BOOK OF ABSTRACTS OF THE 3RD INTERNATIONAL CONFERENCE ON SUSTAINABLE FUTURES: ENVIRONMENTAL, TECHNOLOGICAL, SOCIAL AND ECONOMIC MATTERS

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Preface

This Collection contains materials (abstract) of the **3RD INTERNATIONAL CONFERENCE ON SUSTAINABLE FUTURES: ENVIRONMENTAL, TECHNOLOGICAL, SOCIAL AND ECONOMIC MATTERS (ICSF 2022)**, which took place in Ukraine, 24-27 May 2022.

The International Conference on Sustainable Futures: Environmental, Technological, Social and Economic Matters (ICSF) is a peer-reviewed international conference, which is the premier interdisciplinary forum for social scientists, life scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications. The ICSF occupies contributions in all aspects of sustainable development, focused on the intersection of sustainability, environment and technology, and their larger implications for corporations, government, education institutions, regions and society both at present and in the future.

The conference included the following workshops:

- ✓ Sustainable Development of Mining Science and Industry (SusDevMiningScI'2022) Kryvyi Rih (https://sites.google.com/knu.edu.ua/nigri-ecochemsd-ws2021/);
- ✓ Geography for Sustainable Development (GSD-2022) Kryvyi Rih (https://bondarenkoolga9.wixsite.com/gsd-2022);
- ✓ Biodiversity and Ecosystems Sustainability (BiodES-2022) Melitopol (http://biodes.mdpu.org.ua/);
- ✓ Water Management and Environmental Engineering (WaterManEnvE-2022) Rivne (https://sites.google.com/nuwm.edu.ua/watermanenve-ws2022);
- ✓ Innovative Approaches for Solving Environmental Issues (IASEI-2022) Kyiv (https://www.igns.gov.ua/en/iasei-ws-2022/).

The Collection includes selected 104 papers, which were carefully reviewed out of 169 papers submitted to the conference. Submission, selection and "blind review" of conference materials took place on a specialized platform Morressier (https://www.morressier.com).

ICSF 2022 was organized by the Academy of Cognitive and Natural Sciences (Kryvyi Rih) in cooperation with Kryvyi Rih National University (Kryvyi Rih), Kryvyi Rih State Pedagogical University (Kryvyi Rih), National University of Water and Environmental Engineering (Rivne), Bogdan Khmelnitsky Melitopol State Pedagogical University (Melitopol) and State Institution “The Institute of Environmental Geochemistry of National Academy of Sciences of Ukraine” (Kyiv).

The success of ICSF 2022 depends on the contribution of many people and organizations. With this in mind, we thank all the authors who submitted papers to the conference. The quality of the submitted works this year remains high, and we are satisfied with the quality of the result and the work process. The Organizing Committee is also grateful to all members of the program committee for their help and support. The Organizing Committee is responsible for reviewers who have voluntarily given their own precious time to evaluate the materials and provided useful feedback to the authors.

In addition, any conference will be successful without the strong support of its participants. Thank you to all participants for submitting materials to the conference.

ICSF 2022 Conference Committee

Geotechnical and Geoenvironmental Engineering

Mathematical tools for the problem of remote evaluation of spatially distributed radioactive materials

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Introduction. The use of radioactive materials is widespread in scientific investigations and various sectors of the economy. Radioactive materials can not only serve useful purposes but also to cause undesirable or dangerous effects. To safe handling with such materials, the correct their detection and characteristics evaluation are vital. The modern development of small flying machines, measurement equipment, and information technologies allow one to increase the amount of measurement data and their accuracy, and to reduce the processing time. On the other hand, the requirements to accuracy, quickness, and correctness of data interpretation increase as well. To solve these problems effectively, we should improve the mathematical tools of data processing.

Aim/tasks. The main mathematical problem at the remote evaluation of radioactive fields relates to the solving the inverse problem for the Fredholm integral of the first kind.

Methodology. In this research, we consider the reconstruction of surface density of gamma radiation on the ground using the data of aerial shooting. We survey the methods for solving the inverse problem, their ad-vantages and disadvantages.

Results. The adaptation of the methods to the reconstruction of nonstationary discontinuous radioactive fields is presented. We modify the numerical algorithms using the opportunities of modern calculating software. In particular, the accuracy and stability of algorithm's work are studied and the criteria for assessing the quality of field's reconstruction are developed.

Conclusions. The findings presented can be useful for the problems of revealing and specification of weak ionic radiation occurring in homeland security, ecology, nuclear medicine, and etc.

Substantiating the arched support made of composite materials (carbon fiber-reinforced plastic) for mine workings in coal mines

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Abstract. This paper studies a new composite material based on carbon fiber-reinforced plastic, which is planned to be used for supportingthe preparatory workings when mining the coal at depths of more than 1000 meters. The composite material made of carbon fiber-reinforced plastic has sufficiently high physical-mechanical properties, which are even higher than that of low-alloy steelused as the main materialfor supportingin coal mines. The purpose of the research is to substantiate the model of support (arched three-link) and determine its rational parameters. The calculation of the stress-strain state around mine working, using the support made of composite materials, has been performed based on the method of finished elements in the Solid Works software product. In addition, a model of the support for coal mines has been developed on a 3D printer. This made it possible to conduct additional research on the interaction of the support with the rock mass. Using the Solid Works software, a detailed modeling of the composite supporting system has become possible. The stress-strain state of the rock mass has revealed that support can be used to improve the strength characteristics and prevent uneven pressure distribution around mine workings. A support made of composite materials contributes to the introduction of resource-saving technologies in the mining industry.

Dissipative structure suppression as a way to increase the sustainable improvement of the frame support bearing capacity

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Introduction. A yield frame support is a basic means of providing the underground roadways' stability in the deep mines operating in the hard ground control condition when the ratio of the ground pressure to the unconfined strength of surrounding rock mass exceeds 0.33. The operators adjust the nominal bearing capacity of the frames at 0.55 of their maximum or peak resistance F_m because the frames operate in a dry friction mode spontaneously generating oscillation, which causes variation of the resistance in the range from 0.1 up to 0.9 of F_m.

Aim/tasks. We intended to reduce the dynamic oscillation of the support resistance that allows for increasing their bearing capacity.

Methodology. We used a computer simulation by FLA3D model, indoor testing of the frames, and actual measurements in an underground coal mine.

Results. We revealed a specific behavior of the frame support that reduced the limit of the bearing capacity by 45%. During yielding, the frames generate dissipative structures (DS) that become apparent due to the dynamic nature of stick-slip friction following the yielding process. We demonstrated that DS control and especially its suppression provides a sustainable increase in the frame bearing capacity.

Conclusions. Improvement of the yield frames design and especially their clamps are the prospective way to control DS and provide sustainable enhancement of the frame bearing capacity.

Stress environment around head entries with pillarless gob-side entry retaining through numerical simulation incorporating the two type of filling wall

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Introduction. Longwall mining is the most productive system for underground extraction of coal. Many coal mines use a pillarless mining. Reserving a gateroad for the use of next panel mining is a popular gob-side entry retaining. Thus, the conventional entry retaining method requires an installation of filling walls. The mechanical properties of filling materials largely determine the quality of job-side entry retaining.

Purpose. Stress field evolution study around head entries when main roof console length increase with two variants of filling wall.

Methodology. Ansys code was used to analyze the stress evolution law under different mining conditions.

Results. As a result of numerical simulation, it was found that in the case of gob-side entry retaining, the localization of maximum stresses in surrounding rock is determined by the length console the main roof, which hanging on the border with the gob, and the filling walls deformation module. Potential location of roof cutting, stress gradient and extremum stress in the main roof define the stability of entries.

Conclusion. Main roof console length and filling material parameters control can help to the formation of a stable structure around the entry to meet the requirements of the next working face.

Justification of micro seismic control for iron ore mines

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Introduction. On the territory of Kriviy Rih city have been registered ten earthquakes since 2007 to 2013, with the help of seismic station of institute of Geophysics of NASU, such activity is not typical for this region. One of the reasons is mining of mineral resources in this area, which leads to irreversible changes in the stress-strain state of the massif, which activate dangerous natural and man-made processes (landslides, flooding, earthquakes, mountain strikes, etc.) The collapse of the mountain massif and the exit of the funnels occurs when the limit value of the loading in the massif is reached.

Aim. Limit value warning of the stress-strain state of the massif is a condition for the danger of the zone. The task of control – to prevent big phenomena, controlling the minor ones.

Methodology. Any unloading of the massif is accompanied by the formation of a crack, which is characterized by a burst of amplitude and a certain frequency of oscillations. For the geographic information system of mines, it is important to highlight significant phenomena by types of energy, affiliation to the mining allotment of the mine (distance to the hypocenter) and the nature of the primary source - technical or natural. To increase noise immunity, it is advisable to use both physical filtration methods and software selection of significant phenomena against the background of man-made noise. To form conclusions, it is necessary to form a sample, so for reliable identification of the stress - strain state of the array it is necessary to perform statistical processing of the measurement results. The experience of usage of micro seismic control in mines has shown the advisability of a monitoring radius within 400 meters.

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Formation of artificial profiles of reclaimed lands in different subzones of the steppe of Ukraine

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Introduction. The development of technologies for biological land reclamation depends on the edaphic characteristics of rock substrates. Peculiarities of creation of artificial constructions of two-, three- and multilayer profiles depend on the direction of development of reclaimed minelands. A pre-condition for an effective land reclamation program is the characterization of properties of soil and other materials in terms of their limitations to plant growth and potential impacts on environment quality. Recommendations resulting from cooperative research of Dnipro State Agrarian University and Pokrov Mining Company have been adopted by all strip-mining operations in the Nikopol manganese deposit replacement

Aim/tasks is to assess the suitability of agrophysical properties of rocks for land reclamation in different subzones of the Ukrainian Steppe.

Methodology. Sedimentary rocks of different geological ages were studied on agrophysical parameters. Tested overburden rocks with the largest share in the stratigraphy of the exposed strata in the Pokrov and Kamysh - Burun land reclamation station were loamy like loess (Quaternary) and gray-green clay (Neogene). Two types of soil substrates used as control: a) black soil mass (BSM); b) a mixture of accumulative and first transitional soil horizons of the zonal black soil (ZBS). Traditional research methods were applied to estimate agrophysical properties of the soil and rock samples.

Results. Loess-like loam and gray-green clay of the Kerch iron ore deposit are distinguished by a higher bulk density, but lower porosity and wilting moisture compared to samples from the Nikopol manganese ore basin. The use of the rotor complex leads to mechanical destruction and increase in the content of small particles of rocks. Using gray-green clay as artificial waterproof in arid conditions can be considered as a cost-effective water saving technology for irrigation.

Conclusions. There is a certain parametric relationship between texture, density, porosity, structural and physical state of different models of artificial reclaimed profiles. The composition and properties of rocks at different stages of land reclamation change due to the creation of edaphic structures of technosoils in accordance with natural and climatic conditions. The best conditions for land reclamation are connected with including grey-green clay in two- and three-layer constructions of techno-soils, providing a waterproofing effect.

Explosive charge providing stability of open-cast edges

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Introduction. Many scientists have tried to disperse the charge along the well length, depending on the size of the blasted mass from the wellhead to its bottom, while trying to reduce seismic effect of the explosion on the mass. However, they all have practically the same disadvantages: the impossibility of mechanized loading, the use of expensive materials for dispersing charges like wood and metal.

Objective. Due to the growth in mass explosions, there is a need for a new design of an explosive charge that would ensure uniform development of the exploded mass, while reducing the seismic effect of the explosion on surrounding peripheric mass.

Methodology. We have developed a new design of the explosive charge, which makes it possible to distribute the explosive along the axis of the well in accordance with the volume of the exploded rocks. This design provides not only uniform development of the blasted mass, but also reduces the seismic effect of the explosion both in the horizontal and vertical planes, thereby ensuring safety of adjacent rocks due to the special design of the charge in the lower part of the well, which has 8 cumulative excavations directed in the horizontal plane. The design of the charge, as well as special notches in the form of a funnel and the existing broadening of the explosive charge in places of its diameter changes serve to compact the explosive in the well, which makes it possible to charge the wells in a mechanized way.

Results. Experiments on equivalent materials have shown good performance of this structure, while, in comparison with the traditional method, the penetration of compression and tension waves deep into the massif is reduced by 2.5 times, overdrilling amount - by 5 times.

Conclusions. The proposed design improves development of blasted rocks along the entire height of the bench, while practically eliminating penetration of stress waves into the lower horizon.

Device for reducing the seismic effect of explosion on lower horizon

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Introduction. At present, maintaining the stability of benches, increasing the safety of operations and increasing the productivity of drilling rigs are among the urgent tasks of open pit mining. To do this, it is necessary to minimize the impact of the explosion on the lower horizons.

Methodology. The design of the lower part of the well has been developed. A foam block is installed in a sub-drill of about 0.5 meters, the upper part of the block has a conical protrusion, which creates a cumulative recess in the lower part of the explosive charge. A cavity with a depth of 8-10 cm is cut out at the bottom of the block. The cavity is closed with a foam plastic cover, a swept hole with a diameter of at least 5-20 cm and a height of 25 cm is made from it in the middle. The hole is directed upwards, the entire space is filled with moistened sand.

During an explosion, the bulk of the energy of the lower part of the charge rushes down towards the block. The cumulative notch creates an energy stream with a velocity higher than the main charge energy. To soften the effect and redistribute energy from a vertical to a relatively horizontal plane, there is a swept excavation in the block and a layer of sand below. Thus, the energy of the explosion will be directed not towards the lower horizon, but relatively horizontally and towards the surface of the benches. Experiments carried out on equivalent materials confirm the results of the study. A well with a diameter of 30 mm was drilled in a previously prepared model simulating the rock mass, where the reduced layout of the device of the lower part of the charge went down. Then, the well was filled with explosive and stemming was performed. After the explosion, the model was cut, analysis showed that the cracks had an almost horizontal direction, and the lower part remained intact.

Results. This design has all the advantages of a charge with an air gap at the bottom and eliminates its disadvantages. Redistribution of the explosion energy increases duration of the explosion effect on the mass, reduces the seismic effect on the rocks of the lower horizon.

Conclusions. The proposed design ensures development of the massif along the upper platform of the lower ledge with minimal impact on the lower horizon.

Acoustic online quality control of flow water and wastewater

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Introduction. To control the purity of wastewater and flow water (used, for example, for cooling) is an urgent problem of our time. This issue exists in all countries around the world, with developed industries. In Ukraine, almost all industrial productions constantly carry out water intake and discharge, and quality control of discharged water is performed sporadically. This does not allow to control short-term unauthorized anthropogenic pollution of the aquatic environment.

Aim/tasks. To analyze foreign experience in determining the parameters of the aquatic environment and to offer new acoustic methods for online detection of anthropogenic impurities in wastewater (flow water).

Methodology. A set of measures was used to conduct this study, namely: analysis, systematization, generalization of technical means and devices for online measurement of water environment parameters and detection of soluble and insoluble anthropogenic impurities; as well as mathematical and computer modeling to determine the dependences of the process of acoustic online control of the purity of flow water and wastewater.

Results. Foreign experience of using various methods to determine the parameters of the aquatic environment has been studied. It is shown that water, like any other liquid, it is a distributed. In distributed medium, the rate of propagation of acoustic oscillations and the degree of their attenuation depends on the physicochemical properties of the distributed medium. For water, these are the three main parameters (properties), namely: the temperature of the aqueous medium, the concentration of dissolved impurities in water and the number of insoluble impurities. There are three types of special small hydroacoustic devices: sound speed meters in water, acoustic wave attenuation meters, recorders of the spectra of transmitted signals. Having the maximum permissible concentrations of soluble and insoluble anthropogenic impurities in water, it is possible to calculate or empirically determine the values of permissible deviations of the three parameters listed above. Exceeding these permissible deviations indicates the excess of anthropogenic impurities in the controlled aqueous medium.

Conclusions. It is proposed to use various combinations of special small-sized hydroacoustic devices (sensors) to control the purity of wastewater and running water. They can be installed in different places (in drainage wells, cooling collectors, sewer pipes, etc.). Measurements from sensors to the remote control are broadcast by wires or radio signals (bluetooth, wifi, etc.).

The mining and geometrical methodology for estimating of mineral deposits

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Introduction. Ensuring the correct development of the deposit is a priority production task, which is based on a scientifically grounded assessment of the geometrical characteristics of the mineral deposit and a clear understanding of the nature and quantity of the deposit's re-serves.

Aim/tasks of the study is a geological and industrial assessment of a mineral deposit, which provides for the correct determination of the quantity and quality of explored reserves, requires the collection and processing of such material, which would be sufficient to draw up a technically correct and economically feasible project for the development of the deposit.

Methodology. The research methodology consists in mining and geometrical modeling and monitoring of subsoil based on progressive and classical methods and techniques for geometrization of the array of minerals and host rocks. This includes a set of measures aimed at collecting and evaluating the initial information, assessing its accuracy, mathematical processing and determining the optimal and most effective methods for solving the problem of geometrization of the field.

Results. The results allow us to practically solve the problems of mining operations related to the assessment of reserves of mineral deposits, their genesis, the nature of occurrence, quality, the possibility of sorting, forecasting and industrial development.

Conclusions. An effective set of methods has been developed based on the statistical assessment of mineral deposits, as well as the use of the latest geoinformation systems, which provide the possibility of high-quality and accurate calculation and assessment of mineral deposits.

Mineralogical substantiation for improving the quality of sinter ores produced by the mines of Kryvyi Rih basin

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Introduction. The sinter ores currently produced by the mines of Krivbass are characterized by an iron content of about 55 mas.%, which does not meet the needs of the world market. The reason is the decline in the quality of the extracted iron ore and the insufficient efficiency of the currently used technology for its enrichment. The proposed alternative technologies are not effective enough due to the fact that they do not consider the mineralogical features of hematite raw materials.

Aim. Mineralogical substantiation of the optimal technology for enrichment of the ore mass extracted from the depths for the production of sinter ore with an iron content of at least 60 mas.%.

Methodology. Study of the geological structure and mineralogical peculiarities, chemical composition of ores of specific deposits. Mineralogical substantiation and development of technology for the production of hematite concentrate with an iron content of at least 65 mas.%. Development of a method for the production of high-quality sinter ore from low-grade sinter ore and hematite concentrate.

Results. On the example of the deposit of the mine of the ArcelorMittal Kryvyi Rih plant, the features of the heterogeneous structure of ore bodies were revealed. The mineralogical characteristics of the four main mineral varieties of ores and their quantitative ratio in the ore mass extracted from the depths were determined. The technologies of ore preparation (crushing, grinding, desliming) and wet gravitational enrichment of the obtained products are substantiated. This made it possible to obtain a concentrate with an iron content of about 65 mas.%, to determine the methods for assembling sinter ore of the required (60 mas.% iron) quality.

Conclusions. The implementation of the proposed solution allows, without violating the existing mine operation technology, to increase the efficiency of using the ore mass extracted from the depths and significantly increase the quality of the sinter ore produced.

Geological factors of the stability of the open pit walls

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Introduction. The development of deposits is the reason for the transition of geological structures into a mechanically unstable state. The need to compensate for this instability leads to the movement of masses of rocks. With an increase in the depth of open pits in the Kryvyi Rih basin, the intensity of this process increases. This is accompanied by a violation of mining technology, economic losses. When developing methods to combat these negative processes, the features of the geological structure of deposits and the mineral composition of ores and rocks are not sufficiently taken into account.

Aim. Study of the influence of geological and mineralogical features of deposits on the physical, technical characteristics of ores and rocks that determine the stability of masses of rocks.

Methodology. Mineralogical, chemical, hydrogeological, geological study of deposits. Identification of factors affecting the physical and technical properties of ores and rocks. Systematization of massifs of ores and rocks in terms of their strength. Mapping of deposits with the allocation of areas with varying degrees of stability of rock masses.

Results. On the example of the Pervomaiskoye and Annovskoye deposits, regularities of the influence of geological and mineralogical factors on the strength characteristics of ores and rocks are revealed. Their corresponding classification has been developed. Maps of the variability of rock masses strength of ores and rocks, the stability of rock masses have been built.

Conclusions. Features of the relationship between mineralogical and geological indicators of ores and rocks and their physical and technical characteristics are revealed. Recommendations have been developed aimed at optimizing the operational and long-term planning of mining operations.

A reliability indicator based on assessment entropy of mining building and structure elements

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Purpose. The quality reconstruction of the mine industrial facilities is the maximum possible elimination of the identified defects. Assess the suitability of the object for further operation or reconstruction based on the inspection results of a building or structure as actual values of the controlled parameters. Provide the science-based methodology for diagnosing the technical state, assessing the reliability and physical wear for mining buildings and structures by using the probabilistic and statistical methods.

Methods. A retrospective analysis of the results of surveys, collection, processing and generalization of information on states (diagnoses) and characteristic defects (diagnostic features), based on the probabilistic-statistical apparatus of technical diagnostics and elements of information theory. An assessment of state and reliability, physical wear of structures of all levels. The Kulbak-Leibler distance as a key indicator in the method of estimating the "survivability of the element" provides for the probability distribution of the tensile strength.

