250673 - Characterization, Management and Treatment of Waste

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2014). (Teaching unit Compulsory)
ECTS credits: 5
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: VICENÇ MARTI GREGORIO
Others: IGNASI CASAS PONS, JOSE LUIS CORTINA PALLAS, VICENÇ MARTI GREGORIO

Teaching methodology
- Attending class favouring active participation (26%)
- Exercise attending class (12%)
- Autonomous learning (non-attending) (52%)
- Cooperative learning (non-attending) (10%)

These methodologies include a visit to a waste treatment installation, the development of works on waste management and treatment case studies and the organization of a workshop where the students will expose the work performed.

Learning objectives of the subject
CE01 - Apply scientific concepts to environmental problems and their correlation with technological concepts.
CE04 - Identify, define and propose technological management and appropriate solution to an environmental problem.
CE05 - Dimension conventional treatment systems and raise their mass balance and energy.

Explore scientific concepts and technical principles of quality management of the receiving environments, atmosphere, water and soil.
Explore scientific concepts and technical principles of management and treatment of gaseous emissions, water supply, sewage and waste and remediation techniques for groundwater and contaminated soils.

Sized systems for the treatment of major pollutants vectors.

Interprets rules, identifies goals, evaluates alternative techniques, proposes appropriate solutions and prioritize actions.

Production waste classification and producing sectors.

Thermal and chemical processes: incineration, gasification, pyrolysis, production of biodiesel.

Biochemical processes: aerobic decomposition, composting, anaerobic digestion, other biological transformation processes.

Treatment of sewage treatment plants: origin and characterization; flowchart for treatment, identification and characterization of processes, development of mass balances.

Controlled deposits: classification of deposits; considerations on the planning, design, operation and decommissioning; deposit as bioreactor, leachate and gas emissions.

Special waste. Inactivation processes, encapsulation and vitrification.

The subject is addressed to obtain knowledge and competences in the field of characterization, management and treatment of wastes, starting from the problems associated to each typology. Objectives, thus, include:

- Identification of each typology of wastes and the type of management to apply
- Identify and apply in an adequate way the main technologies of treatment, valorization or disposal of wastes
- To manage in a correct way the different types of wastes that could be generated in specific activities

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 15h</th>
<th>12.00%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 10h</td>
<td>8.00%</td>
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<tr>
<td></td>
<td>Laboratory classes: 10h</td>
<td>8.00%</td>
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<tr>
<td></td>
<td>Guided activities: 10h</td>
<td>8.00%</td>
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<tr>
<td></td>
<td>Self study: 80h</td>
<td>64.00%</td>
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</tbody>
</table>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time:</th>
<th>Description</th>
<th>Specific objectives:</th>
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</thead>
<tbody>
<tr>
<td><strong>1 - INTRODUCTION AND FUNDAMENTALS</strong></td>
<td>7h 11m</td>
<td>Introduction of key concepts in the characterization, classification, management and treatment of wastes linked to environment and sustainability: reusing, recycling, recovery, minimization, valorization, treatment, disposal, type of wastes and their management attending to its origin (urban, industrial, agricultural, forestal and farm wastes, construction, mining, sanitary ans specific) and impact on environment. Waste management plans and byproduct database</td>
<td>Fundamentals Knowledge</td>
</tr>
<tr>
<td><strong>2 - CLASSIFICATION AND CHARACTERIZATION OF WASTES</strong></td>
<td>9h 36m</td>
<td>Characterization, classification (waste catalogue risk phrase), management and treatment of Industrial wastes and its legal framework will be considered. Analytical methods for classification and disposal of industrial waste and characterization of urban wastes for disposal will be exposed</td>
<td>Knowledge for classification of wastes and legal framework See application examples</td>
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<tr>
<td><strong>3 - PHYSICAL OR PHYSICO-CHEMICAL TREATMENT PROCESSES</strong></td>
<td>14h 23m</td>
<td>Properties of contaminants linked to these treatments, description of fundamentals of mechanical separation, stripping, vapour extraction, adsorption, chemical oxidation, supercritic fluid extraction, membrane processes, stabilization and other</td>
<td>Knowledge of waste treatment See application examples</td>
</tr>
</tbody>
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**Learning time:**
- Theory classes: 3h
- Practical classes: 2h
- Self study: 4h 11m
- Theory classes: 2h
- Practical classes: 2h
- Self study: 5h 36m
- Theory classes: 3h
- Practical classes: 3h
- Self study: 8h 23m
### 4-BIOLOGICAL TREATMENT PROCESSES

**Learning time:** 14h 23m  
- Theory classes: 3h  
- Practical classes: 3h  
- Self study: 8h 23m

**Description:**  
Fundamentals of biological processes (electron acceptors and electron donors, Monod, microbiological kinetics) and the description of composting and anaerobic digestion plants from FORM, other biotreatments of contaminants (lagooning, leaching phase, in-situ treatment, fitotreatment and other  
Examples

**Specific objectives:**  
- Knowledge of waste treatment  
- See application examples

### 5-THERMAL TREATMENT PROCESSES

**Learning time:** 9h 36m  
- Theory classes: 2h  
- Practical classes: 2h  
- Self study: 5h 36m

**Description:**  
Description of drying, combustion, incineration, pyrolysis, gasification, thermal desorption, vitrification, thermic plasma, and other techniques  
Examples

**Specific objectives:**  
- Knowledge of waste treatment  
- See application examples

### 6-ENERGETIC VALORIZATION OF WASTES

**Learning time:** 14h 23m  
- Theory classes: 3h  
- Practical classes: 3h  
- Self study: 8h 23m

**Description:**  
A description of the technical facilities and thermal energy production by cogeneration, biomass, biofuels, fuel cells, biogas and others.  
Examples

**Specific objectives:**  
- Knowledge about management energy recovery  
- See application of examples
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7-CONTROLLED DISPOSAL OF WASTES

Learning time: 7h 11m
Laboratory classes: 3h
Self study: 4h 11m

Description:
Activity on gas phase reactions and its developments in landfills.

Specific objectives:
Simulation and application case studies. Activity evaluable

8-RADIOACTIVE WASTES

Learning time: 7h 11m
Theory classes: 3h
Self study: 4h 11m

Description:
Fundamentals on radiation, wastes of low, medium and high activity, nuclear power plant impact, type of storage (ATC, AGP, low activity)

Specific objectives:
Knowledge management disposal

Qualification system

GLOBAL NOTE NT=0.1*NAC+0.1*NAC+ 0.2*NEP+ 0.6*NEP
NAC1: Continuous evaluation
NAC2: Case study work and exposition punctuation
NEP: Partial Exam Punctuation
NEF: Final Exam Punctuation

For the re-evaluation only NEF will be substituted, maintaining the rest of punctuations. Students NP (Not presetend) cannot attend to reevaluation exam.

Regulations for carrying out activities

The continuous evaluation exercises will be delivered in digital virtual campus and will be individual.

The case study work will be performed in group and will be delivered in digital virtual campus. A presentation of the works will be presented in the workshop (total time of workshop 1 hour).

Class notes, formulas and books could be used in EP and EF tests. An electronic calculator will be needed for these tests.
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Bibliography

Basic:


Complementary: