UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Waste, Wastewater and Contaminated Sites Management

2021-2-F5401Q047

Aims

Knowledge of the system cycle of integrated management of municipal and industrial waste, urban and industrial wastewater treatment, remediation of contaminated sites.

Knowledge and understanding

At the end of the course the student knows:

- The foundations of sustainable development;

- The physico-chemical processes of neutralization, precipitation and sedimentation;

- The municipal wastewater treatment processes;

- The fundamentals and technologies of thermal treatment;

- The processes for the treatment of incinerator flue gas;

- The methods of characterization of a contaminated site;

- The physico-chemical processes for the remediation of contaminated sites.

Applying knowledge and understanding

At the end of the course the student is able to:

- Calculate mass and energy balances in the waste management cycle.

- Calculate mass flows and balances in the wastewater management cycle.

Making judgements

At the end of the course the student is able to:

- Analyze the environmental problem;

- Critically evaluate the different available options of processes and plants;

- Identify the most suitable treatment technology.

Being able to apply the acquired knowledge to contexts different from those presented during the course, and to understand the topics covered in the scientific literature concerning the characterization and treatment of wastes and contaminated sites.

Contents

Environmentally sustainable technologies. Chemical and physico-chemical treatments. Wastewater treatment systems. Fundamentals of the combustion process: physico-chemical and chemical bases and mechanisms. Thermal treatments. Municipal solid waste management. Methodologies for investigation, characterization and analyses of contaminated sites. Processes and physico-chemical technologies.

Detailed program

Environmentally sustainable technologies: General and methodological aspects. Technology and Sustainable Development. Indicators. Life Cycle Assessment. Treatment of urban and industrial wastewater: Physico-chemical processes and technologies: sedimentation, flotation, process of acid-base neutralization, precipitation, reduction and dehalogenation. Urban wastewater treatment plants: Qualitative and quantitative parameters which characterize urban vs. industrial waste water; pretreatment, pumping, grilling, EQ, suspended solid removal, chemical and chemico-physical processes, activated sludge and lined sludge processes; nitrification / denitrification; phosphate removal; tertiary treatment; sludge cycle management. Treatment of solid waste. Thermal destruction: chemical and physical fundamentals of combustion, gasification and pyrolysis. Indicators of combustion. Products of incomplete combustion. Processes and technologies for thermal treatment: grate furnace, rotary kiln, fluid bed furnace. MSW incineration: parts of the incinerator plant. Mass and energy balances. Residues of the treatment. Fume processing: dust precipitation, acid and micropollutant scavenging. Prevention of NOx formation, NOx scavenging. Treatment of solid residues. Monitoring the emission quality. The management system of municipal solid waste (MSW): Qualitative and quantitative parameters for waste characterization. General features of the processes which compose the MSW management cycle: collection, transportation and storage; MSW characterization, separate collection, materials recovery; energy recovery, waste-derived fuels, materials recycling, wet fraction processing. The remediation of contaminated sites: The characterization plan: collection and processing of records and existing data, classification, definition of intervention priority; inspection and preliminary investigation, sampling and analysis. The sampling plan and its implementation. Contaminated site remediation by physico-chemical technologies and processes: in situ (Soil Flushing) vs. ex-situ (Soil Washing); thermal desorption, solvent extraction, extraction of vapours from soil.

Exercises: Mass and energy balances in waste management cycles. Flow and mass balances in wastewater cycle. Case Studies.

Prerequisites

Fundamentals of Physical Chemistry (kinetics and thermodynamics), Inorganic Chemistry (precipitation and redox reactions), Organic Chemistry, Physics.

Teaching form

The course includes 4 CFU of lecture classes, 1 CFU of exercise sessions, 1 CFU of campus abroad. In the exercise sessions, students are given a problem to solve using the methods presented in the theoretical lessons. The development of the problem is guided by the teacher and tends to develop and strengthen the student's ability to identify the most suitable techniques for the application. During the campus abroad one or more waste treatment plants are visited.
The teacher is available to teach English.
For the duration of the Covid-19 emergency period, the lecture classes will take place remotely asynchronously, the exercise sessions in synchronous videoconference.

Textbook and teaching resource

Teaching material will be available on the e-learning platform.

Textbooks:

Colin Baird and Michael Cann “Environmental Chemistry”

George Tchobanoglous, Hilary Theisen and S. A. Vigil “Integrated solid waste management: engineering principles and management issues”, McGraw-Hill

Renato Vismara “Depurazione biologica”, Hoepli

Semester

second semester

Assessment method

oral examination

the examination foresees the resolution of one or more exercises based on the exercise sessions (contributes 25% of the final grade) and an interview aimed at verifying the knowledge of the topics covered in the lectures and the autonomy of analysis and judgment (contributes 75% of the final grade)

exam grade in the range 18-30/30

it is possible to take the exam in English

During the Covid-19 emergency period, oral exams will only be online. They will be carried out using the WebEx platform and on the e-learning page of the course there will be a public link for access to the examination of interested virtual spectators.

Office hours

By appointment to be made by e-mail (elena.collina@unimib.it)