

# Advanced Treatment of Industrial Wastewater (250669)

## General Information

<b>School</b>	ETSECCPB
<b>Departments</b>	Departament d'Enginyeria Civil i Ambiental (DECA) Departament d'Enginyeria Química (EQ) Departament d'Enginyeria Tèxtil i Paperera (ETP) Departament de Ciència i Enginyeria de Materials (CEM)
<b>Credits</b>	5.0 ECTS
<b>Programs</b>	MÀSTER UNIVERSITARI EN ENGINYERIA AMBIENTAL (pla 2014)
<b>Course</b>	2023/24

## Main teaching language at each group

- Group 10Q2 Spanish (Q2)

## Faculty

Responsible Faculty: Jose Luis Cortina Pallas

Faculty: Jose Luis Cortina Pallas, Elena Guillen Burrieza, Julio López Rodríguez, Mònica Reig I Amat

## Objectives of Education

CE01 - Apply scientific concepts to environmental problems and their correlation with technological concepts.

CE08-Dimension unconventional systems and advanced treatment and raise their mass balance and energy.

Explore scientific concepts and technical principles of quality management of the receiving means, atmosphere, water and soil, and applied to problem solving.

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 in specific sectors of activity.

Interprets rules, identifies goals, assesses technical alternatives proposed unconventional solutions and priority actions.

Characteristics of effluents from the main industrial sectors.

Advanced oxidation processes.

Processes Fenton.

Photocatalysis.

Ozonation.

Photochemical Processes.

Wet oxidation.

Processes coupled.

Advanced Biological Processes.

Membrane Bioreactors (MBR).

Sequential biological reactors (SBR).

Fixed bed reactors. Biocilindros and biodiscs. Mobile fixed bed.

Granular anaerobic reactors fixed and expanded bed.

Combined systems.

New treatment techniques and use of sludge.

Control systems treatment plants.

The objectives of the course are to enable students to evaluate the quality of a wastewater depending on the characterization parameters.

Select and design the treatment process depending on the quality of wastewater, the destination of the treated water (landfill, recycling, reuse) of the rules and other conditions as the waste taxes.

Do the basic design of a wastewater treatment plant of Industrial effluents.

Manage the sludge produced in the sewage treatment plant.

Learn to manage wastewater treatment plants by physicochemical processes and by biological process.

Relate the major operating problems with the causes that produce, and learn the changes to be introduced in the purification plant to solve these problems.

## Competencies

### Especific

Apply scientific concepts to environmental problems and their correlation with technological concepts.

Dimension unconventional systems and advanced treatment and raise their mass balance and energy.

### Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

## Contents

### Unit 1: Regulations on industrial wastewater. Types of industrial waters and identification of the m

Competent organisms: European Legislation, Spanish legislation, Autonomic Legislation, Local Administration Legislation.-Policy discharge to: Continental waters, Public System.-Law for wastewater reusing.-Calculation of discharge fees in Catalonia (DUCA)

Nature and types of pollutants in wastewaters .- Heavy metals, metals and organometallic compounds .- Inorganic Pollutants .- Nutrients.-Effluent characterization studies

-General characteristics of municipal effluents.

-Characteristics of the main industrial sectors: \* Textile and tanning industry \* Paper Industry \* Chemical Industry \* Fine Chemical Industry \* Food industry \* Mining

### Specific Objectives

- Identify the legislation applicable in each case for wastewater .
- Set discharge values for the main parameters of pollution of wastewaters .
- Perform calculations relating to the declaration of use and pollution charges of water (DUCA) existing Catalonia.
- Identify the main families of pollutants in wastewaters .- Understanding the effect that different pollutants produced on the aquatic living organisms.- Understand the concepts of biodegradability, acute and chronic toxicity, bioaccumulation, substances that consume oxygen.
- Knowing the most important characteristics of effluents from each sector industrial.
- Identify the degree of difficulty in treating industrial effluents to the limits required by law.
- Understanding the differences in composition that condition the treatment of domestic and industrial effluents.

### Tema 2. Processes for the purification of industrial waters

Main wastewater treatment processes for industrial effluents.-Physical processes: Screening, settling, flotation, filtration.-Physicochemical processes: chemical coagulation / flocculation , electro-coagulation, adsorption, chemical and electrochemical oxidation, membrane processes .- Biological processes: aerobic, anaerobic and mixed processes .  
Presentation of practical cases

### **Specific Objectives**

- Know the fundamentals of the main wastewater treatment processes.
  - Identify the type of contaminants that each process can remove best.
  - Know the magnitude of the economic costs of each process.
  - Identify the wastewater treatment processes best suited to each type of industrial effluent.
- Learning to focus on solving complex industrial effluents

### **Topic 3. Physical-chemical treatment processes**

- Coagulant and flocculant Products
- Jar test test.
- Decanters.
- Flotators : DAF and CAF.

### **Specific Objectives**

- Design and evaluate the results of the Jar Test
- Do the basic design of a wastewater treatment coagulation-flocculation plant.

### **Topic 4. Biological purification processes**

Foundamentals of biological processes .- Respirometric Tests.- Aerobic processes.- Activated sludge processes.-Microorganisms.-F/M ratio.- Oxygen consumption .-Nutrient Effect of pH and temperature.- Design of a wastewater activated sludge treatment plant

### **Specific Objectives**

- To know the different types of microorganisms involved in biological treatment and its role in the process.
- Knowing how biological processes properly removing nutrients.
- Specify the nomenclature and symbols used in the study of these processes.
- Identify and define correctly the influence of the parameters and factors that govern biological processes.

