Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Ecology and technology of plant polymers

PURIFICATION AND RECOVERY OF INDUSTRIAL EMISSIONS OF ENTERPRISES PROCESSING PLANT RAW MATERIALS

Work program of the discipline (Syllabus)

Requisites of the discipline	
Level of higher education	***Second (master's)***
Field of expertise	*16 Chemical and bioengineering*
Speciality	*161 Chemical Technology and Engineering*
Educational program	*Chemical resource-efficient technologies of inorganic and organic substances, materials and coatings*
Discipline status	*Custom*
Form of education	*full-time / remote / mixed*
Year of preparation, semester	*1st year / spring semester*
Scope of discipline	*8 credits (240 hours)*
Semester Control/ Control Measures	*Exam*
Schedule of classes	*5 hours per week (2 hours of lectures, 1 hour of practical classes and 2 hours of laboratory classes)*
Language of instruction	*Ukrainian*
Information about the course leader/teachers	Lector: *https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytky/galish-vita-vasilivna.html* Practical/Seminar: *https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytky/galish-vita-vasilivna.html* Laboratory: *https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytky/galish-vita-vasilivna.html*
Course placement	*https://do.ipo.kpi.ua/*

The program of the discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

The urgent task of chemical technology is the development of resource-saving technologies, including through the creation of closed cycles of water use, recovery of valuable components from gas emissions, effective schemes for the disposal of industrial waste, which allows not only efficient use of energy and water resources, but also the integrated use of vegetable raw materials in technological processes.

Knowledge of methods of regeneration and recovery of valuable components from industrial emissions of enterprises for processing plant raw materials, methods of efficient waste disposal and reduction of the volume and pollution of wastewater in technological processes in the processing of plant materials, the impact of production processes of industrial enterprises on the environment and the ability to choose the main and auxiliary technological equipment of the processes of regeneration and recovery

of industrial emissions will allow in the future carry out the development and implementation of new technologies or modernization of existing industries with the principles of resource saving.

The subject of the discipline "Purification and recovery of industrial emissions of enterprises for processing plant raw materials" is the study of the latest technologies for wastewater treatment and gas-dust emissions of enterprises for processing plant raw materials, methods of utilization and processing of by-products into waste from relevant industries.

The purpose of the discipline "Purification and recovery of industrial emissions of enterprises for processing plant raw materials" is professional training and formation of masters of a complex of knowledge on thermodynamic, constructive and functional properties of modern processes of chemical processing of plant raw materials, purification and recovery of industrial effluents and emissions, *efficient processing and utilization of by-products and vegetable processing waste Raw. In accordance with the purpose, the preparation of masters in this specialty requires the acquisition of appropriate competencies:*

- *ability to search, process and analyze information from various sources;*
- *ability to research, classify and analyze quality indicators of chemical products, technological processes and equipment of chemical production;*
- *ability to organize and manage chemical and technological processes in industrial production conditions and in research laboratories, taking into account social, economic and environmental aspects.*

*According to the requirements of the program of the discipline "**Purification and recovery of industrial emissions of enterprises for processing plant raw materials**", students after mastering it must demonstrate the following program learning outcomes:*

- *organize their work and the work of the team in industrial production, design departments, research laboratories, determine goals and effective ways to achieve them, motivate and train staff;*
- *carry out in scientific and technical literature, patents, databases, other sources the search for the necessary information on chemical technology, processes and equipment for the production of chemicals and materials based on them, systematize, analyze and evaluate relevant information;*
- *knowledge and skills regarding the methods and concepts of modern trendy research in the field of chemical technology and engineering of inorganic, electrode materials and water treatment.*

2. Prerequisites and post-details of the discipline (place in the structural and logical scheme of training in the relevant educational program)

*The study of the discipline "Purification and recovery of industrial emissions of enterprises for processing plant raw materials" **is based on the principles of integration of various knowledge gained by masters during the bachelor's degree in the study of natural and engineering disciplines.** The discipline "**Purification and recovery of industrial emissions of enterprises for processing plant raw materials**" should help students in performing scientific work on the topic of a master's thesis and in fulfilling a master's thesis.*

3. Contents of the course

Section 1. Impact of individual components and their combinations on the environment

Topic 1.1. Protection of water bodies and atmospheric air from pollution by industrial emissions
Topic 1.2. Dispersion and conversion of industrial emissions in the atmosphere

Section 2. Types and composition of industrial emissions

Topic 2.1. Characteristics of wastewater
Topic 2.2. Characteristics of gas-dust emissions

Section 3. Methods for preventing industrial emissions, regeneration and recovery of valuable components

