

Biological Reactors

Calendar: 5th semester

Contact Hours: T - 30,0; PL - 30,0; OT – 7,5

Scientific Area: Processos em Engenharia Química e Biológica

Learning outcomes of the curricular unit

The purpose of this curricular unit is in-depth knowledge of the operation mode of the various biological reactors, allowing the study of the mass transfer phenomena and design of agitation systems in fermentation broths. It is thus intended that students acquire knowledge about: the various operation modes of biological reactors and application of mass and energy balances for each type of reactor, the phenomena underlying the mixing and stirring of fermentation broths, sterilization and sizing criteria.

Syllabus

Chapter 1: Comparison of chemical reactors with biological reactors. Key factors for the design of bioreactors.

Chapter 2: Microbial Kinetics; mass balance equations. Yield of a reaction and its determination. Classification of products. Inhibition of cell growth by the substrate and product.

Chapter 3: Operation Mode models for general CSTR; batch reactors and a bio-reactor working in semi-continuous mode.

Chapter 4: Oxygen Transfer in cell culture.

Chapter 5: Mixing and agitation. Bioreactors without mechanical agitation.

Chapter 6: Heat transfer in bioreactors.

Chap 7: Sterilization of fermentation media by heat in discontinuous and continuous mode. Air filtration.

Chapter 8: Criteria for bio-reactor scale-up and scale-down.

Chapter 9: Examples of application of bio-reactors.

Demonstration of the syllabus coherence with the curricular unit's objectives

The content of this curricular unit addresses the concepts necessary for the design of biological reactors. Thus, in chapter 1 a comparison of chemical and biological reactors is made, so that students will realize the increased complexity of the latter, which require a higher level of control. In the 2nd and 3rd chapters are lectured the necessary equations for cells, substrate and product mass balances required for application in different modes of operation of bioreactors. The importance of oxygen transfer (gas phase) in the microbial broths (solids present in the liquid phase) and the need to control the heat transfer and homogenization/mixture of microbial cultures are explained in Chapters 4 to 6. The importance of sterilization and scale-up and scale down criteria are lectured in chapter 7 and 8. The contents are discussed based on a dynamic display of matter and problem solving with examples of laboratory and industry.

Teaching methodologies:

This curricular unit includes a theoretical component and a practical. The theoretical component is taught by computer presentations via PowerPoint slides. The practical component includes exercise solving.

Demonstration of the coherence between the teaching methodologies and the learning outcomes.

The lecture method with student intervention, adopted for the lectures is appropriate for the presentation of the content covered in the curricular unit. The exercises solved in practical classes serve to help understand some concepts that may be difficult to understand in the theoretical exposition. The written tests during the semester allow students to consolidate the knowledge acquired by steps during the course classes. The assignments allow students to practice their foreign language skills (in English) as well as to practice for oral presentations and to deepen their knowledge in the certain aspects of the curricular unit's syllabus.