Results. Developed methods of using technical diagnostics based on probabilistic statistical methods - Bayesian method, statistical solutions - including the concepts of theory information. When performing a probabilistic analysis of the technical condition of all elements, the numerical solution showed the effectiveness of the proposed diagnostic methodology.

Conclusions. The innovative method is to analyze and assess the reliability of mine facilities using a mathematical modeling to determine the probabilistic characteristics of defects in structural elements. The analysis method in the survey allows for determining the technical state of the object, the set of further measures, effective planning the operating and restoring costs.

Application of new constructive solutions of high buildings' zero cycle during building in difficult engineering and geological conditions

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Introduction. Recently, there has been a significant reduction in the number of favorable areas for construction of buildings and structures, which leads to the need to build various facilities in special conditions, so in areas with difficult engineering-geological and mining-geological conditions of construction, which are deteriorating due to natural and man-made factors. It is necessary to assess the possibility of deformation of structures located on foundations with possible uneven deformation in the practice of design and operation. Only with reliable and accurate determination of the stress-strain state of foundation structures and soil mass the service life of buildings and structures can be predicted.

Aim/tasks. The study is to solve the problem of choosing an effective zero cycle design that has increased load-bearing capacity and and allows the safe design of multi-storey buildings in special conditions.

Methodology. The study used the finite element method, using modern computer programs – "Lira" and "Plaxis".

Results. Constructive calculations of two variants of foundations for high-rise buildings were carried out. Step-by-step modeling of joint work of variants of foundation constructions of high-rise buildings with soil base was performed. The development of non-uniform deformations and the change in the elastically deformed state of the "base - foundation" system under the influence of unfavorable physical and mechanical processes have been studied. The choice of the design method of the zero cycle allowing safe design of high-rise buildings in special construction conditions is substantiated.

Conclusions. Design and modern methods of modeling the joint interaction of the foundation structure with the soil base help to increase the integrated efficiency of urban areas, while solving the problem of choosing zero cycle structures. Such structures in the design of multi-storey buildings in adverse conditions provide compatible spatial work, perceiving and redistributing the emerging forces in the elements of the superstructure during the deformation of the foundations in complex engineering and geological conditions.

Interaction behaviors of longitudinal and transverse seismic waves with underground objects

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Introduction. Main pipelines as long linear objects are vulnerable to dangerous natural and man-made influences. One of the technogenic source is large-scale explosions, which cause a sharp fluctuations of soil and cause serious damage to underground pipelines. When calculating the strength of pipeline systems, it is assumed that the damage occurs mainly due to additional axial stretching. However, the destruction and damage of pipelines can occur during seismic impacts directed perpendicular to the longitudinal axis of the pipeline

Aim/tasks. The aim of the work is to assess the impact of transverse waves on the underground pipeline during seismic action from an explosive source.

Methodology. To achieve this goal, a software-calculation module is developed. It implements a model of dynamic strength analysis, which allows to estimate the magnitude of longitudinal and transverse seismic loads on the underground pipeline to establish safe parameters of seismic loads and geometric dimensions of the protected object. The final system of equations of motion of N nodes of a discrete system for a single length of the pipeline is presented as a system of $4N$ equations of the first order. The system of equations is supplemented by the corresponding initial and boundary conditions.

Results. The dependences of the inflow of longitudinal and transverse pressure of explosive seismic pressure on the pipeline are established. The dependences of stresses in the pipeline of the diameter, thickness and type of soil are researched. It is calculated that, with an increase in loads intensity and an increase in the diameter of pipes, the stress is increased in the following order: for pipes with a diameter of 800 - in 1.05 ... 1.25 times, for pipes with a diameter of 1000 mm - in 1.10 ... 1.35 times, for pipes with a diameter of 1200 mm - 1.20 ... 1.50 times. The transverse wave causes much more damage in the pipe than the longitudinal one, thus the area of damage increases in 1.5 times.

Conclusions. The results obtained in this work can be used in the design, construction and operation of pipelines subjected to seismic and other dynamic loads.

A study of rock response to failure in the context of the bending properties and comparison with uniaxial tensile and compression behaviour

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Introduction. A commonly used material constant describing the strength properties of rocks, but also concretes, composite granular materials and cohesive soils is the one- (and three-) axial compression strength σ_C. The use of this constants as a strength parameter is usually sufficient to solve most problems in the field of geomechanics, geotechnics and strength at the engineering level.

Compression and shear tests are in common use, while uniaxial tensile tests are much less common. Failure of rocks is often due to *flexure*. Bending of rock layers occurs in the case of underground chamber roofs, mining excavations, tunnels and even rising headings at high horizontal stress values. Also in building engineering, the problem of bending of floors is key when designing ground-based and underground structures.

Although the phenomenon of rock damage and failure occurs in many cases as a result of their *flexure*, issues related to rock stability are solved primarily on the basis of compression and shear constants. Constants of elasticity are used, e.g., Young's modulus *E*, volumetric modulus *K* and shear modulus *G*. Similarly, in the numerical modelling the basic constants are already mentioned constants and constants related to shear strength such as cohesion *c* or angle of internal friction φ.

Aim/tasks. The main task was to conduct laboratory tests to describe the strength and deformation properties of rocks under bending. Then comparing these constants with constants determined in uniaxial compression and tension conditions.

Methodology. In this research, laboratory tests were performed on shaped rock samples under different loading conditions. The tests were performed in according to the recommendations of the International Society of Rock Mechanics.

Results. For the homogeneous, isotropic, fine-grained *Brenna* sandstone studied, the differences in constant values are clear. The bending strength σ_B of about 9.5MPa is almost 3 times greater than the direct tension strength σ_T of about 3.2MPa and is 1/10 of the uniaxial compression strength σ_C.

Differences also occur in the case of deformability moduli *E*. Under three-point bending, *E* is equal to: for tensioned *fibres* about 6.7GPa, and for compressed *fibres* 14.6GPa. For the same sandstone, the *E* values were equal: in uniaxial compression tests around 13.0GPa, and in direct tensile tests 4.8GPa. The deformability is therefore very different.

Rock material was also failured at various strains values ε. In the case of three-point bending tests, the ε_x strains were equal: for tensioned *fibres* about 0.125%, and

for compressed *fibres* 0.065%. In uniaxial compression tests, failure occurred at a ε_z value of about 0.63%, and in direct tensile tests 0.07%.

Conclusions. The presented results of laboratory tests clearly indicate the differences between the values of constants calculated on the basis of three-point bending, direct tension and uniaxial compression tests. The rock material properties under bending are important, especially from the point of view of researching and forecasting the development of damage zones in the excavation ceilings and underground structures, mining excavations and tunnels, and in the description of the rock material during numerical analysis and simulations.

Governance, Legislation and Policy for Sustainability

Model substantiation of strategies of economic behavior in the context of increasing negative impact of environmental factors in the context of sustainable development

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Introduction. The concept of sustainable development has become a priority model for the development of most countries. Its emergence was a requirement of time to solve urgent acute problems of both socio-economic and resource-environmental nature. The most progressive concept today is the threefold concept of sustainable development. Within this understanding of sustainable development, environmental, social and economic issues are considered in general, and the goals of resource conservation and socio-economic development not only do not contradict each other, but can also contribute to mutual strengthening. This understanding of sustainable development implies achieving a high standard of living, a prosperous economy and conserving resources.

Aim/tasks is the study of strategies of economic behavior as a response to the deterioration of environmental indicators, as well as the development of a methodology for qualitative assessment of the results of their application in the context of sustainable development.

Methodology. The following methods were used to conduct the study: analysis, systematization, generalization - in order to classify possible forms of adaptation of the economic entity to increase the negative impact of environmental factors; mathematical and computer modeling to evaluate the results of the suction of certain forms of economic behavior.

Results. Passive, active and proactive strategies of economic behavior as a response to environmental degradation are studied. A mathematical model has been built in the state space, which reflects the self-organizational nature of the studied process and makes it possible to assess the dependence of the amount of resources used for livelihood on the chosen adaptive strategy.

Conclusions. Within the framework of the proposed model, it is established that the criterion for the effectiveness of the applied strategy of economic behavior may be the value of the "coefficient of resilience" to external factors. It is shown that the economic entity is more motivated to overcome the negative impact than to passively maintain the current state. This approach is consistent with the concept of sustainable development.

Improvement of the social service system in Ukraine in conditions of sustainable development on the experience of Canada and Finland

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Introduction. The main goals of the social services system in each state are the social protection of various social groups, especially those who are in difficult life circumstances. Effective social protection is not only state-guaranteed social benefits but a well-developed network of social services provided with consideration of the features and needs of different population categories. The modern system of social services must meet the goals of sustainable development of society and the needs of citizens, improve their quality of life, overcome poverty, ensure good health and well-being. However, we can talk about sustainable social development in Ukraine in actual conditions only as a desire, not a real state of affairs.

Aim/tasks. The work aims to analyze the system of social services in Ukraine and find out the prospects for its improvement based on the goals of sustainable development of society based on the generalization of the experience of Canada and Finland.

Methodology. Based on a study of the legal framework, social services institutions, levels of activity, and principles of social policy, we identified the main characteristic differences between the social services system of Canada and Finland. The principles of social security of the social-democratic (Scandinavian) and Anglo-Saxon (liberal) models are clarified, and we also identified their advantages and disadvantages. We determined the influence of the studied social service systems on the solution of the goals of sustainable development.

Results. The analysis shows that today Ukraine needs to reform the social services system, which can be done by re-evaluating the methods of planning and providing social services, continuing to improve the regulatory framework in this area, improving the financial support of institutions providing social services and other areas of management.

Conclusions. As a result of our work, we have developed a modernized model of social services in Ukraine that meets the Sustainable Development Goals and is adapted to the realities of Ukrainian society.

We focused on the redistribution of values, priorities, took into account the peculiarities of the mentality of citizens, current legislation, the socio-economic situation in Ukraine.

Measuring, Forecasting and Monitoring Sustainability

Spatial organization of the soil macrofauna community in a floodplain forest

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Background/introduction. Soil fauna is an important functional component of terrestrial ecosystems. Several hierarchical levels of spatial organization of pedobionts communities can be distinguished: point level, ecosystem level and landscape level. Of particular importance is the ecosystem level of spatial organization where the results of interaction between soil animals and soil and plant environmental factors, as well as the results of the influence of factors of neutral nature are expressed to the greatest extent.

Purpose/objective. The aim of the work is to test the hypothesis that the spatial patterns of soil macrofauna at the ecosystem level can be explained by ecomorphs.

Methodology. Soil animals were sampled in floodplain ecosystems in the Dnieper River valley. Animals were sampled according to a regular grid with recording of local coordinates of sampling points. At the same points, soil properties were measured and geobotanical descriptions of vegetation were made. Phytoindication assessment of environmental factors was carried out on the basis of vegetation descriptions.

Results/findings. The soil animal community is represented by high taxonomic and ecological diversity. The spatial distribution of soil macrofauna is not random and is a consequence of environmental factors and causes of a neutral nature. The ratio of these factors varies depending on the scale level. The fine-scale level is represented by factors of neutral nature. Medium- and broad-scale components are determined by soil and vegetation factors.

Conclusions. The main spatial patterns of variation in the soil animal community correlate with the ecomorphic features of the animals. The ecomorphic approach allows interpreting the information on the spatial organization of pedobionts communities.

Use of factor analysis to assess the ecological and economic competitiveness of regions

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Introduction. The development of the regional economy in Ukraine and the world in the conditions of intensifying interregional, national, and world competition stimulates active scientific interest. Researchers pay more and more attention to the ecological direction of economic systems development, the formation of competitiveness of new types of regions, the introduction of criteria for environmental efficiency of markets and market infrastructure in the uniqueness and uniqueness of regional economic complexes. The ecological component of competitiveness largely determines the development of other components, because, in the event of an ecological catastrophe, the importance of all major and related subsystems is leveled. Ecological and economic competitiveness is a logical consequence of the development of the world economic system, the growing needs of the population, the deterioration of the environment and is extremely relevant for all regions of the country. The need to increase the economic and social efficiency of market transformations highlights the problem of compliance of the development of production, the economic, innovation potential of the regions to modern environmental and economic challenges.

Aim/tasks. The aim is to develop a model for studying the dynamics of ecological and economic competitiveness of regions in the context of globalization, taking into account groups of indicators and coefficients that reflect environmental, economic competitiveness, social factor, and atmospheric rent.

Methodology. The paper uses factor analysis within which the matrix of cross-correlation of indicators is calculated, the Kaiser-Meyer-Olkin criterion is used to determine the feasibility of factor analysis.

Results. Carrying out successive iterations of factorization of the matrix of cross-correlations and rotation of the factorized matrix gave grounds to identify seven groups of indicators that have a significant impact on environmental and economic competitiveness. An integrated additive model (more accurate than a multiplicative one) was built according to the adjusted system of indicators, which allowed obtaining a forecast ranking of regions according to ecological and economic competitiveness. The factor analysis also confirmed that the amount of atmospheric rent is an influential factor in the formation and strengthening of the environmental and economic competitiveness of the regions.

Conclusions. Thus, the application of factor analysis will allow obtaining an adequate model for ensuring a new quality of the system of ecological and economic competitiveness of regions. This will help substantiate the strategy of development of regions and the state concerning the environmental and economic situation. In addition, a systematic study of the ecological and economic competitiveness of the regions will identify trends in its current development and national specifics.

Monitoring the sustainability of small and medium business in the regions of Ukraine based on the resource approach

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Introduction. The features of small and medium business in Ukraine require an integrated approach to sustainability management, which includes taking into account the positions of key stakeholders and their resource contribution to business activities. The main guideline in sustainability provision is the detection and scanning of social requirements, as well as adequate and timely response to the stakeholders’ requests.

Aim/tasks is to monitor the level of imbalance of resource exchange between small and medium business and its key stakeholders in the regions of Ukraine.

Methodology. The following methods were used in the research: focus groups survey, statistical generalization, correlation-regression analysis, linear modeling, and graphical method.

Results. Based on the results of modeling the resource interaction of small and medium business with the main stakeholders, the vectors of the "ideal" and "real" resource exchange structure were constructed. The difference in the structures of these vectors reflects the imbalance of the existing resource exchange in the system, which can be expressed by the ratio of imbalance. The smaller the value of this ratio, the more balanced is resource exchange.

Conclusions. It is proved that small businesses have an increased need for strong personal relationships with the local community and authorities. It is important for companies to identify the importance of stakeholders according to their resource contribution. To form a strategy of sustainability it is necessary to understand which of the stakeholders’ groups make the greatest contribution to the imbalance between the "ideal" and "real" resource exchange structure.

Creation of new algorithms for express detection of the pathogens (B. anthracis and tuberculosis) in ultrafast and sensitive sensor platform

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Introduction. In the frames of NATO SfP Program and implementation of project G 5798 "A Novel Nanoparticle based Real-Time Sensor for B. anthracis and M. tuberculosis" one of the objectives is to make an express analysis of biological samples for the presence and detection of pathogens B. anthracis and M. tuberculosis in a composition.

Aim/tasks. Development, optimization of new algorithms - methods of structural dynamic model analysis that will increase the signal-to-noise ratio, selectivity of measured objects, high sensitivity, as well as optimization of various components of the laboratory setup.

Methodology. Following methods were used: analysis, mathematical modelling, methods to conduct scientific experiments.

Results. The development of algorithms for the recognition, classification and visualization of analytical laser-fluorescence spectroscopy data is carried out.

Conclusion. Our purpose of this study was to reduce the observation time required for reliable detection of pathogens with ultra-low concentrations. This goal is achieved by the fact that the response of the detector of optical radiation to recorded photons is additively mixed with an auxiliary pulse process, the intensity of which is known and many times higher than the intensity of the radiation source to be detected. Further work will be concentrated on a generalized mathematical model of the generation of a laser-fluorescent signal in multicomponent samples, and models of the response function from single-component samples will be built.

Temporal dynamics of steppe plant communities

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Background/introduction. Global climate change affects the conditions of ecosystems. However, the nature of changes induced by climatic factors remains unknown due to the complex nature of climatic transformations. The global trend of temperature increase is associated with an increase in precipitation and changes in its rhythm. The dynamics of plant communities under the influence of climate occurs against the background of natural successional phenomena.

Purpose/objective. The aim of the study is to develop methodological approaches in order to identify aspects of vegetation variability that are caused by global climate change and give them an ecological interpretation.

Methodology. Geobotanical descriptions of vegetation in steppe ecosystems were carried out over the last 20 years. Exactly in this period dramatic climatic changes were observed, which allows to compare climatic and vegetation trends. For ecological interpretation the results of ordination of plant communities were explained with the help of phytoindication scales.

Results/findings. Plant communities exhibit dynamics that are driven by endogenous and exogenous causes. These aspects of community dynamics were differentiated using the ordination procedure as different ordination axes. The axes that reflect endogenous dynamics were described using temporal variables. The axes that reflect exogenous dynamics were described using phytoindication scales. The phytoindication scales made it possible to assess the ecological directions of plant community transformation under the influence of global climate change.

Conclusions. The transformation of the plant community under the influence of global climate change is inconsistent with the concepts of desertification. The revealed temporal patterns of the plant community have a complex and multidirectional trajectory.

Keywords: global climate change, desertification, community ordination, temporal ecology.

Air pollution monitoring system from energy objects based on mesh network

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Background. The intensive development of energy, industry and transport causes an increase in the consumption of hydrocarbon fuels, which, in turn, increases the amount of its combustion products which emitted into the atmosphere. The toxicity of exhaust gases emitted into ambient air depends mainly on the quality, grade and type of hydrocarbon fuel burned, the conditions for organizing the combustion process, the technical condition of heat engines and fuel-burning installations.

Purpose/objective. To develop system for monitoring the air pollution near the energy objects (thermal power plants, TPPs) based on the wireless networks (mesh).

Methodology. Theory of information and measuring systems, ecology monitoring, probability theory, statistical analysis.

Results/findings. State Institution "The Institute of Environmental Geochemistry of National Academy of Sciences of Ukraine" managed to create experimental modules of the air pollution monitoring system. A feature of the use of these modules is the ability to form a closed measurement system based on the mesh network. Among the advantages of such a network is an increased level of energy saving. For this purpose the capability information field in a beacon and in answers to trial packages is used. The node cannot switch from the active mode to the power saving mode until it informs all devices with which it is connected about its desire to switch.

Conclusions. At present, a working prototype of the measuring module has been created as an element of monitoring the environmental pollution system. A feature of using these modules is the possibility of forming a closed measurement system based on a mesh network.

Current state of artificial forests in the south of Zaporizhzhya region

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Introduction. The conservation and analysis of forests in Ukraine are relevant issues in the context of sustainable development and global climate changes.

Purpose/objective. Analysis of the current state of the forests in the south of Zaporizhzhya region on the example of Bohatyr forestry, development the recommendations for their protection and optimization.

Methodology. The research was conducted in 2018-2020 according to the traditional methods in geobotany and forest taxation.

Results. There were detected 25 species of trees in the forestry. The most widespread ones – *Robinia pseudoacacia* (53.0% of the forested area), *Pinus pallasiana* (20.5%), *Quercus robur* (16.0%), *Celtis occidentalis* (8.5%). *Q. robur* and *P. pallasiana* forms the oldest stands (average age – 54.8 and 45.8 years). The total area of Bohatyr forestry – 2451.0 ha. 1792.1 ha are covered with forest. There is 23.3% of forest stands with the highest 4th-5th fire safety classes.

Conclusions. 73.1% of the Bohatyr forestry area is covered by forest stands. This indicator is one of the highest among other forestries in the region, where the increase of the forest stands area is limited by the lack of land for the forest crops.

The current state of *Celtis occidentalis* stands in Bohatyr forestry allows to recommend this specie as promising for the forest crops in the region.

Dynamics in forestry over the past 15 years shows the increasing frequency and area of fires, which requires adjustment of existing fire prevention measures.

Sustainable Building and Architecture

Vectors of sustainable development of hospital architecture (case for Poland)

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Introduction. According to FutureProofing Healthcare, Poland's Sustainability Index is one of the lowest in the EU (23rd out of 30 in 2020). The concept of "sustainability" is considered as the ability of the system to respond to the emerging needs of the population and provide resources for adaptation to innovation. Taking into account that the health care system is a multi-component complex mechanism, the article attempts to determine the vectors of sustainable development of the architecture of Polish hospitals.

Aim/tasks is to determine the vectors of sustainable development of hospital architecture (on the example of Poland).

Methodology. The study and analysis were carried out using an integrated, functional, systemic, and historical research approach.

Results.

1. Cluster approach (interaction and concentration in a certain area of hospital buildings, diagnostic, advisory, research, experimental, training centers, laboratories, and auxiliary facilities).
2. Multifunctionality and accessibility (aimed at expanding traditional hospital functions with the integration of new services).
3. Comprehensiveness.
4. Openness and visual communication.
5. Comfortable and trusting environment (to use experience in designing medical, hotels, residential and public buildings).
6. Landscaping.
7. Green approach.

Conclusions. Sustainable hospital architecture is feasible, focused on improving the quality and comfort of hospital stay for patients, visitors, and staff. The proposed vectors will reduce operating costs, increase the possibility of obtaining additional financial resources, and create conditions for the formation and development of the potential of the healing properties of the architectural space.

Ecological park – a step towards sustainable development

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Introduction. The issues of nature restoration, climate protection, and preservation of the ecological balance are today key issues for all civilized countries. We are used to consuming everything excessively, living for today and not thinking much about what will happen to our planet in the future. But recent events (pandemics, forest fires, floods, temperature rises, etc.) faced by almost all countries forced us to reconsider our views on the issues of climate and environmental preservation. One of the ways to solve the existing problems is the design of ecological parks, which combine representative, educational, recreational and restorative functions.

Aim/tasks is to identify the main functions and characteristics of an ecological park as a promising direction for the formation of space, which concentrates human knowledge about the restoration and preservation of the ecological balance.

Methodology. The study was carried out using an integrated, functional and systemic research approach.

Results.

1. Representative function (visual demonstration of innovative technologies).
2. Educational function (for everyone who wants to learn to live with respect for the planet).
3. Recreational function (the territory of the ecological park creates all conditions for restoration in the environment of nature).
4. Restoration function (an ecological park can be designed in areas that have lost their original function and are subject to renovation).

Conclusions. The Ecological Park is a public space with a unique combination of demonstrating the possibilities of energy production, water purification, resource reuse and climate management, which is also a recreational environment and has an educational purpose.

Architecture and water – interaction and complementarity

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Introduction. In the world architectural practice, there are examples of ideal interaction and complementarity of architectural objects with elements of the aquatic environment. Based on the analysis of the best samples and examples (Fallingwater / Frank Lloyd Wright, Chemical Plant Offices in Huai'an City, China / Alvaro Siza, Moses Bridge / RO&AD Architecten, Louvre Abu Dhabi / Jean Nouvel, Mondadori Headquarter / Oscar Niemeyer, Blur Building / Diller Scofidio + Renfro's, Jewel Changi Airport / Safdie Architects, The Winery at VIK / Smiljan Radic, Emperor Qianmen Hotel / ASAP, The Blue Planet, Denmark / 3XN) the article reveals the basic principles of the harmonious coexistence of architecture and water elements.

Aim/tasks. Based on the analysis of the best world projects, to identify the basic principles of the harmonious coexistence of architectural objects and water elements.

Methodology. The study and analysis were carried out using an integrated, functional, systemic, and historical research approach.

Results.

1. Interaction is a principle due to which an architectural object receives an undeniable advantage in comparison with similar ones, but implemented without water elements (artificial and natural waterfalls, rainwater collection, cooling and increasing air humidity, etc.).
2. Complementarity - a principle that involves the use of water as an integral element of an architectural object.
3. Integration is a principle that involves the introduction of an architectural object into the aquatic environment or vice versa.

Conclusions. Water is an integral part of the entire existence of mankind and we need to find a harmonious balance of coexistence with the aquatic environment. Architecture, like man-made or second nature, can and should interact and complement the aquatic environment, thereby subconsciously evoking a sense of harmony and naturalness.

Recycling technologies in the production of modular architectural structures as a step towards sustainable development

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Introduction. In Ukraine, there is a critical situation in the waste management area due to the high level of waste generation and low level of recycling. Accumulation of waste, non-ecological methods of utilization and storage deepen the ecological crisis. There is an urgent need to develop new methods of using secondary resources in architecture and construction, which would reduce the share of recycled waste and their negative impact on the environment.

Aim/tasks The purpose of this research is the justification for the need to introduce new areas of secondary resources usage in the field of architecture and construction.

Methodology. The research methodology includes the analysis of the domestic and foreign experience of recycling technologies application in architecture and the description of new usage possibilities of recycled plastic waste.

Results. An analysis of domestic and foreign experience has shown that the main ways to use household and industrial waste recycling technologies in architecture and construction are the production of structural and roofing elements, paving, decorative materials, and furniture.

A fundamentally new direction for using secondary materials in architecture can be the production of prefabricated structures by 3d printing using building mixtures based on secondary plastic.

Conclusions. The use of construction mixtures based on recycled plastic will open new opportunities for the development of the architectural and construction industry, will optimize the production process of architectural structures, will significantly reduce the cost of finished products, reduce waste and improve the environmental status environment. Ultimately, this will help achieve sustainable development goals.

Justification of the method of soil densification of the interstation tunnel by jet injection based on computer modeling

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The article is devoted to a topical issue - the development of a method of densification of the base of the underground interstation tunnel to prevent further intensive subsidence of tunnel structures.

Based on computer-mathematical modeling, the work establishes experimental dependence between the angle of inclination of jet grouting piles and the amount of subsidence of the distribution plate on which the tunnel structures rest upon. Inspection of the technical condition and analysis of defects in a comprehensive comparison with subsidence graphs allowed us to identify the main typical deformations during subsidence of a shallow tunnel built from blocks of a solid-section frame, namely their characteristic features, geometric parameters and placement points.

Increasing of strength-rigidity parameters of bases of metallic silos

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Introduction. The provision of reliability and safety of operation of metallic silos in the context of decreasing of settlement of their foundations is topical for both new construction and in their reconstruction. To date, effective codes of Ukraine limit settlement of foundations of metallic silos to 15 cm. To provide normative settlement of foundation with diameter up to 40 m and more is not always possible without additional essential measures for strengthening or changing base soils.

Aim/tasks. Application of parametric strengthening of soil for foundations of great dimensions, which makes it possible to optimize stressed-deformed state of foundation, its settlement and to increase operational reliability of foundation and structure as a whole.

Methodology. Construction of agro-industrial objects in Ukraine more frequently takes place in complex geological and hydro-geological conditions. Taking into account high levels of loads, soils of bases in natural condition can not carry stress under the base of foundation and require strengthening. Execution of works on change of soils of bases or installation of soil cushions is not always possible taking into account underflooding of territory, building development that exist near at hand, or other complicating factors.

Results. Different types and subtypes of variants of strengthening of soils of bases have been analyzed from the viewpoint of technology of work execution and their technical-and-economical indices, in particular, equipment, materials and other. Soil cement after Deep Soil Mixing (DSM) technology, Jet Grouting, injection and micropiles were considered for different types of strengthening taking into account application in great volumes.

Conclusions. From analysis of the obtained results, it was determined that soil cement after Deep Soil Mixing technology is the most economically justified method. Application of Jet Grouting is justified during strengthening of soil thicknesses locally separated by depth. Injection and micropiles are used appropriately only in conditions of reconstruction under absence of direct access to the base.

Curved steel frames as unit modern architecture

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Introduction. Steel spatial structures are a useful tool for creating exclusive architectural forms of building structures with large spans. This is important in construction of iconic public buildings such as showrooms, transport buildings, airports, flyovers, etc.

Aim/tasks. This paper describes the experience of author's team in the design of steel spatial roof of waiting room and bus station of the international airport "Borispol".

Methodology. The spatial roof has a complex geometrical surface of double curvature with a total area 3560 sq.m. To accordance to architectural concept, curvature of surface is not set analytically, but so presented by polygonal lines and this could not be changed. This greatly complicated the problem of modeling and design, since the total number of finite-elements of the design model was more than 27000. The design model process was very laborious and required large computer resources. The calculation was carried out in the Scadoffice software with increased attention to modelling wind and snow loads.

Results. The 59 individual metal trusses were designed with a polygonal shape in the form of wave, a system of rafter structures and spatial columns in the form of octagons. All elements is hot-rolled seamless steel pipes. This made it possible to create original design solutions for joints and minimize wind loads on the steel frame. The total steel consumption of the frame is about 245 tons.

Conclusions. The creation of spatial structures from steel has a strong visual effect. However, the use of such solutions requires significant professional experience and scientific support.

Sustainable Cities and Society

The readiness of architecture technology of government integrated system network in Indonesia

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Technology development continues to roll and run in every government agency, both central and local. Frameworks, tools, principles, patterns, fundamental features, and shared services are all included in a typical government architecture application. Government architecture cannot be viewed in isolation from governance, as effective governance necessitates it. The purpose of this research is to ascertain how prepared Indonesians are to fundamentally adopt government architecture and to minimize the costs associated with operating the Enterprise Architecture Framework. This research examines the readiness of Indonesian government architecture by comparing it to other TOGAF frameworks. The data is using government policy, brief decision, and other legally source. It also uses engine of NVivo to find out which stage of ToGAF framework are not related to Indonesia's architecture technology. Government architecture is intended to guide and direct the development of ICT projects in government. Each Central Agency (Ministry and Institution) is encouraged to establish and develop general and specific applications. The TOGAF ADM presents iterative and tested processes for developing the architecture.

Spatial distribution of micromollusks under the impact of recreation

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Anthropogenic impacts lead to a decrease in the abundance and diversity of communities of living organisms. The rate of recovery of populations is inversely proportional to size: the smaller the size, the greater the potential for population recovery after negative impact. Therefore, under conditions of extremely high levels of anthropogenic impact, small-sized animals are a reliable source of ecosystem state. The aim of the work is to: 1) to evaluate rates of the micromollusc *Vallonia pulchella* (Müller, 1774) abundance in ecosystems that are subject to extremely high levels of recreational pressure; 2) to identify factors that influence the spatial patterns of soil micromollusks; and 3) to investigate the possibility of using micromollusks for the purposes of bioindication of recreational pressure. The soil sampling was performed on a regular grid with recording of local coordinates. The micromollusks were extracted from the soil samples by hand sorting. Physical properties of soil sensitive to recreational load were also measured. Micromolluscs were found to exhibit a non-linear response to recreational impact. The maximum abundance of animals is observed at a certain distance from recreational trails. This distance is specific for different species of micromollusks. Micromollusks have high population abundance even under conditions of high recreational load. The regular spatial patterns of these animals are caused by changes in the soil habitat, which are induced by recreational load. This circumstance allows to consider micromollusks as a reliable indicator of the level of recreational load.

Sustainable development of the Pirnovo community in the Kyiv region: problems and perspectives

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Introduction. Currently, Ukrainian rural communities experience difficulties in developing economic and social growth strategies, social infrastructure, creating jobs, expanding environmentally friendly local production, protecting and restoring natural sites, developing local culture and preserving environmental and cultural heritage.

Purpose. This study aims to analyze the challenges faced by the Pirnovo community and to offer ways of architectural environment transformation in order to improve the quality of life of the local population.

Methodology. The research methodology includes analysis of the community's current problems and unrealized opportunities; spatial modelling of the complex territory development; developing gentrification proposals of existing settlements and environment improvement through innovative recycling technologies.

Results. Among the community's acute problems are seasonal fluctuation of the population, lack of jobs, chaotic housing, reserve destruction, lack of sorting, and recycling facilities. However, the territory has an advantageous location and significant recreational potential. The offered plan of integrated development allows considering alternative use of the territory's recreational potential, methods of modernizing the cultural and consumer service system for the population and ways of achieving ecological balance. Our version of Pirnovo's general plan focuses on the necessary changes of land-use planning, social infrastructure improvement and improvement of the living environment quality without destroying the natural. Pirnovo's specific central area plan demonstrates possible approaches to redevelopment and creation of modern public spaces by means of recycled materials.

Conclusions. The study offers new ways of dealing with existing problems in particular areas, which might help other settlements and rural territorial communities to achieve sustainable development.

Substantiation of the socio-economic effect of a city outdoor lighting modernization

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Introduction. The issue of improvement of outdoor lighting with the use of energy-saving technologies to reduce the environmental burden in old industrial and monocities is extremely relevant, as it corresponds to the list of sustainable development goals.

Aim/tasks is to propose substantiation of expediency of energy modernization of outdoor lighting networks (on the example of Kamianske, Dnipro region) in order to provide city residents with quality outdoor lighting services, increase public safety by effectively illuminating urban space, reducing environmental impact (reducing "Light pollution" and CO2 emissions into the atmosphere) by optimizing the consumption of energy resources.

Methodology. The previous socio-economic conditions and the volume of energy consumption of the city during 2012-2020 were studied. In order to substantiate the economic efficiency of the project, electrical measurements were used in outdoor lighting control units, measurement of the level of illumination of representative streets were held.

Results. Energy modernization with the transfer of outdoor lighting to renewable energy sources (solar panels) with the installation of remotely controlled LED lamps will reduce the actual energy consumption of the city network by 6-7 times, while reducing the estimated emissions of CO2 - 6,215 tons per year.

Conclusions. It is determined that the implementation of the project will save up to 1.8 GW of electricity in street lighting systems compared to the expected total consumption (as of 2021). Additional installation of grid-connected solar stations will allow not only to meet their own energy needs, but also to realize a surplus in the wholesale energy market.

Spatial variation of soil macrofauna community of an oak forest ecosystem in the steppe zone of Ukraine

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The forest ecosystems of the steppe zone of Ukraine are of interest as refugia of nemoral flora and fauna with a high level of biological diversity. The functional role of these types of ecosystems is very high. Forests in the steppe are regulators of the water regime of landscapes and protect the development of water and wind erosion. A zoogenic soil horizon was found in forest soils in the steppe zone, which indicates the important role of soil animals in the soil-forming process and the functioning of the forest in the steppe. The aim of the article was to find out the patterns of spatial organization of the soil macrofauna assemblage of the oak woodland on the right bank of the Samara River. The soil macrofauna was sampled in an oak tree located on the right bank of the Samara River. After taxonomic identification, invertebrate species belonging to different groups of ecomorphs were identified. The functional state of the macrofauna community was assessed on the basis of ecomorphic spectra. The results indicate a high level of taxonomic and ecomorphic diversity of the soil macrofauna community. Forest species predominate in the community. The value of steppe species is also high. A high level of functional activity is open for litter species. The ecomorphic structure of the community indicates a high level of functional stability of the forest ecosystem in the conditions of steppe environment. The soil macrofauna community of the oak forest on the slope of the right bank of the steppe river has a high level of abundance, taxonomic and ecological diversity. The soil macrofauna community exhibits spatial patterns in which soil and vegetation properties are involved. The redistribution of forest litter under the influence of gravity along the riverbank slope creates a large-scale spatial pattern of soil macrofauna, which predominantly includes epigean species. The spatial distribution of trees forms the broad-scale component of the soil macrofauna community variation, while grass cover forms the medium-scale component. The fine-scale component of community variation is driven by factors of a neutral nature.

Biwako channel at Kyoto Japan: sustainable development and revitalization

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Introduction. Lake Biwa Canal (engineer Tanabe Sakuro) connects Lake Biwa and Kyoto. The canal is over 11 km long and is interspersed with tunnels. The canal was built at the end of the 19th century in order to revive Kyoto, which decayed after the transfer of the capital to Edo (Tokyo) in 1868 and served to supply Kyoto with drinking and industrial water, as well as for cargo navigation.

Aim/tasks. The aim of the work is to determine the historical periods of the Biwa Canal existence and its significance for ensuring the sustainable development of Kyoto.

Methodology. The research was conducted at Kyoto mainly with field studies and interview methods.

Results. As a result, three historical periods of the Lake Biwa Canal existence were identified. In the first period (1885-1948), the canal combined aquifer and transport functions and was fundamental to the sustainable development of Kyoto. In the second period (1948-1990), the transport role of the canal became unclaimed, and its role in sustainable development of the city significantly decreased. In the third period (since 1990), the canal was recognized as nationally designated Historic Site, and a campaign of its revitalization began. In 2018 the canal acquired a tourism function and increased its role in the sustainable development of Kyoto.

Conclusions. Thus, at the time of its construction, the Lake Biwa canal was the main driving force that saved Kyoto from decline. Now, we can talk about the opposite process, when the city supported the sustainable development of the canal.

Solutions of solid waste management problems: international and domestic experience

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Introduction. Analysis of scientific approaches on waste management in Ukraine and abroad show that most scientists are inclined to implement effective foreign experience of such countries as Sweden, Germany, Switzerland, Austria and Japan. These countries use recycling of waste to heat buildings, generate electricity, make various household items, and so on. Currently, Ukraine is one of the countries with the largest absolute volumes of waste generation and accumulation. Situation with landfills in Ukraine is uncontrolled and it is evidenced by illegal landfills. This constantly worsen environmental situation in Ukraine with their harmful chemical emissions.

Aim/tasks is to analyze foreign experience in household waste management and ways of their utilization; determine impact of landfills on pollution of environmental components (air, soil, groundwater).

Methodology. Following methods were used to conduct this study: analysis, systematization, generalization – in order to study and systematize foreign and domestic experience in solid waste management; mathematical and computer modeling to determine level of air pollution from solid waste disposal sites.

Results. Foreign experience of various methods using for household waste management and ways of their utilization are investigated. Statistical data on household and similar waste management in Ukraine for the period from 2011-2020 are analyzed and shown. Landfills influence on pollution of environmental components (air, soil, groundwater) is described. Mathematical and software tools to define level of air pollution from solid waste disposal sites were developed and their work was demonstrated on example of some landfills in Ukraine.

Conclusions. Number of recommendations was prepared to reduce pollution of environmental components from landfills, in particular their locations. It is possible to reduce environmental hazards caused by landfills through number of measures: sorting of solid household waste; recycling; control and register of landfills; relocation of landfills; construction of waste processing and incineration plants; environmental education on responsible treatment of waste, etc.

Digital transformation of social business

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Introduction. Socio-economic problems in the development of the world economy, high unemployment, regional differentiation, the reduction of government spending on the social infrastructure determine the search for innovative, economically profitable mechanisms for solving social problems. According to world practice, one of the successful and effective tools for solving this problem is the development of the social entrepreneurship.

Aim/tasks. The purpose of the research is to identify objective prerequisites, promising areas and key problems in digital transformation of social business. The universal economic digitalization affect the social entrepreneurship. So, the task of finding the most comfortable model of digital transformation is updated.

Methodology. The innovative phenomenon of social business determines the choice of tools for transforming classical business models in the digital economy, as well as the methodological and organizational aspects in the functioning of social entrepreneurs. The general scientific knowledge will make it possible to form an author's approach to the theoretical and methodological justification of digital transformation in social business.

Results. The result of the study is a digital platform "Social Entrepreneur," which combines information, education and financial functions. The proposed project is aimed at ensuring interdepartmental, interdisciplinary and intersectoral interaction between social entrepreneurs, state authorities, financial agents and investors.

Conclusions. Further linking of client services to this platform will form a digital ecosystem of social business. In general, the results can be used to strengthen the relationship between the state, business and society, which will become a new driver of economic development in the context of digital transformation.

Traditional water supply systems of arid regions and their modern situation (cases of M’zab Valley, Algeria and Miyakojima Island, Japan)

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Introduction. The historical development of water supply systems for portable and irrigation water gathering is traditional in arid regions of the world. The diversity of such systems can be observed at Middle East and Asiatic cultures. Some of them are still in use or partly in use now. The study cases of the work are traditional distribution systems of rainwater in the deserted M'zab Valley, Algeria and tropical Miyakojima Island, Japan.

Aim/tasks. The research is aiming to precise the modern situation of traditional water supply systems estimating the possible ways of theirs sustainable development and revitalization.

Methodology. The research conducted on the case grounds mainly with field studies and interview methods.

Results. The water supply system of M`zab has been implemented more than eight centuries ago and is still in use. It is a complex hydraulic system based on the principle of total utilization of torrent water and on the equitable division of this water over the entire oasis. Local people now beginning to understand its cultural significance aiming to popularize it. Miyakojima Island medieval water supply underground system consist of the network of cave sources integrated with architecture. Now it is in decay not using like a source of potable water but still preserving some sacral significance with not pointing on popularization.

Conclusions. For the sustainability and revitalization of the traditional water supply systems, it is not enough now to preserve their initial function but also need to develop the potency of tourist attraction with reservation as cultural property.

The influence of socio-demographic and external factors on the change of urban parameters of Luhansk region

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Introduction. The scale and nature of changes in the urban planning parameters of the Luhansk region under the influence of socio-demographic and external factors are studied. The actual development trends of the Lysychansk-Rubizhne-Sievierodonetsk agglomeration, the evolution of the regional settlement system, the state and problems of the urban development of the region are determined.

Aim/tasks. Quantitative and qualitative changes in the main territorial and urban planning parameters of the Luhansk region have been studied.

Methodology. To conduct the study, methods of system analysis, analytical comparisons, statistical analysis, urban planning analysis were used. The information base consists of literary and archival sources, cartographic materials.

Results. A methodology for assessing and making urban planning decisions is proposed. The urban planning tasks and directions of transformation of the residential environment of the Luhansk region, controlled by Ukraine, are analyzed. Lugansk region in modern conditions is an outsider of socio-economic development. The occupied territories of the Lugansk region of the so-called ORLO (separate districts of the Luhansk region) are in a state of crisis. Industrial, ecological, social degradation is intensifying. This trend can lead to the devastation of settlement systems. The tasks of rational transformation of the territorial-planning organization of the Lugansk region remain relevant. From the intermediate conclusions, it is advisable to single out: the region has significantly changed its functions. The border and the line of demarcation of the JFO will still indefinitely be the determining factor influencing the state and development of the region.

Conclusions. The task of the territorial development should be considered at the level of the Lysychansk-Rubizhne-Sievierodonetsk agglomeration and the structure of the region as a whole to ensure the growth of its potential. It is expedient to implement priority tasks according to unconditionally effective options that give a quick and demonstrable result. It can be education, transport infrastructure, anything that raises social standards. It is necessary to achieve a consensus of different groups of the population in the implementation of urban planning tasks and projects.

