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Factors of environmental awareness formation in students

The relevance of the study is due to the understanding of the impossibility of solving environmental problems only by technical means and the need for worldview changes in this regard. Today, the problem of environmental awareness belongs to the so-called global socio-philosophical problems studied by world and national philosophy. In today's conditions, it is important to study the dynamics of environmental consciousness, which is seen as a holistic phenomenon that requires a person to have an active attitude towards nature and himself.

The main function of ecological consciousness is to ensure optimisation of relations in the society-nature system, prevention of a global environmental catastrophe, and resolution of the global environmental crisis. Therefore, we cannot underestimate the importance and necessity of developing environmental awareness in the younger generation.

Environmental knowledge is of particular importance for university students as future environmental managers. After all, mastering any profession should be based on the priority role of environmental knowledge and relevant skills, which will allow them to predict the consequences of their professional activities. In addition, it helps to involve students in creative cognitive activities. However, the awareness of modern youth about environmental issues is fragmented and undifferentiated; they are better aware of global environmental problems than of the problems of their local area. A significant number of students consider themselves uninvolved in solving environmental problems. Therefore, the necessary conditions for developing students' environmental awareness should be: understanding their own responsibility for the state of the environment and their dependence on it; developing a system of values that includes nature; developing practical skills and a certain behavioural strategy.

In this context, it is important not only to understand the concept of "environmental awareness" and its structural elements, but also to search for factors that influence its formation in students. After all, only by understanding the specifics of the process of forming environmental awareness in students, it is possible to solve the problems faced by young people on the way to understanding their own place in the world, building environmental behaviour, etc.

Keywords: *environmental awareness, emotional component, cognitive component, behavioural component.*

Formulation of the problem. It is difficult to imagine the life of a modern person without the achievements of scientific and technological progress. Over the past decades, scientists from around the world have made many discoveries, some of which have become real breakthroughs in their field and for humanity as a whole. However, along with the development of science and research, other problems have

arisen that are becoming more acute every day. These problems relate to environmental degradation, pollution and massive destruction of flora and fauna.

Thus, with each new achievement, humanity has been putting itself higher and higher on the evolutionary hierarchy. Against the backdrop of this exaltation of his own power, man destroyed more and more living things around him. Therefore, it is quite obvious that natural disasters occur in the world every day. And man cannot control it. Therefore, there is an urgent need to restructure relations with the environment, to understand its role and the consequences of irreparable damage caused by humans. The task is not only to acquire environmental knowledge, but also to form one's personal attitude to the environment, an understanding of one's place in the human-environment plane, readiness to take actions that preserve the environment or readiness to refrain from actions that harm the environment, to support or not support environmental policy, environmental measures, etc. Thus, a person needs to form and develop environmental awareness. In modern conditions, the formation and development of environmental awareness is extremely important for all inhabitants of the planet, but the most conscious category of the population that consciously approaches this process and understands its importance is young people.

Analysis of recent research and publications. In the psychological literature, there are several main approaches to the study of environmental awareness. The key among them are anthropocentric, nature-centric and ecocentric, which are aimed at forming the type of environmental consciousness and self-awareness of the individual that corresponds to them. Representatives of the anthropocentric approach define environmental consciousness as an understanding of the relationship between humans and their environment and an assessment of the possibility of influencing this relationship in order to meet one's own needs (K. Romanova, A. Liovochkina, T. Kulyk). Within the framework of the nature-centred approach, the main value is nature, and the individual's activity is aimed at serving nature and its development, while the needs of the individual are not significant (V. Panov, H. Bilyavsky, R. Furdui). The ecocentric approach and the type of ecological consciousness assumes that in the relationship between humans and the environment, the emphasis should be on harmony, interconnection, interaction and mutual development (V. Vernadsky, A. Schweitzer).

In addition to the above, there are other approaches in the psychological and pedagogical literature that substantiate the content of the concept of "environmental awareness". Thus, environmental consciousness is understood as: an independent form of social consciousness, a set of views, theories, emotions that reflect the problems of the relationship between society and the natural environment in terms of their optimal solution in accordance with the specific needs of society and natural capabilities (E. Girusov); a set of generalised ideas about nature, beliefs and ideals that reflect and determine a person's attitude to nature, its laws, and relevant assessments of interrelationships with it (M. Vasiliev, A. Kochergin, Y. Markov); the level of mental reproduction of the natural and artificial environment, one's inner world, self-reflection of the place and role of a person in the biological, physical, and chemical world, as well as self-regulation and filling this reproduction with ecological content (V. Skrebets).

Despite the considerable number of works and approaches to the study of the problem of environmental consciousness, it is still extremely relevant. After all, there is currently no unified understanding of the essence and content of the concept of "environmental consciousness", the factors that influence its formation are not sufficiently described, etc.

The purpose of the article is to present the results of an empirical study aimed at identifying the main factors influencing the formation of environmental awareness among students.

Outline of the main material. The category of environmental awareness is one of the key concepts of environmental psychology. Thus, according to M. Skladanovska, the concept of "environmental consciousness" should be understood not just as an attitude to nature and a set of ideas about the relationship within the "human-nature" system, but as a higher level of development of human consciousness and self-awareness, its worldview aspect, which largely corresponds to the concept of "environmental" and is characterised by the awareness of life as a great value for any creature [2].

According to O. Saltovsky, environmental consciousness is the reproduction by people of environmental living conditions and relations between society and nature in the form of environmental theories, ideas, and perceptions that reflect the attitude to nature in a given historical era [6].

It is worth noting that it is environmental awareness that reflects the unity of society and nature, an understanding of the common future and the definition of a person's own place in the ecosystem. In addition, the level and type of a person's environmental awareness affects his or her behaviour towards the environment, the choice of actions that may harm the environment or those that minimise negative environmental impact. Therefore, the state of the environment directly depends on the level and type of environmental awareness of the population. The level of environmental awareness, as well as the content of its elements, can change throughout a person's life, so the main task of forming environmental awareness, according to N. Negruts, is to develop creative thinking in a person that would allow him or her to set and implement goals that reflect the real relationship between man and nature, using the full range of available knowledge.

The formation of environmental awareness is a long process that involves the formation of its three main elements: behavioural, emotional and cognitive. The behavioural element includes readiness for individual actions and attitudes to support (or not support) social proposals. The emotional element is personal, subjective assessments of the individual, his or her own vision of the human-environment system. The basis of the cognitive element is theoretical (professional, scientific) and practical (gained from everyday experience of contact with the environment) knowledge [4].

Thus, we can speak about the formation of environmental consciousness if there is: environmental knowledge (a system of scientific knowledge aimed at understanding processes in the environment; perception of oneself as a part of nature, awareness of nature as a national and public domain and the ability to predict the consequences of various impacts on it) environmental thinking (level of knowledge, culture, understanding of environmental phenomena, conscious attitude to nature, ability to make adequate, reasonable decisions in relation to the natural environment); environmental beliefs (intellectually grounded, emotionally experienced, morally conscious attitude to reality; principles, life position, which guides the individual in his/her activities); environmental responsibility (ability and opportunity to consciously, purposefully, voluntarily care, foresee, comply with the requirements of activities in the natural environment).

Given the above, it is appropriate to note that the most complete formation of the structural elements of environmental awareness occurs during the student years, because unlike other age periods when the foundation of environmental awareness is laid, it is during studenthood that it becomes conscious. During this period, knowledge about the world around us is expanding, especially in the context of science, and the amount of information that a person has and can use is increasing. Accordingly, the individual's worldview expands, which allows for a different perspective on the familiar, including their own attitude to the world and the environment.

That is why, taking into account the results of the theoretical analysis, we conducted an empirical study of the factors of environmental awareness formation in students. The study involved 267 students of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University. To achieve the research goal, we developed a questionnaire aimed at identifying the main factors that influence the formation of students' environmental awareness. The questionnaire included mostly closed-ended questions about attitudes towards the environment, the level of consciousness of nature, and what influences this attitude. In the process of analysing the results, we identified four main groups of factors that, according to the respondents, influence the formation of environmental awareness. The results are presented in the figure below.

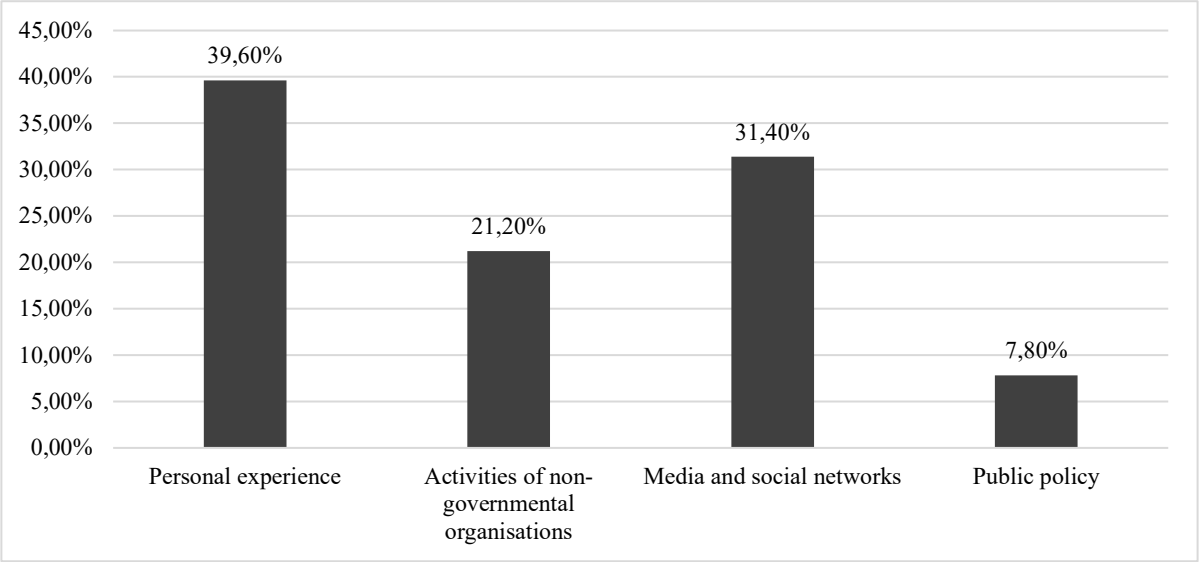

Fig. 1. Groups of factors that influence the formation of environmental awareness among students
(based on the results of the survey)

As can be seen from the diagram, 39.6% of respondents believe that personal experience influences the formation of environmental awareness. This group of factors includes family upbringing, which lays down certain values and patterns of human behaviour from an early age. And the initial level of formation of important elements of environmental awareness will directly depend on how much time and attention parents paid to forming a positive attitude towards nature and environmental behaviour in their children. In addition, each person has a specific personal experience of contact with the environment and environmental problems. This experience forms the basis for practical knowledge, personal attitude to the environment and a certain readiness for action.

A somewhat smaller number of students (31.4%) believe that the media and social media influence the formation of environmental awareness. In their opinion, the media play an important role in raising public interest in environmental issues, in disseminating information about environmental problems, natural disasters, their causes and consequences, expert opinions on how to prevent such consequences in the future, etc. The media are able to promptly disseminate environmental information among the general public, shape public opinion and attitudes towards certain environmental issues, phenomena, etc.

As for social media, they allow for faster dissemination of environmental information, promotion of environmental trends, and increase in the number of people aware of and interested in solving environmental problems. And it is social media that allows not only to disseminate and receive up-to-date information on the environmental situation not only in our country but also around the world, it also allows us to communicate with different people, share our own experiences, learn from the experience of other people and other countries in preserving the environment, etc.

Almost a quarter of the respondents (21.2%) indicated that the activities of non-governmental organisations influence the formation of environmental awareness. After all, non-governmental environmental organisations play an important role in raising public awareness of environmental problems and ways to solve them. This is done through the dissemination of information, development of online courses, manuals, booklets, videos, trainings, conferences on environmental issues, which in turn raises public awareness of environmental problems and ways to solve them, and increases the number of people interested in environmental issues. Respondents noted that NGOs' activities in one way or another create a public demand for state changes, which has a certain impact on the formation of environmental awareness among citizens, not only young people.

According to 7.8% of respondents, environmental awareness is significantly influenced by public policy, where education and awareness-raising activities are key to the formation of environmental awareness and its cognitive element. Equally important is the adoption of legislative rules of conduct, obligations, restrictions, prohibitions, procedures for liability for environmental offences, the establishment of taxes, fees for the use of natural resources and for emissions. These measures, according to the students, form a value-based attitude to the environment, raise public awareness of the impact of certain actions on the environment and the importance of preserving it. However, regulations and educational activities alone are not enough to create environmental awareness. For this purpose, the state needs to create the appropriate infrastructure and other opportunities for the population to fulfil their environmental responsibilities. The availability of the necessary resources and means directly affects the readiness of the population to take real action to preserve the environment and reduce their personal negative impact.

Conclusions and Prospects for Further Research. The problem of the essence of environmental consciousness of the individual is a promising and relevant area of psychological research. The emergence and development of an individual's environmental consciousness is determined by changes in the reality surrounding him or her (both changes in the natural environment and transformations in other spheres of human existence: society, culture, economy, etc.) Human interaction with the world around us can take place at different levels of our existence: planet, biosphere, technosphere, society, etc. The understanding of the living environment and human activity at these levels determines the formation of environmental awareness.

As for the factors that influence the formation of students' environmental awareness, it is formed under the influence of its structural elements - behavioural, emotional, cognitive. Environmental awareness is influenced by culture, traditions, personal needs and experience, values of the environment in which young people grow up and live, etc.

In view of the above, we see prospects for further research in the development and substantiation of a theoretical model of environmental awareness of the individual in the period of growing up, as well as in the study and comparative analysis of the level of environmental awareness in adolescents and adults.

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Fundamental changes in the determinants of western ecopsychology at the end of the 20th and the beginning of the 21st century

The article reveals the theoretical aspects of the subject and the genesis of ecological psychology and ecopsychology as a branch of modern psychological knowledge. It is noted that the ecological crisis and the awareness of the limits of subduing nature have actualized the problem of both protecting nature and preserving psychological health. Different definitions of the subject of environmental psychology, which are available in scientific and educational literature, are considered. It is noted that they are tangential to Western environmental psychology. The fundamental difference between environmental psychology and ecopsychology is indicated. It was found that the first of them is a branch of behaviorist research, the second is a type of Jungian-oriented psychoanalysis. The article argues that ecopsychology arose on the basis of fundamental transformations of the determinants of Western self-awareness in the second half of the 20th century. Nine principles of ecopsychology by T. Roszak are given, which determine the foundations of this psychological direction. It is noted that ecopsychology pays the main attention to the ecological unconscious, which relates a person to the natural world. It is indicated that on the basis of the theoretical approaches of ecopsychology, whole complexes of psychotherapeutic methods of restoring the human connection with the surrounding world, overcoming alienation from nature, have been created. In the conclusions, it is stated that the domestic environmental psychology by subject and method gravitates more towards environmental psychology, but recently tries to take into account the achievements of ecopsychology, sharing its certain theoretical foundations. It is the synthesis of these two directions that will give a new impetus to the development of this field of psychological science and psychotherapeutic practices.

Key words: *ecological psychology, ecopsychology, environmental psychology, ecological consciousness, ecological unconscious, synergistic interaction. education.*

Problem statement. Russian aggression and the large-scale Russian-Ukrainian war, in fact in the center of Europe, brought not only great human losses and the destruction of cities and energy and industrial infrastructure, it also has devastating ecological consequences. These consequences once again highlight the need to overcome established stereotypes about the anthropocentric foundations of modern civilization.

Nowadays, the Western civilizational paradigm of domination and use still remains the dominant view of man's relationship to the surrounding and his own nature in most developed and developing societies. It is characterized by a reductionist, exploitative, demoralized attitude towards natural processes, sometimes extending to the processes of human life.

However, recently the destructive results of this comprehensive system of science are beginning to raise serious doubts about the viability of this outdated paradigm of separation from the natural world and the very cultures that use it. Today, a rapidly growing number of people around the world are calling to change this dominant colonialist, industrialized way of thinking, arguing for a transition to an ecologically sustainable model, embracing regenerative and spiritual attitudes towards nature.

Therefore, it is not surprising that such new fields of psychology as ecological psychology and ecopsychology are attracting interest. In domestic science, these two terms are often equated, however, they have a fundamentally different origin and differ in the subject of their research.

Previous research publications certifies that over the past decades, a number of studies have been conducted in Ukraine, devoted to the problem of defining the subject and genesis of environmental psychology. Thus, such domestic psychologists as O.V. Bacileva, A.M. consider the emergence, object, subject and tasks of environmental psychology. Lyovochkina, O.V. Rudomino-Dusyatska, V.O. Skrebets, Yu.M. Shvalb and others. Analysis of changes in the determinants of Western ecopsychology found its place in the works of leading researchers of Western environmental psychology R. Barker, J. Gibson, K. Pawlik, K. Stapf and ecopsychology M. Gomes,.A. Fellows, A. Fisher, S. Harper, T. A. Kanner, S. A. Conn, T. Roszak, R. Shepard, ecophilosophers R. Marshall, A. Næss, G. Snyder and others.

The main material. Ecological psychology or ecopsychology is one of the relatively new branches of domestic psychological science. The first studies in it began only in the mid-90s of the last century. However, until now, there is no established opinion in Ukrainian science regarding its subject, genesis and theoretical basis. Thus, one of the founders of domestic ecological psychology, Vasyl Skrebets, believed that "ecological psychology is an independent branch of psychological science that studies the nature and features of psychological influences on consciousness (individual or social), a kind of influence on the psyche of the natural, artificial and social environment, and also the inner state of the person himself" [1]. As follows from this definition, the field of environmental psychology is not just a reflection of the environment by the senses and not just a relationship to the environment, but the influence of the environment, which entails changes of a complex nature - from emotions and moods to motives of activity, aspirations, value orientations, actions , preferences, manifestations of will.

Yuriy Shvalb, one of the leading scientists in this field, the head of the laboratory of environmental psychology at the G.S. Kostyuk Institute of Psychology of the Academy of Sciences of Ukraine, insists that "the subject of ecopsychological research can be various levels of anthroponic systems that arise in the process of direct interaction of individual individuals, groups and groups with the environment" [2]. However, this definition is based on the introduction of the new concept "anthroponic system" and has a specialized character.

We come across simpler definitions in numerous domestic textbooks on environmental psychology. The latter is defined as ""the science of the psychological aspects of the relationship between man and the environment (natural, artificial, social, cultural)..." (Lyovochkina) [3] or "a multidisciplinary science that deals with the environmental well-being of human mental health, studies the role and the influence of harmful human factors on other people: their psyche, brain, behavior and the consequences arising from this" (Batsileva) [4].

In general, these definitions of the subject of environmental psychology are based on the corresponding definition of "Ökologische Psychologie" made by the Swiss researcher Kurt Pavlyk back in 1992: "...ecological psychology (or ecopsychology) is the study of mental processes, i.e. experiences and behavior, in environmental conditions in which experiences and behavior occur "on their own", without the intervention of a researcher or a psychologist of the tester. In environmental psychology, human experiences and behavior in an inextricable connection with the environment are investigated and attempts are made to theoretically substantiate them" [5].

