Course guide
240EQ022 - 240EQ022 - Advanced Separation Operations

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: **Academic year:** 2024 **ECTS Credits:** 6.0
Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE LUIS CORTINA PALLAS

Others:

PRIOR SKILLS

In order to carry out this course is necessary that the students have passed the course Transport Phenomena

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
1. Possess independent learning skills to maintain and enhance the competencies of chemical engineering to enable the continued development of their profession.

Transversal:
2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

LEARNING OBJECTIVES OF THE SUBJECT

By the end of the course the student will have to be able to:
1. Apply the scientific method in the resolution of advanced separation processes in the field of chemical engineering
2. Understanding of the theory concepts of the equipment, applications and the effects which the advanced separation processes produce on the quality of the products and its environmental impact.
3. Be able to evaluate current problems, applying the scientific method to solve practical problems
4. Propose and select the mathematical models describing the results, which allow to predict and simulate them
5. Ability to analyse in a critical way some of the current problems which have not yet been resolved in the field of chemical Engineering

STUDY LOAD

Type	Hours	Percentage
Hours large group	54,0	36.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

1. Process of membranes separation

Description:
Definition of the membrane. Nature and structure of the membranes. Configuration of the modules. Driving force. Transport mechanism. Parameter process. Classification of separation pocesses with membranes. Facts which limit the permeate flow: polarization of the concentration, contamination. Applications: inverse osmosis, ultrafiltration, pervaporation, electrodialysis

Specific objectives:
Learn the basis of the operations with membranes, as well as the calculation methods and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 25h
Theory classes: 10h
Practical classes: 4h
Self study : 11h

2. Extraction of solid-solid

Description:
Definition. Applications in the industry. Stages of the process. extraction speed and characteristics of the solvent. Facts which affect the speed extraction. Ways of operating. Calculation of solid-liquid extraction. Equipment

Specific objectives:
Learn the basis of the operation, as well as the calculation methods and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 17h
Theory classes: 4h
Practical classes: 3h
Self study : 10h

3. Extraction liquid-solid

Description:
Definition. Applications in the industry. Characteristics of the solvent. Liquid-solid balance. Ways of operating. Calculation in the air extractors by stages. Calculation in differential extractors. Equipment

Specific objectives:
Learn the basis of the operation, as well as the methods of calculation and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 17h
Theory classes: 5h
Practical classes: 3h
Self study : 9h

4. Extraction of supercritical fluids

Description:
Definition and characteristics of the supercritical fluids. Physical-chemical properties of the supercritical fluids. Extraction with supercritical fluids: advantages and disadvantages. Liquid-fluid and solid-fluid balance. Equipment. Applications

Specific objectives:
Learn the basis of the operation, as well as the methods of calculation and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 14h 10m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 10m

5. Adsorption

Description:
Basis. Application in the industry. Main absorbent materials. Adsorption balance. Calculation in absorbers by stages. Calculation in differential absorbers. Regeneration methods. Peristaltic pumping and CZA. Equipment

Specific objectives:
Learn the basis of the adsorption operation, as well as the calculation methods and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 14h 10m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 10m

6. Ionic exchange

Description:
Basis: analogies and differences between the adsorption processes. Applications in the industry. Ion exchange resins: capacity of the resin. Balance between phases. Calculation in extractions of ion exchange by stages and differentials. Equipment

Specific objectives:
Learn the basis of the ion exchange, as well as the calculation methods and the design of the corresponding equipment

Related activities:
Resolution of problems

Full-or-part-time: 10h
Theory classes: 4h
Practical classes: 2h
Self study : 4h

7. Crystallization

Description:
Basis: Growth and properties of the crystals, saturation, nucleation, speed of crystallisation. Applications in the industry. Effect of the impurities and the temperature. Agglomeration of crystals. Fractional crystallisation. Equipment

Specific objectives:
Learn the basis of the crystallisation operation, as well as the calculation methods and the design of the corresponding equipment.

Related activities:
Resolution of the problems

Full-or-part-time: 9h
Theory classes: 2h
Practical classes: 2h
Self study : 5h

Hybrid Processes

Description:
Definition of the hybrid process. Ways of operation. Hybrid process with membranes: reactors with membranes, distillation with pervaporation and other applications. hybrid processes with modified absorbers. Other hybrid processes. Study of the viability of the process

Specific objectives:
Planning of the project. Resolution of the doubts with the professors

Related activities:
Two monitoring sessions during the semester

Full-or-part-time: 50h
Theory classes: 7h
Self study : 43h

GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

BIBLIOGRAPHY

Basic:
- McCabe, Warren L; Smith, Julian C; Harriott, Peter; Lanto Arriola, María Aurora. Operaciones unitarias en ingeniería química. 7ª ed. Madrid: MacGraw-Hill, cop. 2007. ISBN 9789701061749.
- Coulson, J. M; Richardson, J. F. Chemical engineering. 6th ed. Oxford: Butterworth Heinemann, 1999. ISBN 0750665386.
- Perry, Robert H; Green, Don W; Maloney, James O. Manual del ingeniero químico. 4ª ed. Madrid: McGraw-Hill, cop. 2001. ISBN 8448130081.
- Henley, Ernest J; Seader, J. D; Roper, D. Keith. Separation process principles. 3rd ed. Chichester: John Wiley & Sons, cop. 2011. ISBN 9780470646113.

Complementary:
- Smith, J. M; Van Ness, Hendrick C; Abbott, Michael M. Introducción a la termodinámica en ingeniería química. 7ª ed. México: McGraw-Hill, cop. 2007. ISBN 9789701061473.
- Brunner, Gerd H. Supercritical fluids as solvents and reaction media. Amsterdam, Netherlands: Elsevier Science, 2004. ISBN 9780080542102.