ABSTRACT AND REFERENCES

ECOLOGY

THE DEVELOPMENT OF MODERN BIOCENOTIC CONTROL METHODS FOR THE ECOLOGICAL STATE OF AQUATIC ECOSYSTEMS OF RIVERS (p. 4-10)

Vera Udod, Igor Vildman, Elena Zhukova

Existing ecological-hygiene control methods for the AE state under the action of anthropogenic factors do not fully characterize the structural-functional changes in water bodies, and therefore do not characterize the degree of their transformation. Sanitary-hygienic standards (TLV, MPD) allow to determine the class of water pollution and changes in chemical composition. At the same time, in the process of self-purification of the water body, there is destruction of pollutants, which leads to the formation of new chemical compounds, which are not considered by the applied control methods. Therefore, for the characterization of biological regulation of aquatic ecosystems, it is advisable to use integrated environmental approaches, including the existing sanitary-hygienic standards and biocenotic methods were proposed. Biocenotic methods allow to determine ecotoxicokinetic processes in bio- and aquatic ecosystems and based on the analysis of the data obtained find out the cause-effect relations of AE, which lead to the transformation of AE.

Keywords: aquatic ecosystem, structure, properties, functions, interrelations, transformation, hydrochemistry, hydroecology, monitoring, development.

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ADSORPTION REMOVAL OF COPPER-CONTAINING WASTEWATER ON YAZUV SULFUR MINE BENTONITE (p. 11-15)

Marianna Petrova, Mariana Voitovych

The adsorption properties of bentonite clay of Yaziv mine (Lviv district, Ukraine) was investigated in the process of copper removal. Water contamination by copper originates from industrial wastewater discharge, thus effective methods for copper removal are required. Copper adsorption was effective in wide range of concentrations; the adsorbent saturation by copper ions did not take place. The assay boundary adsorption capacity was 31 mg/g. The kinetic characteristics of the adsorbent were defined and the time for copper removal did not exceed 2 hours. The pH range for the effective adsorption was determined, namely pH>4. The kinetic models were applied for the experimental data, namely pseudo-first, pseudo-second order, intraparticle diffusion, Bangham and Ritchie models. The process followed the pseudo-second order model, thus it was found to be limited by the chemical reaction between copper and functional groups of bentonite. When copper removal from solutions with high concentrations of potassium (up to 0.1 M) was performed, the insignificant adsorption retardation was observed. This confirmed the activity of functional adsorption sites selective for copper during adsorption process. The combination of high capacity and favourable kinetic characteristics, along with the selectivity, confirmed the prospective for bentonite application in waste water treatment technologies.

Keywords: effluent, purification, copper, adsorption, chemisorption, montmorillonite, bentonite, capacity, selectivity, kinetics.

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MODELING OF BIOLOGICAL WASTEWATER TREATMENT PLANT EFFICIENCY (p. 16-20)

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The research explores the efficiency of wastewater treatment at a biological treatment plant with respect to the biochemical oxygen demand indicators within five days at the inlet and outlet of the treatment plant. Different seasons have been provided with the mathematical models of the plant's operational efficiency depending on the weather conditions that affect the load on the activated sludge and its treatability (taking into account the reliance on the air temperature, precipitation amount, and the presence of melting snow). The quality of the obtained models is evaluated with the determination coefficient d. The best determination coefficients are: for winter d=0.92, for spring d=0.98, for summer d=0.80, and for autumn d=0.82.

Accounting for the forecast and the obtained dependencies will contribute to the implementation of operational actions, which provide the wastewater treatment quality.

Keywords: wastewater, treatment efficiency, temperature, biological oxygen demand, biocenosis.

