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AGRICULTURAL SCIENCES AND BIOLOGICAL SCIENCES

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Green Choices: The Environmental Impact of Consumption Habits

Abstract

Ecological footprint is an important indicator used to measure the impact of human activities on ecosystems. This measure reflects how people consume natural resources, the waste they generate, and the state of biodiversity. In modern times, reducing the ecological footprint is an important issue for protecting ecosystems and ensuring sustainable development.

The first aspect of the ecological footprint is the efficient use of natural resources. Proper management of water and energy aims to minimize the waste of these resources. The use of renewable energy sources, such as solar and wind power, helps reduce carbon emissions. This approach not only preserves the health of ecosystems, but also meets people's energy needs in a more sustainable way.

The second important issue is waste management. Reducing waste in production processes, promoting recycling and recirculation of used materials contributes to reducing the environmental footprint. Each individual can help this process by making small changes in their daily life; for example, reducing the use of plastic and choosing more environmentally friendly products.

Biodiversity conservation is also an important part of the ecological footprint. The health of ecosystems is related not only to the availability of natural resources, but also to the diversity of flora and fauna. Implementation of conservation projects to protect rare and endangered species ensures the sustainability of biological diversity. This also affects the strengthening of the relationship between people and ecosystems.

Combating climate change is another important step in reducing our ecological footprint. Applying strategic approaches to reduce the carbon footprint is one of the most important tasks facing modern society. It also includes strategies for adapting to the effects of climate change. The active participation of the society in these issues makes it possible to achieve more effective results at the global level.

Keywords: *ecological footprint, climate change, ecosystems, consumption habits, green choice*

Introduction

The world is facing increasing environmental problems, climate change, resource depletion and social injustices in recent years. These challenges threaten people's daily life, health and future. The concept of "Green Choice" brings a positive approach to these problems and aims to build a better future by combining ecological, social and economic sustainability.

Green Choice is based on ecological thinking. Environmental problems are caused by issues such as environmental pollution, loss of biological diversity, climate change and rapid exploitation of natural resources. These problems threaten the future of not only modern society, but the entire planet.

The Green Option promotes the protection of ecosystems and the sustainable use of natural resources through the implementation of environmental policies. The use of renewable energy sources, such as solar, wind and hydropower, aims to reduce carbon emissions. Ecological thinking encourages people to change their consumption habits, reduce waste and use less resources (Abbasova, 2005, p. 77). This approach not only produces positive environmental outcomes, but

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also protects human health, as clean air, water and healthy ecosystems enhance people's quality of life.

Research

The Green Choice places a strong emphasis on social justice principles as well as environmental issues. This approach requires that all individuals in society have equal rights and ensure social justice (Abbasov, 2006, p. 57). Human rights, gender equality, ethnic minority rights and social justice are the principles at the heart of the Green Choice.

Social justice is not only about economic equality, but also about the fair distribution of resources. Environmental policies aim to create a fairer society by protecting the weakest and most vulnerable groups, hearing their voices and promoting the principle of social justice. For example, climate change and environmental problems mostly affect low-income and socially vulnerable groups (Aghakishiyeva, 2000, p. 35). For this reason, the Green Option should focus on protecting these groups and advancing their rights.

The Green Option also emphasizes the compatibility of economic development with ecological balance. A sustainable economy is not just about financial gain; at the same time, it should consider the environment and the welfare of society. This approach promotes the development of green technologies, environmentally friendly production methods and the creation of green job opportunities.

Green economy creates new opportunities for not only environmental but also economic growth. Areas such as the renewable energy sector, energy efficiency, eco-friendly agriculture and sustainable tourism aim to drive the economy forward by creating jobs. This approach also supports the development of local communities, as environmentally sustainable projects strengthen the local economy.

Ecological footprint is an indicator that measures the impact of a person, community or activity on ecosystems. This includes the amount of resources consumed (water, energy, food, raw materials) and the waste generated during the processes of their production, transportation and consumption. The ecological footprint shows how the choices and behaviors a person makes in his daily life are located within the ecological boundaries of the planet (Aghayeva, 2000, p. 68).

This indicator is useful for understanding human impacts on the environment, promoting more sustainable use of resources, and combating climate change. Reducing the ecological footprint encourages the adoption of greener lifestyles and conservation of resources.

The ecological footprint includes the following elements:

Carbon footprint: refers to the total amount of greenhouse gases (especially carbon dioxide) released into the atmosphere by a person or an activity. This measure includes emissions from energy production, transportation, production processes, and other activities. Reducing the carbon footprint is one of the important steps to minimize the effects of climate change. This is possible by consuming less energy, switching to renewable energy sources and focusing on sustainable production methods (Ahmadov, 2006, p. 85).

Water footprint: refers to the total amount of water produced by a person or an activity. This includes water used directly (eg. drinking water) and indirect use (eg. water used in the production process, food production). The water footprint is an important measure for water resource management and sustainable consumption, as the proper analysis of such data becomes even more important as water scarcity increases. Reducing the water footprint, water conservation and sustainable consumption are important.

Land footprint: an indicator that measures the impact of a person or an activity on land and the amount of land use. This includes factors such as land use, land yield, reduction of above-ground vegetation and soil erosion. The land footprint helps us understand how farming, urban development and other activities affect land resources. Monitoring and reducing this indicator is important for the sustainable use and protection of land, as soil health is fundamental to the sustainability of ecosystems and food production.

Material footprint: a measure of the total amount of materials (especially raw materials, products and waste) produced by a person or an activity. This includes resources used in product

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production, consumption and waste management processes. The material footprint is important for measuring the efficiency and sustainability of raw material use, as this indicator helps to adopt more sustainable approaches in the production and consumption of resources. It is important in terms of reducing the material footprint, protecting resources and reducing waste (Mammadov, 2005, p. 95).

Measuring the ecological footprint helps people and societies value environmental health, move towards more sustainable consumption habits and protect ecosystems.

The purpose of the ecological footprint is to understand the impact of human consumption habits and activities on ecosystems. It helps individuals and communities to appreciate the environmental situation, increase environmental awareness and promote sustainable lifestyles.

Ecological footprint is an important indicator that measures the impact of human activities on ecosystems. This measure reflects the consumption of natural resources, the generation of waste and the biological diversity in ecosystems. The tasks of the ecological footprint include systematic approaches aimed at solving environmental problems facing modern society (Mirbabayev, 2005, p. 73).

The first task is the efficient use of natural resources. Water and energy consumption are the most important components of the ecological footprint. Effective management systems are essential to prevent water wastage. At the same time, the use of renewable energy sources helps to reduce carbon emissions. This serves both to protect ecosystems and to meet the needs of future generations.

The second task is waste management. Waste reduction is possible by optimizing modern production processes. Extending the life cycle of the manufactured product, waste conversion and recycling help to significantly reduce the ecological footprint. Each individual can contribute to this process by changing their consumption habits and trying to reduce waste (Carbonfootprint.com).

Biodiversity conservation is also an important aspect of the ecological footprint. The health of ecosystems is important for the sustainability of human society. Implementation of conservation projects for the protection of rare and endangered species is an important step towards the preservation of biological diversity. This not only ensures the stability of ecosystems, but also has a positive effect on human health.

Combating climate change is another task of the ecological footprint. Reducing the carbon footprint is one of the main steps people should take to combat the effects of climate change (WWF's Living Planet Report). It also includes cooperation with local communities, implementation of innovative solutions and climate change adaptation strategies.

Public education is also among the tasks of ecological footprint. Education programs on ecology and sustainable development encourage people to think and act in the direction of solving environmental problems. It is possible to ensure the active participation of the society by conducting wide discussions on environmental issues through public discussions.

Finally, promoting sustainable development is extremely important to reduce the ecological footprint. Sustainable agriculture and forest management practices serve to conserve natural resources. The development of environmentally friendly innovations makes it possible to apply new and efficient methods (U.S. Environmental Protection Agency).

Thus, the tasks of the ecological footprint are important to maintain ecological balance in modern times and present a livable world to future generations. The realization of these tasks requires joint efforts not only of individuals but also of societies. Small steps each of us can take to reduce our environmental footprint have the potential to make a big difference.

Here are some recommendations to reduce your ecological footprint:

1. Energy use

Renewable energy sources: Trying to reduce electricity production by installing solar panels or wind turbines at home.

Energy efficient appliances: Choose appliances with A++ or higher energy output.

Lighting: Use LED bulbs and turn on lights only when needed.

2. Transportation

Public transport: Using a bus, subway or train instead of a car.

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Cycling: Cycling for short distances can help reduce congestion and improve your health.

Carpooling: Sharing a car with people going in the same direction.

3. Food consumption

Local and seasonal produce: Produce from local farmers reduces the carbon footprint caused by transportation.

Plant-based food: Reducing meat consumption has less impact on the environment.

Reducing waste: Planning before shopping to minimize food waste.

4. Waste management

Waste separation: Join the recycling process by separating paper, plastic, glass and organic waste.

Composting: Improve soil fertility by composting your food waste.

Reuse: Use reusable shopping bags and avoid plastic products.

5. Water Use

Save water: Take short showers, wash without running water, and fix water leaks.

Green gardening: Creating a garden of native plants reduces water consumption.

6. Shopping habits

Eco-friendly products: Choose eco-certified products, avoid chemicals.

Second-hand shopping: Reduce the production of new products by shopping at second-hand stores, markets.

7. Education and awareness

Environmental awareness: To learn and inform others about environmental issues and sustainable development.

Active participation: Participate in environmental initiatives, support local community projects.

By integrating these recommendations into our daily lives, we can help reduce our environmental footprint and build a greener future. Every little step counts!

Green choices are essential to ensure a sustainable future. These choices must be made not only at the individual level, but also at the community and state level. States should promote green choices through environmental legislation and incentive programs. And community-based projects can play a positive role in guiding people toward environmentally conscious consumption habits (Research and data to make progress against the world's largest problems).

Green choices are an important step in reducing our environmental footprint and creating a more sustainable future. Small changes each of us can make can create a collective positive impact. Focusing on green choices to protect ecosystems, use resources more efficiently and create a healthy environment means ensuring a healthy planet for future generations. Each of us can take individual steps to reduce our environmental footprint. Small changes can lead to long-term positive results. By making eco-friendly choices, it is possible to fight for a healthier planet (Make an impact, make a difference and donate).

The innovation of the ecological footprint is the development of new approaches and methods to more accurately measure and understand the impact of humans on ecosystems. These approaches include:

1. Digital Tools: Tracking and analyzing users' consumption habits through mobile applications and web platforms.
2. Data Analytics: More accurate assessment of environmental impacts with the use of big data.
3. Eco-certificates: New certification systems that promote sustainable product production.
4. Educational Programs: New educational methods and lectures that increase environmental awareness.
5. Collective Participation: New approaches that promote active participation of people through community-based projects and events.

These innovations aim to expand the understanding of the ecological footprint and provide more effective solutions.

Conclusion

The bottom line is that thinking about and reducing our ecological footprint is a critical step in protecting the future of our planet. Rethinking our consumption habits and moving to a more sustainable lifestyle is important not only for ourselves, but also for future generations. The small steps each of us can take can play a big role in preventing global environmental change and creating a healthier planet. Reducing our ecological footprint is essential for maintaining a healthy environment and sustainable use of natural resources. To this end, we aim to create a more sustainable future by combining our individual and collective efforts.

References

1. Abbasova, E. (2005). *Human ecology: Biological and sociological aspects*. Science-Education.
2. Abbasov, M. (2006). *Global environmental problems of our century*. Science.
3. Aghakishiyeva, T. (2000). *Features of socio-economic development in the conditions of modern ecological reality*. Science.
4. Aghayeva, Z. (2000). *Environmental policy and its socio-philosophical aspects*. Science.
5. Ahmadov, A. (2006). *Soil ecology*. Shirvaneshr.
6. Carbonfootprint.com. https://www.carbonfootprint.com
7. Mammadov, G. (2005). *Ecology and environmental protection*. Science.
8. Mirbabayev, M. (2005). *Airspace ecology* (Study material). AzTU.
9. *Make an impact, make a difference and donate*. Ecolifeconservation.org. ecolifeconservation.org
10. *Research and data to make progress against the world's largest problems*. Ourworldindata.org. ourworldindata.org
11. *U.S. Environmental Protection Agency*. Epa.gov. epa.gov
12. *WWF's Living Planet Report.* Worldwildlife.org. worldwildlife.org

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Possibilities of Using Environmental Knowledge in the Process of Environmental Protection

Abstract

In the globalising world, scientific and technical progress, increase in production areas, industrial and economic development have positively affected society and human life, but have caused serious deterioration of the ecological balance. Every person working in any field should have ecological culture and ecological knowledge. Since chemistry is mostly related to ecology among the subjects taught, the role of chemical production and anthropogenic effects in disrupting the ecological balance is great. In chemistry teaching, importance should be given to providing students with the necessary knowledge and skills about the source of environmental problems, environmental concepts, causes of problems and ways to eliminate them.

Keywords: *environmental education, chemical industry, anthropogenic effects, harmful substances, sulphur gas, nitrates, acid rain, environmental literacy, environmental education*

Introduction

The rapid advancement of science and technology has greatly affected humanity and the environment. Humans have had very serious effects on the environment without realising it. The level of pollution of the atmosphere, water and soil by various chemical products, including industrial, domestic and agricultural waste, is increasing rapidly. Such a question has arisen before humanity: What is the way out of the global environmental crisis?

Ecological Literacy, Culture and Ecological Consciousness

The highest stage of the ecologisation of consciousness is ecological culture, understood as the totality of the skills of contact with the natural environment. The existence of man and society requires the formation and observance of at least a minimum ecological culture. Humans are already facing very serious environmental problems. In order to eliminate such a problem, important processes such as ecological literacy and ecological culture should be brought to the agenda. Therefore, this can be achieved by increasing the role of environmental education throughout the entire educational process (Abbasov, 2004, pp. 36-43; Aliyev, 1987, pp. 20-25).