In the German-language scientific tradition, Ökologische Psychologie draws on the ecological behaviorism of the American psychologist Roger Barker and the perceptivism of his compatriot James Gibson. Thus, in his classic work "Ecological Psychology" (1968), R. Barker argued that human behavior is radically dependent: in other words, you cannot make predictions about human behavior if you do not know in which situation, context, or environment a given person was . For example, there are certain behaviors that are appropriate for attending a church, attending a lecture, working in a factory, etc., and the behavior of people in these environments is more similar than the behavior of an individual in different environments [6]. Subsequently, supporters of this approach in the English-speaking tradition abandoned the use of the term "ecological psychology" and use the term "environmental psychology", which is identical to the German "Ökologische Psychologie". By and large, Ukrainian environmental psychology can also be considered (with certain reservations) a domestic variant of environmental psychology.

As for ecopsychology itself, it has a slightly different genesis, subject and research priorities. The authorship of the term "ecopsychology" and the creation of its basic concept are attributed to Theodore Roszak, an American historian of ideas, who became famous for his analysis of the youth movements of the 1960s, which he called Counterculture ("The Making of a Counterculture", 1969). Adequate understanding of the specifics of ecopsychology is possible only in the context of fundamental changes in the determinants of Western self-awareness in the second half of the 20th century. It was at the end of the 1960s that shifts in public consciousness occurred in the USA and Western European countries, associated with the awareness of the limitations of the anthropocentric approach of the entire Western philosophical and ethical paradigm, starting with the Renaissance. Against this background, the ecophilosophy of the French postmodernist F. Guattari and the Norwegian thinker A. Næss appears. Some radical representatives of alternative subcultures began to call for the abandonment of anthropocentrism as an ideology of subjugation of nature in favor of biocentrism. Environmentalist movements, which became an influential social force already in the 1980s, are becoming widespread.

Therefore, it is not surprising that T. Roszak's announcement in the book "The Voice of the Earth" (1992) of a new psychological direction - ecopsychology was enthusiastically supported by many Western intellectuals. The American thinker believed that ecopsychology brings back a child's fascination with the world, a deep sense of responsibility for the planet and other people, makes it possible for humanity to improve psychologically by listening to the "voice of the Earth" [7].

Subsequently, T. Roszak's reasoning was systematized into the famous nine principles of ecopsychology. Let's list them:

1. The core of the mind is the ecological unconscious. For ecopsychology, repression of the ecological unconscious is the deepest root of collusive madness in industrial society; open access to the ecological unconscious is the path to sanity.

2. The contents of the ecological unconscious represent the living record of cosmic evolution, tracing back to the distant initial conditions of the creative event we call the Big Bang. Contemporary studies in the ordered complexity of nature tell us that life and mind emerge from this evolutionary history as culminating natural systems within the unfolding sequence of physical, biological, mental, and cultural systems we know as the universe. Ecopsychology draws upon these findings of the new cosmology, striving to make them real to experience.

3. Just as it has been the goal of previous therapies to recover the repressed contents of the unconscious, so the goal of ecopsychology is to awaken the inherent sense of environmental reciprocity that lies within the ecological unconscious. Other therapies seek to heal the alienation between person and person, person and family, person and society. Ecopsychology seeks to heal the more fundamental alienation between the person and the natural environment.

4. For ecopsychology as for other therapies, the crucial stage of development is the life of the child. The ecological unconscious is regenerated, as if it were a gift, in the child's enchanted sense of the world. If the rearing and education of the young preserved and deepened this spontaneous experience, ecopsychology would be left without a therapeutic role.

5. Since, however, the effect of child-rearing in our culture is exactly the opposite - namely to repress the innate animism of children - the task of ecopsychology is to recover this quality of experience in functionally "sane" adults. To do this, it turns to many sources, among them traditional healing techniques of primary people, nature mysticism as expressed in religion and art, the experience of wilderness, the insights of deep ecology. It adapts these mans to the goal of creating the ecological ego.

6 The ecological ego matures toward a sense of ethical responsibility to the planet that is as vividly experienced as our ethical responsibility to other people. It seeks to weave that responsibility into the fabric of social relations and political decisions.

7. Among the therapeutic projects most important to ecopsychology is the re-evaluation of certain compulsively "masculine" character traits that permeate our political structures of power and which drive

us to dominate nature as if it were an alien and rightless realm. In this regard, ecopsychology draws significantly on some (not all) of the insights of ecofeminism and feminist spirituality.

8. Whatever contributes to small scale social forms and personal empowerment nourishes the ecological ego. Whatever strives for large-scale domination and the suppression of personhood undermines the ecological ego. Ecopsychology therefore deeply questions the essential sanity of urban-industrial culture, whether capitalistic or socialistic in its organization. It counsels that we "scale down, slow down, decentralize, democratize."

9. Ecopsychology holds that there is a synergistic interplay between planetary and personal well-being. The term "synergy" is chosen deliberately for its traditional theological connotation, namely that the human and divine are cooperatively linked in the quest for salvation. Or in contemporary ecological terms: the needs of the planet are the needs of the person, the rights of the person are the rights of the planet.

According to Shepard, the key question of ecopsychology is the question of why a person destroys his habitat - the environment of his life in general. In his opinion, to understand destructive human behavior, it is not enough to know the history of ideas, although we are now dealing with the largest gap in history between the dominant philosophy and the Earth [9]. Shepard saw the sources of the modern crisis in the relationship between man and the environment not in modern dualism, but several thousand years ago, at the threshold of the Neolithic era, when agricultural civilization arose and the way of life of the human race changed from hunter-gatherer to settled.

Transformation over time has led to the creation of a completely artificial environment that does not correspond to human nature or our biological and psychological needs. According to Shepard, this prevents natural development and maturity, which leads to the structural alienation of man from nature and psychological consequences in the form of mental disorders and diseases. Civilizational madness (the title of Shepard's book) is the opposite of natural order and ecological balance. According to Shepard, the expression of humanity's childish immaturity is fantasizing about omnipotence and eternal expansion, narcissism and egocentrism, indistinguishability between reality and fiction, illusions, inconsistency and irresponsibility. These features have become an invariable element of the personality of a modern person. Civilization and its institutions have created systems to support this immaturity. An example is an economic system based on forced consumption. This is supported by the Western mentality (especially, as Shepard points out, the American one), which is characterized by obsessive overconsumption, extravagance and the desire for immediate gratification here and now. The psychological consequences of immaturity, according to Shepard, are: escape into dependence and escapism, violence and destruction, depression, indiscriminate use of psychotherapy, susceptibility to manipulation. The ecological effect is an unprecedented destruction of the natural environment in history. Overeating the world becomes an unconscious, desperate substitute for self-development. Modern man is immersed in insane helplessness, not realizing his own and ecological boundaries and the possibilities of his internal development, destroying himself, the world and his future [10]. Unlike P. Shepard, Theodore Roszak did not see the causes of the modern ecological crisis until the agrarian revolution, but, like the vast majority of ecophilosophers, in the expansive Western culture and in the dualism that dominated the Western cognitive paradigm from the second half of the 17th century.

Thus, ecopsychology can be seen as a field that tries to give Jungian-oriented psychoanalysis the features of philosophical environmentalism. The ideas of Roszak and Shepard were developed at the beginning of the 21st century by other Western thinkers. In particular, A. Fisher, A. Fellows, R. Metzner and many others offer their original versions of ecopsychological research.

The undoubted contribution of ecopsychology is the creation of a number of psychotherapeutic methods of restoring connection with the world, overcoming alienation from nature. They are described as methods of ecoeducation and ecotherapy. This direction attracted practical psychologists and psychotherapists who chose this particular way of working with clients. Thus, Sarah A. Conn, a practicing psychologist, draws attention to the importance of questions used in the individual psychotherapy process. "We can begin to ask ourselves, our clients, friends, and neighbors questions about our relationship with the larger world, including the natural world" [10]. In the model used by Sarah A. Kony in the process of

work, it is suggested to ask questions that contribute to shifting the focus of attention to the client's relationship with the natural world, which makes him more psychologically stable and expands his consciousness. "In addition, - writes Sarah A. Conn - I can learn about the details of my students' attitude to the world, including the natural world" [10]. It defines one of the exercises that reveal the interconnectedness of global problems. She asks students to brainstorm topics relevant to the whole world, name them and say a few words. She writes these topics on the board in random order, and when the board is full, she asks them to draw and talk about their feelings caused by the list. Such an exercise, in her opinion, leads to an intimate conversation about the pain of the Earth. Analyzing the list of problems on the board, she asks how the students think they are related to each other. They say, for example, that the incidence of AIDS in Africa is related to illiteracy, which, in turn, is related to poverty, etc. Very soon the board is filled with connections from arrows. Next, she asks each student to choose one of the problems and trace the connections that go to it. As a result, it turns out that almost all or absolutely all problems are related to each other.

Steven Harper in the article "The way of Wilderness" [10] (Ecopsychology, 1995) writes that there are a huge number of programs that use the wilderness to solve people's personal problems, but the most impressive changes occur with people under the influence of wilderness nature "Although I imagine wild nature as a psychological search for restoring the integrity of life with those with whom I work," writes S. Harper [10] – I do not consider myself to be engaged in therapy, I prefer the word " practice." Nature herself showed me this difference. Therapy, as it is usually used, implies a disease. It also implies that there is a beginning and an end to the treatment. Also, it requires a therapist—someone who is an expert, who analyzes, interpreted, gave advice. I am somewhat suspicious of this... Practice implies a process, it has no beginning and no end, there is a time of life and discoveries. When we really want to take a step, look at nature and get in touch with wild environment, we discover wisdom deeper than everyday discoveries.

S. Harper describes his more than 20 years of experience working with groups. He points to the need for individual experience: this is precisely the healing essence of interaction with the wild environment. Some trips improve physical abilities, others aim to achieve psychological transformations.

Today, approaches are very popular abroad, which allow to increase the psychotherapeutic effect several times due to conducting group and individual classes in nature together with nature. It is about various extreme trainings and programs related to the fact that the participants are obliged to take care of themselves, overcome difficulties and survive in unknown, unpredictable conditions, and the source of such conditions is not society, but nature.

A distinctive feature of such psychological work is a certain task that must be completed within a specific time frame. It can also be about survival for a certain time, in which case the emphasis is not so much on the result, but on the process of what is happening. Solving the problem can take place both in a group and at the level of an individual (depending on the goals of the training). The conditions of the situation provide the participants with circumstances in which they are faced with the impossibility of solving the task in known ways. These are manifestations of uncharacteristic ways of behavior from them, going beyond the framework of everyday life. The experience of communicating with wild nature allows you to feel those powers and opportunities that are inherent in every person, but which people usually do not use and do not even suspect about them.

That is, within the framework of ecopsychology, several varieties and psychotherapeutic practices arose: deep ecology (deep ecology), ecotherapy (ecotherapy), global therapy (global therapy), green therapy (green therapy), therapy centered on the Earth (Earth-cent therapy), psychotherapy based on nature (nature-based psychotherapy), shamanic counseling (shamanic counseling) and many others.

Conclusions. Thus, it can be considered that nowadays the general change in worldview determinants, which began in the West in the 60s of the last century, and has been happening in our country since the mid-1990s, became the basis for the emergence of two branches of modern psychological knowledge - ecological psychology and ecopsychology. The first of them arises on the basis of the behaviorist researches of R. Barker and the perceptivity experiments of J. Gibson and has now actually

turned into environmental psychology. The second has a slightly different genesis. Ecopsychology arises on the basis of fundamental transformations of the determinants of Western self-awareness in the second half of the 20th century towards environmentalism and is a type of Jungian-oriented psychoanalysis that uses various ecopsychopractices. Despite the fact that domestic environmental psychology in terms of subject and method gravitates more towards the first direction, recently it tries to take into account the achievements of ecopsychology, sharing its certain theoretical foundations.

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Ecology of personal boundaries among youth

The article examines the problem of the ecological nature of personal boundaries among youth. It is emphasized that personal boundaries separate the inner world of a person from the outside world, from other people, because life is almost impossible without boundaries. It is noted that the optimal boundaries of the individual give the right to openly express their feelings, to be themselves, ensuring the environmental friendliness of the personal space of young people. The psychological boundary is important in the process of interpersonal communication and people's perception of each other. It is highlighted that without clearly defined comfortable boundaries, people experience significant problems in everyday life, in relationships with relatives and friends, colleagues, environment, etc. The author also draws attention to the fact that a person feels well in the environment with normal and healthy personal boundaries. Such a person is able to communicate, enter into relationships, develop and support them. Healthy boundaries are flexible; a person easily understands and determines at what level they is comfortable communicating, and whether they wants this communication at all. A person is able to get closer or, on the contrary, move away if they understand that something is not working out in the relationship.

The article contains the conducted empirical research. The results of the correlation analysis confirm the relationship between self-esteem and personal boundaries in adolescence. That means that a person with low self-esteem has a high probability of difficulty distancing themself from other people. According to the results of the empirical research, we determined that the ecology of personal boundaries depends on self-esteem of adolescents. The ecology of personal boundaries is a psychological formation that arises as a result of the interaction or establishment of relationships between the desire to preserve spontaneity and authenticity and the need for social adaptation. A person protects their own ecological space from aggressive invasion attempts.

Key words*: ecology of personal boundaries, personal boundaries, psychological boundaries, youth, self-esteem of young people.*

Formulation of the problem. Personal boundaries are a life skill, the practice of open communication and defending personal ones as a way of preserving and protecting them from being compromised or violated. This is a psychological formation that arises as a result of interaction or establishment of relationships between the desire to preserve spontaneity and authenticity and the need for social adaptation. A person protects the psychological space from invasion attempts, which helps them to separate themself from everything that makes up the natural background of life. In this way, a person maintains their own security, freedom and independence and thus ensures the ecology of personal boundaries.

Analysis of recent research and publications. The problem of the specificity and content of personal boundaries was the subject of research by both domestic (O. V. Grigor'eva, A. V. Drapaka, A. S. Yarotska, etc.) and foreign scholars (Fisher S., Hartmann E., Lewin K. and others). In the philosophical,

psychological and psychotherapeutic literature, different terms are used to denote this phenomenon: the limit of life and the limit of Self-feelings (V. Podoroga), the contact limit (F. Perls), the energy limit (L. Marcher), in particular, O. Grigor'eva puts forward the following definition of psychological boundaries: the psychological boundaries of an individual are an intrapsychic formation that arises as a result of interaction or establishment of parity relations between the desire to preserve spontaneity and authenticity and the need for social adaptation. Two tasks of psychological boundaries are meant: preserving the self in an unchanged form as a guarantee of preserving a harmonious personality and achieving a state of personal happiness and establishing contacts with the surrounding world. The degree of experience of «one's own» and «someone else's» determines the individual's ability to dialogue and joint creativity in any spheres of life. Thus, Ukrainian researchers discover an additional aspect of psychological boundaries as a kind of dilemma between the desire for one's own authenticity and social adaptability, success, communication with others, which the individual is forced to overcome.

Outline of the main material. Personal boundaries separate a person's inner world from the outside world, from other people, because life is almost impossible without boundaries. Even at the cellular level, a person intuitively determines what is harmful for them, and what, on the contrary, improves life, and sets limits according to benefit or harm to the body. The optimal limits of the personality give the right to refuse, to express one's feelings openly, to be oneself. The psychological boundary is important in the process of interpersonal communication and people's perception of each other. It is known that without clearly defined comfortable boundaries, people experience significant problems in everyday life, in relationships with relatives and friends, colleagues, environment, etc. [9].

The psychological boundaries of the personality are formed in early childhood and reflect the child's relationship with their parents. At first, the child does not feel separated from the mother, but gradually becomes more and more aware of themself as an independent individual [4].

U. James proposed the following components of the psychological space of an individual: physical, social and spiritual. Primary development of physical space occurs in children at an early age, social space is born in 3-6 years on the basis of physical space, spiritual space begins to form later, in adolescence. Therefore, certain aspects of personality are formed at different times, and if a child falls under uncomfortable, unfavorable conditions at a certain age, the formation of certain types of boundaries may be disturbed [3].

If the boundaries are fine and healthy, then a person feels well in the environment. They is able to communicate, enter into relationships, develop and support them. Healthy boundaries are flexible; a person easily understands and determines at what level they is comfortable communicating, and whether they wants this communication at all. A person is able to get closer or, on the contrary, move away if they understands that something is not working out in the relationship.

A. Gris highlights the following functions:

1. «Not letting in» - the inclusion of "protection" from external influences that are evaluated by a person as negative. Boundaries become impenetrable and limit the inner psychological space of the individual.

2. Permeable - it reflects the «throughput» capacity of boundaries. It happens in the case of a sufficient level of self-confidence and a person's trust in another person, as well as the absence of dangerous influencing factors. Boundaries seem to dissolve, but at the same time, a person does not lose their sense of self.

3. Absorbing - the boundary allegedly pulls the necessary and desired things from the surrounding reality. This function helps to ensure the internal right to satisfy a person's needs - a person can openly talk about their needs, ask for help, etc.

4. «Giving» function - passes internal impulses. It allows you to express yourself - your feelings and emotions externally.

5. Restraint - if it is necessary, it allows you to restrain impulses for adequate interaction with external stimuli.

6. Calm-neutral - it reflects the calm, neutral state of a person who does not seek to interact with the outside world at the moment [2].

Violation of this function and incorrect assessment of the area of responsibility by a person can lead to taking on too much responsibility, the inability to ask for help, a neurotic sense of guilt or, on the contrary, to infantile manifestations [1].

I. Shapoval offers an interesting classification of the functions of the limits of I. The author advises to divide all functions into two main groups: 1) key or dominant functions; 2) structured functions. The first (key) functions include:

- avoidance of disorganizing emotional experiences;
- preservation of self-respect; maintaining a strong, consistent, positive sense of self;
- encouraging a person to master compensatory forms of behavior;
- preventing the individual from accessing themself;
- self-restraint and ensuring autonomy through civilizational mechanisms of self-control;
- regulation of adaptation, development and formation of personality due to limitation of its activity.

The author refers to the structured functions of boundaries:

– distinguishing between self and non-self, allowing for what is possible in contact, choosing the form of contact, interacting with important parts of oneself, expanding the range of self-expression;

– birth of subjectivity, definition of personal identity, creation of opportunity and tool of equal interaction, creation of possibility of selection of external influences, definition of limits of personal responsibility;

- active isolation from harmful influences or allowing fusion with the world; active absorption (need satisfaction) or giving (self-expression); active containment, "containment" of internal energy; calm and neutral agreement with the world;

– differentiation, identification and integration of self; communication, socialization and social realization of self;

– encouragement to overcome limits; suppression of activity by external requirements; designation of the boundaries of the virtual state, beyond which it is not relevant to achieve the goal (boundaries-catalysts, inhibitors and markers) [9].

A person, defining their individual space, changes psychological boundaries: sometimes they narrows them, sometimes they expands them. To successfully adapt means to reach such a state of the relationship between the individual and the group, when the individual without long-term external and internal conflicts effectively performs their leading activities, absolutely satisfies their basic sociogenic needs, meets the role expectations set for them by the reference group, experiences states self-assertion and free expression of one's creative abilities. Social adaptation means ways of adjusting, regulating, and harmonizing the interaction of an individual with the environment: at the same time, the individual acts as an active subject who adapts to the environment in accordance with their needs, interests, aspirations and actively determines themself [5].

