295570 - 295EQ242 - Design of Equipment Coating Technologies

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Spanish

Teaching staff

Coordinator: José Ignacio Iribarren Laco
Others: José Ignacio Iribarren Laco
Elaine Armelin Digroc
Georgina Fabregat

Opening hours

Timetable: Each teacher will establish a schedule of student service according to their availability

Prior skills

Availability for teamwork, investigation of solutions to corrosion problems and cost evaluation at the company level

Requirements

Basic knowledge in chemistry and chemical engineering

Degree competences to which the subject contributes

Generical:
CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

Transversal:
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

Master classes based on the material available in Athena and cooperative learning in practical classes

Learning objectives of the subject

Obtain the electrochemical bases of corrosion phenomena
Know and compare different types of corrosion
Know the different types of coatings, their properties and applications to the different industrial sectors
Know the industrial methods of application of the coatings and their quality control

Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 150h</td>
<td>28h</td>
<td>0h</td>
<td>14h</td>
<td>6h</td>
<td>102h</td>
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<tr>
<td></td>
<td>18.67%</td>
<td>0.00%</td>
<td>9.33%</td>
<td>4.00%</td>
<td>68.00%</td>
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</table>
### Basics of Corrosion

**Description:**
1.1. Thermodynamics of corrosion.
1.2. Pourbaix diagrams.
1.3. Kinetics of corrosion. Polarization by activation, concentration and resistance.
1.4. Factors that affect the corrosion rate.

**Related activities:**
Laboratory sessions on determining the corrosion rate and electrochemical tests.

**Specific objectives:**
Introduce the student to the basics concepts related to corrosion processes and their thermodynamic and kinetic implications.

**Learning time:** 29h
- Theory classes: 6h
- Laboratory classes: 6h
- Self study: 17h

### Corrosion types

**Description:**
2.1. Classification of the types of corrosion.
2.2. Environmental corrosion, by water, soil, microbiological and erratic currents
2.3. Galvanic corrosion, generalized, pitting, intergranular and metallurgical conditions.
2.4. Inspection techniques in corrosion studies

**Related activities:**
Application exercises and seminar on the evaluation of the types of corrosion in real cases.

**Specific objectives:**
Bring the student to the different types of corrosion that occur in the real world

**Learning time:** 11h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 7h
# 295570 - 295EQ242 - Design of Equipment Coating Technologies

## Cathodic protection

<table>
<thead>
<tr>
<th>Description:</th>
<th>Related activities:</th>
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<tbody>
<tr>
<td>3.1 Fundamentals of cathodic protection.</td>
<td>Application exercises on cathodic protection in pipes, tanks and other equipment.</td>
</tr>
<tr>
<td>3.2 Cathodic protection by sacrificial anodes</td>
<td></td>
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<tr>
<td>3.3 Cathodic protection by impressed current</td>
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<tr>
<td>3.4 Cathodic protection applied with coatings</td>
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</tbody>
</table>

<table>
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<tr>
<th>Specific objectives:</th>
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<tbody>
<tr>
<td>Bring the student to the knowledge of how cathodic protection is applied in real cases.</td>
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<tr>
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## Metallic coatings

<table>
<thead>
<tr>
<th>Description:</th>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Characteristics of the electrolytic processes.</td>
<td>Application exercises and electrodeposition laboratory session</td>
</tr>
<tr>
<td>4.2 Electrolytic processes on an industrial scale.</td>
<td></td>
</tr>
<tr>
<td>4.3 Metallic coatings by electrodeposition.</td>
<td></td>
</tr>
<tr>
<td>4.4 Coating of alloys.</td>
<td></td>
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<tr>
<td>4.5 Coatings by immersion and projection</td>
<td></td>
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</tbody>
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<table>
<thead>
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<th>Specific objectives:</th>
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<tbody>
<tr>
<td>Know the main types of metal coatings and their application in the protection against corrosion</td>
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### Polymer coatings

**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 7h

**Description:**  
5.1. Coatings in the form of plates  
5.2. Preparation of surfaces  
5.3. Thermoplastics. PVC, polyethylene, PTFE  
5.4. Natural and synthetic elastomers

**Related activities:**  
Discussion on the different coatings applied as plates

**Specific objectives:**  
Know the characteristics of the coatings in the form of plates and their main applications in different industrial sectors

### Paints

**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 7h

**Description:**  
5.1. Classification of paintings  
5.2. Components of the paints. Binders, vehicle and additives.  
5.3. Application of paints.  
5.4. Manufacture and formulation of paints. Quality control  
5.5 Application examples

**Related activities:**  
Discussion on the applications of paints in different industrial sectors

**Specific objectives:**  
Know the characteristics of the pintures, their formulation, components, applications and manufacturing.
# Equipment design and coatings application in chemical industry

**Description:**
- 7.1 Factors that cause corrosion in the chemical industry
- 7.2 Design of equipment and types of corrosion failures in the chemical sector
- 7.3 Selection of materials
- 7.4 Economic aspects: costs of corrosion

**Related activities:**
Sharing and / or work on the characteristics of corrosion in the chemical sector

**Specific objectives:**
Bring the student to the knowledge of the peculiarities of corrosion, its economic costs and solutions in the chemical sector

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## Automotive coatings

**Description:**
- 8.1 Corrosion in the car. Differential aspects.
- 8.2 Corrosion in the body and design.
- 8.3 Metal coatings: hot dip galvanized and electrolytic zinc
- 8.4 Zincrometall and aluminized.
- 8.5 Phosphating and cataphoresis

**Related activities:**
Sharing and / or work on corrosion and body protection in the car

**Specific objectives:**
Know the main peculiarities of corrosion and protective solutions in the automotive industry

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## Qualification system

Resolution of exercises individually or in groups through cooperative learning (40%) and final exam (60%)

## Regulations for carrying out activities

Complementary material may be used in case the teacher deems it appropriate
Bibliography

Basic:


