National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

Ecology and technology of plant polymers

Protection of Atmospheric Air from Gaseous Pollution

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	***Bachelor***
Field of knowledge	*16 Chemical and bioengineering*
Speciality	*161 Chemical technology and engineering*
Educational program	*Industrial ecology and resource-efficient clean technologies*
Discipline status	*Custom*
Form of study	*extramural studies*
Year of preparation, semester	*2ndyear/4 semester*
Scope of discipline	*4 credits (120 hours)*
Semester control/ control measures	*Final test*
Schedule of classes	*4 hoursand lectures, 2 hours of laboratory classes, 2 hoursand practical classes*
Language of instruction	*Ukrainian*
Information about thecourse / teachers	*Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html* *Teacher of practical classes: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html* *Teachers of laboratory classes: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html* *https://eco-paper.kpi.ua/pro-kafedru/vykladachi/trus-inna-mikolajivna.html*
Course placement	*https://do. ipo. kpi. ua/course/view. php? id=5942*

The program of the discipline

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

One of the main vital elements of the environment is atmospheric air. The negative impact of human economic activity, namely emissions of vapors and gases, leads to a deterioration in air quality. Based on an understanding of the mechanisms of human influence on the environment and the processes occurring in it; selection of scientifically based technical, technological and organizational measures to prevent environmental pollution; selection, planning, design and calculation of parameters of work of certain types of equipment, parameters of technological processes and regulatory indicators of the state of the environment; it is possible to protect the environment from the negative anthropogenic load on the airspace of the planet.

The subject of the discipline "Protection of atmospheric air from pollution by gaseous impurities" – for the implementation of environmental technologies aimed at protecting the atmosphere, is the purification of gaseous waste from vapors and gases before their release into the atmosphere.

The solution to this problem will be determined by the level of skills of specialists working in the field of environmental protection, including state environmental safety management institutions, scientific institutions and organizations, enterprises.

To successfully solve the problems of protecting and preserving the atmosphere, specialists must be fluent in information, analyze the directions for improving existing environmental and environmentally renewable technologies for ensuring environmental safety, and be able to solve complex problems of air protection from pollution at a high professional level.

The purpose of the discipline "Protection of atmospheric air from pollution by gaseous impurities"

The purpose of studying this discipline is to form students' complex of knowledge in the field of modern methods of purification of waste gases, a set of skills and abilities necessary for conducting scientific research in this direction, for creating modern gas cleaning technologies and for qualified management of existing technological processes. In accordance with the goal, the preparation of bachelors requires strengthening the competencies formed by students:

- *Ability to assess the impact of technogenesis processes on the state of the environment and identify environmental risks associated with production activities*
- *Ability to master international and domestic experience in solving regional and cross-border environmental problems*
- *Ability to develop design and working technical documentation in the field of environmental technologies, to draw up structural schemes with elements of equipment and industrial buildings, to draw up completed design and development*
- *Ability to improve, design, implement and operate technologies and equipment for the treatment and processing of waste gases, wastewater and solid waste*
- *Zdatnist sastosovv vati suhasni metodi i casob kontrolu stuatmosfern ogo povitri, prirodny waters, gruntandc and biots, determine the level of contamination of natural and industrial materials with radioactive elements, own methods for assessing the impact adverse factors on living organisms, to determine the adaptive capabilities of the human body in environmental conditions*
- *The ability to distinguish the technological processes of production, to determine df erela i shlixi nadhodgeey y nav kolishne pp rone seredovysh e shkidlivykh komponentic, ocinyut yx vfloat na state sdorovya liudini and ikist to vkill i*

*According to the requirements of the program of the discipline "**Protection of atmospheric air from pollution by gaseous impurities**", students after its mastery must demonstrate the following programmatic learning outcomes:*

- *Solve problems in the field of environmental protection using generally accepted and / or standard approaches and international and domestic experience*
- *Be able to search for information using appropriate sources to make informed decisions*
- *Conduct laboratory tests using modern devices, ensure sufficient measurement accuracy and reliability of results, process the results obtained*
- *Apply methodologies and technologies for the design, implementation and implementation of environmental technologies and equipment, carry out design activities*
- *To assess the state of the environment, determine the level of impact of the enterprise (production) on the environment, determine the main environmental pollutants of this enterprise (production)*
- *Develop technologies, use processes and devices that ensure effective separation, concentration, extraction, destruction of harmful impurities in water systems and gas environments, recycling and disposal of waste*

Prerequisites and post-requisitions of disciplines (place in the structural and logical scheme of education according to the relevant educational program)

The study of the discipline "Protection of atmospheric air from pollution by dispersed particles" is based on the principles of integration of various knowledge gained by students during the undergraduate

period in the study of natural and engineering-technical disciplines: "Chemistry with the basics of biogeochemistry", "Special sections of biogeochemistry", "General ecology".

The discipline "Protection of atmospheric air from pollution by dispersed particles" is the fundamental basis for the study of the following disciplines: Acquired knowledge and skills are used in the study of the following disciplines: "Environmental Monitoring", "Modeling and Forecasting of the State of the Environment", "Rationing of anthropogenic load on the environment", "Ecological and natural-technogenic safety", "Technoecology" and ensures the implementation of a bachelor's project.

3. The content of the discipline "Protection of atmospheric air from pollution by gaseous impurities"

Topic 1. Calculations of emission indicators (specific emissions) of pollutants into the atmospheric air by various industries.

Topic 2. Basics of absorption methods for cleaning gas emissions from gaseous pollutants.

Topic 3. Adsorption treatment of gas emissions.

Topic 4. Catalytic gas purification.

Topic 5. Membrane and magnetic processes of neutralization of gas emissions.

Topic 6. Chemical and biochemical methods of purification of gas emissions.

Topic 7. Thermal afterburning of gas emissions.

Topic 8. Technologies for cleaning emissions from gaseous impurities.

Topic 9. Purification of waste gases in various industries.

Learning materials and resources

Basic literature

1. Beketov V. E., Yevtukhova G. P. Sources and processes of air pollution. Kharkiv : KhNUMG them. O. N. Beketova, 2019. 113 p. https://core.ac.uk/download/pdf/228030186.pdf

2. Sarapina M. V. Processes and apparatuses of dust and gas cleaning: a course of lectures. Kharkiv: NUCZU, 2018. 125 p.

3. Krusir G. V., Madani M. M., Garkovich O. L. Technique and technologies for cleaning gas emissions. Odessa: ONAFT-Odessa, 2017. 207 p.

4. Protection of atmospheric air from pollution by gaseous impurities. Laboratory workshop [Text]: textbook for students of the specialty 101 Ecology; 161 Chemical technologies and engineering / Igor Sikorsky Kyiv Polytechnic Institute; compiled by: T. A. Overchenko, O. I. Ivanenko, Y. V. Nosachov, M. M. Tverdokhlib. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. – 34 p.

Further reading

5. Ivanenko O.I. Methodical instructions for the implementation of course projects on the course "Technology and equipment for atmospheric protection", -K.: LLC "Infodruk", - 2012. -107 p.

6. Industrial technologies and purification of technological and ventilation emissions: training staff / Y. S. Yurkevich, O. T. Voznyak, V. M. Zhelikh , MINISTRY OF EDUCATION AND SCIENCE of Ukraine, NU "Lviv Polytechnic".
2012. 120 p.

7. Severin L.I., Petruk V.G., Bezvozyuk I.I., Vasylkivsky I.V. Environmental technologies (protection of the atmosphere) / Ch.I: Textbook. Vinnytsia : UNIVERSUM–Vinnytsia, 2010. https://web.posibnyky.vntu.edu.ua/iebmd/severin_priodoohoronni_tehnologii/dop-m.html

8. Ratushniak G.S., Lyaliuk O.G. Means of purification of gas emissions.
Vinnytsia : UNIVERSUM–Vinnytsia, 2008. 207 p.

9. Environmental technologies. Part 1. Protection of the atmosphere: a textbook / Severin L.I., Petruk V.G., Bezvozyuk I.I., Vasylkivsky I.V. – Vinnitsa: VNTU, 2012. – 388 p. 10. Beketov V.E. Lecture notes from the course "Applied Aeroecology". Module 1 "Atmosphere. Basic terms and definitions" / Hark. National. acad. city. households; V. E. Beketov, G. P. Yevtukhova, Y. L. Kovalenko. H.: KHNAMG, 2011. 44 p.

11. Beketov V. E. Lecture notes from the section "Methods and devices for controlling concentrations

dust and gas impurities in the atmosphere and in industrial emissions" in the discipline "Methods and
instruments for monitoring the state of atmospheric air" / Beketov V.E., Yevtukhova G.P., Kovalenko Yu.L.; Hark. National. acad. city. households. H.: KHNAMG, 2011. 40 p.
12. КД 52.9.4.01–09. Methodical instructions for forecasting meteorological conditions for the formation of air pollution levels in the cities of Ukraine. Kyiv: State Hydrometeorological Service, 2010. 78 p.
13. Ryzhkov S. S. Devices for air purification from pollution : method. instructions / S. S. Ryzhkov, Y. M. Kharitonov, V. V. Blagodatny. - Nikolaev : UDMTU, 2002. - 36 p.
14. Collection of indicators of emission (specific emissions) of pollutants into the atmospheric air by various industries. - Ukrainian Scientific Center for Technical Ecology. - Donetsk, 2004.

Information resources on the Internet

15. Ministry of Environmental Protection and Natural Resources of Ukraine / [Electronic resource]. – Access mode: https://mepr.gov.ua/
16. Industrial ecology. Community of environmental specialists / [Electronic resource]. – Access mode: http://www.eco.com.ua/
17. Professional Association of Ecologists of Ukraine / [Electronic resource]. – Access mode: https://paeu.com.ua/
18. Scientific and Technical Library named after G.I. Denysenko / [Electronic resource]. – Access mode: https://library.kpi.ua
19. Vernadsky National Library / [Electronic resource]. – Access mode: http://www.nbuv.gov.ua/
20. Electronic archive of scientific and educational materials of igor Sikorsky Kyiv Polytechnic Institute / [Electronic resource]. – Access mode: https://ela. kpi. ua/

Educational content

5. Methods of mastering the discipline (educational component)

Lectures

Lectures are aimed at:

*providing modern, holistic, interdependent knowledge of the discipline "**Protection of atmospheric air from pollution by gaseous impurities**", the level of which is determined by the target installation for each specific topic;*

- *ensuring in the process of the lecture the creative work of students together with the teacher;*
- *education of students' professional and business qualities and the development of their independent creative thinking;*
- *formation of students' necessary interest and determination of the direction for independent work;*
- *determination at the modern level of development of science in the field of modern methods and processes of gas purification, forecasting development for the coming years;*
- *reflection of the methodical processing of the material (selection of the main provisions, conclusions,*
  recommendations, their clear and adequate wording)

-use for demonstration of visual materials, combining, if possible, them with a demonstration of the result and samples ;

-teaching research materials in a clear and high-quality language in compliance with structural and logical connections, explanation of all newly introduced terms and concepts;

-accessibility for perception by this audience.

