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E-mail:
rsglobal.poland@gmail.com

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TRANSPORT

ENSURING THE RELIABILITY OF TRANSPORT

Gumeni Maria,
PhD-student, Technical University of Moldova, Doctoral School - Mechanical and Civil Engineering, Engineering and production management (in the transport branch), Chishinau, Moldova
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7430

Abstract. *Road safety is becoming the number one issue. Reliability - a branch of science that studies the general measures to be considered when designing, manufacturing and operating technical systems, in order to ensure maximum efficiency in their use. The car is dependent on the environment, on the processes that influence the triggering of its basic characteristics, during operation. An operation strategy is a set of rules that ensure the specified control of the corresponding operation process. Commercial operations governs the intended use of vehicles. All strategies are closely related to it. Thus, the automobile transport system has the features inherent in complex technical systems: the presence of a single goal, controllability, the interconnection of elements, a hierarchical structure. The system of technical operation of vehicles is a set of vehicles, traffic control devices, drivers, regulations and norms that determine the selection and maintenance of the most advantageous modes of operation of vehicle units, as well as the maintenance and restoration of the lost performance of vehicles in the process of performing transport work. The reliability of the car is the ability of the car to perform the specified functions, keeping the values of the established performance indicators within the limits corresponding to the specified modes and conditions of use, maintenance, repair, storage and transportation.*
Keywords. *design, durability, influence, operation, quality, reliability, road safety.*

Introduction. Car transport plays a main role in the country's transport complex, regularly serving enterprises with different forms of ownership, as well as the country's population. More than 80% of goods are transported by car each year, and around 75% of passengers travel using public transport.

At the same time, road transport is the main consumer of resources:

- 66% of petroleum fuels,
- 70% of human resources,
- and about half of all investments.

The car is operated in a variety of conditions and is a complex system, a set of operating elements - assembly units and parts that ensure the performance of its functions.

By road transport is meant any transport operation carried out by road vehicles for the movement of goods or persons even if the road vehicle is, in a certain part of the road, in turn transported by another means of transport (railway wagon).

Reliability (STAS 8174/77) [6] means the ability of a product to perform its required function under given conditions over a given period of time.

Purpose. Increase traffic safety on national roads.

Specific objective. Analysis of road safety at present, highlighting the characteristic aspects of road accidents, the circumstances and dynamics of their occurrence, and identifying the best practices to increase road safety that could be implemented.

The main motivation for the study of the mentioned aspects comes from the desire to give an answer to an always controversial situation that we encounter frequently.

Reliability of means of transport and ensuring it.

Reliability - a branch of science that studies the general measures to be considered when designing, manufacturing and operating technical systems, in order to ensure maximum efficiency in their use [3].

The car is dependent on the environment, on the processes that influence the degradation of its basic characteristics, during operation. These processes are random and, therefore, for the evaluation of vehicle reliability, methods are used, such as - probability theory and mathematical statistics. Reducing the reliability of vehicles leads to overheads for their repair and time spent for zero travel, at the time of non-operation.

The most complete and objective, following an experimental test, to assess the influence of all conditions and tasks performed, can determine various features of reliability - complete and objective. For this, the following sources of information are used. Fig.1 [2]:

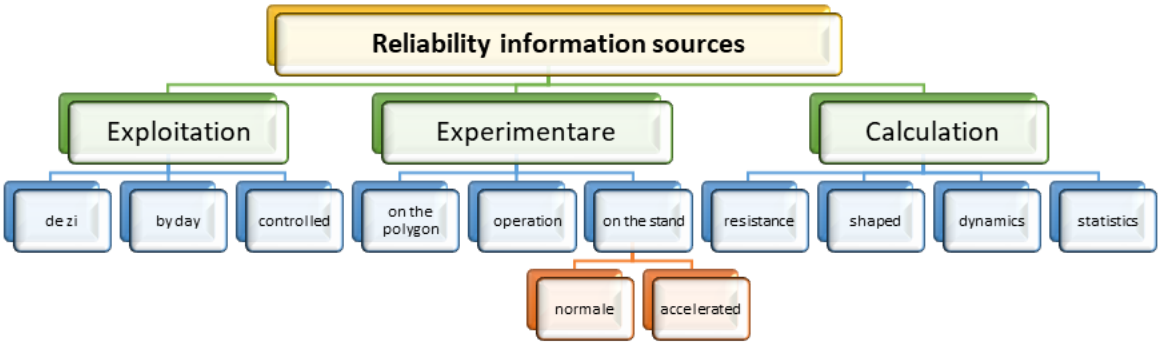

Fig. 1. Sources of information

Reliability, as a complex indicator, is determined by: safety, maintainability, durability and depends on: Fig.2

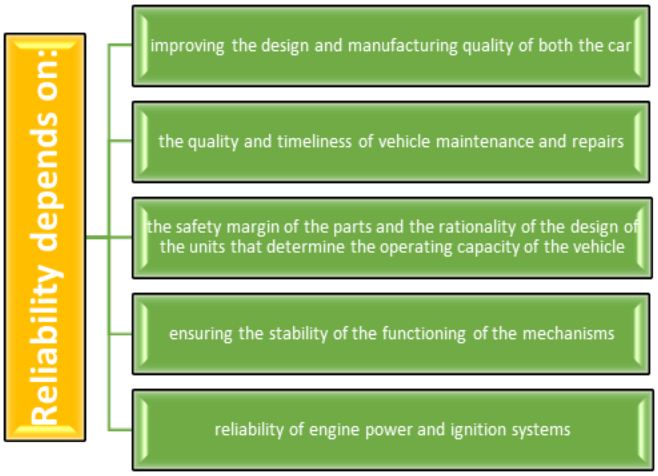

Fig. 2. Ensuring the reliability of means of transport

The extensive use of the "individual" capabilities of various vehicle mechanisms and systems will be allowed through the provision of technical maintenance and repair of cars.

The problem of reliability of mechanisms is in the first place in any industry, because it is necessary to operate the mechanisms with minimal costs. In addition, the importance of the problem lies in the mass production. The reliability of a car is characterized by a complex of qualities, Fig. 3:

Fig. 3. The matrix of the concept of "vehicle reliability"

The quality of the products is understood as the totality of product properties that determine its suitability to meet certain needs in accordance with its intended purpose. The totality of product quality properties is assessed by quality indicators. They are divided into indicators of purpose, reliability, manufacturability, transportability, standardization and unification, safety, ergonomic, environmental, aesthetic and patent law. Thus, reliability is one of the main indicators of product quality. There can be no high quality products without high reliability.

The impact of the technical condition of vehicles on road safety.

The improvement of the roads, the diversity of the car models and the gradual adaptation of the human body, lead to the increase of the extraordinary speeds in circulation. The development of vehicle designs only confirms this growth. In the twentieth century, the speed of the car is increasing, from 30 – 40 km/h to 120 – 200 km/h. Race cars became even faster, increasing the speed from 100 km/h to 300 km/h. There are also speed records, with speeds reaching over 1000 km/h. The speed of intercity buses becomes practically the same as that of cars.

Also, taking into account the safety requirements, the speed allowed in the localities has tripled. The weight of the vehicle has a significant impact on its efficiency in operation. [2] The weight of the car also has a great influence on its cost. The higher the production of a car model (in series), the lower the need for design and research, which reduces its cost. Reducing the weight of the car essentially leads to economy and increased speed. In turn, increasing speed requires more efficient braking system, wheel stability, maneuverability, post-accident and environmental safety. Changing the design of the vehicle requires us to: new driving methods, in various conditions, quality roads and traffic management, the establishment of new rules and even a new organization of their maintenance.

The operating conditions under which cars are used affect the operating modes of units and parts, accelerating or slowing down the change in the parameters of their technical condition, Fig.4:

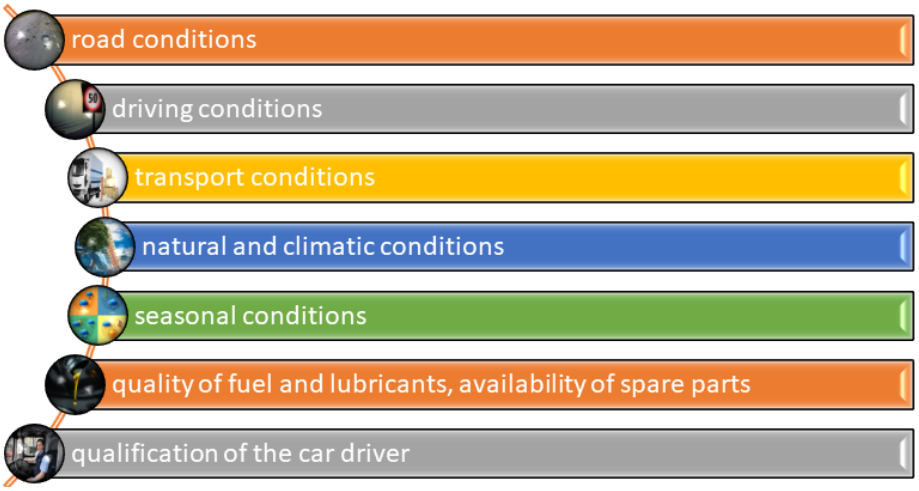

Fig. 4. Influence of operating conditions on changes in the technical condition of vehicles

- road conditions determine the mode of operation of the car and are characterized by the technical category of the road, the type and quality of the road surface, the resistance to the movement of the car, the width of the carriageway, the slopes of the road, the radius of curvature;
- driving conditions are characterized by the influence of external factors on the operating mode of the vehicle and its units;
- transport conditions are characterized by the length of the loaded ride, the coefficients of using the mileage and carrying capacity, the type of cargo;
- natural and climatic conditions are characterized by ambient temperature, humidity, wind load, level of solar radiation;
- seasonal conditions, with more than 60% of all car failures and malfunctions occurring in the spring-autumn period of operation.

At the current stage, the car rarely refuses the driver to fulfill orders, thus reaching the level of excellence. In turn, man, although he developed physically and spiritually, practically did not change his speed of reaction. Being in his youth, the driver is the owner of the fastest reaction, at the same time he is subject to the enthusiasm of competition, eager for accelerated speed. Passing through the

middle age - the reaction slows down. But, being at any age, the driver is influenced by: the technical conditions of the car, weather conditions, dexterity in driving, psychophysiological condition, consumption of food and drugs, not to mention alcohol. Hence, more than half of all road accidents are caused by the human factor,[7] ie the fault of the driver.

Road safety is becoming the number one issue. Cars were created for the benefit and joy of the people, but their development was so rapid that it came into conflict with the development of localities and roads, with the psychophysiological capabilities of people, with the necessary fuel and resources. Traffic safety depends on many factors. The driver influences the increase of road safety through the way and style of driving, which is very significant. While all other factors directly or indirectly influence its circulation. Fig. 5.

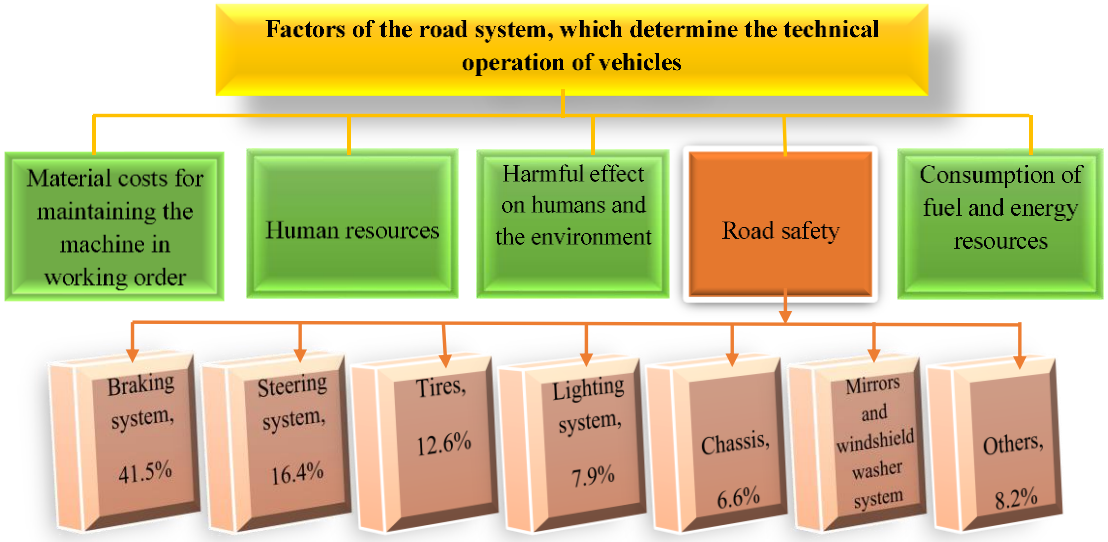

Fig. 5. The technical operation of the vehicles determines the following factors of the transport process

Increasing the operational reliability of vehicles and reducing their maintenance costs is the important problem facing road transport. The solution to this problem is offered by the automotive industry by producing cars with high reliability (maintainability), on the one hand. On the other hand: Fig.6, Fig.7.

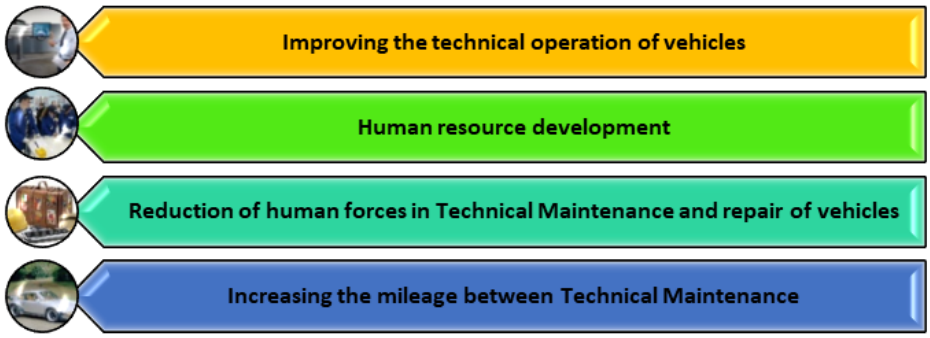

Fig. 6. Increasing the operational reliability of vehicles and reducing their maintenance costs

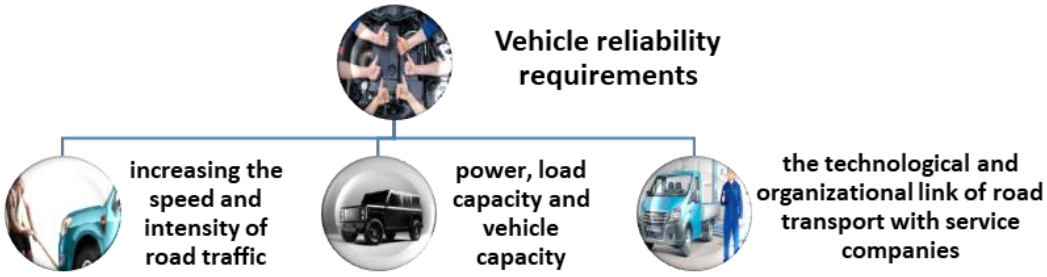

Fig. 7. Ways to streamline vehicle reliability requirements

The reliability problem is addressed in four main stages:

- determination of the initial requirements for the quality of the new model, taking into account the level of modern technology, existing analogues, market conditions and consumer interests;
- design, i.e. development of design documentation, implementation of complex bench and road tests;
- production;
- work with consumers (collection of information about all failures and malfunctions arising during operation, simplification and reduction of labor intensity of maintenance and repair work, provision of spare parts).

Conclusions. When designing cars, the rule must be observed: the less the expected durability of a particular interface part, the more maintainability the car structure must have. Therefore, the reliability of a car is not only a technical category, but also an economic one. It should reflect the costs of socially necessary labor to create a car and maintain it in working condition during operation. Reliability depends primarily on the level of technical equipment of the manufacturing plant, factories - suppliers of raw materials, the quality of materials, semi-finished products and finished parts. The solution of complex problems of reliability of modern cars is impossible without a deep theoretical study of the physical and chemical processes that cause wear and tear of parts, and the development on this basis of appropriate practical recommendations for the design, production and operation of cars.

The subject described helps us to understand the causes of the decrease in vehicle quality. The deterioration and decrease of the efficiency of the use of vehicles, leads to the creation of certain preconditions for the occurrence of road accidents.

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BIOLOGY

SOME MEDICAL-BIOLOGICAL ASPECTS AND ECOLOGICAL BACKGROUND DURING THE USAGE OF POISON CHEMICALS AGAINST THE PATHOGENESIS OF BUXUS COLCHICA

Giorgi Parulava,
professor, Georgian State Teaching University of Physical Education and Sport, Tbilisi, Georgia
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7431

Abstract. *It is proved, that the unique model of Georgian flora, Colchian box-tree (Buxus), is in the phase of ecological catastrophe. The chance of survival is minimal in the refuges, gorges and mountain slopes. Relict or introductory plants of all Georgian box-tree species should be sprayed with pesticide "Dimelin" and tilled with fungicides. All types of Deltamethryn (Decis) pesticides must be removed from purging scheme, since, according to survey results, abovementioned drug is an ecological threat fot the human health and the fauna complexes.*
Keywords. *Ecology, metabolism, refugium, fauna complexes, pathogenesis, lethal.*

Introduction. Buxus Colchica is member of Buxceae family and Buxus genus [6]. In the Georgian environmental conditions, there are two relict species – Buxus colchica and Buxus hyrcana; Introduced four species: Common or evergreen buxus (Buxus sempervorens), Balearic (Buxus balearica), Japanese buxus (Buxus japonica) and narrow leaf buxus (Buxus microphylla). Buxus is a special plant. Antic age authors frequently indicated to it, Old Roman poet Ovidius Naso mentioned that Goddess Athena made a flute form the buxus.

Buxus colchica is included in the red book of Georgia. It is also special plant for the Georgian flora. According to vertical distribution of the forest, it thrives in first, damp subtropical belt, till 350 meters above the sea level, as well as in second, mixed wide leafed Colchian type tree forest belt, located from 350 to 900 meters above the sea level. It feels itself especially good in the refugiums of Samagrelo region. It also must be noted that in the foothills of Samegrelo mountains and territories adjacent to the black sea beach belt, in the beginning of Pliocene, Colchian refugium of old Mesophilic forest flora relicts, plant refuge was formed, which was assisted by the formation of mountain slopes in a way that ensured the maintenance of warm and damp climate in some territories of Samegrelo. The remarkable example of it is the relict forest refugium of quaternary period across Khobistskali, near village Mukhuri of the Chkhorotsku region where Zelkova tree, Colchian ivy, sapwood, Caucasian bilberry, laurel, Pontic rhododendron, fig and forest dominant Buxus Colchica thrive next to each other [2]. It is evergreen bush or tree plant; It rises from 2 to 5 meters in height; Lives up to 600 years; Rises slowly, it starts its fructuousness in groves in bound forests from the age of 35, but the sole growing plant – from the age of 15. It endures the trimming well, because of which it gets special decorative meaning. It has very hard and solid, because of which it is valuable in furniture making and ship building. From the ancient times, it was used as healing plant. It is also noteworthy that its leaves are poisonous and contains around 70 types of alkaloids, including cyclobuxine D. The whole amount of alkaloids in the plant is 3%. Deadly dose of cyclobuxine D for warm blooded species during a peroral intake, on 1 kilogram per body mass, is 0.1 mg [7].

Research results. Today, this wonderful piece of Georgian flora is under the threat of extinction. Environmental protection organizations assess the situation as an ecological catastrophe. Causes of this are the Buxus pathogens. Over the last 5 years, Buxus groves are being intensively desiccated. Expedition, which was held in Lugela ravine in 2010, spotted the massive damage of Buxus groves in the abovementioned refugiums, which expressed itself in stripping the plant from its leaves and intense development of moss on branches. Supposedly, it is caused by viruses. Initially, the plant roots are damaged. Root indumentums are being rotted, as a result of which the mixed mineral salts in water is not absorbed in the plant, which therefore cannot feed itself, process of photosynthesis is ceased and wilted leaves are falling down. Bark does crack on a stem, xylem gets black and starts

rotting. This itself represents a wonderful substrate for a development of fungus and moss. Second one is the more dangerous disease – Buxus burn, which is caused by the Buxus fungus (Cylindrocladium buxicola) that is very famous in Europe. It has been vastly spread in decorative agriculture and is massively destroying Buxus plants. Brown spots are occurring on the leaves of an afflicted plant, leaves are consequently being discoloured, gets yellow and falls down [6]. Similar process repeats itself in second-third year. After this, branches are wilted first and then the whole tree does the same.

Besides this, the Cydalima perspectalis walker became the reason of wilting of the Buxus. Its homeland is the Eastern Asia. In Georgia, it was born in 2003, officially spotted in the Guria region, specifically in the territories of Shekvetili. It belongs to the Lepidoptera order and Crambidae family [5]. Despite that its biology and zoogeography is well studied, additional researches must be made in Georgian settings. Here it is must also be noted that said maleficent was not discovered in the refugiums. In the area of spreading, chemical fight against it gives good result, where pesticide Deltamethrin (Decis), whose toxicocinetics and toxicodynamics analyses show that the preparate in the process of metabolism creates many bioactive derivate, is widely used; Has clearly expressed hydrophobic characteristics and is easily absorbed to some specific molecules, which represent its main transport factor. Physical-chemical processes play important role in the dislocation of Decis (serum, supernatant), whose essence is aimed towards maintaining the constant level of current substance on the expense of depo-processes, which take place on the surface of erythrocyte-plasma division [3]. In addition to this, Decis is quickly degraded because of hydrolytes, oxidants, protolithic products and mixtures connected to them. Following types of complexes were discovered: transdeltamethrin, transhydroximetrol deltamethrin, 3-dibromovinil, 2,2-dimethylcyclo-propane and so on. There is also enough amount of remains, which are of ambiguous constitution (on the 35% practical dose) Metabolism is different between animals and plants by mixture constitution. Quick release of Decis and its metabolism in animals is made with unimportant tendency of bioaccumulation [3]. Under the influence of Decis, on the skin of warm blooded, erythematic and dematic damage occurs after 1 hour and 49 minutes; Eye irritation, in particular eye blinding and cornea damage happened after 1 hour. Preparate showed short duration irritative effect with washing it off and not washing it off; with macroscopic and histologic observation, no trace of sensitivity was seen. Effect of meaning connected to rat reproduction try has not been caused in 3b generation organic mass, small embryo toxic effect was being noticed as well as hard atyxia and partial degenerative changes of the spinal marrow, approximately 20% [1]. For the invertebrate animal fauna, any kind of contact with Decis is lethal, destructive for fauna complexes. Pesticide Dimelin, which is safe for human and warm blooded animals, is effective against the worms of Cydalima perspectalis walker. Bacterial origin biologic preparate Bacillus thuringiensis is greatly effective against the newly-born worms.

Mechanic method, which means a heavy trimming of plant, is widely used for protecting the Buxus from maleficent. In addition to this, it is also noteworthy that in the recreational zone, using chemical method against maleficent and diseases is strictly limited, that is why the orientation must be aimed toward the integrated method of fighting.

Far more complex situation is connected to the groves in the mountain slopes, ravines and refugiums, to where arrival with special technology is impossible. Land cultivation and fight against viruses is unimaginable.

Therefore, Colchian box-tree (Buxus Colchica) is on the verge of ecologic catastrophe, to save it, it is necessary for specialists of this field, scientific potential to unite, special program to form and to practically implement. The usage of deltamethrin and similar pesticides must be abolished in order to not be harmful for human health, especially on touristic routes. Enough supply of preparate Demilin must be imported, Buxus plants on places, where it is physically impossible to do so, must be immediately sprayed and worked with fungicides. It is proved with our research that the usage of any form of Decis is dangerous for human health and fauna complexes around it.

Conclusions. 1. Pesticide deltamethryn (Decis) must be removed from the means of fight against the pathogenesis of Colchian box-tree (Buxus colchica)

2. Deltamethryn (Decis) with its toxicokinetic and toxicodynamic indicators represents a dangerous poison chemical for the human health.

3. The usage of deltamethryn (Decis) in Buxus groves causes the change of fauna complexes in this ecological environment.

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THE METHODOLOGY OF THE FORMATION OF INFORMATION CULTURE OF STUDENTS IN BIOLOGY

Aubakir Aidana, *master's degree student of biology, Kazakh National pedagogical University after named Abai, Almaty, Kazakhstan*
Maimataeva Asiya, *PhD doctor, Kazakh National pedagogical University after named Abai, Almaty, Kazakhstan*
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7432

Abstract. *The article deals with the dynamic development of information and communication technologies and their impact on the education system, as well as the importance of forming an information culture of students through the use of information technologies in biology lessons. For biological science, which is constantly updated and updated information base, the use of information technologies in the educational process is becoming more rational and acceptable. In particular, the use of a virtual laboratory, an online microscope, multimedia information systems and various animations in biology classes makes the lesson interesting and useful. Thus, with the help of systematic informatization, students can be helped to study in an open education system, to form a system of thinking and independence.*
This article contributes to the formation of information culture in the process of teaching and training students through information and communication technologies using new information systems in biology lessons and contributes to a more detailed understanding of the problem of Informatization of education.
Keywords: *information culture, information and communication technologies, computer literacy, informatization of education, formation of information culture*.

Introduction. The process of informatization all over the world is considered to be a key condition for the successful development of society, the dominant trend in the development of civilization in the 21st century. Thanks to the rapid development of informatics, telecommunication systems and new information technologies, a new information environment for the habitation and life of tens and hundreds of millions of people is emerging on our planet, and an information society is being actively formed. The active development of information technology and the formation of an information society have influenced the educational system.

Modern society is more and more in need of new information and big news from modern knowledge. Therefore, due to the rapid development of new information technologies and excessive information content, there is an intensive informatization of the educational process in the country. Thus, it should not be excluded that the level of development and application of modern technologies in each country is determined not only by the development of its material base, but also by the level of information development of the population, the ability to form, master and apply new knowledge. All this is directly related to the level of development of education in the country and the problem of informatization of education.

Main part. Informatization is an organizational, socio-economic, scientific and technical process aimed at the formation and development of information resources, information systems based on the use of information technologies in order to meet the needs of each person and legal entities in information.

Informatization of education is a process full use of new information technologies in the theory and practice of the educational area and take advantage of it in the conditions of implementation of psycho-pedagogical training and education.

The main directions of informatization of education are determined by:

- creation of an information and educational environment at the level of an educational institution, considered as a set of works that ensure the technology of its functioning;
- system integration of information technologies in education, providing educational process, scientific research and organized management;
- creation of a unified educational information space.

The education system can no longer remain unchanged in the turbulent maelstrom of social change, and the mutual adaptation of society and education is a strategic necessity, the absence of which can be disastrous for both the education system and society as a whole.

The problem of informatization of education is an urgent problem of the XXI century due to the following factors:

- the process of rapid development of informatization of society, which is a manifestation of the general pattern of development of civilization, has acquired a global character and has covered almost all developed countries of the world;

- the rapid development of ICTs and their widespread introduction into social (educational, industrial, etc.) practice have led to the formation of a new information environment of society.

Informatization of education is developed as a certain purposeful human activity for the creation and implementation of various programs and technologies. Namely:

- in the educational process for the preparation of citizens;
- improving the quality of general education and professional training of specialists;
- in the management of the education system;
- in methodological and scientific-pedagogical activities;
- development and implementation of new educational technologies.

Under the means of informatization of education is understood computer hardware and software equipment, as well as their content content used to achieve the goals of informatization of education. And the means of information technology include: electronic computers (computers), personal electronic computers (computers); Set terminal devices for all classes of computers, local area network, the input and output of information, the means of entering and manipulating text and graphic information, tools, archiving large amounts of information and other peripherals modern computers; devices and inverse transform the data passed in graphics and sound form; modern means of communication; artificial intelligence; systems computer graphics; software systems (programming languages, streamers, compilers, operating systems, application packages, etc.), etc. In this regard, the basis for the formation of computer science and information culture is computer literacy.

Computer literacy is a technical component of Information Culture (Table-1). The computer comes to the aid of a person in processing information, evaluating it, transmitting it, etc. Computer literacy is the knowledge of a computer, its functions and capabilities, it is the ability to use ICT tools to solve information problems.

Table 1. The relationship between computer literacy and information culture

Computer literacy	**Information and communication competence**	**Information literacy**	**Information culture**
acquire a minimum set of computer skills.	the ability of students to use information and communication technologies.	have the knowledge and skills to identify the information needed to solve a specific problem or complete a task.	one of the components of universal human culture, a set of information worldviews and systems of knowledge and skills.

The formation and development of information and communication competencies of students includes the formation and development of information and communication competences of students in the process of learning and general education, including: the ability to cooperate and communicate, independently acquire, supplement and integrate knowledge; the ability to solve personal and socially significant problems and apply solutions in practice using information and communication technologies.

Information and communication competence is a part of information culture at a basic level and a set of knowledge, skills and personal values for the effective implementation of various types of information services and the use of new information technologies to address socially significant life issues.

Information literacy is a tool that allows people to determine their information needs, localize and assess the quality of information, accumulate and restore information, conduct effective and ethically correct use of information, as well as create other information and share knowledge.

Information culture should be considered as the level of organization of information processes and the level of satisfaction of people with information communications, the level of efficiency in the creation, collection, storage, processing, transmission, presentation and use of information, providing a holistic view of the world, forecasting the consequences of decisions.

The main components of information culture are:

- information (computer) literacy;
- information competence;

- information-value-semantic component;
- information and cultural component;
- reflection of information.

The process of forming these components takes place in the process of productive educational and cognitive activity. Thus, during the lesson, new teaching methods, including modern information technologies, should be used along with traditional ones during the lesson.

Methodology. At the moment, such dynamically developing sciences as biology, chemistry, physics and computer science are filled with new information every day. Therefore, the use of new information technologies in teaching biology has become a requirement of today. The main distinctive feature of the use of new information technologies in biological education is the redistribution of information flows in the classroom. The teacher's dialogue with students is carried out through a digital educational resource. In this case, students become active participants in the educational process. Active activity of students leads to a significant increase in their motivation, stimulates active search and cognitive activity.

In general, biological education needs new information technologies that increase the information content, visibility and personal orientation of the educational material. They provide the formation of a systematic image of the mastered biological process or concept, its holistic, holistic representation. The greatest degree of expression when using new information technologies is advisable to provide computer modeling of biological processes and phenomena, rather than video fragments. In addition, priority should be given to modeling using information technology. In contrast to the real process or its video publication, the computer model allows the student to focus on the main, most important characteristics of the biological processes under consideration, to abstract from secondary features, to position themselves as within the "system". An important condition for the consistent introduction of new information technologies in biological education is the availability of the necessary hardware infrastructure. It should include computer-based workstations for teachers and students, new information technologies, communications, devices for receiving and transmitting information, visualization and documentation.

The use of computer technologies in the process of teaching biology can be carried out in several directions:

The first direction is Information support of the discipline using standard software-various electronic textbooks and interactive visual aids. These include: electronic textbooks, images, texts, 3D, 2D, gif animations, videos, models, virtual laboratories, etc.

The second direction is the development of a lesson using a multimedia digital projector, a carefully selected video series that will help illustrate the theoretical material presented in the lesson. Multimedia presentations are effective forms of presenting biology material. This form allows you to present the training material in an algorithmic order in the form of a system of bright reference images filled with comprehensively structured information. At the same time, students use various channels of perception (visual, auditory, kinesthetic and discrete), which allow placing information in the memory of students not only specifically, but also associatively.

The third direction is conducting experiments, practical work and virtual laboratory work. When studying the material in the biology lesson, great importance is attached to the demonstration experiment and laboratory practice. To date, very interesting computer (virtual) laboratories have been created, in which students and teachers can conduct various experiments and laboratory work on a computer screen, for example: to conduct various chemical reactions, to examine cells under a microscope.

The fourth direction-computer technologies allow to carry out intermediate and final control in the form of various test tasks in the audience. The tests are processed quickly and the results are visible immediately. Tests allow you to test the theoretical and practical knowledge, skills and abilities of students.

The fifth direction is the use of the Internet for the preparation and conduct of classes. The Internet is used for various didactic purposes:

- first, you can set a task-to find additional educational information that can be reused every time;
- secondly, the ability to find information: to find fundamentally new information, to compare it with known data, i. e. to create a problem situation that initiates constructive communication;
- third, you can prepare tasks for making a review (analytical review, digest, abstract) on a pre-formulated topic, which can be evaluated as a student's project work.

Research results. Recently, various computer programs have been developed for students and teachers of biology: electronic textbooks, reference books, online encyclopedias and educational games, online microscopes, virtual laboratories in biology, programs for test and training, practical tasks. These computer programs are the best visibility, not only for schools that are not equipped with classrooms and technical devices for biology, but also for those that have all the opportunities to study biology in general. Therefore, the introduction of various computer programs in the process of teaching biology contributes to the enrichment of the teaching content and provides access to various resources for visual learning, thereby giving it a logical character, and also solves such problems as the development of students' creative abilities and finding ways to activate their interest. That is, using such computer programs, the biology lesson becomes not only interesting and informative, but also in the course of work, students can develop their creative abilities and apply them in the future.

A great contribution to the formation of the information culture of students in biology lessons is made by social networks and various websites. In turn,the creation of websites is one of the methods of forming the information culture of students. In addition, the teacher can share information in various directions with his students, opening a website with an individual approach to himself and his students. In addition, the network is of great importance both for the teacher's self-education, as well as for preparing for the lesson and using its rich resources.

Therefore, in the era of the development of information and communication technologies, as well as within the framework of the "trilingual policy" program, a website was opened in Kazakhstan, which will become the basis for studying biology in English and an assistant for biology teachers.

The site contains various resources for teaching biology in English and materials for teachers. The site is called "Biology tips" (Fig. 1). On the website for conducting biology lessons in English, such as:

- biological video materials (with a direct link to YouTube);
- animations and images in 2D, 3D and gif format;
- short-term lesson plans for teachers;
- individual, creative works of students;
- presentations and interesting biological facts.

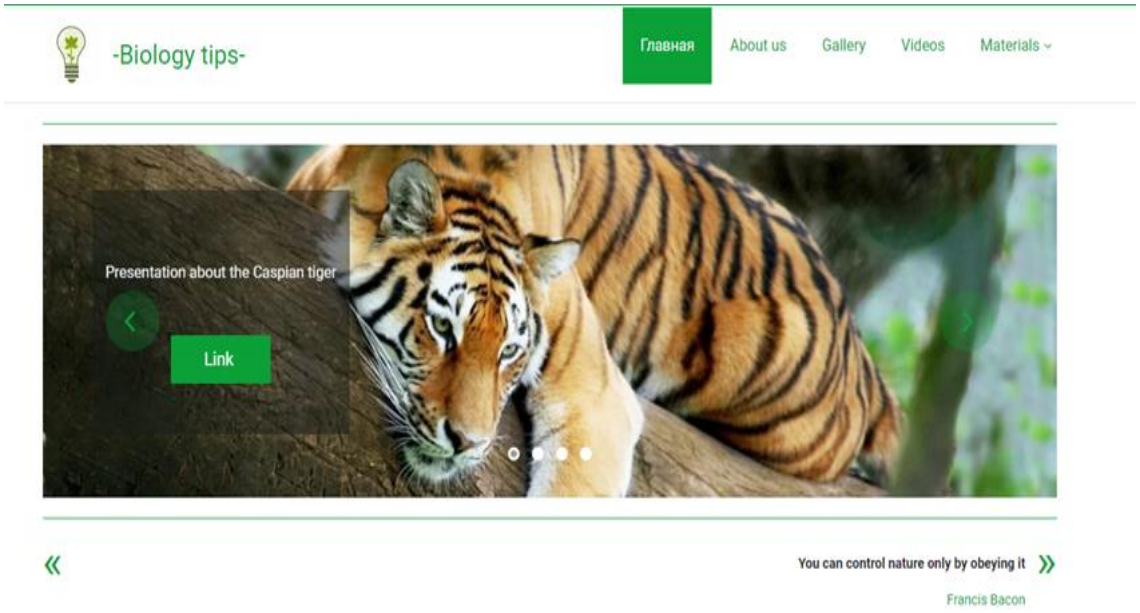

Fig. 1. Website "Biology tips"

At the moment, the site is actively used by students during a biology lesson. In addition, students independently create electronic 3D, 2D and hyphal models. The works of students are displayed on the site. In addition, the site is actively used by teachers during the lesson, as there are many interesting resources on the site. Thus, conducting classes using this site allows:

- to build an open education system, which each provides its own learning path;
- change the traditional organization of the learning process of students, forming their systemic thinking;

- correctly organize and implement the cognitive activity of students in the course of the educational process;

- use information and communication technologies in order to individualize the educational process and turn to new cognitive means and resources;

- to study some phenomena and processes in the micro and macroworld, using computer graphics and models;

- to represent various biological, physical, chemical processes that actually occur at a very high or low speed;

- to form the information culture of students, using different information technologies in biology lessons.

Conclusions. In general, the formation of an information culture means the free functioning of the process of searching, collecting, processing, storing and transmitting any information necessary for students in the education system through personal computers, hardware and computer networks.

With a high level of information culture formation, students show interests and needs for information, a voluminous information collection, an excellent outlook and fluency in information processing methods, the formation of high moral qualities, extensive knowledge of information sources, the ability to critically evaluate information and excellent knowledge of information and communication technologies.

In this regard, we would like to offer students the values that are formed during the study of biology:

- students develop flexibility in the ability to perform information processes, the ability to replenish their knowledge base with valuable information, etc.;

- formation of students' interest in meaningful information, effective use of innovative technologies and interactive teaching methods;

- students' mastery of information technologies of training, the ability to use electronic textbooks in their activities is formed.

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MEDICINE

FUNCTION AND SAFETY EVALUATION OF 3D TECHNOLOGY TO PREPARE BONE REPAIR BIOMATERIALS

Elcin Huseyn, *Research Laboratory of Intelligent Control and Decision-Making Systems in Industry and Economics, Azerbaijan State Oil and Industry University, Baku, Azerbaijan,*
ORCID ID: https://orcid.org/0000-0001-5965-7419
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Abstract. *PLGA/HA composite biomaterials are prepared, and 3D printing technology is used to make bone scaffolds that can be implanted in the body. Its performance is tested by in vitro physical and biological methods, and its safety is evaluated by animal experiments. Methods: 3D printing technology was used to print the PLGA/HA composite three-dimensional stent biomaterial, and the tensile strength and bending strength of the stent material were tested with reference to GB/T1040 and GB/T9341 to verify its ability to support the proliferation and differentiation of hMSC. The biological evaluation standard (GB/T16886) evaluates the biocompatibility and biosafety of scaffold materials in vitro and in vivo. Results: The porous 3D scaffold made of PLGA/HA composite material was successfully fabricated; the mechanical tensile strength and flexural strength of the composite material were 38 MPa and 42 MPa respectively, which were 5.35 times and 5.25 times that of normal human cartilage; in vitro cell test It is proved that the 3D scaffold can support the proliferation and differentiation of hMSC into chondrocytes. The results of the biosafety test show that the scaffold meets the national medical device biological evaluation standards.*
Keywords: *Biomanufacturing, biomaterials, differentiation, human bone marrow mesenchymal stem cells.*

1. Introduction. Bone tissue damage is a major problem facing human health. With the development of medical science, bone cement materials and artificial bone grafting technology have been widely used in clinical practice, but there are still some problems. For example, organic bone cement has poor biocompatibility and large heat generation during the forming process, which may aggravate the patient's condition; inorganic bone cement will have a slow forming and curing rate in the body and poor flexibility; artificial bone transplantation treatment is always There are problems such as source limitation and possible immune response. Tissue engineering is an important potential alternative treatment measure, which is expected to eventually solve this problem [1].

The purpose of tissue engineering scaffold materials is to provide a three-dimensional (three-dimension, 3D) scaffold for cells, which is conducive to cell adhesion, proliferation, and differentiation, and provides suitable environmental support for cell growth. The production of 3D scaffolds plays an especially important role in tissue engineering research, and it is the key to the industrialization of tissue engineering.

Traditional 3D scaffolding techniques include solvent casting-particle leaching method [2], gas foaming method [3], emulsification/freeze-drying method, phase separation method, etc. However, when considering the porosity and pore size of the material, the above the medical recycled materials produced by the method have certain limitations. The use of 3D printers to make stent materials is a hot spot in the international regenerative medicine research [4-5]. Zopf et al. [6] reported the use of a 3D printed tracheal splint for the treatment of tracheobronchomegalies. One year after the treatment, the infant patient grew the left main bronchus. Generally, MRI is used to obtain the three-dimensional data of the patient's bone injury site, the obtained three-dimensional data is converted into a three-dimensional printing model by software, compiled into a file format recognized by a 3D printer, and rapid prototyping technology is used to make bone tissue models and tissue scaffolds [7], After adapting the stent material made in vitro and transplanting it into the diseased part of the patient, it may greatly alleviate the patient's illness and even save some patients' lives. Tarafder et al. [8] used the tricalcium phosphate (tricalcium phosphate, TCP) scaffold made by 3D technology and transplanted it into a mouse femoral defect model for treatment and found that it can accelerate the formation of osteocytes in new bone tissue in the early stage.

This experiment describes a method of rapidly manufacturing polylactic acid-glycolic acid [9]/ hydroxyapatite [poly (lactide-co-glycolide)/hydroxyapatite, PLGA/HA] composite 3D scaffold using a 3D printer. The materials were tested for the corresponding mechanical properties, in vitro supported human bone marrow mesenchymal stem cells (human bone marrow derived mesenchymal StemCells, hMSC) proliferation and differentiation test and in vivo biological safety assessment.

2. Materials and methods

2.1. Material

2.1.1. Bracket material

PLGA (75:25), with a relative molecular mass of 100,000 was purchased from Istanbul Biotechnology Industrial Co., Ltd.; HA was purchased from Siemens Biotech Company; dioxane was purchased from Asminaros Industry Co., Ltd.

2.1.2. Equipment and consumables

The 3D printing equipment was Automation 3200, and the software used was NVVIEWER, provided by the Istanbul Fatih Technical School of Istanbul University; 3D printing containers and needles were purchased from Japan's Hitachi Company; cell incubators were purchased from American Thermoelectric Company; CKX41 inverted microscope system was purchased from Japan Olympus; BHC-1000IIA2 biological safety cabinet was purchased from Jiangsu Sujing Company; desktop centrifuge was purchased from Eppendorf; Quanta450 scanning electron microscope was manufactured by FEI Company of the United States; CS-600B automatic biochemical analyzer produced by Di Rui; Shenzhen Pu Kangchan PE-6800 semi-automatic blood cell analyzer.

2.1.3. Cells and reagents

hMSC cells (ATCCPCS-500-012) were purchased from the American Type Culture Collection (American Type Culture Collection, ATCC); cell basal medium (ATCCPCS-500-010M-A-PCS-500-10H0M-A-PCS-9500)) Purchased from Saiye (Guangzhou) Biotechnology Co., Ltd.; complete medium and cartilage formation complete medium are basal medium and cartilage formation basal medium containing final concentration of 10% fetal bovine serum; fetal bovine serum and pancreatin are purchased from Gibco Company; Recombinant human β1a interferon (recombinant human interferon-β1a, rhIFN-β1a) was prepared by our laboratory; Recombinant human nerve growth factor (recombinant humananervectin II lab anti-collagen, mouse anti-collagen) Collagen II) antibody was purchased from Abcam; Alcian Blue solution was purchased from Sigma Aldrich; nuclear fast red counterstaining kit was purchased from Shanghai Jiemei Company.

2.1.4. Experimental animals.

Healthy big-eared white rabbits, male or female, weighing 1.8 to 2.0 kg, provided by Istanbul Institute of Biological Products Co., Ltd.

2.2. Method

2.2.1. Preparation and pretreatment of scaffold materials.

PLGA is divided into 3 groups. Weigh 1.2g, 1.8g and 3.0g of PLGA respectively, add them to 5ml of dioxane, and dissolve them completely; each group has a fixed HA mass of 3g, add an appropriate volume of dioxane Infiltrate and stir to make it completely infiltrated; each group will mix and stir the dissolved PLGA and HA evenly.

2.2.2. 3D bracket printing and post-processing.

Print a 3D bracket of 4cm×4cm×2cm, the 3D printing equipment is Automation 3200; set the printing parameters of the 3D material bracket: the material between layers is stacked vertically and crosswise, and each layer is placed in parallel, with a gap between each strip 2mm, the step height of each step in the Z axis direction is 0.2mm, the movement speed items in the X axis and Y axis directions are 2mm/s, the aperture of the discharge port is controlled at 0.5～0.1mm, the discharge port The pressure is controlled at 30 to 60 psi. Put the pre-processed stent material into the raw material storage room of the printing equipment, run the program, and print out the designed three-dimensional stent according to the set program. During the printing process, the temperature of the stent platform is maintained at -20～-10℃, and cold air is continuously applied to separate the solid and liquid phases. After the stent is printed, it is vacuum freeze-dried.

2.2.3. Material mechanical performance testing.

The tensile strength and flexural strength of the three prepared materials were tested by Istanbul Material Surface Analysis and Testing Center. The testing instrument was a universal electronic testing machine, and the testing methods were GB/T1040 and GB/T9341.

2.2.4. Cutting and pretreatment of 3D stent.

The 3D material is laser cut into small pieces of 1cm×1cm×2cm. After being sterilized by γ-ray radiation, the sealed package is placed in a suitable aseptic container. The material is completely immersed in 75% ethanol, soaked overnight, and the ethanol is discarded. Wash with sterile saline for 3 times, place the material in a suitable sterile container, add 5ml of saline at 37°C for 24 hours, and use the extract and material for pyrogen experiment and subcutaneous implantation experiment in safety evaluation. Before the scaffold material is used in the cell differentiation experiment, the material needs to be soaked in the complete medium for 24 hours. After taking it out, the residual solution is blotted with sterile filter paper and then inoculated with hMSC.

2.2.5. Cultivation and inoculation of hMSC cells.

The hMSC cells were cultured in T175 gas-permeable cell flasks and cultured with complete medium. After the cells covered the bottom of the flask, 2ml of trypsin was added for 1 min, and 10ml of complete medium was added to terminate the trypsinization reaction, and the cell suspension was collected in a centrifuge tube After centrifugation, the cells were collected, the supernatant medium was discarded after centrifugation, and an appropriate amount of complete medium was added to resuspend the cells to a density of 2×106cel/ml. Place the aseptically treated 3D scaffold in a 6-well plate, drop the cells dropwise to the center of the material, add 0.5 ml of each material dropwise, let it stand for 1 hour, then add 3 ml of complete medium and place it at 37°C, Culture in a 5% CO2 incubator.

2.2.6. Electron microscopic detection of hMSC proliferation and osteogenic differentiation on the scaffold.

After the hMSC was inoculated on the scaffold material, the material was taken on the 7th day, and the material was washed with phosphate buffered saline (PBS), fixed with 3% glutaraldehyde, dehydrated by ethanol series, critical point drying, sprayed with gold, and observed by scanning electron microscope. Proliferation of adhesion on the stent. At the same time, the scaffold material without cells was observed under electron microscope.

2.2.7. Chondrogenic induction and differentiation of hMSC cells to be cells.

After culturing on the 3D material for 2 to 3 days, remove the complete medium. Complete medium was added to the negative group, and complete cartilage medium was added to the positive control group. In the positive group, the complete cartilage medium was replaced every 3 days, and differentiation was induced for 21 days. The negative group was replaced with complete medium every 3 days for a total of 21 days.

2.2.8. Glycosaminoglycans derived from osteogenic differentiation of hMSCs (glucosamine glycan GAG).

Assay: Remove the cartilage-forming complete medium from the positive group of the 6-well plate, wash the material twice with PBS, transfer the material to a new 24-well plate, add 0.2ml of trypsin to the surface of the material, and digest the cells for 2 minutes. Then add 1ml of complete medium to wash the cells in the material into a 24-well plate, and incubate in a 37°C, 5% CO2 incubator for 72 hours. On the third day, carefully remove the medium from the wells, add cleaning solution to wash, incubate in acidic solution for 3 minutes, treat with AlcianBlue staining solution for 30 minutes at room temperature, wash twice, and observe under an inverted microscope after nuclear fast red counterstaining. The negative control was also processed according to the above method.

2.2.9. Western blot detection of chondrocyte specific marker collagen II

Trypsin digests the cells on the material, add 1ml of complete medium to stop the trypsin reaction. After counting, each group is centrifuged to collect 1.0×105 cells, discard the supernatant, add 20μl of cell lysate, and centrifuge for 10min. Afterwards, take the supernatant, add 2× protein loading buffer, mix and heat, load the sample for denaturing polyacrylamide gel electrophoresis. After electrophoresis, the protein on the separation gel is transferred to the polyvinylidene fluoride membrane, the blocking solution is blocked, the anti-collagen II antibody is incubated, the enzyme-labeled secondary antibody is incubated, and the substrate color developing solution is added for color development.

2.2.10. Safety assessment of 3D scaffold materials in animals

The pyrogen and subcutaneous implantation of 3D stents are tested according to the current biological evaluation standards of medical devices and relevant standards such as the Pharmacopoeia of the People's Republic of China (2010 Edition). There are 3 animals in parallel for each experiment, and the average value of the experiment is taken.

2.2.11. Pyrogen experiment

Before the experiment, select 3 rabbits whose highest and lowest body temperature does not exceed 0.4 ℃. For the preparation method of the physiological saline extract of the test material, see 2.2.4. Slowly inject the extract that has been preheated to 38℃ through the ear vein at a dose of 10ml/kg to ensure that the injection is completed within 15min. After the injection, the body temperature was measured every 1 hour for a total of 3 times. The highest value of the rectal temperature minus the basal body temperature is the body temperature rise value.

2.2.12. Subcutaneous implantation test

For the treatment of the tested materials, see Method 2.2.4. Take 3 healthy New Zealand white rabbits, remove the coat on the test site on the back of the rabbits. After disinfection, prepare a subcutaneous sac at the skin incision site 2 cm away from both sides of the spine by blunt dissection. The bottom of the sac should be at least 1 cm away from the skin incision. The test material block was implanted under the skin, the skin was sutured, and kept for 12 weeks. During this period, observe and record the rabbit's general condition, activities, diet, drinking, weight gain, etc., before and 4 weeks after subcutaneous implantation., 8 weeks, 12 weeks, weighed, blood samples were collected from the ear veins, blood routine indexes and serum biochemical indexes were measured.

3. Experimental results

3.1. 3D material printing

The printer prints the 3D stent material according to the above procedure and can print out the 3D stent whose appearance and structure meet the expectations. After the later vacuum freeze-drying, the 3D stent material as shown in Figure 1 can be obtained.

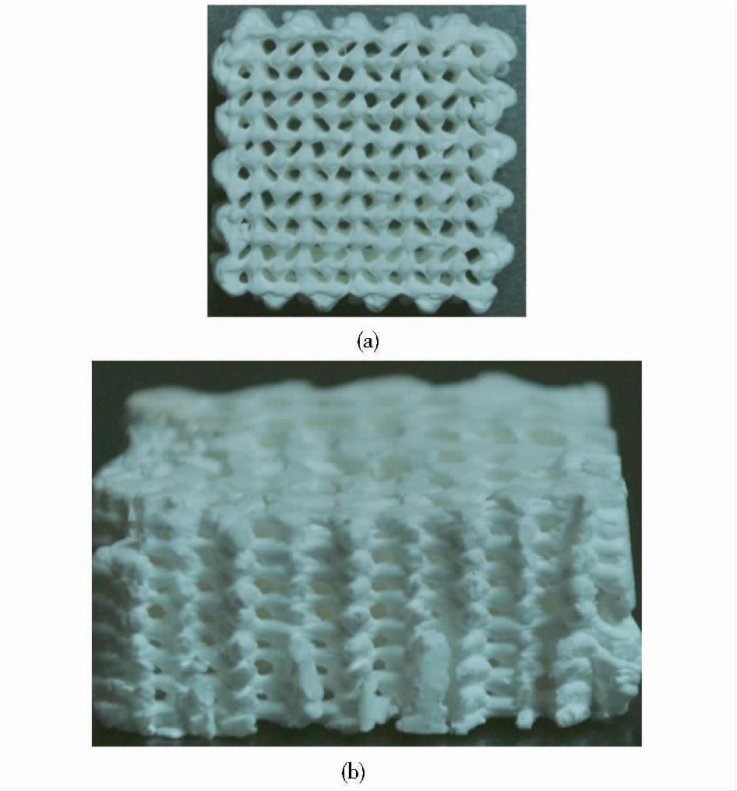

Fig. 1. Photo of 3D scaffold
Bird's eye view (a) and View of longitudinal section (b)

3.2. Testing of mechanical properties of PLGA/HA composite materials.

The measured values of the tensile strength and elastic strength of the PLGA/HA composite material mixed in different proportions are shown in Table 1. Among them, the material with PLGA: HA ratio of 3:5, its tensile strength and elastic strength are 5.35 times and 5.25 times of the average value of human cartilage. This group is selected for further testing.

Table1. The strength detection result of PLGA/PLA composite material.

PLGA: HA	2:5	3:5	5:5	Human cartilage [10]
Tensile performance (MPa)	24	38	45	3.7~10.5
Bending strength (MPa)	35	42	58	0.7~15.3

3.3. Electron microscope results of cell attachment and proliferation of scaffold materials.

After the material is processed, observe the growth of the cells under an electron microscope, as shown in Figure 2. Figure 2 (a) is an electron microscope image of the material without cells. The surface of the material has small holes and roughness; Figure 2 (b) is the hMSC inoculated on the material, the cells are attached, the surface of the material is smooth, the connections between the cells are smooth, and the cells in the stretched state can be seen, and the cell growth is in good condition.

3.4. Proteoglycan detection.

Results After proteoglycan staining, the cells in the negative group showed a long spindle shape, and no blue glycoprotein appeared around the cells, as shown in Figure 3 (a).

The positive group has obvious changes in cell morphology, and many proteoglycans appear around the cells, as shown in Figure 3 (b).

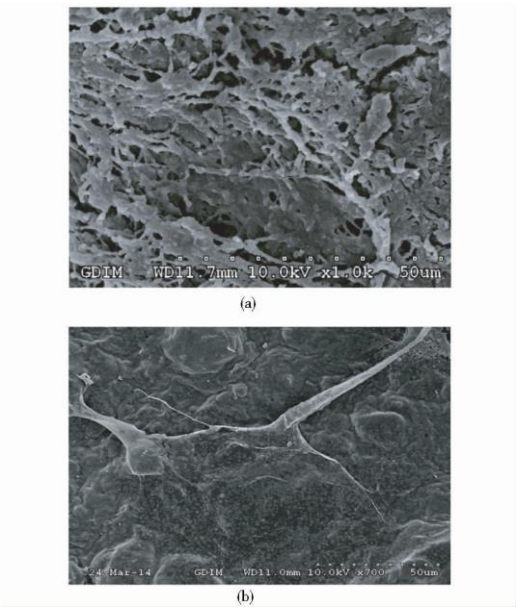

Fig. 2. SEM photo of blank biomaterial (a) and SEM photo of hMSC on biomaterial (b)

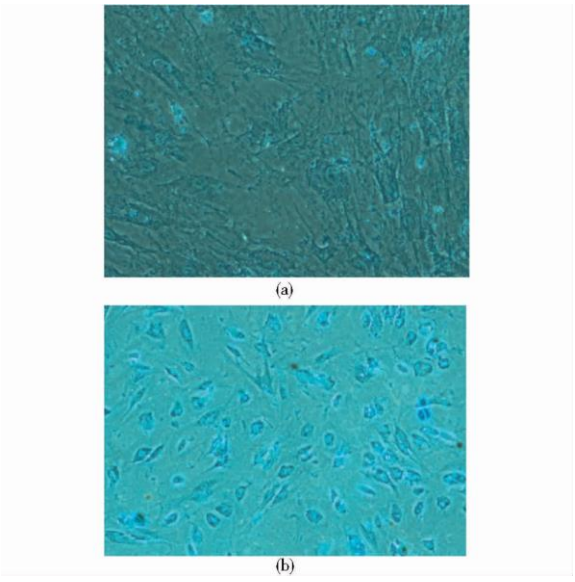

Fig. 3. GAG decision photo of MSC on biomaterial
Negative control (a) and Positive control (b)

3.5. Western blot detection results of Collagen II. The cells of the negative group and the positive group were detected by immunoblotting of type II collagen. The results showed that the immune bands of collagen II appeared in each group, the negative group was the lowest, and the expression level of collagen II in the positive group was higher than that in the negative group. The gray scale analysis value proved that the relative expression of the positive group was significantly different than that of the negative group (P<0.01). It shows that the scaffold material can promote the differentiation of hMSC into chondrocytes, as shown in Figure 4.

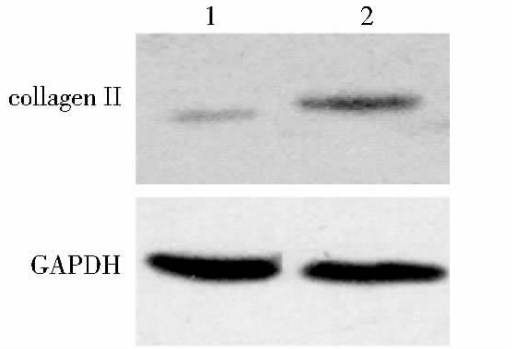

Fig. 4. Western blot result of collagen II of different experimental groups
Negative control (1) and Positive control (2)

3.6. Results of pyrogen experiment. In the 3 rabbits tested, the body temperature rise was lower than 0.6°C, and the total body temperature rise of the 3 rabbits was lower than 1.4°C. The pyrogen inspection of the test product PLGA/HA stent complied with national regulations. The test results are shown in Figure 5.

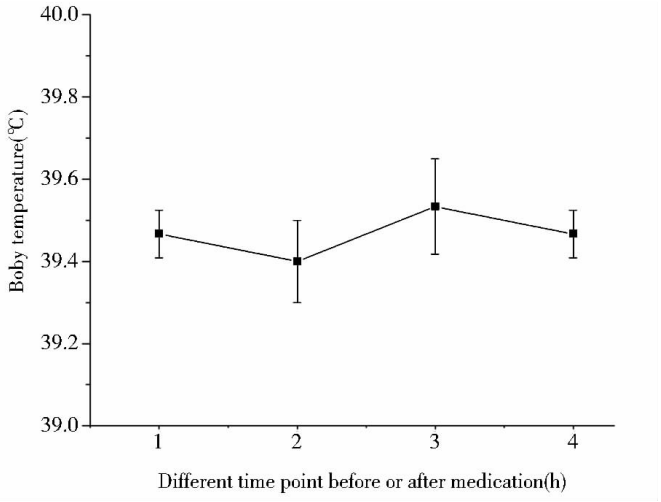

Fig. 5. Pyrogen test experiment samples based on animal method.
0.5h before medication (1), 1h after medication (2), 2h after medication (3) and 3h after medication (4)

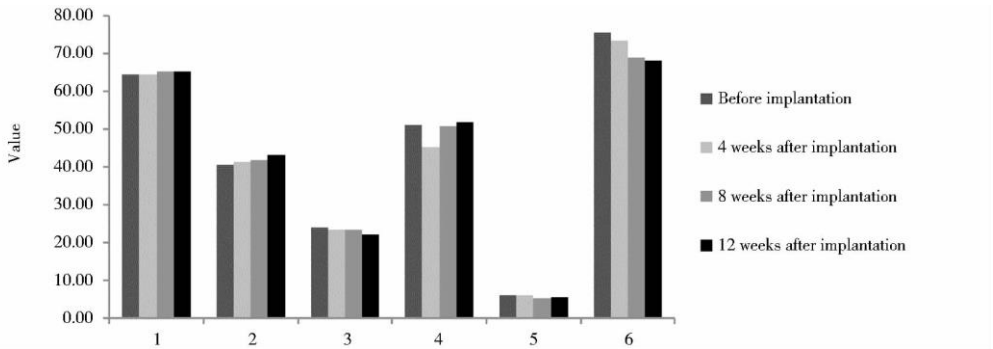

Fig. 6. Serum biochemical values of experimental animal
Serum total production (g/L) (1), Albumin (g/L) (2), Globulin (g/L) (3),
Alanine transaminase (U/L) (4), Urea nitrogen (mmol/L) (5) and Creatinine (μmol/L) (6).

3.7. Test results of subcutaneous implantation test

For the treatment of the scaffold material of the test product, refer to Method 2.2.4. During 12 weeks after the test material was implanted subcutaneously in the rabbit, there was no abnormality in its general condition, activity, diet, drinking, weight gain, etc.; its serum biochemical indicators and transplantation There was no obvious abnormality in the comparison before entry, the test result is shown in Figure 6; the blood routine index has no obvious abnormality compared with that before the implantation, and the test value is shown in Figure 7. After 12 weeks of implantation, the implanted test material block has been degraded and absorbed There is no purulent or secretion in the surrounding tissues of the implantation site. The pathological examination results of the surrounding tissues of the material show that they are all normal tissues (results not shown). It shows that the animal subcutaneous implantation test of the scaffold material of the test product meets the requirements.

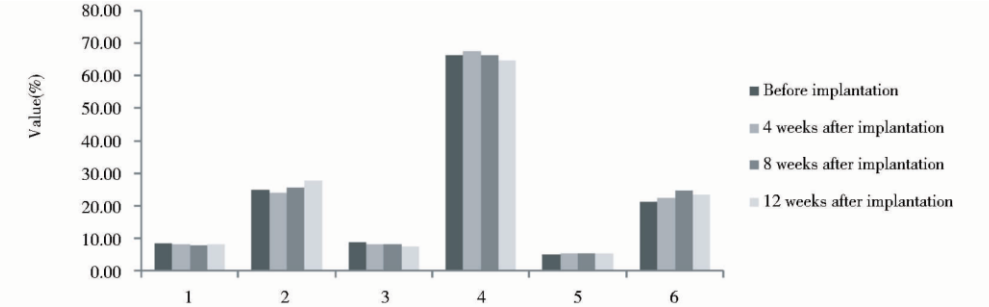

Fig. 7. Blood test result of experiment animal
Leukocyte (10x9/L) (1), Lymphocyte (%) (2), Neutrophil (%) (3),
Granulocyte (%) (4), Ericsson (10x12/L) (5) and Platelet (10x9/L) (6)

4. Discussions. PLGA is a biodegradable material approved by FDA for use in the body. It can be gradually degraded over time without affecting the growth of fresh bone tissue. The grid-like topology facilitates the formation of blood vessels and the exchange of body fluids. The degradation products are brought into the body fluid circulation to facilitate the growth and differentiation of cells and the formation of new bone tissue. Attawia et al. [11] used a three-dimensional PLGA/HA (50:50) composite scaffold prepared by a particle leaching method. After being planted with bone cells, the bone cells can adsorb and proliferate perfectly. In this experiment, PLGA (75:25) was selected, with a relative molecular mass of 100,000, which ensures that the material made has a degradation cycle of 2 to 3 months in the body [10] and does not affect the production of fresh bone tissue. According to the different application functions of the stent material, the appropriate proportion of PLGA is selected to achieve the corresponding application effect [12].

The 3D printing technology mainly compiles three-dimensional material parameters through software and realizes the printing of materials through precise control of the printer, while the solidification and molding of materials rely on different molding mechanisms. In the literature of bone repair materials, polymer liquid solidification technology or fused deposition technology is often used in combination with a 3D printer to form 3D printing of bone repair materials. This experiment uses a traditional phase separation molding technology combined with a 3D printer. The specific process is to dissolve and mix inorganic materials and organic materials in a volatile organic solvent to form a liquid with a certain viscosity, spray it through a pressure-controlled nozzle to a work surface with a surface temperature of about -15°C, and give the work surface a certain amount. With strong cold air, the organic materials and electrodeless materials in the sprayed liquid will quickly solidify, the solvent will evaporate, the solid phase and the liquid phase will separate, and finally a preset 3D scaffold will be formed [13]. After the molded 3D material is freeze-dried to remove residual organic solvents, it will eventually become the required scaffold material that can be used for experiments.

The mechanical strength of the scaffold material was tested. The measured values of tensile strength and bending strength of the mixed material were 38 MPa and 42 MPa, which were 5.35 times and 5.25 times the strength of human cartilage [10], both of which were greater than the strength of human cartilage. Higher strength may meet the needs of clinical trials. On the one hand, the strength of the skeleton will decrease with the degradation of the components, and the addition of inorganic HA may promote the reduction of the strength of the stent. Therefore, in order to ensure that the PLGA/HA scaffold material maintains a specific three-dimensional structure during cell culture and in vivo experiments, and to ensure that the decrease in its autogenous strength can be compensated by the strength of new bone

deposition, its mechanical properties before degradation are higher than the corresponding human bone mechanics Performance is a necessary condition for the degradation of bone materials. Giordano et al. [14] used a 3D printer to prepare a PLA (relative molecular weight of 230,000) three-dimensional scaffold material, and its bending strength was 93 MPa and 206 MPa respectively after 48 hours of preparation and one week after freeze-drying, but its tensile strength was only respectively 10MPa and 11MPa. The flexural strength of the organic material scaffold prepared by Giordano et al. is much greater than the tensile strength, which is determined by the characteristics of the material itself. The mixed materials selected in this experiment make the prepared materials have the flexibility of organic materials and the flexibility of inorganic materials. Hardness, the clinical application effect will be more effective.

In this experiment, the inducing substance used in the chondrogenic differentiation control group was the classic TGF β3 [15]. In addition, other cytokines or proteins have been tried to induce chondrogenesis [16], such as rhNGF, thymosin, and rhIFN β. Through experiments, it is found that TGF-β3 combined with certain cytokines can better promote the chondrogenic differentiation effect of hMSC. Subsequent experiments will further study the mechanism of the combined use of cytokines to induce differentiation.

According to the current biological evaluation standards for medical devices promulgated by the State Food and Drug Administration and relevant standards such as the pharmacopoeia, this experiment has tested the contents of pyrogen, hemolysis, systemic acute toxicity, intradermal irritation, subcutaneous implantation, etc. (only part of the experiment). Display) for testing (GB/T16886, Biological Evaluation of Medical Devices). The results of animal experiments showed that the pyrogen test, hemolysis test, systemic acute toxicity test, intradermal irritation test, subcutaneous implantation test and other contents of the tested stent material all meet the biological evaluation standards of medical devices. It shows that the method of making 3D scaffold materials in this experiment is feasible. Later experiments will conduct pharmacodynamic tests of scaffold materials in animals to further verify the function of 3D scaffold materials prepared by this method.