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DEVELOPMENT OF A MATHEMATICAL MODEL OF THE SYSTEM OF INTEGRATED RADIO ECOLOGICAL MONITORING OF DNIPRODZERZHYNSK TOWN (p. 21-25)

Valeriia Kovach

Seven tailings dams and two uranium waste storages were formed in the Dniprodzerzhynsk city (Ukraine) in the PA "Pridneprovsky Chemical Plant" (PA "PCP") influence zone after a long mining and processing of uranium ore (1949–1991). Protective covers of most tailings dams and engineering facilities of the uranium production infrastructure in the PA "PCP" territory are poor and getting worse every year under the influence of natural factors and because of the lack of remedial operations. Given the current difficult economic situation in Ukraine, least-cost creation of an effective system of integrated automated radioecological monitoring of the Dniprodzerzhynsk industrial-urban agglomeration area and influence zone of tailings dams is necessary. This was proposed to do by using a mathematical description of the monitoring system through the control loop, which describes the elements of influence on the management object in accordance with the received commands. The measurement results in the management object state are fixed by observation elements and a new management cycle begins. This differs from the systems, previously suggested for this area since the pro-

posed control loop can be used not only for fixed, but also for mobile posts. The developed mathematical model has allowed to justify the optimal number of posts that are be placed in the Dniprodzerzhynsk industrial-urban agglomeration and the influence zone of tailings dams to control the difficult ecological situation in the given area.

Keywords: mathematical model, integrated monitoring, control loop, industrial-urban agglomeration.

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INFLUENCE OF THE NITROGEN-CONTAINING COMPOSITIONS ON THE GRINDING PROCESS AND PHYSICO-MECHANICAL PROPERTIES OF CEMENTS (p. 26-30)

Hanna Fleysher, Volodymyr Sokoltsov, Volodymyr Tokarchuk, Valentin Sviderskiy

To utilize the waste, accumulated in Ukraine, and optimize the clinker grinding process, chemical additive, which is a product of processing the polymer fraction of solid domestic waste was developed. The polymer fraction was used to obtain nitrogen-containing organic compounds, which have a significant influence on the clinker grinding process and physico-mechanical properties of cements and products based on them in the composition of additive.

It was found that additive effectively influences clinker grinding processes within the concentrations of 0,045–0,065 wt % and has almost no impact on the process of grinding active mineral additives. The additive in a broader concentration range (0,025–0,085 wt %) increases the strength of composite cements in all hardening periods and accelerates the setting time.

Additive, obtained by chemical processing of polymer fraction of solid domestic waste can be used in the construction industry as clinker grinding activator and cement strength increasing additive. Thus, it is possible to reduce the energy consumption in grinding technology operation and improve the physico-mechanical properties of composite cements, which in turn reduces the content of the cement component in such cements.

Keywords: solid domestic waste, polymer fraction, additive, grinding, strength, composite cement.

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STUDYING THE NATURE OF MATERIAL SORPTION BASED ON PEAT MOSS SPHAGNUM (p. 30-35)

Olena Matvyeyeva, Iuliia Bondarets

The paper considered the existing methods of using sphagnum moss as a liquid sorbent, including oil and oil products for identifying regularities of sorption processes on the material. The existing data on the studies of the absorptive capacity of sphagnum moss was analyzed. It was found that the existing studies investigated the dependence of the adsorptive capacity on the processing method (grinding, thermal modification, encapsulation, etc.). However, the

nature and mechanism of sorption have not been studied at all, but there is a set of theoretical assumptions that have not been checked. The characteristic of the existing descriptions of the sorption processes on the material made of sphagnum moss was given. The need for further research for defining the nature and the mechanism of the sphagnum moss interaction with a substance absorbed in the sorption process was determined.

Keywords: sorption, sphagnum moss, sorbent structure, absorption, adsorption, oil, oil spills, water treatment.

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ADSORPTION AND BARRIER PROPERTIES OF YAZIV MINE BENTONITE AS MATERIAL FOR LANDFILL LINERS (p. 36-41)

Marianna Petrova, Mariia Postnikova, Kateryna Stepova

The properties of natural bentonite clay of Yaziv mine (Lviv region, Ukraine) as a material for landfill liners and solid household and industrial waste storages were investigated. Copper and ammonium were selected as components that imitate the filtrate composition. Filtration coefficient, which is 10.9 m/s was experimentally found. Based on the porosity analysis, it was determined that the mineral belongs to the microporous materials with an average pore radius of 5 Å. It was revealed that bentonite is able to irreversibly absorb large amounts of copper by the ion exchange mechanism. The full capacity of the mineral by copper is 115 mg/g. Ammonium adsorption proceeds according to the physical adsorption mechanism; maximum adsorption capacity is 0.175 mg/g. Saturation of the adsorbent is reached on the first day due to the high specific surface area. Remobilization ability of components when applying different desorbing agents was examined. The data obtained suggest that the adsorption ability of bentonite clay liners is not enough to ensure the environmental safety of ground and surface waters. Barriers, made of several materials with low permeability, different porosity, specific surface area and high adsorption ability of the filtrate components must be used.