It is accepted to distinguish the following types of personal boundaries:

1. Soft, when a person merges with other people.

2. Spongy - to absorb other people's things, people are unsure of themselves.

3. Rigid - a person does not change their psychological space in all situations. Anyone who tries to violate it will be severely rebuffed. Sometimes this leads to problems in personal life.

4. Flexible, which change depending on the situation.

Sometimes the psychological boundaries of an individual are violated by other people.

- They blame other people for their problems.
- They control the behavior of people around them.
- Give advice to others on what and how to do.
- Give settings, which events and how to evaluate.
- Give a negative assessment of appearance and personality [6].

A person whose boundaries have been invaded by others feels fear, anger, frustration, tries to avoid communication.

If the boundaries are weak, they are interfered with quite regularly, such a person feels quite strong stress, they cannot adequately protect themself from an attack. Such people feel like losers, blame themselves for all failures and troubles.

A person with weak boundaries is at risk of developing depression because they cannot stop the constant intrusions. At the same time, it should be noted that the weaker the boundaries of an individual, the more often they violates the boundaries of others [4].

The modern Ukrainian scientist P. Karelin, who is the author of the scheme for the study of psychological boundaries, emphasizes the importance of studying this phenomenon taking into account social and psychological contexts [4].

Therefore, psychological boundaries are a psychological formation that arises as a result of interaction or establishment of parity relations between the desire to preserve spontaneity and authenticity and the need for social adaptation. In order to be a socialized and self-sufficient person, it is necessary to clearly feel one's own self, as well as the communication partner's, urgent mental states, to be able to reflect, to develop empathy skills. All these things cannot be formed without establishing psychological boundaries during communication.

The need to set boundaries is as important as basic needs. If psychological boundaries are not established or are not clearly established, then a person will feel uncomfortable, depressed, will not be able to perform productive activities and may have problems related to psychological health in the future.

Gris A. [2] emphasizes the non-linearity and non-normativeness of the development of personality boundaries. The formation of a psychological boundary in the ontogenesis includes a successive transition from indivisibility and symbiosis in childhood to the autonomy and independence characteristic of a mature personality (we add that the age of maturity in modern conditions does not have a fixed value and is individual) with the corresponding breadth, differentiation and organization of life space [2]. At the same time, the physicality of the boundaries felt in stressful situations is gradually supplemented by the boundaries of subjectively significant aspects of life that do not have a clear spatial and temporal localization (for example, values, meanings, worldview positions, taste preferences). This process is also accompanied by the complication of ways of marking and protecting boundaries, and the accumulation of episodes of defending boundaries contributes to the sovereignty of the psychological space of the individual.

The most intense period of boundary formation is childhood, when the child is included in the system of social relations, adapts, accumulating life experience. Psychological boundaries act as a kind of «buffer» that helps the child «integrate into society» [5].

It is believed that in adolescence and young adulthood, the boundaries reach optimal indicators: their effective functioning is determined by activity, flexibility, the ability to hold and protect by verbal means; lower efficiency correlates with permeability, undifferentiatedness, non-adaptability, difficulties in regulation and control, physical protection or the use of socially disapproved ways of behaving. The optimal variant of the development of boundaries allows one to build an adequate system of interaction with external and internal reality already in adolescence and young adulthood [7].

Summarizing the theoretical analysis, we can draw the following conclusions: personal boundaries are a necessary component of the harmonious development of the personality, its successful adaptation to society.

The empirical sample of the study consisted of 60 respondents (37 girls, 23 boys), students of the Vinnytsia Mykhailo Kotsyubynskyi State Pedagogical University, aged from 20 to 23 years. Students of several faculties and specialties, both humanitarian and natural sciences, as well as representatives of exact sciences, participated in the study. Taking into account the goal and task of our scientific research, the following methods were used: «Definition of psychological boundaries» (E. Hartman), «Self-assessment scale» and the author's questionnaire «Psychological boundaries».

After conducting the author's questionnaire «Psychological boundaries» it was revealed: *Are you familiar with the concept of psychological boundaries?* 43,3% believe that they are well acquainted with this concept; 45% have read something and have some knowledge about what psychological boundaries are, what they are for, what are their main functions; 11,7% only superficially know about psychological limits, they heard something, but did not study it in detail. Therefore, the majority (57%) believe that they are not sufficiently familiar with this concept.

What do you think psychological boundaries are? 10% could not define psychological boundaries; 50% defined that boundaries are certain principles, desires, emotions, opportunities; 33,3% called psychological limits psychological barriers; 6.7% marked psychological boundaries as a comfort zone. We can claim that, in general, these definitions are not acceptable and those that convey the essence of this concept.

Do you think a person needs psychological boundaries? 65% answered affirmatively that a person needs psychological boundaries, 29% said that they are not needed, others (5%) found it difficult to answer. Interestingly, based on the previous answers, a large part of the respondents believe that a person needs psychological boundaries, while not understanding the essence of this psychological phenomenon.

Do you think there is a benefit to psychological boundaries? 53,3% assured that the benefit of psychological boundaries is protection, 31.7% - it is demarcation and understanding where are one's own boundaries and where are others', 8,3% - assured that there is no benefit, 6,7% - to prevent dangerous actions of others.

Can psychological boundaries help in communication with people? 46,7% - assured that psychological boundaries help in communication by not offending us and helping us to not offend other people, 23,3% - do not see the benefit of psychological boundaries in communication with other people, 11,7% - for advocacy own opinion, interests, 10% - for self-expression, 8,3% - establishing contacts. The respondents' answers, in our opinion, are appropriate and indicate an understanding of the practical use of the construction of psychological boundaries by the individual.

What are the main functions of psychological boundaries, in your opinion? In this question, it was possible to choose several answer options. Protection from external negative influences (81,7%); satisfaction of own needs (56,7%); allows you to express your emotions and feelings (53,3%); restrains impulses if necessary (61,7%).

Summarizing the results of the survey, it should be noted that despite unclear definition of the concept of psychological boundaries, the respondents understand their significance, especially clearly naming their functions. That means, there is an understanding of the importance of some practical application, building personal boundaries when interacting with other people.

After carrying out the method «Definition of psychological boundaries» (E. Hartman), we obtained the following results (see Fig. 1):

37% were found to have «thin» psychological boundaries. Such results indicate that such people can sympathize and emotionally connect with others. They are creative, dreamy, sometimes weak in defending their boundaries, in a stressful situation they would rather retreat than fight, mistrustful, but more easily influenced and lost when pressured.

In 63%, «thick» boundaries prevail, which indicate that the subjects do not experience any difficulties in communicating with others, they can calmly refuse a request if it violates their boundaries. Such individuals can defend their own interests. They keep some people at a distance whom they do not trust, they keep closer ones close. This helps to adequately perceive the surrounding world and filter the resources they spend on communicating with others.

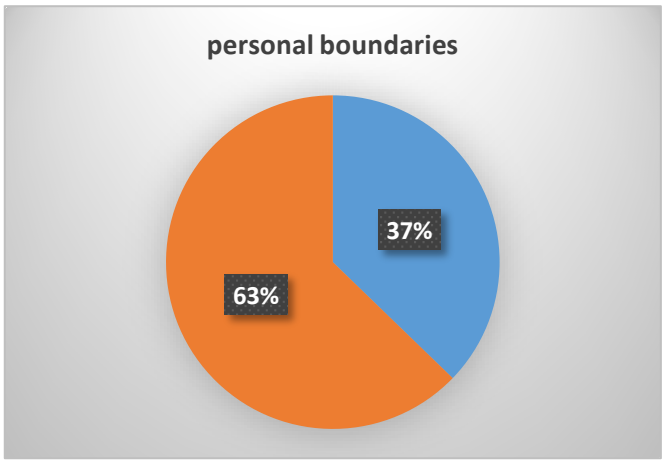

Fig. 1. The results of the study of personal boundaries according to E. Hartman

So, we see a significant prevalence of "thick" psychological boundaries among youth, which indicates both a positive aspect - the ability to defend one's own interests, and a certain lack of trust in society among modern youth, which can be interpreted as a negative aspect of the results.

Results of self-assessment diagnostics. After studying the indicators of the general sample using the «Self-evaluation scale» method, we obtained the following results (see Fig. 2):

26,7% have a low level of self-esteem. They have a negative attitude towards themselves, they give up, lose faith in themselves at the first failures. They are insecure, closed, more often introverted personalities, they treat others with suspicion.

28,3% of the respondents have a high indicator according to the method. Such individuals know how to defend personal boundaries, are confident, have a clear opinion and skillfully convey it to others, they are often extroverts.

45% of the respondents have an average level of self-esteem. This indicates that they adequately perceive themselves, their characteristics, character and situations that happen to them, but negative events and stressful situations can negatively affect the reflection and well-being of the individual.

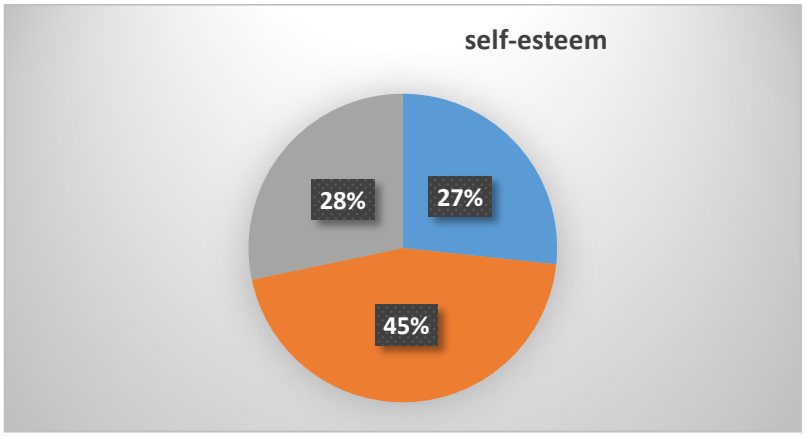

Fig. 2. The results of the study of self-esteem among young men

So, we can see that, in general, the sample is dominated by average indicators of self-esteem, which is generally typical for this age period. For a more detailed analysis, we performed a correlational analysis of the investigated indicators of the relationship between self-esteem and personal boundaries. Direct and inverse correlations were revealed between the following indicators of the methods (see Table 1.):

Table 1. Indicators of correlational research connection of self-esteem and personal boundaries

Indexes	«Thick» boundaries	«Thin» boundaries
Low self-esteem	**-0,341**	**0,385**
Average level of self-esteem	-0,145	0,269
High level of self-esteem	**0,583**	0,312

Let's analyze significant correlations:

- low level of self-esteem and «thin limits» (0, 385, at the level of statistical significance $p<0.05$). Such a connection indicates that when a person is in a certain «vacuum» of their experiences and emotions, has a vague framework of their own «I», it is difficult for them to defend their position, to prove their opinion. Such a person believes that it is better not to communicate with others at all than not to be able to convey their position to them. Personalities lose meaning in interaction and close in on themselves. Some, on the contrary, due to thin boundaries and low self-esteem, try to get into the boundaries of other people to belittle their certain achievements and achievements.

- a high level of self-esteem and «thick boundaries» (0, 583, at the level of statistical significance $p<0.05$), which indicates an active position of individuals in personal and interpersonal communication. Such people can stand up for themselves, can often deliberately create conflicts in order to win them, they have clear frameworks and positions in interpersonal and personal communication. Some personalities may have high boundaries and self-esteem, but inflated, and therefore try to encroach on the peace and confidence of others. They sense a certain competition and try to get rid of it.

- an inverse correlation was found between the indicators of low self-esteem and «thick boundaries» (-0.344, at the level of statistical significance $p<0.05$). This result indicates that when an individual feels insecure, anxious, and has doubts about their thoughts and positions, the boundary score decreases. A person loses the ability to stand up for themself, closes in on themself, cannot adequately respond to the situation and believes that in a stressful moment it is better to leave than to defend their own boundaries.

In general, the results of the correlation analysis confirm that a high level of self-esteem and «thick boundaries»; an inverse correlation was revealed between indicators of low self-esteem and «thick boundaries» and vice versa, low self-esteem is associated with the indicator of «thin boundaries». That means, a person with low self-esteem has a high probability of difficulty distancing themself from other people. According to the results of the empirical research, we determined that the ecology of personal boundaries depends on self-esteem of adolescents.

Conclusions. The ecology of personal boundaries is a psychological formation that arises as a result of the interaction or establishment of relationships between the desire to preserve spontaneity and authenticity and the need for social adaptation. A person protects their own ecological space from aggressive invasion attempts. Thus, a person maintains their own security, freedom and independence. It is at a young age that a person begins to realize their uniqueness and uniqueness, in their consciousness there is a gradual reorientation from external evaluations to internal ones. At a young age, psychological boundaries reach optimal indicators: their effective functioning is determined by activity, flexibility, the ability to hold and protect by verbal means; in the case of unformed boundaries: reduced efficiency is correlated with permeability, undifferentiatedness, inadaptability, difficulties in regulation and control, physical protection, use of socially disapproved ways of behavior.

Prospects for further research in this direction. Prospects for further research can be seen in a comprehensive analysis of the peculiarities of the relationship between the ecology of personal boundaries and the psychological properties of the individual.

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Ecology of childhood: the problem of imagination development of younger schoolchildren

The article emphasizes the need to develop the imagination of younger schoolchildren as an important factor in the formation of their creative personality. It is emphasized that primary school age is a sensitive period for the development of imagination, and therefore the task of a modern primary school is to use a period favorable for the development of this mental function.

The role of the teacher in the development of students' imagination is revealed. It is emphasized that the main priority in the educational process of primary school should be to ensure proper childhood ecology. The teacher needs to organize the educational process so that it is environmentally friendly for children. The teacher's task is to preserve the creative tendency of the preschool age, to strengthen it in the younger school age, in other words, to preserve the creative potential of the child in new conditions where abstract, conceptual, theoretical knowledge prevails.

It was found that in order to ensure the activation and effective course of the imagination development process in younger schoolchildren, it is necessary for the teacher to create and observe the following psychological and pedagogical conditions: possession of scientific knowledge and technological skills regarding the development of imagination of students; taking into account the age, gender and individual psychological characteristics of the development of imagination of younger schoolchildren; ensuring a favorable psychological atmosphere in the course of extracurricular and extracurricular educational activities; creation of a creatively developing educational environment, as well as organization of joint creative activities with students; building educational and educational interaction with students on the basis of a dialogical approach; the use of a system of creative tasks, innovative technologies for the development of imagination; promoting the manifestation and realization of students' interests and abilities by involving them in various types of creative activities.

Key words: *ecology of childhood, younger schoolchildren, educational activity, development of fantasy, creative personality, fantasy.*

Formulation of the problem. In the context of the development of independent statehood and Ukraine's accession to the European Community, the problem of developing a creative personality, capable of independent thinking, generating original ideas, making bold, non-standard decisions and being responsible for their implementation, becomes particularly relevant. Especially the problem of forming a creative person concerns the younger generation, on whom the future of our country largely depends.

One of the strategic tasks of education reform in Ukraine, proclaimed in a number of normative and legal educational documents, in particular the Laws of Ukraine «On Education», «On General Secondary Education», the Concept «New Ukrainian School», the State Standard of Primary Education, is to ensure the most favorable conditions for personality development and creative self-realization of the younger generation.

Implementation of this task in primary school can be carried out under the condition of productive use in educational activities of those psychological assets of preschool age, which form internal resources for further personal development of children of primary school age. One of these key neoplasms of preschool children is fantasy, which is the main characteristic of a creative personality and its activity (V. Klymenko, G. Kostyuk, O. Kulchytska, V. Molyako, V. Rybalka, V. Romenets).

A sensitive period for the development of fantasy, according to the definition of psychologists (H. Kostyuk, V. Molyako, V. Rybalka, V. Romenets), is preschool and junior school age. Therefore, the task of the modern primary school is to use the period favorable for the development of this mental function.

During the transition from preschool to junior school age, the leading activity of children changes – play gives way to learning, which, unfortunately, in comparison with play, does not sufficiently activate

their imagination in a traditional school. The dependence of the child's imagination on the change of the leading activity leads to the predominant development of the creative imagination at the primary school age, and the fact that the creative imagination, already sufficiently developed by play, does not find its proper place in the learning process is, in our opinion, a serious psychological and pedagogical problem. To correct this situation, it becomes necessary to develop the imagination of younger schoolchildren, along with their assimilation of standard elements of educational activity.

The analysis of the latest research and publications proves that at the current stage psychologists pay attention to the study of certain aspects of the outlined problem, in particular the formation of fantasy in the early stages of ontogenesis, the psychological mechanisms of its functioning (O. Golyuk, I. Gruzynska, V. Ivanova, N. Matsko, N. Pakhalchuk, L. Podolyak), development of imagination of gifted children of preschool and primary school age (I. Karabaeva, M. Konovalchuk, T. Yatsenko), development of imagination of children with special needs (K. Rechytska, K. Soshina), development of imagination as component of formation of subjectivity of younger schoolchildren (I. Titov), technologies of imagination development in younger schoolchildren (I. Bartashnikova, O. Bartashnikov, S. Gin, L. Makridina, O. Teterina, L. Tkach, L. Shragina).

At the same time, the problem of fantasy development in younger schoolchildren needs further thorough study, which will make it possible to eliminate contradictions between:

- social needs for the development of creative personalities and insufficient attention and readiness of teachers to stimulate the imagination of younger schoolchildren as the main characteristic of a creative personality, a necessary component of their creative activity;
- the need to intensify the influence of various educational subjects on the development of students' imagination and the insufficient development of pedagogical tools.

Presenting main material. Ukrainian education has chosen the path of humanization, and therefore the main priority in the educational process of primary school should be to ensure proper ecology of childhood. Teachers need to organize the educational process so that it is environmentally friendly for children. The task of the teacher is to preserve the creative tendency of the preschool age, to strengthen it in the younger school age, in other words, to preserve the creative potential of the child in new conditions where abstract, conceptual, theoretical knowledge prevails. After all, without fiction, without the ability to fantasize, there can be no normal mental activity, and even more so, the child's world cannot be harmonious without fiction. The teacher needs to create conditions that would ensure the possibility of showing the creative potential of younger schoolchildren, the development of their creative personality. As you know, one of the strategic tasks of modern school reform is its reorientation to the personal development of students. «...More and more importance in reforming education, – writes S. Maksimenko, – is given to the consistent implementation of the personal principle in it, meaning the provision of effective assistance to the full disclosure of the productive potential of each pupil (student, etc.) in their individual uniqueness and the stimulation of harmonious development (and self-development) of the individual» [2, p. 7].

During the transition from preschool to junior school age, the leading activity of children changes – play gives way to learning. At the same time, the creative imagination, which was actively developed first in the game, and later in other types of artistic and creative activities of the preschooler, often does not find a proper place in the educational activities of the younger schoolboy. Usually, the level of development of creative imagination reached by a preschooler is simply not used by the primary school. From the first days of their stay at school, children enter the education system, which is dominated by teaching, aimed mainly at the transfer of ready-made knowledge to students, which consists in passive memorization of educational material with its subsequent reproduction. Pupils are often forced to study against their own will, – they are to a greater extent the objects of educational and educational influences of the education system. And therefore, it does not create the conditions necessary for the development of creative possibilities, in particular, the imagination of students and, as a result, their personality [1; 3; 4; 5; 6].

Under the influence of education, younger schoolchildren mainly develop a reproductive imagination, thanks to which they have the opportunity to create images of objects in the surrounding world, which have not yet been in their experience, according to a certain description (verbal or graphic). «Imagine», «transport yourself in your mind», «recreate in your imagination» – with these words, teachers try to evoke certain images in children, explaining the educational material to them. They can be evoked in them in other ways – while reading educational and fiction literature, watching movies, viewing reproductions, drawings, maps, diagrams, graphs, layouts.

In our opinion, the traditional system of school education does not sufficiently contain special methods aimed at the consistent and systematic development of students' creative imagination. In these

conditions, the latter develops mainly spontaneously, from time to time, and as a result, as a rule, does not reach a high level. It is not surprising that in an ordinary lesson, among the many questions that the teacher asks the students, there are various questions (recall, show, tell, explain, describe, prove), but among them there are very rarely those that contain the requirement to imagine, invent something (in the sense of create, not reproduce), predict. According to V. Sukhomlynskyi, the most terrible thing about disdain for the development of children's imagination is formalism in the assimilation of knowledge, a decrease in students' interest in learning. «Putting ready-made truths, generalizations, and conclusions into children's heads, the teacher sometimes does not give them the opportunity to even get close to the source of thought and the living word, binds the wings of dreams, fantasy, creativity. From a living, active, active being, the child turns into a memory device... No, it shouldn't be like that» [7, p. 86].

Unfortunately, not all teachers have enough experience, patience, and perhaps their own creative imagination to take into account the peculiarities of children's imagination and widely apply it in the educational process. Some teachers do not find any benefit in the manifestations of fantasy, mistakenly believing that the child's desire to fantasize distances him from reality. They tend to attribute harmful effects to it, and therefore avoid its study, testing and practical use. Underestimation of the importance of the organization of the necessary conditions for the development of fantasy can lead to the fact that its activity will acquire an undesirable direction or take place sluggishly, unproductively.

One of the main conditions for the development of meaningful imagination is the child's accumulation of knowledge, bright, diverse ideas. And therefore, the teacher faces an important task – to enrich the experience of students in order to create a solid foundation for their creative activity. Although it should be noted that simply enriching the child's mind with a sufficient supply of knowledge is, of course, not enough for the development of his imagination. In life, we often observe such a phenomenon, when children with a large amount of knowledge are capable only of its passive reproduction, and not of active creativity. That is why, while enriching students with knowledge, the teacher should never for a moment forget that this acquisition of knowledge is not just a passive memorization of the material, but that it always turns into action, prompting the student to observe, research, predict, draw conclusions.

The development of the imagination of younger schoolchildren is facilitated by such an organization of their activities, in which each child has the opportunity to act independently, when they show interest in such an activity or when the task proposed by the teacher can be performed in different ways. The child's habit of imitating others, acting according to the model, according to the teacher's instructions often inhibits the development of his imagination. After all, the functions of fantasy are related to situations of uncertainty, problems, and awareness of contradictions. In order to develop the imagination of younger schoolchildren, teachers should include so-called imaginative tasks, in the solution of which the leading role belongs to the imagination, to the educational activity. It is important to induce active mental activity in students, which is necessary for creating new images, to develop in them the ability to imagine.

Teachers need to offer students creative tasks as often as possible. We understand a creative task as a task in the process of which the student creates a certain creative product. A creative product is understood as a formalized result of a student's activity, for example, writing stories, poems, creating drawings, plasticine products, applications, etc. It is clear that in each cycle of school subjects, the types and types of creative tasks differ, because this is determined by the specifics of a certain subject: their content, means (linguistic, technical, visual, etc.) that are used during tasks. Creative tasks can be included in programs for any educational subjects.

The development of the imagination of younger schoolchildren is facilitated by such a situation when they understand the meaning of the creative activity they perform, for example, making a holiday card to congratulate their mother. A positively emotionally charged image created in the imagination encourages the child to work on the development and implementation of his idea in a creative product. The creation of new meaningful images requires subordinating the activity of fantasy to a certain goal, the selection of appropriate material. Without appropriate regulation, the process of imagination can turn into a stream of bright, but random images. It is necessary to direct the work of students' imagination in accordance with a certain task, to focus on achieving a certain result. In this regard, it is important in the development of the productive imagination of students to form a critical attitude towards works of fantasy, their comparison with reality, an assessment of the importance of these works and the possibility of their implementation.

A significant role in the development of children's imagination is played by the organization of collective creative activities of students (for example, creating large models, collective drawing with chalk on asphalt, staging a fairy tale, etc.). Performance of collective creative tasks by students is usually

accompanied by enthusiasm for a common goal, active exchange of creative ideas, development of the ability to work in a team, awareness of everyone's own responsibility for improving the overall result, in addition, more capable students activate less capable ones by their example.

A powerful catalyst for children's creativity is the teacher's own example, his direct performance of this or that task. In such a case, the students show admiration for the teacher's work, the desire to work just as easily and inspiredly, and this is another incentive for creativity.

In order to purposefully and systematically develop imagination in students, the teacher can use special creative trainings.

An important condition for the development of students' imagination is their active involvement in various types of creative activities both inside and outside the school. So, for example, in order to develop the literary creativity of students, you can organize literary circles, as well as holidays, evenings, poetry moments, contests, introduce keeping a journal, where children's works are recorded, and create wall newspapers. The development of musical creativity will be facilitated by students' visits to music clubs and studios, as well as participation in such events as music festivals and competitions. For the development of students' design creativity, their participation in the work of technical circles and workshops, visits to production facilities, as well as the creation of exhibition shelves and racks for the products created by them will be useful.

For the development of students' imagination, the teacher must ensure a favorable psychological atmosphere in the lesson. In our deep conviction, the independent creative activity of students is facilitated by the teacher's observance of the following conditions: not to impose his opinion on students, not to deny their suggestions, it is only possible to partially provide assistance to students at a certain stage of their independent creative activity (if, of course, there is a need for this); demonstrate their own creative products, actively discuss them with students; show faith in students' creative abilities, treat them as full partners, change the position of «superiority» to the position of «equality», be «not above the students», but «together with them», strive for mutual understanding; show sincerity in behavior: be able to rejoice in the successes of your students, sympathize with their failures, as well as admit your mistakes; to show emotional elation from the creative process, to support students' interest in creativity, to promote the development of emotional stability in them (in case of intense creative search, in case of disappointments, criticism or failures).

The creation of a favorable climate for creative students should lead to a change in the social status of these students, on the one hand, and on the other hand, to change the «value orientation» of all students in the class, to increase the prestige of creative thinking, imagination, which, in turn, should affect their development creative abilities. It is necessary that education enlivens and supports students' sense of independence, courage to deviate from generally accepted patterns, templates, desire to find new ways of solving problems. In this regard, in our opinion, the opinion of E. Torrens is apt, according to which a teacher, developing children's imagination, is able to perform a wide variety of functions: to give a child with an ardent imagination a repository, to become his friend, to help him understand his own divergence, to sympathize with his ideas, to protect her creativity, to help parents and friends understand such a child, not to make her an exception and an object of ridicule, which children with unusual imagination often fall under [10].

Teachers need to see potential creative opportunities in every student. According to the results of the research conducted by R. Rosenthal and L. Jacobson, in a situation where the teacher expects significant successes from children, they really begin to show them, even if they did not have special creative abilities [9].

According to the results of our research, it was found that only the organization of the educational process, which ensures optimal loading of the imagination of a junior high school student, can create a positive direction for its development, help the child to better understand the world around him and himself, and contribute to the formation of his creative personality. It was found that in order to ensure the activation and effective course of the imagination development process in younger schoolchildren, it is necessary for the teacher to create and observe the following psychological and pedagogical conditions: possession of scientific knowledge and technological skills regarding the development of imagination of students; taking into account the age, gender and individual psychological characteristics of the development of imagination of younger schoolchildren; ensuring a favorable psychological atmosphere in the course of extracurricular and extracurricular educational activities; creation of a creatively developing educational environment, as well as organization of joint creative activities with students; building educational and educational interaction with students on the basis of a dialogical approach; the use of a system of creative tasks,

innovative technologies for the development of imagination; promoting the manifestation and realization of students' interests and abilities by involving them in various types of creative activity [8].

Conclusions. Thus, the development of creative imagination and imagination of students should always be in the field of view of teachers, as it contributes to the improvement of children's creative abilities, the development of their creative personality. Teachers should develop children's imagination, which would be aimed at creating new images and embodying them in new creative products. In our opinion, only a creative teacher with a well-developed imagination can contribute to the formation of the creative personality of each student, positively influence the development of their imagination. And that is why a modern primary school needs a teacher who is ready for the fact that every day of work with children is a search, capable of creative pedagogical activity, who has a need for creative interaction with students, who is capable of creative imagination, fantasy, able to easily generate new. Encouraging younger schoolchildren to fantasize contributes both to the direct goals of forming original and multifaceted views on the phenomena of the surrounding reality, and to the general development of their cognitive abilities. This is the necessity of the development of imagination as the basis of the creative potential of the individual and a factor in the success of the education of children of primary school age.

Prospects for further exploration in this direction. Questions related to the study of the development of fantasy at other age stages, in different learning conditions, clarifying the readiness of teachers to implement psychological and pedagogical programs for the development of the imagination of students need further study.

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Enviromental education of students using the school chemistry course on the basa of the principle of local history

The purpose of the article is to reveal the method of using elements of environmental knowledge based on the principle of local history in teaching some topics of the school chemistry course.

The article establishes that environmentalization of educational subjects can be carried out by: introduction of elements of ecological knowledge when teaching some topics of various educational subjects; use of tasks, questions, problems of ecological content; carrying out interdisciplinary environmental activities; introduction of electives and optional courses in specialized classes; teaching ecology as a separate academic discipline.

Chemistry, as an educational discipline, makes it possible to use the means of its subject to carry out environmental education of students directly in the learning process, provided that environmental knowledge becomes a function of chemical education. Since the school chemistry course has its own research subject, content, goal, tasks and learning methods, it is subject to both general didactic and specific learning principles. The principle of regionality, or local lore, belongs to the specific principles of teaching chemistry. The principle of local history involves introducing into the educational material information about the locality in which schoolchildren live, about the natural conditions, economy, ecological state of the native region with cognitive, scientific, educational, educational and practical purposes. The use of local history material in chemistry lessons helps to reveal general laws and phenomena that are studied, improves the depth of understanding of the educational material, increases interest in it, enriches students with knowledge about their native region, promotes the development of creative thinking and leads to an understanding of the main problems of their area.

The use of ecological material in the school chemistry course based on the principle of local history makes it possible to carry out environmental education of schoolchildren, which contributes to the awareness of students of the need for a careful attitude and rational use of natural resources.

Key words: *environmental education, school chemistry course, principle of local history, institutions of general secondary education.*

Introduction. Environmental education of schoolchildren is one of the most important tasks of society in the field of environmental protection. In the concept of environmental education of Ukraine, it is indicated that the institution of general secondary education is assigned a leading role in its implementation, which consists in the formation of a system of knowledge, views and beliefs of students, which will ensure public responsibility for the state of the environment and readiness to improve it by making the necessary ecologically competent decisions. This leading idea should be developed at all levels of general education and consists in the greening of school academic disciplines by including ecological aspects related to the basic material to the educational subject [4].

The analysis of literary sources showed that environmentalization of educational subjects can be carried out by:

1) introduction of elements of ecological knowledge when teaching some topics of various educational subjects;

2) use of tasks, questions, problems of ecological content;

3) carrying out interdisciplinary environmental activities;

4) introduction of electives and optional courses in specialized classes;

5) teaching ecology as a separate academic discipline.

Chemistry, as an educational discipline, makes it possible to use the means of its subject to carry out environmental education of students directly in the learning process, provided that environmental knowledge becomes a function of chemical education.

The problem of environmentalization of the school chemistry course is considered in the works of many Ukrainian Methodist scientists and practicing teachers. A well-known scientist in the field of chemistry teaching methods N.M. Burynska considers the main tasks to be solved by environmental education in the process of teaching chemistry: "relying on students' chemical knowledge, to reveal their ecological essence, which will enable students to consciously participate in environmental protection in the future; promote understanding of the role of chemical facts that affect nature, including humans; to make it possible to develop a certain position, which conditions the environmentally competent behavior of the student" [1, p. 26]. According to the author, environmental information included in the content of the school chemistry course should: "be organically related to the content of the chemistry curriculum in order to avoid overloading the course with additional material; to contribute to mastering the basics of chemistry, strengthening the polytechnic education of students; to help the teacher reveal the essence of anthropogenic influence on the biosphere, to educate students in a careful attitude towards nature, a sense of civic responsibility for its preservation" [1, p.26].

A.M. Yasynska scientifically substantiated the social necessity and pedagogical expediency of creating specialized classes of a chemical-ecological profile and created a special course for students of grades 8-11 "Fundamentals of chemical ecology (environmental chemistry)" [8]. In connection with the increased attention to environmental education and education of students and the deterioration of the ecological state of the environment, the author suggests the introduction of the special course "Chemistry and Nature" in the classes of the chemical-technological profile [9].

According to T.I. Voronenko , optional classes are an effective means of environmental education. The author developed optional courses "Chemistry and environment" for students of grades 8-9 and " Ecological-hydrochemical characteristics of the state of natural waters" for students of grades 10-11, which have a practical and ecological orientation [2].

As the analysis of pedagogical literature and school practice shows, solving chemical problems with ecological content is an effective means of forming students' knowledge about environmental problems [3,7].

As for the problem of using the local lore principle in environmental education when studying the school chemistry course, it has practically not been investigated.

The purpose of the article is to reveal the method of using elements of environmental knowledge based on the principle of local history in teaching some topics of the school chemistry course.

The main part. Since the school chemistry course has its own research subject, content, goal, tasks and learning methods, it is subject to both general didactic and specific learning principles. The principle of regionality, or local lore, belongs to the specific principles of teaching chemistry.

The principle of local history involves introducing into the educational material information about the locality in which schoolchildren live, about the natural conditions, economy, ecological state of the native region with cognitive, scientific, educational, educational and practical purposes. The use of local history material in chemistry lessons helps to reveal general laws and phenomena that are studied, improves the depth of understanding of the educational material, increases interest in it, enriches students with knowledge about their native region, promotes the development of creative thinking and leads to an understanding of the main problems of their area.

H.P. Pustovit believes that local history is the most important didactic principle of environmental education, and the use of local history material in education makes it possible to study environmental problems using concrete examples [5].

In order to find out the practical state of the investigated problem, we conducted a survey among chemistry teachers. They were asked the question: "Do you carry out environmental education of schoolchildren by means of the school chemistry course, using material about the ecological state of your area?". From the results of the questionnaire, we learned that 19.3% of the interviewed teachers use materials about the ecological state of their locality in teaching chemistry to schoolchildren, but not systematically, 57.2% carry out environmental education of schoolchildren in chemistry lessons, but do not use the principle of local history and 23.5% - do not carry out environmental education of students in

chemistry lessons, explaining this by lack of time and insufficient amount of didactic materials. The results of the answers are clearly illustrated in figure 1.

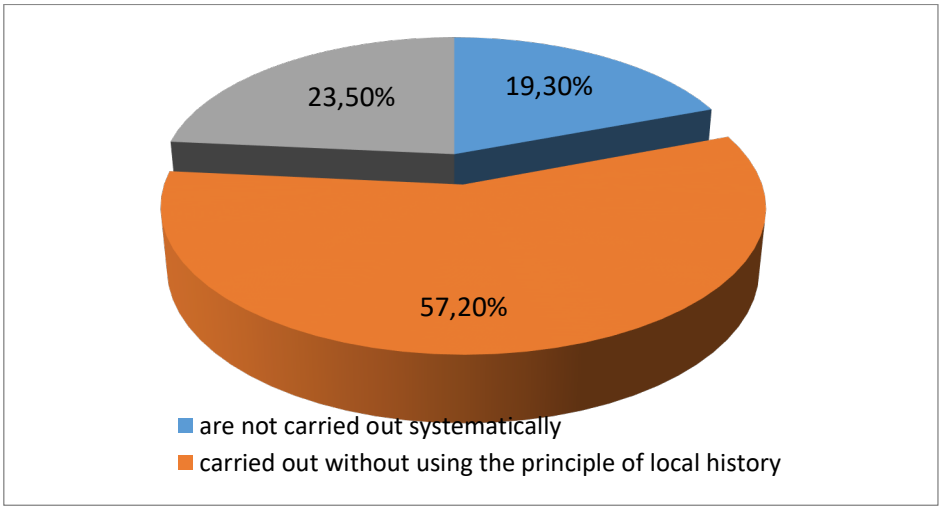

Fig. 1. The results survey on the question " Is carry out you ecological education schoolchildren means school chemistry course, using material about the ecological state of yours area?".

Based on the above survey results, it can be concluded that teachers do not sufficiently use the possibilities of the school chemistry course and local history material for the purpose of environmental education of schoolchildren.

In order to carry out environmental education of students through the school chemistry course based on the principle of local history, we chose to use information about the main chemical and ecological indicators of the water of the Southern Bug River, because it is the main source of drinking water supply of the city of Vinnytsia.

Based on the analysis of the chemistry curriculum for general educational institutions [6] and current textbooks, we have chosen topics, during the study of which it is appropriate to use knowledge about the chemical and ecological assessment of water (table 1).

Table 1. The use of knowledge about the chemical and ecological parameters of the water of the South Bug River in a school chemistry course

Class	Topic name	*The content of the environmental component*
7	Basic chemical concepts.	Filtering as one of the methods of cleaning sewage and natural waters during water treatment .
	Water.	Problems drinking water. Water resources of Ukraine. Ecological condition of the South Bug River. Influence activity of man on the ecological state of water objects in .
	Solutions.	The role of water as a solvent in living nature and practical human activity. Maximum permissible concentrations of substances in drinking water and indicators of its quality. Anthropogenic sources of water pollution of the Southern Bug River.
0	Aromatic hydrocarbons. Pesticides.	Pollution of the aquatic environment with pesticides and its consequences.
	Oil	Pollution of water bodies with oil and oil products and its impact on the vital activity of hydrobionts.
	Phenol	Phenol as a pollutant of the water environment.
	Synthetic detergents	Pollution of the water environment of the SMZ.
	Chemistry and ecology	Ecological condition of rivers and reservoirs of Ukraine and the native region. Assessment of the water condition of the Southern Bug River according to chemical and ecological indicators. Rational use of water. Water pollution. Problems of wastewater treatment.

Continuation **table 1**

1	Mineral fertilizers: nitrate and phosphate.	The content of nitrates and phosphates as an indicator of contamination of water bodies with mineral fertilizers.
	Carbonic acid and carbonates	Water hardness (carbonate and non-carbonate). Ways to eliminate water hardness.
	Physical properties of metals.	Concept of heavy metals, their content in water and negative impact on hydrobionts and human health.

The introduction of the material on the chemical and ecological assessment of the water of the Southern Bug River in the school chemistry course took place in accordance with the patterns of its assimilation and the age characteristics of the students. The educational material was studied from simple to complex as students developed relevant chemical knowledge and skills. First, methods of water purification, physical and chemical properties of water, characteristics of water objects, types of pollution of the water environment, etc., were studied.

Let's consider a specific example of the use of material on the chemical and ecological assessment of the water of the Southern Bug River in the process of studying the school chemistry course. Today, the issue of oil pollution of water bodies has become acute, so when studying the topic " Oil and its processing products " (10 cl) it is important to show the impact of oil products on the state of water bodies. In this lesson, we note that the degree of toxicity of different types of oil products is not the same, but they have one property in common - they attract other toxic chemicals, as a result of which whole depths of "time bombs" float in rivers, seas and oceans. This property of oil should be taken into account by people who pour oil tanker washing water directly into the ocean, or build gas stations near water bodies without thinking about the future. The South Bug River is also polluted with oil products, their average annual concentration is 0.3 mg/l, while the maximum permissible concentration of oil products for drinking water bodies is 0.1 mg/l. After that, we jointly discuss measures aimed at reducing the negative impact on the environment. This approach contributes to the development of students' cognitive interest in the problems of environmental protection and chemistry as a science.

Conclusions. So, the use of ecological material in the school chemistry course based on the principle of local history makes it possible to carry out environmental education of schoolchildren, which contributes to the awareness of students of the need for a careful attitude and rational use of natural resources.

We see the prospects for further research in identifying the impact of group work of students in chemistry using local history material of an ecological orientation on the environmental education of schoolchildren.

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PROBLEMS OF ENVIRONMENTAL PROTECTION AND BALANCED NATURE MANAGEMENT

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Usage of spent clay sorption materials in leather and fur production technologies

The work is devoted to solving the current problem of increasing the level of environmental safety of treatment industrial wastewater of leather production from chromium ions (III) through the use of natural and modified bentonite. The most promising way of wastewater purification is the sorption technology, which is widely used in many countries to prevent pollution of the environment by wastewater from industrial enterprises. Studies of the use of natural and modified bentonite in the adsorption of Cr^{3+} ions have been carried out. The purpose of the research was to study the use of clay sorbents previously applied for the purification of wastewater from heavy metal ions in technological processes of leather and fur production. The possibility and modes of application of spent bentonite dispersions for the processing of leather semi-finished products to increase resource conservation and environmental friendliness of leather production were also established. The influence of the process duration on the sorption efficiency of chromium ions has been studied. Studies have been conducted to use spent bentonite in tanning and filling processes. The efficiency of modification of montmorillonite has been proved and the expediency of using mineral dispersion for qualitative formation of the structure and properties of the leather during tanning has been established.

The efficiency of adsorption of anionic dyes on spent montmorillonite is investigated. Was identified a high level of adsorption of anionic dyes at pH 5-6.5. The role of the dye structure, the level of the critical concentration of micelle formation on the dye adsorption on the surface of montmorillonite is provided. Utilization of spent bentonite by using it as part of multifunctional materials for the processing of leather semi-finished products contributes to a considerable increase in resource conservation and environmental friendliness of leather production.

Keywords: *ecological safety, natural clay sorbents, adsorption, bentonite, ions of heavy metals, modification, semi-finished item*

Introduction. Wastewater and surface water contamination with chromium ions remains a dramatic environmental problem that currently has no sufficiently effective solution. In spite of a great number of scientific studies, the technologies developed on their basis have not been widely used, since they are not flawless enough and provide no opportunity to achieve the necessary depth of clearance. The issue of wastewater filtering is also of great importance in leather technology, since chromium (III) salts are used for leather tanning, while the maximum degree of tanning is 90%, and the rest goes down the drain.

The most promising way of wastewater purification is the sorption technology, which is widely used in many countries to prevent pollution of the environment by wastewater from industrial enterprises. At present, considerable experience has been accumulated in the use of natural clays and their modified forms for the purification of wastewater from heavy metal ions. The foremost advantages of using adsorption materials are the following ones:

1. Deposits of natural sorbents are widespread in Ukraine;
2. Natural sorbents are a cheap and available material;
3. The spent natural adsorbent can be regenerated by the desorption method, although it is possible to use the spent sorbent in subsequent sorption;

4. Adsorption technologies provide a high degree of purification.

A thorough analysis of the latest publications revealed that an important direction of scientific research nowadays is also the determination of effective methods of regeneration and ways of utilization of sorbents, which were hitherto used as sorbents in the treatment of wastewater and communal drains. Ultimately, the utilization of sorption materials helps not only reduce the man-made burden on the environment, but also improve the technologies of creating alternative materials due to the use of high-quality clay material.

At present, highly dispersed spent minerals are extensively used in many sectors of the national economy, including the production of various consumer goods. However, the limitation of scientific research determines the low level of use of spent clay sorbents in leather production processes. Their use is based on specific colloidal chemical properties, which are caused by the crystalline structure of minerals.

The chemical composition and peculiarities of the crystalline structure of highly dispersed minerals in terms of the ratio of alumino- and silica layers determine the complex of their sorption, exchange, coagulation properties as well as their ability to disperse. The relevance of this research for leather production is also due to the need to dispose of sorbents used for wastewater filtering, in particular for chromium-containing wastewater from tanning and decor shops.

The purpose of the research was to study the use of clay sorbents previously applied for the purification of wastewater from heavy metal ions in technological processes of leather and fur production. The possibility and modes of application of spent bentonite dispersions for the processing of leather semi-finished products to increase resource conservation and environmental friendliness of leather production were also established.

Materials and methods, Wastewater after tanning is regarded the most concentrated in leather production since it makes up 1% of the total water consumption. It has an acidic reaction, its pH is from 3 to 6.5. Such wastewater contains a maximum of: 170 g/dm^3 of dense sediment, 15 chlorides, 22 sulfates, and 5 chromium oxide.

Heavily polluted wastewater includes spent solutions after re-dosing, which also contain a considerable amount of chromium salts (in terms of Cr_2O_3, a maximum of 3g/dm^3). The amount of such waste is approximately the same as after tanning.

Foregoing studies allow stating [2] that the use of sorption methods is most effective at an initial content of chromium ions of 1-1.5 g/dm^3. That is, preliminary wastewater treatment is advisable, which includes the stage of sedimentation, filtration and reagent sedimentation with lime followed by the subsequent removal of the formed sediment [4]. The resulting filtrate contains about 1 g/dm^3 of chromium ions and 5 g/dm^3 of chloride ions.

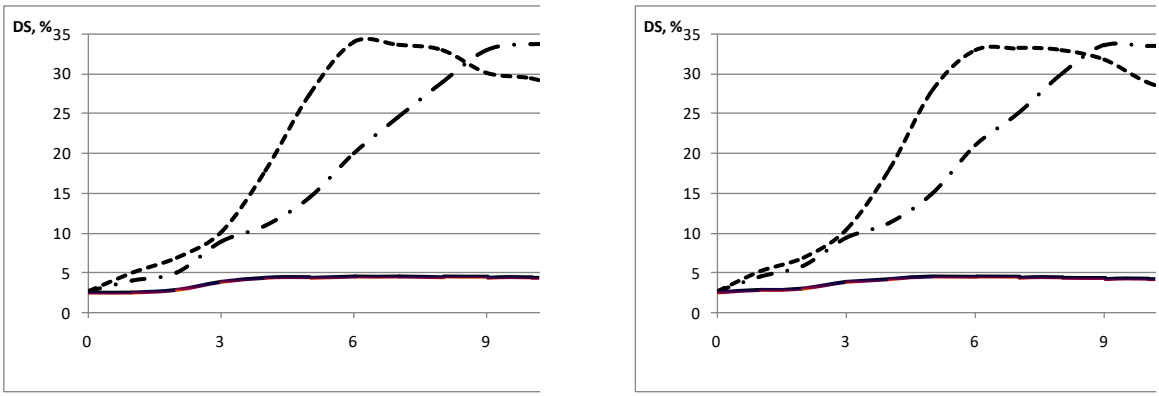
We obtained the results of determining the content of chromium ions in the spent dry sorbent according to the known method [5]. The practical content of metal ions in the clay sample is 95-97% of the calculated value of Cr^{3+}.

Research results. Taking into consideration the structural features and colloidal chemical properties of highly dispersed minerals, in particular bentonite, it is possible to use them as fillers for chrome semi-finished products and to regulate the formation of the dermis structure during the production of skins depending on their intended purpose [6]. In research papers [7,8], the possibility of effective use of bentonite specially modified with chromium salts in the processes of filling, tanning, and re-tanning of leather semi-finished products was much paid attention to. Given the structural features and colloidal-chemical properties of highly dispersed minerals, we investigated the possibility of using bentonite saturated with chromium ions at the stage of wastewater filtering, as a filler in chrome semi-finished products, a component of pigment pastes or to regulate the formation of the dermis structure during tanning.

Bentonite dispersion is extremely influenced by the following factors: the nature of the salt chosen for dispersion and its concentration (Cs,%). The degree of swelling (Ds,%) of water dispersions of spent bentonite (experiment) and pure bentonite (control) under the influence of sodium carbonate H_2CO_3, sodium formate HCOONa, and sodium hexametaphosphate $Na_6P_6O_{18}$•$6H_2O$ was determined.

The results of the relevant studies are presented in Figure 1, indicating that the best level of dispersion is achieved when using sodium carbonate, but it is also possible to achieve a sufficient degree of swelling when using sodium hexametaphosphate The nature of the dependences for modified and spent bentonite is very similar.

The best influence of sodium carbonate on dispersion structure formation and dispersing determined its use in further research. To establish the optimal consumption of sodium carbonate, the viscosity of dispersions was determined at different salt consumption.



control experiment

Fig. 1. The degree of swelling of aqueous bentonite dispersions under the influence of salts.
---- H_2CO_3; -•-- $Na_6P_6O_{18}•6H_2O$; ── HCOONa.

The results of rheological studies indicate that the highest viscosity of the dispersions is achieved with a sodium carbonate consumption of 5.5-7% and at the same time determines the maximum degree of dispersion of the system both with spent bentonite and in the case of its previous modification.

The viscosity of dispersions with different degrees of saturation with chromium ions was also established. The results of the research are presented in Figure 2.

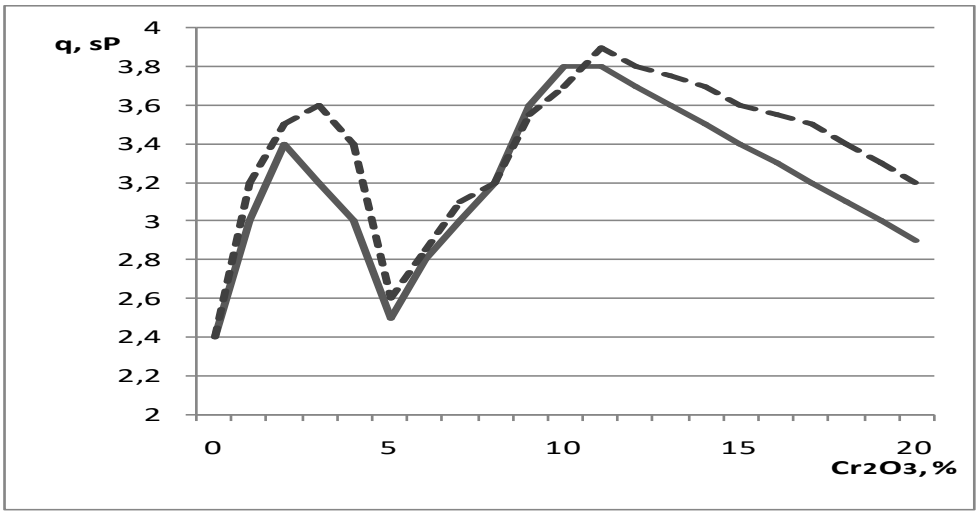


Fig. 2. Dependence of kinematic viscosity on the content of chromium ions in bentonite.
── control — —experiment

In general, the analysis of the dependence of viscosity on the consumption of chromium indicates the obtaining of the most diluted dispersions of spent and natural bentonite with the content of chromium compounds in them of 5–6% Cr_2O_3 by mass of montmorillonite. At the same time, the dispersions are characterized by a stable pH level in the range of 3–4 at the appropriate consumption of chromium compounds. The dilution effect can be explained by the adsorption of sodium ions and mutual repulsion between montmorillonite particles.

The adsorption stability of the dispersions was evaluated by settling them for 30 minutes at different pH values, which were adjusted by mixing appropriate amounts of HCI 0.02 M, NaCl 0.02 M, and NaOH 0.02 M solutions. The obtained results indicate that the dispersions based on spent bentonite show high stability in wide pH ranges. A certain level of delamination is observed at pH 2.5 and at pH 12. In the latter case, hydrolysis of chromium compounds probably occurs, which is confirmed by a change in the color of the dispersion. Therefore, it is feasible to recommend the use of dispersions based on spent bentonite in liquid processes occurring in acidic (pH=3) and slightly acidic (pH=4.5÷5.6) environments.

The degree of adsorption of anionic dyes by dispersions of spent bentonite was determined to study the possibilities of obtaining hybrid pigments, As a result of processing spent bentonite with solutions of anionic dyes of different chemical composition, the efficiency of adsorption of anionic dyes on mineral particles was determined (Table 1).

Table 1. Qualitative analysis of adsorption of dyes on bentonite

Type of dye	Molecular weight	Dye consumption, % of the mass of completely dry mineral			
		25	50	75	100
Anionic dark green	863	-	-	-	+
Anionic black	859	-	-	-	+
Anionic blue	637	-	-	+	+
Anionic yellow	710	+	+	+	+
Barvalan blue-black	794	+	+	+	+
Barvalan bright red	836	+	+	+	+

+ – appearance of a colored ring around a sample of modified montmorillonite
- – absence of paper staining around the sample of modified montmorillonite

A low level of adsorption of such dyes as barvalan bright red, barvalan blue-black and anionic yellow was visually established. This is evidenced by the absence of coloring of bentonite in the color of the dye after its separation from the dispersion medium: only a colored ring around the sample was observed. At any dosage of the aforementioned anionic dyes from the mass of the mineral, the color of the solid phase in the color of the dye did not occur.

However, as a result of the use of anionic dark green and anionic black dyes, the dispersed phase was completely colored in the color of the dye, which indicates the ability of the dye particles to adsorb on the surface of the modified bentonite and interact with each other to a greater extent. Only when the dye was dosed at 100% by weight of the mineral, a slight staining of the diffusion ring occurred during paper chromatography, which indicates the maximum level of absorption of the dye on the surface of the clay mineral.

Qualitative analysis revealed no regularities regarding the influence of the molecular weight of the dye on the intensity of adsorption. Perhaps, the crucial importance is not the molecular weight, but the presence of various reactive dye groups (-OH, -COOH, -NH2, -SO3H), which are capable of interacting with montmorillonite particles.

The research results testify to the fact that the dyes anionic dark green, anionic black and anionic blue are able to precipitate and adsorb on the bentonite surface when their consumption is 100% of the mass of the completely dry mineral, that is, when the ratio of montmorillonite: dye is 1:1, which is taken into account in further research. The obtained results also demonstrate that the adsorption level of the selected dyes (anionic black, anionic blue, and anionic dark green) was determined and adsorption isotherms of these dyes on chromium-containing bentonite particles were obtained, which is shown in Figure 3.

Given that adsorption is a function of dye concentration, pH, concentration electrolyte, solid phase concentration, and temperature, during the tests temperature, pH, electrolyte and solid phase concentration were constant. It should be noted that the nature of adsorption for all dyes corresponds to the Langmuir isotherm. At the beginning, all curves were characterized by rapid growth, i.e., in this area, dye molecules are adsorbed on the surface of montmorillonite particles due to the electrostatic interaction of the chromium cation with the dye anion. Further, the peak of each isotherm shows the saturation of the bentonite surface with dye molecules and the neutralization of the surface charge of the mineral. The interaction with montmorillonite is completed by polymolecular dye adsorption due to Vander-Waals forces [6].

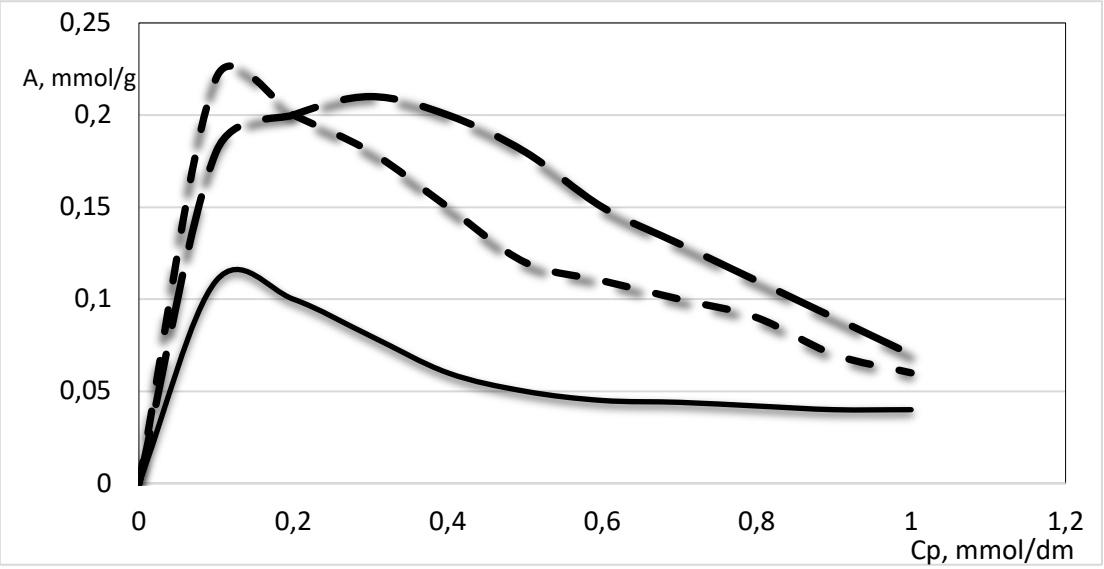


Fig. 3. Adsorption isotherms on montmorillonite of dyes: anionic black (──), anionic dark green (- - -) and anionic blue (— —).

Comparison of the adsorption isotherms of different dyes (fig. 1) demonstrates that the maximum adsorption is observed in the case of anionic dark green use. Despite the fact that the adsorption of all the dyes chosen for the study increases, the lowest adsorption maximum is observed for the anionic black dye. This phenomenon can be explained by the rapid formation of micelles in solutions of anionic black. The manifestation of the steric factor during the adsorption of its associates in the micropores of the cationic form of chromium-containing bentonite is so significant that the amount of its adsorption reaches minimum values. The lower level of adsorption of dyes from micellar solutions, compared to molecular solutions, is explained by steric complications. Increasing the concentration of the anionic black dye above 0.4 mmol/g causes rapid, irreversible polymolecular adsorption, which is positive for obtaining a high-quality pigment. An increase in the concentration of anionic blue and anionic dark green dyes causes a further decrease in the level of adsorption of dyes, which is probably due to the predominant formation of micelles. It is worth noting that for all the selected anionic dyes, it was visually established that a pigment of a saturated, intense color was obtained, especially in the case of using an anionic black dye.