Topic 3.1. Technological methods for preventing and reducing industrial emissions
Topic 3.2. Regeneration and recovery of valuable components from industrial emissions
Topic 3.3. Reducing the volume and pollution of wastewater in technological processes

Section 4. Recycling valuable industrial emissions products and controlling industrial emissions

Topic 4.1. Recycling valuable products from industrial emissions
Topic 4.2. Control of industrial emissions

Section 5. Methods and technologies of purification and recovery of industrial emissions

Topic 5.1. CPV wastewater treatment methods
Topic 5.2. Methods for cleaning gas-dust emissions

4. Training materials and resources

Basic literature

1. *Purification and recovery of industrial emissions of pulp and paper industries: textbook. persons. / L. P. Antonenko, I. M. Deikun, M. D. Gomel. – K.: NTUU "KPI", 2010. – 188 p.*
2. *Galish V.V. Purification and recovery of industrial emissions of pulp and paper industries-2 / Recommendations for the implementation of course work: textbook. persons. for studios. Specialties 161 Chemical technologies and engineering, specializations Chemical technologies of wood and plant raw materials processing. – Kyiv: KPI them. Igor Sikorsky, 2019. – 36 p.*
3. *Galish V.V. Purification and recovery of industrial emissions of enterprises for processing of plant raw materials Method. instructions for performing home tests for students of specialty 161 - Chemical technologies and engineering, specialization - Chemical technologies of wood processing and vegetable raw materials. – Kyiv: KPI them. Igor Sikorsky, 2016. – 33 p.*
4. *Gomel M.D., Shabliy T.O., Radovenchyk Ya.V. Physico-chemical bases of water purification processes: textbook. – Kyiv: Condor Publishing House, 2019. – 256 p.*
5. *Basics of industrial emissions purification processes from vapors and gases. Laboratory workshop: textbook for students of specialty 101 Ecology, 161 Chemical Technologies and Engineering / Igor Sikorsky Kyiv Polytechnic Institute; compiled by: Ivanenko O.I., Overchenko T.A., Nosacheva Yu.V., Tverdokhlib M.M. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. – 34 p.*
6. *Krusir G. V., Madani M. M., Garkovich O. L. Technique and technologies of purification of gas emissions. Odesa: ONAFT-Odesa, 2017. 207 p.*

Further reading

7. *Cheryopkina R.I., Trembus I.V., Deikun I.M. Sulfate cellulose production technology: textbook for students. specialty 161 "Chemical technologies and engineering", educational and professional program "Industrial ecology and resource efficient clean technologies" /;- Kyiv : KPI them. Igor Sikorsky, 2022. – 274 p.*
8. *Primakov S.P., Barbash V.A., Cheryopkina R.I. Production of sulfite and organosolvent cellulose. – K.: ECMO, 2009. – 279 c.*

Information resources on the Internet

9. *Association of Ukrainian enterprises of pulp and paper industry "UkrPapir" / [Electronic resource]. – Access mode: https://ukrpapir.org*
10. *Ministry of Environmental Protection and Natural Resources of Ukraine / [Electronic resource]. – Access mode: https://mepr.gov.ua/*

11. *Scientific and technical library. G.I. Denysenko / [Electronic resource]. – Access mode: https://library.kpi.ua*
12. *National Library. V.I. Vernadsky / [Electronic resource]. – Access mode: http://www.nbuv.gov.ua/*
13. *Electronic archive of scientific and educational materials KPI. Igor Sikorsky / [Electronic resource]. – Access mode: https://ela.kpi.ua/*

Educational content

5. Methods of mastering the discipline (educational component)

Lecture classes

Lectures are aimed at:

- *providing modern, holistic, interrelated knowledge in the discipline "**Purification and recovery of industrial emissions of enterprises for processing plant raw materials**";*
- *ensuring the creative work of the student together with the teacher during the lecture;*
- *cultivation of student professional and business qualities, development of their independent creative thinking;*
- *formation of the student's interest in independent scientific activity;*
- *mastering modern trends in the development of the information environment for research activities;*
- *display of results (clear and adequate formulation of results, conclusions, recommendations);*
- *use of visual materials to demonstrate the results;*
- *teaching material in clear language in compliance with structural and logical connections;*
- *accessibility for audience perception.*

