In-depth Practical

Module number	Credits	Workload	Term	Frequency	Duration
	8 CP	240 h	1. Sem.	only WS	1 Semester

Courses	Contact hours	Self-Study	Group size
Reaction Engineering of Heterogeneously Catalyzed Reactions	a) 8 SWS b) 1 SWS	105 h	Max. 8 participants

Prerequisites

Solid knowledge of basics in *Chemical Reaction Engineering*, *Heterogeneous Catalysis*, Physical Chemistry, and in Industrial Chemistry

Learning/Course Objectives:

Advanced knowledge in basic fields of chemical reaction engineering, which are important for heterogeneously catalyzed reactions: ignition/quenching behavior and stability, reaction limitation by external and internal mass transfer, influence of mixing on conversion. After the course students are familiar with procedures used for the analysis of kinetics of heterogeneously catalyzed reactions (operation of a challenging flow set-up with on-line analysis, test for transfer limitations, collection of kinetic data, data processing).

Soft skills: teamwork and collaboration while carrying out experiments, graphical presentation of practical results, general knowledge about operating flow systems, software and computing

Content

In-depth kinetic experiment (one experiment per group of two students):

- steam reforming of methane
- photocatalytic degradation of methylene blue
- isothermal and transient biochar oxidation
- further experiments depending on availability

Investigation of the kinetics of a complex heterogeneously catalyzed reaction (calibration of the experimental set-up, testing the analytical detection of reaction products, standard tests of external and internal mass transfer limitations, measurement of concentration/time dependences, evaluation of practical results concerning the reaction mechanism, calculation of kinetic parameters)

Basic experiments (for each group of two students):

- nitrite reduction
- polytropic tank reactor
- residence time distribution and conversion calculation

Studying ignition/quenching behavior and instabilities (oscillations) exemplified with an exothermic reaction (decomposition of hydrogen peroxide); influence of internal mass transfer (pore diffusion, Thiele modulus) on the overall reaction rate in a three-phase system (nitrite reduction); experimental determination of residence time behavior and conversion of different reactors (CSTR, PFR, CSTRs-in-series) depending on mixing; data evaluation using different models for ideal and non-ideal reactors (dispersion, CSTRs-in-series and segregation model, calculation of Bodenstein and Damköhler number).

Teaching methods

a) Practical; b) Seminar

Mode of assessment

50 min end-of-term presentation of the results including discussion

Requirement for the award of credit points

Successful experimental performance, accepted protocols (1+3), and successful oral presentation

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 required documents incl. safety instructions are distributed via *moodle*.