No s/n	The title of the lecture topic and the list of main issues (list of didactic tools, references to literature and tasks for the ISW)	Hours
1	***Calculations of emission indicators (specific emissions) of pollutants into the atmospheric air by various industries.*** *CORINAIR Emissions Inventory Manual. Determination of gross emissions of pollutants. Generalized emission index. Specific emission index.* *Literature: [14].* *Tasks on the ISW. Determination of the volume of dry flue gases* *Literature: [14].* ***Basics of absorption methods for cleaning gas emissions from gaseous pollutants.*** *Physico-chemical laws of absorption processes Physical absorption. Chemical absorption Technological design of processes. Open and circulating processes. Requirements for absorbents. Hardware design of absorption processes.* *Literature: [2, 3, 8, 7, 13].* *Tasks on the ISW. RegenerateandI absorbentandc.* *Literature: [2, 3, 8, 7].*	*0,5*
3	***Adsorption treatment of gas emissions.*** *Types of adsorption. Physico-chemical laws of the adsorption process. Characteristics of adsorbents Equipment design of adsorption processes for purification of gas emissions.* *Literature: [2, 3, 8, 9, 13].* *Tasks on the ISW. Ways to implement the adsorption process.* *Literature: [8, 9, 10].*	*0,5*
4	***Catalytic gas purification.*** *The basic laws of catalytic methods. Requirements for catalysts. Hardware design of catalytic processes.* *Literature: [2, 3, 8, 9, 13].*	*0,5*

	Tasks on the ISW. Methods of implementation of catalytic processes. Stationary process. Reverse process. *Literature: [1, 9, 11, 13].*	
5	***Membrane and magnetic processes of neutralization of gas emissions*** *Types of membranes used in gas purification processes. Electromagnetic filters with a core nozzle. Multi-pole filters with "separated" electromagnets. Selection and calculation of nozzles.* *Literature: [8, 9, 13].* *Tasks on ISW: Filters with permanent magnets* *Literature: [9].*	*0,5*
6	***Chemical and biochemical methods of purification of gas emissions.*** *Ozonation methods, laser methods. The peculiarity of the method of using natural biological processes. Devices in which the biological method is implemented. Filtering biolayer.* *Literature: [8, 9, 13].* *Tasks on the ISW. The main factors on which efficiency depends capture in the biolayer* *Literature: [8, 9, 13].*	*0,5*
7	***Thermal afterburning of gas emissions.*** *Metode of neutralization of gases by thermal oxidation of various harmful substances. Afterburning in stoves of various designs. Afterburning in flare installations.* *Literature: [8, 9, 13].* *Tasks on the ISW. Disadvantages of the thermal method.* *Literature: [8, 9, 13].*	*0,5*
8	***Technologies for cleaning emissions from gaseous impurities.*** *Purification of gases from carbon dioxide. Purification of gases from carbon monoxide. Oxidative methods for cleaning gases from hydrogen sulfide. Cleans gases from nitrogen oxides. Cleans gases from sulfur dioxide.* *Literature: [2, 3, 8, 9, 13].* *Tasks for ISW: methods for the reduction of sulfur dioxide.* *Literature: [2, 3, 9, 13].*	*0,5*
9	***Purification of waste gases in various industries.*** *Cleaning of ventilation emissions of chemical fiber production. Purification of nitrous gases of nitric acid production. Purification of gases of metallurgical production. Purification of gases of coke oven and by-product production. Cleaning of flue gases of thermal power facilities.* *Literature: [2, 3, 8, 9, 13].* *Tasks on the ISW. Recovery of volatile solvents of asbestos and rubber industries.* *Literature: [8, 9, 10, 12].*	*0,5*
	Total hours	***4***

Laboratory classes

In the system of professional training of students, laboratory classes occupy *25% of the classroom load.*

No s/n	*Name of laboratory work*	*Number of classroom hours*
1	*Entry. Safety briefing, familiarization with the program of laboratory work, issuance of methodological literature*	0,25

2	*Determination of the concentration of toxic substances in the air using the gas analyzer UG-2. Determination of the concentration of hydrochloric acid, ammonia and carbon dioxide in the air*	*1,25*
Total hours		*2*