No salary	*The title of the lecture topic and the list of main issues and tasks on the CPC*	*Hours*
1	**Protection of water bodies and atmospheric air from pollution by industrial emissions.** Impact of pollutants on humans and the environment. Maximum permissible concentrations of pollutants in water and atmospheric air. Maximum permissible discharges and maximum permissible emissions of pollutants into the environment. Tasks on the CPC. Specially authorized bodies in the ONS. Definition of the ONS system and its main tasks. Objects subject to protection. Observation, forecasting, accounting and reporting to the ONS.	***4***
2	**Dispersion and transformation of industrial emissions in the atmosphere.** Factors affecting the dispersion of industrial emissions. Conversion of pollutants in the atmosphere. Environmental protection by industrial enterprises. Tasks on the CPC. Acid rain. Destruction of the ozone layer. Measures to protect the ozonosphere. Montreal Protocol on Substances that Deplete the Ozone Layer. Anthropogenic climate change in large cities. Air temperature. Temperature inversion. Radiation. Wind speed. Haze, fog, smog and visibility in cities.	***2***
3	**Characteristics of wastewater.**	***2***

	Quantity and quality of wastewater. Characteristics of industrial emissions (wastewater): wastewater of wood-preparation department and sulfate-cellulose production. Characteristics of industrial emissions (wastewater): wastewater from sulfite-cellulose production, production of wood pulp and paper and cardboard. Tasks on the CPC. Permits and limits on emissions of harmful substances.	
4	**Characteristics of gas-dust emissions.** Characteristics of gas-dust emissions: emissions of sulfite-cellulose production, emissions of sulfate-cellulose production, emissions of thermal power plants. Tasks on the CPS. Harmful effects and pollution. Chemical composition, physicochemical properties of aerosols, sources of their entry into the atmosphere. Changes in the chemical composition of atmospheric air and climate dynamics of the Earth. Change in carbon dioxide concentration. Conversion of carbohydrates in the atmosphere. Aerosols in the troposphere.	***3***
5	**Technological methods for preventing and reducing industrial emissions.** Prevention of emissions during cooking of sulfate cellulose. Reduction of emissions during evaporation of black waste cooking solutions of sulfate-cellulose production. Prevention of emissions from burning black waste cooking solutions and energy fuels Tasks on the CPS. The chemical composition of cellulose sulfate emissions, physicochemical properties of aerosols, sources of their entry into the atmosphere.	***4***
6	**Regeneration and recovery of valuable components from industrial emissions.** Thermal methods of regeneration. Recovery of sulfur and chlorine-containing components from gas emissions. Tasks on the CPS. Changes in the chemical composition of atmospheric air and climate dynamics of the Earth. Change in carbon dioxide concentration. Conversion of carbohydrates in the atmosphere.	***4***
7	**Reducing the volume and pollution of wastewater in technological processes.** Technological methods that prevent industrial emissions (prevention of emissions from burning black cheeks and energy fuel). Closed cycle of water movement in production. Tasks on the CPC.The impact of industry on water bodies. Impact on water bodies of household (municipal) wastewater. Urbanization and its impact on water basins. The impact of reclamation measures on water bodies. Change in water quality in reservoirs. Pollution of water bodies in Ukraine.	***3***

8	**Utilization of valuable products from industrial emissions.** Methods of utilization of valuable products from wastewater – complex processing of sulfite cheeks (composition of cheeks, production of alcohol, fodder yeast, burning of cheeks, chemical processing of lignosulfonates, schemes of complex processing of sulfite cheeks, cymol capture.) Complex use of by-products of sulfate-cellulose production (preparation of sulfan odorant, preparation of purified turpentine and technical pinene, preparation of dimethyl sulfoxide, dimethylation of black lignin chelok, production of raw tall oil and its distillation products, utilization of pre-hydrolysate, wastewater disposal of bleaching and acid plants). Solid waste disposal. Use of bark, knots, penetration, waste fine sorting of cellulose and fine fiber. Tasks on the CPC. Integrated use of raw materials and waste. Waste-free production in the hydrolysis industry	***6***
9	**Control of industrial emissions.** General provisions. Industrial wastewater control. Control of industrial emissions into the atmosphere. Tasks on the CPC. Impact on water bodies of domestic wastewater. Rationing of water quality depending on the category of water body. Engineering methods of water protection. Water self-purification processes.	***4***
10	**CPV wastewater treatment.** Methods of mechanical wastewater treatment: settling and filtration, flotation, separation of suspensions in the field of centrifugal forces. Physico-chemical methods of purification: mixing and neutralization of wastewater, methods of oxidation, desorption, coagulation, adsorption and ion exchange, membrane methods. Biological methods of wastewater treatment. Tasks on the CPS. The main factors affecting the formation of pollution concentrations in the surface layer. Classification of sources of air pollution.	***2***
11	**Purification of gas and dust emissions**. Characteristics of dust capture methods. Devices for dry cleaning of gases from dust particles. Fabric and fibrous filter apparatus. Devices for wet cleaning of gases from dust particles. Electrostatic gas purification devices. Tasks on the CPS. Taking into account background concentrations in calculations of air pollution and setting the background by calculations.	***2***
12	***Just***	***36***

