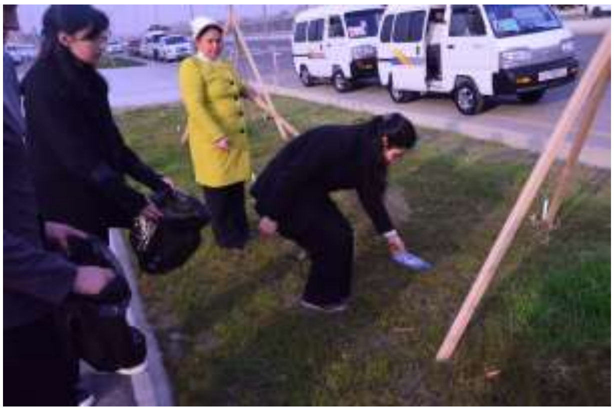
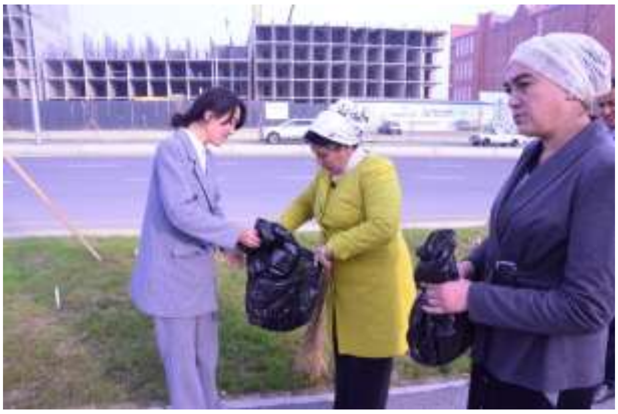
EXTENDED ANNUAL REPORT OF NAMANGAN STATE UNIVERSITY ON SDG 12

At the initiative of the tutors of the Faculty of Natural Sciences of Namangan State University, a cleanliness campaign was organized under the slogan “Let’s Turn the Neighborhood into a Waste-Free Area.”

During the event, faculty tutors N. Ahmedov, M. Qurbonova, and X. Sayfitdinova organized a community cleanup, which included collecting trash from the neighborhood, sweeping streets, and strictly maintaining cleanliness. Students also voluntarily contributed to this campaign. Follow-up activities are continuing in the area.

The collected waste was sorted according to its type and sent for recycling.

Namangan State University operates in cooperation with **“NAMANGAN MUSAFFO IQLIM” LLC** based on contract No. 2704502 dated October 18, 2023.

Namangan Musaffo Iqlim LLC primarily engages in waste collection, transportation, and environmental services.

This company is recognized as a good practice in the field of environmental protection: under the “Namangan Experience” initiative, waste collection and recycling are carried out on a public-private partnership basis, improving the quality of services provided.

In 2024, Namangan Musaffo Iqlim LLC collected 120 tons of waste from Namangan State University for recycling.

Extraction of Cellulose from Plant Waste

We chose the alkaline method for cellulose extraction because it is considered a safe and simple method. To carry out the laboratory work, we needed the following:

Required Equipment and Materials:

- Sugarcane stalks (fresh or dried)
- Sodium hydroxide (NaOH)
- Distilled water
- Beakers (250 ml, 500 ml)
- Measuring cylinders (100 ml, 250 ml)
- Electric hot plate or water bath
- Magnetic stirrer
- Filter paper and funnel
- Analytical balance
- Drying oven or cabinet
- Bleaching agent (hydrogen peroxide, H_2O_2, or sodium hypochlorite, NaClO)
- Laboratory gloves, safety goggles, and lab coat