Conclusion. The chance of using dispersions of spent bentonite containing chromium ions for tanning, re-tanning and filling of leather semi-finished products with partial replacement of chromium compounds was established. The use of dispersions based on spent bentonite with a residual content of chromium ions dispersed by sodium carbonate will definitely contribute to the effective formation of the chrome tanning hides, structure and quality indicators.

The ideal composition of dispersions with specified rheological properties and sufficient stability was also determined: the content of chromium ions in spent bentonite is 5÷6%. in terms of Cr_2O_3, consumption of sodium carbonate 5.5-7%, the pH is ranges from 3 to 4.

The combination of chromium compounds and chromium-containing montmorillonite dispersions for tanning will allow reducing the consumption of chromium tanner, improve the degree of absorption of chromium compounds and reduce their concentration in spent tanning liquids.

A high level of adsorption of anionic black, anionic dark green and anionic blue dyes, which are widely used in industry, was revealed. The role of the dye structure, its functional groups and the level of the critical concentration of micelle formation on the level of adsorption of the dye on the surface of montmorillonite is demonstrated.

Utilization of spent bentonite by using it as part of multifunctional materials for the processing of leather semi-finished products contributes to a considerable increase in resource conservation and environmental friendliness of leather production.

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Method of uilizaion of the forbidden chlorinated pesticides through the recycling of the raw materials that include titanium

Abstract. *The article is dedicated to the actual problem of the recycling of the forbidden Chlorinated pesticides. The capacity of the usage of the forbidden Chlorinated pesticides as the chlorinating agents in the process of ilmenite concentrate recycling on the example of hexachlorobenzene is described. The thermodynamic parameters and equilibrium concentrations of obtaining carbon tetrachloride from hexachlorobenzene are defined. The process of chlorinating of the ilmenite concentrate is researched, the change of equilibrium to the concentration starting reagents and the reactions' products with the carbon tetrachloride from Mining and Metallurgical Complex of Vilnogirsk with the carbon tetrachloride is calculated. It is also showed that with the help of metabolic reactions of carbon tetrachloride and ilmenite it is possible to avoid the difficult redox transformations, which take place in the traditional technology of titanium obtaining.*

Keywords: *forbidden pesticides, hexachlorobenzene, chlorinating, carbon tetrachloride, ilmenite concentrate*

Introduction. The intensification of the environmental objects' pollution with pesticides is caused by the processes of their long-term usage and accumulation. The ecological situation in Ukraine is becoming more difficult due to the almost absolute ignorance of the long-term problem of the obsolete pesticides recycling even though the annual formation of amount of those was high and the level of secondary use was incredibly low. Also, as the result of disruption of economic activity, the huge masses of obsolete and forbidden to use pesticides were accumulated. Today, the world is trying to solve the problem of recycling, utilization or the secondary use of the synthetic chemical pesticides. Hexachlorobenzene, or perchlorobenzene is a chemical compound with the formula C_6Cl_6, which is used for fighting the ustilaginales; and also used as insecticide and fungicide. Moreover, it was used in a mixture with other products to poison the seeds of the grain crops. It is the Stockholm Convention on Persistent Organic Pollutants that was applied regarding hexachlorobenzene, due to which this substance is forbidden all over the world [1].

Currently, more than a half of the amount of Titanium (IV) oxide is obtained by the chlorine technology. Elemental chlorine is widely used in the industry of rare and non-ferrous metals [2]. It is due to its high reactivity. In the interaction of Chlorine with the mineral raw materials that include titanium it's relatively easy to obtain not only Titanium chloride, but also the chlorides of the other present metals. Variety of the properties of chlorides, the easy way of their interaction with the other chemical compounds lets us to exclude them out of the reaction products, emitting valuable components effectively. The main advantage of the chlorine technology of producing $TiCl_4$ is the opportunity of obtaining some specific metals, the production of which is possible only due to the chlorides [3, 4]. Furthermore, this technology can be realized in the continuous mode. Due to the high reactivity of Chlorine, degree of the starting material conversion to the chlorides can reach 99% [5]. Also, the little amount of waste, a very few stages of production, almost full absence of the wastewater, and the possibility to create the closed Chlorine cycle (Chlorine may be rotating) might be important to mention.

The purpose of this work is to research the possibility of the use of the forbidden Chlorinated pesticides as the chlorinating agents in the process of ilmenite concentrate recycling on the example of hexachlorobenzene.

The results of the discussion. During the first stage, we calculated the value of enthalpy, entropy, Gibbs energy, and the equilibrium constant of interaction of hexachlorobenzene with the elemental Chlorine (table 1) for the cumulative equation of the reaction:

$$C_6Cl_6 + 9Cl_2 = 6CCl_4 \quad (1)$$

Table 1. Dependence of the enthalpy, entropy, Gibbs energy, and the equilibrium constant change on the temperature of the interaction reaction of hexachlorobenzene and Chlorine

T, °C	ΔH, kJ	ΔS, J/K	ΔG, kJ	K	log(K)
0	-540,231	-589,531	-379,200	3,317E+072	72,521
100	-538,173	-583,161	-320,567	7,544E+044	44,878
200	-535,133	-575,978	-262,609	9,859E+028	28,994
300	-531,598	-569,209	-205,356	5,211E+018	18,717
400	-527,933	-563,315	-148,738	3,488E+011	11,543
500	-524,360	-558,363	-92,661	1,823E+006	6,261
600	-521,016	-554,293	-37,035	1,643E+002	2,216
700	-517,932	-550,946	18,221	1,052E-001	-0,978
800	-515,091	-548,165	73,173	2,742E-004	-3,562
900	-512,435	-545,798	127,868	2,024E-006	-5,694
1000	-509,878	-543,706	182,341	3,298E-008	-7,482

Out of conducted thermodynamic calculations, it is obvious that as the result of the process of hexachlorobenzene chlorinating the formation of CCl_4 is possible, so there emerged a problem of defining the optimal conditions that would lead to the maximum degree of conversion. To study the impact of temperature on the hexachlorobenzene chlorinating, the change of equilibrium concentrations of the starting and chlorinating reaction products was calculated (figure 1).

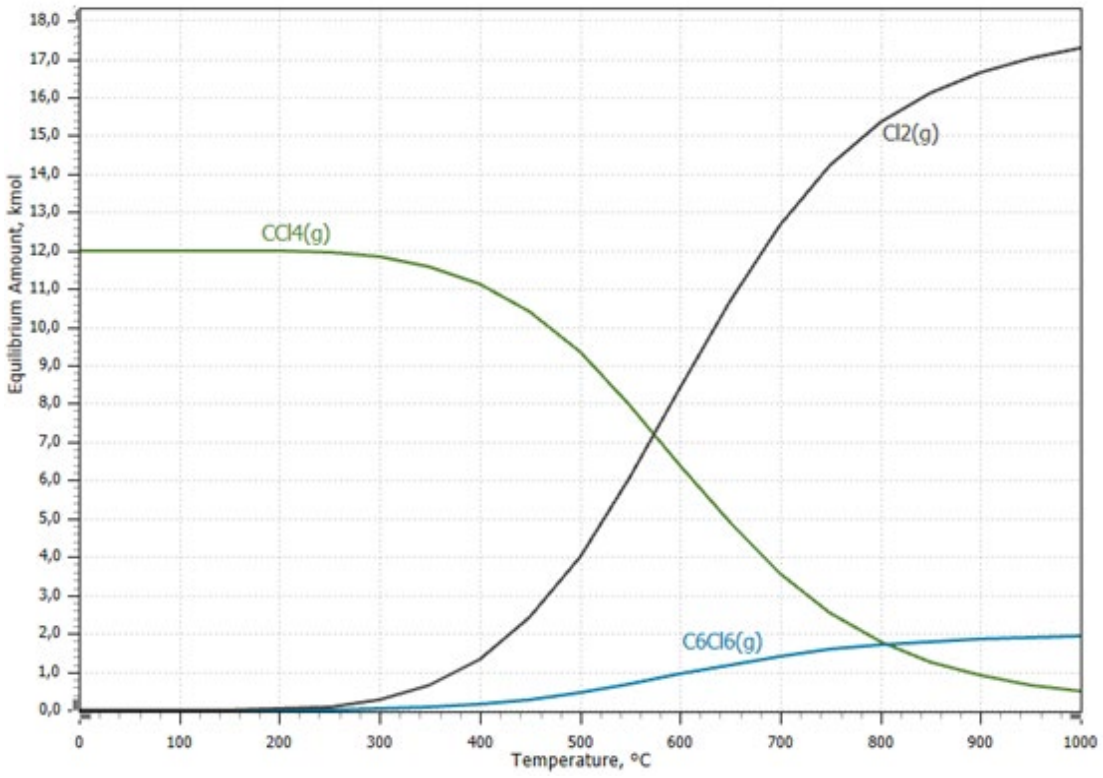

Fig.1. Impact of the temperature on the equilibrium composition in the system C_6Cl_6 - Cl_2

Out of the results of calculating equilibrium concentrations of the system C_6Cl_6 - Cl_2 that is depicted on the illustration 2, it may be stated that relatively full degree of conversion of hexachlorobenzene in the temperature range of 180 to 200 ^{0}C is reached. The lower temperature bound is due to the condensation of carbon tetrachloride, and the upper – to the low degree of hexachlorobenzene conversion.

The ilmenite ores are the solid solutions of variable composition in the systems $FeTiO_3 – MgTiO_3 – Fe_2O_3$ and $FeTiO_3 – MgTiO_3 – MnTiO_3 – Fe_2O_3$, moreover, the impurities such as Al, Si, Nb, Cr, Ca, V, Co, Ni are also used. Ilmenite concentrates are obtained via gravitational enrichment and magnetic separation.

The chemical composition of the ilmenite concentrate of the Mining and Metallurgical Complex of Vilnogirsk is shown in the table 2.

Table 2. The chemical composition of the ilmenite concentrates of the Mining and Metallurgical Complex of Vilnogirsk

Компоненти:	TiO_2	Fe_2O_3	FeO	$Fe_{(заг.)}$	Al_2O_3	SiO_2	MnO	CaO	MgO	P_2O_5	Інші	Разом
Quantity, %	0,65	24,2	0,97	17,7	1,9	1,0	0,75	1,4	0,23	0,13	4,42	100

As we can see in the table 2, basic, acidic, and amphoteric oxides are the part of ilmenite concentrate. They are almost never excluded during the enrichment process and can negatively affect the excluding of titanium. In the process of using CC_4 for ilmenite concentrate decomposition, it is avoided the complex redox transformations that take place in the traditional technology of titanium obtaining.

Carbon tetrachloride was used for the ilmenite concentrate decomposition. We studied the cumulative schemes of the ilmenite concentrate decomposition processes according to the schemes of the following reactions:

$TiO_2 + CCl_4 = TiCl_4 + CO_2$ (2)

$2Fe_2O_3 + 3CCl_4 = 4FeCl_3 + 3CO_2$ (3)

$2FeO + CCl_4 = 2FeCl_2 + CO_2$ (4)

$SiO_2+CCl_4 = SiCl_4 + CO_2$ (5)

$2Al_2O_3+3CCl_4 = 4AlCl_3 + 3CO_2$ (6)

$2MnO + CCl_4 = 2MnCl_2 + CO_2$ (7)

$2MgO + CCl_4 = 2MgCl_2 + CO_2$ (8)

$2CaO + CCl_4 = 2CaCl_2 + CO_2$ (9)

$2P_2O_5 + 3CCl_4 = 4POCl_3 + 3CO_2$ (10)

After analyzing the obtained results, we can state that the examined ilmenite concentrate decompositions with Carbon(IV) chloride are thermodynamically possible in the considered temperature interval and happening with the high exothermic effect.

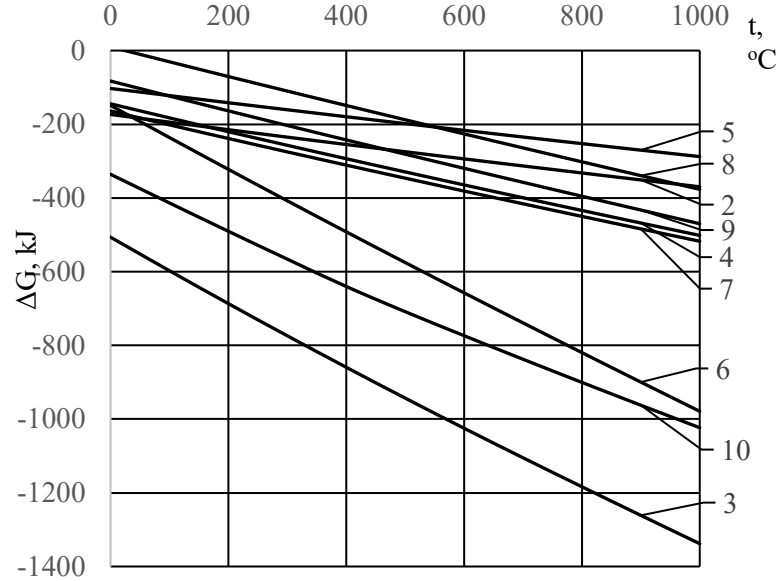

Fig. 2. Dependance of the conversion of Gibbs energy on the temperature of the ilmenite concentrate reactions of interaction with carbon tetrachloride (numbers of dependents are appropriate to the reactions numbers in the text).

Conducted analysis of the literary sources and thermodynamic researches claim that as the result of ilmenite concentrate decomposition processes it is possible to obtain such gas-phased products as Aluminum, Iron (III) and Silicium chlorides, and on the base of the temperatures' adjustment difference it is possible to selectively obtain Titanium tetrachloride.

To study temperature impact on the process of obtaining Titanium (IV) chloride, the change of equilibrium to concentration starting reagents and products of interaction reactions of ilmenite concentrate with carbon tetrachloride was calculated according to the schemes of reactions 2 – 10 (Figure 3).

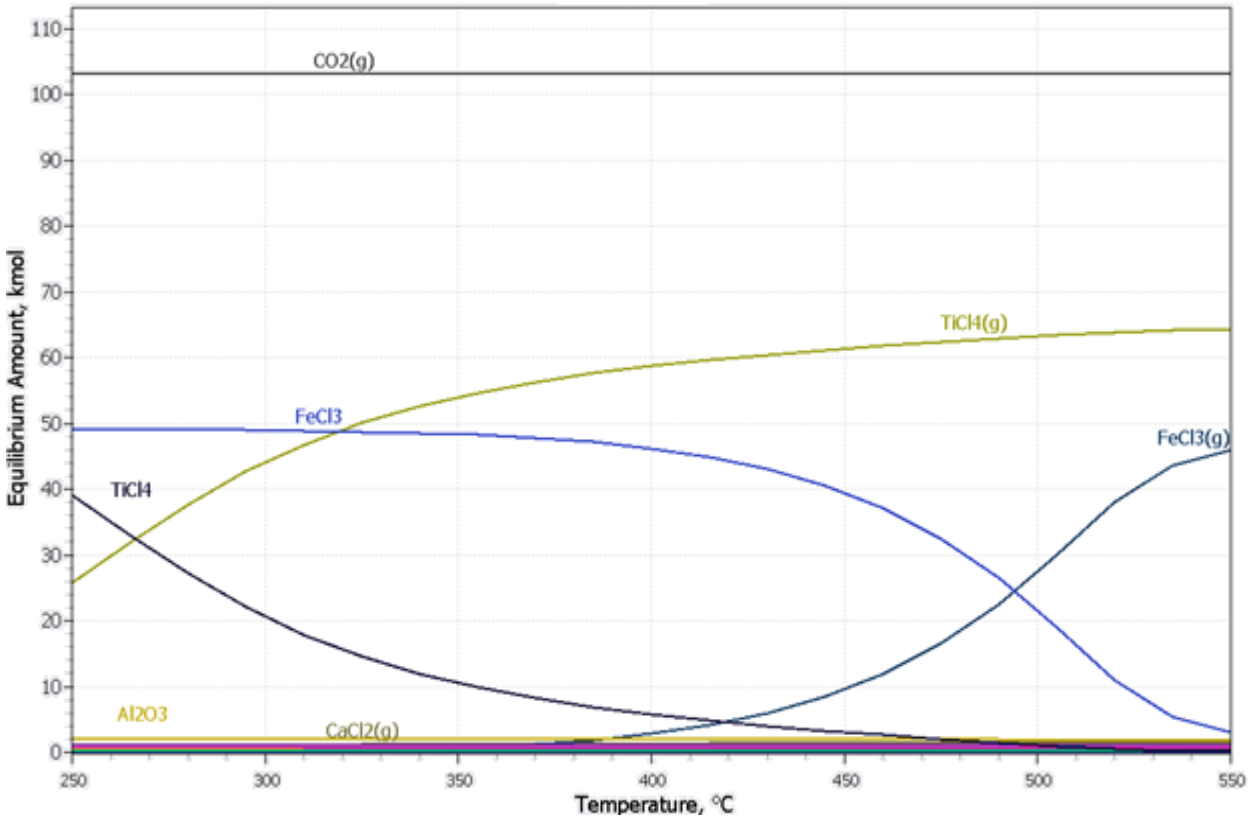

Fig. 3. Temperature impact on the equilibrium composition of products of ilmenite concentrate interaction with carbon tetrachloride

According to the calculating of equilibrium component concentrations results (illustration 3), it is statable that all of the ilmenite concentrates components almost fully react as it may be seen due to quite high degree of the concentrate components conversion into the final reaction products – Titanium, Aluminum, Iron, Calcium, Manganese, and Cranium chlorides.

Thus, such gas products thermodynamically most probably may be expected in the multicomponent reactionary system ilmenite – carbon tetrachloride: $TiCl_4$, $FeCl_3$, $FeCl_2$, $MnCl_2$, $MgCl_2$, $CaCl_2$. The split of such multicomponent compound is possible due to the rectification – split on the base of chlorides boiling temperatures of the appropriate salts.

Conclusions. In the system C_6Cl_6 - Cl_2 a relatively full degree of conversion of hexachlorobenzene in the temperature range of 180 to 200 ^{0}C is reached. The lower temperature bound is due to the condensation of carbon tetrachloride, and the upper – to the low degree of hexachlorobenzene conversion.

1. The process of the ilmenite concentrate of the Mining and Metallurgical Complex of Vilnogirsk chlorinating was studied. It was also showed that with the help of metabolic reactions of carbon tetrachloride and ilmenite it is possible to avoid the difficult redox transformations, which take place in the traditional technology of titanium obtaining.

2. Such process conducting rational conditions were defined: temperature regime of interaction process of CCl_4 with the ilmenite concentrate 390…400^{0}C and the stochiometric carbon tetrachloride expense.

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Research on the regeneration of concentrated ammonium solutions from municipal wastewater

The conducted studies confirm the possibility and expediency of using the reagent method to remove ammonium nitrogen from wastewater in the form of slightly soluble magnesium-ammonium orthophosphate $MgNH_4PO_4 \cdot 5H_2O$, which is a high-quality fertilizer.

The most optimal conditions for the process of reagent precipitation of ammonium nitrogen at an initial concentration of NH_4^+ - N – 470 mg / l are pH 8.5 and the stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1,5: 1: 1,5.

It was determined that according to the chemical composition, properties and behavior during heating of the obtained magnesium-ammonium phosphate crystallohydrate corresponds to the biogenic mineral struvite and can be used as a mineral fertilizer of prolonged action.

It was found that the method of preserving struvite does not significantly affect the germination of the disease and the value of the humidity of germination.

Key words: *regenerate, ammonium nitrogen, magnesium-ammonium orthophosphate, fertilizer.*

Introduction. Over the past 20-30 years, effluents containing many compounds of nitrogen and phosphorus have been entering reservoirs. This is due to washout from fertilizer fields and waste discharges from enterprises. As a result, there is eutrophication of such reservoirs and increased development of phytoplankton, algae, etc. When the content of phosphorus and nitrogen in water exceeds a critical level, the life processes of aquatic organisms are accelerated. As a result, the mass development of planktonic algae ("blooming of water") begins. Water acquires an unpleasant odor and taste, its transparency decreases, its color increases, and the content of dissolved and suspended organic substances increases. In the deep zone, anaerobic metabolism increases, hydrogen sulfide, ammonia, etc. accumulate. Redox processes are disturbed and oxygen deficiency occurs. This leads to the death of valuable species of fish and plants, the water becomes unsuitable not only for food purposes, but also for household purposes. For water bodies, excessive intake of biogenic substances, which contain nitrogen and phosphorus, is no less dangerous than toxic water pollution. With an excess of organic matter in water, stable organomineral complexes with heavy metals are formed, in some cases more toxic than the metals themselves.

The most common problem is the removal of ammonium nitrogen from water. Ammonium nitrogen is found in water mainly at pH 6-8. Organic and mineral nitrogen compounds are present in wastewater from many industries: chemical, petrochemical, medical, microbiological, metallurgical, food, agrochemical, as well as in underground and domestic waters. Purification of water from nitrogen compounds by chlorination, ozonation, ultraviolet irradiation, ion exchange, electrolysis, demineralization requires expensive reagents and equipment, these methods are difficult to operate and ineffective. Wastewater from these industries is purified from biogenic elements by conventional biological methods, but the degree of extraction of nitrogen compounds is very low.

The development of new highly efficient technological schemes for water purification, as well as the improvement of existing ones, is one of the ways to solve the problem of discharging insufficiently treated wastewater into water bodies. The use of the nitro-denitrophication method in combination with dephosphatization requires the improvement of reagent wastewater treatment with the help of a detailed

study of the formation of poorly soluble magnesium ammonium orthophosphate $MgNH_4PO_4 \cdot 5H_2O$, which is a valuable fertilizer.

The purpose of the research is to develop recommendations on the optimal conditions for the precipitation of ammonium nitrogen from the ion exchange regenerate for its further use as an ammonium fertilizer based on experimental data.

Experimental part. For research, a strongly acidic cation exchanger KU-2-8 was used, which has a gel structure and contains only one type of ion-exchange groups - sulfo groups. KU-2-8 is distinguished by high chemical resistance in dilute solutions of alkalis and acids, organic solvents and some oxidizing agents.

In these studies, the KU-2-8 ion-exchange material was saturated with ammonium ions from model effluents in a column apparatus until breakthrough was reached, after which the ion-exchange material was regenerated by pumping NaCl with a concentration of 30 g/L through it [1, 2]. The characteristics of the obtained concentrate are presented in table 1.

Table 1. Characteristics of the ion exchange regenerate

Ion exchange material	KU-2-8
Ionite regeneration solution	NaCl - 30 g/l
NH_4^+-N, mg/l	470
Ca^{2+}, mg/l	260
Mg^{2+}, mg/l	240
pH	6.5

For research, a model solution was prepared, the composition of which corresponded to the composition of the ion exchange concentrate. The studies were carried out at room temperature by chemical precipitation. For this, solutions of magnesium chloride were used. ($MgCl_2 \cdot 6H_2O$) with a concentration of Mg^{2+} – 10000 mg/l and sodium hydrogen phosphate (Na_2HPO_4) with a concentration of PO_4^{3-} - 9500 mg / l. To determine the optimal conditions for the deposition of ammonium nitrogen, experiments were carried out at various stoichiometric ratios of Mg^{2+}:NH_4^+:PO_4^{3-} (1:1:1; 1.5:1:1; 1:1:1.5; 1, 5:1:1.5; 1:1.5:1) and pH 7-11.

Precipitating agents were added to the model solution in the required volumes to achieve the appropriate ratio of Mg^{2+} : NH_4^+: PO_4^{3-} . After that, the pH was adjusted to a predetermined value [3]. The reaction mass was stirred on a TYPE: OP-912/3 magnetic stirrer for 1 min at 350 rpm (rapid stirring, reaction time), then for 30 min at 20 rpm (slow stirring, floc formation). The resulting suspension was allowed to stand for 60 min, filtered (using an ashless blue ribbon filter with a pore size of 3μm). The resulting filtrate was analyzed for the content of residual ammonium ions and phosphate ions. The analysis was carried out on an FEK-56M photoelectrocolorimeter according to the methods of photometric determination of ammonium ions with Nessler's reagent in wastewater (KND 211.1.4.030-95) and photometric determination of phosphate ions in wastewater (KND 211.1.4.043-95). The obtained data were compared with the initial concentrations in the model solution of the corresponding ions to determine the precipitation efficiency.

Due to the large number of variable parameters during the experiments, a study was conducted in five groups (A, B, C, D, E) depending on the molar ratio of ions: Mg^{2+}, NH_4^+, PO_4^{3-}.

- Group A - stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1:1:1, pH 7; 8; 9; 10; 11.
- Group B - stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1,5:1:1, pH 7; 8; 9; 10; 11.
- Group C - stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1:1:1,5, pH 7; 8; 9; 10; 11.
- Group D - stoichiometric ratio Mg^{2+}:NH_4^+:PO_4^{3-} = 1,5:1:1,5, pH 7; 8; 9; 10; 11.
- Group E - stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1:1,5:1, pH 7; 8; 9; 10; 11.

Correction of the corresponding stoichiometric ratios Mg^{2+} : NH_4^+: PO_4^{3-} was provided by mixing different volumes of working solutions in accordance with the calculations.

Sodium phosphate (Na_2HPO_4) was used as the precipitant, so the filtrate was examined for the content of residual phosphate ions. When analyzing the research results, attention was paid not only to the maximum degree of extraction of NH_4^+-N, but also the degree of extraction of PO_4^{3-} .

Analyzing the results of laboratory studies of five groups, it was proved that the maximum efficiency of ammonium nitrogen removal is achieved at a pH of about 8.5 and a ratio of Mg^{2+} : NH_4^+ :

PO_4^{3-} = 1.5:1:1.5. A change in the ratio of Mg^{2+}:NH_4^+:PO_4^{3-} , as well as with an increase in pH above 8.5, leads to a decrease in the removal efficiency of NH_4^+-N. The maximum degree of extraction of PO_4^{3-} is also achieved under similar conditions [4].

Therefore, the most optimal conditions for the process of reagent deposition of ammonium nitrogen at the initial concentration of NH_4^+-N - 470 mg/l is pH 9 and the stoichiometric ratio Mg^{2+}:NH_4^+: PO_4^{3-} = 1.5:1:1.5. At the same time, the content of adsorbed NH_4^+-N ions is 93.91%, PO_4^{3-} - 95.26%.

The weight method was used to determine the moisture content of the sediment and for optimal conditions (Mg^{2+}:NH_4^+:PO_4^{3-} = 1.5:1: 1.5, pH 9) it is 40.7%. The calculation of the sediment moisture made it possible to establish the formula of the crystalline hydrate - $MgNH_4PO_4 \cdot 5H_2O$.

Magnesium-ammonium orthophosphate is a concentrated fertilizer that contains three nutrients: phosphorus, nitrogen and magnesium. $MgNH_4PO_4 \cdot 5H_2O$ can be used as a stand-alone fertilizer or to produce mixed fertilizers. This compound is one of the few fertilizers containing nitrogen in a water-insoluble form. Therefore, this fertilizer can be considered as a long-acting fertilizer.

The purpose of further of research was carrying out agronomic evaluations fertilizer obtained by the reagent method deposition of ionic concentrate exchange, and installation him suitability for use in organic production products crop production. Previously defined solubility magnesium -ammonium phosphate in water and in water solutions lemon acids of small concentrations. It is established that synthesized struvite has a solubility coefficient in water K_1^{20}=0.025, in 1% solution lemon acid K_2^{20}=0.068, in a 2% solution lemon acid K_3^{20}=0.203.

For the purpose of definition, biological efficiency struvite were conducted laboratory research by definition germination Raphanussativusvar. sativus radish seeds of the Saksa variety, manufacturer: Ukraine, also seeds watercress - salad. Efficiency effects of synthetic struvite determined by the following indicators as: resemblance seeds, energy germination for three days, duration germination. Also determined humidity germinated seeds.

For the germination analysis, three samples of 30 seeds in each variant were counted in a row, without selection. Seeds were germinated in Petri dishes at room temperature. Filter paper was used as a bedding. The reliability of the average germination rates was determined by the value of the least significant difference at the 5% significance level of $HI_{0.5}$.

The experimental data were varied according to the following scheme:

1 – control (distilled water).

1.1 – rate of application of magnesium-ammonium phosphate (MAF) 0.025 g/ml of distilled water;
1.2 – rate of application of MAF 0.068 g/ml of distilled water;
2.1 – rate of application of MAF 0.025 g/ml of 1% solution of citric acid;
2.2 – rate of application of MAF 0.068 g/ml of 1% solution of citric acid;
3.1 – rate of application of MAF 0.025 g/ml of 2% solution of citric acid;
3.2 – rate of application of MAF 0.068 g/ml of 2% solution of citric acid.

Table 2. Effect of struvite on germination of radish seeds

№ experiment	Seeds germination, %	Deviation from control, %	$HIP_{0,5}$	Duration of germination, days	The energy of germination
1.Control	90,0	-		1	90,0
1.1	93,3	3,3	1,07	2	93,3
1.2	93,3	3,3		2	93,3
2.1	90,0	0	0,86	2	90,0
2.2	86,7	-3,3		3	86,7
3.1	86,7	-3,3	1,85	3	86,7
3.2	80,0	-10		4	76,7

As a result of five days of germination of radish seeds, it was found that in the control variant with distilled water, the seeds germinated on the second day of the experiment. In variants with citric acid solution, seeds germination averaged 88.35% for variants of the second group and 83.35% for variants of group 3. In the variants with MAF solutions, higher germination rates were characteristic of aqueous solutions, but it is likely that stucco slows down germination. It can be definitely stated that the citric acid solution slows down the germination of radish seeds and reduces the germination rate to a greater extent due to acidification of the medium. The values of seeds moisture content (Fig. 1) confirm that citric acid

medium reduces the moisture content of germinated seeds, which indicates a decrease in the efficiency of their germination.

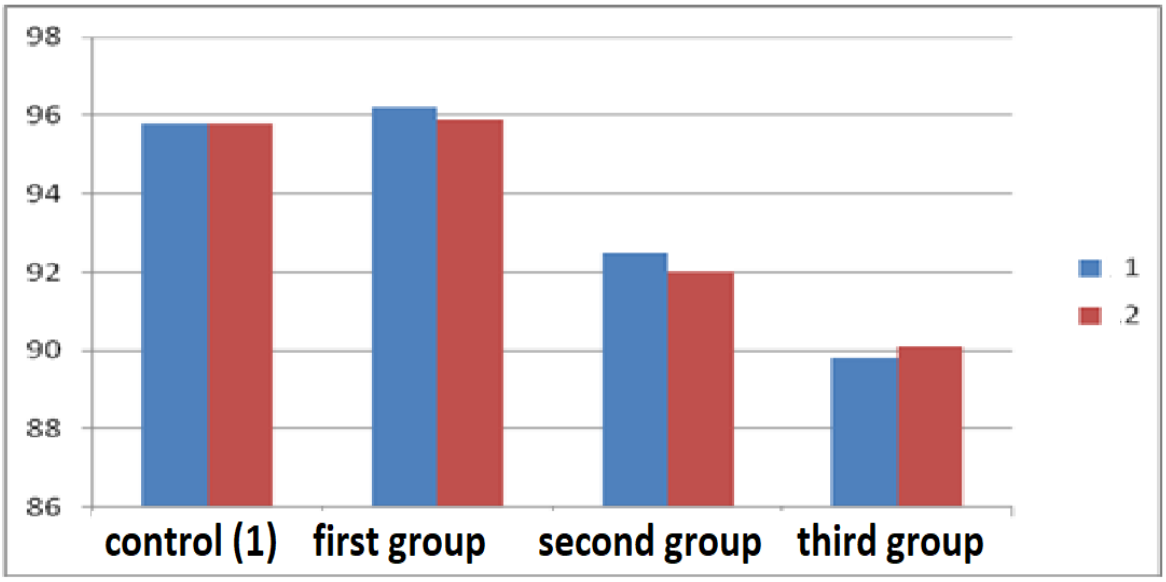


Fig.1 - Germination moisture values, %, for radish seeds

The results of watercress seeds germination are presented in Table 3. In all cases, seeds germination took place within 1-2 days, respectively; the values of the indicators of seed germination and germination energy are the same.

Table 3. Effect of struvite on watercress seeds germination

№ experiment	Seeds germination, %	Deviation from control, %	Duration of germination, days
1.Control	93,3	-	1
1.1	83,3	-10,0	2
1.2	80,0	-13,3	2
2.1	83,3	-10,0	2
2.2	76,7	-16,6	2
3.1	97,7	4,4	1
3.2	90,0	-3,3	2

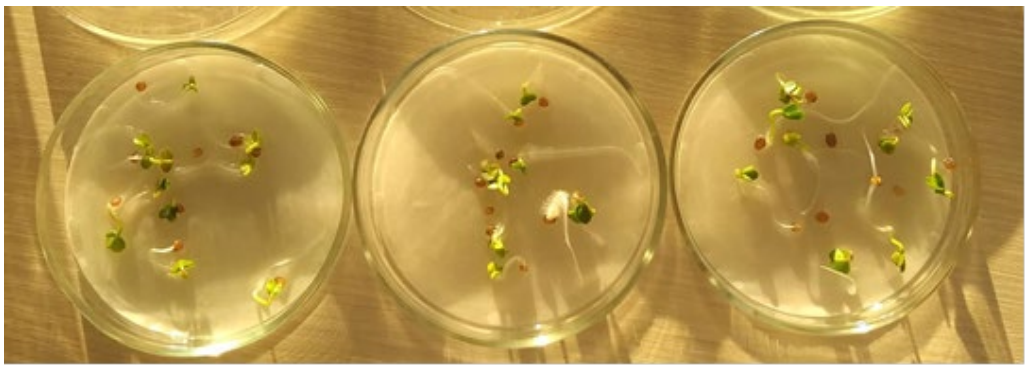
Research results indicate that the use of struvite reduces seeds germination and increases germination time. At the same time, the citric acid solution, on the contrary, promotes germination. Additional experiments on seed germination using only solutions of citric acid confirm the above: watercress seeds germinate in one day, and seed germination, respectively, is 93.3% when using a 1% solution of citric acid and 97.7% when using 2 % solution of citric acid. Therefore, the use of struvite at the stage of germination of watercress seeds is ineffective.

According to the best option for germination of radish seeds, a comparative agronomic evaluation of struvite mineral fertilizer obtained according to two options was carried out:

A. By reagent precipitation of ion exchange concentrate after purification of the model solution with natural zeolite or KU cationite with a concentration of ammonium ions of 40 mg/l.

B. By reagent precipitation of model solutions.

When using an aqueous solution with a dosage of 0.025 g/ml of Struvite, seed germination was 93.3% for both variants (Fig. 2).



A. B. 1-Control

Fig. 2. Germination of radish seeds on the 5th day after the start of the research.

The moisture content of germinated seeds was 96.20%±0.40 for variant A. and 96.00%±0.34 for variant B. Consequently, the reliable value of the experiment is [4]:

$$P_1 = \frac{1}{0{,}4^2} = 6{,}25; \qquad P_2 = \frac{1}{0{,}34^2} = 8{,}65;$$

$$\overline{X} = \frac{96{,}20 \cdot 6{,}25 + 96{,}00 \cdot 8{,}65}{6{,}25 + 8{,}65} = 96{,}08; \qquad (2)$$

The error of the result in case of uneven measurement is:

$$S_X = \left(\sqrt{6{,}25 + 8{,}65}\right)^{-1} = 0{,}2591; \qquad (3)$$

Since the error of the result does not exceed 3%, the measurement results for the two variants are reliable and close in value.

Conclusions. After conducting a set of experimental studies on model solutions established:

1. The reagent method allows extracting simultaneously ammonium ions and phosphate ions with the achievement of the degree of adsorption 93.91% and 95.26%, respectively.
2. The most optimal conditions for the process of reagent precipitation of ammonium nitrogen at an initial concentration of NH_4^+ - N – 470 mg / l are pH 8.5 and the stoichiometric ratio Mg^{2+}: NH_4^+: PO_4^{3-} = 1,5 : 1: 1,5.
3. The humidity of the mineral fertilizer under optimal conditions is 40.7%, respectively, the established formula of crystalline hydrate - $MgNH_4PO_4 \cdot 5H_2O$.
4. These data demonstrate the ability of synthetic struvite effectively to influence the germination of radish seeds and, obviously, the seeds of other plants of the radish genus of the cabbage family.
5. The need for further research to determine the effectiveness of struvite in terms of its impact on agricultural crops, as well as the ecotoxicological characteristics of the resulting fertilizer, was determined.
6. It was found that the method of obtaining struvite does not significantly affect seed germination and germination humidity.

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ENVIRONMENTAL QUALITY MONITORING

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Prospects for the preservation of hydrophilic zoocenosis under the conditions of the urbanized landscape of Vinnytsia

The formation of a network of protected objects under the conditions of the urbanized landscape is one of the effective measures for implementing the concept of sustainable urban development. The transformation of natural ecosystems within settlements causes significant changes in the structure of zoocenoses: some species disappear from the territory; others are forced to adapt to new conditions. Reducing the level of anthropogenic pressure in the created protected objects due to the limitation of certain types of economic activity will allow preserving the species wealth of fauna even under the conditions of the urban landscape.

Work was carried out on the study of the taxonomic wealth of the vertebrate fauna of one of the tracts of the city of Vinnytsia for the further preparation of the scientific justification for the creation of a protected object within its boundaries. To study the seasonal structure of zoocenoses of chordate animals, the tract 'Brigantyna' was chosen, which is located on the left bank of the Sabariv reservoir (Southern Bug river), the mouth of the Tyazhilivka river and the surrounding area. The total area of the studied territory is about 5.1 hectares. Generally accepted methods were used to study the species composition of the chordate animals of the tract. During all seasonal periods of 2020-2022, the seasonal structure and nature of topical connections of representatives of 5 classes of Chordata were studied within the facility: class Actinopterygii, Amphibia, Reptilia, Aves, Mammalia.

For the first time, the taxonomic and ecological structure of the zoocenoses of the tract were analyzed, in its species structure representatives were identified, which are subject to protection at the local

or global level.

Within the studied territory, as a result of the records, the presence of representatives of 99 species of animals of the Chordata type was found: class Actinopterygii (16 species), Amphibia (4 species), Reptilia (4 species), Aves (66 species), Mammalia (9 species). Taxonomically, they are united in 79 genera, 42 families and 21 orders. The vast majority of discovered chordates are typical representatives of the fauna of Eastern Podillia. The creation of a protected object within the surveyed tract will contribute to the preservation of the biological diversity of the urban zoocenosis.