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ЭТИОЛОГИЯ И ОСОБЕННОСТИ ТЕЧЕНИЯ ХБП У ДЕТЕЙ ПРИ ПАТОЛОГИИ МОЧЕВЫДЕЛИТЕЛЬНОЙ СИСТЕМЫ

Никитенко О. П., *Кандидат медицинских наук, ассистент кафедры педиатрии №2, Одесский национальный медицинский университет, г. Одесса, Украина,*
ORCID ID: https://orcid.org/0000-0002-1608-2536
Стоева Т. В., *Доктор медицинских наук, профессор, заведущий кафедры педиатрии №2, Одесский национальный медицинский университет, г. Одесса, Украина,*
ORCID ID: https://orcid.org/0000-0003-0372-1498
Федин М. В., *Кандидат медицинских наук, ассистент кафедры педиатрии №2, Одесский национальный медицинский университет, г. Одесса, Украина,*
ORCID ID: https://orcid.org/0000-0002-1219-8398
Гоженко А. И., *Доктор медицинских наук, профессор, директор НИИ медицины транспорта МЗ Украины, г. Одесса, Украина, ORCID ID: https://orcid.org/0000-0001-7413-4173*
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7434

Abstract. *This article presents data on the development of (chronic kidney disease) CKD in children. In particular, with the pathology of the urinary system in children of different age groups. We analyzed the main clinical characteristics and laboratory parameters in children with pathology of the urinary system. The main parameters of the functional state of the kidneys were considered, the glomerular filtration rate (GFR) was calculated using the CKD EPI formula. The chronic pathology of the urinary system in children was also analyzed. The course of CKD in children with various clinical nosological forms of kidney pathology was studied.*
Keywords: *chronic kidney disease, urinary system, children, glomerular filtration rate, UTI.*

Введение. В настоящее время заболеваемость органов мочевыделительной системы (МВС) у детей остается актуальной. В мире ежегодно увеличивается нефрологическая патология у детей. Согласно данным многих популяционных исследований отмечается значительное увеличение числа пациентов с заболеваниями органов МВС. Особенно высокие темпы роста обнаруживают врожденные пороки развития почек и дисметаболические нефропатии, что приводит к изменению структуры патологии. К примеру, только в России показатель общей распространенности заболеваний органов МВС у детей за последние два десятилетия увеличился на 74,5% ($p<0,0001$) [1,2].

Общеизвестно, что в педиатрии термин «хроническая болезнь почек» (ХБП) впервые применил R.J. Hogg в 2003 г. идентично используемому термину в терапевтической практике у взрослых пациентов и в настоящее время определение и классификация ХБП по стадиям у детей не отличаются от таковых у взрослых, и широко используется в детской клинике и при проведении научных исследований [3,4]. Однако течение ХБП у детей имеет свои отличительные особенности, которые проявляются воздействием на рост ребенка, на нейрогуморальную и вегетативную систему, психологическое воздействие на семью в целом и наличием осложнений со стороны сердечно-сосудистой системы [4,5].

Исходя из данных национальных регистров, за последнее десятилетие нарушение фильтрационной способности почек на 1 млн. детского населения диагностируется в 18,5 – 58,3 случаях, а средняя заболеваемость терминальной хронической почечной недостаточностью (ХПН) у детей до 16 лет составляет 1 – 3 новых случая в год на 1 млн. общего населения. В Европе распространенность терминальной ХПН у детей составляет 4-6 случаев на 1 млн. детского населения в год, в США – 11 случаев и в России – 4-5 случаев на 1 млн. детского населения в год [6-8].

По данным регистра European Renal Association – European Dialysis and Transplant Association (ERA-EDTA), установлено, что ежегодная заболеваемость терминальной ХПН в Европе составляла 7,1 на 1 млн. детей в 1980–1984 гг. и 9,9 – в последующие 15 лет [9].

Развитие терминальной ХПН также зависит и от возраста ребенка: среди детей 15–18 лет ее распространенность вдвое выше, чем в возрастной группе 10–14 лет, и почти в 3 раза выше, чем среди детей с рождения до 5 лет. Согласно данным Японского национального

реестра и реестра Австралии и Новой Зеландии по диализу и трансплантации (ANZDATA), ежегодная заболеваемость терминальной ХПН равна 22 на 1 млн. детского населения, у детей коренного населения риск его возникновения значительно выше, чем у остального детского населения [10,11].

Особенностью ХБП у детей является также то, что даже на ранних ее стадиях при отсутствии лечения с высокой вероятностью приводит к терминальной ХПН. Что, в свою очередь, должно учитываться при составлении диагностических и терапевтических подходов к ХБП с направленностью на раннее обнаружение, предупреждение и активное лечение всех нефропатий с целью предотвращения развития терминальной ХПН [4].

Таким образом, **целью** нашего исследования было охарактеризовать клинико-лабораторную характеристику и проанализировать хроническую патологию мочевыделительной системы у детей.

Методы исследования.

В исследовании приняли участие 288 пациентов, находившихся на стационарном лечении в Городской детской больнице им. академика Б.Я. Резника г. Одессы. Проводилось ретроспективное исследование историй болезни стационарных пациентов детей нефрологического отделения в возрасте от 1 года до 18 лет, за период обращения за медицинской помощью с 1 декабря 2016 года по 1 августа 2018 гг.

При анализе клинического материала учитывали анамнез заболевания, клинический диагноз, осложнения, сопутствующие заболевания, данные общего и биохимического анализ крови, общий анализ мочи, проба Зимницкого, Нечипоренко, бактериологическое исследование мочи, Rg-урологическое исследование.

Все пациенты получали лечение согласно Международным Европейским рекомендациям.

Статистический анализ выполняли с помощью программы Statistica (StatSoft, Inc. (2001) STATISTICA (data analysis software system), version6. Www.statsoft.com). Достоверность качественных показателей определялась по $\chi 2$-критерию Пирсона.

Критерии включения в исследование: врожденные аномалии почек и мочевыводящих путей; острые и хронические заболевания почек; инфекции мочевыводящих путей; возраст моложе 18 лет.

При классифицировании ХБП по стадиям были использованы Clinical Practice Guidelines of the National Kidney Foundation’s Kidney Disease Outcomes Quality Initiative (KDOQI guidelines) [12].

Результаты исследования.

Общая характеристика изучаемой группы пациентов была следующей: средний возраст обследованных детей составил 8,62±0,7 года. Мальчиков было 69 человек (24,0 %), девочек – 219 (76,0 %) детей, соотношение составило 1:3,17 (табл.1). Средние показатели роста и веса детей при рождении составили 51,86±0,38 см. и, соответственно, 3305,25±83,63 кг, в среднем гистационном сроке 39,27±0,26 недель.

По клиническим нозоформам у детей отмечали следующие: инфекция мочевыводящих путей (ИМВП) (142 человека – 49,31 %), хронический пиелонефрит (45 чел. – 15,63%), хронический цистит (37 – 12,85%), острый цистит (10 – 3,47%), острый пиелонефрит (28 – 9,72%), пузырно-мочеточниковый рефлюкс (ПМР) (18 – 6,23%), острый гломерулонефрит (4 – 1,39%), хронический гломерулонефрит (2 – 0,69%), нейрогенный мочевой пузырь (12 – 4,17), нефропатия с изолированным мочевым синдромом (1 – 0,35%), дисметаболическая нефропатия (18 – 6,23%), мочекаменная болезнь (МКБ) (7 – 2,43%), кристаллурия (гиперурикозурия) (5 – 1,74%), интерстициальный нефрит (0,35%). ВАРМС: агенезия левой почки (0,35%), ротация правой почки (0,35%), поликистоз почек (4 – 1,39%), подковообразная почка, неполное удвоение правой половины почки (0,35%), неполное удвоение ЧЛС слева (0,35%), удвоение левой почки и мочеточника (2 – 0,69%), экстрофия мочевого пузыря (0,35%), дивертикулы мочевого пузыря (0,35%), левосторонний уретерогидронефроз (3 – 1,04%), правосторонний уретерогидронефроз (2 – 0,69%), двусторонний уретерогидронефроз (0,35%), пиелоэктазия справа (3 – 1,04%), пиелоэктазия слева (0,35%), пиелоэктазия обеих почек (0,35%), повышенная подвижность правой почки (0,35%), аплазия левой почки (0,35%), гипотония лоханок обеих почек (2 – 0,69%), спинальный мочевой пузырь (4 – 1,39%) подвздошная дистопия правой почки (0,35%), гипоплазия правой почки (0,35%),

единственная почка (0,35%). Соответственно, по стадиям ХБП пациенты распределялись следующим образом: ХБП 1 ст. – 19 (6,6%), ХБП 2 ст. – 136 (47,22%), ХБП 3 ст. – 68 (23,61%), ХБП 4 ст (3 – 1,04%), ХПН 5 ст. (1,04%).

Состояние пациентов при поступлении в отделение стационара было следующее: удовлетворительное – 55 человек (19,1%), средней степени тяжести – 212 (73,61%), тяжелое – 21 пациент (7,29%). Дизурические явления отмечались у 78 детей (27,08%) и боли в пояснице – у 83 человек (28,82%). Симптом Пастернацкого справа положительным был у 76 пациентов (26,39%) и слева – у 79 (27,43%).

Таблица 1. Распределение детей по возрасту и полу

Возраст	**Мальчики**			**Девочки**		
	Количество детей	% в группе мальчиков	% от общего количества детей	Количество детей	% в группе девочек	% от общего количества детей
Ранний возраст (с 1 года до 3 лет)	10	14,49	3,47	38	17,35	13,19
Дошкольный возраст (с 3 до 7 лет)	10	14,49	3,47	67	30,59	23,27
Младший школьный возраст (с 7 до 11 лет)	15	21,74	5,21	39	17,81	13,54
Средний школьный возраст (с 11 до 15 лет)	21	30,43	7,3	33	15,07	11,46
Старший школьный возраст (с 15 до 18 лет)	13	18,85	4,51	42	19,18	14,58

Для характеристики функционального состояния почек рассчитали скорость клубочковой фильтрации (СКФ) по формуле CKD EPI. Средние показатели СКФ составили 67,142±3,053 мл/(мин×1,73 м^2). При этом распределение пациентов по уровню СКФ было следующее: от 6 до 20 мл/(мин×1,73 м^2) было 3 пациента, что составило 1,04%, от 20 до 50 мл/(мин×1,73 м^2) – 52 ребенка (18,06%), от 50 до 60 мл/(мин×1,73 м^2) было 46 человек (15,97%), от 60 до 90 мл/(мин×1,73 м^2) – 161 человек (55,9%), от 90 до 125 мл/(мин×1,73 м^2) – 24 больных (8,33%) и выше 125 мл/(мин×1,73 м^2) – 2 (0,69%).

Таблица 2. Показатели общего анали за крови у детей

Показатель	**M±m**
Эритроциты, 1×10^{12}/л	4,05±0,06
Гемоглобин, г/л	124,99±2,58
ЦП	0,93±0,01
Лейкоциты, 1×10^9/л	6,57±3,21
Тромбоциты, 1×10^9/л	7,21±0,51
СОЭ, мм/ч	14,94±1,63

Примечание: p≥0,01.

Также мы проанализировали изменения общего анализа крови (табл.2) у детей и некоторых биохимических показателей крови (табл. 3).

Таблица 3. Показатели биохимического анализа крови у детей

Показатель	*M ± m*
Билирубин общий, мкмоль/л	13,97±1,28
Мочевина, ммоль/л	4,23±0,31
Креатинин, мкмоль/л	81,93±3,15
Тимоловая проба	1,96±0,08
АлАТ, ммоль/ч×л	0,72±0,33
АсАТ, ммоль/ч×л	0,92±0,49
Глюкоза, ммоль/л	4,10±0,10
Альбумин, Г/л	60,42±1,04
Общий белок, Г/л	69,85±1,55
Мочевая кислота, ммоль/л	356,14±18,33
Холестерин, ммоль/л	3,64±0,10
Натрий, ммоль/л	143,00 ± 0,41
Калий, ммоль/л	4,31±0,22

Примечание: p≥0,01.

Согласно данным уровня гемоглобина крови анемия была определена у 44 пациентов (15,28%), по степени тяжести отмечали легкую – 41 ребенок, что составило 14,24% от общего количества пациентов, и средней степени тяжести – 3 детей (1,04%). Число пациентов с анемией в разных возрастных группах было неравномерным, соотношение мальчики и девочки составило 1:3,4 (табл. 4). Коэффициент корреляции Пирсона между уровнем гемоглобина и возрастом детей составил 0,39.

Таблица 4. Распределение детей по степени тяжести анемии согласно возрасту.

Возраст	**Легкая степень тяжести, Нв 110-90 г/л**		**Средняя степень тяжести, Нв 90-70 г/л**	
	Мальчики, чел. (% от общего количества детей; % в группе детей с анемией)	Девочки, чел. (% от общего количества детей; % в группе детей с анемией)	Мальчики, чел. (% от общего количества детей; % в группе детей с анемией)	Девочки, чел. (% от общего количества детей; % в группе детей с анемией)
Ранний возраст (с 1 года до 3 лет)	5 (1,74; 11,36)	12 (4,17; 27,27)	1 (0,35; 2,27)	1 (0,35; 2,27)
Дошкольный возраст (с 3 до 7 лет)	0	16 (5,55; 36,36)	1 (0,35; 2,27)	0
Младший школьный возраст (с 7 до 11 лет)	3 (1,04; 6,82)	2 (0,69; 4,55)	0	0
Средний школьный возраст (с 11 до 15 лет)	0	1 (0,35; 2,27)	0	0
Старший школьный возраст (с 15 до 18 лет)	0	2 (0,69; 4,55)	0	0

Обострение инфекции верхних мочевых путей сопровождались гипертермией свыше 37,5°С (40,97%), ухудшением общего состояния (84,72%), болью в поясничной области (28,82%) и мочевым синдромом (100%). Рецидивы инфекции нижних мочевых путей характеризовались наличием дизурических явлений (27,08%) и изменений мочевого осадка (100%).

В период обострения у обследованных детей определялась значимая лейкоцитурия (79,86%), микропротеинурия (40,28%), микрогематурия (25,0%). В тоже время у 23,26% пациентов, независимо от периода заболевания, количество лейкоцитов при микроскопии мочи

не превышало 10/мм^3. Коэффициент корреляции Пирсона (***r***) в анализе мочи по Нечипоренко между уровнем лейкоцитов и эритроцитов составил 0,34 ($\chi 2$ =0,12). При анализе пробы мочи по Зимницкому ***r***-Пирсона между ночным и дневным диурезом составил 0,56 ($\chi 2$=0,31), между дневным и общим диурезом – 0,89 ($\chi 2$=0,8) и ночным и общим диурезом 0,88 ($\chi 2$=0,78).