Research

If we look at the educational, educational and developmental functions of teacher activity, which is one of the main and priority topics of chemistry teaching methodology, we can show that the educational function is an aspect of special interest. It also connects several other parts. The educational function includes:

- to provide students with a scientific perspective,
- job training for students,
- cultivating love for the Motherland in students,
- environmental education in students.

Ecological culture is one of the manifestations of general culture. Unlike natural phenomena that arise spontaneously, culture is a product of human activity. Ecological culture, as one of the manifestations of culture in general, covers the sphere of relations between man, society and nature. We are talking about relations that reflect the positive beginning of human activity, aimed at harmonising the interests of man, society and the possibilities of nature.

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The elimination of the ecological crisis is possible only on the basis of ecological culture, whose main idea is to promote the harmonious development of nature and man.

The formation of the ecological culture of young people takes place mainly at school. This is done by educating schoolchildren in the spirit of respect for nature, scientific and ecological understanding of the world landscape (Mammadova, 1985, pp. 30-32; Guliyev, 1998).

The main indicators of ecological culture are:

− knowing the general laws of development of nature and society,
− lack of consumer attitude towards nature,
− the ability to predict the consequences of the impact of human activity on the Earth's biosphere,
− to treat the environment with care.

Environmental education is a consciously organised, planned and systematic process for the acquisition of environmental knowledge and skills. Environmental education aims to help people to create a new environmental awareness in modern conditions, to learn values, professional knowledge and skills that will help the country and the world overcome the ecological crisis and to guide society towards sustainable development.

Environmental education can be considered as a necessary element of general secondary education of young people, because:

− school is the main place of environmental education of young people,
− the study of the scientific foundations of nature conservation at school allows the whole young generation of the country to acquire ecological culture.

Environmental education of schoolchildren is currently one of the priority areas of work with young people. The scientific organisation of the process of ecological education requires the precise determination of all its links, the distinction of connections and dependencies.

Environmental education and environmental education are sometimes confused concepts. Some people think that the more people know about nature, the more consciously they will protect it. Knowing nature is a necessary sign, but not sufficient. Having knowledge about a subject does not always determine the attitude towards that subject. The school should also be concerned with the timely training of students in environmental activities.

Ecological education is not only the acquisition of ecological knowledge. Environmental education, which is the acquisition of a special ecological ethics, the ethics of human relations with nature, is more important. At the same time, ecological morality and ecological ethics are essentially one of the deep humanistic elements of personality (Streltsova, 1985; Nazarenko, 1992, pp. 40-45).

Ecological education is one of the new directions in pedagogy, which differs from the traditionally established “acquaintance of children with nature”. Environmental education is the formation of children's environmental knowledge, thinking, feelings, will as a set of emotions and active preparation for the protection of the environment. As a result, environmental education is an important component of personality, which helps students to understand the surrounding reality as a place of residence and aesthetic perfection and is directed towards them (Abbasov, 2004, pp. 36-43).

The following organisational forms, methods and tools of ecological education are distinguished (Abbaszade, 2021, pp. 47-51; Ecological aspects of chemistry teaching at school):

a) traditional,
b) active, innovative.

− lessons in the traditional format (introductory lessons, thematic lessons, lecture lessons, conversation lessons, etc.),
− special lessons (independent work of students, discussion teaching method, role-playing games),
− extracurricular and extra-curricular activities (research method, experience, solution of environmental problems),
− elective courses, lectures, lessons, stories, watching films,

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- various types of excursions (Ismayilova & Mammadov, 2018, pp. 24-29; Ways of teaching environmental knowledge in the process of chemistry teaching, 1985; Nasirova, 2011, p. 121).

The use of mineral fertilisers in agriculture above the permitted concentration has a direct impact on the food products grown. If the amount of nitrates and other elements in fruits and vegetables exceeds the recommended limit, it causes a dangerous situation for the human body. Nitrates are well absorbed by plant roots. In addition, the conversion of nitrates into amino acids is carried out in chain reactions occurring in plants. As a result of this process, protein is formed. Life without protein is unthinkable and life without protein is unthinkable. When excessive amounts of nitrate are used in agriculture, the excess nitrate accumulates in the organs in such a way that it cannot be absorbed and causes intestinal diseases in the form of dangerous substances for humans. In addition, when divalent iron oxidises into trivalent iron, it also affects haemoglobin and the ability of haemoglobin to carry oxygen is impaired. For this reason, the amount of nitrate in fruits and vegetables, i.e. whether it is normal or not, should be checked regularly. More than 120,000 tonnes of sulphur dioxide are emitted into the atmosphere during the year and water vapour in the atmosphere reacts with sulphur dioxide to form sulphuric acid.

$SO_2 + H_2O\ H_2SO_3 \longrightarrow$

Dissolved oxygen in the water vapour oxidises with sulphuric acid to form sulphuric acid.

Once in the atmosphere, these compounds are carried thousands of kilometres away by the wind and fall to the ground as fog, rain and snow. Acid rain turns rivers and lakes into “dead” puddles and harms all living things there, from forests to fish to microorganisms. Although acid rain does not cause global warming and ozone depletion, its polluting effect can go far beyond national borders. In order to purify the gas mixture from arsenic, selenium and other toxic gases, it must be burned with water. In this cleaning method, the water itself is contaminated with toxic substances. Such contaminated water poses an environmental hazard when released into water bodies without treatment. It is therefore necessary to purify such water from toxic substances such as arsenic, nickel, cobalt and mercury. A special water purifier is used for this.

Pyrite is used as the main raw material in the sulphuric acid production process. The production of sulphur dioxide from the combustion of sulphur ores, hydrogen sulphide and sulphur is the first step in sulphuric acid production. In the next stage, the sulphur gas obtained as a result of combustion is purified from mixtures. The gas purified from dust with special electrolytes is oxidised in the contact apparatus. The oxidation process is carried out at 4500 ℃.

$2SO_2 + O_2\ 2SO_3 \longrightarrow$

SO3 dissolved in solid H2SO4 is converted to oleum in the absorption tower. When sulphuric acid is obtained by contact method, its density is 93,4 %.

$SO_3 + H_2SO_4\ H_2S_2O_7 \longrightarrow$

The part of the Earth consisting of gases is the atmosphere. The atmosphere is the layer of air that surrounds the earth. The word ‘atmosphere’ literally means “breathing sphere”. Its history has been researched since ancient times. The atmosphere is a thin layer of air covering the earth's surface and has very important properties.

For a biologist, an important characteristic of the atmosphere is that it supports various forms of life. For a chemist, the atmosphere is a place where continuous photochemical processes take place on a large scale.

One of the phenomena that complicate living conditions on Earth is the pollution of the atmospheric environment by anthropogenic wastes and their products. As we know, toxic substances are increasing in the environment and transport plays a major role in the increase of such substances, as the chemicals used in transport cause pollution by spreading around with the wind. The increase in the concentration of carbon dioxide in the atmosphere and the change in the ozone layer are the result of the effects on the atmosphere. Atmosferin heterogen təbiətli olması onun əsas xüsusiyyətlərindən biridir.

In atmospheric chemistry, water is extremely important in almost all phase states. It is known that the main participant in gas phase reactions is the hydrogen group and that the oxidising agent in reactions between liquid components is hydrogen peroxide and that the natural source of these

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substances is water. The study of heterogeneous chemical processes is of decisive importance for clarifying the features of the formation of the biogeochemical cycle in the atmosphere. The effects of anthropogenic influences on climate are diverse and numerous. Anthropogenic effects on climate are based on chemical and physical transformations, determining the role of heterogeneous processes, explaining the relationship between these processes, determining the rate of gas phase reactions.

The composition of the atmosphere is determined by the processes occurring in the biosphere. In the biosphere organic substances are continuously synthesised and their decomposition processes take place. The stability of the chemical composition of the environment is ensured by the closed circulation of substances in the biosphere.

The following areas are relevant to the demand for this factor:

1) Impact of industrial development on the biosphere,
2) Explanation of the regularity process of the carbon cycle,
3) By developing climate theory.

Aerosols have a major impact on climate change. Atmospheric aerosol is a product of complex physical and chemical processes. The reason why the chemical composition and physical quantities of aerosol change is the complexity of these processes as well as the short lifetime of the aerosol.

There are the following types of natural aerosols according to source and composition:

1) Products from volcanic eruptions,
2) Products obtained from evaporation of sea water,
3) Fumes during combustion,
4) Products from reactions in the natural gas phase,
5) Mineral dusts that can be discharged into the atmosphere by wind.

There is another type of aerosol other than these types of aerosol, which is anthropogenic aerosol.

Conclusion

In addition to the main components, atmospheric air may also contain the necessary amount of substances released from natural sources. Plants, sea salt and water vapour particles, dust generated during soil erosion, gases generated during forest fires and volcanoes are attributed.

The composition of air consists of different gases. These gases include nitrogen, rhodium, argon, oxygen, etc. belong. However, it is not possible to find air with such a composition in nature. The gaseous medium of air contains a large amount of small liquid and solid particles. Air is in the form of a dispersed or aerosol system. These air pollutants enter the air through the biosphere. When air interacts with other components of the biosphere, namely water, soil and living organisms, it forms liquid and solid particles in the biosphere. Part of the biosphere is air (Ecological aspects of chemistry teaching at school).

A number of natural processes occurring in nature are the suppliers of air with dispersed particles. When a powerful volcano erupts, tiny solid and liquid particles rise into the air. These particles and the accompanying gases, which can remain in the air for weeks, rise to heights of 20 kilometres or more (Taghiyev, 2018).

In fires that occur in many countries every year, crushed solid smoke particles can spread over tens or hundreds of kilometres. Steppe and peat fires can produce mineral dust. During soil erosion and associated sandstorms, fine particles are released into the air when rocks are eroded and crushed.

There are industries that need to be considered among the factors that pollute the atmosphere more in relation to chemical production. In the process of providing students with environmental culture and environmental literacy, the teacher who teaches chemistry should definitely bring the appropriate links to the attention of the students.

These industries artificially pollute the atmosphere. These are the following:

1. Black metallurgy.
2. Chemical and petrol-chemical industry.

3. Building materials industry.
4. Thermal power plants.
5. Air pollution of transport waste etc.

References

1. Abbasov, M. M. (2004). Problems of formation and development of environmental knowledge in the process of teaching school chemistry course. *Chemistry at school*, 4, 36-43.
2. Aliyev, R. Y. (1987). Teaching of natural resources of Azerbaijan in IX-X classes in chemistry teaching. *Teaching chemistry and biology*, 3, 20-25.
3. Abbaszade, N. B. (2021). Formation of environmental concepts in the process of teaching concepts related to metals in school chemistry course. *Chemistry at school, Scientific theoretical and methodical collection*, 1(73), 47-51.
4. *Ecological aspects of chemistry teaching at school.* Gigabaza.ru. https://gigabaza.ru/doc/76066.html
5. Guliyev, V. S. (1998). *Protection of nature.*
6. Ismayilova, G. N., & Mammadov, I. Z. (2018). *Formation of ecological aspect in chemistry teaching, scientific-theoretical and methodical collection*, 2-3(62-63), 24-29.
7. Mammadova, M. H. (1985). Ways of interest and care for nature. *Teaching chemistry and biology*, 1, 30-32.
8. Nazarenko, V. M. (1992). Chemistry and environmental protection. *Chemistry at school*, 3-4, 40-45.
9. Nasirova, G. N. (2011). Development of environmental knowledge in chemistry lessons. *Pedagogical University News*, 2, 121.
10. Streltsova, V. B. (1985). *Our friend is nature!* Pedagogy.
11. Taghiyev, T. I. (2018). *Environmental education of students in chemistry teaching*. Textbook for high school students.
12. *Ways of teaching environmental knowledge in the process of chemistry teaching.* (1985). Methodological proposal.

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MEDICINE AND PHARMACEUTICAL SCIENCES

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Parasitology – As an Important Scientific Field of Medicine

Abstract

Medical parasitology is the science that studies human parasites, diseases caused by them, and measures to combat these diseases. Medical parasitology is an important part of the science of parasitology (which includes zooparasitology and phytoparasitology) and studies the causes, transmission, pathogenesis, clinic, epidemiology, immunology and treatment of parasitic diseases in humans, as well as ways of prevention and control of these diseases. Traditionally, parasitic diseases include diseases caused by protozoa (protozoa), diseases caused by helminths (helminthoses) and diseases caused by arthropods. One of the most important tasks facing parasitology is the development and implementation of scientific-based measures against diseases caused by parasites in order to protect people's health, protect agricultural animals and plants from various diseases.

Keywords: *parasites, medical parasitology, helminthoses, protozoa, prevention*

Introduction

Taking into account the global importance of parasitic pathology in modern times, most countries of the world have set the problem of fighting parasitic diseases as a goal to be solved. According to the World Health Organization, more than 4.5 billion people worldwide suffer from parasitic diseases. About one million parasitic patients are registered in Russia every year. Their actual number exceeds 20 million people. Protozoan diseases and helminthoses, which are the subject of parasitology, are an important part of infectious pathology. WHO indicates that diseases caused by helminths are the third most important infectious and parasitic diseases in the world, and diseases caused by plasmodials are the fourth (1.4 billion and 600 million cases, respectively). The socio-economic importance of parasitic diseases, above all malaria and intestinal helminthosis, is so great that this pathology creates an obstacle for the economic development of many countries of the world. Cases of introduction of tropical parasitic diseases in non-endemic countries seriously harm people's health. All this determines the study medical workers with the modern principles of diagnosis, treatment and prevention of human parasitic diseases and increases its importance.

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Research

One of the most important issues facing our healthcare in modern times is the reduction and eventual elimination of infectious and invasive diseases. Among the practical disciplines dealing with this, parasitology occupies one of the leading places (Aghayev, 2022, p. 822). To understand its importance, let's briefly review the content of the subject.