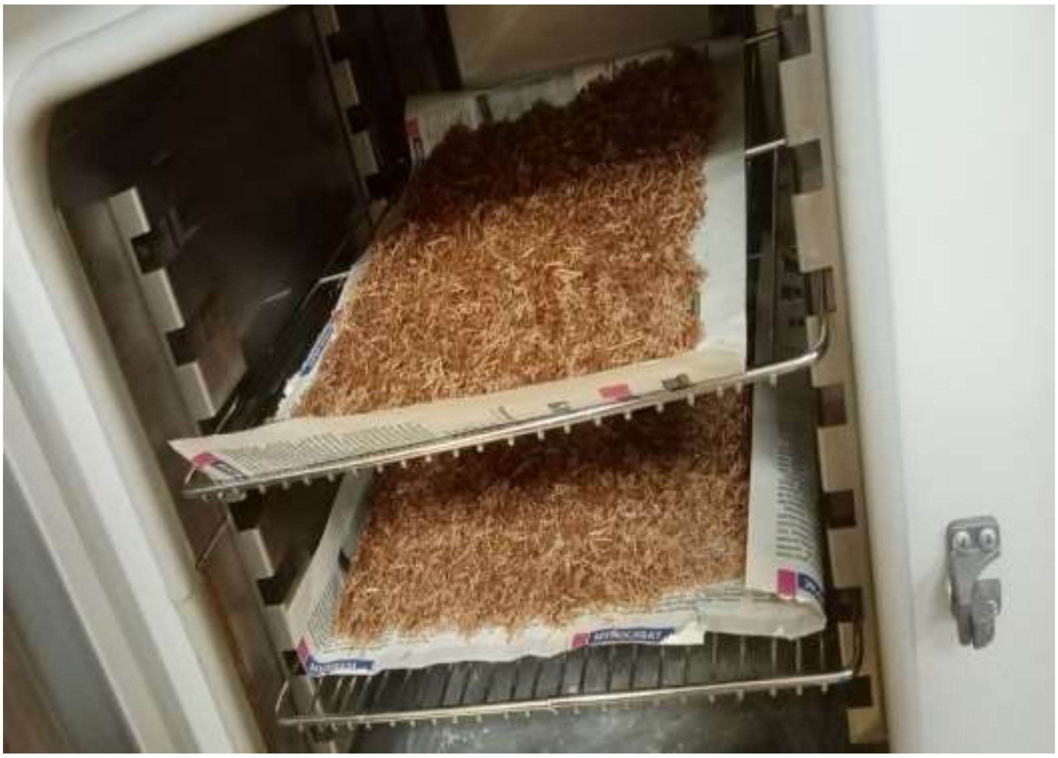
Procedure:

We began by preparing the sugarcane stalks. First, we collected the stalks and thoroughly washed them to remove impurities. Then, we cut the sugarcane into small pieces (Figure 3) and further ground them using a laboratory grinder.

The ground sugarcane was air-dried initially. To ensure better drying, we placed it in a drying oven at 50–60°C until fully dried.

We weighed the dried sugarcane on a technical balance, obtaining a mass of 203.31 g. The process of separating non-cellulosic polysaccharides, hemicellulose, and lignin from the sugarcane stalks was as follows.

To remove polysaccharides, the stalks were initially treated with water in an autoclave equipped with a heating and stirring device at 100–110°C for 6 hours. Under the same conditions, to separate hemicellulose and lignin, the plant stalks were treated with a 7–10% NaOH solution at a liquid-to-solid ratio of 1:20.



Substances that are removed by water treatment are called water-soluble substances, while those that are difficult to remove with alkaline solution are called hard-to-remove substances.

To extract the water-soluble substances from the stalks, we boiled them at 105–110°C for 6 hours. After boiling for 6 hours, the material was cooled to room temperature. Once cooled, the water was drained, and the stalks were thoroughly washed with fresh water and set aside for drying. After a few hours, for further drying, the material was placed in a drying oven at 100–105°C for half an hour (Picture 5).

After drying, the mass measured 169.32 g. Thus, the amount of water-soluble polysaccharides and dust extracted was 33.99 g.

Similarly, the sample was boiled in an alkaline solution at the same temperature for 3 hours. During boiling in the alkaline solution, non-cellulosic substances (hemicellulose and lignin) pass into the NaOH solution.

After boiling, the hot alkaline solution in the beaker was poured into another container. Then, the boiled sample in the beaker was washed 3–4 times with a 0.1–0.2% hot NaOH solution. Afterwards, it was rinsed 2–3 times with clean water, squeezed, and dried in open air.

After drying, the mass of the sample was 119.74 g. Thus, the amount of hemicellulose and lignin removed was 49.58 g.