***Keywords**: Vinnytsia, protected object, zoocenosis, nature protection, fauna.*

Introduction. Under the conditions of the expansion of the areas of settlements, the issues of sustainable development of cities are becoming more and more relevant [3, 4]. The urban landscape absorbs, partially or completely transforms natural ecosystems. The zoocenoses of such areas are also undergoing transformation: some species disappear, and others are integrated into the urbanized landscape. Measures to preserve the latter are an important stage in implementing of the sustainable development strategy.

One of the effective tools for maintaining biodiversity and stabilizing the urban ecosystem is the creation of protected areas in places of the highest concentration of animals of various taxonomic groups, with the restriction of economic activity on their territory, but without its complete removal. For this purpose, we made an attempt to assess the possibility of creating a protected object - a nature reserve of local importance in one of the locations of the city, which has undergone the least transformation so far.

A similar promising territory within the city is part of the tract 'Brigantyna', located on the left bank of the Sabariv reservoir (Southern Bug river). Survey work was carried out along the lower reaches and at the mouth of the Tyazhilivka River, which flows into the Southern Bug in the eastern part of the tract, in the water area of the reservoir adjacent to the estuary and along the concrete embankment from its beginning and 0.5 km downstream.

It is known that the taxonomic and ecological structure of the zoocenosis of the territory is determined by a complex of abiotic and biotic factors: orographic, hydrological, the nature and strength of anthropic pressure, the flora of the tract.

For obvious reasons, the ecological structure of the fauna is dominated by hydrophilic, mainly limnophilic, animals: bony fish, amphibians and reptiles, aquatic and waterfowl birds, aquatic mammals.

The presence of tree and shrub plantations of different ages in the flora of the tract determines the presence of a number of dendrophilous, in particular crown-nesting and double-nesting birds, and tree mammals.

Finally, the ecological structure of the territory's fauna is complemented by species that carry out regular invasions from adjacent biotopes: mainly synanthropic campophilic and sclerophilic animals.

Theoretical foundations of research. The species structure and seasonal features of the zoocenosis of vertebrate animals were studied during 2020-2022. The records were carried out in different seasonal periods of the year. Due to this all representatives of the fauna that use the territory at different stages of their life cycles were noted. All representatives of chordates were noted directly during the records or a conclusion was drawn about their presence based on the analysis of characteristic traces.

Accounting was carried out according to generally accepted methods.

Experimental part. In general, during different seasons of the year, the presence of 99 species of chordates, represented by 5 classes, 21 orders, 42 families, and 79 genera, was noted within the investigated part of the water area of the Sabariv reservoir and on the adjacent shores. From a taxonomic point of view, birds are predominant among chordate animals of the studied zoocenosis (Fig. 1).

Obligate hydrophiles are only representatives of the class Ray-Finned fish, which are represented by 4 orders, 5 families, 15 genera and 16 species within the studied water area.

Most of them use the shallow coastal water area of the reservoir, the mouth and the water area of the lower reaches of the Tyazhilivka River as feeding and spawning areas.

The background species that mostly occupy the surface and near-surface layers are *Alburnus alburnus*, *Leucaspius delineatus*, *Pseudorasbora parva*, *Scardinius erythrophthalmus*.

The ichthyofauna of the water column and bottom layers is formed by *Rutilus rutilus*, *Abramis brama*, *Carassius gibelio*, *Perca fluviatilis*, which are quite numerous. *Blicca bjoerkna*, *Cuprinus carpio*, *Esox lucius*, *Sander lucioperca* show a lower number.

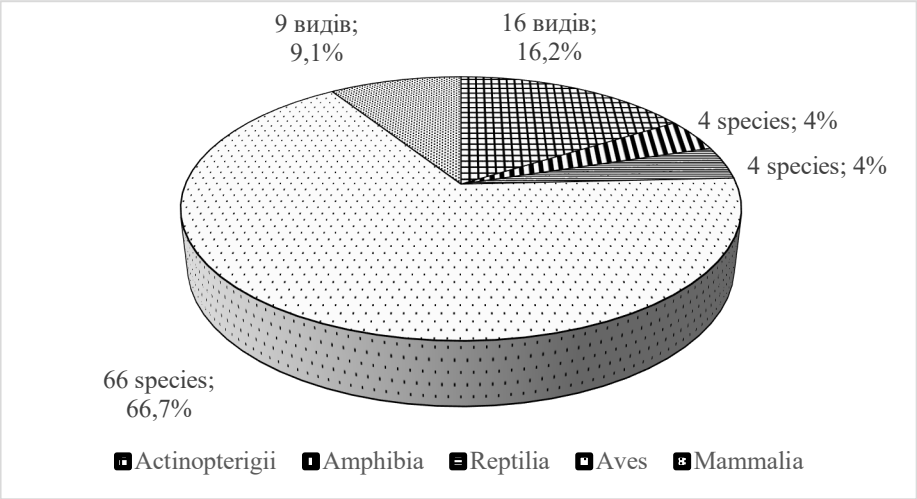

Fig. 1. Taxonomic diversity of the target area

Bottom layers are inhabited by *Gymnocephalus cernuus*, *Neogobius melanostomus* and *Neogobius fluviatilis*. Frequent infestations of *Silurus glanis* are noted.

Shallow water with phytoassociations consisting of yellow water lilies and white water lilies is an important spawning station for the vast majority of fish species of the Southern Bug. In addition, this station is used by adults and young fish as a feeding area, and therefore it plays an extremely important role in maintaining the biological and taxonomic diversity of the ichthyofauna of the Sabariv Reservoir.

In the structure of the studied ichthyofauna, 2 species of fish included in Annex II of the Convention on the Protection of Wild Flora and Fauna and Natural Habitats in Europe were noted. Another 14 species of fish are included in the Red List of the International Conservation Union with the status of 'Least Concern' (Table 1).

Table 1. Representatives of the ichthyofauna of the studied biotope in International environmental conventions

№ n/s	Species	Bern Convention.	IUCN
1.	Roache *Rutilus rutilus*		Least Concern
2.	Common Rudd *Scardinius erythrophthalmus*		Least Concern
3.	Bleak *Alburnus alburnus*		Least Concern
4.	Sunbleak *Leucaspius delineatus*	III	Least Concern
5.	Silver Bream *Blicca bjoerkna*		Least Concern
6.	Common Bream *Abramis brama*		Least Concern
7.	Stone Moroco *Pseudorasbora parva*		Least Concern
8.	Common Carp *Cyprinus carpio*		
9.	Prussian Carp *Carassius gibelio*		
10.	European Catfish *Silurus glanis*	III	Least Concern
11.	Northern Pike *Esox lucius*		Least Concern
12.	Common Zander *Sander lucioperca*		Least Concern
13.	European Perch *Perca fluviatilis*		Least Concern
14.	Common Ruffe *Gymnocephalus cernuus*		Least Concern
15.	Round Goby *Neogobius melanostomus*		Least Concern
16.	Pontian Monkey Goby *Neogobius fluviatilis*		Least Concern

Notes: Bern Convention – Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe; IUCN – Red List of Threatened Species of International Union for Conservation of Nature

In the fauna structure of the studied water area of the reservoir, amphibians are represented by 2 orders, 3 families, 3 genera and 4 species (Fig. 1).

The base consists of tailless amphibians, particularly *Pelophylax lessonae* and *Pelophylax ridibundus*, which are associated with the water area during the reproductive and non-spawning periods.

Another species of this series, namely *Hyla orientalis*, inhabits coastal reed phytoassociations in small numbers.

Lissotriton vulgaris was observed in small numbers in the lower reaches and mouth of the Tyazhilivka River.

A number of representatives of the amphibian fauna of the studied area are included in international environmental conventions. Thus, 1 species of Amphibians is included in Appendix II, and 3 species are included in Appendix III of the Convention on the Protection of Wild Flora and Fauna and Natural Habitats in Europe. All identified amphibians are included in the Red List of the International Union for Conservation of Nature with the status of 'Least Concern' (Table 2).

Table 2. Representatives of the batrachofauna of the studied biotope in International environmental conventions

№ n/s	Species	Bern Convention.	IUCN
1.	Smooth Newt *Lissotriton vulgaris*	III	Least Concern
2.	Eastern Tree Frog *Hyla orientalis*	II	Least Concern
3.	Pool Frog *Pelophylax lessonae*	III	Least Concern
4.	Marsh Frog *Pelophylax ridibundus*	III	Least Concern

Notes :same as for Table 1

The coastal areas of the Sabariv reservoir at the mouth of the Tyazhilivka River near the 'Brigantyna' tract support the existence of 4 species of reptiles belonging to 3 genera, 3 families, and 1 order.

Two species of obligate hydrophiles, namely *Emys orbicularis* and *Natrix tessellata*, may be found in the shallow zone of the studied water area, using it to hunt young fish and amphibians.

Stations near the water cut are occupied by *Natrix natrix*, and further on by *Lacerta agilis chersonensis*. The last one was discovered on the right bank of the Tyazhilivka River in the Brigantyna tract and on its left bank – on a water-protective dam, filling the gaps between concrete slabs.

All species of reptiles we noted within the studied territory are protected by international environmental conventions. Among them, there are 2 species included in Appendix II, and the other 2 species are included in Appendix III of the Convention on the Protection of Wild Flora and Fauna and Natural Habitats in Europe. In addition, 3 species of reptiles are included in the Red List of the International Union for Conservation of Nature with the status of 'Least Concern', and 1 species has the status of 'Near Threatened' (Table 3).

Table 3. Representatives of the herpetofauna of the studied biotope in International environmental conventions

№ n/s	Species	Bern Convention.	IUCN
1.	European Pond Turtle *Emys orbicularis*	II	Near Threatened
2.	Sand Lizard *Lacerta agilis chersonensis*	II	Least Concern
3.	Grass Snake *Natrix natrix*	III	Least Concern
4.	Dice Snake *Natrix tessellata*	II	Least Concern

Notes :same as for Table 1

Birds in the studied biotope form the largest taxonomic group, uniting 66 species from 50 genera, 26 families, and 12 orders (Fig. 1).

The vast majority of bird species observed within the water area of the reservoir and in nearby stations is protected by a number of international environmental conventions, agreements, lists, etc. (Table 4). Thus, 43 species of birds are included in Appendix II, and 16 species are included in Appendix III of the Convention on the Protection of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention).

Also, 1 species is included in Appendix I, and 10 species are included in Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

The Agreement on the Conservation of Afro-Eurasian Migratory Wetland Birds (AEWA) lists 6 species of birds noted in the biotope.

Finally, 65 representatives of the avifauna of the tract are under the protection of the Red List of the International Union for Conservation of Nature with the status of 'Least Concern' (Table 4).

Table 4. Representatives of the avifauna of the studied biotope in International environmental conventions

№ n/s	Species	Bern Convention.	Bonn Convention.	AEWA	IUCN
1.	Little Grebe *Podiceps ruficollis*	II			Least Concern
2.	Great Crested Grebe *Podiceps cristatus*	III			Least Concern
3.	Bittern *Botaurus stellaris*	II	II	+	Least Concern
4.	Little Bittern *Ixobrychus minutus*	II	II	+	Least Concern
5.	Great White Egret *Egretta alba*	II	II	+	Least Concern
6.	Grey Heron *Ardea cinerea*	III			Least Concern
7.	Mallard *Anas platyrhynchos*	III	II	+	Least Concern
8.	Eurasian Sparrowhawk *Accipiter nisus*	II	II		Least Concern
9.	Kestrel *Falco tinnunculus*	II	I		Least Concern
10.	Water Rail *Rallus aquaticus*	III			Least Concern
11.	Little Crake *Porzana parva*	II	II		Least Concern
12.	Moorhen *Gallinula chloropus*	III			Least Concern
13.	Coot *Fulica atra*	III	II		Least Concern
14.	Black-headed Gull *Larus ridibundus*	III			Least Concern
15.	Yellow-legged Gull *Larus cachinnans*	III			Least Concern
16.	Black Tern *Chlidonias niger*	II	II	+	Least Concern
17.	Common Tern *Sterna hirundo*	II	II	+	Least Concern
18.	Woodpigeon *Columba palumbus*				Least Concern
19.	Rock Dove *Columba livia f. domestica*	III			Least Concern
20.	Collared Dove *Streptopelia decaocto*	III			Least Concern
21.	Cuckoo *Cuculus canorus*	III			Least Concern
22.	Swift *Apus apus*	III			Least Concern
23.	Kingfisher *Alcedo atthis*	II			Least Concern
24.	Grey-headed Woodpecker *Picus canus*	II			Least Concern
25.	Great Spotted Woodpecker *Dendrocopos major*	II			Least Concern
26.	Lesser Spotted Woodpecker *Dendrocopos minor*	II			Least Concern
27.	Swallow *Delichon urbica*	II			Least Concern
28.	Pied Wagtail *Motacilla alba*	II			Least Concern
29.	Golden Oriole *Oriolus oriolus*	II			Least Concern
30.	Starling *Sturnus vulgaris*				Least Concern
31.	Jay *Garrulus glandarius*				Least Concern
32.	Magpie *Pica pica*				Least Concern
33.	Rook *Corvus frugilegus*				Least Concern
34.	Hooded Crow *Corvus cornix*				
35.	Wren *Troglodytes troglodytes*	II			Least Concern
36.	Savi's Warbler *Locustella luscinioides*	II			Least Concern
37.	River Warbler *Locustella fluviatilis*	II			Least Concern
38.	Sedge Warbler *Acrocephalus schoenobaenus*	II			Least Concern
39.	Marsh Warbler *Acrocephalus palustris*	II			Least Concern
40.	Great Reed Warbler *Acrocephalus arundinaceus*	II			Least Concern
41.	Blackcap *Sylvia atricapilla*	II			Least Concern
42.	Whitethroat *Sylvia communis*	II			Least Concern
43.	Lesser Whitethroat *Sylvia curruca*	II			Least Concern
44.	Chiffchaff *Phylloscopus collybita*	II			Least Concern
45.	Goldcrest *Regulus regulus*	II			Least Concern
46.	Spotted Flycatcher *Muscicapa striata*	III	II		Least Concern

Continuation **table 4**

47.	Redstart *Phoenicurus phoenicurus*	II			Least Concern
48.	Black Redstart *Phoenicurus ochruros*	II			Least Concern
49.	Robin *Erithacus rubecula*	II			Least Concern
50.	Trash Nightingale *Luscinia luscinia*	II			Least Concern
51.	Fieldfare *Turdus pilaris*	II			Least Concern
52.	Blackbird *Turdus merula*	II			Least Concern
53.	Song Trash *Turdus philomelos*	II			Least Concern
54.	Marsh Tit *Parus palustris*	II			Least Concern
55.	Blue Tit *Parus caeruleus*	II			Least Concern
56.	Great Tit *Parus major*	II			Least Concern
57.	Nuthatch *Sitta europaea*	II			Least Concern
58.	House Sparrow *Passer domesticus*	-			Least Concern
59.	Tree Sparrow *Passer montanus*	III			Least Concern
60.	Chaffinch *Fringilla coelebs*	III			Least Concern
61.	European Serin *Serinus serinus*	II			Least Concern
62.	Greenfinch *Chloris chloris*	II			Least Concern
63.	Siskin *Spinus spinus*	II			Least Concern
64.	Goldfinch *Carduelis carduelis*	II			Least Concern
65.	Bullfinch *Pyrrhula pyrrhula*	III			Least Concern
66.	Yellowhammer *Emberiza citrinella*	II			Least Concern

Notes: Bern Convention – Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe; Bonn Convention – Convention on the Conservation of Migratory Species of Wild Animals; AEWA – Agreement on the Conservation of African-Eurasian Migratory Waterbirds; IUCN – Red List of Threatened Species of International Union for Conservation of Nature

Birds are the most mobile component of the urban zoocenoses. They are able to make daily and seasonal movements over different distances. According to the results of the records of the species structure of the bird fauna, we found 5 main types of topical connections of birds with the studied territory. Almost half of them – 29 species or 43.9% of the entire avifauna nest directly within the territory, but after the end of the nesting period, they make long flights to wintering places. Another 14 species (21.2%) are also nesting and migratory in the region [1, 2], but were not found in the tract for nesting. They fly to the studied territory even during the nesting period mainly in search of food.

The share of sedentary birds is somewhat smaller (12 species, 18.2%). Like the nesting and migratory ones, they nest within the territory, but unlike the latter, in the winter they make only short-distance migrations. Another 8 species (12.2%) of birds settled in Eastern Podilly [1, 2] carry out trophic invasions during the nesting period within the boundaries of the studied site, but do not nest within it.

Finally, in winter, the territory supports the existence of 3 more species of birds (4.5%), which are observed in our region exclusively during the winter period [1, 2].

The mammalian fauna of the studied area is represented by 9 species belonging to 8 genera, 5 families, and 2 orders (Fig. 1).

The structure of the teriocomplex is determined by the nature of the stations that form the studied territory. Thus, the main topical groups of mammals are hydrophilic, dendrophilic and synanthropic species.

Ondatra zibethicus is an obligate hydrophile animal. Its number within the biotope reaches 4-5 individuals.

Sciurus vulgaris shows close trophic and topical connections with tree plantations. The station supports the existence of 2-3 individuals of this species.

Rodent fauna is the most diversified one: *Sylvaemus tauricus* and *Sylvaemus sylvaticus*, *Myodes glareolus*, synanthropic *Mus muculus* and *Rattus norvegicus* are present here. Animals inhabit the lower layer of grass and shrub vegetation along the Tyazhilivka River, under the concrete slabs of the reservoir's water-protective dam. *Erinaceus roumanicus* and *Mustela nivalis* show a small number – up to 2-3 individuals.

All representatives of the theriofauna noted by us are included in international nature conservation conventions. Thus, 3 species of mammals are included in Appendix III of the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention). Also, all detected

mammals are under the protection of the Red List of the International Union for Conservation of Nature with the status of 'Least Concern' (Table 5).

Table 5. Representatives of the theriofauna of the studied biotope in International environmental conventions

№ n/s	Species	Bern Convention.	IUCN
1.	Red Squirrel *Sciurus vulgaris*	III	Least Concern
2.	Yellow-necked Mouse *Sylvaemus tauricus*	-	Least Concern
3.	Wood Mouse *Sylvaemus sylvaticus*	-	Least Concern
4.	House Mouse *Mus muculus*	-	Least Concern
5.	Brown Rat *Rattus norvegicus*	-	Least Concern
6.	Muskrat *Ondatra zibethicus*	-	Least Concern
7.	Bank Vole *Myodes glareolus*	-	Least Concern
8.	Northern White-breasted Hedgehog *Erinaceus roumanicus*	III	Least Concern
9.	Least Weasel *Mustela nivalis*	III	Least Concern

Notes: same as for Table 4.

Conclusions. Thus, records of the species composition of chordate animals, conducted throughout all seasonal periods demonstrated that the studied territory supports the existence of not only synanthropic species, but also, thanks to the mosaic of facies, creates conditions for the formation of a wide range of types of topical and trophic relationships of fish, amphibians, and reptiles, birds and mammals. The creation of a reserve of local significance within its boundaries will have environmental, educational, and aesthetic significance.

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