Practical exercises

In the system of professional training of masters in this discipline, practical classes occupy 25% of the classroom load. Being a complement to the lecture course, they lay and form the foundations of the Master's qualification in Chemical Engineering. The content of these classes and the methods of their conduct ensure the development of the creative activity of the individual. They develop scientific thinking and the ability to use special terminology, allow you to test knowledge. Therefore, this type of work is an important means of operational feedback. Practical classes perform not only cognitive and educational functions, but also promote the growth of students as creative specialists in the field of chemical

technologies who are able to apply modern methods of purification and recovery of industrial emissions in professional activities.

The main objectives of the series of practical classes:

- *help students systematize, consolidate and deepen theoretical knowledge in the field of purification and recovery of industrial emissions;*
- *teach students techniques for solving practical problems, promote the mastery of skills and abilities to use information sources to solve the problems of environmental pollution by components of industrial emissions and discharges;*
- *form the ability to learn to independently master the methods, methods and techniques of self-study, self-development and self-control.*

No salary	***The title of the topic of the practical lesson and the list of the main issues of the task on the CPC***	***Hours***
1	**Protection of water bodies and atmospheric air from pollution by industrial emissions** Organoleptic analysis of wastewater of CPV enterprises. Tasks on the CPC. Preservation of water samples taken for analysis.	***2***
2	**Characteristics of wastewater** Calculation of silted matter content, dry residue and residue after ignition of silted substances in wastewater of CPV enterprises. Tasks on the CPC. Calculation of mineral and organic component of silted substances in wastewater of CPV enterprises.	***8***
3	**CPV wastewater treatment methods** Calculation of the theoretical optimal dose of coagulant for purification of turbid water. Coagulant selection, calculation of optimal dose and coagulant consumption Tasks on the CPC. Calculation of the theoretical optimal dose of coagulant for cleaning colored water. Effect of the cation in the composition of the coagulant on the treatment of CPV wastewater	***8***
4	***Just***	***18***

Laboratory classes

In the system of professional training of masters in this discipline, practical classes occupy 50% of the classroom load. Being a complement to the lecture course, they form a significant base for the training of a highly qualified professional in chemical technology and engineering. The purpose of laboratory classes is to develop masters' experimental research skills to study the subject and consolidate theoretical material.

No salary	***Title of laboratory work***	***Hours***
1	Entry. Safety instruction, familiarization with the program of laboratory work, issuance of methodical literature, issuance of model samples of industrial wastewater	***2***
2	Organoleptic analysis of wastewater (determination of temperature, odor, transparency, turbidity, color of wastewater)	***4***

3	Determination of acidity and alkalinity of wastewater, silted substances, dry residue and residue after ignition of silted substances	***8***
4	Analysis of wastewater for chlorides and sulfates	***4***
5	Determination of permanganate oxidation of water and water hardness	***4***
6	Determination of the optimal dose of coagulant for water purification and water purification by coagulation	***6***
7	Analysis of water after coagulation: organoleptic analysis, acidity, alkalinity, content of silted substances and dry residue, content of chlorides and sulfates, determination of permanganate oxidation of water, water hardness	***6***
8	Protection of laboratory works	***2***
4	***Just***	***36***

6. Independent work of the student

Independent work takes 62.5% of the time studying the credit module, including preparation for a modular test and exam. The main task of independent work of students is the mastery of scientific knowledge in areas that are not included in the list of lecture issues through personal search for information, the formation of an active interest in the creative approach in educational work. In the process of independent work, the student must learn to use modern information systems to perform scientific research.

No salary	*The name of the topic submitted for independent study*	*Number of hours CPC*
Section 1. Impact of individual components and their combinations on the environment		
1	Specially authorized bodies in the ONS. Defining the ONS system and its main tasks. Objects subject to protection. Observation, forecasting, accounting and reporting in the ONS. Acid rain. Destruction of the ozone layer. Measures to protect the ozonosphere. Montreal Protocol on Substances that Deplete the Ozone Layer. Anthropogenic climate change of large cities. Air temperature. Temperature inversion. Radiation. Wind speed. Haze, fog, smog and visibility in cities.	*21*
Section 2. Types and composition of industrial emissions		
2	Permits and limits on emissions of harmful substances. Harmful effects and pollution. Chemical composition, physicochemical properties of aerosols, sources of their entry into the atmosphere. Changes in the chemical composition of atmospheric air and climate dynamics of the Earth. Change in carbon dioxide concentration. Conversion of carbohydrates in the atmosphere. Aerosols in the troposphere.	*17*
3	*Preparation for modular tests in sections 1-2*	*4*
Section 3. Methods for preventing industrial emissions, regeneration and recovery of valuable components		
4	The chemical composition of cellulose sulfate emissions, physicochemical properties of aerosols, sources of their entry into the atmosphere.	*23*

