UAB
Universitat Autònoma de Barcelona

Separation Processes II

2026/2027

Code: 106060
Credits: 6

Degree programme	Type	Course
Chemical Engineering	OP	4

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the end of the document.

Prerequisites

It is recommended having reached the basic knowledge and fundamentals on: Computer applications, Heat transfer and Thermotechnics, Transport Phenomena, Separation processes I and Simulation of Chemical processes.

Objectives

This subject deals with separation processes based on mass transfer, both equilibrium and rate-controlled. In particular: Humidification, Adsorption, Ion Exchange and separations by Membranes. At all times is carried out a development of each block in a cumulative way regarding the separation operations that the student already knows, using the concepts of equilibrium, transfer rate, transport coefficients, countercurrent systems, cross flow, etc.., and making a synthesis of the common concepts among all of them. Finally, it is intended to know the basic concepts of these operations and the different methods and applications as a necessary basis on new separation technologies.

Learning outcomes

1. Develop critical thinking and reasoning
2. Apply and identify basic concepts related with chemical engineering.
3. Identify, analyse and resolve balances of matter in a stationary or non- stationary state, with or without a chemical reaction, in simple chemical processes.
4. Identify, analyse and resolve balances of energy in simple chemical processes.
5. Apply the scientific and technological basics of matter transfer to separation operations.
6. Apply the scientific and technological basics of balance and transfer of matter and separation operations.
7. Practice the fundamental laws of thermodynamics in chemical process engineering problems.

8. Choose between different options for defining separation processes.
9. Apply IT resources to the simulation and control of processes.
10. Make one's own decisions.

Contents

TOPIC 0.- INTRODUCTION

Separation processes based on mass transfer. Phase equilibria. Transfer rate. Configurations. Equilibrium-stage operations.

TOPIC 1.- HUMIDIFICATION

1.1. Introduction

1.2. Definitions and nomenclature

1.3. Phase Equilibria

1.4. Adiabatic-saturation Temperature (T_s)

1.5. Measurement of humidity and wet-bulb Temperature (T_w)

1.6. Psychometric or Humidity chart

1.7. Theory and calculation of cooling towers

1.7.1. Equations and balances for cooling towers

1.7.2. Estimation of the outlet gas temperature

TOPIC 2.- ADSORPTION

2.1. Introduction. Definition and types of adsorption processes

2.2. Adsorbents

2.3. Equilibria. Adsorption isotherms. Adsorption models.

2.4. Stage adsorption processes

2.4.1. Cross flow

2.4.2. Countercurrent

2.5. Continuous contact adsorption processes and equipment

2.5.1. Fixed bed

2.5.2. Moving bed

2.5.3. Fluidized bed

TOPIC 3.- IONIC EXCHANGE

3.1. Principles of ionic exchange

3.2. Ionic exchange resins

3.2.1. Physical structure

3.2.2. Chemical structure. Polymeric matrix

3.2.3. Functional groups

3.3. Ionic equilibria between S-L phases

3.4. Rate of Ionic exchange

3.5. Ionic exchange operations

3.5.1. Countercurrent

3.5.2. Fixed bed

3.6. Techniques and their uses

3.6.1. Water softening

3.6.2. Total demineralization. Deionization

3.6.3. Waste treatment and metal ions recovery

3.6.4. Chromatography

TOPIC 4.- MEMBRANES

4.1. Fundamentals and types of membrane separation processes

4.2. Microfiltration

4.3. Osmosis, Reverse Osmosis and Ultrafiltration

4.3.1. Reverse Osmosis

4.3.2. Ultrafiltration

4.3.3. Configuration of membrane systems

4.3.4. Concentration polarization

4.4. Dialysis

4.5. Electrodialysis

4.6. Membrane modules

4.7. Equipment and applications

4.7.1. Metal ions recovery. Electrodialysis

4.7.2. Recycling of degreasing baths

4.7.3. Separation of enzymes produced by fermentation

4.7.4. Desalinization

4.7.5. Hemodialysis

4.7.6. Algae harvesting and preparation as food

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Classroom practices (Problem solving)	15	0.6	1, 2, 4, 5, 6, 8
Further tutorials	5	0.2	1, 2, 4, 5, 6, 8
Problem solving	34	1.36	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Theoretical work, problems and computer simulation	8	0.32	1, 2, 3, 4, 5, 6, 8, 9, 10
Study	42	1.68	1, 2, 4, 5, 6, 8
Tutorials with professor	2	0.08	1, 2, 4, 5, 6, 8

Seminars	4	0.16	1, 2, 4, 5, 6, 8, 9
Expository lectures (master class)	31	1.24	1, 2, 4, 5, 6, 8

MD1 Presentation of content in class - Master class or conference

MD2 Participatory classes (joint problem solving, debates, case analysis, presentations of work done by students)

MD3 Tutorials

MD5 Evaluation activities (continuous evaluation with two partial milestones)

MD6 Problem/use case/project based learning

MD7: Use of specific software for the design of separation operations through simulation

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Partial test 2	40 %	3	0.12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Problem solving and case studies, reports, works and their defense	20 %	3	0.12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Partial test 1	40 %	3	0.12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Check the catalan version for details

Bibliography

- Coulson, J.M., Richardson, J.F. ChemicalEngineering. Vol 2. Particle Technology andSeparation Processes. 5th ed. Butterworth-HeinemannLtd. UK. (2002).

  Geankoplis, C. J., Hersel, A.A., Lepek, D.H. Transport Processes andSeparation Process Principles. 5th ed. Prentice Hall PTR. USA (2018).

  McCabe, W. Unit operations of chemicalengineering. 7th ed. McGraw-Hill Education. UK. (2005).

  Perry'sChemicalEngineers' Handbook. 8th ed. McGraw-Hill Education. USA. (2008).

  Wankat, P. C. Ingeniería de procesos de separación (2a. ed.). PearsonEducación. (2008).

Software

- Pal, Nirupam & Siletti, Charles & Petrides, Demetri. (2008). Superpro Designer: An Interactive Software Tool for Designing and Evaluating Integrated Chemical, Biochemical, and Environmental Processes.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	21	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	211	Catalan	first semester	morning-mixed
(SEM) Seminars	211	Catalan	first semester	morning-mixed