Course Unit	Chemical Engineering Laboratory II			Field of study	Chemical Process Engineering		
Bachelor in	Chemical Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9125-755-3201-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	-	60	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Ramiro José Espinheira Martins

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Remember the chemical kinetics fundamentals.
2. Analyse experimental data for the correct estimation of chemical reaction kinetic models.
3. Design ideal reactors.
4. Determine experimentally the adsorption kinetics in batch vessels.
5. Analyse dynamical adsorption phenomena through a packed column setup.
6. Analyse statistically the influence of a set of input parameters in a solid-liquid extraction process.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Reveal knowledge acquired by the study of Chemical and Biological Engineering ground sciences.
2. Reveal knowledge of Reaction Engineering and Separation Processes.
3. Have experience in using computational tools.

Course contents

Execution of the following experimental protocols: Study of the residence time distribution in a cascate of three continuously stirred vessels; Kinetical study of a chemical reaction in a continuously stirred tank reactor; Determination of adsorption isotherms for a activated carbon/acetic acid system; Study of acetic acid adsorption in an activated carbon packed column; Study of the influence of several operational parameters in a coffee leaching process. Chlorine decay kinetics in water.

Course contents (extended version)

1. Introduction to Chemical Processes Engineering.
   - Design equation for a continuously stirred reactor.
   - Kinetic study for a second order reaction: integral method.
2. Introduction to Separation Processes: Adsorption.
   - Adsorption equilibria: adsorption isotherms.
   - Adsorption kinetics. Breakthrough curves. Stoichiometric times estimation.
   - Adsorption processes modelling and simulation.
3. Introduction to Experimental Planning.
   - Construction of total factorials.
   - Computation of effects. Statistical analysis of effect significance: Analysis of Variances.

Recommended reading

1. Davis, M.E.; and Davis, R.J. (2003). Fundamentals of Chemical Reaction Engineering, 1st edition, McGraw-Hill.
2. Singh, J.K.; Verma, N. (2020). Aqueous Phase Adsorption Theory Simulations, CRC Press.
3. Wankat, P.C. (1990). Rate Controlled Separations, 1st edition, Elsevier.
4. Schmittinger, P. (2000). Chlorine: Principles and Industrial Practice, Wiley-VCH Verlag GmbH
5. D. C. Montgomery, Design and Analysis of Experiments, 10th Edition, John Wiley & Sons (2019)

Teaching and learning methods

The students prepare the experimental tasks based in the protocol, to access the objectives to be attained, the data that ought to be registered and the relevant questions to be addressed during the experimental session. The students may process the experimental data, namely more complex numerical procedures, during the presential classes.

Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Laboratory Work - 10% (Practical work quality assessment (planning and implementation). Online evaluation (Virtual.IPB).)
  - Reports and Guides - 30% (Practical work reports.)
  - Final Written Exam - 10% (Practical work video production (3rd Exp Work))
  - Work Discussion - 10% (Oral presentation (4th Exp. Work))
  - Final Written Exam - 40% (Minimum mark of 8 values.)

Language of instruction

English

Electronic validation

Ramiro José Espinheira Martins	Hélder Teixeira Gomes	José Carlos Rufino Amaro
16-02-2023	21-03-2023	25-03-2023