	Changes in the chemical composition of atmospheric air and climate dynamics of the Earth. Change in carbon dioxide concentration. Conversion of carbohydrates in the atmosphere. The impact of industry on water bodies. Impact on water bodies of domestic (municipal) wastewater. Urbanization and its impact on water basins. The impact of reclamation measures on water bodies. Changes in water quality in reservoirs. Pollution of water bodies in Ukraine.	
5	*Preparation for modular test work for section 3*	*4*
Section 4. Recycling valuable industrial emissions products and controlling industrial emissions		
6	Integrated use of raw materials and waste. Waste-free production in the hydrolysis industry. Impact on water bodies of domestic wastewater. Rationing of water quality depending on the category of water body. Engineering methods of water protection. Water self-purification processes.	*18*
Section 5. Methods and technologies of purification and recovery of industrial emissions		
7	The main factors affecting the formation of pollution concentrations in the surface layer. Classification of sources of air pollution. Taking into account background concentrations in calculations of air pollution and setting the background by calculations.	*19*
8	*Preparation for modular tests in sections 4 – 5*	*4*
9	*Execution of OCD*	*10*
10	*Exam preparation*	*30*
11	*Total hours*	*150*

Policy and control

7. Policy of the discipline (educational component)

Rules for attending classes and behavior in classes

Attendance at classes is a compulsory component of assessment. Students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without a good reason, not to interfere with the teacher to conduct classes, not to be distracted by actions that are not related to the educational process.

Rules for assigning incentive and penalty points

- *Incentive points can be awarded by the teacher solely for active participation in the educational process (practical classes) or additional completion of online specialized courses with obtaining the appropriate certificate:*

But their amount cannot exceed 10% of the rating scale.

- *Penalty points within the discipline are not provided.*

Deadlines and rebuilds policy

In case of arrears in the discipline or any force majeure circumstances, students should contact the teacher through the available (provided by the teacher) communication channels to solve problem issues and agree on an algorithm of actions for working out.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism refers to the lack of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible hints and cheating when writing tests, conducting classes; passing an exam for another student; copying materials protected by the copyright system without the permission of the author of the work.
The policy and principles of academic integrity are defined in section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code

Academic Conduct and Ethics Policy
Students should be tolerant, respect the opinions of others, formulate objections in the correct form, constructively maintain feedback in the classroom.
The norms of ethical behavior of students and employees are defined in section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code

8. Types of control and rating system for assessing learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline according to the working curriculum:

Semester	Study time		Distribution of training hours				Control measures		
	Loans	Acad. H.	Lecture	Practical	Lab. Rob.	CPC	FDM	OCD	Semester control
2	8	240	36	18	36	150	+	+	Exam

The starting rating of a student in a discipline consists of points that he receives for:

1) *Answer in practical classes;*
2) *Performance and defense of 7 laboratory works;*
3) *Performance of modular tests;*
4) *Doing homework tests;*
5) *The answer to the exam.*

Semester control is an exam.

System of rating (weight) points and evaluation criteria

1. *The answer in practical classes.*

Survey to check the student's mastery of material or problem solving.
The weight score for answering/solving the problem is 3 points. The number of answers is 3.
The maximum number of points for practical work is 3 points x 3 = 9 points.

Completeness and signs of response	Points
"Excellent": Good preparation in discussing issues, performing all tasks. The problem is solved correctly	*3*
"Good": The answer does not provide a sufficient number of factors, examples and conclusions or makes some inaccuracies in the solution	*2*
"Satisfactory": The student is willing to discuss only part of the questions and/or makes gross mistakes in the answers. Gross errors in calculations were made	*1*
"Unsatisfactory": There is no active work and preparation for practical classes. The problem is not solved	*0*

2. *Work in laboratory classes.*

Execution and defense of 7 laboratory works. Criteria for evaluating work in laboratory classes.