After removing the non-cellulosic components from the plant sample, we used 5% and 10% H_2O_2 for bleaching. The bleaching process lasted 24 hours.

When 20 g of the sample was treated with 5% hydrogen peroxide, the remaining mass was 14.9 g. When treated with 10% hydrogen peroxide, the remaining mass was 14.8 g.

The obtained cellulose was recommended for use as raw material in the production of single-use containers.

Extraction of Cellulose from Cotton Lint

Cellulose is one of the long-known and widely distributed natural high-molecular compounds. Similar to proteins, which constitute the main part of living organisms, cellulose forms the primary structural component of plants and actively participates in their development.

Globally, the annual production of industrial cellulose exceeds one hundred million tons. In Uzbekistan and neighboring cotton-growing countries, the amount of fiber and linters obtained from cultivated cotton is approximately 3.5 million tons. Of the cellulose raw material, about one billion tons are used as fuel, around 550 million tons as construction materials, more than 90 million tons in the paper industry, and about 15 million tons for the production of various textile products and fibers.

Pure cellulose is extracted using different methods. The highest purity and quantity of cellulose is found in cotton linters (90–91%), while wood contains up to 58% cellulose. The conditions for extracting cellulose from plant materials depend on the characteristics of the applied components and the type of machines and equipment used in the technological processes.

The process of obtaining cotton cellulose includes:

- Preparation of linters (beating, mechanical cleaning, and combing)
- Boiling
- Washing
- Fiber bleaching, washing, and treatment with acid
- Final washing and drying

Cellulose is a widely distributed natural polymer in nature. Extensive research has been carried out on cellulose for a long time. Today, cellulose is used not only in laboratory or small-scale production but also at an industrial scale. Through treatment with acid solutions, complex esters are produced, and simple esters are obtained by processing in alkaline solutions.

In various sectors of industry and the national economy—including textiles, mining and metallurgy, paper and cardboard production, and construction—cellulose-based products serve as emulsifiers, stabilizers, structuring agents, and adhesives. Examples of such esters include ethyl, propyl, and carboxymethyl cellulose.

The production of these simple esters begins with natural cellulose or cellulose-containing raw materials, which are treated with aqueous solutions of alkalis at different concentrations to obtain alkali cellulose. When cellulose is treated with an alkali solution, the cellulose fibers swell, shortening in length, becoming more porous, and their reactivity increases.

Various methods for obtaining alkali cellulose have been described in the literature, including classical batch methods, continuous processes, dry methods, and suspension techniques in organic solvents. The chemical structure and other properties of alkali cellulose are influenced by the alkali concentration, treatment temperature, and duration.

Experimental Procedure:

A sample of 3 g of dry cellulose fibers with a length of 10–15 mm was weighed on a balance and placed in a 200 ml glass beaker. Then, 60 ml of NaOH solution was added, and the mixture was stirred for 30–40 minutes at room temperature. Afterwards, the excess alkali solution was drained through a funnel lined with filter cloth (while wearing rubber gloves). The alkali was pressed to such an extent that the mass of the initial cellulose would increase threefold (M: $3 \times 3 = 9$ g).

The resulting pressed mass (alkali cellulose) was then placed in a porcelain mortar and gently beaten with tweezers to separate the fibers from each other, transforming them into a porous mass.

To obtain **alkali cellulose**, cellulose is treated under specific conditions with an alkali solution. The resulting alkali cellulose is then pressed and matured. During the interaction of cellulose with alkalis, the following physicochemical processes can occur:

1. **Swelling of cellulose** and dissolution of low-molecular-weight fractions.
2. **Formation of cellulose-alkali complexes** in an additive state.
3. **Oxidative degradation** under the action of atmospheric oxygen.

The extent and rate of these processes depend on the chemical structure of the alkali, its concentration and temperature, as well as the packing density of cellulose structural elements. According to available data, when cellulose interacts with an alkali, **alkali cellulose** is formed. This is an **exothermic process**. The uptake of alkali by cellulose occurs simultaneously with water sorption. Treatment with an alkali solution leads to the formation of a product with the composition $C_6H_{10}O_5 \cdot NaOH$.

