Universidad Zaragoza

Academic Year/course: 2024/25

28937 - Unit operations II

Syllabus Information

Academic year: 2024/25
Subject: 28937 - Unit operations II
Faculty / School: 201 - Escuela Politécnica Superior
Degree: 583 - Degree in Rural and Agri-Food Engineering
ECTS: 6.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

The subject "Basic Operations II" aims to enable students to analyze the most common basic operations with solid materials in the food industry by means of physical models that reproduce the operation.

In addition, it is also intended that students acquire a global vision of the most important processes of the agri-food industry.

The approach and objectives of the course are aligned with some of the Sustainable Development Goals, SDGs, of the 2030 Agenda:

- *Goal 7: Ensure access to affordable, secure, sustainable and modern energy.*
- *Goal 9: build resilient infrastructures, promote sustainable industrialization and foster innovation.*

It is recommended to have taken (and passed if possible) the subject "Basic Operations I". The knowledge and skills acquired in this previous subject are very important for the adequate follow-up of the subject at hand.

2. Learning results

1. Estimate the drying time required for a given solid feed in a batch dryer with laminar geometry.

2. Carry out the basic design of a continuous hot air dryer for solids.

3. Determine the maximum allowable pressure drop in pneumatic conveying systems for solids in dilute phase.

4. Calculate the minimum section of a continuous settler that ensures clarification and thickening.

5. Quantify the design parameters and operating conditions of a centrifuge for a clarification operation.

6. Determine the number of cyclones in parallel and their optimum dimensions for the separation of solid particles from a gas stream.

7. Estimate the filtration time required to obtain a given filtrate volume.

8. Determine the required membrane area and number of stages in series for an ultrafiltration operation.

9. Develop block and flow diagrams for a given agri-food process.

10. Analyze the advantages and disadvantages of the different alternatives that can be used for a determined basic operation within an agri-food process.

3. Syllabus

Block I: basic operations based on the simultaneous transfer of heat and matter

Topic 1: Fundamentals of psychrometry. Humid air properties and characteristic temperatures.

Topic 2: Drying of solids with hot air. Water activity. Types of dryers. Calculation of drying time in batch dryers. Design equation for continuous dryers.

Block II: basic operations based on the transport of the quantity of movement

Topic 3: fluidization and pneumatic conveying. Characterization of solid particles. Ergun's equation. Sizing of fluidized bed dryers. Dilute phase pneumatic conveying.

Topic 4: sedimentation and centrifugation. Calculation of the minimum area of a continuous settler. Centrifugal separation of immiscible liquids. Centrifugal clarification. Calculation of the dimensions of standard cyclones.

Topic 5: filtration and membrane separation. Filtration at constant pressure drop and constant average volumetric flow rate . Ultrafiltration. Reverse osmosis.

Thematic block III: Agri-food industry processes.

Topic 6: **Dairy industry processes**. Skimming, homogenization and UHT treatment.

Topic 7: **processes in the elaboration of fruit juices**. Production of juice and juice concentrate.

Topic 8: **wheat flour industry processes**. Milling and screening. Optimal blending of flours of different strengths.

Topic 9: **Processes in industrial brewing**. Cooking. Must clarification and cooling. Discontinous fermentation and filtration.

4. Academic activities

Theoretical classes (30 h) for the development of the contents of the proposed topics.

Practical problem-solving sessions (15 h) related to theoretical content

Practical laboratory sessions (8 h).

Collaborative work (15 h), to be done in groups of 2-3 students and focused on the description of an agri-food process and the study of alternatives to carry out a given unitary operation.

Technical visits (6 h), subject to the available budget.

Personal study (70 h).

Assessment tests (6 h).

5. Assessment system

The subject will be assessed by a global assessment system through the following activities:

1. Individual written test (60% of the final grade; minimum of 4 out of 10 points), where several problems will be solved. The assessment criteria will be: approach, numerical solution, conceptual mastery and argumentative justification.

2. Assessment of laboratory practices (20% of the final grade, minimum of 3.5 out of 10 points). Students who have attended at least 75% of the practical laboratory sessions will take an individual written test, where will solve two practical cases. Students who do not meet the attendance requirement will be required to take an additional practical testin the laboratory.

3. Assessment of the cooperative work (20% of the final grade, minimum of 3.5 out of 10 points). During the last week of the semester, the teams will be able to deliver the report of the work and make the oral presentation of during class time. The grade of the paper will be determined according to the quality of the written report and oral presentation, taking into account the following weights: 50% content, 30% presentation and defense, and 20% formal aspects . Students not evaluated in this activity -which are presented in the first or second call- will deliver the report and the presentation of the work through moodle, with a deadline that will coincide with the official call. In justified cases, students may carry out the activity in the individual mode.

The detailed definition of the assessment system will be presented in class during the

presentation of the subject.

Success rates in previous years: 2020-21 (0%, only one student applied); 2021-22 (66.67%); 2022-23 (NA, no students applying).

6. Sustainable Development Goals

7 - Affordable and Clean Energy
9 - Industry, Innovation and Infrastructure