Due to the high level of organization of parasitosis agents compared to microorganisms, their interaction with the host organism is more complex and diverse than that of parasitic prokaryotes (Salehov, 2022, p. 233). The presence of a multicellular organism (often a parasite) in another complex organism is possible only when the natural defense mechanisms are weakened. Therefore, parasitic diseases are always accompanied by allergies and immunosuppression. The susceptibility of the infected organism to infection by other infectious agents increases, and at the same time, the resistance of this organism to the influence of negative environmental factors decreases. In recent years, along with the more severe course of infectious diseases, there has been an increase in cases of infection with a number of parasitosis.

Parasitology (from the Greek *parasitos* – "living thanks to another", *logos* – word, teaching) is a science that studies parasites, their hosts, carriers and their relationship with the environment, as well as the diseases they cause and measures to combat them. Parasitology is one of the main branches of biological science, it studies the phenomenon of parasitism (Briko, 2013, p. 768). The subject of parasitology is to study the complex mutual relations between the parasite and the host and the change of these relations depending on external environmental factors. That is why parasitology belongs to the system of ecological sciences.

The main task of the science of parasitology is to study the structure of the parasite, its life cycle, its adaptation to nutrition in the host organism, as well as its geographical distribution, origin, etc. (Sergiyev, 2006, p. 592). It is for this purpose that parasitology is primarily closely related to zoology, botany, medicine, veterinary medicine, chemistry and other sciences. The study of complex interactions between parasites and the external environment plays a major role both theoretically and in the development of measures to control parasitic diseases. Therefore, the science of parasitology is closely related to epidemiology and epizootology, and studies the general laws of the occurrence of invasion and infectious diseases.

Parasites, that is, organisms that permanently or temporarily use the organisms of other species as a place of residence or a source of food, are all living agents of human, animal and plant diseases without exception. Existence at the expense of the host organism is characteristic of prions, viroids, viruses, rickettsiae, bacteria, parasitic fungi, protozoa, helminths and many species of arthropods (Zuyeva, 2006, p. 752). However, according to current practice, diseases caused by prions, viroids, viruses, rickettsiae and bacteria are called infectious diseases. Mycoses are diseases caused by pathogenic fungi.According to the current terminology, parasitic diseases include only protozoa caused by protozoa, which are pathogenic single-celled organisms, and helminthose, whose causative agents are parasitic worms. Sometimes diseases caused by arthropods are also included in the group of parasitic diseases. According to the modern classification, out of 1415 known causative agents of human diseases, 353 cause protozoan diseases and helminthoses (Sergiyev, 2006, p. 592).

Parasitology is divided into general, medical, veterinary and phytoparasitology. General parasitology deals with general laws of parasitism, theoretical aspects of parasite-host relationships, issues of taxonomy, classification, etc. reviews. Depending on the systematic position of the studied group of parasites, the following sections of parasitology are distinguished: protozoology (protistology), helminthology and arachnoentomology (Briko, 2013, p. 768). As mentioned, according to the 3 main groups of parasites, this science is divided into 3 sections: protozoology (the science of primitives), helminthology (the science of helminths) and arachnoentomology (the science of arthropods) (Aghayev, 2022, p. 915).

Diseases caused by parasites of animal origin are called parasitic or invasive diseases. In the animal world, there are a large number of microorganisms belonging to the family of primitives (Protozoa), which enter the human body and cause a number of diseases – protozoa (giardiasis, toxoplasmosis, malaria, leishmaniasis, etc.) (Chobanov, 2006, p. 280). Protozoa are very

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widespread. For example, malaria, leishmaniasis, diseases caused by intestinal protozoa are recorded in all countries (Aghayev, 2010, p. 117).

The second largest group of parasitic diseases is helminthosis. Helminths also have important medical and social importance (Sergiyev, 2006, p. 592). They (ascaridosis, trichocephalosis, enterobiosis, echinococcosis, teniidoses, etc.) come across very often to both treating doctors and pediatricians. In general, more than 250 species of parasitic worms, thousands of which are common in nature, are encountered in the human body.

The third part studied by medical parasitology is the arthropods.Arthropods play a significant role in the spread of a number of diseases (malaria, leishmaniasis, encephalitis, typhoid fever, plague, yellow fever, etc.) (Briko, 2015, p. 768). Many of their representatives (mites, insects) lead a parasitic life in human organs and tissues and have various harmful effects on it. In addition, arthropods play the role of live carriers (malaria, leishmaniasis) or reservoir (tick-borne encephalitis) of many diseases. It should be noted that rodents can also be reservoirs and sources of infection in parasitic diseases (Chebisheva, 2005, p. 440). Therefore, in the fight against diseases, it is important to implement certain measures in relation to vectors. Thus, often their destruction (disinsection) ensures the effectiveness of anti-epidemic measures (Hajiyev, 2010, p. 238).

Parasitism is one of the main processes studied by parasitology. Parasitism is a form of relationship between two organisms of different species, where one (the parasite) uses the body of the other (the host) as food and habitat, and both organisms are in an antagonistic relationship with each other. Parasitism is one of the forms of biotic communication between living organisms of different species. Before its appearance, various types of interactions between different organisms have arisen. The main types of these interactions are as follows: synoicism, commensalism, mutualism.

From this point of view, the teaching of parasitology is very important, and it consists primarily of familiarization with the carriers and agents of parasitic diseases, the biological and ecological characteristics of medically important protozoa, helminths, arthropods, the role they play in human pathology, laboratory diagnosis and treatment methods, involves carrying out measures to fight against the carriers of invasion and infectious diseases. Medical parasitology is also involved in the implementation of counter-epidemic and preventive measures.

Training of medical personnel in this field is carried out in higher education institutions, primarily in universities and colleges providing medical education. It should be noted that the subject of parasitology is also taught at the Azerbaijan Medical University and specialists in this field are trained. At this time, students master the scientific and organizational bases of epidemiological diagnostics and epidemiological control during separate nosological forms of parasitic diseases. Also, the nature of the interaction of parasites with the host organism, the potential effect of the anti-epidemic measures implemented in preventing their spread, the functional directions of the activities of the institutions and departments of the anti-epidemic system, as well as the measures to combat them, depending on the ecological characteristics and epidemiological role of the vectors, are studied.

The aim of the course is to acquaint students with the basics of parasitology, parasitic diseases occurring among humans, their epidemiological characteristics, laboratory diagnostics of parasitic diseases, as well as the main principles of the fight against parasitic diseases, which play an important role in the pathology of the country of Azerbaijan. Also, the biological-ecological characteristics of parasites and the nature of the interaction between them and their host organisms, the potential effectiveness of anti-epidemic measures, the mastering of the scientific and organizational bases of epidemiological control during separate forms of parasitic diseases in accordance with the functional directions of the activities of anti-epidemic system institutions and departments.

Teaching is conducted according to a newly developed program. The program is primarily designed for students of the Faculty of Public Health and the Faculty of Medicine. But at the same time, it will be useful for epidemiologists, parasitologists, sanitary-epidemiological service workers, including medical doctors. The program is developed on the basis of examples taught in the field of parasitology in world practice and includes both theoretical and practical issues.

Conclusion

Thanks to the training conducted under the new program, students: Plan and implement preventive and anti-epidemic measures in protozoa and helminthosis foci; Evaluates the results obtained during parasitological examinations; Based on the diagnosis of individuals in different developmental stages of parasites, it differentiates them; Determines the epidemiological nosogeography of the causative agent based on the microscopy of preparations on glass slides with a more suitable diagnostic method of malaria; Based on the microscopy of the preparations obtained from different substrates, it determines the ways and factors of the infection of parasitic diseases; to make a parasitological diagnosis by differentiating helminth eggs; He is able to perform sanitary-helminthological and parasitological examinations. We believe that this subject is an important field of medicine and teaches knowledge and skills about parasitic diseases, so it should be taught not only in the Faculty of Public Health and Medicine, but also in other faculties. Because every doctor definitely encounters the complications of these diseases in his professional activity.

References

1. Aghayev, I. A., Khalafli, X. N., Taghiyeva, F. Sh., Vekilov, V. N., & Aghayeva, A. I. (2022). *Epidemiology: National guidelines*.
2. Aghayev, I. A., Khalafli, X. N., & Taghiyeva, F. Sh. (2012). *Epidemiology: Textbook for medical faculty students.*
3. Aghayev, I. A., Abdullayev, X. I., Mammadov, S. M., Vahabov, E. F., Khalafli, X. N., Taghiyeva, F. Sh., & Qasimov, E. (2010). *Organization of epidemiological surveillance on malaria: Methodical recommendations*.
4. Briko, N. I., & Pokrovsky, V. I. (2015). *Epidemiology: Textbook.* GEOTAR-Media.
5. Briko, N. I., Zuyeva, L. P., Pokrovsky, V. I., Sergiyev, V. P., & Shkarin, V. V. (2013). *Epidemiology: Textbook in 2 volumes* (Vol. 2). OOO "Medicinskoe informacionnoe agentstvo".
6. Chobanov, R. Ə. (2006). *Human protozoan diseases*.
7. Hajiyev, I. A. (2010). *Laboratory diagnostics of parasitic diseases*. Tabib Publishing House.
8. Salehov, A. Ə., Vahabov, E. F., & Huseynova, F. H. (2022). *Human parasitic diseases: Textbook.*
9. Pokrovsky, V. I., Pak, S. G., Briko, N. I., & Danilkin, B. K. (2004). *Infectious diseases and epidemiology: Textbook (2nd ed.).* GEOTAR-Med.
10. Sergiyev, V. P., Lobzin, Y. U., & Kozlov, S. S. (2006). *Parasitic diseases of humans* (protozoan and helminthic diseases). OOO "Izdatel'stvo Foliant".
11. Chebyshev, N. V., Vorob'ev, A. A., & Pak, S. G. (Editors). (2005). *Transmissive infections and invasions: Interdisciplinary textbook for medical university students*. Med. Inform. Agentsvo.
12. Zuyeva, L. P., & Yafayev, R. H. (2005). *Epidemiology*. Foliant.

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PHYSICS AND ASTRONOMY

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Electromagnetic Phenomena in Nature and Their Causes

Abstract

All physical phenomena that occur in nature are related to one or another mutual effects. Electric and magnetic phenomena are of particular importance in order to gain extensive knowledge about the structure of the world around us. Electric and magnetic forces can be transmitted over a certain distance like gravitational forces. While the source of the gravitational field is mass, the source of the electromagnetic field is electric charge.

The only reason for such a contradiction may be the discrepancy between the research methods used by science and the essence of the problem being studied. Historically, all research methods should be divided into methods before and after the advent of the computer era. It was the former that were at the disposal of researchers whose recommendations were used in the formation of the existing regulatory framework.

Keywords: *electromagnetic, charge, partticles, framework, interaction*

Introduction

Electric charge is the property of electromagnetic creation between objects or particles. Electromagnetic interaction is the interaction between particles or objects that have an electric charge.

At the beginning of the 19th century, the English physicist Rutherford proposed the nuclear model of the atom. The atom consists of a positively charged nucleus and negatively charged electrons revolving around it. Later, it was determined that the nucleus of the atom is composed of protons and neutrons (Artemyev, Tikhodeev, & Shur 1965). The electric charges of the electron and proton are opposite in value. The nature that surrounds us is rich in electrical phenomena. We live in the earth's electric field. Various electrical processes also occur in living organisms.

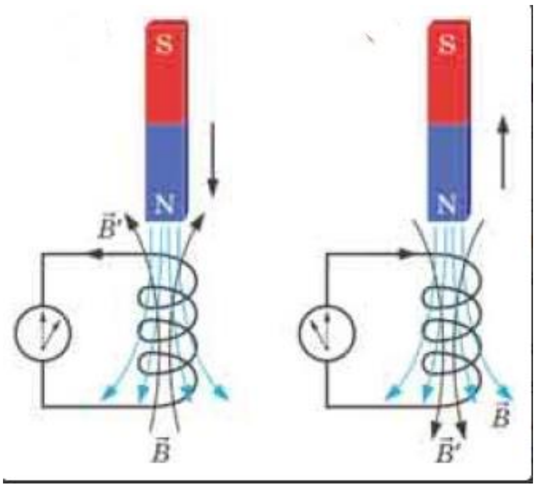

Figure 1. The induced current is caused by the change in the magnetic flux

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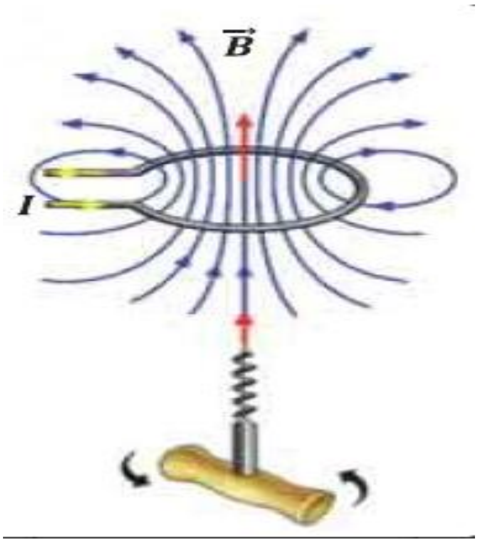

Figure 2. The direction of the induction of the magnetic field within the circular current

Research

The Earth is charged with a negative charge. The upper layers of the atmosphere have a positive electrical charge. The regular movement of charged particles is called an electric current. Electric current is magnetic. is the source of the magnetic field. The magnetic field is a type of matter created by electric charges in motion. It can be seen as a large magnet on the ground (Voldek & Popov, 2007). The connection between the changing electric field and the changing magnetic field creates the electromagnetic field. The propagation of the electromagnetic field in the form of waves in space was first experimentally confirmed by the German scientist Hers. I wonder if the electromagnetic field has a role in the development of the world from yesterday to today?