The concept of sustainability of the urban realm and community as the key feature of the Utopia

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Introduction. At present, the concept of sustainability of the urban realm includes several different aspects, such as the formation of smart cities; reduction of the level of environmental pollution and switching to alternative sources of energy, etc. Though, the concept of sustainability has not just emerged in public discourse; it was raised, when applicable, in ideas of politicians in previous centuries and thus, reflected in architecture. The concept was widely spread in the works of utopian authors, who believed that the ideal community could only realize its true potential in a certain sustainable realm.

Aim/tasks is to identify the correlation between spatial sustainability and the overall well-being of citizens in the works of utopians (architects, politicians, etc.); and compare their approach to the environmental issues with the approaches that prevail and are implemented nowadays.

Methodology. The methods used in this research paper are content-analysis of graphic and text works; comparative analysis and grapho-analytical method.

Results of the research summarize different approaches to the development of an eco-friendly urban realm in the works of utopians and their impact on the community. For instance, the thoughtful decision regarding the site to construct a new city, that would create a healthy, comfortable urban realm (“Happy City” by Patricia); emphasis on the usage of alternative sources of energy that alters the residents' attitude to natural sources (ecotopia); re-urbanization of territories, by destroying large cities and forming a network of settlements with a good-neighborly community of people (cities-gardens; the concept of rural utopias), etc.

Conclusions. The utopian concept states that a clean city and the possibility to improve the physical characteristics of the space are key aspects of comfortable life that shape the behavioral habits of the residents. The main conclusion of the research is that the desire to form sustainability of urban realm and community is the key feature of the utopia.

Reconsidering the construct of sustainability: adaptability dynamics in young adults during COVID-19 pandemic

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Introduction. Currently we are witnessing the emergence of novel models of the world as well as the concepts of sustainability integrated into them. In particular, understanding of the world changed at least three times over the span of 20 years: SPOD-, VUCA-, BANI-world. The traditional idea of sustainability is challenged by the VUCA world model (volatile, unpredictable, complex and ambiguous).

Aim/tasks. We hypothesized that the ongoing COVID-19 global crisis supports the paradoxical nature of system's change within the emerging world model (rhythmical, emerging, hybrid and innovative, REHI-world).

Methodology. In order to verify the hypothesis, we examined the adaptability potential of young adults, about 25 years of age (N=127). The research period is ranging from April, 2019 till April, 2021. During the period we had four assessment sessions which coincide with the four COVID-19 pandemic waves. The targets of the research were: meaning of life orientations, coping strategies, readiness for change.

Results. The indicators of the general meaning of life, self-confidence and readiness for change has decreased from the first pandemic wave to the second. The results obtained during the third pandemic wave (October 2021) resumed the pre-pandemic level of the research parameters. The same occurred to the coping strategies: the search for the social support strategies weakened at the beginning of the pandemic; we also observed a solid tendency to strengthen orientation for problem avoidance. During the fall of 2021 the situation went back to the pre-pandemic level.

Conclusions. Adaptive potential to post-traumatic growth during the COVID-19 pandemic can be characterized in terms of undulating nature. This can also support the understanding the world modal as rhythmical, emerging and innovative which is an attribute of a REHI-world, while the concept of sustainability being - facilitating of the rhythm of change of self-organization of any open ecosystem.

Strategyproof decision-making mechanism in territorial community land resources management

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Introduction. The urgency of the work is due to the development of decentralization processes in Ukraine, namely the transfer to the territorial communities (TC) competence on land management outside the settlements. Modern requirements for ensuring openness and soundness in decision- making necessitate the development and application of new methodological approaches to the management of economic processes. This work is devoted to the development of mathematical tools to substantiate the results of the competition for land lease in the TCs.

Purpose. Conducting any competition involves the submission of information by participants. However, the information provided to the tender commission may be inaccurate, and some participants may try to manipulate the commission through its content. The purpose of this work is to develop a management method with an strategyproof mechanism to support decision-making in solving the problem of increasing revenues to the budget of the TC through the lease of their own land.

Methodology. To develop the method, a mathematical model based on the use of cooperative game theory, namely the mechanism of pivotal agents, was built. The structure of constraints and the type of objective function of the problem allowed to identify it as an assignment problem with many criteria.

Results. Approbation of the model on real data allows to be convinced of its adequacy and to reveal a number of questions which research is prospect of the further searches.

Conclusions. The scientific novelty of the research is to develop a method of decision support, which prevents the risk of negative consequences of unfair behavior of participants in the lease competition in TC.

Micro-intervention strategy in urban development as a component of the concept of sustainable city development (case of Lviv)

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Introduction. The challenges facing the Ukrainian city today in urban development require a search for new strategies. One of them today is the strategy of micro-interventions.

Aim of this article is to show how the strategies of micro-interventions contribute to the implementation of the sustainable development concept in a historic city. *Tasks* of this paper are to analyze micro-projects which have been implemented in Lviv and to define how these interventions improved the physical condition of the public spaces.

Methodology. The materials of the article are based on the methods of comparative analysis, systematization, and graphical method.

Results. Micro-intervention is an activity focused on minimal delivery to the urban space, not on the implementation of large urban projects, but on limited and careful activity. The strategy of micro-interventions is embedded in the concept of sustainable city development as "economically and ecologically balanced development of urban and rural settlements, aimed at creating a full living environment for modern and future generations on the basis of rational use of resources". In the last decade, many micro-projects have been implemented in Lviv: from the arrangement of internal neighbourhood spaces, to the reorganization of small, but significant spaces on Mytna Square and near the Opera House. The implementation of these projects has significantly improved the physical condition of the spaces and given them a "new life".

Conclusions. Thus, micro-interventions have become a common tool in the spatial development of the city and are an alternative to various revitalization measures in the historic parts of cities. Micro-intervention in urban structures is often the best strategy for urban development, as it is a "gentle" activity that improves the living environment, saves money and can be reversible.

Territorial assessment of the ecological and social comfort of the population living environment of large industrial cities (on the example of Kryvyi Rih)

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Introduction. Providing a favorable and comfortable living environment for the population is one of the main tasks of optimizing urban development. The level of comfort is formed with the territorial interaction of natural and socio-economic conditions for the region development. This interaction is especially manifested in large industrial centers, characterized by a strong negative anthropogenic impact on the environment. The territorial assessment of the comfort of the living environment involves a comprehensive spatial analysis of the population comfort main factors.

Aim/tasks. The purpose of this work is a spatial analysis of the population living comfort of one of the most industrialized regions not only Ukraine, but also Europe - the city of Kryvyi Rih.

Methodology. Functional zoning was carried out using GIS Map Info with the allocation of the following areas: residential zones, public and business zones, industry and warehouse zones, resort and recreation zones.

Results. The distribution of the residential area according to the level of comfort of the population living environment was carried out according to 3 groups of factors: transport accessibility, development of social infrastructure and ecological state. The first group characterizes the habitat from the point of view of the city`s provision with transport routes for various types of public transport. The second group characterizes the population social conditions, namely the number of educational, cultural and medical institutions.The third block includes the ecological state of the territory according to the criterion of atmospheric pollution.

The method of scoring made it possible to compare individual parts of the area under study across the entire range of natural, ecological and social population comfort. The combination of indicators of the totality of all three groups factors was carried out using overlay operations.

Conclusions. As a result of the research, a map characterizing the spatial differentiation of indicators of the living comfort in the city of Kryvyi Rih has been created. The specialization of the city as a large industrial center has determined the leading role of the group of environmental indicators in the situational model of the living environment comfort in the region.

Analysis of possibilities of using disturbed territories of mining enterprises

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Introduction. The experience of operating and shutting down coal mining enterprises has shown a fundamental difference between the processes that accompany their activities at these stages in terms of the impact on the environment and the state of the earth's surface. This issue is of particular relevance if the enterprises of the coal mining industry are located within the city. In the normal operation of a coal mine, the main focus is on creating a safe environment for underground mining, as they are always highly hazardous. These risks are associated both with direct technological operations and with the need to create conditions acceptable for human life in underground conditions. These conditions are provided primarily by ventilation of mine workings and pumping water to the earth's surface. These forced technological processes over a long period of operation of a coal enterprise cause changes both in the state of the rocks containing the coal seams and affect the ecological situation in the surrounding areas.

Aim/tasks is to study – to study the impact of the operation of coal mining enterprises and waste from the coal industry on the urban environment. Analyze the impact of the operation of coal mining companies located within the city. Analyze the impact of dumps and heaps of coal mines on the urban environment.

Methodology. The methodology is based on the analysis, systematization and generalization of the results of research on the impact of coal mining enterprises on the environment from known literature sources.

Results. Coal waste in the form of heaps and dumps of coal mines and concentrators are objects of increased environmental danger, as they are not only sources of constant release of harmful substances, but also in some cases the cause of landslides with the movement of rock over long distances. Particular attention should be paid to waste heaps located in urban areas.

Conclusions. The conclusions and recommendations of the study are a list of possible measures to reduce the harmful effects of operation and waste of coal mines. The analysis of the impact of the coal mining enterprise on the urban environment is given.

Revitalization of the industrial heritage: guidelines for Kryvyi Rih

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Introduction. The post-industrial stage of development determined a significant reduction of the importance of industrial production, which led to the restructuring the economy. An active process of revaluation has begun - reassessing the value of industrial heritage and finding options for its further use. Kryvyi Rih is the most powerful industrial center of Ukraine and despite the fact that the industry is in an active stage of operation, the issue of diversification of the city's economy and further transformation of industrial facilities is raised in a timely manner.

Tasks. Theoretical analysis of the concept of "revitalization", the essence of this process, the study of practical experience of revitalization in Ukraine and abroad, the result of which should be an analysis of prospects for the implementation of this process in the industrial heritage of Kryvyi Rih.

Methodology. The analysis of the possibilities of Kryvyi Rih industrial heritage revaluation was carried out through the prism of an interdisciplinary approach based on research in architecture, ecology, economics, geography and culturology. Disclosure of this issue took place at two levels of research: theoretical and empirical. Theoretical research was based on the use of general scientific systems approach, analysis and synthesis, structural-functional analysis, comparative analysis, modeling methods, design, SWOT and PEST-analyzes of the probable effectiveness of revitalization in Kryvyi Rih. Empirical research was expeditionary methods, observations, the method of field visual inspections.

Results. The study has structured the concept of "revitalization", revealed promising areas of industrial facilities revitalization. The world tendencies and the best domestic samples of transformation of industrial territories into various innovation spaces have been analyzed. An assessment of the potential of the city's various objects in terms of revitalization opportunities has been given. Conceptual models of creation of the post-industrial park "Mine" on the place of the preserved mine "Artem-2", and also industry-and-landscape park on the place of Burshchitsky dump have been prepared, futuristic possibilities of their use in the tourist activity have been allocated.

Conclusions. Intensification of efforts of specialists in various related fields to ensure the sustainable development of the urban environment of old industrial areas is the key to a qualitative revival of industrial spaces, harmonization and ecological optimisation of the former industrial environment, solving a number of socio-economic problems.

Sustainable Energy

Economic aspects of introducing pumped-storage hydroelectric power plants into the mine dewatering system for distributed power generation

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Introduction. It is possible to improve the level of competitiveness of Ukrainian mining enterprises products due increasing the ore mining process energy efficiency. This can be achieved due distributed generation, which will reduce the cost of purchasing electricity from energy companies. Renewable energy sources, namely wind and solar energy, are mainly used for distributed generation. However, due to the peculiarities of technological processes in ore mines, namely the underground location of major consumers, as well as the availability and location of areas suitable for the generating equipment installation, their use is limited.

Alternatively, it is possible to offer the use of technological facilities that are located directly in the mines or near them for distributed generation. One such facility is mine dewatering system, whose energy potential is currently not fully utilized. Considering it as a set of reservoirs placed at different heights relative to each other, it can be argued that there are prerequisites for the creation of a pumped-storage hydroelectric (PSH) power plant.

Aim/tasks is to determine the optimal configuration of the mine power system, which includes a pumped-storage hydroelectric (PSH) power plant, using economic performance indicators such as the net present value (NPV) and the levelized cost of energy (LCOE).

Methodology. Following methods were used to conduct this study: analysis, systematization, generalization - in order to study and generalize the experience of using the energy potential of mine dewatering system; computer simulation to determine numerical values of NPV and LCOE of mine power system with different pumped-storage hydroelectricity power plant configurations.

Results. An economic benefits study of distributed generation implementation in the power system of the mine "Rodina" JSC "Kryvbaszalizrudkom" was performed. Installation of one or two hydro turbines into the 500 meters horizon and four turbines - two into the 500 meters horizon of and two into the 940 meters horizon are considered. Analysis showed that the use of different economic criteria to determine the optimal system configuration shows opposite results. For example, according to the LCOE, it is advisable to install only one turbine into 500 meters horizon. Because the LCOE exceeded current power price for almost all of the considered operating conditions, except for cases with very low water flow rates through the turbine.

However, the analysis of the NPV value showed that the system with single hydro turbine has the highest cost due to the low power generation. This makes it inexpedient to use.

PSH with four turbines is the best option at the peak power price. It has the lowest NPV and the highest area of rational use within the change of electricity consumption and water flow rates through hydro turbines. At the base power price, it is advisable to install only two turbines into the 500 meters horizon. It has the largest area of rational use among all configurations.

The greatest economic effect can be achieved due using a PSH consisting of four hydro turbines, two of which will operate during the base power price hours, and at other times, when the peak power price is used, all turbines will operate.

Conclusions. The use of PSH at the mine dewatering system of mining enterprises for distributed power generation will increase power system efficiency due reducing the cost of purchasing electricity from the external power grid. However, to ensure the proper level of generation, it is necessary to maintain the level of water flow rate through the turbine above a certain limit. Also, with increasing power consumption by production facilities, distributed generation efficiency decreases due to increasing power shortages. Therefore, the feasibility of using PSH should be studied in each case.

Research of characteristics of solid waste as an energy resource

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Introduction. In Ukraine, about 10 million tons of municipal solid waste (MSW) are generated annually, of which less than 10% is recycled. On average, the formation of MSW per capita is 220-250 kg per year, and in large cities up to 380 kg. Thus, MSW is a major environmental problem. Accordingly, landfills are currently overcrowded and cause a difficult environmental situation in the surrounding areas. Solving this problem is a multi-stage process: starting with producers of various products and creating the conditions for them to prevent waste generation, public awareness of the importance of reducing waste flows, as well as consideration of already established solid waste as a resource.

Aim/tasks is to analyze the main characteristics of the system of the management of the municipal solid waste; to determine of energy potential in Ivano-Fankivsk region, of the calorific value for the waste samples and of the ratio of reduction of the total mass of waste by thermal treatment.

Methodology. The methods of field and laboratory researches are used in the work. During laboratory research, methods of analysis of chemical composition and physical characteristics of solid waste were used.

Results. The morphological composition of MSW is analyzed. An approximate percentage of MSW suitable for energy recovery from the total mass of MSW entering landfills has been established. The level of reduction of mass of MSW by burning is determined. Some characteristic parameters of heat treatment of MSW by experimental method are determined.

Conclusions. Thus, the emissions during combustion of the samples, fuel consumption for their combustion, excess oxygen and combustion temperature were analyzed. Determination of the calorific value of the samples was the basis for determining the energy potential of solid waste in Ivano-Frankivsk region.

Combined principle of diagnosing the technical condition of power supply systems

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Introduction. The system of maintenance of the power supply system (EPS) is routine and uses a diagnostic system that periodically repeats the diagnostic cycles, and one that accumulates hidden defects. The methodological basis of its construction is the classical theory of reliability. A purely plausible approach is used, and reliability estimates are reliable on average for the population as a whole, rather than as a single EPS. Estimates obtained by averaging both a large number of different EPS operating conditions and influencing factors lead to significant methodological errors in estimation theory and, as a consequence, to large estimation tolerances, which makes it ineffective to predict individual EPS reliability.

Aim/tasks is to creation of diagnostic support of the process of dynamic control of individual reliability of the EPS of industry and agriculture during their operation on the basis of combined diagnostic methods to increase the level of reliability and safety and high efficiency of their intended use.

Methodology. The methodology of the principle of combined diagnosis is based on the coordination of the causal deterministic approach with its stochastic development, ie on the structural-information theory of reliability.

Results. The process of managing the technical condition of the object is based on the coordination of interrelated deterministic and stochastic analyzes, when the main thing is the deterministic approach, and stochastic its development. The deterministic approach is based on the idea of the information variable of the control system signals that determine the initial effect of the EPS operation, ie the deterministic approach takes into account analog connections. Stochastic allows you to build a model of communication between the object and control circuits. The efficiency of the system is assessed by the probability of random output flow of the object - the coefficient of readiness.

Conclusions. The scientific and applied problem of development of the theory of construction of combined methods of diagnosis is solved in the work. The introduction of diagnostic support for the stages of operation and repair will increase the period of trouble-free operation, reduce energy and resource costs associated with these stages.

To the formalization of synergetic control algorithm electric power complex on the basis of mine drainage complexes

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Introduction. Capitalization of relations in Ukraine requires a more careful approach to mining. Among the ancillary works, it is natural to distinguish drainage from the underground horizons of the mine, the value of which is most important in underground work. Drainage processes are quite significant in the total cost of iron ore production. As a result, it is important to digitally track drainage processes, which can be done by mathematical modeling with widespread use of IT technologies.

Aim/tasks is to development of a mathematical model of drainage as a stochastic process to assess energy efficiency.

Methodology. General methodological approaches were used to form models in which both the indicators of electricity consumption by drainage complexes and the corresponding cost indicators are related. Methods of combining stochastic modeling with the use of modern digital modeling methods. The principles of construction of fuzzy regulators, and also algorithms of their work in the conditions of multichannel management are used.

Results. The synthesized model allowed to determine such stochastic characteristics of the drainage process as the average and dispersion of power consumption for drainage, volumes of water accumulation on the underground horizon of the mine and energy consumption for drainage from a given depth of the underground horizon of the mine. It is proved that if the ordinates of the velocity of water accumulation on the underground horizon of the mine have a normal distribution law, then the normal distribution law has and obtained on the model of power consumption for drainage, volumes of water accumulation on the underground horizon of mine and energy consumption for drainage from a given depth.

Conclusions. The study of drainage as a stochastic process was carried out. A mathematical model based on the use of statistical material on the rate of water accumulation on the underground horizon of the mine "Ternivska" is built. Innovative results have been obtained, which allow to characterize the drainage not only by average values, but also by dispersions, ie by their scatter. The analysis of the obtained models allows to be the basis for making effective management decisions to address the issue of optimizing energy consumption at the relevant iron ore enterprises.

Three-level model of forecasting demand for energy resources at different hierarchy levels of economy

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Introduction. Forecasting the demand for energy resources in the country's economy is necessary to ensure sustainable development. Two methods of forecasting energy consumption in the country are widely used: the first - the sum of energy consumption by type of economic activity in the country, the second - as the sum of energy consumption in the regions of the country with the coordination of forecasts, which defined at different hierarchical levels.

Aim/tasks of developing a new model is to improve the accuracy and quality of forecasts through the combined use of different methods.

Methodology. The authors propose a three-level model for forecasting the demand for energy resources (electricity, heat, fuel in total and its types: coal, natural gas and other fuels). This model uses a double agreement of forecasts: between the third (types of economic activity in regions), the second (regions) levels, and the subsequent agreement with the top (country) level.

Results. The calculations performed using this model demonstrate the feasibility of this approach. This model was tested on retrospective data with an error of less than 5%. Calculations under this model show a forecast of savings of 8.7 million tons of coal by 2040 due to structural and technological changes (2.272 million tons and 6.428 million tons, respectively). Reduction of coal consumption will reduce emissions of pollutants into the atmosphere (thousand tons): nitrogen oxides – 19.671; sulfur oxides – 295.06; carbon monoxide – 393.414; solid dispersed particles – 104.255; carbon dioxide – 5271.75.

Conclusions. Solving the problem of forecasting is a necessary condition for the preparation of any development programs: countries, regions, industries. This determines the need for further development and improvement of forecasting methods and coordination of forecasts. The presented three-level model allows solving two problems: forecasting energy consumption at two down (regional) levels, which may vary depending on the task. The three-level model has the same energy efficiency indicators at different hierarchical levels - the energy intensity of gross added value at the corresponding level, which reduces the error of forecasts, when using different indicators.

The Impact of Fuel Delivery Logistics on the Cost of Thermal Energy on the Example of Organic and Biofuels Boilers in Ukraine

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Background. One of the important directions for achieving the goals of sustainable development and decarbonization is to increase the share of biofuels, including in heat supply systems. In this case, an important factor in deciding on the use of biofuel boilers is the cost of fuel, which is affected by the delivery logistics.

Purpose/objective. Develop recommendations for the use of remote sources of biofuels for low-power solid fuel boilers.

Methodology. Theory of statistical analysis, the levelized cost of heat (LCOH).

Results/findings. The authors determined the impact of logistics for different types of fuel for low-power boilers (0.5 and 1 MW, burning organic and biofuels) on LCOH. The calculations take into account the existing and projected rates of environmental tax and different approaches to its administration. The paper considers the transportation of biofuels by road to small consumers over short distances (within a radius of several hundred kilometers).

