COURSE DESCRIPTION CARD - SYLLABUS

Course name
Recycling in electrochemistry [S1TCh2>RwE]

Course

Field of study
Chemical Technology

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

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Lecturers

Prerequisites

The student has basic knowledge in the field of physical chemistry, electrochemistry and basic electrochemical technology. It also has basic information about materials used in the chemical and electrochemical industries, in addition, it has basic information on construction of basic chemical energy sources

Course objective

Gaining knowledge about raw materials and materials used in electrochemistry, methods and technologies of their recovery and recycling, including materials used in chemical energy sources, electrochemical capacitors and fuel cells. Strengthening knowledge of electrochemical processes used in broadly understood environmental protection

Course-related learning outcomes

Knowledge:
1. Has knowledge of complex chemical processes involving correct selection of materials, raw materials, apparatus and equipment applied in the processes of neutralization and recovery and planning of laboratory experiments and drawing up the acquired results. - [K_W3]

2. Has a well-established knowledge in the field of occupational health and safety. - [K_W10]

Skills:
1. He is able to critically assess the results of experimental studies and to determine the direction of further research solving the problems in the field of chemical technology. - [K_U21]
2. He is able to design and evaluate the experiment course and the process in the field of chemical technology, is also able to make the analysis of possibilities of the unit processes integration due to the raw material and the final product, in accordance with the principles of economy of materials and energy, taking into account the principles of risk assessment. - [K_U22]

Social competences:
1. Is aware of the limitations of science and technology related to environmental protection. - [K_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by a written final pass in the subject consisting of 3 questions. Passing threshold will correspond to 51% of the maximum number of points.
In the case of on-line classes, the pass will take the form of a test consisting of 20 test questions and five open questions. Passing threshold: 51% of the maximum number of points.

Programme content

1. Introduction into the problems connected with the development and recycling of materials used in electrochemistry.
2. The most important methods used in the process of spent primary cells.
3. The most important methods used in the process of spent secondary cells.
4. Examples of processes used in recycling of spent supercapacitors.
5. Examples of processes used in recycling of spent construction elements of fuel cells.
6. Examples of recycling processes of electrode materials used for electrochemical oxidation of organic pollutants.
7. Examples of electrochemical processes used in the recovery and recycling processes other than those originally used in electrochemistry.
8. Electrochemical purification of gases and products formed during recycling processes of various materials.

Teaching methods

Lecture, problem lecture, explanation, didactic discussion

Bibliography

Basic:
1. R. Dylewski, Metody elektrochemiczne w inżynierii środowiska, Wyd. Politechniki Śląskiej, Gliwice, 2000
2. R. Dylewski, W. Gnot, M. Gonet, Elektrochemia przemysłowa Wybrane procesy i zagadnienia, Wyd. Politechniki Śląskiej, Gliwice, 1999
3. H. Scoll, T. Błaszczyk, P. Krzyczmonik, Elektrochemia Zarys Teorii i Praktyki, Wyd. Uniwersytetu Łódzkiego,1998
4. A. Czerwiński, Akumulatory Baterie Ogniwa, Wyd. Komunikacji i Łączności, Warszawa, 2005.

Additional:
1. B.Bartkiewicz, K. Umiejewska, Oczyszczanie ścieków przemysłowych, Wyd. Naukowe PWN, Warszawa 2020.
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. C. H. Hamann, A. Hamnett, W. Vielstich, Electrochemistry, Wiley-Vch, 2007.
4. M. B. Hocking, Handbook of Chemical Technology and Pollution Control, Elsevier Inc. 2005.
5. Praca zbiorowa pod red. Czerwińskiego A., Rogulskiego Z., Utylizacja i recykling zużytych akumulatorów i baterii, Przegląd Komunalny 4 (2005).
7. D.C.R. Espinosa, A. M. Bernardes, J.A.S. Tenório, An overview on the current processes for the

recycling of batteries. J. Power Sources 135 (2004) 311.
8. J. Lipkowski, P.N. Ross, Electrocatalysis, Wiley-VCH, 1998.
9. P. Krawczyk, J.M. Skowroński, Multiple anodic regeneration of exfoliated graphite electrodes spent in the process of phenol electrooxidation, Journal of Solid State Electrochemistry, 2014, 18, 917-928.

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	10	0,50