Completeness and signs of response	*Points*
"Excellent": Good preparation in discussing issues, performing all tasks	*3*
"Good": The answer does not provide enough factors, examples, and conclusions, or contains some inaccuracies	*2*
"Satisfactory": The student is ready to discuss only part of the questions and/or makes gross mistakes in the answers	*1*
"Unsatisfactory": There is no active work and preparation for the practical lesson	*0*

Maximum points for work in laboratory classes: 3 points x 7 = 21 points.

3. *Modular test:*

The ICR consists of three parts, each of which contains 10 questions. In the case of distance learning - performed on the distance learning platform MOODLE - https://do.ipo.kpi.ua/

The weight score for the modular test paper is 5 points.

Completeness and signs of response	*Points*
"Excellent": Full answer to the question	*5*
"Good": The answer does not provide enough factors, examples, and conclusions, or contains some inaccuracies	*4*
"Satisfactory": The answer is superficial, serious mistakes have been made, there is no specific wording of laws and terms	*3*
"Unsatisfactory": Question not counted or no answer	*0*

The maximum number of points for a modular test is 15 points.

4. *Homework test*

   It involves the use of a creative approach to solving the problem of industrial wastewater pollution of enterprises using vegetable raw materials as a starting material.

The weight score for the home test is 10 points.

Completeness and signs of response	*Points*
The topic of OCD is fully disclosed; The student thoroughly explains all aspects of the relevant topic, draws the necessary conclusions and generalizations, and clearly answers the questions posed	*10*
The OCD does not provide enough facts and examples; proper analysis has not been carried out; insufficiently clearly formulated conclusions; The answers to the questions are unclear or have some inaccuracies	*9-5*
OCD is not sufficiently disclosed; no conclusions; No answers to individual questions	*1-4*
OCD does not correspond to the formulated topic; All the questions asked remained unanswered. OCD not credited	*0*

The maximum number of points for a home test is 10 points.

Thus, the maximum amount of points of the starting component that a student can receive from the credit module is:

$$Rc = 9 + 21 + 15 + 10 = 55 \text{ points.}$$

The examination component is 50% of R:

$$Rex: = 45 \text{ points.}$$

The overall rating scale for the credit module is:

$$R = Rc + Ex = 55 + 45 = 100 \text{ points.}$$

According to the results of educational work for the first 7 weeks, the "ideal student" should score 15 points. At the first certification (8th week), the student receives "credited" if his current rating is at least 8 points.

According to the results of educational work for 13 weeks of study, the "ideal student" should score 35 points. At the second certification (14th week), the student receives "credited" if his current rating is at least 20 points.

A prerequisite for admission to the exam is the enrollment of all laboratory works and home tests with an overall level of starting rating of at least 35 points.

Exam

At the exam, the student performs a written test. Each ticket contains two theoretical questions and one practical one, which consists in solving the problem. The list of questions is given in Chapter 9. Each question is evaluated at 15 points.

Completeness and signs of response	*Points*
"Excellent": Complete answer to the question, at least 90% of the necessary information (complete, error-free solution to the problem)	*15-13*
"Good": Sufficiently complete answer, at least 75% of the required information (complete solution of the problem with minor inaccuracies)	*12-7*
"Satisfactory": Incomplete answer, at least 60% of the required information and some errors (task completed with some inaccuracies)	*6-1*
"Unsatisfactory": The answer is missing or does not satisfy the conditions	*0*

The sum of all rating points R received during the semester is translated according to the table:

Score	***Score***
95...100	*Perfectly*
85...94	*very good*
75...84	*well*
65...74	*Satisfactory*
60...64	*enough*
RD <60	*Disappointing*
Not met the conditions of admission	*not admitted*