A high alkali concentration may result in the formation of molecular complexes or cellulose alkylates. Alkali cellulose formation can occur at any alkali concentration. However, when treated with diluted alkali solutions, the reaction may shift to the left (i.e., reaction proceeds less completely).

During alkaline treatment, at a certain temperature, a decrease in alkali concentration initially increases the degree of cellulose swelling and later leads to its reduction. A decrease in temperature slows down alkali cellulose formation but increases the degree of cellulose swelling. This correlation has been observed for other alkalis as well.

According to many references, the ability of various alkalis to produce alkali cellulose can be arranged in the following order:

LiOH < NaOH < KOH < RbOH < CsOH

Changing any parameter of the alkaline treatment—such as temperature, alkali concentration, type of cellulose preparation, duration, bath ratio, or degree of pressing—affects the composition of the resulting alkali cellulose.

When cellulose swells under alkali treatment, **significant structural changes** occur. Intermolecular interactions decrease substantially, increasing the active surface area of the material and enhancing the reactivity of cellulose. At the same time, **hemicelluloses are washed out** of the cellulose.

After alkaline treatment, alkali cellulose is pressed and sometimes **milled** to increase the reactive surface (e.g., for subsequent reaction with alkylating agents). During this process, the physical form of the material changes, and oxidative degradation occurs. The degree of degradation depends on the conditions of milling, including duration, temperature, and equipment design.

From each ton of cotton lint, approximately 0.8 tons of pure cellulose can be obtained, with a moisture content of around 10%.

Reagents:

- Sodium hydroxide (NaOH) 20 g/L

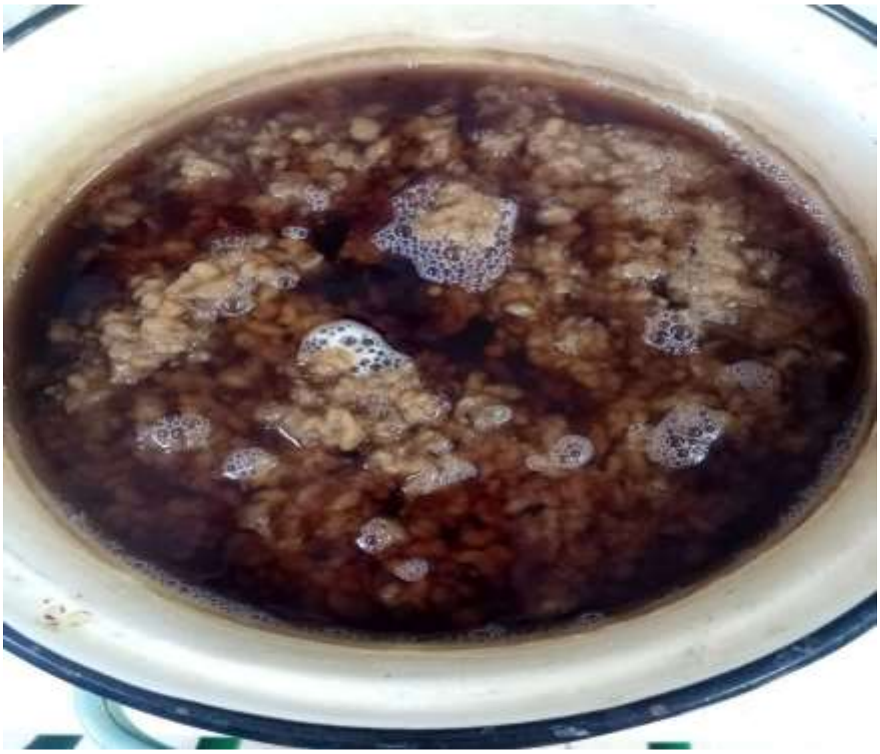
Equipment:

- Boiling vessel with a capacity of 3000–4000 mL
- Electric hot plate
- Metal spoon
- Distilled water
- Sieve
- 7% NaOH solution
- Balance
- Drying oven

Procedure:

1. Weigh 60 g of cotton lint using a laboratory balance.
2. Purify the sample from impurities by **grading**: initially remove dust particles (diameter 1–3 mm) and then larger impurities (diameter 3–6 mm). After removing dust and other foreign particles, the sample mass is reduced to 52.49 g.
3. Wash the purified sample with distilled water.
4. Dry the sample in a drying oven at 110°C and then allow it to cool to room temperature. After cooling, weigh the sample; the mass is 49.38 g.
5. Prepare a 7% NaOH solution in a 2 L vessel. Immerse the sample in the alkali solution and boil for 3 hours. After 1 hour, add 500 mL of distilled water, and continue boiling. After some time, add another 500 mL of distilled water.

