

MINISTRY OF HIGHER EDUCATION, SCIENCE AND
INNOVATIONS OF THE REPUBLIC OF UZBEKISTAN
URGANCH STATE UNIVERSITY



CURRICULUM OF CHEMICAL TECHNOLOGY OF INORGANIC
SUBSTANCES 1,2

Field of knowledge:

700 000 – Engineering, processing and construction
industries

Field of study:

710 000 – Engineering work

Course of Study:

60710100 – Chemical technology (inorganic substances)

Urganch - 2024

Subject/module code NMTB4122	Academic year 2024-2025	Semester 7,8	ECTS - Credits 6/6	
Subject/module type Mandatory	Language of education English language		Class hours per week 6	
The name of the subject		Audience training (hours)	Independent study (hours)	Total download (hour)
1.	Chemical technology of inorganic substances 1.2	180	180	360
2. I. The content of science The purpose of teaching science is to help students master the production technologies of sulfuric acid and bound nitrogenous compounds, which form the basis of the technology of inorganic substances, as well as to form and develop the thinking of students to perform technological calculations, their own opinions, It consists of teaching to clearly state the conclusions in a reasonable way, to acquire the skills of applying theoretical and practical knowledge in practice. Fanny's role is students study the properties of raw materials such as natural gas and nitrogen, oxygen, hydrogen, carbon monoxide, carbon dioxide, ways to accelerate the process of purification, enrichment, flotation, oxidation and conversion, ammonia, nitric acid and mineral fertilizers based on them consists of training methods of production of dyes and technological schemes. II. The main theoretical part (lecture sessions) II.1. The subject includes the following topics: Subject 1 Introduction to "Chemical technology of inorganic substances". Sulfuric acid production methods, types and equipment materials. The place, content, parts of NMKT subject, they are study hours. Physico-chemical properties of sulfuric acid and its importance in the national economy. Sulfuric acid production scale and enterprises in the Republic of Uzbekistan. Methods of production of sulfuric acid. Diagram of the compounds of sulfuric acid and sulfur trioxide with water, as well as their crystallization temperatures. Types of sulfuric acid and oleum. Equipment materials used in the production of sulfuric acid. 2nd topic. Furnace gas raw materials in the production of sulfuric acid. Types of raw materials for the production of furnace gas. Colchodans and similar: ordinary colchodans; flotation colchodans; coal furnaces; magnetic burners. Sulfur and its varieties. Natural and gaseous sulfurs. Production of natural sulfur by the flash method of weak furnace gases and their concentration by the cyclic method.				

3rd topic. Gaseous sulfur and other sulfur-containing raw materials.
Production of non-ferrous metallurgical waste gases and gaseous sulfur from them. natural gas and related treatment process, production of gaseous sulfur in waste gases. Sour tars, blast furnace slag, calcium sulfates and other raw materials. About the future of travel from raw materials.

4th topic. Technology of combustion of sulfur raw materials.
The burning mechanism of charcoal. The release of rust from the burning of coal and other metal sulfides, removal of rust from furnaces. Composition of stove gas. Volume of flue gas produced when burning sulfurous raw materials.

5th topic. Types of coal and sulfur incinerators: mechanical, powder incineration, hot layer, cyclone.
Structure, operation of a mechanical rack oven. Structure and operation of hearths with hot layers and dust. Types of sulfur burning furnaces. Nozzle, cyclone. About the technological image of sulfur burning in two stages of the "Lurgi" company of the GFR.

6th topic. Basics of production of sulfuric acid by contact method.
Regarding the physical and chemical properties of sulfur trioxide, the states of the oxidation process of sulfur dioxide, the level of oxidation in equilibrium conditions and the influence of technological factors on it. Kinetics of sulfur dioxide oxidation process. Catalysts and their poisoning.

Mechanism of sulfur dioxide in the presence of a platinum catalyst.

Mechanism of oxidation in the presence of a vanadium catalyst.