9. Additional information on the discipline (educational component)

APPROXIMATE LIST OF QUESTIONS FOR MODULAR TESTS

1. What changes do wastewater containing pollutants cause in water bodies?
2. How is water divided by quality?
3. How many hazard classes are industrial substances divided according to the degree of danger?
4. What is monitoring?
5. Are the MPCs in the air of the working area of industrial premises and in the atmospheric air of settlements the same and where are they smaller?
6. How are the MPCs of harmful substances divided in the atmospheric air of settlements?
7. In what units is MPC determined?
8. What characterizes the background concentration?
9. What is the determining criterion for assessing the conditions for the discharge of wastewater into water bodies?
10. List the groups into which CPV wastewater can be divided.
11. What factors influence the dispersion of industrial emissions?
12. What types of wastewater are generated in industrial plants?
13. What is the rate of drainage?
14. What are the main flows of industrial wastewater generated during sulfate pulp production?
15. What compounds are part of the wastewater of brewing, washing and treatment plants of sulfite-cellulose production?
16. Wastewater from the production of XTMM or HMM is polluted more and why?
17. What is the purpose of a gas contact evaporator?
18. In what directions are technological resource-saving methods of preventing and reducing industrial emissions developing?
19. What factors determine the yield of sulfur-containing compounds during cooking sulfate cellulose?
20. What is called a single action zone of a substance and what does it characterize?
21. What does wastewater pollution depend on during paper production?
22. What components are contained in gas-dust emissions of sulfate-cellulose production?
23. What is the reason for the appearance of H2S and MM in the gas-dust emissions of the pulpable sulfate-cellulose production evaporation plant?
24. What is the purpose of a gas contact evaporator?
25. How can the amount of methyl sulfur compounds be reduced in sulfate-cellulose production?
26. What is the purpose of oxidation of black mast?
27. Define recovery.
28. What are the main methods of regeneration.
29. What groups can be divided into recovery methods?
30. How can the volume and contamination of wastewater in the industrial cycle be reduced?
31. What are potential secondary material resources?
32. What can be obtained from used sulfite cheeks?
33. What can be obtained from black mast cellulose sulfate?
34. What methods of mechanical wastewater treatment do you know and on what equipment is it carried out?
35. What condition must be fulfilled for complete mutual neutralization of wastewater?
36. What are the most common methods of physicochemical wastewater treatment.
37. Draw a graph of changes in ζ – the potential of negatively charged particles depending on the dose of coagulant.
38. What methods of water purification belong to membrane and for purification from what impurities are they used?

39. What is biological wastewater treatment based on?
40. What types of dust collection devices are divided into?

LIST OF HOME TEST TOPICS

1. Wastewater pollution during newsprint production and methods to prevent these contaminants.
2. Pollution of wastewater during the production of cardboard for flat layers of corrugated cardboard with a bleached surface layer and methods for preventing these contaminants
3. Pollution of wastewater during offset paper production and methods to prevent these contaminants.
4. Pollution of wastewater during the production of container cardboard and methods for preventing these contaminants.
5. Pollution of wastewater during the production of toilet paper from 100% waste paper and methods to prevent these contaminants.
6. Pollution of wastewater during the production of chromium-ersatz cardboard from waste paper and methods to prevent these contaminants.
7. Pollution of wastewater during the production of corrugated paper with 100% waste paper and methods for preventing these contaminants.
8. Pollution of wastewater during the production of writing paper and methods to prevent these contaminants.
9. Wastewater pollution during printing paper production and methods to prevent these contaminants.
10. Wastewater pollution during cigarette paper production and methods to prevent these contaminants.
11. Wastewater pollution during napkin paper production and methods to prevent these contaminants.
12. Pollution of wastewater during the production of toilet paper, waste paper and methods to prevent these contaminants.
13. Pollution of wastewater during the production of container cardboard from waste paper and methods for preventing these contaminants.
14. Pollution of wastewater during the production of writing paper No. 2 and methods for preventing these contaminants.
15. Pollution of wastewater during the production of towel paper and methods to prevent these contaminants.
16. Pollution of wastewater during the production of electrical insulation paper and methods to prevent these contaminants.
17. Pollution of wastewater during the production of capacitor paper and methods to prevent these contaminants.
18. Wastewater pollution during tissue paper production and methods to prevent these contaminants.
19. Pollution of wastewater during the production of printing paper No. 2 and methods for preventing these contaminants.
20. Pollution of wastewater during the production of newsprint from waste paper and methods to prevent these contaminants.

SAMPLE LIST OF QUESTIONS FOR THE EXAM

1. Impact of pollutants on humans and the environment (wastewater);
2. Regeneration and recovery of valuable components from industrial emissions (definitions and

methods);