6. After 3 hours of boiling, wash the sample 5 times with distilled water and dry it in a drying oven.
7. Allow the sample to cool to room temperature and weigh it. The final mass is 42.26 g, which represents the obtained **unbleached cellulose**.



Bleaching of Cellulose with Hydrogen Peroxide

Cellulose boiled by both continuous and batch methods can be subjected to bleaching. Common bleaching agents include hydrogen peroxide (H_2O_2), chlorite, or chlorate salts of sodium.

During bleaching, besides breaking down pigments that impart a grayish color to cellulose, residual lignin and other additional compounds are removed, improving the reactivity of the fibers. As a result of cellulose oxidation, the content of high-molecular-weight products in its structure increases.

When cellulose is treated with chlorine, two main processes occur:

1. The formation of chlorine-lignin compounds that are soluble in diluted alkali solution.
2. Oxidation of color-giving pigments and some remaining resins.

Reagents:

- Hydrogen peroxide (H_2O_2, 30%) at 3–10% relative to the mass of cellulose

Procedure:

1. The previously obtained 42.26 g of alkali cellulose was subjected to bleaching.
2. A portion of 10 g of unbleached cellulose was treated with 10% H_2O_2 for 24 hours.
3. The remaining 22 g of unbleached cellulose was treated with 5% H_2O_2 for the same duration.
4. The remaining unbleached cellulose was subjected to bleaching using other methods.

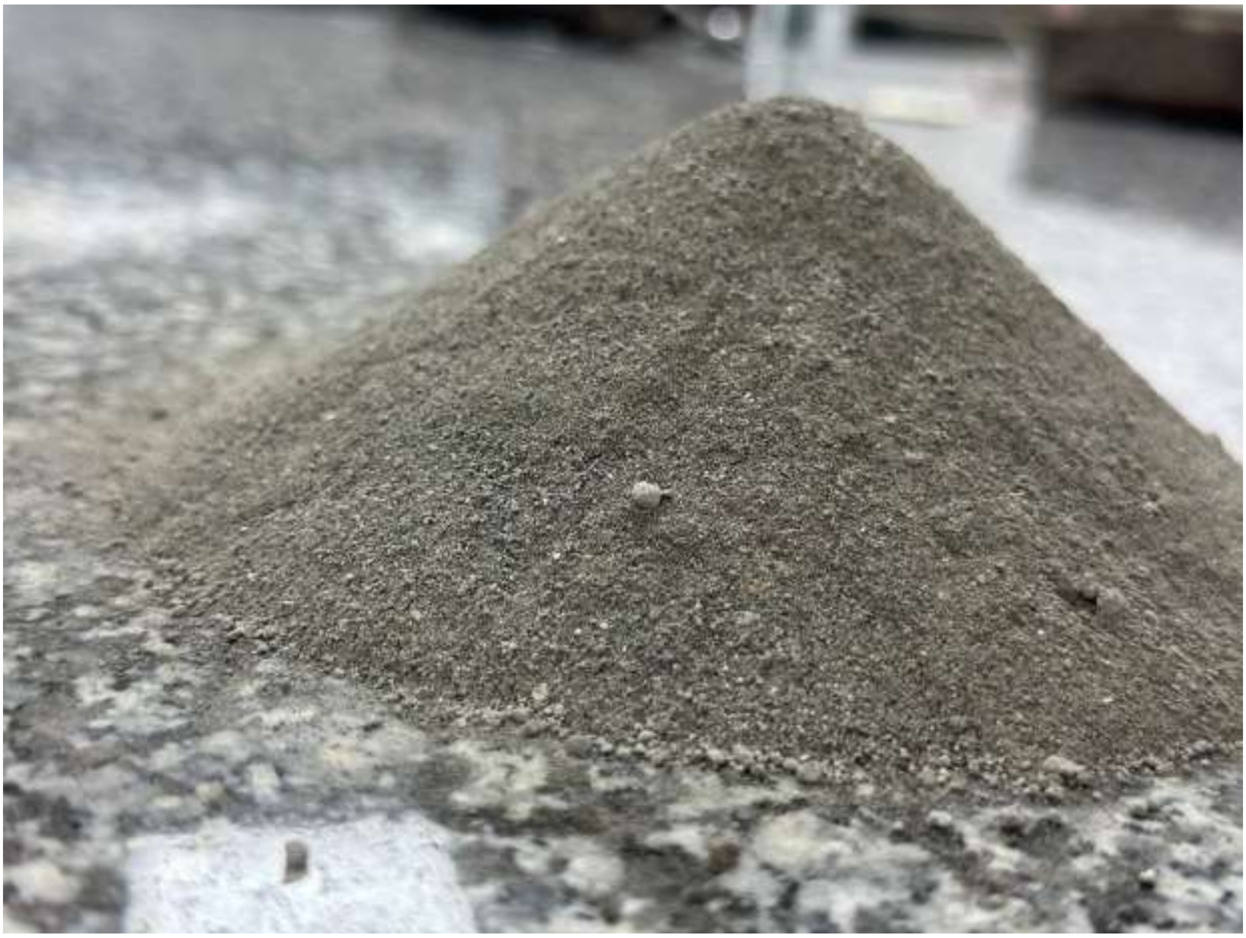
Improving the Processing Methods of Central Kyzylkum Waste to Reduce Waste Volume