По данным ретроспективного анализа было установлено, что все дети в анамнезе получали противорецидивную терапию ИМВП: антибиотикотерапия (86,81%), уросептики (93,75%), фитотерапия (68,75%). При этом средняя частота рецидивов ИМВП составила (3,45±0,51) эпизодов в год.

При микробиологическом исследовании мочи в структуре уропатогенов наиболее часто определяли E.coli – в 65,97% случаев. Значительно реже выделяли представителей родов Proteus (6,25%), Enterobacter (6,25%). В спектре граммотрицательных бактерий также была выделена Pseudomonas aeruginosa (5,00%). Среди грамположительных микроорганизмов наиболее часто выявляли Enterococcus (12,15%), Staphylococcus (5,00%).

При определении микробного числа в пробах мочи установлена степень бактериурии ≥ 10^5 КОЕ – у 65,97%, 10^3 – 10^4 – у 30,20% и < 10^3 – у 5,00%) детей.

Выводы. Наиболее частыми клиническими нозоформами с хроническим течением у детей отмечались ИМВП (49,31%), хронический пиелонефрит (15,63%) и хронический цистит (12,85%). Соотношение мальчиков и девочек составило 1:3,17. Также в группе мальчиков чаще отмечался средний школьный возраст (30,43%), а в группе девочек – дошкольный возраст (30,59%). Обострение ИМВП сопровождались гипертермией свыше 37,5°С (40,97%), изменением общего состояния (84,72%), болью в поясничной области (28,82%) и мочевым синдромом (100%). Рецидивы характеризовались наличием дизурических явлений (27,08%) и изменением мочевого осадка (100%). Средняя частота рецидивов ИМВП составила (3,45±0,51) эпизодов в год.

Таким образом, анализируя полученные нами данные мы можем прийти к выводу, что течение ХБП у детей при разных клинических нозоформах патологии почек сопровождаются в 100% случаев мочевым синдромом, при чем, в период обострения ИМВП у обследованных детей определялась значимая лейкоцитурия (79,86%) и микропротеинурия (40,28%), у 23,26% детей, независимо от периода заболевания, количество лейкоцитов при микроскопии мочи не превышало 10/мм^3, что подтверждает факт недостаточной реактивности локального иммунного ответа у детей.

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CHEMISTRY

ПОЛЗУЧЕСТЬ ПА Ф-2 В СПИРТАХ

Порчхидзе А. Д.,
ассоциированный проф. академический доктор, Государственный университет Акакия Церетели, г. Кутаиси, Грузия
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7435

Abstract. *Is learnt PAF-2 creeping in spirts.*
Is shown that Metanol's diffusion carries as fast as in water, creeping curve in spirits is not different from creeping curve in water.
Experiments that took place into spirits solutions and received curves show that if we rise spirits concentration it rises polymer's creeping size and mostly is received S alike curve.
Keywords: *polymer, creeping, spirits, curves, concentration, experiments, diffusion.*

Введение. В качестве объекта исследования нами был выбран ПА Ф-2, для которого были подробно изучены сорбция и диффузия различных спиртов. Как известно ползучесть полимеров в жидких средах зависит в общем случае от природы среды, температуры и напряжения, приложенного к полимеру.

Рассмотрение результатов. На рис.1. приведены кривые ползучести ПА Ф-2 в метаноле, этаноле, Н-пропаноле и Н-бутаноле, при 40 °С и напряжении 20 МПа. Предельные значения высокоэластической деформации различные для этих спиртов, что может быть связано с их способностью сорбироваться ПА Ф-2.

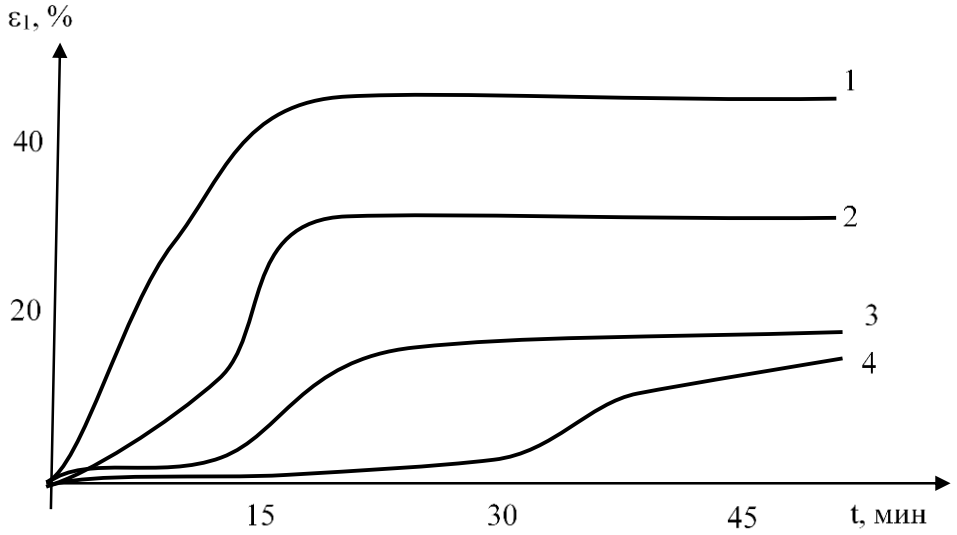

Рис. 1. а) Кривые ползучести пленок ПА Ф-2 в спиртах при t=40 ℃, σ=20 МПа, 1) – метанол; 2) – этанол; 3) – н-пропанол; 4) – н-бутанол.

Имеется два типа кривых ползучести. Для метанола, диффузия которого протекает с такой же скоростью, как воды, кривая ползучести в спирте не отличается по виду от кривой ползучести в воде и описывается экспоненциальным уравнением с одним временем запаздывания [1-3].

Для этанола, Н-пропанола и н-бутанола имеют место S-образные кривы ползучести, на которых можно выделить два характерных участка участок слабого роста ползучести и значительного возрастания с постеленным запределиванием по экспоненциальному закону.

Таблица 1. Значения времен запаздывания (θ) ползучести ПА Ф-2 в спиртах при различных темпера турах и напряжениях.

Спирты	Т, °С	σ, МПа,	θ, мин
Метанол	20	20	2,4±0,3
	40	20	2,7±0,3
Этанол	20	20	1,7±0,4
	20	30	1,6±0,2
	20	40	2,0±0,3
	40	20	2,1±0,4
	60	20	1,9±0,3
Н-пропанол	40	20	2,3±0,3
	60	20	1,7±0,4

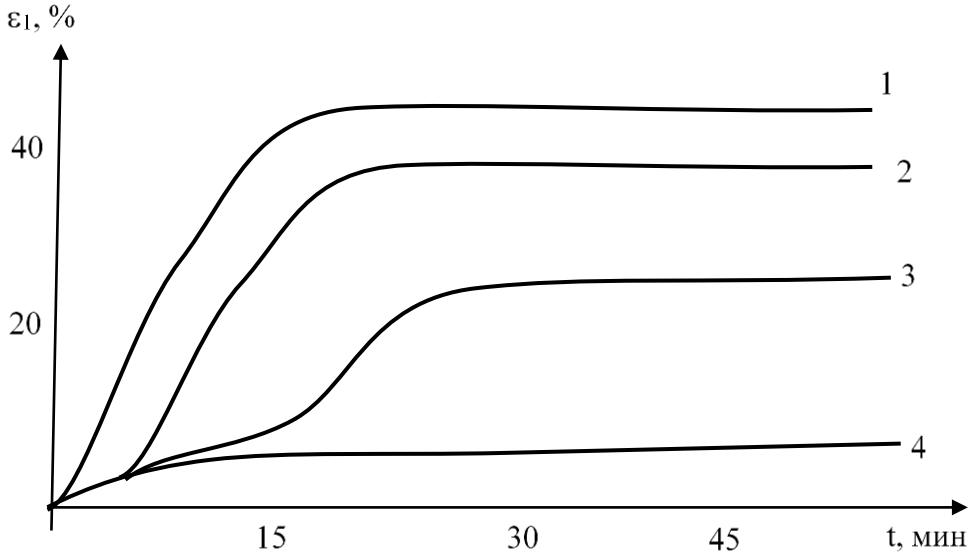

Рис. 2. Кривые ползучести пленок ПА Ф-2 в водно-спиртовых растворах при 20 ℃, σ=20 МПа: 1) - 60% C_2H_5OH; 2) - 50% C_2H_5OH; 3) –33% C_2H_5OH; 4) – 16% C_2H_5OH.

Выводы. Очевидно, что если к какому-либо спирту, где имеется S-образная ползучесть добавлять воду, то S-образность кривой будет уменьшаться.

На рис.2. приведены кривые ползучести ПА Ф-2 в водно-спиртовых смесях. Как и следовало ожидать с увеличением концентрации спирта резко возрастает величина ползучести полимера и в большей степени вырисовывается S-образный характер кривой.

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GEOLOGY

ОСОБЕННОСТИ ХРУСТАЛЕНОСНОСТИ УЛЫТАУСКОГО РАЙОНА

Aralbekova M. A., *candidate of technical sciences, associate professor of the Department of physical and economic geography L. N. Gumileva Nur-Sultan, Kazakhstan,*
ORCID ID: https://orcid.org/0000-0002-2240-9443,
Kunbassova D. M., *master of geography, senior lecturer of the Department of physical and economic geography L. N. Gumileva Nur-Sultan, Kazakhstan,*
ORCID ID: https://orcid.org/0000-0003-1610-3445
DOI: https://doi.org/10.31435/rsglobal_conf/28022021/7436

Abstract. *The Ulytau crystal-bearing region is located in the western part of the Kazakh folded country, distinguished by a significant complexity of the geological structure. The latter is due to the heterogeneity and varying degrees of dislocation of its constituent rocks.*
In connection with the manifestation of two stages of tectogenesis, two structural stages are distinguished in the folded base of the Ulytau zone.
The purpose of this article is to study the features of the crystal content of the region.
On the territory of the Ulytau district, 140 vein fields were identified, numbering up to 6,000 quartz veins, of which 1,700 with signs of crystallinity. Of the total number of crystal-bearing veins, 1100 were explored, located within 75 vein fields. Quartz veins, including crystal-bearing ones, are found in almost all rocks, including deposits of the Middle Carboniferous, which determine the upper age limit of the veins in the region.
Productive (industrially - crystal-bearing) mineralization is manifested in the contours of the region more locally. Of the 110 identified fields and areas, industrial mineralization is associated with vein formations only 18 objects.
Keywords*: quartz, crystal-bearing region, crystallinity, quartz-vein mineralization, productive objects.*

Введение. Улытауский хрусталеносный район приурочен к Улытауской зоне поднятий Центрального Казахстана.

Хрусталеносная минерализация района выявлена в 1949 году и ее освоение продолжалось до конца 80-х годов. Улытауский хрусталеносный район, ограниченный координатами 47º00′ - 50º00′ с.ш. и 65º30′ - 67º30′ в.д., имеет площадь около 50 000 км².

Административно он входит в состав Улытауского районов Карагандинской области, протягиваясь в меридиональном направлении более чем на 300 км.

Улытауский хрусталеносный район расположен в западной части Казахской складчатой страны, отличаясь значительной сложностью геологического строения. Последнее обусловлено разнородностью и различной степенью дислоцированности слагающих его пород.

В разрезе территории выделяются докембрийские и палеозойские комплексы, а также рыхлые кайнозойские отложения.

Докембрийские образования в низах разреза представлены двуслюдяными, слюдяно-гранатовыми сланцами, реже – мраморами архейско-нижнепротерозойского комплекса. Выше по разрезу они сменяются кварцитами, кварц-амфиболовыми и полевошпат-амфиболовыми сланцами среднего протерозоя. Верхи докембрия (серицит-кварцевые, кварц-хлорит-серицитовые сланцы) относятся к верхнему протерозою.

Палеозойская группа в основании сложена метаморфизованными конгломератами, песчаниками, железисто-кремнистыми и углисто-кремнистыми сланцами кембрийского возраста. Ордовикские отложения представлены флишоидными образованиями. Девонская толща сложена в основном пестроцветными и красноцветными песчаниками, алевролитами, конгломератами жаксыконской серии (D_2 - D_3fr). Палеозойский разрез замыкается известково-песчанистыми и кремнистыми отложениями верхнего девона (D_3fm) и карбона (C_{1-2}).

Кайнозой представлен рыхлыми платформенными образованиями (глины, пески, галечники) палеогена, неогена и антропогена.

Интрузивные образования в районе относятся к пяти автономным комплексам. Это верхнепротерозойский комплекс гранито-гнейсов и граносиенитов, раннепалеозойский гранодиоритовый комплекс и среднедевонский комплекс лейкократовых гранитов. Ордовикский комплекс включает интрузивы основных и ультраосновных пород Улытауских змеевиковых поясов. Верхнепалеозойский комплекс представлен кварц-полевошпатовыми жилами и дайками диоритовых порфиритов, а также соответствующими последним вулканогенными образованиями (редки).

В структурно-тектоническом плане Улытауская зона поднятий приурочена к крайней западной части Центрально-Казахстанской зоны консолидации (Центрально-Казахстанский средний массив) геосинклинальной системы, существовавшей до среднего девона. Начиная со среднего-верхнего девона структура подвергалась герцинской активизации, проявившейся в наложении глыбовой тектоники.

В связи с проявлением двух этапов тектогенеза, в складчатом основании Улытауской зоны выделяются два структурных этажа. Нижний этаж включает все докембрийские и каледонские складчатые комплексы. Для них характерен четкий меридиональный план дислокаций, развитие линейной складчатости многих порядков. Основные складчатые сооружения нижнего структурного этажа – Улытауский антиклинорий и Байконурский синклинорий, осложненные складками более высоких порядков.

