Course guide
240EQ232 - 240EQ232 - Polymer Experimental Methods

Last modified: 02/06/2022

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

Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2012). (Optional subject).

Academic year: 2022 **ECTS Credits:** 4.5 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: Elaine Armelin Diggroc

Others: Lourdes Franco García
Jordi Puiggalí Bellalta
Núria Saperas Plana

PRIOR SKILLS

It is a very interesting subject from a practical standpoint because most of the classes are conducted in the laboratory of experimentation, working directly with the synthesis and characterization of polymers and biopolymers. The students should have general knowledge of chemical and physicochemical characterization of polymers. It is interesting to have studied topics related to polymers such as those taught in the following subjects: Polymers and Biopolymers, Polymer Technology I and II.

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. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

4. 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

The student will adquire the abilities to:
- Perform the synthesis of several types of polymers: thermoplastics, thermosets and elastomers.
- Understand the characterization of polymers employing techniques like RMN, FTIR, swelling degree, viscosity, and others.
- Perform practical experiments with polyesters, proteins and polysaccharides in order to understand their applicability.
- Corroborate the properties of polymers (chemical composition, molecular weight and structure) with their applications.

STUDY LOAD

Type	Hours	Percentage
Hours small group	40,5	36.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

Topic 1. Syntheses of thermoplastic polymers, commodities (like polystyrene) and engineering (like nylons and polyurethanes)

Description:
In this laboratory practice, the synthesis of polystyrene will be carried out by suspension polymerization, the synthesis of nylon 6.10 by interfacial polymerization and the synthesis of a thermoplastic polyurethane (TPU) by condensation polymerization. We will also work on polymer purification and plastics processing techniques.

Full-or-part-time: 6h
Laboratory classes: 6h

Topic 2. Synthesis of thermoset polymers

Description:
Two types of thermosets will be prepared: a two component epoxy and a polytriazole. Its adhesive properties, with or without catalyst or with the use of thermal curing treatments, will be evaluated.

Full-or-part-time: 3h
Laboratory classes: 3h

Topic 3. Preparation of elastomers

Description:
The polymerization of the natural rubber can be carried out in two stages, a pre-vulcanization stage and the complete vulcanization stage, the latter being the main one. In this practice, vulcanized rubber specimens will be fabricated and their degree of crosslinking will be determined using ASTM standards.

Full-or-part-time: 3h
Laboratory classes: 3h

Tema 4. Preparation of glass fiber reinforced plastics: composites

Description:
A commercial polyester resin, with an initiator (peroxide), will be used to obtain a rigid polymer with incorporated glass fiber. Glass-reinforced plastic (GRP), also known as Glass-Fiber Reinforced Plastic (GRP), is a composite material with better mechanical properties than the pure homopolymer.

Full-or-part-time: 3h
Laboratory classes: 3h

Tema 5. Characterization of polymer structure with infrared spectroscopy and nuclear magnetic resonance

Description:
In this practice we will work with the chemical identification of polymers using spectroscopic techniques: FTIR and NMR. The student will learn how to use an infrared spectrophotometer and how to process the graphs in order to analyze the main absorption bands of a given polymer. In the part of RMN, they will know the equipment and how to process and interpret the chemical shifts with the help of a computer program and standard tables, which contain the relation of the different organic functional groups and their theoretical displacements.

Full-or-part-time: 3h
Laboratory classes: 3h

Topic 6. Preparation of alginate-based hydrogel polymers: application as a biocatalyst

Description:
In this practice the student will work with another class of polymers, the polysaccharides. The aim is to carry out the hydrolysis reaction of an alginate gel and to evaluate the D-glucose content obtained after the hydrolysis by spectroscopic methods (UV-visible). On the other hand, it is noteworthy that in this practice the student will come into contact with the preparation of a type of biohydrogel and the immobilization of enzymes.

Full-or-part-time: 3h
Laboratory classes: 3h

Topic 7. Determination of the presence of enzymes in a commercial detergent

Description:
Detergents have, in addition to surfactants and bleaches, polycarboxylates and enzymes. Enzymes accelerate certain chemical reactions by acting as a biochemical catalyst. In this practice the student will evaluate the proteolytic activity of enzymes in a commercial detergent using the electrophoresis technique.
Therefore, in this subject the student will have the opportunity to work with SYNTHETIC POLYMERS, NATURAL POLYMERS and BIOPOLYMERS.

Full-or-part-time: 3h
Laboratory classes: 3h

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:
- Braun, Dietrich. Polymer synthesis : theory and practice : fundamentals, methods, experiments. 5th ed. Berlin: Springer, cop. 2013. ISBN 9783642289798.
- Hundiwale, D. G. Experiments in polymer science. New Delhi: New Age International, cop. 2009. ISBN 9788122423884.
- Vullo, Diana L. "Biopolymers, enzyme activity, and biotechnology in an introductory laboratory class experience". Biochemistry and molecular biology education [on line]. Vol. 31, No. 1, pp. 42-45 [Consultation: 22/05/2020]. Available on: https://onlinelibrary.wiley.com/journal/15393429.
- Collins, Edward A; Bares, Jan; Billmeyer, Fred W. Experiments in polymer science. New York: Wiley-Interscience, cop. 1973. ISBN 0471165840.
- Saperas, Núria ; Fonfría-Subirós, Elsa. "Proteolytic enzymes in detergents : evidence of their presence through activity measurements based on electrophoresis". Journal of chemical education [on line]. 2011, 88 (12), pp 1702-1706 [Consultation: 22/05/2020]. Available on: https://pubs.acs.org/loi/jceda8.
- Sandler, Stanley R. Polymer synthesis and characterization : a laboratory manual [on line]. San Diego: Academic Press, cop. 1998 [Consultation: 22/05/2020]. Available on: http://www.sciencedirect.com/science/book/9780126182408. ISBN 012618240X.

Complementary:
- Odian, George G. Principles of polymerization [on line]. 4th ed. Hoboken, N.J: Wiley-Interscience, cop. 2004 [Consultation: 22/05/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/047147875X. ISBN 9780471478751.
- Billmeyer, Fred W. Textbook of polymer science. 3rd ed. New York: Wiley-Interscience. Division of John Wiley & Sons, 1984. ISBN 0471031968.

RESOURCES

Other resources:
Internship dossier available at Atenea