Practical classes

In the system of professional training of bachelors in this discipline, practical classes occupy *2-5% of the classroom load. Being an addition to the lecture course, they lay and form the foundations of the bachelor's qualification in the field of ecology, namely the protection of the atmosphere from anthropogenic impact. allow you to check knowledge, so this type of work is an important means of operational feedback. Practical classes should perform not only cognitive and educational functions, but also contribute to the growth of bachelors as creative workers in the field of environmental protection.*

The main objectives of the cycle of practical classes:

- *help bachelors to systematize, consolidate and deepen knowledge of a theoretical nature in the field of fundamental methods and technologies of air purification;*
- *teach bachelors techniques for solving practical problems, promote mastery of skills and abilities to perform calculations, graphic and other tasks;*
- *teach them to work with scientific and reference literature and diagrams;*
- *to form the ability to learn independently, that is, to master the methods, methods and techniques of self-learning, self-development and self-control.*

No s/n	***The title of the topic of the practical lesson and the list of main issues (list of didactic support, references to literature and tasks to the ISW)***	***Hours***
1	***Calculation of the material balance of the gas cleaning process and gascleaning*** devices *Literature: [6].*	***1***
8	***MCT***	***1***
	Total hours	***2***

Independent work of a student / postgraduate student

Independent work takes 93.3 % of the time to study the credit module, including preparation for the test. The main task of independent work of students is to master 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 a creative approach in educational work. the latest technologies for the purification of contaminated waste gases, based on the concentrations of polluting impurities and standards for emissions of the gas mixture. The student should be able to create the most effective methods for cleaning contaminated gases.

No s/n	*The name of the topic submitted for independent study*	*Number of hours of ISW*
	Calculations of emission indicators (specific emissions) of pollutants into the atmospheric air by various industries.	
1	*CORINAIR Emission Inventory Guide. Determination of gross emissions of pollutants. Generalized emission index. Specific emission index.* *Literature: [14].* *Tasks on the ISW. Determination of the volume of dry flue gases*	*11*

	Literature: [14].	
	Basics of absorption methods for cleaning gas emissions from gaseous pollutants.	
2	*Physico-chemical laws of absorption processes Physical absorption. Chemical absorption Technological design of processes. Open and circulating processes. Requirements for absorbents. Hardware design of absorption processes.* *Literature: [2, 3, 8, 7, 13].* *Tasks on the ISW. Regeneration of absorbents.* *Literature: [2, 3, 8, 7].*	*11*
	Adsorption treatment of gas emissions.	
3	*Types of adsorption. Physico-chemical laws of the adsorption process. Characteristics of adsorbents Equipment design of adsorption processes for purification of gas emissions.* *Literature: [2, 3, 8, 9, 13].* *Tasks on the ISW. Ways to implement the adsorption process.* *Literature: [8, 9, 10].*	*12*
	Catalytic gas purification.	
4	*The basic laws of catalytic methods. Requirements for catalysts. Hardware design of catalytic processes.* *Literature: [2, 3, 8, 9, 13].* *Tasks on the ISW. Methods of implementation of catalytic processes. Stationary process. Reverse process.* *Literature: [1, 9, 11, 13].*	*12*
5	***Membrane and magnetic processes of neutralization of gas emissions***	
	Types of membranes used in gas purification processes. Electromagnetic filters with a core nozzle. Multi-pole filters with "separated" electromagnets. Selection and calculation of nozzles. *Literature: [8, 9, 13].* *Tasks on ISW: Filters with permanent magnets* *Literature: [9].*	*12*
6	***Chemical and biochemical methods of purification of gas emissions***	
	Ozonation methods, laser methods. The peculiarity of the method of using natural biological processes. Devices in which the biological method is implemented. Filtering biolayer. *Literature: [8, 9, 13].* *Tasks on the ISW. The main factors on which the effectiveness of capture in the biolayer depends* *Literature: [8, 9, 13].*	*12*
7	***Thermal afterburning of gas emissions.***	
	The method of neutralization of gases by thermal oxidation of various harmful substances. The advantages of the thermal method. Afterburning in stoves of various designs. Afterburning in flare installations. *Literature: [8, 9, 13].* *Tasks on the ISW. Disadvantages of the thermal method.* *Literature: [8, 9, 13].*	*12*
8	***Technologies for cleaning emissions from gaseous impurities.***	
	Purification of gases from carbon dioxide. Purification of gases from carbon monoxide. Oxidative methods for cleaning gases from *hydrogen sulfide. Cleans gases from nitrogen oxides. Cleans gases from sulfur dioxide.* *Literature: [2, 3, 8, 9, 13].* *Tasks for ISW: methods for the reduction of sulfur dioxide.*	*11*

