COURSE DESCRIPTION CARD - SYLLABUS

Course name
Raw and secondary materials in inorganic chemical technology [S1TOZ1>SNiWwTN]

Course

Field of study
Circular System Technologies

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-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

Basic knowledge of general, inorganic and physical chemistry as well as the basics of chemical technology and chemical industry apparatus (materials relating to 1st and 2nd year of full-time 1st cycle studies). The ability to solve elementary problems in chemical technology based on the acquired knowledge and information obtained from the indicated sources in Polish and in a foreign language. Understand the need for further training and awareness to expand competence, readiness to cooperate within the team.

Course objective

Acquiring basic knowledge on the circulation of natural and secondary raw materials in inorganic chemical technology. Ability to select raw materials and chemical intermediates for the indicated technology. Understanding the basic industrial processes and unit operations describing the controlled circulation of raw materials in large-scale production. Acquiring knowledge concerning the methods of production of inorganic products, based on selected, natural raw materials. Indication of the possibility of using by-products/waste (secondary raw materials) in specific production processes. Acquiring knowledge in the field of minimizing the effects of production processes on the environment by introducing closed circulation of raw materials in technological lines.

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 closed-loop technologies as well as of characteristics of connections and relationships between its components
k_w04 - has systematized, theoretically founded knowledge of inorganic chemistry
k_w06 - knows the rules of environmental protection related to chemical production and management of raw materials, materials and waste in inorganic chemical technology
k_w07 - has basic knowledge of neutralization processes and recovery of industrial and municipal waste in the area of inorganic chemical technology
k_w08 - has knowledge of the negative impact of manufacturing and processing technologies on natural environment
k_w10 - has knowledge of raw materials, products and processes used in inorganic chemical technology
k_w13 - has the knowledge to describe basic development trends related to closed-loop technologies of raw and secondary materials in inorganic chemical technology
k_w22 - has knowledge of physical and chemical foundations of unit operations in inorganic chemical technology

Skills:
k_u01 - can retrieve information from literature and databases and other sources related to inorganic chemical technology, also in a foreign language, integrate and interpret it and draw conclusions and formulate 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_u05 - correctly uses in discussions and adequately uses nomenclature and terminology in the field of closed-loop economy, chemistry, technologies and chemical engineering, environmental protection and related disciplines, also in a foreign language
k_u08 - knows how to plan and organize individual work as well as team work
k_u09 - knows how to collaborate with other persons in the context of inorganic chemical technology as well as in interdisciplinary contexts
k_u10 - selects methods of process monitoring and quality assessment of raw materials, products and waste
k_u12 - knows how to assess usefulness and select tools and methods to solve problems in the field of inorganic chemical technology

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_k05 - objectively assesses the level of his own knowledge and skills, understands the importance of improving both professional and personal competences in line with changing social conditions and progress in science
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:

Learning outcomes presented above are verified as follows:
Lecture - exam, criterion: 3 - 50.1%-70.0%; 4 - 70.1%-90.0% and 5 from 90.1%
Laboratory - reports from laboratory exercises, colloquium, oral/written answer, presentation of theoretical and experimental material, solving scientific problems, assessment of student"s activity in laboratories, evaluation of teamwork; criterion: 3 - basic theoretical and practical knowledge, preparation skills concerning reports from laboratories, basic participation in practical classes without additional involvement; 4 - practical preparation supported by theoretical knowledge, the ability to formulate the right conclusions from the data obtained during the laboratory, active participation in classes supported by the desire to acquire additional practical and theoretical knowledge; 5 - complete preparation for classes, the ability to draw conclusions at an advanced level, and also posed defense, presentation of experimental data, precise execution of entrusted tasks, independent search of an additional theoretical knowledge, coordination of work in a research team, an ambitious approach to the subject matter.

