UCLouvain

lbirc2109a

2021

Génie des procédés : Opérations unitaires

3.00 credits	30.0 h + 7.5 h	Q2

Teacher(s)	Debaste Frédéric (compensates Debecker Damien) ;Debecker Damien ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	Transfer phenoma (for partim A) Physical chemistry I and II + fuild mecanics (for partim B)
Main themes	Partim A - Particles in flowing medium - Study of a flowing liquid through porous media and membranes - Mechanical processes for physical separation: sedimentation, decantation, centrifugation, filtration, cycloning, membrane separation - Drying processes : drying, lyophilisation, atomisation Partim B - Diffusion, mass transfer and energy transfer between phases (diffusion theory, mass transfer coefficients, film theory). - Phase equilibrium - Fluid/fluid and fluid/solid separation processes involving mass transfer : Distillation, liquid-liquid extraction, absorption, adsorption, crystallization
Learning outcomes	
Evaluation methods	Written exam systematically covering the LO (theory and exercises). The written report concerning the field study in the industry weight 20% of the final grade.
Teaching methods	Lecture with a powerpoint presentation as the main support (available via iCampus). Even if the slides are used as a support for the lectures, an important part of the course is given orally and on the blackboard (e.g. explanations, examples, mathematic developments, etc.). Quantitative exercises of dimensioning with a tutor. Scientific articles are recommended for reading as a complement to the course. Students may be instructed to visit a company of their choice and to study a unitary operation involved in the production process. A short, didactical and critical report is asked, in the form of a poster. The report is presented to other students. Owing to the limited capacity of the class rooms, related to the restrictions of the COVID-19 crisis, some lecture may be given remotely (Teams).
Content	Introduction Objectives ' instructions ' process engineering and unitary operations : definitions ' main working principles of unitary operations for separation ' the different operating modes ' context ' classification of unitary operations Partim A Separation processes based on mechanical action Particles in fluids (Context ' Description of a divided solid ' the isolated particle ' a bunch of particles ' Characterization of a bed of particles) / Sedimentation and Centrifugation (Definitions ' Interactions between the fluid and one particle ' flow regimes ' sedimentation rate) / Flows through porous media (the Darcy law ' the Kozeny Carman model ' turbulent flow ' the Ergun relation) / Filtration (Context ' Support filtration ' Coupling the variables ' Humidity ratio ' Cake dimensions ' Resistance to the flow ' Operating modes ' Filtration technologies) / Membrane separation (Description ' Applications ' Diffusion principles ' Materials ' Mass transfer ' Dialysis ' Electrodialysis ' Inverted osmosis ' Gas permeation ' Pervaporation ' Membranes in bioprocesses Drying processes Motivation / Definitions and concepts (wet solid ' gaz-liquid-solid equilibrium ' wetting enthalpy ' sorption isotherms ' equilibrium diagrams) / Techniques et set-up (classification ' machines often used in the industry ' drying by ebullition ' drying by flow ' lyophilisation ' drying of bio-products) / Theoretical principles of drying (drying kinetics ' hygrometry ' wet air diagram ' case study: the drying of cereals in a grain silo) / Alternative mode for providing energy / supercritical drying Partim B Fluid/fluid separation and fluid/solid separation involving mass transfer

	Liquid-gaz equilibrium of binary systems (Reminders ' the Raoult law ' non ideal mixtures ' Influence of pressure ' Systems with more than two species) / Distillation (Basic working principles of distillation' Simple discontinuous distillation(batch)' Continuous distillation(flash distillation)' Fractionated distillation: working principle, Plate colonne, the method of Sorel, the method of Lewis, the method of Mc Cabe & Thiele, Study of the column with the equilibrium diagram, vapor injection, the method of Ponchon& Savarit, Study of the columns with the enthalpy diagram, Rectification of azeotropic mixtures, Rectification mixtures with more than two species, Column efficiency) / Liquid-liquid extraction (Reminders on ternary diagrams ' Extraction in one contact stage ' Extraction with multiple contact stages ' Countercurrent extraction with separate contact stages ' Countercurrent extraction with uninterrupted contact ' Countercurrent extraction with reflux) / Gas absorption by liquids (Equilibrium condition ' Graphical representation ' Number theoretical stages ' Continuous transfer ' Absorption of several species ' Absorption with chemical reaction) / Adsorption (Adsorption on a solid ' Adsorption equilibrium for a pure gas 'Adsorption equilibrium for a gaseous binary mixture ' Adsorption equilibrium for a liquid binary mixture - Adsorption separated stages ' Adsorption in fixed bed) / Crystallization (Definitions ' the crystalline state ' Solubility curves ' Sursaturation curves ' Basic principles of crystallization in solution ' Crystallization processes ' Purity and morphology of crystals
Inline resources	Moodle: - slides posted at the beginning of the semester - list of exercices - remainders for mathematical formula - instructions for the plants visit
Bibliography	Aucun support payant n'est obligatoire. Une impression des diapositives (powerpoint) utilisées au cours et préalablement mises à disposition sur Moodle est vivement recommandée. Comme supports de cours facultatifs et disponibles en bibliothèque : - Introduction au génie des procédés de D. Ronze (Editions Tec et Doc, 2008), ISBN : 978-2-7430-1066-9 - Separation process principles de E.J. Henley, J.D. Seader, D.K. Roper (Wiley, 2011) ISBN : 978-0-470-64611-3 - Le pétrole - Rafinage et genie chimique I de P. Wuithier (Editions Technip, 1972) ISBN : 2-7108-0198-1 - Procédés de séparation de J.P. Wauquier ((Editions Technip, 1998) ISBN : 2-7108-0671-1
Other infos	This course can be given in English.
Faculty or entity in charge	AGRO

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Agricultural Bioengineering	BIRA2M	3		🔍
Master [120] in Environmental Bioengineering	BIRE2M	3		🔍