It is impossible to imagine crop yields without the use of mineral fertilizers containing various essential nutrients such as nitrogen, phosphorus, and potassium. Recently, a growing trend in the extraction of phosphate raw materials has been observed, and therefore it is not surprising that the global extraction of phosphate ore reaches 190 million tons annually.

By 2050, the annual production and consumption of phosphate raw materials are projected to be approximately 70 million tons of P_2O_5, which corresponds to around 220 million tons of phosphate ore.

Phosphate deposits have formed as a result of the precipitation of phosphates from seawater. Phosphorites differ by type: stratified, nodular (stones of various shapes and colors), granular, and crusted (rock layers saturated with phosphatized shells).

Phosphate ore reserves have been identified in 76 countries worldwide and are estimated at 70,587.4 million tons of P_2O_5, including 65,328.4 million tons of phosphorites and 5,259 million tons of apatite ores. Morocco, the United States, the Russian Federation, China, Mexico, Kazakhstan, Peru, South Africa, Western Sahara, and Tunisia hold 61,015.4 million tons of P_2O_5, accounting for 87% of global reserves.



Apatite ores account for approximately 15% of total phosphate production. They have been identified in only 10–12 deposits worldwide. The main reserves are located in the Russian Federation, South Africa, Uganda, China, Brazil, Finland, and Vietnam.

The P_2O_5 content in phosphate raw materials produced in different countries varies significantly—from 21% (Uzbekistan) to 38.2% (Nauru). The higher the P_2O_5 content in the raw material, the more economically efficient its processing becomes.

The world's best phosphate raw material is the Khibiny flotation apatite concentrate (RF). This concentrate is obtained from apatite-nepheline ore containing 16–17% P_2O_5 through flotation enrichment. It contains the highest phosphorus content (39.5% P_2O_5) and has the lowest calcium module, i.e., a $CaO : P_2O_5$ ratio of 1.32. When subjected to acid decomposition, its consumption is minimal. It contains virtually no carbonates (0.15% CO_2), which prevents foam formation during acid treatment. Additionally, it is free of chlorine, preventing severe corrosion of plant equipment during sulfuric acid extraction of phosphate raw materials.

Mechanical-Chemical Activation and Phosphate Fertilizer Production from Central Kyzylkum Phosphorites

Mechanical-chemical activation involves extremely fine grinding of phosphate raw materials in the presence of a chemical reagent. The use of reagents helps control the rate of polymorphic transformations in the phosphate raw material, enhances the beneficial properties of the final product, and improves the solubility of phosphate minerals.