Programme content

1. Introduction to the implementation of production processes in the field of inorganic technology
2. Poland"s raw material situation compared to other countries
3. Production of synthesis gas in fuel gasification processes
4. Waste fly ash
5. Closed gas cycle in the production of nitrogen compounds
6. Phosphorites and apatites in the technology of phosphorus compounds
7. Gypsum as a natural and secondary raw material
8. Sulfur and sulfur dioxide as basic raw materials in the production of sulfuric acid
9. Ilmenite raw materials
10. Waste brine solutions

Course topics

1. Wprowadzenie do realizacji procesów produkcyjnych w zakresie technologii nieorganicznej (stosowane procesy, przykłady reakcji chemicznych, równowaga reakcji chemicznych a wydajność produkcji, rola katalizatorów w procesach produkcyjnych i ich wpływ na selektywność reakcji oraz możliwość generowania produktów odpadowych, rodzaje produktów ubocznych/odpadowych z różnych gałęzi przemysłu nieorganicznego, podstawowe metody neutralizacji oraz możliwości ich ponownego wykorzystania).
2. Sytuacja surowcowa Polski na tle innych krajów (charakterystyka surowców naturalnych dla przemysłu chemicznego nieorganicznego, metody ich wzbogacania i przygotowania do procesów produkcyjnych celem podniesienia ich jakości oraz ograniczenia potencjlanej emisji substancji odpadowych na etapie ich przetwarzania, gospodarka substancjami odpadowymi powstałymi podczas wzbogacania surowców naturalnych).
3. Produkcja gazu syntezowego w procesach zgazowania paliw (wykorzystanie gazu syntezowego, problem emisji CO2, charakterystyka obiegu zamkniętego gazów w procesach pozyskiwania energii).
4. Odpadowe popioły lotne - charakterystyka, źródła pochodzenia, kierunki wykorzystania w aspektach technologicznych oraz środowiskowych.
5. Obieg zamknięty gazów w produkcji związków azotowych (amoniak, kwas azotowy).
6. Fosforyty i apatyty w technologii związków fosforu i związany z tym problem emisji związków fluorowych.
7. Gips jako surowiec naturalny oraz wtórny (pochodzący z technologii związków fosforu) jako wartościowy surowiec dla przemysłu budowalengo.
8. Siarka oraz ditlenek siarki jako podstawowe surowce w produkcji kwasu siarkowego (siarka jako surowiec naturalny, alternatywne źródła SO2 na potrzeby produkcji kwasu siarkowego w tym m.in. odsiarczanie paliw oraz spalin, nowe rozwiązania technologiczne).
9. Surowce ilmenitowe w produkcji pigmentów nieorganicznych, neutralizacja i potencjalne kierunki wykorzystania surowców ubocznych generowanych podczas produkcji bieli tytanowej.
10. Odpadowe roztwory solankowe w produkcji sody kalcynowanej oraz żrącej (wykorzystanie NaCl w procesie Solvaya, proces elektrochemiczny produkcji NaOH, kompleksowa metoda pozyskiwania nawozów oraz szerokiej gamy soli nieorganicznych w oparciu o zasolone wody kopalniane).

Teaching methods

Lecture - multimedia presentation
Laboratory - teaching materials for the laboratory in pdf files, practical exercises

Bibliography

Basic
1. K. Schmidt-Szałowski, J. Sentek, J. Raabe, E. Bobryk, Podstawy technologii chemicznej. Procesy w przemyśle nieorganicznym, Oficyna Wydawnicza Politechniki Warszawskiej Warszawa 2004
2. Moulijn Jacob A., Chemical Process Technology, Wiley-Blackwell 2013, ISBN13 (EAN): 9781444320251, ISBN10: 1444320254.
3. M.B. Hocking, Handbook of chemical technology and pollution control, Elsevier, Amsterdam 2005.
4. Jess Andreas, Chemical Technology: An Integral Textbook, Wiley 2012, ISBN13 (EAN): 9783527304462, ISBN10: 3527304460.
Additional
1. C.H. Bartholomew and R.J. Farrauto, Fundamentals of industrial catalytic processes, Wiley, Hoboken, New Jersey 2006.
2. J. Szarawara, J. Piotrowski, Podstawy teoretyczne technologii chemicznej, WNT Warszawa 2010
3. Ciesielczyk F., Inorganic acids–technology background and future perspectives (2020), de Gruyter, str. 1-21, DOI:10.15 15/psr-2019-00308. Laboratory materials (exercise elaboration).

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	65	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50