COURSE DESCRIPTION CARD - SYLLABUS

Course name

The use of post-recycling materials for energy storage

Course

Field of study

Circular System Technology

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/6

Profile of study

general academic

Course offered in

Polish

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Wydział Technologii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

The student has a basic knowledge of physics, mathematics and in the field of inorganic chemistry, organic chemistry, physical chemistry, chemical technology and electrochemical technology.

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.

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

Course objective

The aim of the course is to provide students with knowledge of the use of post-recycling materials in modern chemical power sources and storage devices. The lecture will present the utilization of electrode materials, electrolytes, separators and current collectors in primary cells, secondary cells (rechargeable batteries), fuel cells and in electrochemical capacitors, i.e. EDLC (electric double layer capacitors), pseudocapacitors and hybrid capacitors .

Course-related learning outcomes

Knowledge

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

2. Has knowledge of raw materials, products and processes used in closed-cycle technologies [K_W10]

3. Has the knowledge to describe the basic development trends related to closed-cycle technologies [K_W13]

4. Has knowledge of the physical and chemical basis of unit operations of closed-cycle technology [K_W22]

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

Skills

1. Can obtain information from literature, databases and other sources related to closed-cycle technologies, also in a foreign language, integrate them, interpret and draw conclusions and formulate opinions [K_U01]

2. 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, summaries, critical assessments and correct conclusions [K_U04]

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

Social competences

1. Objectively assesses the level of their knowledge and skills, understands the importance of improving professional and personal competences adequately to the changing social conditions and the progress of science [K_K05]

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

3. 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:

1. Written final exam in stationary conditions or an exam in a remote form using the e-learning platforms of the Poznań University of Technology.

Programme content

1. Electrochemical principles of chemical power sources and energy storage devices, i.e. cells, batteries and electrochemical capacitors.

2. Construction, electrode materials and electrolyte solutions used in individual chemical power sources, i.e. primary, secondary and fuel cells.

3. Construction, electrode materials and electrolyte solutions used in energy storage devices, i.e. electrochemical capacitors with particular emphasis on electric double layer capacitors (EDLC), pseudocapacitors and hybrid capacitors.

4. Analysis of the influence of materials used in the production of energy storage and power sources devices on the working parameters (operation characteristics) of these devices.

5. Possibilities of optimizing the working parameters of chemical power sources and energy storage devices.

6. Analysis of computational tasks presenting the operating characteristics of energy storage devices and power sources.

7. Post-recycling materials used for the production of individual components of modern primary cells, batteries, fuel cells and electrochemical capacitors, i.e. electrodes, electrolyte solutions, separators and current collectors.

8. Influence of post-recycling materials on the energy storage devices and power sources working parameters.

10. Global market for energy storage devices and the possibility of their recycling in the term of economy.

Teaching methods

1. Supply methods (lectures, problematical lectures, explanations, analysis of accounting tasks and discussion).

Bibliography

Basic

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

2. A. Ciszewski, Technologia chemiczna, procesy elektrochemiczne, Wydawnictwo Politechniki Poznańskiej, Poznań 2008.

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

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

5. http://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20090790666/U/D20090666Lj.pdf

6.http://www.gios.gov.pl/images/dokumenty/gospodarka_odpadami/baterie/wytyczne_techniczne_baterie_i_akumulatory.pdf

Additional

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

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

9. J. Gomółka, F. Kowalczyk, A. Franke, Współczesne chemiczne źródła prądu, Wydawnictwo Ministerstwa Obrony Narodowej, Warszawa 1977.

10. D. Linden, T.B. Reddy, Handbook of batteries, 3rd ed., McGraw-Hill 2002.

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 tests) [1]	37	1,5

[1] delete or add other activities as appropriate