Based on the chemical activation of high-carbonate phosphorites from the Central Kyzylkum region, a simplified method for producing stabilized ammonium nitrate incorporating plant-available forms of calcium and phosphorus has been developed. This method involves mixing ammonium nitrate with high-carbonate phosphate powder, granulating it, and coating the granules with high-carbonate phosphate powder in the presence of ammonium sulfate or ammonium phosphate solution. An alternative variant involves coating the ammonium nitrate granules with high-carbonate phosphate powder in the presence of ammonium sulfate, ammonium nitrate, or ammonium phosphate solution. This SAF production technology has been implemented at the "Farg'onaazot" Joint-Stock Company.

To develop phosphorus fertilizer production technology, studies have been conducted on the activation of Central Kyzylkum and Guliob phosphorites under conditions of insufficient sulfuric and nitric acids, with participation of their ammonium salts. Research indicates that when phosphate minerals are activated in the soil solution, the dissociated ions of the salts react with phosphate components to form plant-available P_2O_5 forms.

The work of Seytnazarov A.R. and colleagues developed technologies for producing primary and complex fertilizers using chemical and mechanical-chemical activation of phosphorites. This approach enables the utilization of phosphate raw materials, including mineralized mass that is often considered a by-product of phosphate production. Furthermore, chemical activation of phosphates with phosphate acids allows the production of primary phosphorus fertilizers necessary for soil enrichment in agriculture. This research has been patented in the Republic of Uzbekistan. To logically conclude these studies, extensive industrial and agrochemical trials are necessary.

Preparation of Natural Biologically Active Medicines Using Bee Products

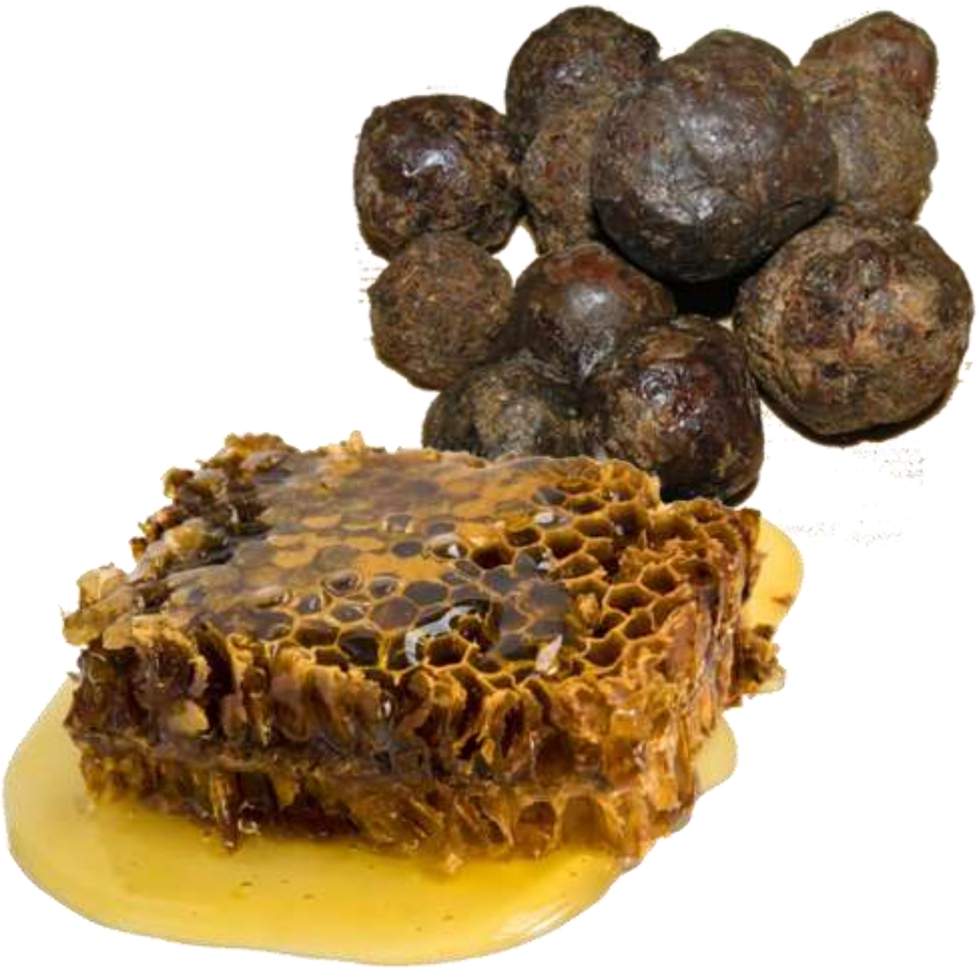
Propolis should be used in treatment primarily in combination with other medications. It can be taken alone only for preventive purposes.