7th subject. Primary and secondary oxidation of sulfur dioxide in the presence of a vanadium catalyst.
Process conditions and contact devices. Conditions of the process of oxidation of sulfur dioxide in the presence of a vanadium catalyst. Oxidation speed depends on the temperature of the practical oxidation level. Secondary oxidation of sulfur oxide. About the technological image of the two-stage oxidation of sulfur dioxide to sulfur trioxide, created in the USA company "Parsons". Types of contact apparatus.

Topic 8. A classic system of production of sulfuric acid by contact method.
The main sections of the classic system: furnace section, washing section, drying absorption section and contact section technological systems and working principles. Basic equipment.

Topic 9. Absorption of sulfur trioxide and classical countermeasures.
Sulfur trioxide absorption and factors affecting it. Types of sulfur absorbent; classical system conflicting processes and shortcomings.

Topic 10. Production of sulfuric acid by the contact method
nigzamanov technology systems.
Dry cleaning system and its types. Wet catalysis method. Short system method, main devices. Ways to improve the production of sulfuric acid by the contact method.

Topic 11. Basics of production of sulfuric acid by nitrous method.
Theoretical basis of the nitrose method. Statics and kinetics of nitrogen

monoxide oxidation, types and production units of the nitrous method. The mechanism of formation of sulfuric acid in the nitrous part. A seven-tower technological system for the production of sulfuric acid by the nitrous method. Basic equipment. Prospective ways of production of sulfuric acid. Production of sulfuric acid according to the cycle system. Condensation of sulfuric acid and the effect of temperature on it. Condensing devices and types: direct heat transfer devices barbat; Venturi indirect heat transfer dephlegmator device. Sulfuric acid industrial waste and environmental protection.

Topic 12. Concentration of sulfuric acid.

Concentration of sulfuric acid in a bubble concentrator. Concentration of Sulfuric Acid in Venturi Tubes. Description of the scheme of concentration of sulfuric acid under pressure. Description of the technological scheme for obtaining high-concentration oleum and 100% SO_3 .

Topic 13. Processing of waste generated in the production of sulfuric acid. Description of waste from sulfuric acid production, description of the technological scheme of waste treatment with sulfite-bisulfite solution. Cleaning of generated waste by catalytic method. Treatment of waste gas with magnesite.

Topic 14. Types of mineral augites, production enterprises in the Republic of Uzbekistan.

Production of nitrogen and phosphorus fertilizers in the Republic of Uzbekistan "Maksam-Chirchik", "Amnofos Maksam", Navoi Azot" and others raw materials and technological systems.

Topic 15. Methods of production of soda ash.

Description of raw materials for the production of soda ash, physical and chemical basis of the process. Description of soda production stages and technological system.

Topic 16. Basic properties of elemental nitrogen and bonding methods.

Physical and chemical properties of nitrogen. Nitrogen industry raw materials. Nitrogen cycle in nature. The importance of nitrogen compounds. Methods of fixing elemental nitrogen. About the ToshKTI method of obtaining calcium cinnamide.

Topic 17. Elemental nitrogen production technology.

Methods of obtaining elemental nitrogen. Taking a low temperature. Types of cryogenic devices. Low-pressure air separation cycle using a turboexpander.

18th subject. Atmospheric air separation devices.

Rectification of liquid air. Types of air separation devices. Separation units. Atmospheric air separation in AKt - 15 type device. Main devices.

Topic 19. Kinetics of methane and carbon monoxide conversion using catalysts.

Properties of hydrogen. Meeting and use of hydrogen in nature. Technical methods of obtaining hydrogen. Conversion of methane and carbon monoxide. Methane conversion kinetics and catalysts used. Carbon monoxide conversion kinetics and catalysts used. Carbon monoxide conversion catalysts.482 (SSRI),

S-12-1 (USA, "SiSi-Ay" company), 15-4 (England, "Ay-Si-Ay" company), K-6-10 (FR "BASF" "firm" physicochemical characteristics of carbon monoxide conversion catalysts

Topic 20. Industrial hydrogen production facilities.