Conclusions. The study showed that the cost of delivery of pellets from producer to consumer can be up to 50% of their cost. It is established that the transportation of a ton of pellets per 1 km increases the cost of this ton by about 1 UAH, therefore, the logistical component in the final cost of pellets can be significant. Based on the results of the analysis and calculations, practical recommendations for the use of biofuels from remote sources for low-capacity solid fuel boilers have been developed, taking into account different values of environmental tax rates and approaches to its administration.

Sustainable Environment and Environmental Management

Response of earthworms to changes in the aggregate structure of floodplain soils

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Earthworms are actively involved in the transformation of organic matter and in the formation of water-resistant soil aggregate structure. In the short time perspective earthworms are a factor that affects soil properties. However, other factors also influence soil properties and it is these factors that determine the total level of earthworm abundance and patterns of their spatial distribution. In urban park environments, the recreation load is an additional factor. The recreational load significantly affects the physical properties of the soil. An aggregate soil structure regulates the ratio of solid, liquid, and gaseous soil fractions and thus determines the living conditions of soil animals. Purpose/objective. The study tested the hypothesis about the influence of the aggregate structure of soil on the spatial distribution of earthworms under recreational load conditions. Methodology. Geostatistical methods and evaluation of animal response models to environmental factors. Results/findings. The aggregate structure of the soil is an important factor that affects the spatial patterns of earthworms under recreational load conditions. Earthworms prefer sites with a predominance of meso-aggregates. A recreational load leads to an increase in the proportion of macro- and micro-aggregates, which negatively affects the living conditions of earthworms. Conclusions. The processes of mutual influence of earthworms and soil aggregate structure have different temporal scales: earthworms influence soil structure in the time range of a few days or weeks, and aggregate structure influences in the time range of a few months or years.

Commercial products of mining and metallurgical companies in river sediments of industrial regions

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Background. Current researches require a comprehensive approach to the study of environmental systems. Modern alluvium is a complex multicomponent system that includes both natural and man-made material. The research of fluvial bottom sediments provides important data about the anthropogenic impact on the geoecosystems of river basins. The amount of these pollutants can be used as industrial raw materials for manufacturing useful goods due to implementation of specialized waste-free technologies.

Purporse. To estimate possibilities for industrial exploitation of modern river sediments in industrial regions.

Methodology. Quantitative mineralogical analysis was used for evaluation of compound of bottom sediments. The authors propose a green technology for the separation sludge components in the air stream. It is based on the physical properties of minerals (especially density).

Findings. In the process of research on the pollution of river sediments with industrial waste, the authors established the presence of commercial products of mining and processing enterprises in the sediments. It includes crushed granite, metallurgical slags, ores and concentrates, coal and other products. Amount of this materials so great that it will be advisable to use for economic purposes. It is enough to develop and implement the appropriate technology. The all products generated in the process of applying the proposed technology can be used in industries. This is a waste-free processing technology.

Conclusions. Significant volumes of industrial inputs into the ecosystems encourage the development of special technologies aimed at additional production of mineral products through the complex processing of modern river alluvium. It shows a great potential for economic use. In addition to economic benefits, the implementation of these projects will improve the state of the environment in regions with large technogenic load.

Influence of Organic and Inorganic Precipitators on the Efficiency of Surfactants Extraction from Wastewater by Flotation

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Introduction. The chemical structure of surfactants causes their accumulation on the surface of water sources and leads to the formation of stable foam, which prevents the access of oxygen to the water and leads to the death of hydrobionts and deterioration in water quality. Therefore, the extraction of surfactants from wastewater is an urgent task.

Purpose. Increase the efficiency of flotation extraction of cationic surfactants, namely hexadecyl pyridinium chloride $[C_{16}H_{33}NC_5H_5]Cl$ (HDPC) and surfactants based on it - cetazol, by introducing organic – (sodium alkyl sulfate (SAS), $C_nH_{2n+1}OSO_3Na$, n=10-16), and inorganic - potassium hexacyanoferrate (II, III) precipitators.

Result. The solubility of the products of interaction of cationic surfactants with SAS (sublates) was determined, which are extracted from solutions at different temperatures and impurities of electrolytes. The Gibbs free energy (ΔG^0_{ads}), enthalpy (ΔH^0_{dis}), and entropy (ΔS^0_{dis}), which take place in the process of dissolution, are calculated. The low value of the heat of dissolution (2.1-16.6 *kJ/mol*) indicates a small effect of temperature on the solubility of sublates. The thermodynamic analysis of the process of formation of sublates allows determining the optimal length of the hydrocarbon radical of the precipitator.

Conclusions. It is established that the extraction of the studied cationic surfactants should be extracted from water solutions and wastewater by the method of precipitation flotation using organic and inorganic precipitators. The presence of electrolytes and an increase in temperature leads to an increase in the degree of extraction hexadecyl pyridinium alkyl sulphonates sublates.

Influence of Fe^{2+} and Mn^{2+} ions on ^{137}Cs adsorption by precipitates during ozonation of wastewater from Nuclear Power Plants

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Introduction. Ozonation is one of the promising methods of radionuclide extraction from nuclear power plants (NPPs) wastewater. Previous studies have shown that ozone effectively decomposes wastewater organic components – EDTA, oxalic acid and surface-active agents which prevent further radionuclide extraction. During ozonation, precipitates of (hydro)oxides of metals (Fe^{2+}, Mn^{2+} etc.) are formed. They are able to adsorb part of the radionuclides from the solution. Increase in Fe^{2+}, Mn^{2+} ion concentration in the simulated wastewater solution rises the efficiency of organic component decomposition at high pH (8 - 12) owing to the Fenton process and increases the amount of precipitates, which potentially will increase the degree of radionuclide extraction.

Aim/task of the study is to determine the effect of Fe^{2+} and Mn^{2+} ion concentration in the simulated wastewater solution on the degree of ^{137}Cs sorption by precipitates formed during their ozonation.

Methodology. Ozonation of the simulated wastewater solution was performed at the pH=11-12 units, 60 ^{o}C for 2 hours. ^{137}Cs activity in the solutions was measured with a gamma spectrometer.

Results. It was found that increase in the concentration of Fe^{2+} from 5 to 50 mg/dm^3 in the simulated wastewater solution increases the degree of ^{137}Cs extraction from 26 to 43.5%, and increase from 10 to 100 mg/dm^3 in Mn^{2+} concentration - to 46%. The simultaneous increase in the concentration of both cations results in 50.5% increase of ^{137}Cs sorption degree.

Conclusion. Increase in the Fe^{2+} and Mn^{2+} ion concentration increases the degree of ^{137}Cs extraction during ozonation of wastewater from NPP.

Innovative hardware and software to solve actual problems of nuclear, radiation and technogenic-environmental safety of Ukraine

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Introduction. Ukraine has developed nuclear industry. It is based on four existing nuclear power plants: Rivnynska, Khmelnytska, Pivdenno-Ukrainska and Zaporizka. For the next decades according to the "Energy Strategy of Ukraine until 2035" it is planned to increase generation of this industry. Nuclear power plants are objects of increased danger, so conditions should be provided to maintain environmental balance on the territory of Ukraine, innovative developments for radioactive waste management should be introduced, methods of wastewater treatment should be developed/improved, prevention and elimination of natural and technogenic emergency consequences should be provided. It is important to create various scientific, technical and innovative developments to solve outlined tasks. Their development is carried out by institutions and organizations, in particular by the National Academy of Sciences of Ukraine.

Aim is to analyze, summarize and highlight innovative developments of the State Institution "The Institute of Environmental Geochemistry of the National Academy of Sciences of Ukraine" to improve nuclear, radiation and technogenic environmental safety of Ukraine.

Methodology. Following methods were used in the study: analysis, generalization and systematization for study of domestic innovative developments to improve nuclear, radiation and man-made environmental safety of Ukraine.

Results. The research analyzes and summarizes activities of the State Institution "The Institute of Environmental Geochemistry of the National Academy of Sciences of Ukraine" on developments that improve nuclear, radiation and technogenic-environmental safety. Uniqueness of the Institute's developments for nuclear power plants is determined and described. Fundamental research was aimed to solve problems of sustainable development of nuclear energy, environmental problems of nuclear fuel cycle, handling of radioactive materials at all stages of their life cycle. Main directions of basic research were: problems of environmental safety of nuclear fuel cycle; scientific support of work to overcome consequences of the Chernobyl disaster. Number of innovative developments for this industry were also developed.

Conclusions. Numerous researches are conducted in the Institute. Its results is creation of methods, technologies, prototypes and with their further implementation to improve nuclear, radiation and technogenic- environmental safety of Ukraine.

Endo-adaptive mechanisms of mesophytic plants'functioning as a component of ecosystem resistance

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Introduction. Deterioration of the ecological state of the biosphere contributes to the formation of general mechanisms of plant adaptation to negative factors of various origins. In recent decades, the scientific community is increasingly aware of the need to integrate the knowledge gained in the study of processes occurring at different levels of living systems organization. Plants have many mechanisms to respond to changes in the environment, including the action of various stressors.

Aim/tasks is the investigation of endo-adaptive specificity of mesophytic plants' formation as a component of ecosystem resistance.

Methodology. Methods are experimental research, quantitative and anatomical analysis, mathematical and statistical processing of the obtained data.

Results. The article presents the peculiarities of histological structure and functional specificity of vegetative organs of plants *Portulaca oleraceae L.* under chloride load and without it in the conditions of the south of Ukraine. It is proved that the study of various parameters of metabolism and anatomical and morphological reconstruction of the plant plays an important role in studying the mechanisms of salt resistance, which determines the existence of mesophytic plants under stressful environmental changes, in particular in southern Ukraine.

Conclusions. It is shown that adaptability is an equal component of two interdependent processes – the development of damage caused by stressors and the restoring the values of structural and functional parameters, which generally forms an endo-adaptive mechanism of plant functioning and ensures steadiness and ecosystem stability.

Salts in bottom sediments of surface water bodies of Ukraine

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Introduction. Chemogenic minerals are a permanent, but still poorly studied, component of river alluvium. They are of particular importance in the bottom sediments of the river system of industrial regions. It has been established, that over the past 20 years, the salinity of fresh water in surface reservoirs has increased. This is due to an increase in the amount of salts in their composition, which affect the quality of water. The activities of man-made enterprises, dumping of waste water in the industrial process into surface reservoirs, outlets of salt water sources from storage ponds, tailings dumps, etc. also played a role in this.

Aim /tasks. The complexity of the crystal growth process leads to the fact that often their appearance, which we observe, differs significantly from ideal crystals. Their morphology and chemical composition were the main subject of study. And also the task of the research is to use the results obtained to determine the main sources of salt ingress into the studied surface reservoirs.

Methodology. To conduct this study, the following methods were used: mineralogical analysis of the obtained material under binoculars; confirmation of the chemical composition was carried out using electron microscopic and microprobe analyses; determination of mineralization and content of macro-components in surface waters was carried out by a sanitary and ecological chemical laboratory based on a standard methodology for surface reservoirs.

Results. The article presents new data on the findings of gypsum, calcite, aragonite, halite and silvin in the river deposits of Ukraine. The main forms of finding salts in the bottom sediments of surface reservoirs were determined. Most often they occur in the form of earthy clusters, as well as crystals of regular shape, ranging from crusts and loose masses to needles, rhombic shape, gypsum roses, aggregates of granular crystals. A connection was established between the chemical composition and the content of macro-components in the studied reservoirs with the mineral forms of salts that were obtained. Terrigenous, chemogenic and technogenic formations have been established on a genetic basis among the minerals of this group.

Conclusions. Salts in the bottom sediments of rivers are an important indicator of sedimentation conditions and man-made load on the natural hydroecosystem from industrial enterprises, land and water transport, as well as the territories of settlements. A number of recommendations were developed to prevent an increase in mineralization in surface reservoirs, to preserve and monitor the natural ecological situation in the research area.

Awareness of antibiotic resistance for the Sustainable development: a questioner in the framework of JM One Health project

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Introduction. Antimicrobial resistance (AMR) is a significant risk factor for global health and has been recognized as a threat to the world's sustainable development affecting several sustainable development goals (SDG). Uncontrolled and unjustified use of antimicrobial drugs in both agriculture and human medicine, leads to the emergence of new strains of microorganisms resistant to antibiotics that can be distributed through the environment and poses both direct and indirect threat to human health, which is manifested in the impossibility of treatment of infectious diseases of bacterial etiology. The Global action plan on antimicrobial resistance consider the level of awareness and understanding of AMR among key stakeholder groups, that include the human health, animal health, food sector, environment and plant health sectors, to be one of five strategic objectives.

Aim/tasks. The aim of our study was to determine the level of awareness on antibiotic resistance among future veterinarians and physicians, as well as students of other specialties.

Methodology. The 25 questions survey based on WHO multi-country public awareness survey in the framework of a program to raise awareness of antibiotic resistance among the population was conducted online via Google Forms. The questionnaire covered demographic, personal antibiotic use, attitude, awareness and contributory factors to antimicrobial resistance. The study involved students of Ukrainian Universities. Descriptive statistics for frequency distribution and percentages were used to analyse the respondents' attitude and awareness.

Results. The majority of respondents were under the age of 25 (96.8%), female (75.9%) and single (96.8%). 38% of respondents had sufficient clinical training as they were senior undergraduate students. 22.5% used antibiotics in the last six months, and 14.4% - within last month. While 90.9% bought antibiotics at the pharmacy, 15% used antibiotics without a doctor's prescription, and 15.5% stated that they follow the instructions for the drug. 11.2% of respondents consider it possible to stop taking antibiotics when they feel better and 24.6% suggested re-use of the drug, which was effective in the past. 87.2% misunderstand the concept of AMR.

Conclusions. The survey shows insufficient awareness of AMR issues among young people, the need to continue research for identification the gaps in knowledge and take them into account in the curricula of clinician and awareness program development among young people in general.

Improvement of technology for obtaining modified phenol-formaldehyde compositions with low formaldehyde emission

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Introduction. Phenol-formaldehyde resins are the main component of many adhesive components which have both a valuable set of properties and significant disadvantages. Those disadvantages include increased emissions of formaldehyde and phenol from resin compositions, low heat resistance and fragile. Due to the strengthening of environmental restrictions in use of composite materials and growing requirements for their quality, the development of new high-quality and environmentally friendly phenol-formaldehyde composites is becoming relevant.

Purpose. Improving the technology of obtaining phenol-formaldehyde compositions modified with rubbers and polyvinyl acetals, with low formaldehyde emissions and improved physicochemical properties.

Result. Phenolic rubber compositions can be used for bonding metal structures and fiberglass to achieve high strength. The adhesive properties of the phenol-formaldehyde resin-polyvinyl acetate system is influenced by the acetal structure. The strength of the adhesive compounds is significantly affected by the ratio between phenol-formaldehyde resin and polyvinyl acetal. The content of free formaldehyde and phenol in composites obtained by advanced technology is 10-20 times less than in those obtained by traditional.

Conclusions. It has been established that phenol-formaldehyde adhesives modified with rubbers are elastic heat-resistant products, with good adhesive properties and high mechanical strength. Phenol-formaldehyde resol resins, in combination with polyvinyl butyral (in alcohol solutions), are adhesives with very high adhesion to metals and most non-metallic materials. This advanced technology will expand the scope of composite materials and increase their environmental friendliness.

Assessment of the ecological hybrid threat to the region in connection with the vital state state of artificial woody plantations in Kryvyi Rih

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Introduction. Among the concepts of sustainable nature management, forest conservation is considered an important element. Forest stands make up 36% of the European territory. The state of the Kryvyi Rih forest ecosystem depends on the development trend of the mining and industrial area and the complex of social, ecological, and economic problems of Kryvyi Rih city.

Aim/tasks The aim of the work is to analyze artificial woody plantations as a promising factor of environmental safety in the Kryvyi Rih mining and metallurgical area from the standpoint of an ecosystem approach.

Methodology. During 2015-2020, we studied the natural forest ecosystems and the artificial forest plantations, which are located in contrast environmental conditions. The ecomorphic analysis of woody plant species was carried out according to: a) classic approach (by numbers of species); b) innovative approach. All data were submitted to descriptive statistics and analysis of variance (ANOVA). The statistical analysis was performed using the program SPSS for Windows. For all statistical analysis, significance was considered $P < 0,05$.

Results. Forests in the Kryvyi Rih mining and metallurgical region are located very unevenly. They are mainly concentrated in River gullies, woody stands of city parks, woody stand of health protection zones, woody stands of city protection forest and woody stands of river protection forest. The woody plantations located on Kryvyi Rih territories are very different in terms of coverage area and do not reach the optimal level. This level allows woody plantations affect optimally the climate, soil, and water resources. The woody plantations also mitigate the effects of erosion processes, as well as provide more clean air. The artificial woody plantations are important elements of environmental safety in Kryvyi Rih area. The main function of the artificial woody plantations is to maintain the soil in an optimal form for operation. It is also the protection of ground water and the stability of the meso- and microclimate in the region, moreover preserving the biodiversity of the territory's ecosystems. The artificial woody plantations perform an anti-stress function for residents.

Conclusions. Therefore, as a result of research, it was established that the quality of reforming the ecological approach to greening the city's territories, as well as preserving artificial woody plantations, is determined by the choice of such a management model and nature management policy. These models together should ensure the competitive ability and long-term development of the artificial woody plantations in Kryvyi Rih area. Kryvyi Rih city should develop as an environmentally stable and safety metallurgical region in accordance with the principles of sustainable development.

Retrospective and geographical features of forestry use of lands in Podilski Tovtry

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Forest cover is an important component of the landscape and is responsible for the conservation of other components. Forests of the Podolian Upland are distinguished by a high natural resource potential and a significant risk of manifestation of unfavorable natural processes. The aim of our research is to study the forest cover of Podilski Tovtry and analyze the dynamics of its changes for the period from 1880 to the present.

Forestry nature management in Tovtry is second only to agriculture in terms of the area of occupied land. Forests of the reef zone and adjacent territories within the Ternopil oblast are part of the Ternopil forestry enterprise and the Medobory Nature Reserve.

Within the study area, forests of a relatively large area are confined to the summit surface and slopes of the main ridge. Our research has established that in the period from 1880 to 1930, there was a significant decrease in forest cover practically throughout the entire study area, which is associated with both the need for firewood and agrarian overpopulation and the desire to expand the arable land. A direct relationship was found between the decrease in forest cover and the approach to villages and hamlets. After the Second World War and until the present, there have been no significant changes in forest cover. In some areas, even an increase in forested areas was found. Active forest expansion was observed at the beginning of the two thousandth years amid a decline in agricultural production.

Strategic development stabilization of Ukraine industrial companies based on the final decision model application

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Introduction. European Economic Community integration conceptually dictates new views on the processes of Ukrainian industrial company’s strategic development. The article proposes model formation for making final decision in the process of choosing the best option for company’s strategic development. According to the investigation results of mechanical engineering product indices dynamics and the strategic development analysis of the Ukrainian regions according to the cluster approach, the need to stabilize industrial companies functioning in Ukraine was revealed.

Aim/tasks is to analyze strategic development of Khmelnytsky region industrial companies apply the cluster approach and create recommendations for stabilization of their successful operation using the final decision model.

Methodology. The application of final decision model provided an effective choice for the machine-building company’s development strategy taking into account stabilization factors. In it’s turn, cluster approach, analysis and systematization methods gave a completed research result of Khmelnytsky region industrial companies strategic development.

Results. Among the identified promising segments of the engineering industry with successful operation of Khmelnytsky region companies, the production of measurement equipment, research and navigation goods, production of electric motors, generators, transformers, electrical distribution and control equipment were revealed.

Conclusions. Based on the research results, sustainable development of machine building strategic directions in Khmelnytsky region are proposed. Research of Khmelnytsky region industrial companies development allows providing recommendations for making effective reasonable managerial decision on the selection of the most profitable and successful ones. Proposed cluster approach based on provided final decision model gave an opportunity for making the list of the most successful Khmelnytsky region industrial companies. Thus, the problem of choosing the direction of the company's development in the strategic perspective and efficiency improvement of machine-building company’s strategic development stabilization is solved.

Conceptual foundations of the mechanism of management of enterprise interaction with environment

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Introduction. The article is devoted to the definition of the peculiarities of the formation and development of the mechanism of management of enterprise interaction with environment. It has been determined that the environment plays an important role in shaping the living conditions of local communities, and the state of the environment determines the opportunities for achieving the goals of sustainable development.

Purpose / objective. The purpose of the article is to provide further development of the conceptual foundations of the mechanism of management of enterprise interaction with environment.

Methodology. The basis of the research is a system approach. The methods of economic and statistical analysis, classification, generalization, analysis and synthesis, graphical method were used as well.

Results. The authors formed an approach to structuring the mechanism of management of enterprise interaction with environment, taking into account economic, environmental, and adaptive components. The peculiarities of the management of the interaction of economic entities, whose activities are related to the generation and management of waste and which, at the same time, provide environmental services, with the environment are analyzed.

Conclusions. The article identifies the features of the formation and management of waste of economic entities of the analyzed activity type. Based on the analysis, the problem areas of the management system of interaction with the environment are identified and the authors' approach to solving existing problems is proposed.

