Heterogeneous reaction engineering

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
67h

Presentation

Description

Program (detailed contents):

- Interest and technologies for heterogeneous reactors.

- Catalytic reactors: Notions of catalyst and heterogeneous kinetics; Limitations by external or internal mass transfer, Calculation of effectiveness factors, Thiele Modulus, Modelling and design of fixed bed reactors (mass balances).

- Gas/liquid reactors: Gas/liquid mass transfer with chemical reactions; Hatta Number; Enhancement factor, Working regimes; Modelling and design of gas/liquid reactors; Choice of the reactor type.

- Biological reactions and reactors: analysis of stoechiometry and kinetics of biological reactions; Bioreactor analysis: design and operation of batch, fed-batch and continuous bioreactors, with or without recycling based on simple reaction kinetics with the goal of cell or metabolite production and pollution treatment

Organisation:

Lectures, tutorials, labwork.

Cases study project in small groups: definition of the physical problem and writing of the equations for a complex system including the transport and heterogeneous reaction steps and its resolution using a numeric tool.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the different types of chemical and biological catalysts and their working modes

- the stoichiometry, kinetic laws and their combination for the description of microbial cell behaviour for growth and production,

- the notion of limiting step(s) in heterogeneous reactions

- the notion of apparent reaction rate

- the expression and meaning of dimensionless numbers (Hatta, Thiele, Weiss, Biot...)

- the notions of effectiveness factor and enhancement factor

- the description and modelling of batch, fed-batch and continuous, single or multi stage biological reactors with or without recycling.

The student will be able to:

- determine the limiting process(es) in a chemical heterogeneous reaction

- express the apparent global rate of a chemical reaction depending on the working conditions

- identify the general metabolic scheme of microbial growth

- establish the stoichiometric equations and kinetic laws for biological reactions with respect to the environment conditions

establish an intrinsic kinetic law

- select and design the most suitable reactor to perform a given reaction

- integrate and prioritize the mechanisms in order to model homogenous and heterogeneous biological and chemical reactors

Pre-requisites

Transport and reaction in fluid media

Fluid properties and mass transfer

Thermodynamics

Thermal transfers and reactors

Microbiology and statistics

Useful info

Place

Toulouse