Proper Use of Propolis:

Propolis is widely recognized both in traditional medicine and in conventional medicine. In pharmacies, you can purchase medicines containing propolis. However, many people believe that remedies based on traditional medicine are often more effective.

Forms of Propolis Products Available in Pharmacies:

1. Propolis (alcohol tincture) – used for disinfection of the oral cavity, treatment of respiratory system issues, and gastrointestinal tract disorders. Contains 20% active substances.
2. Rino Factor – a preparation for treating mucous membranes, relieving pain, and strengthening blood vessel walls.
3. Propolis (ointment) – used externally to reduce inflammation and treat skin diseases, including for chronic conditions.



Although these medications do not have a toxic effect on the body, they must be used strictly according to doctors’ recommendations.

Homemade Propolis Treatment Recipes:

- Pure propolis is considered the most beneficial. The recommended method of use involves chewing the product. Simply swallowing it reduces its effectiveness. For treatment, propolis should be chewed or allowed to dissolve in the mouth for about 15 minutes. This method helps treat oral infections and colds.
- When treating gastrointestinal diseases associated with inflammatory processes, propolis is swallowed. In this case, it should be taken three times a day, with a single dose of 5 grams.
- For rheumatic pain, pure, unprocessed propolis can be applied directly to the affected area.

- For preventive purposes, propolis can be mixed with honey in a ratio of 1:4 and taken once daily before bedtime. One dose corresponds to approximately 1 teaspoon. This procedure strengthens the immune system and is recommended during the autumn and spring seasons.
- To treat oral diseases, propolis can also be used as a mouth rinse. For this, propolis is diluted with water in a ratio of 1:10 and slightly warmed. Accidental ingestion of the solution is harmless.

Propolis Tincture

Alcohol-based propolis tincture can be used both internally and externally. It helps eliminate toxins, reduce inflammation, and improve overall health. The tincture is prepared according to the following method:

1. Mix 1 liter of 95% ethanol with 200 grams of crushed propolis in a glass container.
2. Store the mixture in a dark and warm place. The tincture can be used after two weeks.

- External use: The tincture is applied to skin diseases and infected wounds.
- Internal use: Recommended for treating colds. For internal administration, 1 teaspoon of tincture is diluted in 3–4 tablespoons of water and taken 1 hour before meals.

Propolis supports the treatment of respiratory system disorders, including the throat, nasal passages, sinuses, as well as influenza, bronchitis, and common cold.

- Inhalation procedure for respiratory diseases:
    1. Mix 300 ml of water, 50 g of propolis, and 40 g of beeswax in an enameled container.
    2. Place the mixture in a water bath and inhale the vapors for at least 15 minutes per session.
    3. To achieve effective results, the treatment course should last 10 days.

This method can also alleviate the condition of patients with tuberculosis.

Advantage: Propolis retains its beneficial compounds even after 1 hour of heating, ensuring its therapeutic effect is preserved.

Propolis Ointment

Propolis ointment is intended for external use only. The preparation follows this recipe:

1. In an enameled container, combine:
   - 70 g petroleum jelly,
   - 20 g lanolin, and
   - 15 g propolis.
2. Place the container in a water bath and heat for 10 minutes.
3. Filter the mixture through two layers of cloth and allow it to solidify.

Application: The ointment is applied to areas affected by skin and mucous membrane diseases, aiding in the healing of wounds and injuries, reducing pain, and accelerating recovery from burns and frostbite.