	Literature: [2, 3, 9, 13].	
9	***Purification of waste gases in various industries.***	
	Cleaning of ventilation emissions of chemical fiber production. Purification of nitrous gases of nitric acid production. Purification of gases of metallurgical production. Purification of gases of coke oven and by-product production. Cleaning of flue gases of thermal power facilities. *Literature: [2, 3, 8, 9, 13].* *Tasks on the ISW. Recovery of volatile solvents of asbestos and rubber industries.* *Literature: [8, 9, 10, 12].*	*12*
	Preparation for MCT	*2*
	Preparation for the test	*4*
	Total hours	*112*

Policy and control

Policy of the discipline (educational component)

Rules for attending classes and behavior in the classroom

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 performing creative work in the discipline or additional completion of online specialized courses with the receipt of the appropriate certificate:*
- *https://www. coursera. org/learn/globalenergyandclimatepolicy. Global Energy and Climate Policy*
- *https://www.coursera.org/learn/global-warming*

  But their amount cannot exceed 10% of the rating scale.
- *penalty points in the framework of the discipline are not provided.*

Deadlines and Rescheduling Policy

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

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of links when using printed and electronic materials, quotes, opinions of other authors. Unacceptable hints and write-offs when writing tests, conducting classes; passing the test 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 Chapter 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 Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code

Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline in accordance with the working curriculum:

Semester	Study time		Distribution of study hours				Control measures		
	Loans	acad. H.	Lecture	Practical	Lab..	ISW	MCT	RGR	Semester control
4	4	120	4	2	2	112	1	–	Final test

The student's rating on the discipline consists of points that he receives for:

The student's rating from the credit module is calculated from 100 points, of which 52 points are the starting scale.

The starting rating (during the semester) consists of points that the student receives for:

– work in practical classes (1 lesson);

- performance of 2 laboratory works;

– performing a modular test (MCT is divided into 2 works lasting 45 minutes each);

The system of rating (weight) points and evaluation criteria

Criteria for calculating points:

Work in practical classes:

– active creative work – 2 points;

– fruitful work – 1 point;

– absence from class without good reason – -1 point.

"unsatisfactory" – the answer does not meet the requirements for "satisfactory" – 0 points.

Performing laboratory works:

– flawless work – 10 points;

– there are certain shortcomings in the preparation and / or performance of work - 9-1 points;

– absence from class without good reason – –1 point.

Tests are estimated at 15 points:

– "excellent" – complete answer (at least 90% of the necessary information) – 15 points;

– "good" – a sufficiently complete answer (at least 75% of the necessary information), or a complete answer with minor inaccuracies –14-9 points;

– "satisfactory" – incomplete answer (at least 60% of the necessary information) and minor errors – 8-1 points;

– "unsatisfactory" – the answer does not meet the requirements for "satisfactory" – 0 points.

The rating scale of the discipline (RD) is 100 points and is formed as the sum of all rating points received by the student based on the results of current and semester control measures: R = 2×1 + 20×1 + 15×2 + 48 = 100 points

The condition for admission to the test is the enrollment of at least one part of the test and laboratory work, the starting rating is at least 25 points.

At the test, students perform a written test, consisting of 48 test questions.

