COURSE DESCRIPTION CARD - SYLLABUS

Course name
Waste management from the organic industry [S2TOZ1>ZOPzPO]

Course

Field of study
Circular System Technologies

Year/Semester
1/2

Area of study (specialization)
Material recycling and chemical recovery

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student has knowledge of/to: 1. basic concepts of organic chemistry, including structures, properties and reactions of organic compounds, which is essential for the analysis of waste treatment processes. 2. basic methods, techniques and tools used in chemical technology and environmental engineering. 3. obtain information from literature, databases and interpretation of the data in order to formulate conclusions and opinions. 4. a foreign language at B2 level to understand the terminology and literature in organic chemistry, chemical technology and closed loop technology. 5. effective group work, prioritisation of tasks and organisation of activities, which is essential in the context of waste treatment projects.

Course objective

Gain knowledge of waste treatment from the organic industry.

Course-related learning outcomes

Knowledge:
1. Student has a systematic and advanced knowledge to recognize and evaluate the harmfulness, as well as to neutralize the hazardous factors associated with waste from the organic industry. (K_W04)
2. Student has an in-depth and theoretically founded knowledge of modern and environmentally

friendly technologies for the waste treatment from the organic industry. (K_W05)
3. Student has extended knowledge to recognize and differentiate hazardous factors resulting from the activities of the organic industry and knows the principles of waste neutralization and recovery taking into account the requirements of the closed loop economy. (K_W06)
4. Student has an extended knowledge of the methods of recovery of raw materials from organic waste required to design, optimise and implement innovative technological processes in the organic industry. (K_W12)
5. Student has an in-depth knowledge of methods of using plants and microorganisms to neutralise and convert organic waste into biological substances of useable value. (K_W16)

Skills:
1. Student is able to use his/her knowledge to identify and select methods of utilisation and treatment of waste from the organic industry, taking into account the principles of the closed loop economy, and to propose improvements to existing technologies. (K_U03)
2. Student is able to plan and carry out experiments related to methods of organic waste treatment in a closed loop, and is able to interpret the obtained results and draw conclusions for the optimization of technological processes. (K_U12)
3. Student is able to competently use professional literature and expert opinion in the field of organic waste treatment, integrate obtained information, interpret and critically evaluate it, formulating competent opinions and reports on this basis. (K_U15)

Social competences:
1. Student understands the need to popularise knowledge in the field of sustainable production and technological solutions in a closed loop economy. (K_K02)
2. Student critically evaluates his/her knowledge, understands the need for further education and improving his/her professional, personal and social competences. (K_K03)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - the examination in the course will be in written form, subject to exceptional circumstances (e.g. the lecturer is on a study leave - the examination will then be conducted in oral form. Students will be informed of the form of the exam in advance); evaluation criterion: 3 - <50-60%); 3,5 - <60-70%); 4 - <70-80%); 4,5 - <80-90%); 5 - <90-100%>.
Laboratory - reports from laboratory exercises, oral/written response, evaluation of student activity during laboratory classes, evaluation of teamwork, evaluation criterion:
3 - basic theoretical and practical preparation, the ability to prepare reports from conducted laboratory exercises, basic participation in practical classes without additional involvement;
4 - practical preparation supported by theoretical knowledge, the ability to formulate appropriate conclusions from data obtained during the laboratory, active participation in classes supported by the desire to obtain additional practical and theoretical knowledge;
5 - complete preparation for teaching classes, the ability to formulate conclusions at an advanced level, precise performance of assigned tasks, independent search for additional theoretical knowledge, coordinating work in a research team, ambitious approach to the subject.

Programme content

Issues concerning the waste treatment from the organic industry.

Course topics

1. Introduction to organic waste treatment (closed loop economy, green chemistry and recycling)
2 Classification and characterisation of waste from the organic industry
3. Biomass as raw material
4) Chemical technologies and processes for organic waste treatment
5. Hydrogen and biogas production from organic waste
6. Biofuels from waste materials
7. Waste treatment from organic industry to obtain novel compounds with high application potential
8. Pharmaceutical waste: challenges and technological solutions
9. Biotechnological methods of organic waste treatment

Teaching methods

Lecture - discussion of issues using multimedia presentations.
Laboratory - performing laboratory tasks on the basis of prepared exercises.

Bibliography

Basic:
1. B. Burczyk: Biomasa: Surowiec do syntez chemicznych i produkcji paliw, Oficyna Wydawnicza Politechniki Wrocławskije, Wrocław 2011.
2. B. Burczyk: Zielona chemia. Zarys, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2014.
3. S. Werle: Termiczne przetwarzanie biomasy odpadowej jako element gospodarki obiegu zamkniętego, Wydawnictwo Politechniki Śląskiej, Gliwice 2021.
4. P.N. Cheremisinoff, L.F. Ferrante: Waste reduction for pollution prevention, Butterworth-Heinemann, Oxford 1989.
5. R. Zarzycki: Energia z odpadów, Polska Akademia Nauk. Oddział, Łódź 2008.
6. C. Polprasert: Organic Waste Recycling, IWA Publishing, Londyn, 2007.
7. H. Tian, J. Li, M. Yan, Y. Wah Tong, C.-H. Wang, X. Wang: Organic waste to biohydrogen: A critical review from technological development and environmental impact analysis perspective, Applied Energy, 256, 2019, 113961.

Additional:
1. E. Kociołek-Balawejder (red.): Technologia chemiczna organiczna: wybrane zagadnienia, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2013.
2. S. Kara, M. Hauschild, J. Sutherland, T. McAloone: Closed-loop systems to circular economy: A pathway to environmental sustainability?, CIRP Annals, 71, 2022, 505-528.
3. P. Kaszycki, M. Głodniok, P. Petryszak: Towards a bio-based circular economy in organic waste management and wastewater treatment - The Polish perspective, New Biotechnology, 61, 2021, 80-89.
4. S. Kharola, M. Ram, N. Goyal, S.K. Mangla, O.P. Nautiyal, A. Rawat, Y. Kazancoglu, D. Pant: Barriers to organic waste management in a circular economy, Journal of Cleaner Production, 362, 2022, 132282.
5. D.K. Kaczmarek, D. Gwiazdowska, K. Juś, T. Klejdysz, M. Wojcieszak, K. Materna, J. Pernak: Glycine betaine-based ionic liquids and their influence on bacteria, fungi, insects and plants, New J. Chem., 2021, 45, 6344-6355.
6. D.K. Kaczmarek, T. Kleiber, L. Wenping, M. Niemczak, Ł. Chrzanowski, J. Pernak: Transformation of Indole-3-butyric Acid into Ionic Liquids as a Sustainable Strategy Leading to Highly Efficient Plant Growth Stimulators, ACS Sustainable Chem. Eng. 2020, 8, 3, 1591-1598.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	64	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	61	2,50