Scientific substantiation and development of a technology for processing wastewater from mining and processing plants

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Introduction. Wastewater processing from mining and processing plants is a problem that is urgent all over the world, the solution of which is of great scientific and practical importance. Almost always, wastewater from mining and processing plants (mine, quarry, drainage, filtration waters, etc.) has a complex, most often, aggressive composition. Such water cannot be discharged into surface water bodies without preliminary treatment and used for industrial water supply without appropriate treatment.

Aim/tasks. Scientific substantiation and development of a technology for the integrated processing of wastewater from mining and processing enterprises to obtain purified water, the hydrochemical indicators of which correspond to the quality standards of surface water bodies.

Methodology. The study uses theoretical and experimental methods, namely the analysis of existing and synthesis of new technological methods and technical means for the development of wastewater treatment technology, physical modelling to establish the patterns of intensification of sludge sedimentation processes during water clarification, methods of mathematical statistics when processing experimental data.

Results. The qualitative and quantitative composition of wastewater from mining and processing enterprises was analysed. The well-known methods of purification of waste waters of the mining and processing complex enterprises from their characteristic pollutants were considered; their advantages and disadvantages were established. The technology for processing wastewater from mining and processing enterprises was scientifically substantiated and developed. The proposed technology makes it possible to reduce the concentration of pollutants to standards that meet the requirements for the qualitative composition of water discharged into surface water bodies.

Conclusion. The use of the proposed technology for processing wastewater from mining and processing plants makes it possible to improve the quality of treated water to concentrations that satisfy the conditions for discharging treated wastewater into surface water bodies, reduce the harmful effect of wastewater from plants on water bodies and solve the problem of environmental safety of mining regions.

Spatial variation of temperature fields in a urban park

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Background/introduction. Soil temperature is the most important factor that regulates the rate of physical, chemical and biological processes in the soil. A peculiarity of the urban environment is the occurrence of "heat islands". The increased temperature of urban environment significantly changes environmental conditions and contributes to the activation of phenomena that lead to the acceleration of global climate change.

Purpose/objective. The aim of the work is to reveal the patterns of spatial variation of soil temperature in a city park at the different scale levels.

Methodology. Soil temperature was measured on a regular grid with different lags between measurement points. The measurement results were processed using geostatistical methods to quantify the spatial process at different scales.

Results/findings. The results obtained allowed to quantify the patterns of spatial variability of temperature fields at different hierarchical levels. Scale-dependent effects of soil temperature variation were identified. The role of stand density, litter depth, and soil moisture on soil temperature variation was found. The results of the study are the basis for developing an optimal soil temperature measurement plan for environmental monitoring purposes. Suggestions were also made for the management of park stands in order to reduce the temperature load.

Conclusions. The spatial variation in soil temperature demonstrates the occurrence of scale-dependent patterns. The spatial organization of temperature fields must be taken into account for optimal environmental monitoring and urban environmental management strategies.

Drainage reconstruction in the zone of excessive moisture during the cultivation of blueberries on poorly water-permeable clay soils

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To ensure efficient agricultural production in the humid regions of Ukraine, drainage of wetlands is one of the first places. The area of drained lands is make up to 9.7% of the total arable lands in Ukraine. In 1990, 1,976.500 hectares were used in active agricultural production, and the share of arable land on drained lands was 70.7%. Of the more than 1130 drainage systems with an area of more than 2.2 million hectares only 37% were built between 1980 and 1990, i.e. younger than 35 years. The remaining 63% of systems have been built and operated for more than 35 years. Since the 1990s, the construction of new and modernization of existing drainage systems in Ukraine has been almost non-existent. Maintenance of the systems was significantly reduced, which led to a significant deterioration in their technical condition, a change in the water regime of soils and the development of degradation processes. Traditionally, in Ukraine, a significant (1.4 million hectares) area is drained with ceramic drainage.

We show the experience of reconstruction of the drainage system, which is located in the Pre-Carpathian Upland region of the Ukrainian Carpathians, the Middle Carpathian terrace plain, where a Drainage of Clay Pipes was built more than 35 years ago. The results of the analysis of the reasons of unsatisfactory drainage operation, identification of the most critical zones with the use of field research and earth remote sensing data are presented. Satellite images also make it possible to identify problem areas in which drainage does not fulfill its functions or relief features create local zones of systematic waterlogging. In such zones, the vegetation has an excellent color, which is especially evident when using multispectral (MS) images. For example, in the image NDVI - Normalized Differential Vegetation Index (B8A-B04) / (B8A + B04), zones in which NDVI-index is 0.35 are clearly visible, while zones with unoppressed vegetation have NDVI –index from 0.5 to 0.6.

To eliminate local wetlands, plastic drainage with a diameter of 50 mm is proposed. To increase the efficiency of its work on heavy clay soils with a filtration coefficient less than 0.01, the backfilling of the trench with local material – gravel with a fraction of 5 … 25 mm with geotextile protection. During the construction of the new drainage, ceramic drains of the previously constructed drainage were found. They were cleaned mechanically and connected through a filter backfill to the newly built drains.

Sustainable Materials and Technologies

Biocompatible Gd-containing micro/nanomaterials from renewable recourses: a new class of environmentally-friendly neutron-shielding materials

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Background. Environmental contaminants are chemicals that accidentally or deliberately enter the environment, often as a result of human activities. Most of these contaminants are released due to the interaction of artificially produced materials with nature. Partly, the contamination of the environment can be happening during and after the unpredictable disasters in nuclear places. To avoid such contamination problems, shielding materials can be developed by the "safe by design" principle, where each of the components of the system is selected from the safest components. In this view, the need to protect the environment includes the need for the development of environmentally-friendly materials for neutron shielding. For neutron shielding it is better to use environmentally favorable alternatives to metals like cadmium, for instance, to use composites of gadolinium. Also, as a basic component of such composites, the materials from renewable sources should be used, for instance, the components, derived from wood and marine biomass.

Purpose/objective. To analyze the current state of the development of environmentally-friendly Gd-containing materials.

Methodology. Literature study, comparative analysis.

Results/findings. The results show that current knowledge in Gd-containing environmentally-friendly materials is missing.

Conclusions. Here we claim a new class of Gd-containing environmentally-friendly materials for neutron shielding that could be prepared from renewable non-fossil sources: wood and marine biomass. Such materials can be assembled of micro- and nanoscale level to possess the highest efficacy and compact size with tunable shape.

The use of bischofite in the gas industry as an inhibitor of hydrate formation

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Introduction. Production and preparation of gas for transportation is hampered by hydrate formation and corrosion of metal equipment. The main indirect losses from these factors are the underproduction of products due to emergency and repair stops, environmental sanctions. To date, certain experience has been gained in the use of inhibitors to prevent hydrate formation and corrosion. The use of natural, ecological, cheap raw materials as the basis of a complex inhibitor of hydrate formation and corrosion is promising. The study of these issues and the development of economic technologies for the use of complex reagents based on bischofite will improve the environmental performance and performance of gas collection and processing systems.

Aim/tasks is to prevention of hydrate formation and carbon dioxide corrosion processes in the gas condensate fields operation by using domestic, affordable, inexpensive raw materials instead of costly methanol and corrosion inhibitors.

Methodology. A bischofite with a mass fraction of $MgCl_2$ of 24% from well № 1 of the Zaturin area was selected as a carrier of the complex inhibitor. Surfactants and stabilizers of iron ions have been studied. The work is performed on experimental material using modern general and special physical, chemical, physicochemical, research methods and statistical methods. An original method was developed and used. An experimental setup was designed to study hydrate formation using propane as a hydrate-forming gas.

Results. A set of laboratory studies of the effect of surfactants on antihydrate, corrosion and technological properties of bischofite solutions has been performed. It was found that the introduction of amphoteric surfactant CAPB into the bischofite solution reduces the precipitation temperature of the hydrate by 6 ° C, and also increases the degree of precipitation of $CaSO_4$ by 76.86% in the preparing of the inhibitor. Cationic surfactant KI-1M provides a high degree (99.6%) of metal protection against corrosion. Citric acid contains 96.5% of iron ions in solution.

Conclusions. The formulation of a complex inhibitor of hydrate formation and corrosion with the use of bischofite is substantiated, which is a significant achievement for expanding the ideas about inhibitory protection of gas equipment from hydrate formation and corrosion.

Investigation of the influence of technological factors and compositions of binders on the strength characteristics of blast–furnace cement with magnetized ferromagnetic additives

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Background/introduction. Cement production is a significant source of carbon dioxide emissions. One of the ways to reduce emissions is to reduce the proportion of clinker in cement due to the introduction of blast furnace slag into its composition. One of the ways to increase the activity of such cement is the effect of magnetic fields on the spin multiplicity of the substances involved in the hardening reaction. In this case, the maximum effect is ensured by introducing a magnetized finely dispersed ferromagnetic substance into the cement composition.

Purpose/objective. This work aims to identify the influence of the adding method of the additive, the slag and additive proportion in cement, and the steam curing temperature on the activity effect of the binder.

Methodology. Three groups of studies were carried out: with different times of joint grinding and mixing of components; with different additive and slag amounts; with different additive amounts and different steam cured temperatures. The samples were tested one day, 28 and 90 days after steam curing.

Results/findings. It was revealed that the maximum effect is achieved when the additive is added to the cement composition by joint grinding. The activation effect from the additive addition increases with an increase in the proportion of slag. The activated products steam curing temperature may be reduced by 20-25° C.

Conclusions. It is shown that using a finely dispersed ferromagnetic substance as an activating additive makes it possible to save energy resources and reduce emissions.

Investigation of energy-power parameters of thin sheets rolling to improve energy efficiency

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Introduction. In order to study processes occurring during manufacturing of thin steel sheet by cold rolling and change of energy-power parameters, simulation was performed using engineering software DEFORM 3D, which allows to reflect rolling technology accurately.

Aim/tasks: to investigate cold rolling process of thin steel sheet using DEFORM 3D software to determine energy-power parameters of process.

Methodology. Model of treatment process was created, output data, modes and temperature of treatment, motion parameters of rollers and sheets were set, material of workpiece was selected and its properties were determined. During simulation of sheets cold rolling process, Lagrange analysis was used, number of simulation steps was 100.

Results. As result of investigation of cold rolling of thin steel sheets was executed following: model of cold rolling of thin sheets in DEFORM 3D software was created and research methodology was developed, which allowed to determine changes of energy-power parameters that occur in strain zone during treatment; vector field of metal movement and its stress-strain state during cold rolling of thin sheets were determined; there were determined forces and torques that arise during deformation process, and there was investigated their distribution in strain zone during cold treatment, which made it possible to determine rational energy consumption during cold rolling.

Conclusions. Simulation showed that stress reaches its maximum during 9th second of treatment 5.5 MN during cold rolling, and accuracy of simulation is 5.5%.

Adapting engineering education to challenges of sustainable development

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Introduction. Textile and garment industries generate a lot of waste at both production stages and in the process of wearing garments. Every inhabitant of developed countries annually wastes up to 30 kg of used but still suitable clothes, which decompose very slowly in natural conditions. The broadest possible implementation of textile waste processing technologies, such as downcycling and upcycling, is the key to ensuring the successful operation of the textile and garment industries under conditions of sustainable development.

The aim is to determine factors controlling students' upcycling behaviour to strengthen the educational components and meet sustainable development challenges for the garment industry.

Methodology. Based on interpersonal and planned behaviour models, 93 students of 1-6 years majoring in garment technology, design and sectoral professional education were surveyed to understand their upcycling behaviour.

Results. The surveyed students are divided into similar-sized groups of optimists (practice upcycling more than once every three months) and pessimists (less than once a year). Upcycling behaviour was shown to correlate with intentions, which are, in turn, affected by social factors, attitude, and perceived behaviour control. Perceived habits and facilitating conditions have a relatively small impact. There is almost no difference between students of different years of study and specialities. Students' understanding of the benefits of upcycling is shallow and does not change with training years.

Conclusions. Amid a highly-positive attitude towards upcycling, a low level of understanding of the benefits and lack of progress with years indicate existing problems in developing upcycling behaviour in the learning process.

Technology of forming a wear-resistant termite alloy layer based on the Fe-Cr-C system by self-propagating high-temperature synthesis

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Introduction. Today, the prerequisite for obtaining new materials with optimal technical and economic indicators are the development of technology based on understanding and forecasting processes of structure formation and formation required by physical-mechanical and operational properties of products from them. Application of metallothermy methods for the synthesis of melt melts chemical composition and production of castings with functional layers is a promising area development of modern technologies, as this provides a certain autonomy, lack needs for powerful sources of electricity, simplicity and cheapness of technological equipment, high productivity and more. That is why the use of self-propagating high-temperature synthesis (SHS) to form a wear-resistant layer of thermite alloy on a metal basis can be a cost-effective alternative for the production of bimetallic products.

Aim/tasks of the task is the development of technology for forming a wear-resistant layer of termite alloy on the basis of Fe-Cr-C systems by self-propagating high-temperature synthesis and determination of optimal ones technological parameters of the process of forming a wear-resistant layer of termite alloy.

Methodology. General (empirical, complex and theoretical) and special (graphic and correlation) methods of scientific knowledge were used in the work. In particular, among the components of empirical research methods used experiment. Experimental studies were performed in the laboratory. Processing and analysis experimental data was conducted in Excel.

Results. The technology of forming a thermite alloy layer on the basis of Fe-Cr-C system on a metal basis by self-propagating high-temperature synthesis is offered, which allows to obtain cast functional layers with improved physical-mechanical and operational properties. The optimal technological parameters of the process of forming a wear-resistant layer are determined: the amount of metal filler with the maximum yield of suitable alloy, the heating temperature of the thermite charge and the mold to obtain additional heat, the temperature ranges of the melt for melting the metal base with the subsequent formation of a functional layer.

Conclusions. Metallographic studies of the obtained wear-resistant layer of thermite alloy on the basis of Fe-Cr-C system obtained by self-propagating high-

temperature synthesis showed that the zone of the formation of the functional layer is characterized by macrostructure stability and positive the influence of non-metallic inclusions in the form of Al_2O_3 (corundum). Corundum, creating an inoculating effect of modification of the termite alloy, in turn, promotes the formation of chromium carbides in the resulting thermite alloy.

Seeds on a parachute: the technology of gardening

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Introduction. To strengthen the sides of tailing dams and stockpiles, grow forests from trees, shrubs and plant grass on them. Due to the difficult topography of the terrain, greening technologies require new ideas and material support.

Objective. The objective of the research is to develop a technology for sowing large areas of plants with seeds from the air.

Methodology. The work is theoretical and applied. Methodologically, the research was based on the well-known laws of mechanics, aerodynamics and conservation of energy. In order to sow large areas with plants, it is proposed to scatter seeds (grains) from a height onto hard-to-reach slopes, attached to a parachute system of a special design. Thousands of swarms of miniature capsules with seeds lifted by the drone and released by it at a given height will be scattered by the wind over large cultivated areas.

The capsule is filled with grain, fertilizer, humus and a compartment with water (gel). The parachute system is a three-dimensional paper platform that allows the capsule attached to it to fall smoothly and slowly. It is the long fall time of the platform that provides a large spread of seeds released by the drone in one place and picked up by the wind. The hooked plumage of the platform provides its reliable grip on the ground. The platform is also soaked with seed nutrients before launch. Instead of a paper platform, also will be used other ecological materials that have the property of absorbing moisture from the air (moisture-retaining substances).

Together with the swarm of seeds on the same parachute systems, miniature wireless electronic sensor devices are being produced, which will create a system for monitoring the environment and tracking the growth of trees and shrubs.

Results. The main result of the study is evidence that the combination of drones with miniature parachute three-dimensional (3D) systems provides a solution to an important environmental problem, namely, sowing the slopes of tailing dams and stockpiles with plant seeds.

Conclusions. Analytical, computational and experimental studies have confirmed the highly efficient aerodynamic properties of the developed parachute systems. 3D flying platforms demonstrated controlled rotation kinematics (18 rad/s) and low final speeds of 1.6-1.9 m/s. The aim of the work was achieved using the proposed concept of gardening hard-to-reach places using drones, wind, and microcapsules with seeds on a flying 3D platform.

Magnetite and hematite quartzites - common features and technological differences

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Introduction. In the process of developing deposits of magnetite quartzites, hematite quartzites are simultaneously involved in production. But the processing of hematite quartzites is associated with significant difficulties, therefore, they accumulate in warehouses, in dumps and spread uncontrollably in the environment. Their reserves remain not fully demanded in many fields of the world. Therefore, many companies are looking for cost-effective and environmentally friendly technologies for the processing of hematite quartzite.

Aim/tasks is to show common features and technological differences of magnetite and hematite quartzites for economic use. To estimate possibilities for industrial applying of hematite quartzites and to present the ways of their processing.

Methodology. When conducting research, a comparative analysis of the composition and technological properties of magnetite and hematite quartzites was used according to data from foreign and domestic researchers. Under laboratory conditions, a complex processing of iron ores was carried out in a vortex air-mineral flow.

Results. The distinctive features of the composition, structure and technological properties of hematite ores have been established, which allow using fundamentally new methods for the complex processing of mineral raw materials for them. Unlike beneficiation of magnetite quartzites, they allow the production of several marketable products and no accumulation of any waste. An innovative technology for the complex processing of hematite ores in a vortex air-mineral flow has been developed and its operation has been demonstrated using the example of hematite quartzites and substandard iron ores in Ukraine.

Conclusions. It is shown that the complex processing of hematite quartzites is more profitable compared to the enrichment of magnetite quartzites and in the near future will become an alternative for many mining and metallurgical companies in the world. It complies with the principles of a circular economy and can be used to process various industrial waste.

Information concept of the human health phenomenon as a guarantee of bioecosystem stability

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Introduction. The current idea of the phenomenon of human health is strongly associated with a harmonious, well-developed personality. A healthy person in all respects can be called one who adequately responds and adapts to the changing conditions of the ecological, biological and social environment. The main prerequisites for health are the stability of the bioecosystem and sustainable resources.

Aim/tasks is the theoretically substantiate the information-structural model of human health and the characteristics of its components.

Methodology. The theoretical and methodological basis of the work was the synergistic use of the principles of science and a systematic approach, which led to the choice of research methods: general scientific (analysis, synthesis, systematization, generalization of literary sources); interdisciplinary (structural-system approach, axiological method).

Results. Based on the use of the method of information-structural modeling, the modern trend of natural science is substantiated, which is the key to the stability of the bioecosystem - the information model of human health. It consists of the following blocks: information field of knowledge of the main subject areas; information and technological base of research; information and organizational management tools. The basics of a new interdisciplinary approach to the formation of a generalized idea of the phenomenon of human health from the standpoint of information-structural modeling: systematized information concept of integrated health as a unity of physical, mental and social health, verified it, obtained information about the system in as a whole by translating verbal-qualitative information into quantitative assessments.

Conclusions. It is emphasized that the information space of individual health statuses is a holistic multidimensional dynamic system of a certain structure, in which the system-hierarchical homeostasis of interaction of physical, mental and social health statuses at different hierarchical levels is realized. It is proved that the information concept of the phenomenon of human health promotes the further integration of various data, builds constructive ways to formalize complex natural objects, and determines the stable functioning of the bioecosystem.

Investigation of the influence of the parameters of metal etching units and on-board construction vacuum cleaners on the features of acid vapor utilization

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Introduction. The world experience of metallurgical enterprises determines an important role in the present technological process of rolling utilization of acid vapors from pickling solutions. At the same time it is expedient the issue of reducing harmful emissions into the production environment remains. That is why for today for the conditions of the etching department, the actual problem is the disposal of acid vapors, which pollute the industrial and environmental environment, and study their capture systems.

Aim/tasks of the task is to find ways to increase the efficiency of the system of aspiration of acid vapors from the surface pickling baths in the conditions of the pickling department, determination of their rational parameters depending from the type of acids and suction cups used.

Methodology. General (empirical, complex and theoretical) and special (graphic and correlation) methods of scientific knowledge were used in the work. In the generalization and analysis of scientific and technical literature on the search for ways of improving the working conditions an integrated approach is used in the pickling department. Processing of calculated data of the dependence of ventilation productivity in the pickling department on the size of pickling bath was performed by correlation-regression method in Excel.

Results. For the conditions of the pickling department of the cold rolling shop of PJSC "Zaporizhstal" (Ukraine), which switched to hydrochloric acid etching of the metal, proposed for removal from process baths aerosols generated, the use of double-sided suction. Efficiency of systems for capturing acid fumes in the conditions of the pickling department by means of installation fog catcher is analyzed.

Conclusions. It is shown that for the conditions of the etching department of the cold rolling shop the amount of air that is removed by means of onboard suckers, is defined depending on the sizes of pickling baths; the level of filling with hydrochloric acid pickling bath; indoor air mobility and the temperature difference between the

solution and the environment. The expediency of returning to metallurgical production of acid vapors in the form of pickling solutions is shown. Recommendations for reconstruction direction of pickling baths, taking into account the type of acid used and conditions work in the production environment of the pickling department.

Adaptive method for controlling the properties of molding mixtures

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Introduction. Ukraine has a developed universal foundry industry capable of producing complex castings of any weight from all alloys used in mechanical engineering. The dominant technological process is the production of castings in disposable sand molds, in which 65-70% of the blanks are obtained. Despite the trend towards the spread of chemically hardening mixtures for the manufacture of molds, which provide an increase in dimensional accuracy and quality of castings, the raw sand-clay mold has a wide range of applications. This is explained by the fact that refractory clays are environmentally clean, the cheapest and non-deficient materials. However, according to available data, 40 ... 60% of defects in base castings are due to unsatisfactory quality of molding materials and mixtures.