About methane and carbon monoxide conversion units, technological description of two-stage conversion of methane and carbon monoxide under pressure, main devices. Works of V. Eikers and D. Kempler on methane conversion kinetics.

Topic 21. Methane conversion.

Overview of methane oxidation with water vapor, carbon dioxide, oxygen and a mixture of oxidants. Methane conversion technological devices.

Topic 22. Carbon monoxide conversion.

Carbon monoxide conversion theory. Catalysts. Kinetics of carbon monoxide conversion. Carbon monoxide conversion devices.

Topic 23. Conversion gas cleaning.

Types of purification of natural and technological gases from impurities. Carbon dioxide purification methods, technological description, main equipment. Methods of purifying converted gas from carbon monoxide, technological description, main equipment.

Topic 24. Fundamentals and devices of synthetic ammonia production.

Physical and chemical properties of ammonia. Statics and kinetics of ammonia synthesis. Ammonia synthesis catalysts.

Topic 25. Ammonia synthesis devices.

Technological image of the medium-pressure ammonia synthesis device, main devices. Comparison and characterization of AM-76 and "Kemiko" ammonia synthesis aggregates.

Topic 26. Basics of production of weak nitric acid.

Properties and uses of nitric acid. Methods of production of nitric acid. Basics of production of weak nitric acid. Catalysts in nitric acid production. Oxidation temperature of synthetic ammonia. Ammonia air is the optimal amount of ammonia in the mixture. Oxidation rate of ammonia. Oxidation of ammonia under pressure. Oxidation of azotoxide (II).

Production of nitric acid from nitrogen oxides. The rate of absorption of nitrogen oxides. Clean exhaust gases.

Topic 27. Nitric acid production devices.

Types of plants for the production of weak nitric acid. A weak nitrate technological image of the device for producing acid at a pressure of 0.716 Mpa,

main devices.

Description of the AK-72 technological scheme. The structure of the main equipment and principle of operation.

Description of the AK-72M technological scheme. The structure of the main equipment and principle of operation.

Topic 28. Production of concentrated nitric acid.

Direct synthesis of concentrated nitric acid. Separation of excess water from nitrous gases. Oxidation of NO with nitric acid. Conditions for obtaining liquid nitrogen oxides. Dissolving N_2O_4 in concentrated nitric acid. Rate of release of nitrogen oxides. Rate of absorption of liquid nitrogen oxides by water.

Topic 29. Urea production theory and devices.

Urea physico-chemical properties and production methods. Basics of synthesis of urea from ammonia and carbon dioxide and technological factors affecting it. Kinetics of urea synthesis.

Physico-chemical basis of separation of unreacted substances.

Types of urea synthesis devices. The technological system of synthesis of urea with full liquid cycle, the main devices. Urea production technological image of "Montecatini" company. Technical and economic indicators of urea produced by "Montecatini", "Mitsun toatsu", "Stemikarbon" companies.

Properties and types of synthesis of hydrogen cyanamide. Issues of environmental protection in the technology of inorganic substances.

Topic 30. Methanol production.

Physico-chemical basis of methanol production. Catalysts. Kinetics of methanol synthesis. Technological scheme of methanol synthesis.

III. Instructions and recommendations for practical training

Practical The following topics are recommended for training:

1. Calculations for preparation of sulfuric acid solution of different concentrations
2. Calculation of sulfuric acid storage.
3. To find the consumption amount of sulfur necessary for the production of sulfuric acid.
4. Calculation of gas consumption required for production of sulfuric acid iron rust formed during the burning of flotation embers and the percentage of burning of ember embers.
6. Completing calculations of the heat of burning iron pyre.
7. Calculations to determine the degree of oxidation in equilibrium conditions for the oxidation of sulfur dioxide to sulfur trioxide.
8. Development of mineral fertilizers material and heat balances.
9. Methane conversion material balance accounts.
10. Methane conversion heat balance calculations.
11. Carbon monoxide conversion material balance calculations.
12. Carbon monoxide conversion heat balance calculations.
13. Calculation of the amount of hydrogen and nitrogen used for the production of synthetic ammonia. Calculation of heat released during ammonia synthesis.
14. Atmospheric air separation device calculations.
15. Calculation of the necessary ammonia and atmospheric air

consumption for the production of weak nitric acid.