Electric current was already known to the Greeks 600 years before our era. At that time, people observed that amber attracts other materials by rubbing it on woolen cloth. In 1600, the English physicist GILBERT DE MAGNETE observed in his work that amber is attracted to other materials as well. In the 17th century, with electricity the engaged German scientist Offo Van created the first electrification machine, or rather, the generator. In the 18th century, the main work was done on the development of electric current and batteries to generate it. After the invention of the connection between magnetism and electric current at the beginning of the 19th century, a broad basis for the practical application of this physical quantity C. Maxwell's electromagnetic theory, as a generalization of the basic laws of electric and magnetic phenomena, foreshadowed new phenomena by explaining the results of the experiments that existed at the time (Petrov, 1974). It was later proven that the propagation speed of the free electromagnetic field in a vacuum is equal to the speed of light. It was only a few years after Hertz's discovery of electromagnetic waves. then it was already used to transmit information. In 1895, Popov invented a very primitive radio device. In the following years, the Italian inventor Marconi provided an electric bell ringing from a distance of 9 meters in 1896. The electromagnetic waves that caused the ringing of the bell were called radio waves. played an important role (Bespalov & Kotelenets, 2006).

If the induction vector is parallel to the surface – perpendicular to the surface normal – $\alpha = 90°$ $\rightarrow \cos 90° = 0$, and the magnetic flux passing through the surface is equal to zero: $\varphi = 0$. Therefore, the induction vectors that do not cross the surface do not create a magnetic flux.

The phenomenon of electromagnetic induction discovered by the English scientist Michael Faraday (1791-1867) in 1831 showed that electric and magnetic fields interact.

You know that when a permanent magnet is inserted and removed from a coil connected to a galvanometer, an induced current is created in the contours (loops) of the coil. If the magnet is at rest or rotating inside the coil, no current is produced. Therefore, the induced current is caused by the change in the magnetic flux (Figure 1).

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Generation of electric current in the circuit as a result of the change of the magnetic flux passing through the surface bounded by the conductive circuit is called the phenomenon of electromagnetic induction.

The direction of the induced current depends on the increase or decrease of the magnetic flux.

1. The magnetic flux increases ($\Delta\varphi > 0$). This is possible if the magnet approaches the contour. As a result, the magnetic flux increases, the induction current generated in the loop creates its own magnetic field. That one the field repels the approaching magnet. Therefore, the induction vector of the external magnetic field that creates a current in the circuit and the induction vector of the magnetic field created by the induced current are opposite (Figure 1). In this case, the magnet and the contour repel each other like magnets of the same polarity. By knowing the direction of and applying the right-hand thread rule for circular currents, the direction of the induced current in the circuit is easily determined – the induced current is clockwise.

Right-handed screw rule for circular current: when the support of the coil is twisted in the direction of the circular current, the direction of the forward movement of the coil will indicate the direction of the induction of the magnetic field within the circular current (Figure 2).

When designing and operating intelligent relay protection and automation systems for power transformers supplying complex variable loads, it is necessary to analyze steady-state and transient processes occurring in transformers under normal and emergency conditions in order to make the right decision. For example, with the same instantaneous value of the current surge in the primary winding of the transformer, the protection system must clearly detect the difference between the short-circuit current and the magnetizing current when the transformer is turned on (Kopylov, 2009).

In the first case, the protection should operate instantly, and in the second case, it should not operate, or operate with a time delay. The use of classical mathematical methods for this purpose in many cases turns out to be very difficult due to nonlinear dependencies linking different physical quantities in the transformer, and the adoption of many assumptions or the use of graphical methods gives only approximate qualitative solutions (Lizunov & Lokhanin, 2004). A more effective method of analyzing processes is the method of numerically solving nonlinear differential equations of state in the integrated MathCAD computer mathematics package. To do this, it is necessary to compile a mathematical model of the transformer in the form of a system of nonlinear differential equations in the Cauchy form, which can be solved in the MathCAD package using the fourth-order Runge-Kutta method (Serebryakov & Shumeyko, 2005). The problem considered in this article is to compile a mathematical model of the transformer and study electromagnetic processes in the transformer on this model.

There is a contradiction between traditional scientific approaches to substantiating the required level of transformer insulation, summarized in the current regulatory framework (Serebryakov & Shumeyko, 2013), and operating experience (Serebryakov & Shumeyko, 2013), which consists in the impossibility of explaining the causes of damage to the longitudinal insulation of windings under the influence of internal overvoltages from the distribution network (Sapozhnikov, 1975).

Conclusion

The complexity of the mathematical description of the phenomenon under study forced us to look for rational (simplified) solutions (Ryudenberg, 1955).

The mathematical formulation of the technical problem is the most complex and important part of the work. It is not so much the chosen mathematical calculation methods that are important, but the chosen simplifications of the initial physical problem to be solved (Kostenko & Piotrovsky, 1972).

Any electrical equipment with high-voltage windings (EHVW) consists of at least windings, a magnetic circuit and insulation, which are placed in a housing. As a rule, at the stages of designing electrical equipment and studying the operating modes of electrical networks, all possible relationships between the specified structural components of EHVW are not taken into account.

It has been established for the first time that resonant overvoltages in parts of the winding are the main cause of turn-to-turn short circuits of transformer windings when exposed to internal overvoltages from the network.

Strengthening the longitudinal insulation of the winding will make it possible to increase the reliability of transformer operation.

Resonance of currents in complementary parts of the winding causes overvoltages to appear on these parts in the frequency range from 50 to 100,000 Hz. The frequency of the free component of network overvoltages determines the design of the winding part for which the overvoltages will be maximum.

References

1. Artemyev, D. E., Tikhodeev, N. N., & Shur, S. S. (1965). *Statistical bases for selecting insulation of power transmission lines, switching overvoltages and electrical characteristics of insulation* (N. N. Shchedrin, ed.). Energy.
2. Bespalov, V. Ya., & Kotelenets, N. F. (2006). *Electrical machines*. Academy Publishing Center.
3. Kostenko, M. P., & Piotrovsky, L. M. (1972). *Electrical machines*. Energia.
4. Kopylov, I. P. (2009). *Electrical machines* (6th ed.). Vysshaya shkola.
5. Lizunov, S. D., & Lokhanin, A. K. (2004). *Power transformers: Reference book*. Energoizdat.
6. Petrov, G. N. (1974). *Electrical machines*. Energia.
7. Polovoi, I. F., Mikhailov, Yu. A., & Khalilov, F. Kh. (1975). *Overvoltages on high- and ultra-high-voltage electrical equipment*. Energia.
8. Ryudenberg, R. (1955). *Transient processes in electric power systems.* Publishing House of Foreign Literature.
9. Serebryakov, A. S., & Shumeyko, V. V. (2005). *MATHCAD and solving electrical engineering problems*. Route.
10. Serebryakov, A. S. (2013). *Transformers*. MPEI Publishing House.
11. Sapozhnikov, A. V. (1969). *Insulation levels of high-voltage electrical equipment: Standards and methods for testing electrical strength*. Energia.
12. Voldek, A. I., & Popov, V. V. (2007). *Electrical machines: Introduction to electromechanics. DC machines and transformers*. Piter.

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A Natural Event of Radioactivity

Abstract

Natural radioactivity was first discovered in 1896 by the French physicist Beck Kerelem. As a result of recent research, Pierre and Marie Curie discovered that the nucleus of atoms of some elements spontaneously transforms into the nucleus of atoms of other elements, and during this, the radiation of particles occurs. Most naturally occurring radioactive elements form a radioactive family in which each radioactive element originates from the preceding radioactive element and in turn transforms into the next radioactive element. The transformations continue until the end product is an isotope of a stable element. In nature, there are also radioactive elements that this transformation occurs only once .

In 1934, French scientists Irene and Fredrik Joluo-Curie irradiated aluminum, boron and manganese with particles and obtained isotopes of phosphorus, nitrogen and silicon elements, which do not exist in nature. This type of radioactivity is called artificial radioactivity. Later, by irradiating various elements with proton, deuteron and neutron particles, they obtained isotopes of all chemical elements in the Mendeleev table.

Keywords: *natural, radioactivity, parttticles, irradiated, elements*

Introduction

In January 1896, the French physicist A. Poincaré at a meeting of the Academy put forward a hypothesis about V. K. Roentgen and the connection of this radiation with the phenomenon of fluorescence – a non-thermal glow of a substance under the influence of ultraviolet radiation.

Physicist A. A. Becquerel at the meeting. He was interested in this hypothesis because he had long studied the phenomenon of fluorescence using samples of uranite nitrite and other uranium salts. These substances glow with a bright yellow-green light under the influence of sunlight, but the uranium salts stop glowing in less than a hundredth of a second as soon as the sun's rays stop. It was founded by A. A.'s father. Becquerel was also a physicist (Yaroshinskaya, 1996).

Research

After listening to A. Poincaré's report, A. A. Becquerel said that uranium salts that stop glowing can continue to emit another radiation that passes through an opaque material (Crameri & Burkart, 1989). The researcher's experience proved it. The scientist placed grains of uranium salt on a photographic plate wrapped in black paper and exposed it to sunlight. Developing the plate, he noticed that the grains were darkened where they were located. A. A. Becquerel concluded that the radiation emitted by the uranium salt was stimulated by the sun's rays. But the research process was again invaded by a disaster.

Once A. A. Becquerel had to postpone another experiment due to cloudy weather. He placed the photographic plate he had prepared in a drawer of the table and placed a copper cross covered with uranium salt on it (Tanner, 1978). After some time, he again prepared the board, and on it was shown the outline of a cross. Since the cross and tablet were in a place inaccessible to sunlight, it was left to think that uranium, the last element in the periodic table, spontaneously emitted invisible radiation (Schery et al., 1988).

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Figure 1. Radioactive element-uranium salt

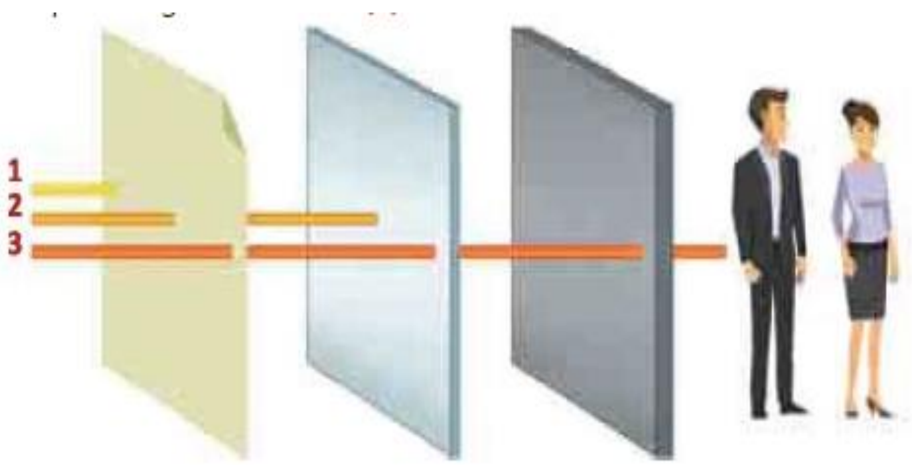

Figure 2. The spread of radioactive rays

The study of this phenomenon was taken up by A. A. Becquerel, his spouses Pierre and Marie Curie. They found that two other elements they discovered have this property. One of them was called polonium – in honor of Marie Curie's native Poland, and the other was called radium, from the Latin word radius – radium. At the suggestion of Marie Curie, this phenomenon was called radioactivity (Schery et al., 1988).

The spontaneous transformation of one radioactive nucleus into another nucleus is called radioactive transformation. There are two types of radioactive transformation: radioactive α-transformation and radioactive β-transformation.

• In α-transformation, the charge number of the nucleus decreases by 2 units, and the mass number decreases by 4 units. As a result, the element changes its place two places towards the beginning of the periodic table:

• In β-transformation, the charge number of the nucleus increases by 1 unit, while the mass number does not change. As a result, the element changes its position one cell towards the end of the periodic table:

E. Rutherford experimentally established that the penetration capabilities of radioactive rays are also different. So, while one type of these rays (1) could not even pass through a sheet of paper, for

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the other (2) an aluminum plate with a thickness of 3 mm became an impenetrable barrier. The third type of rays (3) cannot be resisted by a lead wall with a thickness of several centimeters (Figure 2).

The concept of "radioactivity" is a mystery. Despite the fact that radionuclides are currently used in all areas of the economy, the phenomenon of radioactivity is still treated with caution. Some scientists see the phenomenon of radioactivity as the result of human manipulation of nature. But this is not so. The phenomenon of radioactivity is a completely natural phenomenon that has been inherent in matter since the beginning of mankind. It just happened that some light elements became stable, and heavier ones became unstable. Currently, there is a controversial hypothesis that all known elements are radioactive, but they decay at different rates: heavier ones faster, lighter ones more slowly, and this slow decay occurs so that existing instruments cannot detect their radioactivity. This hypothesis has not yet been confirmed (Schery & Whilstone, 1989).

It is because of their nature that radioactive elements and isotopes are stored in the Earth's crust and its mantle (Schery & Wasiolek, 1993). This applies not only to the widely known elements uranium and thorium (all isotopes of these elements are radioactive), but also to some isotopes of stable elements, for example, the isotope potassium-40, which is included in all substances on Earth. Interestingly, potassium-40 and its other radionuclides are called relic (ancient). This name is given to them because their decay rate is very small (or, in other words, because their half-life is very long) and because they have been around since the formation of the Solar System.

