

ABSTRACT AND REFERENCES

ECOLOGY

MATHEMATICAL MODELING OF SOIL ACIDITY BY THE ADMITTANCE PARAMETERS (p. 4-9)

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We proposed a technique for the operational control over the acidity of soils under field conditions using the admittance method.

The paper highlights results of research into experimental frequency dependences of the admittance parameters on the level of acidity of different types of soils, in particular: black soil, loamy and sandy soils. The experimental data covered soils with acidity from 4.8 to 8.5 pH, frequency of the test signals varied from 0.05 kHz to 100 kHz. Based on the analysis of these experimental data, it was found that it is expedient to use the value of the active component of admittance as the informative parameter for the assessment of soil acidity using the admittance method. To confirm this, we obtained mathematical model, which with sufficient accuracy describe dependence of the active component of admittance on the soil acidity and frequency of the test signal. These analytical dependences take the form of polynomials of the corresponding order. Based on this, mathematical models were constructed that reflect the assessment of acidity for different types of soil depending on the value of the active component of admittance and frequency of the test signal. An application of the obtained models provides for the possibility of organizing operational control over the acidity of soils under field conditions with the use of admittance mapping. The arrangement of such a control over the acidity of soils will contribute to an increase in performance efficiency of the information systems for monitoring conditions of soils.

Keywords: acidity of soils, admittance mapping, uniform approximation of functions, the method of least squares.

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THE EFFECT OF ORGANOCCLAYS ON THE FIRE-PROOF EFFICIENCY OF INTUMESCENT COATINGS (p. 10-16)

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We explored thermal transformations of the intumescent system (ammonium polyphosphate, pentaerythrite, melamine, copolymer of styrene acrylate) in the temperature range of 200–600 °C in the presence of organomodified montmorillonites and titanium nano-oxide. Coefficients of swelling, masses of coke residues are determined and morphology of the formed coke layer is investigated. These data were used for the development of formulations for effective fire-retardant coatings of the intumescent type, which do not contain halogen fire retardants.

As a result of the research, it was established that montmorillonite and organic clays on its base (cetyltrimethylammonium-montmorillonite and tallow bis-hydroxyethyl methyl ammonium-montmorillonite), in contrast to titanium nano-oxide, significantly inhibit the processes of swelling at the initial stages of fire action. At temperatures above 500 °C, the intumescent compositions, which contain organic clays, form a durable and dense coke layer. IR-spectrometric studies of the samples of coke with the participation of organoclays demonstrate deceleration of oxidation processes and decomposition of polymeric protective layer in contrast to the composition with titanium oxide and nano-oxide.

Based on these observations, we give practical recommendations regarding the preparation of formulations for fire-retardant coatings for the building structures depending on the required limit of fire resistance. It is recommended to use additives of nano-oxides for the class of fire resistance R 30–R 45; and for the class of fire resistance R 60 and above, organoclay should be added to the intumescent system. This assumption was confirmed by firing tests of steel columns.

The results we obtained may be used for the design of new fire-retardant coatings of the intumescent type with improved efficiency and ecological safety.

Keywords: organoclay, fire protection, montmorillonite, intumescent compositions, coefficient of swelling, fire resistance limit.

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DEVELOPMENT OF SYSTEMATICS RANKED STRUCTURE OF ENVIRONMENTAL PROTECTING EQUIPMENT FOR CLEANING OF GAS EMISSIONS, WASTEWATER AND SOLID WASTE (p. 17-23)

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The information about existing methods and technical means of purification of gas emissions, wastewater and solid waste processing is summarized. Selection of an object of study – the functional class of magnetic separators – is conditioned by the fact that in practice it is the most widely used environmental equipment for magnetic purification. Devices for magnetic purification are the most technically implemented and described in the information sources.

To build a systematics of selected functional class the concept is proposed, whose objective is to develop a ranked taxonomy structure of environment protecting equipment for magnetic purification.

At the beginning of systematics building the full species composition of the investigated class of devices for magnetic purification was defined. System information on the number and genetic structure of Species enabled to determine the ranked structure of the main taxonomic units of the class. The proposed ranked structure of systematics consists of two parts: taxa that are defined by the periodic structure of the genetic classification of the field primary sources, and taxa that take into account the artificial characteristic – an environment where the magnetic purification is carried out.

