Course Package

Process Technology

Name module	Process Technology - 2B
Educational programme	MSc Chemical Engineering
Period	Second block of second semester (block 2B)
Study load	15 ECTS
Coordinator	C. C. Diepenmaat

Process Technology			
block 1A	**block 1B**	**block 2A**	**block 2B**
			Numerical Methods for Engineers 201800131 (5 EC)
			Multi-phase Flow 201400300 (5 EC)
			Membrane Processes 201800330 (2,5 EC)
			Membrane Materials 201800331 (2,5 EC)

Required preliminary knowledge: Matlab; Fluid Dynamics; Heat and Mass Transfer; Mathematics (among others differential equations); Transport Phenomena; Fluid- and Solid Mechanics.

201800131 - Numerical Methods for Engineers

The course Numerical Methods for Engineers focuses on how transport- and fluid dynamics problems can be solved by numerical methods. The course is systematically organized by relating insight in ordinary and partial differential equations to the stability and accuracy of their numerical solutions. Matlab or Python based routines will be used for discretized problems related to fluid flow and transport phenomena. The knowledge and skills of the student are tested through assignments / cases that will be performed in small groups or individual.

201400300 - Multi-phase Flow

In fluid mechanics, multiphase flow is a generalisation of two-phase flow, i.e. cases where the phases are not chemically related (e.g. dusty gases, particles in fluid) or where more than two phases are present (e.g. propagating steam explosions, suspensions, aerosols, sprays, clouds, ...). More general, multi-phase flow involves the interaction of solids with fluids, or of different fluids with each other and is of utmost importance in many engineering and science fields.

Each of the phases is considered to have a separately defined volume fraction (the sum of which is unity), and its own velocity field. Conservation equations for the flow of each species (perhaps with terms for interchange between the phases), can then be written down straightforwardly.

The momentum equation for each phase is less straightforward. It can be shown that a common pressure field can be defined, and that each phase is subject to the gradient of this field, weighted by its volume fraction. Transfer of momentum between the phases is sometimes less straightforward to determine, and in addition, a very light phase in bubble form has a virtual mass associated with its acceleration. (The virtual mass of a single bubble is about half its displaced mass). These terms, often called constitutive relations, are often strongly dependent on flow regime.

201800330 - Membrane Processes

The course contains aspects related to selective transport phenomena that are relevant for diverse applications and processes. We will include processes utilizing porous, dense and ion selective membranes.

Transport theory will be derived for the different separation processes, including porous and dense membranes. Module design and process related conditions are then highlighted to describe their influence on the separation performance. Concepts like concentration polarization, boundary layer, limiting flux, and pressure ratio, will be introduced and explained connected to their corresponding application.

201800331 - Membrane Materials

The different methods and materials for membrane fabrication will be discussed, including phase inversion, interfacial polymerization (or localized reactions), sintering, crosslinking and coatings. These methods lead to porous, dense, or ion selective membranes. Characterization techniques are presented, crucial to define the separation properties of membranes. The materials properties, combined with the fabrication method, results in a selective transport medium, for which the transport theory is basically explained.