Keywords: adsorption, desorption, bentonite, filtrate, migration, copper, ammonium, waste, landfills, dumps.

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CALCULATION AND ANALYSIS OF PREDICTABLE TECHNOLOGICAL RISK VALUE OF INDUSTRIAL OBJECTS IN STATIONARY OPERATING CONDITIONS (p. 42-46)

Petro Vavulin, Tatyana Boyko

The calculation algorithm of the predictable technological risk value of industrial objects during their operation is described in the paper. The algorithm is based on three methods: the Monte Carlo method, index method and method, based on the reliability theory elements. Using these methods in the present combination allows to avoid the problems, associated with the initial data uncertainty. It should be noted that the initial data uncertainty is a key problem to most common calculation methods.

An example of calculating the technological risk for the system of seven water heaters in the HPP system was considered. The nominal failure probability value of individual elements of the system was calculated by the index method (calculation by the index method includes all the technological risk components, associated with the operating conditions of the object). This allows to avoid the initial data uncertainty problem during the calculation of technological risk of the entire system. The calculated probabilities are the initial data for the Monte Carlo method and the probabilistic method.

After that, computer simulation of the system as a whole was performed by the Monte Carlo method. To obtain accurate results, it is recommended to carry out a sufficiently large number of iterations using the given method. For example, if the nominal element failure probability is 10-8, it is recommended to conduct at least 109 iterations.

As a result, failure probabilities of each element of a complex technological system and the overall system were obtained. To verify the results, the fault tree construction method for the system under consideration was used. This test showed that the results are accurate, and each of the methods can be used to calculate the technological risk of industrial objects during operation.

Keywords: Monte Carlo method, technological risk assessment, failure probability, reliability theory, simulation, acceptable risk.

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CESIUM SORPTION INTENSIFICATION BY COMPLEX NATURAL SORBENTS FROM LIQUID RADIOACTIVE MEDIA (p. 47-50)

Igor Petrushka, Yuri Ytchyshyn, Katerina Petrushka

The studies have shown a growth (up to 90 %) in the sorption degree of strontium ions by composite sorbents based on the modified titanium oxide of bentonite rocks and montmorillonite in a ratio of 1:1. Optimum hydrodynamic regimes (350 rev/min), which increase the emergence effect of complex natural sorbents were determined. Intensification of external diffusion of cesium from liquid radioactive waste was calculated using the theory of local isotropic turbulence, taking into account the flow turbulence hydrodynamics and geometric parameters of mixers. The diffusion coefficient of strontium in the model solution, computed using the Wilkie and Chang dependence allows to predict the kinetics of external diffusion mass transfer of cesium ions in liquid medium based on the theoretical values of mass transfer coefficient. For a correlation of experimental and theoretical data of mass transfer coefficient during external diffusion mass transfer process, correction factor kβ (1,1–1,25) was calculated, which takes into account the radial distribution heterogeneity of solid dispersion particles in the system center and near the walls of the device depending on the particle size distribution and the size of the device.

Keywords: modified bentonite, adsorbent, liquid radioactive waste, Cs-134, external diffusion.

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ELABORATION OF A METHODOLOGY FOR INTEGRAL ESTIMATION OF ECOLOGICAL STATE OF TERRITORIES (p. 51-56)

Victor Belogurov

Ecological state of the territories is usually estimated by determining the belongingness of each of the geosphere ecological state indicators to one of the classes. The developed methodology is characterized by the fact that the estimates are distributed according to the classes not uniformly, but taking into account the normalization principles and Liebig's law; integral estimate is calculated in accordance with the hypothesis on the logistic nature of the ecosystem change.

The methodology allows to determine the integral estimates objectively (without the participation of experts) by calculations according to official data (annual country reports) using a thoroughly structured procedure, which allows to monitor the contribution of each indicator to the overall estimate. The results are presented in the form of maps and attribute tables for geospheres and territory as a whole, and are suitable for management.

Keywords: ecological state, geospheres, integral estimation, indicators, state space, GIS technology

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