COURSE DESCRIPTION CARD - SYLLABUS

Course name

Advanced oxidation processes in the purification of the environment

Course

Field of study

Circular System Technologies

Area of study (specialization)

-

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

4/7

Profile of study

general academic

Course offered in

Polish

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

0

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Katarzyna Siwińska-Ciesielczyk

e-mail: katarzyna.siwinska-ciesielczyk@put.poznan.pl

Wydział Technologii Chemicznej

Instytut Technologii i Inżynierii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Responsible for the course/lecturer:

dr hab. inż. Marcin Janczarek

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Wydział Technologii Chemicznej

Instytut Technologii i Inżynierii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Prerequisites

Basic knowledge of inorganic, organic, physical chemistry as well as chemical technology.

Course objective

Provide theoretical and practical knowledge in the field of application of Advanced Oxidation Processes in the elimination/neutralization of pollutants contained in the air and/or in the water environment. Acquainting with the mechanisms of degradation of pollutants in the gas and liquid phase in the processes of deep oxidation. Presentation of synthesis methods for the production of modern materials with catalytic properties, which are used in AOP methods. Discussion of technological solutions (including devices) used in the elimination of pollutants, both in the liquid and gas phase, which are coming from various industries.

Course-related learning outcomes

Knowledge

K_W02 - has knowledge of physics and chemistry to understand phenomena and changes occurring in technological and environmental processes.

K_W03 - has knowledge of mathematics, physics and chemistry necessary to describe ideas, concepts and principles of technological and enviromental aspects as well as of characteristics of connections and relationships between its components.

K_W04 - has systematized, theoretically founded knowledge of inorganic, organic, physical and analytical chemistry.

K_W06 - knows the rules of environmental protection related to chemical production and management of raw materials, materials and waste in a closed loop technologies.

K_W07 - has basic knowledge of neutralization processes and recovery of industrial and municipal waste.

K_W08 - has knowledge of the negative impact of manufacturing and processing technologies on natural environment.

K_W24 - knows and describes the individual AOP methods and defines related concepts, explains the mechanisms of pollutant decomposition depending on the AOP method used, characterizes the basic devices for the implementation of AOP methods, knows the possibilities of using individual AOP methods in industry.

Skills

K_U01 - can retrieve information from literature and databases and other sources related to the methods of advanced oxidation, also in a foreign language, integrates and interprets it and draws conclusions and formulates opinions.

K_U04 - has the ability to self-study, is able to ethically use source information in Polish and in a foreign language, is able to read with comprehension, carries out analyses, syntheses, summaries, critical assessments and draws correct conclusions.

K_U08 - knows how to plan and organize individual work as well as team work.

K_U10 - selects methods of process monitoring and quality assessment of raw materials, products and waste.

K_U12 - can choose the appropriate AOP method to remove pollutants from given liquid and gas streams.

K_U15 - based on the acquired knowledge knows how to develop an independent or team project/report on the work carried out and how to present it in a multimedia format.

Social competences

K_K02 - demonstrates independence and inventiveness in individual work as well as effectively interacts in a team, playing various roles in it; objectively assesses the effects of own work and work of team members.

K_K09 - supports the idea of a harmonious, global civilization and economic development, promoting the principles of a closed-loop economy, sustainable development and rational management of natural resources locally and globally.

K_K10 - is aware of the negative impact of human activity on the state of the environment and actively prevents its degradation.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Stationary form - the knowledge acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures. The exam consists of 5-10 open questions. Online form - the knowledge acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures via the eKursy platform. The exam includes 3-5 open questions that students answer in the "live view" mode with the webcam turned on via eMeeting or Zoom platforms, and 10-20 opened and closed test questions (single and multiple choice), to which students answer using the test module on the eKursy platform. Grade criteria: 3 - 50.1%-60.0%; 3.5 - 60.1%-70%; 4 - 70.1%-80.0%; 4.5 - 80.1%-90%; 5 - from 90.1%.

Programme content

1. Origin, type, quantitative and qualitative characteristics of environmental pollutants, with particular emphasis on wastewater from various industries, including chemical, pharmaceutical, textile, paper, fuel, energy or agri-food. Legal conditions as to the quality of discharged, treated industrial wastewater.

2. Division of pollutant purification methods, taking into account the way of their elimination into: mechanical (physical), biological, chemical, physical-chemical as well as combined methods.

3. General characteristics and classification of methods included in the Advanced Oxidation Processes (AOP).

4. Oxygen and reactive oxygen species used in AOP processes.

5. Characteristics of chemical and photochemical processes used to remove pollutants from water, soil and air: ozonation and ozonolysis conducted in the presence of UV light, sonolysis, radiolysis, oxidation with H2O2 using the Fenton H2O2/Fe2+ system, advanced oxidation in water under and supercritical, photolysis and photooxidation, photocatalytic oxidation with the use of semiconductors. Combined methods, including and identification of synergistic effects between AOP processes.

6. The mechanism of decomposition of pollutants in the gas and liquid phase in advanced oxidation processes.

7. Production of modern materials with catalytic properties and their use in AOP methods.

8. Application of AOP methods in purification of selected liquid and gaseous streams. Case studies.

Teaching methods

Lecture - multimedia presentation, materials in the form of pdf files on the eKursy platform.

Consultations.

Bibliography

Basic

Barbusiński K., Zaawansowane utlenianie w procesach oczyszczania wybraych ścieków przemysłowych, Wydawnicwo Politechnika Śląska, Gliwice, 2013 r.

Zarzycki R., Zaawansowane techniki utleniania w ochronie środowiska, PAN Oddział w Łodzi, Łódź, 2002 r.

Zarzycki R., Zaawansowane utlenianie w pod- i nadkrytycznej, PAN Oddział w Łodzi, Łódź, 2002 r.

Nawrocki J., Biłozor S., Uzdatnianie wody. Procesy chemiczne i biologiczne, Wydawnictwo Naukowe PWN, 2000 r.

Bartkiewicz B., Oczyszczanie ścieków przemysłowych, Wydawnictwo Naukowe PWN, Warszawa, 2006 r.

Additional

Barbusiński K., Intensyfikacja procesu oczyszczania ścieków i stabilizacji osadów nadmiarowych z wykorzystaniem odczynnika Fentona, Zeszyty Naukowe Politechniki Śląskiej, nr 1603, Gliwice, 2004 r.

Parsons S., Advanced oxidation processes for water and wastewater treatment, IWA Publishing, London SW1H 0QS, UK, 2004 r.

Oppenlander T., Photochemical purification of water and air. Advanced Oxidation Processes (AOP's) Principles, reaction mechanism, reaction concept. Willey - VCH, 2002 r.

Anielak A.M., Chemiczne i fizykochemiczne oczyszczanie ścieków, Wydawnictwo Naukowe PWN, Warszawa, 2002 r.

Zaleska A., Grabowska E., Nowoczesne procesy utleniania – ozonowanie, utlenianie fotokatalityczne, reakcja Fentona, Politechnika Gdańska, Gdańsk, 2008 r.

Garrido-Cardenas J.A., Esteban-Garcia B., Aguera A., Sanchez-Perez J.A., Manzano-Agugliaro F., Wastewater treatment by advanced oxidation process and their worldwide research trends, International Journal of Environmental Research and Public Health, 2020, 17, 170, doi:10.3390/ijerph17010170.

Miklos D.B., Remy C., Jekel M., Linden K.G., Drewes J.E., Hubner U., Evaluation of advanced oxidation processes for water and wastewater treatment - a critical review, Water Research, 2018, 139, 118-131.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	38	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	37	1,5

[1] delete or add other activities as appropriate