What is the role of potassium-40 in our planet? It is believed that the Earth's mantle is kept in a liquid state thanks to it, that is, the mantle heats up due to the heat of radioactive decay of potassium-40 and other radionuclides. On the other hand, the effect of potassium-40 (and its "colleagues") on the background of natural radiation is very significant, that is, life on Earth arose and developed under the constant influence of radiation (Chi-Yu King, 1980). Experiments show that when animals are isolated from natural radiation, their activity decreases (lethargy occurs), reproductive functions decrease. For this reason, natural radioactivity is very important for human life, it is enough to think about the benefits of radon baths for human health (Hotzl & Winkler, 1994).

The reason why so much attention is paid to the potassium-40 isotope is that its chemical properties are exactly the same as non-radioactive potassium - the biogenic element in our bodies! An adult human body contains 170 g of potassium, 20 mg of which is radioactive potassium-40. Thanks to this radionuclide alone, 300,000 radioactive decays occur in the human body every minute!

Such an event happened at one of the exhibitions. In one of the pavilions, a device measuring the radioactivity of the human body was placed, and strangely enough, it showed a relatively high level of radioactivity in men. The explanation for this phenomenon is that potassium accumulates more effectively in muscle tissues, and muscle tissues are more abundant in men (Porstendorfer, Butterweck, & Reineking, 1994).

The mass of the nucleus of heavy radioactive elements exceeds the mass of the nucleons in its composition. This is the reason for the radioactivity of heavy elements, because it is known from Einstein's formula that mass and energy are equivalent. The excess energy of radioactive nuclei causes the decay of heavy nuclei. For light elements, the total mass of nucleons exceeds the mass of their nucleus. Therefore, fusion of light elements – thermonuclear fusion – causes the release of energy from the nucleus. During fission or fusion reactions, the release of energy leads to the transformation of nuclei (Ogorodnikov, 1995).

Unlike radioactive decay, stable nuclei and nuclei of new elements can be synthesized. Such transformations of nuclei are called nuclear reactions. Protons are usually high energy to cause nuclear reactions

The neutron's lack of electric charge makes it extremely easy for it to enter atomic nuclei. Therefore, the neutron is considered the most effective "projectile" to achieve nuclear transformation. Low-speed neutrons are more useful than high-speed neutrons, so fast neutrons need to be slowed down first. Heavy water (D2O), graphite, etc. are used as coolants. It should be

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noted that when the same nucleus is bombarded with different fast particles, the reaction product is also different (Zimmermann et al., 1989).

The splitting of the nuclei of heavy elements under the influence of neutrons constitutes a type of nuclear reaction. During nuclear fission, two nuclear-shells receive 2-3 neutrons and a large amount of energy.

As a result of nuclear fission occurring in different variants, the mass numbers of nuclear fragments can vary from 72 to 161. Each of the 2-3 neutrons released during nuclear fission splits a neighboring nucleus, and each fission produces 2-3 new neutrons that can split other nuclei, and so on. Thus, the number of dividing nuclei increases very rapidly and causes a chain reaction.

Radioactive nuclei can decay, interact with other particles, and synthesize them. In all cases retention laws are followed.

Conclusion

Numerous experiments have shown that the property of natural radioactivity is only related to the composition and structure of the atomic nucleus of the element. External factors (mechanical pressure, temperature, electric and magnetic fields, etc.) do not affect this property.

In 1899, the physical nature of radioactive radiation was studied under the guidance of English physicist Emest Rutherford. It has been established that radioactive radiation consists of a stream of various particles. So, when a flood of these particles passes through a magnetic field, some of them are affected by the Lorentz force:

- part of the rays consists of a stream of uncharged particles, they are not inclined in the magnetic field - they were called λ-radiation;
- since the other part of the rays consists of a flood of positively charged particles, they tend to the direction of the thumb of the left hand from their previous direction (according to the left hand rule) - this radiation was called π-radiation.

The third part called β-radiation is a flood of negatively charged particles, so they tend in the opposite direction of α-radiation. Later, the property of radioactive transformation was discovered in radioactive substances.

References

1. Chi-Yu King. (1980). Episodic radon changes in subsurface soil gas along active faults and possible relation to earthquakes. *Journal of Physical Research*, 85(B6), 3065.
2. Crameri, R., & Burkart, W. (1989). The radon problem. *Radiation Physics and Chemistry*, 34(2), 251.
3. Hötzl, H., & Winkler, R. (1994). Long-term variation of outdoor radon equilibrium equivalent concentration. *Radiation and Environmental Biophysics*, 381.
4. Ogorodnikov, B. I. (1995). *Nuclear archipelago*. IzdAt.
5. Porstendörfer, J., Butterweck, G., & Reineking, A. (1994). Daily variation of the radon concentration indoors and outdoors and the influence of meteorological parameters. *Health Physics*, 67(3), 283.
6. Schery, S. D., Holford, D. J., Wilson, J. L., & Philips, F. M. (1988). The flow and diffusion of radon isotopes in fractured porous media: Part 1, Finite slabs. *Radiation Protection Dosimetry*, 24(1/4), 185.
7. Schery, S. D., Holford, D. J., Wilson, J. L., & Philips, F. M. (1988). The flow and diffusion of radon isotopes in fractured porous media: Part 2, Semi-infinite media. *Radiation Protection Dosimetry*, 24(1/4), 191.
8. Schery, S. D., & Whilstone, S. (1989). Desorption of radon at the Earth's surface. *Journal of Geophysical Research*, 94(D15), 18297.
9. Schery, S. D., & Wasiolek, P. T. (1993). A two-particle-size model and measurements of radon progeny near the Earth's surface. *Journal of Geophysical Research*, 98(D12), 22915.
10. Tanner, A. B. (1978). Radon migration in the ground: A supplementary review. *The Natural Radiation Environment*, 1, 5.

11. Yaroshinskaya, A. A. (1996). *Nuclear encyclopedia*. Yaroshinskaya Charitable Foundation.
12. Zimmermann, P. H., Feichter, J., Rath, H. R., Crutzen, P. J., & Eiss, W. (1989). A global three-dimensional source-receptor model investigation using 85Kr. *Atmospheric Environment*, 23(1), 25-35.

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Geotechnical Justification for Designing Landslide Prevention Measures

Abstract

When designing anti-landslide measures, slope stability assessment is an important factor and is determined by conducting comprehensive engineering and geological studies on a slope with potential landslide risks. The results of correct engineering and geological justification for the design of anti-landslide measures lead to the preservation of the structure and safe operation of infrastructure facilities.

Our experience shows that to eliminate the negative effects of landslide processes, it is necessary to accurately determine the engineering and geological conditions of the slope, including the stability of the slope, taking into account natural dynamic phenomena (seismicity of the territory and tectonic processes) and, if possible, to see the complete elimination of the causes that lead to landslide processes when developing anti-landslide measures. To achieve these goals, the geotechnical justification of the design is the only correct solution.

Geotechnical justification of protective measures intended to protect the structural elements of the Baku-Russian Federation State Border highway, which is part of the north-south transport corridor and passes through the foot of a potentially landslide-hazardous slope west of the city of Shabran, is one of the most important conditions that increase the effectiveness of these measures.

On a slope located 1500 meters southwest of the current research area, the results of our scientific research were not properly utilized and many of our warnings were not heeded, resulting in a landslide during construction, leading to serious damage to the road's structural elements (Fig. 1) and additional costs.

This event once again confirms that landslides are the most common natural and man-made processes that pose a threat to the safe operation of infrastructure facilities, civil and industrial construction in mountainous and foothill areas (Shiraliyev et al., 2024).

Figure 1. Complications of sliding

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The purpose of this study is to determine the geotechnical conditions of the slope that is the object of research, analyze and assess the stability of the slope and provide geotechnical data for geotechnical justification for the design of landslide protection structures.

Thanks to the application of the project solutions developed based on the results of the studies presented in the article, the danger of landslides on the mentioned slope has been completely eliminated and the safe operation of infrastructure facilities has been ensured.

Keywords: *geotechnical measures, design, landslide, slope, stability, soil*

Introduction

A landslide is a ground displacement phenomenon that includes rock falls, shallow debris flows, and deep slope failures (Varnes, 1978).

Landslides are defined as the downward movement of rock, debris and earth along a slope under the action of gravity. A landslide is one of the most common types of slope hazards that can cause significant casualties and economic losses. Slope study and analysis are essential to understand their characteristics and in particular their stability, robustness and deformation (Amashi et al., 2016).

In connection with the above, the study and analysis of the slope located northwest of the city of Shabran is important for understanding their characteristics, for geotechnical justification of the design of anti-landslide measures and for the stability and reliability of infrastructure facilities.

The slope corresponding to the Gusar-Shabran syncline belongs to the structural-denudation foothill and marine abrasion-accumulative relief type and is characterized by a general lowering and leveling of the relief. The upper part of the slope consists of a large area and a gentle section extending to the foot of the Gainardzhi mountain range.

The slope has a variable relief with convex, flat and protruding forms in some areas, and the factors that determine the modern appearance are the agroforestry measures carried out in the 1970s (replacing the slope relief with stepped terraces, planting various trees, etc.).

In February 2009, following a landslide on the slope under the reservoir located in the southwestern part of the city of Shabran (PK11+100 – PK12+300), various works were carried out to remove soil from the slope, which led to a change in its natural relief.

As the engineering-geological, geological, geomorphological and morphometric features of the slope were not taken into account during the excavation works, the relief of the slope became more critical and as a result some parts of the slope became a potential landslide area.

Research

The studied slope with potential landslide hazard occupies an area 580 meters long and 140-175 meters wide. The natural slope inclination is 16˚30’-24˚30’ (in some places up to 30˚), and the height fluctuates between 42-58 meters (Fig. 2).

Figure 2. Research area

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The slope, due to its genetic characteristics, belongs to the polygenic type and is characterized as a moderately steep slope. The natural formation of the slope was due to the endogenous and exogenous development of the relief and the harmonious coordination of climatic and orographic processes. The formation of the current state of the slope, as noted above, is closely related to anthropogenic factors and factors.

In order to determine the stability of the slope and the geotechnical justification for the design of anti-landslide measures, in August 2009, comprehensive engineering and geological surveys (Fig. 3 and Fig. 4) were conducted in the area of the slope in accordance with the requirements of the relevant rules and standards (SP, 2003; ODM, 2013).

Figure 3. Episodes of geotechnical research on the slope

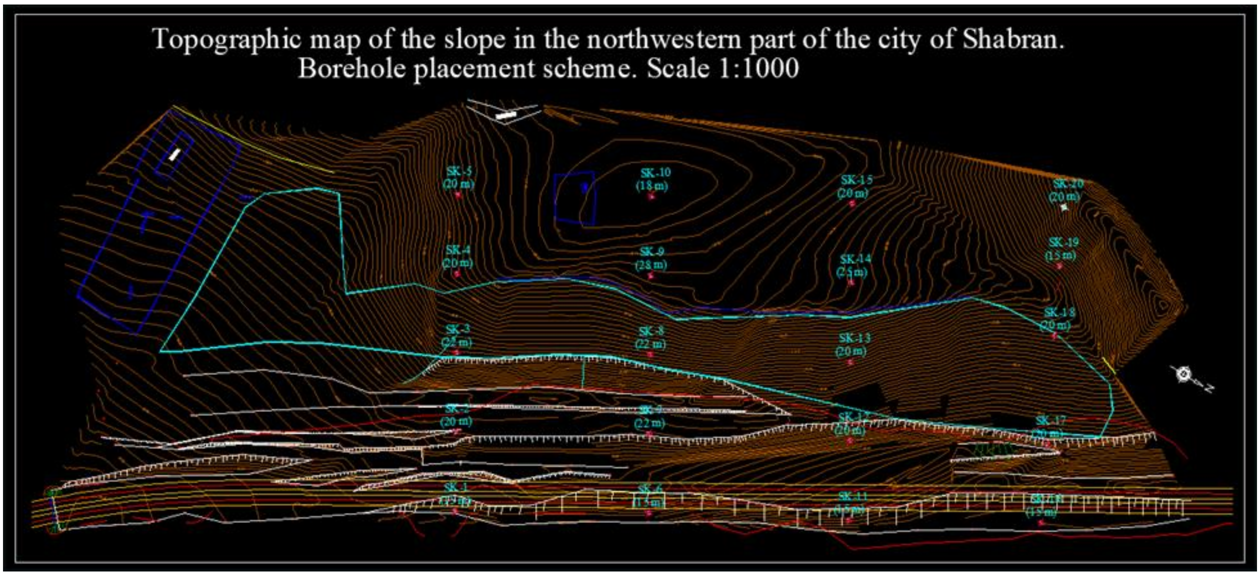

Figure 4. Topographic map of the research area

Engineering and geological surveys are carried out to assess the stability of a slope over the entire area of a dangerous or potentially dangerous slope, covering areas adjacent to its upper edge and base up to the expected boundary of the stable part of the slope, for coastal slopes - with mandatory coverage of their underwater parts, including in cases where the territory of the designed object occupies only part of the slope (Nevolin, 2014).

In the geological structure of the 28-meter depth interval of the slope area, sedimentary rocks are developed, consisting of sandy and clayey soils of technogenic and marine origin.

Geological data determined as a result of engineering-geological studies and the values of physical and mechanical indices of soils were analyzed statistically and analytically and on the basis of the obtained data the slope stability was calculated using the Horizontal Forces (Maslov-Beer) method for the limit state I (Ponomarev et al., 2022).

Currently, the following methods for determining the stability coefficient of slopes and slopes are most widespread (Ukhov et al., 2022; Ginzburg, 2007):

- rectilinear sliding surface method,
- circular cylindrical sliding surface method,
- broken sliding surface method,
- Maslov-Behrer method.

All these calculation methods have one common drawback: one (only) slope creep coefficient, which is defined as the ratio of the sum of the holding forces (i.e. forces or moments) to the sum of the shear forces (Andreyev et al., 2017).