3. Impact of pollutants on humans and the environment (gas and dust emissions);
4. Regeneration of sulfide and caustic soda from spent mast of sulfate-cellulose production;
5. Maximum permissible concentrations of pollutants in water and atmospheric air;
6. Regeneration of lime – auxiliary raw material of sulfate-cellulose production;
7. Maximum permissible discharges and maximum permissible emissions of pollutants into the environment;
8. Recovery of sulfur and chlorine-containing components;
9. Factors influencing the dispersion of industrial emissions;
10. Technological measures to reduce the amount and contamination of wastewater from sulfate-cellulose production;
11. Conversion of pollutants in the atmosphere;
12. Technological measures to reduce the amount and contamination of wastewater of the pulp bleaching shop;
13. Environmental protection by industrial enterprises;
14. Technological measures to reduce the amount and pollution of wastewater;
15. Characteristics of wastewater (quantity and quality of wastewater);
16. Methods of mechanical wastewater treatment;
17. Characteristics of wastewater (wood-preparation department);
18. Closed cycle of water movement in production (necessary measures);
19. Characteristics of wastewater (sulfate-cellulose production);
20. Sedimentation tanks for wastewater treatment;
21. Characteristics of wastewater (sulfite-cellulose production);
22. Closed cycle of water movement in the production of paper and cardboard;
23. Regeneration and recovery of valuable components from industrial emissions (definitions and methods);
24. Cleaning of gas-dust emissions in electrostatic precipitators;
25. Characteristics of gas-dust emissions (sulfate-cellulose production cookhouse);
26. Wastewater treatment methods based on filtration;
27. Characteristics of gas-dust emissions (acid shop of sulfite-cellulose production);
28. Sieves and fractionators for water purification;
29. Characteristics of gas-dust emissions (workshop for preparation of solutions for bleaching);
30. Utilization of substances from liquid waste (sulfate-cellulose production);
31. Utilization of substances from liquid waste (sulfite-cellulose production);
32. Flotation method of water purification;
33. Production of sulfite alcohol;
34. Physicochemical methods of wastewater treatment (neutralization);
35. Characteristics of gas-dust emissions (gas-contact evaporator of sulfate-cellulose production);
36. Physicochemical methods of wastewater treatment (redox processes);
37. Characteristics of gas-dust emissions (melting solvent and lime regeneration furnace);
38. Physicochemical methods of wastewater treatment (desorption of volatile impurities);
39. Characteristics of gas-dust emissions (thermal power plants);
40. Wastewater treatment by coagulation;
41. Technological methods for preventing and reducing industrial emissions;
42. Scheme of complex processing of sulfite masts;
43. Prevention of emissions during cooking of sulfate cellulose;
44. Composition of black mast of sulfate-cellulose production and demethylation of lignin;
45. Recycling of sulfate soap;
46. Biological methods of wastewater treatment (aeration tanks);
47. Prevention of emissions during the burning of black cheeks and energy fuel;

48. Cleaning of gas-dust emissions in electrostatic precipitators;
49. Biological methods of wastewater treatment (biofilters);
50. Coagulants and reagents that promote coagulation.

EXAMPLES OF TASKS IN EXAMINATION TICKETS

1. Determine the theoretically required amount (in cm^3) of coagulant *$FeCl_3$ (concentration $FeCl_3$* = 3.00 g/dm^3) for cleaning *3 dm^3 of pit water after production of printing paper from 100% cellulose, if the content of silted substances in water is 1500 mg/dm^3 and propose a scheme for purification of such water.*
2. Determine the theoretically required amount (in cm^3) of coagulant *Al2(OH)5Cl (concentration* of $Al_2(OH)_5Cl$ *= 4.00 g*/dm^3 according to Al_2O_3*)* for purification of 10 dm^3 of grid water after production of corrugated paper from 100% waste paper, if the silt content in water is 2550 mg/dm^3 and suggest a scheme for purification of such water.
3. Determine the theoretically required amount (in cm^3) of coagulant *$Al_2(SO_4)_3$ x $18H_2O$* at a concentration of 2.85 *g*/dm^3 for cleaning 7 dm^3 of grid water after production of electrical insulating paper, if the content of silted substances in water is 225 mg/dm^3 and propose a scheme for purification of such water.
4. Determine the theoretically required amount (in cm^3) of coagulants *$FeCl_3$ and $Al_2(SO_4)_3$ (coagulant concentration 2.75 g/dm3) for cleaning 10 dm^3 of pit water after the production of chromium-ersatz cardboard, if the silted substances content in water is 2250 mg/dm^3 and analyze the results.*
5. Determine the theoretically required amount (in cm^3) of coagulants *$Al_2(SO_4)_3$* and $Al_2(OH)_5Cl$ *(coagulant concentration 2.55 g*/dm^3) to purify 1 dm3 of pit water after the production of newsprint from 100% waste paper, if the siltant content in water is 2250 mg/dm^3 and analyze the results.
6. Determine theoretically the required amount (in cm^3) of coagulants *$FeCl_3$ and* $Al_2(OH)_5Cl$ *(coagulant concentration 3.50 g/dm^3) for purification of 1 dm^3 of pit water after production of printing paper from 100% cellulose, if the silted content in water is 1450 mg/dm^3 and analyze the results.*

Work program of the discipline (syllabus):

Compiled by Assoc. Prof. *Ph.D., Assoc. Prof. Halysh V.V.*

Approved by the Department of E and TRU (protocol No 14 of 05/18/2023)

Approved by the IHF Methodological Commission (protocol No. 10 of 05/26/2023)