### **Topic 5. Advanced oxidation processes**

Fenton Processes .- Fotocatálisis.- Ozonization.- Fotochemical processes.- Wet Oxidation Processes .- Coupled processes.-Applications

### **Specific Objectives**

- Know the fundamentals of advanced oxidation processes .
- Identify the type of contaminants that each process can eliminate best.
- Know the magnitude of the economic costs of each treatment. -Identify Process best suited to each type of industrial effluent .

### **Topic 6: Technologies for the reuse of industrial effluents: integration of membrane processes**

Line od sludge treatment. - Thickening. - Stabilization. - Sludge Dehydration: centrifuges, filter presses, belt filters and sludge drying beds. - Drying and incineration. - Disposal: landfill, composting, agriculture. Parameters that determine the reutilización.-Aspects related with health.- Technologies used in the recovery of water.- Examples of reuse and recycling industry

### **Specific Objectives**

- Explain the values and the main applications of the different processes of sludge management.
- Plan and solve material balance calculations of sludge treatment processes.

- Meet alternatives to recovery of sludge.

Distinguish between reuse and recycling.- Know the legal conditions for reusing effluents.- To be able to identify the most efficient technologies for reuse and recycling of effluents.- design the most appropriate combination of processes to allow reuse or recycling according to effluent composition.

## **Topic 7: Systems for the monitoring of parameters of water quality in treatment processes**

Tipologies de monitorització: mesures off-line, at-line, on-line i in-line. Sistemes de presa de mostre en sistemes de anàlisis on-line. Principis dels sistemes de monitorització. Tipologies de analitzadors i sensors. Exemples de sensors i analitzadors: matèria orgànica, demanda bioquímica d'Oxigen (DBO), Carboni Orgànic Total (TOC), Matèries en Suspensió (MES) , Conductivitat elèctrica, Oxigen dissol, Nitrogen, Fòsfor.- Matèries inhibidores.-

### **Specific Objectives**

- Conèixer els paràmetres més importants en la caracterització d'un efluent,
- Identificar els errors que es poden produir en l'anàlisi i interpretació dels diferents paràmetres.
- Saber escollir les tècniques més adequades per a les determinacions analítiques.

## **Topic 8: Management of odor problems in industrial effluent treatment plants**

Definition of the annoying annoyance. Odor Scales and Odor Regulation. Systems of odoriferous annoying monitoring. Quantification panels of odoriferous discomfort. Odoriferous emission treatment systems, Odoriferous scattering Odoriferous annoyance control problems. Targets

### **Specific Objectives**

- Understand the different methods of control of a physicochemical EDAR to optimize its performance and reduce costs. - Understand the foundation of the different methods of control of an activated sludge WWTP.
- Perform calculations for the control of a WWTP from of the experimental data of the sewage treatment plant. - Identify the most common problems of operation and propose solutions. Know the main parameters of control

## **Activities**

### **Visit to an industrial effluent treatment plant**

Visit a WWTP of industrial effluents and evaluation work

### **Dedication**

10h

## **Teaching Methodology**

The course consists of 3 hours per week of classes in the classroom (large group).

It lectures dedicated to a total of 22 hours in a big group, in which the teacher explains the concepts and basic raw materials.

Engaged a total of 8 hours (medium group), to solve problems with more interaction with students. Performed exercises to consolidate the learning objectives and general specifics.

The other 15 hours in total, 9 are devoted to lab work, and 6 h. to assisted works .

We employ support material in the form of detailed syllabus by the virtual campus Atenea content, programming and evaluation activities directed learning and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

## Grading Rules

*(\*) The evaluation calendar and grading rules will be approved before the start of the course.*

The rating will be obtained from the continuous assessment marks and corresponding laboratory .

Continuous assessment consists of different activities, both individual and group training and additive nature, carried out during the year (in the classroom and outside of it) .

The evaluation tests consist on issues associated with the concepts of the course learning objectives with regard to knowledge and understanding, and to one year of application.

## Test Rules

Failure to perform a industry visit or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

## Office Hours

Any day from Monday to Friday after agreement on date/hour taking into account availability.

Any day Monday through Friday, by E-Mail

## Bibliography

### Basic

- Water Environment Federation. [Biofilm reactors](#). New York: McGraw-Hill, 2010. ISBN 9780071737074.
- American Public Health Association, American Water Works Association, Water Environment Federatio. [Standard methods for the examination of water and wastewater](#). 23rd ed. Washington, D. C.: American Public Health Association, 2017. ISBN 9780875532875.
- Hernández Muñoz, A. [Depuración y desinfección de aguas residuales](#). 6a ed. rev. y ampl. Madrid: Ibergarceta Publicaciones, S.L., 2015. ISBN 9788416228263.
- Sawyer, C.N.; McCarty, P.L.; Parkin, G.F. [Chemistry for environmental engineering and science](#). 5th ed. Boston: McGraw-Hill, 2003. ISBN 9780071198882.
- Nemerow, N.L. [Industrial water pollution: origins, characteristics, and treatment](#). Reading, Massachusetts: Addison-Wesley, 1978. ISBN 0201052466.
- Parsons, S. (ed.). [Advanced oxidation processes for water and wastewater treatment](#). London: IWA Publishing, 2004. ISBN 1843390175.
- Varis. Manuales DWA.
- Metcalf & Eddy. Wastewater engineering: treatment and reuse. 4th ed. Boston, EEUU: Mc Graw-Hill Higher Education, 2003. ISBN 0070418780.

### Complementary

- Varis. Manuales IWA.