The sum of starting points and points for the test work is transferred to the test score according to the table:

Points: practical classes +LR + MCT + test work	Score
100... 95	Perfectly
94... 85	Very goode
84... 75	Well
74... 65	Satisfactory
64... 60	Enough
Less than 60	Disappointing
Not handed over modular tests or not creditedand LR or starting rating less than 25 points	Not allowed

Additional information on the discipline (educational component)

An approximate list of questions that are submitted to the MCT

1. *Describe the capture of fogs.*
2. *Describe the equilibrium in the gas-to-liquid systems. Name the kinetic patterns.*
3. *Determine the basics of the absorption process and absorption equipment.*
4. *Describe the purification of gases from sulfur oxide (II).*
5. *Describe the purification of gases from hydrogen sulfide.*
6. *Describe the purification of gas mixtures from carbon disulfide and mercaptans.*
7. *Describe the purification of gases from nitrogen oxides.*
8. *Describe the purification of gases from fluorine-containing compounds.*
9. *Give kinetic patterns of adsorption.*
10. *Describe the desorption of absorbed substances.*
11. *Determine the basics of the process of adsorption and chemosorption methods.*
12. *Describe the vapor adsorption of volatile solvents.*
13. *Determine the essence and types of catalysis.*
14. *Explain that thisis the limiting stage of the process.*
15. *Cite, Iuse industrial catalysts in cleaning processes.*
16. *Cite the designs of contact apparatuses and apparatuses with a fluidized catalyst layer.*
17. *Describe, Iam cleaning by the catalytic method from organic compounds.*
18. *Provide a scheme for cleaning contaminated gases from the production of kitchen coverings.*
19. *Justify the purification of gas emissions from sulfur oxide (II) using limestone: physicochemical bases of the method, description of the technological scheme, advantages and disadvantages of the method.*
20. *Justify the magnesite method of purification of gas emissions from sulfur oxide (II): physico-chemical bases of the method, description of the technological scheme, advantages and disadvantages of the method, scope of use.*
21. *Describe the CO, its andthe bsorption of copper - aluminum - chloride solutions.*
22. *Analyze the absorption of carbon monoxide (II) with copper-ammonia solution.*
23. *Describe method of methane, inco trapping with liquid nitrogen.*
24. *Evaluate the methods for cleaning gases from carbon dioxide.*
25. *Specify a brief description of hydrogen sulfide. Lead to thelassification of gas purification products from hydrogen sulfide.*
26. *Justify the iron-soda method of purification of gases from hydrogen sulfide: physico-chemical basis of the method, description of the technological scheme.*
27. *Analyze the methods of purification of gases from nitrogen oxides.*
28. *Evaluate the reducing methods for cleaning gases from nitrogen oxides.*
29. *Analyze the catalytic methods of purification of gases from nitrogen oxides. Physico-chemical bases of catalytic reduction of nitrogen oxides.*

30. Analyze the high-temperature method of catalytic reduction of nitrogen oxides with carbon monoxide, methane, hydrogen: physicochemical bases of the method, description of the technological scheme, scope of use.

31. Describe amiac-catalytic method for cleaning gases from nitrogen oxides: physicochemical basis of the method, description of the technological scheme.

32. Analyze selective methods for cleaning gases from nitrogen oxides. Physico-chemical bases of methods.

33. Give a description of the sources of formation and methods of purification of gases from halogens and their compounds.

34. Describe the method of purification of gas emissions from fluorine and compounds in the production of superphosphate, give the physico-chemical basis of the method, give a description of the technological scheme.

35. Cite, Ik there is a absorption of chlorine in the production of bleach. Give physico-chemical bases, description of the method, area of use.

36. Describe the purification of HCl gases in the production of hydrochloric acid.

The work program of the discipline (syllabus):

Compiled by Assoc. Prof., Ph.D. Nosachova Yu.V.

Approved by Department E and TPP (Protocol No. 14 dated 8.06.2022)

Agreed by the methodical commission of the IHF (protocol No 10 dated 24.06.2022)