16. Urea production material and heat balances.

Instructions and recommendations on the organization of practical training are developed by the department. In it, masters enrich the knowledge and skills they have acquired in their main subjects by solving practical problems. It is also recommended to strengthen master's knowledge on the basis of textbooks and manuals, to use handouts, to increase master's knowledge by publishing scientific articles and theses, to solve problems, to prepare presentations and demonstrations on topics, etc.

IV. Instructions and recommendations for laboratory exercises

The following topics are recommended for laboratory sessions:

1. Getting to know the rules of technical safety.
2. Analysis of technical sulfuric acid.
3. Obtaining sulfuric acid by burning colchedan.
4. Determine the concentration of sulfuric acid.
5. Analysis of oleum.
6. Determination of total nitrogen content in ammonium nitrate.
7. Getting to know the rules of technical safety.
8. Determination of carbon dioxide in the monoethanolamine solution.
9. Determination of the amount of monoethanolamine in the solution.
10. Determination of the content of weak nitric acid.
- 11.4 content of nitric acid and amount of burnt solid residue.
12. Analysis of ammonia-air mixture.

acquire practical skills and competences in chemical analysis of various processes of production of inorganic substances, strengthen and further enrich them by performing laboratory work in laboratory training. The master, who answered the teacher's questions on the topic, is theoretically considered to have mastered the laboratory training and is allowed to perform the laboratory work. The master performs the laboratory work under the supervision of the teacher and prepares the report and submits it to the science teacher.

V. Independent education and independent works

Recommended topics for independent study:

1. Storage of sulfurous raw materials and preparation for burning.
2. Comparison of technological images of production of sulfuric acid by contact method.
3. Technological calculations of the furnace for incineration of colchedan in a hot bed.
4. Storage of sulfurous raw materials and preparation for burning.
5. Heat exchange of sulfuric acid production contact section devices.
6. Toxic chemicals.

7. Obtaining hydrogen by thermochemical decomposition of water. 8. Washing the converted gas from carbon monoxide with liquid nitrogen methods. 9. Types of technological description of production of dilute nitric acid comparison. 10. Production of ammonia at high pressure. 11. Extraction of inert gases from air. 12. Methanol production methods. 13. Production of ammonia water. 14. Ammonia production at low pressure. 15. Extraction of molybdenum from ammonia solution 16. Ammonium nitrate (NH₄NO₃) production technology 17. Urea production methods and technology 18. Ammonium sulfate production technology 19. Production technology of liquid nitrogen fertilizers 20. Classification of mineral fertilizers, physical-chemical and mechanical properties 21. Abroad technologies of ammonium nitrate production 22. Physico-chemical basis of obtaining phosphorus by electrothermal method 23. General physicochemical basis of sulfuric acid decomposition of natural phosphates 24. Superphosphate production technology 25. Technology of extraction of phosphoric acid 26. Double superphosphate production technology 27. Precipitate production technology 28. Potassium chloride production technology 29. Potassium sulfate production technology 30. Potassium nitrate production technology	3. VI. Results of science education (competencies to be formed) As a result of mastering the subject, the student: - composition of raw materials for the production of inorganic acid, furnaces for raw materials, types of cold forming cycles; extraction of gases from atmospheric air; theory of liquid air rectification; obtaining hydrogen from natural gas; purification of technological gases from additives; laws of gaseous reactions; statics and kinetics of technological processes; ammonia production theory; to have an idea and knowledge about the theoretical basis of nitric acid and urea production; - calculation of material and heat balances of technological processes; inspection and mechanical calculation of the main equipment; comparison and analysis of technological schemes; must have the skills to calculate the basic technical and economic indicators of production; - the student should have the skills to analyze production processes and draw conclusions, collect and use data necessary for solving production problems.
4. VII. Educational technologies and methods	