The degree of slope stability is assessed by the value of the safety factor Ks, determined by the formula:

$$Ks = \frac{\Sigma T}{\Sigma H}$$

Where:

T – part of the thrust (pressure on the block wall), perceived by friction and adhesion in the ground (on the sliding surface);

H is the thrust (pressure on the block wall) in the absence of friction and adhesion in the soil between the blocks;

The meaning of the letters used in the formulas for calculating slope stability in tables 1-6:

ψ_p – the angle of resistance to shear on the sliding surface of a given block under normal stress P;

α – the angle of inclination of the sliding surface of a given block to the horizon,

Q – block weight,

R – unextinguished part of the pressure (active pressure),

Fp – shear resistance coefficient,

P – normal shear stress,

Sp – total shear resistance of the rock,

ρ – soil density,

h – average height of the calculation block,

φ – angle of internal friction of soil.

Taking into account the engineering and geological conditions, morphometric parameters and characteristics of the slope relief and indicators of the physical and mechanical properties of the soils that make up the geological environment, the slope stability coefficient was determined using 3 profiles.

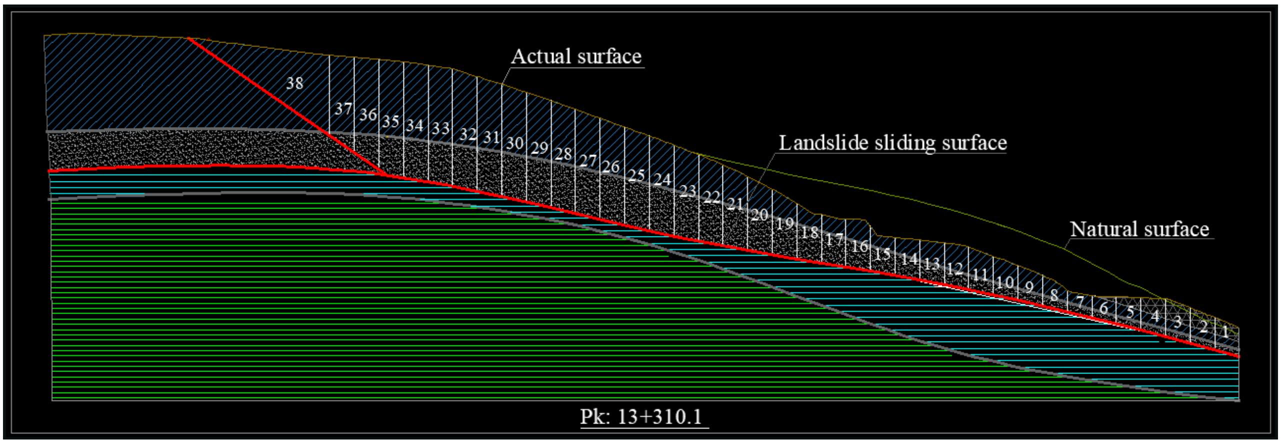

Figure 5. Geomodel for determining slope stability along profile Pk 13 + 310

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Determination of the slope stability coefficient for the profile PK 13+310																		
Block number	F m^2	$Q = F \cdot \rho$ t/m	α degree	tg α	Ψ_p degree	$\alpha - \Psi_p$	$tg(\alpha - \Psi_p)$	$H = Q \cdot tg\,\alpha$ t/m	$R = Q \cdot tg(\alpha - \Psi_p)$ t/m	T=H-R t/m	ρ t/m^3	h m	$P = \rho \cdot h$ t/m^2	φ degree	tg φ	C t/m^2	$\frac{C}{P}$	$Fp = tg\varphi + \frac{C}{P}$
2	34,8	63,7	15	0,268	32	-17	-0,287	17,1	-18,3	35,4	1,83	7,0	12,8	18	0,325	3,7	0,29	0,615
4	36,3	66,1	15	0,268	31	-16	0,287	17,7	19,0	-1,3	1,82	7,3	13,3	18	0,325	3,8	0,28	0,607
6	24,9	47,6	15	0,268	34	-19	-0,344	12,8	-16,4	29,1	1,91	5,0	9,6	19	0,344	3,2	0,34	0,683
8	27,4	51,9	14	0,249	32	-18	-0,325	12,9	-16,9	29,8	1,89	5,7	10,8	19	0,344	3,2	0,29	0,637
10	37,3	71,5	12	0,213	30	-18	-0,325	15,2	-23,2	38,5	1,92	7,5	14,4	19	0,344	3,3	0,23	0,572
12	43,5	82,6	11	0,194	29	-18	-0,325	16,0	-26,8	42,9	1,90	8,7	16,5	20	0,364	3,1	0,19	0,552
14	39,9	73,2	11	0,194	28	-17	-0,306	14,2	-22,4	36,6	1,83	8,0	14,7	21	0,384	2,4	0,16	0,546
16	50,1	91,6	10	0,176	27	-17	-0,306	16,1	-28,0	44,2	1,83	10,3	18,8	21	0,384	2,4	0,13	0,510
18	51,8	92,1	10	0,176	27	-17	-0,306	16,2	-28,2	44,4	1,78	10,2	18,1	22	0,404	1,8	0,10	0,505
20	71,3	129,8	10	0,176	25	-15	-0,268	22,8	-34,8	57,6	1,82	14,3	26,0	21	0,384	2,3	0,09	0,472
22	85,9	157,7	11	0,194	25	-14	-0,249	30,6	-39,3	69,9	1,84	17,2	31,6	21	0,384	2,4	0,08	0,461
24	95,6	176,3	12	0,213	24	-12	-0,213	37,6	-37,6	75,1	1,84	19,1	35,2	20	0,364	2,5	0,07	0,436
26	103	190,2	13	0,231	24	-11	-0,194	43,9	-36,9	80,8	1,85	20,5	38,0	20	0,364	2,6	0,07	0,434
28	109	203,4	14	0,249	23	-9	-0,158	50,6	-32,1	82,8	1,87	21,8	40,8	20	0,364	2,8	0,07	0,432
30	114	215,4	13	0,231	23	-10	-0,176	49,8	-37,9	87,7	1,88	22,8	43,0	20	0,364	2,9	0,07	0,433
32	119	225,6	11	0,194	23	-12	-0,213	43,8	-48,1	91,8	1,90	23,8	45,2	20	0,364	3,1	0,07	0,433
34	119	227,8	9	0,158	22	-13	-0,231	36,0	-52,6	88,6	1,91	23,8	45,5	19	0,344	3,2	0,07	0,414
36	105	203,8	35	0,700	23	12	0,213	142,7	43,4	99,3	1,94	21,0	40,8	19	0,344	3,6	0,09	0,431
38	236	483,4	35	0,700	30	5	0,087	338,4	42,1	296,3	2,05	8,4	17,2	17	0,306	4,7	0,27	0,577

Table 1. Determination of slope stability along profile PK 13 + 310

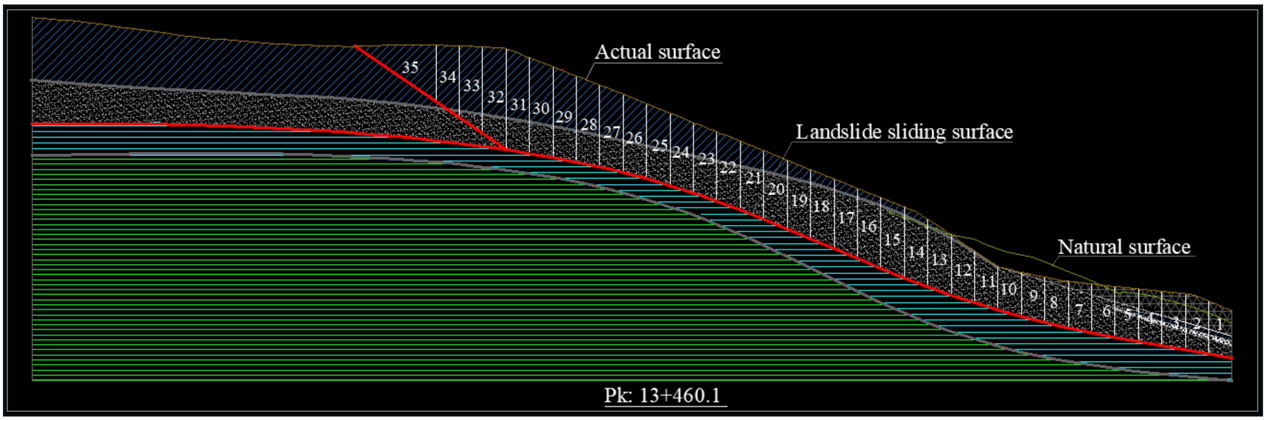

Figure 6. Geomodel for determining slope stability along profile Pk 13 + 460

Determination of the slope stability coefficient for the profile PK 13+460																		
Block number	F m^2	$Q = F \cdot \rho$ t/m	α degree	tg α	Ψ_p degree	$\alpha - \Psi_p$	$tg(\alpha - \Psi_p)$	$H = Q \cdot tg\,\alpha$ t/m	$R = Q \cdot tg(\alpha - \Psi_p)$ t/m	T=H-R t/m	ρ t/m^3	h m	$P = \rho \cdot h$ t/m^2	φ degree	tg φ	C t/m^2	$\frac{C}{P}$	$Fp = tg\varphi + \frac{C}{P}$
1	53,3	103,6	9	0,158	27	-18	-0,325	16,4	-33,6	50,0	1,94	10,7	20,8	19	0,341	3,6	0,17	0,512
3	59,4	113,2	10	0,176	26	-16	-0,287	20,0	-32,5	52,4	1,91	11,9	22,7	19	0,353	3,2	0,14	0,493
5	55,8	99,1	11	0,194	26	-15	-0,268	19,3	-26,6	45,8	1,78	11,1	19,7	22	0,397	1,8	0,09	0,490
7	51,6	88,5	12	0,213	26	-14	-0,249	18,8	-22,1	40,9	1,72	10,3	17,7	23	0,418	1,2	0,07	0,485
9	48,3	80,3	14	0,249	25	-11	-0,194	20,0	-15,6	35,6	1,66	9,5	15,8	24	0,437	0,6	0,04	0,477
11	50,6	83,0	17	0,306	25	-8	-0,141	25,4	-11,7	37,0	1,64	10,1	16,6	24	0,445	0,4	0,02	0,469
13	69,0	115,4	20	0,364	25	-5	-0,087	42,0	-10,1	52,1	1,67	13,8	23,1	23	0,433	0,7	0,03	0,465
15	76,3	128,8	22	0,404	25	-3	-0,052	52,0	-6,8	58,8	1,69	15,3	25,8	23	0,428	0,9	0,03	0,463
17	75,3	127,8	23	0,424	25	-2	-0,035	54,3	-4,5	58,7	1,70	15,0	25,5	23	0,425	1,0	0,04	0,464
19	74,0	128,0	23	0,424	25	-2	-0,035	54,3	-4,5	58,8	1,73	14,7	25,4	22	0,413	1,3	0,05	0,466
21	73,9	131,1	22	0,404	25	-3	-0,052	53,0	-6,9	59,9	1,77	14,7	26,2	22	0,398	1,8	0,07	0,467
23	75,8	138,0	19	0,344	25	-6	-0,105	47,5	-14,5	62,0	1,82	15,0	27,3	21	0,382	2,3	0,08	0,466
25	79,4	147,6	16	0,287	25	-9	-0,158	42,3	-23,4	65,7	1,86	15,9	29,6	20	0,369	2,7	0,09	0,460
27	86,2	162,6	13	0,231	24	-11	-0,194	37,5	-31,6	69,2	1,89	17,3	32,6	20	0,360	3,0	0,09	0,451
29	95,0	181,1	11	0,194	24	-13	-0,231	35,2	-41,8	77,0	1,91	18,9	36,0	19	0,353	3,2	0,09	0,441
31	105,7	202,8	9	0,158	23	-14	-0,249	32,1	-50,6	82,7	1,92	21,2	40,7	19	0,349	3,3	0,08	0,430
33	85,5	169,5	35	0,700	24	11	0,194	118,7	33,0	85,8	1,98	17,1	33,9	18	0,328	4,0	0,12	0,445
35	105,6	216,5	35	0,700	34	1	0,017	151,6	3,8	147,8	2,05	6,2	12,7	17	0,306	4,7	0,37	0,673

Table 2. Determination of slope stability along profile PK 13 + 460

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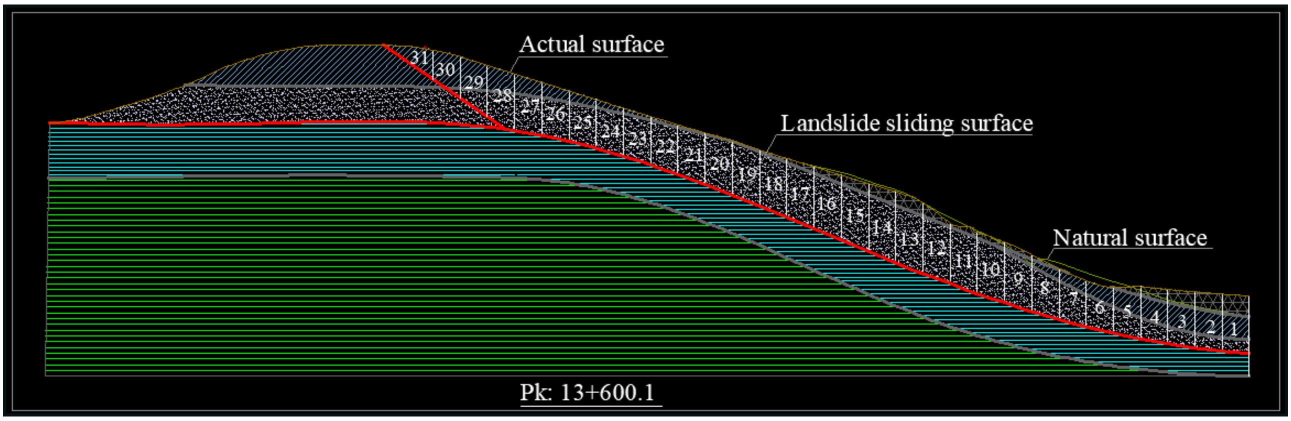