The results of the research can be used to create systematic catalogs, information and design databases and knowledge bases in the field of environment protecting equipment and in the learning process for students of natural and engineering specialties.

Keywords: ranked structure of systematics, environment protecting equipment, magnetic separator, genetic code.

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ASSESSMENT OF SAFETY INDEX FOR WATER ECOLOGICAL SYSTEM (p. 24-34)

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The harmful effect of wastewater factor on stenobiont organisms of the Gammaridae family is experimentally determined. Based on the defined environmental characteristics of aquatic organisms in the estuarine complex of the Southern Bug river (Mykolaiv region, Ukraine), the calculated ecological system safety index, which can vary in the range $0 < \text{ESI} < 1$, takes the value of 0.18. This suggests a crisis ecological situation in the ecological system of the river and is confirmed by the graphic and analytical material, presented in the paper.

Double integration (using living organisms as an integrated status indicator of the river, the lower reaches of which fully reflects the level of balance of the “man-nature” system in its basin) allows speaking about considering the principle of comprehensiveness in the evaluation results. The causal relationships between the economic complex of human and the natural systems, which primarily determine the low current value of the proposed index are analyzed. The experimental work with further ESI calculations proves the failure of regulatory evaluation of the concept of human impact on the environment to ensure the objectivity of evaluation. The result of the research is the practical implementation of new theoretical developments in the field of safety assessment of ecological systems. The resulting index value correlates well with both qualitative and quantitative characteristics of the studied water ecosystem. The theoretical work on the algorithm of ensuring (management) the ecological safety of natural and socio-natural systems is also extended. The developed technique can also be used to assess the social,

economic development components and for a generalized indicator of sustainable development.

Keywords: ecological safety index, water ecosystem, stonobionts, mortality rate, ecosafety management algorithm.

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the formed aggregates of floccules at constant consumption of flocculant is reduced with an increase in the concentration of solid phase in slime exceeding 30 g/dm³. This is explained by the fact that with an increase in the concentration of finely dispersed solid particles, the interphase surface increases, which leads to the non-uniform distribution of polymer at the surface of the particles and decreases the effectiveness of its adsorption. With an increase in the content of solid phase with coarseness exceeding 40 μm, the effectiveness of flocculation (settling velocity and strength of floccules) grows. We proposed a criterion of effectiveness of the process of formation of durable aggregates, which is the residual speed after mechanical action. This indicator characterizes the size of floccules and their strength. Dependences obtained in the course of experimental studies make it possible to intensify the process of forming durable floccules at the minimum consumption of flocculant, as well as to control the process of flocculation by regulating the concentration and disperse composition of polydisperse suspensions.

Keywords: flocculation, polydisperse slimes, development of aggregation, strength of floccules, rate of deposition, intensification.

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EXPLORING THE WAYS TO INTENSIFY THE DEWATERING PROCESS OF POLYDISPERSE SUSPENSIONS (p. 35-40)

Andrii Shkop, Musii Tseitlin, Oleksii Shestopalov

The influence of concentration and disperse composition on the process of flocculation of polydisperse coal slime is examined. It is established that the rate of deposition of

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ANALYSIS OF ROLE OF TIME IN THE PRODUCTION PROCESS IN A 4D SPACE (p. 41-48)

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It was established that theory and practice of calculations of “costs-time” and attempts to examine them in a 4D space are not systemic in nature. Production process is not examined in the system, in which the result of using resources over time is not the object of an interconnected and interdependent process. Time is considered as an independent variable implicitly, which significantly narrows the possibilities of prognostic calculations when introducing advanced technologies

Entering the metric space, geometric interpretation of space-and-time, makes it possible to establish the essence of time in a specific production process. It is manifested in the fact that the system of vectors of increment in time is collinear and co-directed to the corresponding vectors of an increment in volume of works. In this case, the vector of increment in time corresponds to each vector of increment in volume of works. The infinite number of vectors of increment in time corresponds to the infinite number of vectors of increment in volume of works, which is characteristic for a specific production process, causing “compressibility” and “stretching” of the time parameter along with the changes in increments in volume of work and productivity.

The example of calculating prospective volumes of work in a 4D space, including basic production resources and time, was performed. The calculation demonstrated the possibility of a considerable (up to 40 %) increase in accuracy of determining the required parameter.