Aim/tasks . The aim of the study is to improve the quality of sand-clay mixtures in the conditions of automated production of castings by using an adaptive control method.

Methodology. The adaptive method of controlling the technological properties of molding sands makes it possible to give up the harsh universal conditions for its preparation. This method also allows you to go to a flexible system to regulate the properties of the mixture, depending on the parameters of the starting materials, the amount of input materials and technological additives, mixing time and condition of the mixture preparation equipment.

Results. For this purpose, an analysis was made of the causes of the main defects of castings in the conditions of foundry workshops, the real characteristics of the dispersion of the properties of the mixture were determined, active industrial experiments were carried out, and mathematical models of its properties were developed. The optimization parameters were: the strength of the molding sand in the raw state, its gas permeability and humidity.

Conclusions. The adaptive method made it possible to determine the efficiency of introducing technological additives into the mixture, to stabilize its properties, and also to reduce the rejection due to gas-related defects.

Sustainable Mining

Development of iron ore enterprises of Kryvbas

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The raw material base of these enterprises is the Kryvyi Rih iron ore basin. In 2020, Kryvbas enterprises provided mining of 125 million tons of iron ore in the open method, and 7 million tons in the underground way, which is (125+7)/(142+7)) 90% of iron ore production in Ukraine.

Also in 2020, Kryvbas enterprises mined 88 million cubic meters of overburden, which is (88/110) 80% of the total volume of the overburden, mined in Ukraine.

As a result of the conducted researches the basic factors influencing a modern condition of the iron ore enterprises of Kryvbas were defined:

- unstable political situation in Ukraine;
- quality of raw materials (ore);
- high stripping ratio;
- lack of independent land plots for waste products;
- high energy dependence and energy intensity of production;
- long-term non-complex deposits` development;
- the infrastructure formed over the years with outdated equipment does not allow to carry out radical reconstruction of enterprises;
- low level of scientific support and design.

In general, the performed design works allowed the mining enterprises of Kryvbas to stabilize the production of iron ore products, which indicates the need for timely design and solution of these problems.

Technical and technological solutions of risks reduction to the environment from abandoned oil and gas wells

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Introduction. Decommissioned oil and gas wells pose a danger to the environment, as most of them produce methane, which is a powerful greenhouse gas and one of the man-made factors that weaken the stability of the planet in the context of global climate change. The number of abandoned oil and gas wells is not fully established. Determining their number is complicated by the fact that many of the abandoned wells are "lost" without any evidence of their existence on the surface.

Aim/tasks is to analyze of the probable environmental impact of the old stock of decommissioned wells is carried out; to investigate the species composition of phytocenoses and the taxonomic characteristics of the oil-contaminated ecosystem plant groups phyto objects; to analyze methods of abandoned wells restoration; to determine the principles of environmental safety management of the old fund abandoned wells.

Methodology. The choice of separate types of equipment for restoration works is conducted, in particular: the device for unscrewing of pipes and the device for cleaning of the tool which rises from a well. Identifying the stages in the life cycle of a well with the highest risk to the environment involved the use of a life cycle assessment method. The methods of biological monitoring of the environmental state are used in the work: observation, surveys and field researches, which provide the description, study of plant groups as components of ecosystem, in natural conditions, research of their functioning, structure and development. Field research includs preliminary preparatory, field and in-house methods.

Results. The problem of abandoned wells significant number presence, where there is insufficient or no control over their condition and processes occurring in the wellbore space, which can pose a threat to the environment. The prospects of using resistant plants common in natural phytocenoses to the influence of oil contaminants in phytoremediation practice are analyzed. The bioindication suitability of oil-sensitive plant species, which are recommended for use in monitoring studies of the quality of technogenic-transformed environment, is revealed.

Conclusions. The solutions proposed in the work will allow to monitor these wells condition, to reduce the uncontrolled flow of fluids into the environment and to restore areas affected by long-term exposure to hydrocarbon pollution.

Changes in the hydrogeological state of the territories adjacent to the tailing dumps of the Kryvyi Rih Iron Ore Basin

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Introduction. The tailings dams of Kryvbas mining and processing plants are new areas of groundwater recharge, formed after 1960, which led to significant changes in the hydrodynamic and hydrogeochemical regimes of aquifers. Today the problem of chemical pollution of groundwater aquifers has come to the fore.

The research *aimed* to assess the degree of damage to the territories adjacent to the tailings of mining enterprises by hazardous hydrogeological processes, flooding, and inundation.

Methodology. Analysis, systematization, generalization of the hydrogeological situation, and the data of chemical analyses of the groundwater.

Results. At present, at all mining and processing enterprises of Kryvbas quantitative regime of groundwater is in a stable condition and corresponds to modern conditions of operation of industrial facilities.

At the same time at the moment of research in the north, in underground waters of all aquifers, the increased contents of such microcomponents as carcinogenic cadmium and nickel (to 1.9-34 TLV, and 2.6-8.4 TLV respectively); non-carcinogenic lead (to 1.7-7 TLV); manganese (to 2-320 TLV); bromine (to 14-94 TLV) are fixed. In the center was found an accumulation, in abnormally high concentrations of elements such as iron, manganese (up to 36-1420 TLV normal 0.3 mg/dm^3 and 1.3-66 TLV normal 0.1 mg/dm^3 respectively), and a significant increase in the dry residues and the main macro components in all aquifers. In the south, there is the pollution of groundwater by rocks of Quaternary and Neogene systems, which contain iron (15-2800 TLV), manganese (1,9-132 TLV), vanadium, cadmium in places.

Conclusions. During the studies, chemical contamination in the groundwater of all aquifers was recorded. The geochemical essence of the formation of the chemical composition of contaminated waters consists in the intensity of changes in the hydrogeochemical system and changes in the migration properties of chemical elements, rather than in the formal detection of pollution sources. Within the influence of industrial activities of enterprises, where research was conducted, it is necessary to revise the system of protection of groundwater from pollution. The latest methods and scientific developments are required to localize and prevent the migration of heavy metals with subsequent contamination of water.

Recultivation of slopes of gangue material hillock from mines and pits

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Introduction. To carry out the biological recultivation of the gange waste materials from iron ore mines and overburden dumps of open-pit mines of Mining and Processing Plants (MPP), the greatest problem is to make the slope recultivation in significant steepness (18 degrees or more). The more common method of solving this issue is to leave such slopes for self-overgrowing. However, in a natural way, the process of landscaping can last up to 10-15 years, during which the technogenetic object remains a source of air dust pollution.

Aim/tasks. The aim of the work is to develop a technology for stimulation of overgrowth process of hard-to-reach slopes of iron ore mines and dumps of open pit mines.

Methodology. A method of sowing the slopes surface by a typical hydroseeder (for example, HM-0-HARV Turbo Turf type) was applied. The seed mixture includes seeds of perennial grasses, deciduous trees and bushes, as well as mineral fertilizers. A sewage sludge conforming to the state standard of Ukraine DSTU 7369: 2013 is added to the hydromixture as mulch and primary nutrient substrate.

Results. According to the developed technology, hydroseeding can be carried out both from the lower level of the slopes (hydroseeding along the slope from the bottom to the top, by direct flow), and from the upper edge (hydroseeding from top to bottom, by splashing). The density and distance of the hydromixture application is regulated by an inclination of the hydro-blower and by the operation of hydroseeder pump. The sowing sector is up to 30 m from one working point, and up to 60 m with the use of a pressure hose. The hydromixture applied to the surface of the slope is concentrated between the lumps of mine rocks, and the fertilizer-enriched substrate of the sewage sludge creates favorable conditions for the germination of plant seeds.

Conclusions. When using hydroseeding technology there is no need to carry out costly and dangerous work on mining-engineering preparation to recultivation of the slopes of dumps of any steepness and age of its formation. It is also allowed to combine the various types of seeds of herbaceous and woody plants in the hydro-mixture composition, depending on the salinity or the territory hydro-regime, on the chemical and mechanical composition of the derived substrate of the recultivation objects surface. With the help of a hydroseeder, the procedure for caring for plantations (watering or fertilizing) in difficult landscape conditions is greatly simplified.

Investigation into near-contour stresses in stoping with backfilling by the polarization-optical method

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Introduction. When working iron ore deposits with chamber systems of exploitation with laying of the worked out space in the presence of rocks of the hanging side and ore of medium and low stability, it is often possible bringing down of rocks of the hanging side in the worked out space of excavation chambers, which leads to much greater clogging of ore with waste rocks.

Purpose of work is determination of places of concentration of maximum tensions and their quantitative characteristics, which can lead to bringing down of rocks of the hanging side in the worked out space of the chambers, and working out of technological solutions to reduce concentrations of tensions.

Methodology. To solve this problem, it is proposed carrying out modeling with polarization-optical method.

Results of work. Researched on polarization-optical models different variants of the mining excavation of chamber, which located in the hanging side of the deposit. According to the results of the research of polarization-optical models with different configurations of the circuits of the purification chambers, the tensions fields for each model in the zone of influence of the purification chambers are obtained.

Conclusions. The performed researches have shown that when applying the mine excavation by the chamber, with partial working of the rocks of the hanging side in the plane of contact with the host rocks, the maximum tensions are much higher than when giving the vaulted shape of the produced worked out space. Based on the obtained research results in order to reduce clogging of the ore as a result of possible bringing down of the roof and the wall of the hanging side of the chamber in the worked out space it's nesseary formation of the vaulted shape of the chamber.

Assessment of safe exploitability of undermined objects of the Underground Ore Mining Department of the Mine Management of the PJSC “ArcelorMittal Kryvyi Rih”

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Introduction. Underground iron ore mining involves monitoring surface displacement and the condition of monitored objects within the mining allotment. The monitored objects are adversely affected by surface displacement which often results in crater formation. The object of the research is the ore body “Obiednanyi” of the Underground Ore Mining Department of the Mine Management of the PJSC “ArcelorMittal Kryvyi Rih”.

Aim. The aim of the research is to study subsidence of the surface and assess safety of exploitation of the monitored objects within the mining allotment.

Methodology. As a result of instrumental measurements in reference points tied to benchmarks of reference lines on the monitored area, the parameters of surface subsidence are determined on the basis of the analysis, systematization and generalization of the results. The statistical method is applied to predict two-year ahead subsidence values.

Results. The work results in ascertaining that in the southern and central parts of the mine field the displacement process has stopped, in the northern part it is still developing and mining will have no impact on the technological objects of the Mine Management in the next two years. Within the recent two years, actual subsidence rates in the railway area have not exceeded 2.7 mm/month and they are significantly lower than the permissible values (100 mm/month). The *Schistose Rocks* geological natural reserve can be safely exploited. Mining operations at the ore body *Obiednanyi* have no hazardous impact on the settlement of *Karnavatka* and the cemetery *Zakhidne*. Displacement on road, road base and spillway channel sections is in progress. In the vicinity of the village *of Zhukovka*, the maximum relative subsidence (3.2 mm/m) is still much lower than the permissible one (6 mm/m) and it will not reach its maximum permissible values in the nearest two-three years.

Conclusions. Subject to maintained current volumes of ore production, safe exploitability of surface facilities and natural objects within the mining allotment of the Mine Management in 2022-2023 is substantiated.

Ways to reduce technogenic landscape disturbances in mining production

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Introduction. Iron ore mining causes significant landscape disturbances due to both operation of iron ore mining facilities (underground mines and open pits) and disposal of ore mining and concentration wastes on the surface.

Aim/tasks. The scientific work aims to generalize national and foreign experience in optimizing landscape disturbances caused by activities of mining enterprises and develop individual organizational issues and technology of restoring disturbed lithosphere areas in Kryvyi Rih iron ore basin.

Methodology. The methods of analysis, systematization, generalization and forecasting are used in the research.

Results. There are suggested engineering solutions to reduce the impact of anthropogenic disturbances on the ecosystem of Kryvyi Rih iron ore basin, the technology for processing substandard ores at underground mines and open pits, methods of concentration tailings re-treatment, use of waste rocks in construction, transition to the technology of in-pit dumping. Promising technologies of improving processes of biological reclamation include stimulation of vegetation and technogenic biocenoses through remote application of the fertile substrate mixed with mineral fertilizers and seeds of grass ameliorants, shrubs and arboreous plants to the surface of disturbed lands.

Conclusions. Technogenic disturbances of the earth surface accumulated during the period of economic exploitation of Kryvyi Rih region require a comprehensive solution in two directions. The first one is a significant reduction in the rate of new destructive impacts on the environment through transition from extensive methods of deposit mining to all-round intensification of production. The second one consists in optimization of formed landscape disturbances by engineering and biological methods of reclamation.

Peculiarities of the raw material base of the Likhmanovka iron ore region, Kryvyi Rih basin

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Introduction. The Likhmanovka iron ore region is located in the southern part of the Kryvyi Rih basin. The main minerals of the region are rich and poor iron ores. Deposits of rich ores have been worked out. Currently, poor iron ores (magnetite quartzites) are mined for the production of iron ore concentrate. Poor hematite ores are promising minerals. In addition to them, about 10 metallic and non-metallic minerals are present in the productive and enclosing strata of the deposit.

Methodology. Detailed geological and mineralogical studies of the Kryvyi Rih series rocks and underlying amphibolites and granitoids have been carried out. Selected minerals and rocks that can be mined as minerals. Their resources and technological possibilities of their extraction are determined.

Results. In accordance with the results of geological, mineralogical and technological studies, it was concluded that there are manifestations of gold, germanium, platinoids, garnet, muscovite, chlorite, talc, mineral pigments, facing stone, stone for the production of crushed stone in the iron ore and host strata of the deposit. Their formation is associated with manifestations of syngenetic (sedimentation, diagenesis, dynamothermal metamorphism) and epigenetic (tectogenesis, metasomatism, hydrothermal processes, hypergenesis) processes that occurred during the formation of the Likhmanovka region. A classification of associated minerals has been developed, and their priority types have been identified.

Conclusions. The deposits of the Likhmanovka iron ore region are complex. The studied metal and non-metal minerals form industrial deposits that can be developed simultaneously with the extraction of iron ores. Involving them in mining and processing significantly expands the range of alternative directions for using the mined mineral mass, will contribute to a significant replenishment of the mineral resource base of the Kryvyi Rih basin, and Ukraine as a whole.

The principles of risk management in the safety of workers in the mining industry

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Introduction. High rates of occupational morbidity in the mining industry and the lack of effectiveness of ongoing labor protection measures do not satisfy either the owners, or the employees, or the government. The dynamics of occupational morbidity indicates the absence of trends in its decline, and the share of workers in the mining industry accounts for about 80% of diseases. An urgent and priority task is a significant reduction in the level of occupational morbidity of workers at mining enterprises.

Aim/tasks. The aim of the work is to develop methodological principles for managing the risk of occupational diseases at mining enterprises, which allow to increase the efficiency of the labor protection management system and measures to prevent occupational diseases of workers.

Methodology. The importance of work is determined in the identification of harmful production factors, based on an analysis of working conditions for the entire work record of the mining worker. It was also determined the formation of methods for the prevention of occupational diseases. They are based on the principles of taking into account the risk factors of developing occupational diseases. Dependencies were established for certain types of diseases in a particular profession in order to predict a possible occupational disease.

Results. Implementation of measures to ensure measures to ensure occupational morbidity of workers who work at mining enterprises, based on the proposed tasks for managing the risk of occupational diseases according to dependencies, aimed at ensuring labor safety.

Conclusions. Improving the efficiency of labor protection management at mining enterprises makes a significant contribution to the development of the industry in mining regions.

Mineralogical factor influence on the stability of the ore massif for the Pervomayske deposit of the Kryvyi Rih basin

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Introduction. At the present, the main task for the mining service of the Pervomayske Nothern Mining Ore dressing Combine (MODC) deposit is to ensure determine the maximum stability of rock massifs. Geological processes as sedimentagenesis, dynamothemal metamorphism, sodium metasomatism and hypergenesis influenced from the maximum stability of rock massifs. Mineral composition, structure, texture of ore rocks caused different stability of rock massifs in the process of drilling and blasting and mining operations.

Aim/tasks is to analyze the mineral composition, structure, texture data of the ores and rocks of the productive strata of the Pervomayske deposit.

Methodology. Ten samples of skin type ores and rocks of productive strata were taken. From the material of each sample, polished and transparent slides were made. The mineral composition of the ores, their structures and textures were determined using the standard methodology

Results. As a result of these studies, genetic varieties of ores have been identified. It was found that the mechanical stability of the ore massif is influenced by the secondary mineral composition of ores in the productive strata of the Pervomaiskoye deposit. For example, deterioration of pit wall of the quarry is observed in hypergenic and tectonically altered rocks. The results of the study of the main minerals and their variations, depending on the location within ferruginous rock of the Pervomayske Northern region deposits, are represented also.

Conclusions. A classification of rocks according to their influence on the mechanical stability of rock massifs has been drawn up. The main characteristics of the mineral composition of ores to be taken into account when mapping the stability of rock massifs of the Pervomayske Northern region deposits have been highlighted.

Degasation and dust control methods in major blasts in the open pit

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Introduction. The paper presents the results of experimental and industrial tests of the efficiency of reagents in the pre-humidification of units and their use in internal and external water stemming to reduce dust and degassing during mass explosions. In the course of the research from 2017 to 2021 in the conditions reagents safe for humans and the environment were used, the maximum environmental efficiency of internal and external water stemming with the use of humate reagent was proved. The effective solution of humate reagent, which was used in the tests, was determined experimentally by conducting additional laboratory studies, the results of which are presented in the article. At a concentration of aqueous solution of humate reagent of 3%, the ecological efficiency in comparison with water was: dust suppression increased by 20.0%; neutralization of carbon monoxide - 59.4%; neutralization of nitrogen oxides - 55.1%.

Aim/tasks In order to substantiate theoretically the efficiency of the use of a humate reagent for the dust and gas suppression during massive blasting, the authors' team conducted a theoretical study of the main industrial adsorbents, the main of which are activated carbon (AC) and its modifications. It should be noted that AC is a universal unique absorber that is entirely permeated by an extensive system of pores of various sizes. At the same time, it is less selective than other adsorbents, since it is neutral to both polar and non-polar adsorbed molecules. It also absorbs heavy metals (HM) well. As for gases, it absorbs chlorine, ammonia well, but not carbon monoxide, nitrogen, and hydrogen. Activated carbon is a rather expensive adsorbent, and its use for industrial purposes is economically impractical.

Methodology. Determining the concentration of harmful gases is carried out by the express method using the following devices: carbon monoxide (CO), depending on the level of air pollution – Mini Warn, according to the operating instructions of the gas analyser; MSI Vario-x, according to the operating instructions of the gas analyser; nitrogen dioxide (NO2) – Mini Warn, according to the operating instructions of the gas analyser; MKI-20 NO2, according to the operating instructions of the gas analyzer; nitric oxide (NO) – MKI-20 NO, according to the operating instructions of the gas analyser. Dust and gas sampling and conducting measurements are carried out using the devices that at the time of industrial-scale testing have valid certificates of the State Metrological Calibration.

Results. The use of pre-humidification of the blocks with an aqueous mixture of 3% solution of peat hydroxide reagent and 3% solution of carbon alkali reagent

provided a reduction of dust by 23%, with degassing of harmful gases: carbon monoxide by 47%, nitrogen oxides by 54.0%. The use of surfactant "Lexol-5" with pre-moistening of the unit with 5% aqueous solution provides an average efficiency of dust suppression of 21.2%, the effect of degassing is absent. The efficiency of the use of humate reagent in the external water stemming in comparison with the use of technical water was: dust suppression increased by 33.0%; neutralization of carbon monoxide - 61.3%; neutralization of nitrogen oxides - 54.8% (no degassing effect in water).

Conclusions. The use of pre-humidification of the blocks with an aqueous mixture of 3% solution of peat hydroxide reagent and 3% solution of carbon alkali reagent provided a reduction of dust by 23%, with degassing of harmful gases: carbon monoxide by 47%, nitrogen oxides by 54.0%. The use of surfactant "Lexol-5" with pre-moistening of the unit with 5% aqueous solution provides an average efficiency of dust suppression of 21.2%, the effect of degassing is absent.

Working of stocks under the hunting quarry of PJSC “PIVNGZK” by underground method

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Introduction. Deterioration of mining conditions in open-pit mining (increasing the depth of mining, reducing the capacity of ore deposits) leads to an increase in the cost of production. With increasing energy consumption, reducing the parameters of work sites, increasing the angles of the working board and conservation of much of the quarry makes open development unprofitable. Deconservation of quarry reserves leads to a sharp increase in the volume of mining operations and the deterioration of technical and economic indicators.

Purpose. One of the areas of solving this scientific and technical problem is the use of combined field development with integrated use of open and underground methods. The use of combined open-pit mining will reduce the cost of production, improve technical and economic performance. The introduction of scientific recommendations and technological solutions in the production of stocks in a combined way allowed foreign companies to improve economic performance, which traditionally used the open method of development, to involve in intensive operation of deposits that were considered unpromising.

Methodology. In order to implement advanced mining technologies in the Hannivka field, the experience of a number of foreign mining companies with a combined open-underground method of field development is analyzed.