В современном срезе зоны более проявлены структуры верхнего этажа. Его основными положительными элементами являются Карсакпайское и Арганатинское поднятия, также Улытауский и Эскулинский купола. Поднятия разделены субширотными прогибами – Тамдинским и Шагырлинским – и осложнены более мелкими структурами (типа Актасской грабен-синклинали). Верхний этаж сложен комплексами девона (D_1 – D_3fr) и фамена-карбона (D_3fm – C), выполняющими синклинальные образования. В ядрах поднятий и куполов обнажаются породы нижнего структурного этажа и интрузивные комплексы.

Разрывные структуры относятся или к собственно герцинским, или к активизированным каледонским, с преобладанием поздних (герцинских) перемещений. Наиболее значительные меридиональные нарушения (взбросы или взбросо - сдвиги, реже - сбросы) развиты на крыльях герцинских поднятий, где они отделяют ядра структур от зон погружения или осложняют их своды. Концентрация меридиональных нарушений отмечается в двух основных зонах – Кыштауской (Кыштау-Байконурской) и Идыгейской. Кыштауская зона связана с Кыштау-Сарытургайской зоной герцинской линейной складчатости (включающей и Актасскую структуру). Она выделяется по структурно-термальным изменениям пород обоих этажей. Идыгейская зона разрывов, также сопрягающаяся с соответствующей зоной линейной складчатости, выражена менее четко, при более низкой концентрации разрывов (типа сбросов).

Широтные и близширотные нарушения представлены большей частью сбросами с ограниченной амплитудой перемещений – Котринский сброс. Серекская сбросовая зона, серия сбросов в бортах Тамдинского прогиба и др. возраст близширотных нарушений более молодой по отношению к меридиональным разрывам.

Зоны наиболее интенсивных дислокаций пород образуют единую меридиональную систему, расчленяющую Карсакпайское поднятие и затухающую на периферии Тургайской синеклизы. Данная система выделялась как «Улытауский глубинный разлом». Однако анализ геофизических материалов по данному региону показывает. Что понятию «глубинный разлом» отвечают лишь раннее выделяемые Западно- и Восточно-Улытауский разлом и Карсакпайский тектонический шов, а таже (приближается к нему) Кыштауская зона дислокации.

Различные по составу и возрасту массивы интрузивных пород неравномерно и ограниченно распространены в районе, занимая около 9% его площади. Почти все они располагаются в ядрах поднятий среди гнейсов и сланцев докембрия, реже прорывая породы нижнего палеозоя.

Отчетливо проявились кодембрийский и каледонский магматический цикл; условно некоторые небольшие интрузивные тела отнесены к варисским.

Интрузии докембрийского магматического цикла представлены массивами гранитов, гнейсо-гранитов, гнейсированных гранитов-порфиров, нефелиновых-сиенитов и в меньшей степени небольшими межпластовыми дайкообразными телами габброидов.

Выходы докембрийских интрузивов приурочены к наиболее древним свитам гнейсов и кристаллических сланце в центральных частях Улутауского и Майтюбинского антиклинориев и

изредка (район г. Бусторау) содержат кварцевые жилы, лишенные кондиционных кристаллов горного хрусталя.

В структурном отношении Улытауский хрусталеносный район почти полностью находится в пределах Улытауской зоны поднятия, которая в свою очередь является составной частью Центрально-Казахстанской срединной зоны консолидации. На западе и юге Улытауская тектоническая зона скрывается под чехлом платформенных образований Тургайской и Чуйской синеклиз, а на востоке и севере ограничивается Жезказганской внутренней впадиной, Кенгирской зоной брахискладок и Сарысу-Тенизской зоной глыбовых складок.

В строении Улутауской зоны поднятий участвуют три структурных этажа, которые обладают характерными особенностями строения и степенью метаморфизма:

1. Нижний структурный этаж образован толщами докембрия и нижнего палоезоя, слагающими сложно построенные антиклинории и синклинории, вытянутые в меридиональном направлении.
2. В строении среднего структурного этажа принимают участие комплекс отложений среднего и верхнего палеозоя (силур-пермь), смятый в складки долготного простирания.
3. Недислоцированные или почти недислоцированные отложения мезо-кайнозоя составляют верхний структурный этаж.

Разрывные нарушения играют серьезную роль в тектонической структуре Улытау и являются главным фактором, контролирующим в районе размещения кварцевых жил.

Цель. Изучение особенностей хрусталеносности района

На территории Улытауского района выявлено 140 жильных полей, насчитывающих до 6000 кварцевых жил, из которых 1700 с признаками хрустальности. Из общего числа хрусталеносных жил разведано 1100, размещающихся в пределах 75 жильных полей. Кварцевые жилы, в том числе и хрусталеносные, встречаются практически во всех породах, включая отложения среднего карбона, которыми и определяется верхняя возрастная граница жил района. В морфологическом отношении все кварцевые жилы разделяются на пять основных типов:

1. Плитообразные тела пологого падения мощностью до 15-20м., при длине по простиранию до 850м и более. Приурочены они в основном к гранодиоритам Кантюбинского массива и образуют крупные промышленные месторождения пьезокварца и кварца для плавки Актас.
2. Неправильные тела с апофизами и ответвлениями (сложные кварцево-жильные зоны) развиты преимущественно в песчаниках и алевролитах девона, реже в более древних породах и приурочены к зонам интенсивной трещиноватости. Характеризуются они невыдержанной мощностью, многочисленными апофизами и разветвлениями. Длина их до 100–200 м., мощность отдельных жил 0,2 – 1 до 2–4 м. Это часто высоко хрустальные жилы образующие промышленные средние и мелкие месторождения Серек, Актас, Котр, Карабайтам, Кыштау и др.
3. Штокверково-жильные тела (штокверки) приурочены к зонам интенсивного нарушения и брекчирования и характеризуются наличием многочисленных, обычно мелких различно ориентированных прожилков и жил, выполняющих трещины отрыва, реже скола месторождений Западный Ашылысай, Космурын.
4. Жильные зоны, образованные сериями субпараллельных мелких и сближенных жил и прожилков, локализующихся в основном в осадочных породах девона, ордовика и нижнего карбона. Указанные зоны часто хрусталеносные, образуют мелкие промышленные месторождения пьезокварца и горного хрусталя для плавки в месторождении Нурман.
5. Линзы и линзообразные тела, распространенные в основном в докембрийских образованиях, залегают обычно согласно с вмещающими их породами, слабо или не хрусталеносные.

Трещины отрыва бывают многочисленными и часто оперяют разломы по обе стороны от плоскости сместителя. Этот фактор, свидетельствующий о многоярусности хрусталеносных кварцевых жил, указывает на глубину горного хрусталя.

В зависимости от условий образования хрусталеносные кварцевые жилы разделяются на две основные группы:

1. Жилы, сложенные метаморфизованным кварцем первой стадии минерализации, обычно сохранившейся в виде реликтов на крупных жилах, залегающих преимущественно в докембрийских породах. Кварц первой стадии минерализации наиболее высокотемпературный и хрусталеносных гнезд не образует.
2. Кварцевые жилы с наложенными процессами переработки, выщелачивания вмещающих пород, растворения, переотложения и перекристаллизации ранее образованного кварца простого выполнения трещин.

Кварцевые жилы с наложенной минерализацией являются основными промышленными объектами Улытауского хрусталеносного района.

В формировании жил выделяются два этапа. В первый этап (кварцевый) происходит образование кварцевой жилы, сложенной кварцами разной зернистости с участками шестоватой структуры и сингенетическими (остаточными) полостями. Выделение кварца происходило из кислых растворов без изменений вмещающих пород.

Следующим этапом (хрусталеносным) является приоткрывание подновление (одно или несколько) жиловмещающей трещины, под влиянием внутрирудных нарушений, сопровождающиеся дроблением жильного кварца, его перекристаллизация, растворение и переотложение под воздействием новых слабощелочных порций растворов третьей (хрусталеносной) стадии минерализации. Растворение и переотложение кварца происходит вдоль трещин, по которым циркулируют растворы, что, приводит к появлению вдоль них шестоватого, друзового и стекловатого кварца.

Кроме перекристаллизации кварца, особенно в местах пересечения трещин происходит его интенсивное выщелачивание с образованием эпигенетических полостей, на стенках которых кристаллизуются хорошо образованные кристаллы и друзы горного хрусталя и дымчатого кварца.

Кварцевые жилы в границах Улытауской зоны поднятий пользуются широким распространением. Они относятся типичным гидротермальным телам простого выполнения трещин, образовавшимся в интервале глубин 400-1000м.

Методы исследования.

Интервалы температур образования горного хрусталя, жильного кварца и некоторых других минералов определялись несколькими методами:

1. Методом термометрического анализа (гомогенизация включений).
2. Методом термозвукового анализа, основанного на терморегистрации взрыва, растрескивание включений. Делались попытки (к сожалению, не совсем удачные) по определению температур методом термолюминесценции кварца.

Определение температур образования методом гомогенизации включений производилось по общепринятой методике, подробно описанной Н.П.Ермаковым. Наблюдения велись на полированных пластинках и плоских осколках кристаллов кварца, а в отдельных случаях и жильного кварца.

Термометрическое изучение методом декрепитации (растрескивание) производилось на образцах кристаллов кварца, жильного кварца, кальцита, пирита, магнетита, граната. Отдельные положительные данные при термолюминисцентном методе получены по единичным пробам жильного кварца.

Результаты исследования.

В возрастном отношении в Улытауском районе выделяются безрудные кварцевые жилы докембрийского, каледонского и варисского (герцинского) возраста. Однако хрусталеносными являются варисские жилы и в ряде случаев более древние с наложенной варисской «хрустальной» минерализацией. Определение абсолютного возраста жил на кембрийские, каледонские и варисские произведено различными исследованиями по совокупности ряда геологических данных. Так, на докембрийский каледонский возраст жил указывает наличие гальки жильного кварца в конгломератах, залегающих в основании нижнекембрийских и девонских отложений. Характерно, что в составе верхнедевонских конгломератов хребта Кыштау в некоторых других местах галька жильного кварца иногда преобладает над остальными компонентами окатанного материала. С другой стороны, в конгломератах не обнаружена галька горного хрусталя или шестоватого неметаморфизованного кварца, указывающая, что во время древних кварцевых жил хрусталеносных полостей не было и они не образовались. Также отмечались случаи пересечения докембрийских и каледонских кварцевых жил хрусталеносными варисскими. Кроме того, отличительной особенностью докембрийских и каледонских жил является смятость их вместе с вмещающими породами и сильный метаморфизм жильного кварца. Среди них преобладают согласные жилы. Варисские жилы отличает их приуроченность к одновозрастным зонам разрывных нарушений. В результате они локализуются в образованиях от нижнего карбона до архея. Наиболее широкое распространение варисские жилы имеют в девонских отложениях. Для варисских зон

характерно очень слабое проявление метаморфизма в жильном кварце, который представлен преимущественно зернистыми, шестоватыми и друзовыми разновидностями.

Выводы. В региональном плане хрусталеносная кварцево-жильная минерализация Улытауского района охватывает восточную и часть западной ветви Карсакпайского поднятия, зону линейной складчатости Тамдинского и Шагырлинского прогибов, южные выступы Арганатинского поднятия. К северу и югу от широты г.Актас – г.Котр намечается общее затухание кварценосности площади (от 0,5 до 0,1), насыщенности полей кварцевыми жилами, сокращение масштабов хрусталеносности. Максимальные концентрации жильного кварца – горного хрусталя отмечаются в зоне влияния Кыштауской (Кыштау-Байконурской) и Идыгейской тектонических зон. Последние являются, по всей видимости, основными рудоопрделяющими структурами хрусталеносной кварцевой минерализации.

В то же время продуктивная (промышленно – хрусталеносная) минерализация проявлена в контурах района более локально. Из 110 выделенных полей и участков промышленная минерализация связана с жильными образованиями только 18 объектов. Четко выделяются три группы (фактически – узла) хрусталеносных полей и обособленных месторождений.

1 – поля на пересечении свода Карсакпайского поднятия Кыштау-Байконурской зоной разрывов (Актасская зона);

2 – поля погружения восточной ветви Карсакпайского поднятия (Кыштау-Идыгейская зона);

3 – поля Коксайской антиклинали Арганатинского поднятия (Коксайская зона).

По классификации В.М.Крейтера позиции этих групп («хрусталеносных зон») определяются как «участки пересечения антиклинорной структуры зоной разрывов (группа 1) и зоны погружения дополнительных антиклиналей (группы 2 и 3).

В контурах выделенных зон положение продуктивных объектов дополнительно контролируется более локальными факторами. В первую очередь это относится к границе раздела структурных этажей.

В более узком плане положение хрусталеносных полей и обособленных месторождений контролируется разрывными структурами, поперечными по отношению к основной складчатости.

Структуры самих хрусталеносных полей и обособленных месторождений относятся как правило к осложняющим положительным формам III – IV порядков. При этом значение их как локализаторов продуктивной минерализации определяется последовательностью:

горсты и горст-антиклинали;

своды антиклиналей высокого порядка;

брахиантиклинали и пологие антиклинальные перегибы.

Все наиболее продуктивные месторождения района локализованы в структурах горст-антиклинального типа.

Промышленно-хрусталеносные месторождения в границах Улытауского района залегают в породах различных литолого-стратиграфических комплексов. Позиция месторождений и характер вмещающей среды определяют их морфологические и минерализационные особенности. Условно выделяется четыре типа продуктивных объектов:

1. актасский (в гранодиоритах)
2. ащилысайский (в ордовикских терригенных породах)
3. надырбайский (в докембрийских сланцах)
4. котринский (в осадочных породах девона).

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