Keywords: production process, time in a 4D space, production factors, collinearity of vectors, time increment.

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DEVELOPMENT OF ENVIRONMENTALLY SAFE TECHNOLOGICAL WATER DISPOSAL SCHEME OF AVIATION ENTERPRISE (p. 49-57)

Sergii Shamanskyi, Sergii Boichenko

Various methods of organizing water disposal at the aviation enterprises were considered, and their main common shortcomings were characterized. It was shown that modern technologies of water disposal system do not allow reaching a proper level of ecological safety mainly due to the insufficient degree of wastewater treatment and existing environmental risks associated with the recycling of their sediments. We made a conclusion about the need for improvement of the environmental safety of water disposal systems functioning due to the development of a new technology. For this, when applying traditional mechanical and biological treatment methods, it was proposed to carry out additional wastewater purification and to improve the ways of treatment and recycling of their sediments. For additional treatment, it was proposed to use wastewater as a medium for the cultivation of energy microalgae in photobioreactors of the closed type with subsequent production of liquid biofuel of the third generation. For sediment treatment and recycling, it was proposed to use anaerobic digestion with the scheme organization in compliance with the kinetics of digestion processes and subsequent use of digested masses organic fertilizer.

Based on this, we proposed a new technological water disposal scheme, which would make it possible to obtain renewable energy sources for partial or full provision of the needs of enterprises for thermal and electrical energy, and in case of its excess to obtain commercial renewable energy sources, to receive environmentally safe organic fertilizer, commercial carbon dioxide, as well as to reduce emissions of carbon dioxide from cogeneration plants of local thermal and electric power plants into the atmosphere.

Keywords: aviation enterprise, wastewater treatment, renewable energy sources, recycling of wastewater sediment, water disposal technology.

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EXAMINING THE PROPERTIES OF DRY MAGNETICALLY CONTROLLED BIOSORBENT, OBTAINED BY THE METHOD OF MECHANICAL AND MAGNETOHYDRODYNAMIC AGITATION (p. 57-63)

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We determined the efficiency of extraction of the Cu²⁺ ions by a dry magnetically-controlled biosorbent based on *Sacharomyces CEREVISIAE* yeast, obtained by magnetohydrodynamic stirring in the crossed electric and magnetic

fields. The influence of different concentrations of magnetic nanoparticles and yeast cells on the magnetic favorability was also revealed. The optimum content of magnetite is 0.2–0.6 %, biosorbent possesses maximum magnetic favorability and better stability. Sorption capacity of dry MCBS, manufactured by the MHDS method in the crossed electric and magnetic fields, in relation to the ions of copper, is 82 %, and for the MCBS manufactured at mechanical agitation is 60 %. Larger sorption capacity is observed for dry magnetically-controlled biosorbent, obtained using magnetohydrodynamic stirring in the crossed electric and magnetic fields at magnetite concentration 0.2–0.6 %.

Magnetic favorability of dry MCBS, manufactured by the MHDS method in the crossed electric and magnetic fields, is 60 % higher. Magnetically-controlled biosorbent, manufactured by the MHDS method in the crossed electric and magnetic fields, retains its magnetic favorability in the process of stirring within 2–4 %, while that manufactured at mechanical agitation – within 28–34 %.

The process of active and passive biosorption demonstrates that a part of the magnetite nanoparticles was attached to the surface of biosorbent. This indicates that the passive and active sorption proceeds during the process of interaction between yeast cells and magnetite nanoparticles.

Studies of structure and properties of dry MCBS obtained by different methods of stirring will help select biosorbent with the best properties. And it is certainly the MCBS manufactured by the MHDS method in the crossed electric and magnetic fields. It has a number of advantages, which are described above, in comparison with the MCBS, manufactured with mechanical agitation. In future it is recommended to use dry MCBS manufactured by the MHDS method in the crossed electric and magnetic fields in experimental studies for the treatment of wastewater from electroplating enterprises, as well as from household sewage. In turn, the results of experimental research into purification of wastewater from polluting substances might be in future applied for carrying out experimental-industrial experiment under real conditions.

Keywords: dry MCBS, biosorption, magnetite nanoparticles, mechanical agitation, MHDS in the crossed electric and magnetic fields.

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