COURSE DESCRIPTION CARD - SYLLABUS

Course name
Recycling of chemical power sources and electroplating waste

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
compulsory

Number of hours

Lecture
30
Tutorials

Laboratory classes
30
Projects/seminars

Other (e.g. online)

Number of credit points

5

Lecturers

Responsible for the course/lecturer:
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Wydział Technologii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Responsible for the course/lecturer:
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Wydział Technologii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Prerequisites

Knows the basic methods, techniques, tools and materials used in solving simple engineering tasks. She/he knows the rules for the protection of the environment associated with chemical production.

Has knowledge of raw materials, products and processes used in the chemical industry also has basic information on the design, construction chemical energy.

Can work individually and in teams, able to plan and carry out experiments, interpreted the results and draw conclusions.

Understands the need for continuous training and are aware of their responsibility for collaborative tasks related to teamwork.

Course objective

Gaining knowledge in term of raw materials and mterials used in industry of chemical sources of energy and plating. Gaining knowledge about methodes and technologies of recovery and recycling materials used in electrochemical industry. Skills of the laboratory experiments related to the recycling and recovery of materials arised from electrochemical waste.

Course-related learning outcomes

Knowledge

Has basic knowledge of the processes of neutralization and recovery of industrial and municipal waste [K_W07]

Has knowledge of the negative impact of manufacturing and processing technologies on the natural environment [K_W08]

Has knowledge of the physical and chemical basis of unit operations of closed-cycle technology [K-W22]

Knows the basic principles of occupational health and safety and work ergonomics [KW_28]

Skills

Has the ability to self-educate, is able to use source information in Polish and a foreign language in accordance with the principles of ethics, reads with understanding, conducts analyzes, syntheses, summaries, critical assessments and correct conclusions [K_U04]

Can plan and organize work individually and in a team [K_U08]

Can assess the usefulness and select tools and methods to solve problems in the field of closed-cycle technology [K_U12]

Social competences

Demonstrates independence and inventiveness in individual work, and effectively cooperates in a team, playing various roles in it; objectively assesses the effects of team members and own work [K_K02]

Is aware of the negative impact of human activity on the state of the environment and actively prevents its degradation [K_K10]

Understands the need to convey to society - incl. through the mass media - full information about the benefits and challenges related to the implementation of the closed-cycle technology concept [K_K11]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Rating of written answers within the subjects related to the theme of the laboratory.

Current control of knowledge and practical skills, the correction for experimentation during laboratory classes.

An assessment of the final report achieved on the basis of experimental results.

A written final exam in the subject.

Programme content

1. Introduction to water, sewage and waste management of metal surface treatment plants.

2. Technologies of galvanic coating application.

3. Conservation and regeneration of selected solutions.

4. Secondary utilization of spent solutions.

5. Methods used for treatment of liquid and solid waste, for solutions regeneration, materials recovery and recycling.

6. Recovery of metals from post neutralization sludge.

7. Chemical power sources.

8. Global market for chemical power sources and the possibility of their recycling.

9. Design solutions as well as methods of use increasing and decreasing the durability of chemical energy sources.

10. Recycling methods used on a technical scale - problems and directions of development.

11.Laboratories:

a) students carry out the neutralization of galvanic wastewater associated with the recovery selected anions and metals. Students use galvanic sludges as a source of raw materials.

b) students carry out a structural analysis of a lead-acid battery in order to become familiar with the components present in the system, and an assessment of the possibility of their use in the recycling of lead and its compounds, electrolyte and plastics. Structural analysis of the lithium-ion battery and the

possibilities of recycling its components. The analysis of the primary battery and the possibilities of recycling its components.

Teaching methods

Lecture, problem lecture, explanation, didactic discussion, laboratory exercises

Bibliography

Basic

1. T. Stefanowicz, Gospodarka wodno-ściekowa i odpadowa w przemyśle elektrochemicznym, Wyd. Politechniki Poznańskiej, Poznań, 2001.

2. T. Stefanowicz, Otrzymywanie i odzysk metali oraz innych surowców ze ścieków i odpadów pogalwanicznych, Wyd. Politechniki Poznańskiej, Poznań, 1992

3. Praca zbiorowa, Poradnik galwanotechnika, WNT, Warszawa, 2002.

4. A. Czerwiński, Akumulatory, bateria, ogniwa, WKŁ, Warszawa 2005.

5. Ustawa z dnia 24 kwietnia 2009r.o bateriach i akumulatorach

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Additional

1. B. Bartkiewicz, Oczyszczanie ścieków przemysłowych, Wyd. Naukowe PWN, Warszawa 2010.

2. L.K Wang, N.K. Shammas, Y.-T. Hung (eds) Advances in Hazardous Industrial Waste Treatment CRC Press, Taylor and Francis Group, Boca Raton Fl. USA 2009.

3. S.A.K. Palmer, M.A. Breton, T.J. Nunno, D.M. Sullivan, N.F. Surprenant, Metal/Cyanide Containing Wastes Treatment Technologies, Pollution Technology Review No 158, Noyes Data Co, Park Ridge, New Jersey, 1988.

4. M. B. Hocking, Handbook of Chemical Technology and Pollution Control, Elsevier Inc. 2005.\

5. G. Pistoia. J-P. Wiaux S. P. Wolsky Used Battery Collection and Recycling 1st Edition, Elsevier Science 2001.

6. Ed. J. Garche Encyclopedia of Electrochemical Power Sources 1st Edition, Elsevier Science 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	63	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam) The exam will be held in a stationary or online form and will consist of 5 questions. The laboratory classes will be preceded by the students being checked by the teacher from the material covering the scope of the laboratory exercise. [1]	62	2,5

[1] delete or add other activities as appropriate