Results. The scheme of discovery of reserves located under the inner heap of overburden and the technology of underground mining is proposed. The introduction of this technology at the Hannivsky quarry (Ukraine) will reduce the cost of ore production by $ 1.33. At the same time, the construction of an underground mine will cost $ 18.3 million.

Determination of the movement and deformation areas of strata when exploiting longwall of Seam 11 under the open-pit mine at Ha Lam Coal Mine, Vietnam

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Introduction. Ha Lam coal mine is one of the largest and most modern underground mines in Vietnam. Because the upper part of some coal seams are exploited by the open-pit mining method, when the mining part ends, open-pit pits will be formed. According to calculations and forecasts, although the open pits have been dumped, they still contain a large amount of water, especially in the rainy season. Therefore, when mining work continues by underground mining method in the area under these open pits, there will be many potential risks and insecurity, especially the risk of water cracking and mud. Currently, in a number of mines in the Quang Ninh coalfield, including Ha Lam coal mine, which is facing many difficulties in exploiting the seams, the coal reserves located under the open pit have finished exploitation. This is a problem that is not only concerned by the leaders of the mines, but also by the leaders of the Vietnam National Coal - Mineral industry Corporation.

Aim. In order to avoid the risk of water cracking, the impact of these risks on the workers' safety and the exploiting process, the determination of the movement and deformation areas of surrounding rocks when exploiting the longwall face of the coal Seam 11 is very necessary for the Ha Lam coal mine.

Methodology. By collecting and analyzing geological conditions of the rocks around the face, combined with numerical modelling methods, the author has determined the dimension of the collapse and cracking areas when exploiting the face.

Results. The research results of the article can serve as a basis for the Ha Lam coal mine to consider forecasting the movement and deformation height of the roof when exploiting the longwall of Seam 11 for each of the mining options. Based on the assessment and monitoring of hydrogeological conditions, as well as the calculation of the water flow stored in the open pit, Ha Lam coal mine can choose a reasonable exploitation plan for the longwall of Seam 11. In the process of exploiting the longwall, it is necessary to continue to monitor and evaluate the water appearing in the longwall, and at the same time maintain an appropriate drainage solution, if any abnormality is found, it is necessary to have timely solutions.

Conclusions. The rational exploitation plan applied at the longwall of Seam 11 in the Ha Lam coal mine will bring high efficiency and meet the requirements of actual production. On that basis, improve the ability to use the equipment effectively, improve the safety in the mining operation of the longwall, and prevent the occurrence of water and mud problems. The combined results of the article can also serve as a document for researchers in the field of coal mining technology in Quang Ninh coalfield.

Model predictive control of iron ore deslamination process

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Introduction. Optimization of the technological line of ore beneficiation requires determination of the resulting separation characteristic. Therefore, it is necessary to study the formation of the separation characteristics of technological beneficiation processes, in particular, the deslamination process of ore raw materials.

Aim/tasks. The aim of the research is to form the optimal separation characteristics of technological beneficiation processes on the basis of operational information about the dynamics of their parameters on the example of the process of ore deslamination.

Methodology. The following methods are used in the work: analysis of domestic and foreign experience; methods of mathematical statistics and probability theory for processing the results of experiments; methods of analytical design and computer modeling; methods of model predictive control in the development of control algorithms for the thickening process; methods of numerical modeling for synthesis and analysis of mathematical model.

Results. The result lies in determination of the optimal values of the control horizon and the forecasting horizon of the single-channel system of model predictive control of the ore deslamination process. This allows to optimize the separation characteristics of the deslamination process of ore.

Conclusions. To form the separation characteristic of the ore deslamination process based on the method of model predictive control for a single-channel control system, the satisfactory control results are provided by setting the control horizon equal to specific interval. At this value, the square control error should not exceed set values.

Study of the dependence of the ferrosonde sensor output signal on the physical properties of the ore

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Introduction. The main ore mineral is magnetite, but a significant part of it is found in carbonates and other rock minerals. Ferruginous quartzites consist of mixed layers, the thickness of which is from 0.5 to 20 mm. The spaces between the ore grains are filled with quartz, carbonates and silicates. The size of the magnetite grains in the ore layer is 0.1-0.2 mm, and in the mixed layer 0.02-0.03 mm. Fine dissemination of mineral grains requires extremely fine grinding of the ore in order to separate these grains prior to beneficiation. The presence of carbonates and silicates, which have a low hardness, increases the degree of mineral opening.

Aim/tasks. The aim of the study is a technological assessment of the results of grinding iron ore at the discharge of a spiral classifier.

To achieve this goal, the following tasks were set:

- to investigate the dependence of the output signal of the fluxgate sensor on the physical properties of the ore;

- to establish, in order to increase the accuracy of the pulp quality control at the classifier outlet, the relationship between the volumetric magnetic susceptibility and the magnetite content; dependence of the density of intergrowths on the content of magnetite; dependence of the yield of sands and discharge of the classifier on their density.

Methodology. The technological assessment of granulometry methods was carried out, taking into account the need to combine them, if possible, by physical interaction with pulp particles at the classifier outlet. The possibility of developing a more perfect device for the technological assessment of the iron ore grinding results has been substantiated.

Results. The results of investigations of grinding iron ore in a ball mill and opening of intergrowths of ore crystals with rocks are presented. Indicators characterizing the quality of raw materials during ore grinding have been determined, which make it possible to assess the efficiency of grinding processes and subsequent ore concentration.

As a result of the research carried out, the relationship between the volumetric magnetic susceptibility and the magnetite content has been established.

Conclusions. It was found that the correlation coefficient between the dependence of the fluxgate sensor readings on the magnetite content in the classifier drain samples is 0.885 (± 0.05). The dependence of the relative magnetic susceptibility on the average material size is revealed.

Problematics of the issues concerning development of energy-saving and environmentally efficient technologies of well construction

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Introduction. A process of well sinking is accompanied by continuous slurry generation (the rock broken by a rock-breaking tool). Drilling efficiency, especially in terms of complicated mining and geological conditions, depends greatly on proper cleaning of both the well bottomhole and the drill mud itself from slurry. In case of incomplete or untimely removal of the separated rock particles, they are subjected to secondary crushing; as a result, they complicate further effective rock breaking with the following considerable reduction in mechanical drilling rate and accelerated wear of a rock-breaking tool. Great attention is paid to the analysis and formalization of the cleaning processes of well bottomhole and shaft while drilling. However, the indicated problem is far from its complex and logical solution, which is confirmed by the available numerous research and analytical works dealing with this problem and by the existing significant contradictions in the conclusions by competent authors. That is why our consideration of possible ways for further improvement of bottomhole washing while well drilling is of great practical and theoretical interest.

Aim/tasks. The purpose of the paper is to study and generalize the approaches to designing the parameters of hydraulic well washing programme under complicated geological and technical conditions.

Methodology. The drilling circulation processes in a well were modelled in terms of experimental wells involving a drill rig UKB-4P and corresponding auxiliary tools and equipment.

Results. The most significant factors for increasing the drilling operation quality have been identified; that also has helped determine the main directions of complex improvement of well technologies, i.e. in designing rational hydraulic programme of well washing.

Conclusions. Further studies should involve identification and substantiation of the optimal technical and technological solutions with maximum consideration of specific mining and geological conditions of the deposits being developed.

Features of research of amber-containing environments of Volyn region

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Introduction. The current state of the issue of amber mining in Ukraine requires decisions on the complete extraction of minerals from amber-containing media. Scientists of the National University of Water and Environmental Engineering and the Institute of Geotechnical Mechanics named after M.S. Polyakova NAS of Ukraine, in particular Naduty V.P., Malanchuk Z.R., Bulat A.F., Kornienko V.Y., Malanchuk E.Z., Krynytska M.V. and other. Special advances in theoretical and practical complete extraction and extraction of amber from amber-containing media have been achieved in sandy media. It is known that the extraction should be carried out using mechanical, hydraulic methods and combinations thereof. However, in Volyn there are clay amber-containing media that need detailed study. Therefore, the study of physical and mechanical characteristics of these environments is appropriate and requires experimental and practical research.

Aim/tasks. The aim of the research is to establish the qualitative and quantitative characteristics of amber-containing media that affect the process of complete amber mining.

Methodology. Laboratory tests were performed to analyze the influence of physical and mechanical characteristics of amber-containing media. Using the methods of mathematical statistics, dependences describing the influence of the characteristics of clay media on the process of amber mining are obtained.

Conclusions. The results of the research will be recommendations for rational methods of complete amber mining based on the analysis of amber-containing media.

Use of mobile phone cameras for mining

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Introduction. The 21st century has made adjustments to most of the methods for performing surveying work, which has affected the increase in their efficiency. Most surveying tasks today are solved in a much shorter time while maintaining the required accuracy. The improvement of remote methods for surveying mining facilities deserves attention, which is especially important when performing observations in zones of shifts and deformations and when drawing up plans for objects where it is dangerous for people.

Aim is to analyze remote methods of shooting from the air and the ground using various cameras and choose the most appropriate camera for solving a particular task, since each task is solved under certain conditions in compliance with the requirements of the mine surveyor's instructions.

Methodology. During the research, the authors used methods of analysis of their own practical experiments and the experience of leading scientists in this field. The obtained data are analytically worked out and substantiated.

Results. Practical work on surveying objects of mining enterprises - quarries and dumps, was carried out using digital photogrammetry methods based on modern technologies for obtaining images and processing them. Experimental survey work was carried out with the help of various cameras. According to the images obtained by different cameras, digital models were built, characterized by a certain accuracy of determinations on them and different quality. For example, digital SLR cameras make it possible to obtain digital models of high quality and accuracy sufficient to solve any surveying task, but they also have a high cost. The studies also used various mobile phones with cameras with sufficiently high quality characteristics. But the results obtained for the processing of digital models showed significantly lower accuracy rates. This does not mean that they cannot be useful in mine surveying. Mobile phone cameras can be used for tasks that do not require high accuracy.

Conclusions. Based on the results of the research, the qualitative characteristics of digital models built from images obtained by different cameras, both SLR and mobile phone cameras were established. The range of tasks of the mine surveying service has been established, which can be solved using images obtained by a mobile phone camera.

Building Stone Resources of Dnipropetrovsk Region

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Introduction. The article deals with the analysis of building stone resources of the Dnipropetrovsk region that are used and can be used in order to provide construction needs.

Aim/tasks. The main aim of the research is to conduct constructive and geographical analysis of building stone raw materials of the Dnipropetrovsk region, in particular, to highlight briefly qualitative characteristics of rock, to characterize component and territory structure of building stone deposits, their balance reserves, to evaluate building stone provision of regional administrative districts, to analyse raw material extraction during recent years, to study deposit departmental identity, to make conclusions about opportunities of optimization of regional raw building material structure and functioning.

Methodology. The research has been conducted based on materials of SRDE "Geoinform Ukraine" and Summary balance of mineral deposits of Ukraine. The methods of analytical treatment of statistical information and cartography model construction using Data Graft, Map Info are used in the work. The algorithm of constructive and geographical research of mineral and raw material resources, worked out by the authors in the previous article, has been used.

Results. The Dnipropetrovsk region is one of the most economically developed regions of Ukraine due to mineral and raw material resources being located at its territory. Crystalline Pre-Cambrian rocks of East European platform fundament as gneiss, granites, quartzites, migmatites, granodiorites, amphibolites and sedimentary apron rocks – malmrocks – are natural construction material in the region. 42 building stone deposits are located on the territory of the region among them 19 deposits are developed also refer to big and middle and 24 are not developed. The biggest amount of developed deposits is located in the Dnipro, Kryvyi Rih, Kamianske and Nikopol districts.

Conclusions. The conclusions are made about the ways of expanding capacities of building stone extraction due to complex iron ore deposit development and the opportunity of building stone reserve increase in the region.

Sustainable Transport

Final Reserve Fuel study

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Introduction. Aviation emissions, domestic and international, account for approximately 2 % of total global CO_2 emissions. Fuel burn for a given route depends on the weight of an aircraft. To minimize fuel burn it is most economical to carry the minimum required for the sector.

Aim/tasks Focus of this study is the exploration and the assessment of ways to reduce the final reserve fuel carried and thus the amount of fuel needed. To define a set of measures and circumstances which may allow to reduce final reserve fuel, focus is set on the reliability of flight planning and actual operations.

Methodology. Analysis, systematization, generalization were used to conduct the study. Based on provided real flight and fuel data. Fuel data of an operating airline over a roughly five year period where examined to explore the statistical background. The main focus of this paper are the results for taxi and trip fuel.

Results. The current requirements for flight planning and subsequent execution of flights are very reliable and highly accurate these days. The study shows there for the possibility of final reserve fuel reduction while keeping the necessary safety level.

Conclusions. The results indicate that reduction of final reserve fuel has a considerable impact on overall fuel and emission reduction. Further research is needed to identify universal safety factors and performance indicators.

Seafarers high quality training provision by means of VR technologies in the context of maritime transport sustainability

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Maritime transport is the basis of world's trade and globalization. It provides about 90% of world's trade. This type of transport is the most efficient and cost-effective.

The solution to a number of global problems nowadays depends on the nature of human interaction with the world's oceans. The constant growth in shipping operations requires ensuring the environmental safety of the planet and belongs to strategic targets of the environmental policy of IMO Convention (International Maritime Organization).

Adopting the MARPOL Convention, IMO became the first international regulatory body in the transport sector to pass global mandatory requirements for marine pollution from ships and energy efficiency, which play a significant role in achieving the core targets within the UN Sustainable Development Goal. In the current requirements IMO suggests to increase the efficiency of shipping through the electronic exchange of information and by solving problems associated with the computerization of the shipping industry.

The aim of the study is the necessity to form ecological consciousness of future seafarers by means of educational VR technologies in order to find the optimal variant of interaction between a man and the sea. The research is based on the study of philosophical, methodological, value and educational aspects in the context of sustainable development of the maritime industry.

The issue of the effective use of cloud computing and VR technologies is considered throughout the research. The definitions of simulation and distance educational technologies, their role in the formation of environmental competence of seafarers are revealed on the example of applying the "Wall Wash Test" course with the use of virtual reality glasses. According to the experiment's results the quality of environmental competence formation in experimental group is 88% and in control group - 82%.

The research reflects modern approaches and describes a methodology for acquiring practical skills by means of VR simulation technologies. The authors have shown the effectiveness of practical skills mastering using VR simulators in the process of forming the environmental competence of seafarers.

Development of sustainable urban passenger transportations in Ukraine in the context of considering the issues of energy efficiency and environmental friendliness of the transportation process

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Introduction. Meeting the needs of the population for passenger transport link is of great socio-economic importance for the development of the country. The forecasted growth of needs for passenger transportations, the low level of the current state of the production and technical base of transport, the non-compliance of vehicles in Ukraine with modern environmental standards require a wide use of scientific and technological progress, domestic and foreign experience in the field of creating new transport equipment and developing and implementing modern transportation technology.

Aim/tasks of the research is a study of the development of sustainable urban passenger transportations by road in Ukraine in the context of considering the issues of energy efficiency and environmental friendliness of the transportation process since the dominant role in the organization of passenger transportations in the transport complex of Ukraine belongs to road transport.

Methodology. The methodology involves the use of empirical and complex methods of scientific research, namely: observation, comparison, analysis, argumentation; the use of an economic and statistical method.

Results. In the course of the research, it was found that the transition to the use of electric transport (electric cars and electric buses) in the organization of sustainable urban transportations is a necessary condition for the integrated development of passenger transport link in Ukraine. This is due to the fact that the production and use of electric transport is a modern trend of scientific and technological progress, which provides for increasing the efficiency of resource use, the widespread introduction of clean and environmentally friendly technologies.

Conclusions. The results of the transition to the use of electric transport in the context of the development of sustainable urban passenger transportations by road in Ukraine are as follows: higher productivity thanks to the low cost of operation of transport as a result of the lower cost of electricity compared to gasoline, which is used in vehicles with an internal combustion engine; improving the environmental friendliness of transport and enhancement of the urban environment by reducing emissions of greenhouse gases and harmful substances, reducing air pollution and noise; no need to use any type of contact network to power a vehicle and, consequently, high maneuverability; improving road safety.

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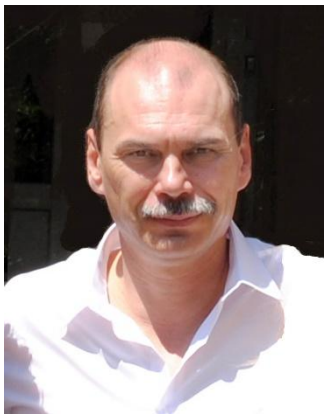

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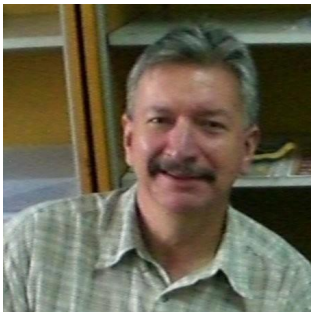

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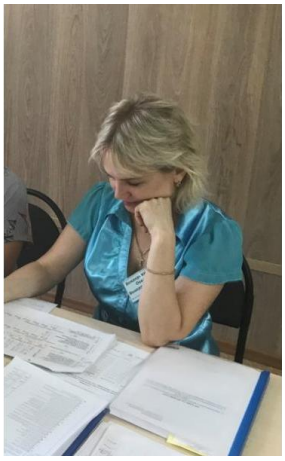

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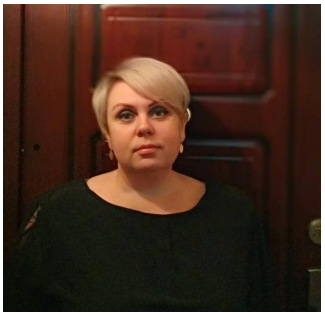

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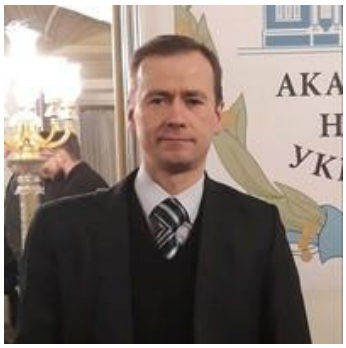

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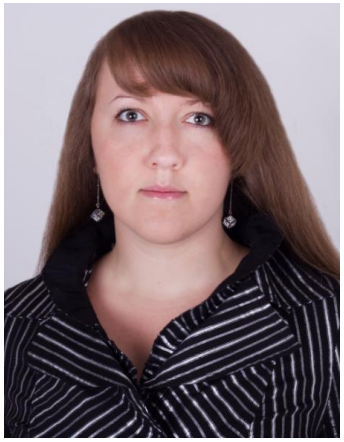

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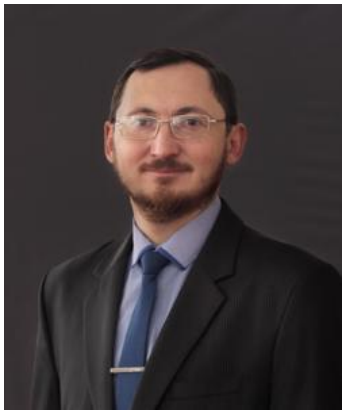

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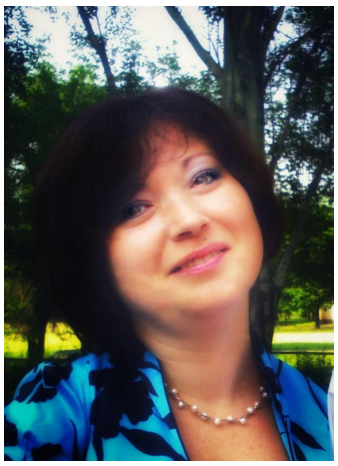

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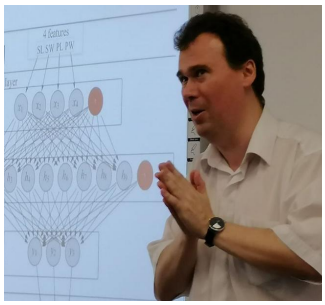

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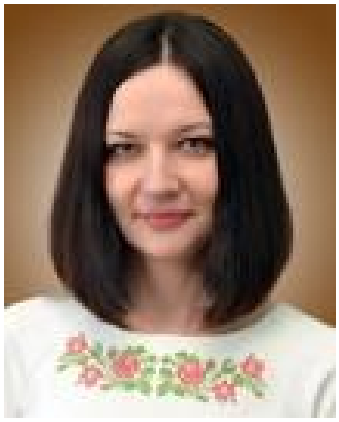

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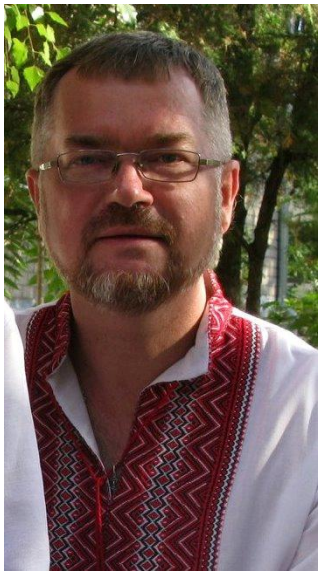

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