents are provided via *moodle*