Figure 7. Geomodel for determining slope stability along profile Pk 13 + 600

Determination of the slope stability coefficient for the profile PK 13+600																		
Block number	F m^2	$Q = F \cdot \rho$ t/m	α degree	tg α	Ψ_p degree	$\alpha - \Psi_p$	tg $(\alpha - \Psi_p)$	$H = Q \cdot tg\,\alpha$ t/m	$R = Q \cdot tg\,(\alpha - \Psi_p)$ t/m	T=H-R t/m	ρ t/m^3	h m	$P = \rho \cdot h$ t/m^2	φ degree	tg φ	C t/m^2	$\frac{C}{P}$	$Fp = tg\varphi + \frac{C}{P}$
1	61,7	121,4	5	0,087	26	-21	-0,385	10,6	-46,7	57,3	1,97	12,4	24,4	18	0,333	3,8	0,16	0,489
3	63,7	124,7	9	0,158	26	-17	-0,302	19,7	-37,7	57,4	1,96	12,8	25,1	19	0,336	3,7	0,15	0,484
5	53,6	100,9	12	0,212	27	-15	-0,264	21,4	-26,7	48,1	1,88	10,8	20,3	20	0,361	2,9	0,14	0,505
7	40,9	70,2	15	0,268	27	-12	-0,208	18,8	-14,6	33,4	1,72	8,1	13,9	23	0,418	1,2	0,09	0,504
9	48,0	78,7	18	0,325	25	-7	-0,126	25,6	-9,9	35,5	1,64	9,6	15,7	24	0,445	0,4	0,03	0,470
11	44,6	73,1	20	0,364	25	-5	-0,093	26,6	-6,8	33,4	1,64	8,7	14,3	24	0,445	0,4	0,03	0,473
13	45,4	74,5	22	0,404	25	-3	-0,057	30,1	-4,3	34,3	1,64	9,1	14,9	24	0,445	0,4	0,03	0,472
15	43	70,5	23	0,424	25	-2	-0,041	29,9	-2,9	32,8	1,64	8,7	14,3	24	0,445	0,4	0,03	0,473
17	39,1	64,1	23	0,424	25	-2	-0,043	27,2	-2,8	30,0	1,64	7,8	12,8	24	0,445	0,4	0,03	0,476
19	41,5	68,1	22	0,404	25	-3	-0,058	27,5	-4,0	31,5	1,64	8,6	14,1	24	0,445	0,4	0,03	0,473
21	36	59,0	21	0,384	26	-5	-0,080	22,7	-4,7	27,4	1,64	7,2	11,8	24	0,445	0,4	0,03	0,479
23	42,4	69,5	18	0,325	25	-7	-0,129	22,6	-9,0	31,6	1,64	8,5	13,9	24	0,445	0,4	0,03	0,474
25	40,4	66,3	15	0,268	25	-10	-0,184	17,7	-12,2	29,9	1,64	8,1	13,3	24	0,445	0,4	0,03	0,475
27	50,8	89,8	10	0,176	26	-16	-0,294	15,8	-26,4	42,3	1,77	10,2	18,0	22	0,400	1,7	0,10	0,496
29	43,2	81,8	35	0,700	29	6	0,113	57,2	9,3	48,0	1,89	8,6	16,3	20	0,358	3,0	0,19	0,544
31	25,6	52,5	35	0,700	44	-9	-0,164	36,7	-8,6	45,3	2,05	3,4	7,0	17	0,306	4,7	0,67	0,976

Table 3. Determination of slope stability along profile PK 13 + 600

As a result of calculations carried out on the specified profiles, the following slope stability coefficients were determined:

1. Pk 13+310 $K_s = 1.78$ $\alpha = 16^\circ$ $\varphi = 23^\circ$ (Fig. 5, Table 1)

Pk 13+310 $K_{ss} = 1.38$ $\alpha = 16^\circ$ $\varphi = 20^\circ$

2. Pk 13+460 $K_s = 1.62$ $\alpha = 19^\circ$ $\varphi = 27^\circ$ (Fig. 6, Table 2)

Pk 13+460 $K_{ss} = 1.22$ $\alpha = 19^\circ$ $\varphi = 22^\circ$

3. Pk 13+600 $K_s = 1.76$ $\alpha = 19^\circ$ $\varphi = 29^\circ$ (Fig. 7, Table 3)

Pk 13+600 $K_{ss} = 1.27$ $\alpha = 19^\circ$ $\varphi = 24^\circ$

Ks is the stability coefficient, Kss is the stability coefficient taking into account seismicity (ODM, 2010), α is the average value of the probable slope of the sliding plane, φ is the average value of the angle of internal friction of the soils of the sliding block.

Based on the analysis of the engineering and geological conditions of the territory and the assessment of certain slope stability coefficients, it can be concluded that the slope in question is in a completely stable state under real conditions.

The slope stability factor is the ratio of the true values of the strength characteristics of the soil to the values of the strength characteristics of the soil at which the destruction of the massif occurs (Tabuyev, 2010).

It should be noted that as a result of excavation work carried out without taking into account the engineering and geological conditions and geomorphological structure of the slope, potentially dangerous landslide areas were created on a significant part of the slope. As a result, the slope stability coefficients taking into account seismicity (Kss = 1.22-1.27) along the PK 13 + 460 and PK 13 + 600 profiles are less than the reserve stability coefficient (Ksf = 1.3).

Due to the fact that the slope stability coefficient is lower than the stability reserve coefficient and the presence of local potential landslide zones formed as a result of anthropogenic factors and taking into account the change in the ratio of forces ensuring the stability of the soil massif as a result of undercutting the heel of the slope during the construction of the highway, in order to ensure reliable slope stability and safe operation of the highway, it is necessary to design anti-landslide engineering and protective measures.

To this end, in order to reduce the load on the sliding area and thus increase the stability of the slope, options for cutting the upper part of the slope along various lines were investigated, the slope stability coefficient for new surfaces was calculated, and the most optimal option for the formation of a new slope morphology was determined.

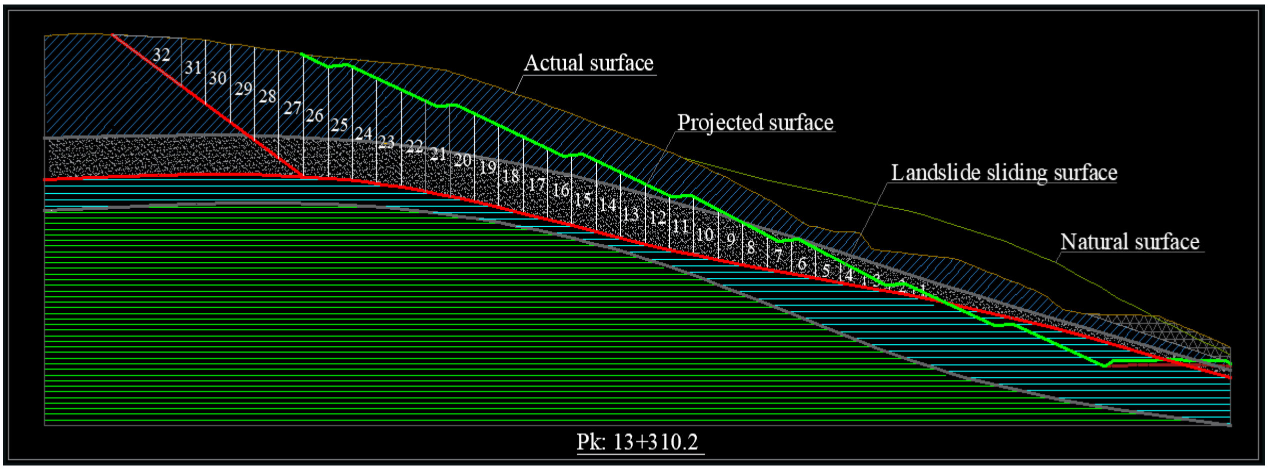

Figure 8. Geomodel for determination of stability on a newly designed slope surface along the profile PK 13 + 310

Determination of stability on a newly designed slope surface along the profile PK 13+310																		
Block number	F m^2	Q = F · ρ t/m	α degree	tg α	Ψ_p degree	α - Ψ_p	tg (α - Ψ_p)	H = Q·tg α t/m	R = Q·tg (α - Ψ_p) t/m	T=H-R t/m	ρ t/m^3	h m	P = ρ·h t/m^2	φ degree	tg φ	C t/m^2	$\frac{C}{P}$	$Fp = tg\varphi + \frac{C}{P}$
2	8,9	14,6	10	0,176	30	-20	-0,364	2,6	-5,3	7,9	1,64	1,9	3,1	24	0,445	0,4	0,13	0,573
4	17,2	28,2	10	0,176	27	-17	-0,306	5,0	-8,6	13,6	1,64	3,5	5,7	24	0,445	0,4	0,07	0,515
6	32,3	53,0	9	0,158	26	-17	-0,306	8,4	-16,2	24,6	1,64	6,6	10,8	24	0,445	0,4	0,04	0,482
8	37,3	61,2	10	0,176	25	-15	-0,268	10,8	-16,4	27,2	1,64	7,5	12,3	24	0,445	0,4	0,03	0,477
10	52,8	89,9	11	0,194	26	-15	-0,268	17,5	-24,1	41,5	1,70	10,5	17,9	23	0,423	1,1	0,06	0,482
12	55,3	93,8	12	0,212	25	-13	-0,231	19,9	-21,6	41,6	1,70	11,0	18,7	23	0,425	1,0	0,05	0,478
14	66	115,6	13	0,231	25	-12	-0,212	26,7	-24,6	51,2	1,75	12,9	22,6	22	0,406	1,6	0,07	0,475
16	67,1	117,8	14	0,249	25	-11	-0,194	29,3	-22,9	52,2	1,75	13,2	23,2	22	0,405	1,6	0,07	0,474
18	77,1	139,3	13	0,231	25	-12	-0,212	32,1	-29,6	61,7	1,81	15,3	27,6	21	0,387	2,1	0,08	0,464
20	87,9	162,4	11	0,194	24	-13	-0,231	31,5	-37,5	69,0	1,85	17,6	32,5	20	0,373	2,6	0,08	0,452
22	91,1	169,8	9	0,158	24	-15	-0,268	26,9	-45,5	72,4	1,86	18,3	34,1	20	0,367	2,7	0,08	0,447
24	105,6	200,5	7	0,123	23	-16	-0,287	24,6	-57,5	82,1	1,90	21,1	40,1	20	0,356	3,1	0,08	0,433
26	114,6	218,9	4	0,070	23	-19	-0,344	15,3	-75,3	90,6	1,91	22,5	43,0	19	0,352	3,2	0,07	0,427
28	97,0	193,5	35	0,700	23	12	0,212	135,4	41,1	94,3	2,00	19,4	38,7	18	0,324	4,1	0,11	0,429
30	68,4	140,2	35	0,700	25	10	0,176	98,1	24,7	73,4	2,05	13,7	28,1	17	0,306	4,7	0,17	0,472
32	65,6	134,5	35	0,700	39	-4	-0,070	94,1	-9,4	103,5	2,05	4,6	9,4	17	0,306	4,7	0,50	0,801

Table 4. Determination of stability on a newly designed slope surface along the profile PK 13 + 310

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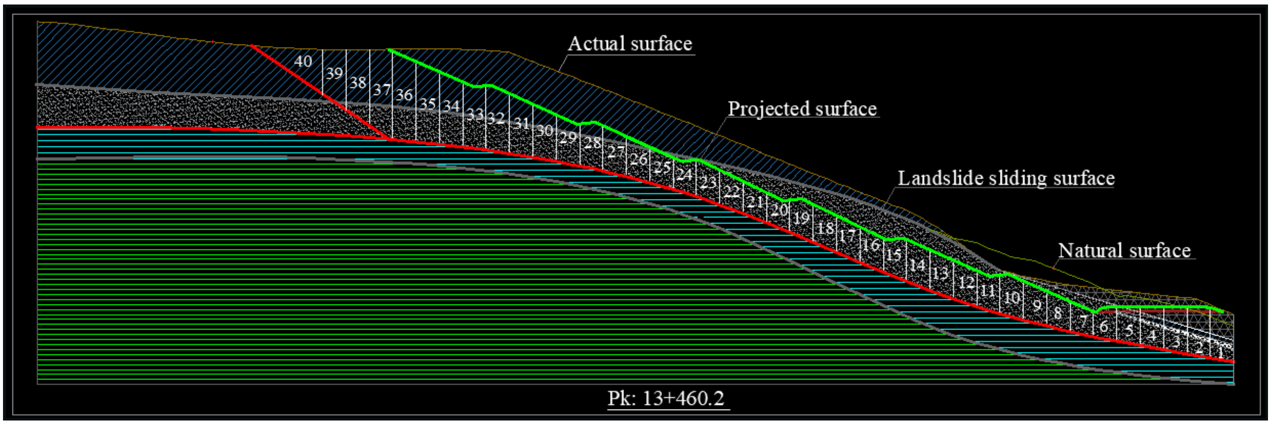

Figure 9. Geomodel for determination of stability on a newly designed slope surface along the profile PK 13 + 460