	• Lectures; • Active case studies, • Seminars (logical thinking, quick questions and answers); • Working in groups; • Making presentations; • Individual projects; • Projects for teamwork and protection
5.	VIII. Students to receive credits: Full mastery of theoretical and methodological knowledge of science, ability to correctly reflect the results of analysis, independent observation of the studied processes and completion of tasks and tasks given in the current and intermediate control forms, written work on final control submit
6.	Basic literature 1. Shamshidinov I.T., Mirzakulov X.Ch. Sulfat kislotasi ishlab chiqarish nazariyasi va texnologik hisoblari. Darslik. -T.: Iqtisod - moliya, 2017. -248 b. 2. Shamshidinov I. T. Noorganik moddalar va mineral o'g'itlar texnologiyasi. Darslik.- T.: Iqtisod-moliya, 2014.-360 b. 3. G'afurov Q., Shamsiddinov I. Mineral o'g'itlar va tuzlar texnologiyasi. Darslik. - T., "Fan va texnologiya", 2007, -352 b. 4. Shamshidinov I. T. Noorganik mineral o'g'itlar Moddalar va texnologiyasi. Darslik. - T.: Iqtisod-moliya, 2014. -360b. 5. Гаврилюк А.Н., Дормешкин О.Б., Эржаев А.У., Шарипова Х.Т. Технология связанного азота и азотных удобрений. Учебн.пособие. Ташкент, 2020,- 224 с. 6. Исмаилов А.А., Отакузиев Т.А., Исмаилов Н.П., Мирзаев Ф.М. Ноорганик моддалар кимёвий технологияси. Дарслик. -Т., Ўзбекистон, 2002, -336 б. Additional literature: 7. Мирзиёев Ш.М. Буюк келажакимизни мард ва олижаноб халқимиз билан бирга курамыз. 488 б, Т. "Ўзбекистон", 2017 й.. 8. Мирзиёев Ш.М. Қонун устуворлиги ва инсон манфаатларини таъминлаш-юрт тараққиёти ва халқ фаровонлигининг гарови 48 б, Т. "Ўзбекистон", 2017 9. Anders Nielsen, K. Alike, L. I. Cristianen. Ammonia: Catalysis and Manufacture Softcover reprint of the original 1st ed., textbook, USA, 2011 10. Ведерников М.И. и др. Технология соединений связанного азота. Учебное пособие. -М.: В/Ш, 1996. -424 с. 11. Позин М.Е. и др. Расчёты по технологии неорганических веществ. Учебное пособие. - М.-Л.: Химия, 1990.-640 с. Websites : www.techology.ru www.google.com www.ziyounet.uz www.disscat.ru

Developed and approved by Urganch State University.

Responsible for the subject/module:
Jumaniyazov A.G'. Jumaniyazov J.Sh. - Assistant teachers of the "Chemical Technologies" Department of UrSU

Reviewers:
Candidate of technical sciences (Dot) Bayjanov I.
Candidate of Chemical Sciences (Dot) Saparbaeva N.

This curriculum was approved by the minutes of the meeting of the University Educational and Methodical Council on August 29, 2024.

This curriculum was approved by the minutes of the meeting of the "Chemical Technologies" department on 24 - August 2024.

Academic activities and registrar
department head:

Signature

Assoc. G. Matlatipov

Dean of the faculty:

Signature

Assoc. Kurambayev Sh.R.

Head of the department :

Signature

Assoc. Aitova Sh.K.

Developers :

Signature

Jumaniyazov A.G'.

Jumaniyozov J.Sh.

Signature