Determination of stability on a newly designed slope surface along the profile PK 13+460																		
Block number	F m^2	Q = F. ρ t/m	α degree	tg α	ψ_p degree	α - ψ_p	tg (α - ψ_p)	H = Q·tg α t/m	R = Q·tg (α - ψ_p) t/m	T=H-R t/m	ρ t/m^3	h m	P = ρ·h t/m^2	φ degree	tg φ	c t/m^2	$\frac{C}{P}$	$Fp = tg\varphi + \frac{C}{P}$
2	52,4	100,2	10	0,176	27	-17	-0,309	17,7	-31,0	48,7	1,91	10,40	19,9	19	0,351	3,2	0,16	0,514
4	44,3	80,8	10	0,176	28	-18	-0,318	14,2	-25,7	39,9	1,82	8,90	16,2	21	0,381	2,3	0,14	0,524
6	32,5	53,3	11	0,194	26	-15	-0,262	10,4	-14,0	24,3	1,64	6,74	11,1	24	0,445	0,4	0,04	0,481
8	34,8	57,1	13	0,231	26	-13	-0,224	13,2	-12,8	26,0	1,64	7,00	11,5	24	0,445	0,4	0,03	0,480
10	43,3	71,0	15	0,268	25	-10	-0,182	19,0	-12,9	31,9	1,64	8,80	14,4	24	0,445	0,4	0,03	0,473
12	40,8	66,9	18	0,325	25	-7	-0,130	21,7	-8,7	30,4	1,64	8,20	13,4	24	0,445	0,4	0,03	0,475
14	45	73,8	21	0,384	25	-4	-0,075	28,3	-5,5	33,8	1,64	9,00	14,8	24	0,445	0,4	0,03	0,472
16	37,1	60,8	23	0,424	26	-3	-0,045	25,8	-2,7	28,5	1,64	7,40	12,1	24	0,445	0,4	0,03	0,478
18	40,3	66,1	23	0,424	25	-2	-0,042	28,0	-2,8	30,8	1,64	8,10	13,3	24	0,445	0,4	0,03	0,475
20	32,9	54,0	23	0,424	26	-3	-0,049	22,9	-2,6	25,5	1,64	6,40	10,5	24	0,445	0,4	0,04	0,483
22	38,4	63,0	21	0,384	26	-5	-0,080	24,2	-5,0	29,2	1,64	7,30	12,0	24	0,445	0,4	0,03	0,478
24	35,5	58,2	18	0,325	26	-8	-0,135	18,9	-7,8	26,7	1,64	6,90	11,3	24	0,445	0,4	0,04	0,480
26	40,6	66,6	15	0,268	25	-10	-0,184	17,8	-12,2	30,1	1,64	8,10	13,3	24	0,445	0,4	0,03	0,475
28	48,4	85,7	12	0,212	27	-15	-0,260	18,2	-22,3	40,5	1,77	9,80	17,3	22	0,399	1,8	0,10	0,500
30	53,9	96,8	10	0,176	26	-16	-0,293	17,1	-28,4	45,4	1,80	10,80	19,4	21	0,391	2,0	0,10	0,495
32	68,1	125,6	8	0,140	25	-17	-0,313	17,6	-39,4	57,0	1,85	13,60	25,1	21	0,374	2,5	0,10	0,475
34	74,1	137,5	7	0,123	25	-18	-0,325	16,9	-44,7	61,6	1,86	14,80	27,5	20	0,370	2,7	0,10	0,466
36	90,8	165,1	5	0,087	26	-21	-0,378	14,4	-62,4	76,8	1,82	12,61	22,9	21	0,383	2,3	0,10	0,481
38	73,4	144,1	35	0,700	25	10	0,177	100,8	25,5	75,4	1,96	14,60	28,7	18	0,334	3,8	0,13	0,465
40	73,6	150,9	35	0,700	38	-3	-0,052	105,6	-7,8	113,4	2,05	4,8	9,8	17	0,306	4,7	0,47	0,780

Table 5. Determination of stability on a newly designed slope surface along the profile PK 13 + 460

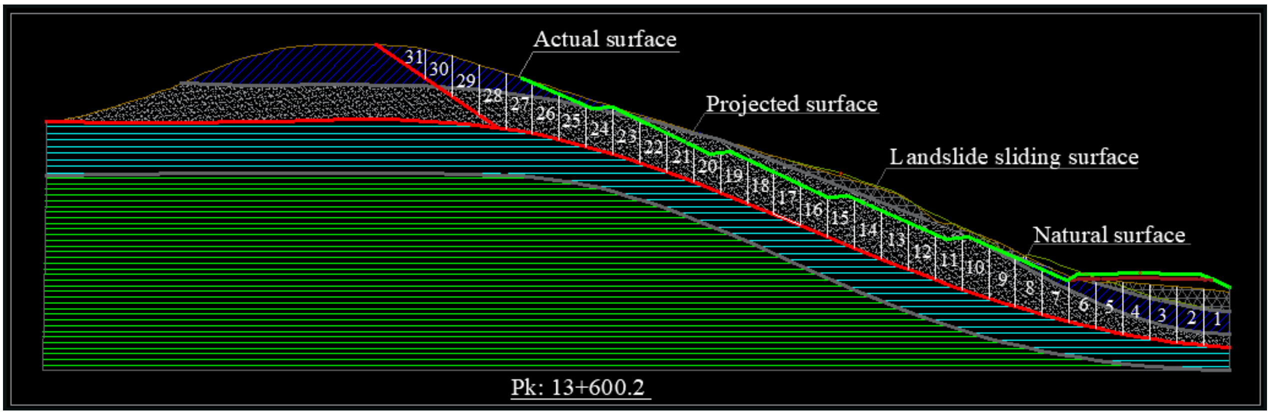

Figure 10. Geomodel for determination of stability on a newly designed slope surface along the profile PK 13 + 600

Block number	F m^2	$Q = F \cdot \rho$ t/m	α degree	tg α	Ψ_p degree	$\alpha - \Psi_p$	$tg(\alpha - \Psi_p)$	$H = Q \cdot tg\,\alpha$ t/m	$R = Q \cdot tg(\alpha - \Psi_p)$ t/m	T=H-R t/m	ρ t/m^3	h m	$P = \rho \cdot h$ t/m^2	φ degree	tg φ	C t/m^2	$\frac{C}{P}$	$Fp = tg\,\varphi + \frac{C}{P}$
1	61,7	121,4	5	0,087	26	-21	-0,385	10,6	-46,7	57,3	1,97	12,4	24,4	18	0,333	3,8	0,16	0,489
3	63,7	124,7	9	0,158	26	-17	-0,302	19,7	-37,7	57,4	1,96	12,8	25,1	19	0,336	3,7	0,15	0,484
5	53,6	100,9	12	0,212	27	-15	-0,264	21,4	-26,7	48,1	1,88	10,8	20,3	20	0,361	2,9	0,14	0,505
7	40,9	70,2	15	0,268	27	-12	-0,208	18,8	-14,6	33,4	1,72	8,1	13,9	23	0,418	1,2	0,09	0,504
9	48,0	78,7	18	0,325	25	-7	-0,126	25,6	-9,9	35,5	1,64	9,6	15,7	24	0,445	0,4	0,03	0,470
11	44,6	73,1	20	0,364	25	-5	-0,093	26,6	-6,8	33,4	1,64	8,7	14,3	24	0,445	0,4	0,03	0,473
13	45,4	74,5	22	0,404	25	-3	-0,057	30,1	-4,3	34,3	1,64	9,1	14,9	24	0,445	0,4	0,03	0,472
15	43	70,5	23	0,424	25	-2	-0,041	29,9	-2,9	32,8	1,64	8,7	14,3	24	0,445	0,4	0,03	0,473
17	39,1	64,1	23	0,424	25	-2	-0,043	27,2	-2,8	30,0	1,64	7,8	12,8	24	0,445	0,4	0,03	0,476
19	41,5	68,1	22	0,404	25	-3	-0,058	27,5	-4,0	31,5	1,64	8,6	14,1	24	0,445	0,4	0,03	0,473
21	36	59,0	21	0,384	26	-5	-0,080	22,7	-4,7	27,4	1,64	7,2	11,8	24	0,445	0,4	0,03	0,479
23	42,4	69,5	18	0,325	25	-7	-0,129	22,6	-9,0	31,6	1,64	8,5	13,9	24	0,445	0,4	0,03	0,474
25	40,4	66,3	15	0,268	25	-10	-0,184	17,7	-12,2	29,9	1,64	8,1	13,3	24	0,445	0,4	0,03	0,475
27	50,8	89,8	10	0,176	26	-16	-0,294	15,8	-26,4	42,3	1,77	10,2	18,0	22	0,400	1,7	0,10	0,496
29	43,2	81,8	35	0,700	29	6	0,113	57,2	9,3	48,0	1,89	8,6	16,3	20	0,358	3,0	0,19	0,544
31	25,6	52,5	35	0,700	44	-9	-0,164	36,7	-8,6	45,3	2,05	3,4	7,0	17	0,306	4,7	0,67	0,976

Table 6. Determination of stability on a newly designed slope surface along the profile PK 13 + 600

Stability coefficients on the new surface formed after the existing surface of the slope has been changed:

1. Pk 13 + 310 $K_s = 1.88$ $\alpha = 15^\circ$ $\varphi = 27^\circ$ (Fig. 8, Table 4)
Pk 13 + 310 $K_{ss} = 1.35$ $\alpha = 15^\circ$ $\varphi = 23^\circ$
2. Pk 13 + 460 $K_s = 1.92$ $\alpha = 19^\circ$ $\varphi = 30^\circ$ (Fig. 9, Table 5)
Pk 13 + 460 $K_{ss} = 1.38$ $\alpha = 19^\circ$ $\varphi = 24^\circ$
3. Pk 13 + 600 $K_s = 1.84$ $\alpha = 19^\circ$ $\varphi = 30^\circ$ (Fig. 10, Table 6)
Pk 13 + 600 $K_{ss} = 1.32$ $\alpha = 19^\circ$ $\varphi = 24^\circ$

After changing the slope relief along a given line, the slope stability reserve condition ($K_{sf} \geq 1.3$) is met for all profiles.

Figure 11. Image of the study area after landslide measures

Conclusion

When providing geotechnical justification for the design of complex engineering anti-landslide measures on similar slopes, it is advisable to take into account the following factors:

- Changing the topography of slopes is a cost-effective and practically easy measure to prevent landslide processes (decreasing the steepness of the slope, removing unstable soil mass, decreasing tensile reactive forces, increasing retaining tangential forces);

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- When determining the slope of a new slope, along with the slope stability coefficient, the seismicity of the area and the angle of internal friction of the soil under conditions of maximum moisture should be taken into account;
- To reduce the impact of varying levels of wear and erosion processes that may occur on the newly created slope surface, terraces should be created on the slope surface and berms 4-6 meters wide at the foot of the terraces;
- When replacing a new slope surface, the width of the terraces formed after excavation work should not exceed 20-22 meters, and the slope of the surface should not exceed 24° in accordance with existing geological conditions;
- The slope of the berms should be 3-4 degrees towards the foot of the terrace on the upper section;
- The flow of atmospheric precipitation (snow and rainwater) along the upper part of the slope must be regulated;
- To regulate the surface water level on terraces, separate telescopic reinforced concrete gutters should be installed at the foot of the terraces and the water flow should be directed to safe areas;
- To protect the surfaces of terraces and berms from over-wetting, wear and erosion processes, and the negative impact of rain and snow water, these areas should be filled with clay soils that do not have specific properties, 15-20 cm thick; after leveling the surface, special types of plants (almonds, rosemary, etc.) should be planted.
- To improve slope stability and maintain soil dryness, agroforestry measures should be carried out, including planting pistachio, almond, and acacia trees on the outer part of the berms;
- Excavation work on the slope should be carried out in the direction from the edge of the slope to the foot;

To ensure the reliable and long-term stability of the slope, the above measures must be comprehensively and fully implemented.

References

1. Amashi, A. R., Hulagabali, A. M., Solanki, C. H., & Dodagoudar, G. R. (2016). Landslide risk assessment and mitigation – a case study. *In: Proceedings of the Indian Geotechnical Conference IGC.*
2. Andreyev, V., Mosicheva, I., & Shapoval, V. (2017). Wschodnioeuropejskie Czasopismo Naukowe. *East European Scientific Journal*, 12(28).
3. Ginzburg, L. K. (2007). *Anti-landslide structures*. Lira LTD.
4. Nevolin, A. P. (2014). *Engineering geology. Engineering-geological surveys for construction: training and methodological manual*. Publishing house of Perm. National Research Polytechnic University.
5. ODM. (2010). *ODMD 218.2.006-2010: Recommendations for calculating the stability of landslide-prone slopes (slopes) and determining landslide pressures on engineering structures of highways.*
6. ODM. (2013). *ODMD 218.2.033-2013: Methodical recommendations for the implementation of engineering and geological surveys on landslide-prone slopes and embankments of motorways.*
7. Ponomarev, A. B., Bogomolova, O. A., Bogomolov, A. N. (2022). *Calculation of slope stability: textbook-method manual.* Publishing house of Perm. National Research Polytechnic University.
8. Shiraliyev, N., Ceylan, J., & Mirjafarli, S. (2024). Determining the Stability of a Potentially Dangerous Landslide Slope. *Nature & Science International Scientific Journal*, 6(9), 39-47.
9. SP. (2003). *Code of practice for design and construction SP 11-105-97: Engineering and geological surveys for construction. Part II. Rules for the performance of work in areas of development of dangerous geological and engineering-geological processes*.
10. Tabuyev, V. P. (2010). Evaluation of slope stability of a rockfill dam under construction. *Bulletin of RUDN, Engineering Research series*, 4.

ISSN: 2707-1146
e-ISSN: 2709-4189

11. Ukhov, S. B., Semenov, V. V., Znamensky, V. V., & Chernyshev, S. N. (2002). *Soil mechanics, bases and foundations.* Higher School.
12. Varnes, D. J., Schuster, R. L., & Krizek, R. J. (1978). Slope movements, types and processes. *Landslide Analysis and Control*. Transportation Research Board National Academy of Sciences.

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AGRICULTURAL SCIENCES AND BIOLOGICAL SCIENCES

CHEMISTRY

MEDICINE AND PHARMACEUTICAL SCIENCES

PHYSICS AND ASTRONOMY

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