ABSTRACT AND REFERENCES

ECOLOGY

## TECHNOLOGY OF DE-IRONING OF WEAKLY ACIDIC LOW ALKALINE UNDERGROUND WATER CONTAINING AMMONIUM NITROGEN (p. 4-11)

**Alexander Kvartenko, Vladimir Galanov, Oksana Pletuk**

Most of the existing de-ironing stations were designed by the technologies of simplified or deep aeration that do not provide for comprehensive purification and are in need of modernization. The research was carried out in several stages on natural waters: pH 6.2–6.4; $Fe^{2+}$=4.0–10.6 mg/dm$^3$; alkalinity 1.25–1.5 mg-eqv/dm$^3$; $NH_4^+$ to 2.0 mg/dm$^3$; $H_2S$ to 2.0 mg/dm$^3$; permanganate oxidization to 6.0 mgO/dm$^3$. The main equipment consisted of an industrial installation with capacity of 2.5 m$^3$/h. Which included: aeration block (ejector or hydrodynamic cavitator), contact column of diameter 420 mm, height 4000 mm, two lighting filters of diameter 720 mm, height 3300 mm. The filters were equipped with a hydro automated system for flushing. We examined the efficiency of using combinatorics of physical-biochemical methods of cleaning. We determined optimal concentration of reagents: soda ash 35–45 mg/dm$^3$, coagulant 15–20 mg/dm$^3$, flocculant 1–1.5 mg/dm$^3$, the velocity of filtration (up to 5 m/h), filtration cycles duration (up to 24 hours) and the intensity of flushing (12 l/cm$^2$). The technology and equipment for purification of multi-component groundwater were designed. The technology is based on stage-by-stage destruction of complicated iron organic complexes, ammonium nitrogen through the processes of hydrodynamic cavitation, biochemical additional oxidation, coagulation of colloids and the ultimate separation of phases in the volume of filtering loading. The obtained data may be useful both in carrying out renovation of the existing stations and when designing new water treatment plants.

**Keywords**: iron organic complexes, ammonium nitrogen, iron bacteria, hydrodynamic cavitation.

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## THE BIOTECHNOLOGICAL WAYS OF BLUE-GREEN ALGAE COMPLEX PROCESSING (p. 11-18)

**Volodymyr Nykyforov, Myroslav Malovanyy, Tatyana Kozlovs’ka, Olha Novokhatko, Sergii Digtiar**

The results of long-term research of various ways and methods of collection and processing of blue-green algae that cause “bloom” of the Dnieper reservoirs were presented. The possibility and feasibility of the blue-green algae biomass processing to biogas by methanogenesis were substantiated. It was found experimentally that preliminary mechanical cavitation of the blue-green algae biomass increases the biogas yield by 21.5 %. It was determined that the biogas produced contains up to 72 % of methane and hydrogen, up to 21 % of carbon dioxide, up to 6.5 % of molecular nitrogen. Oxygen, carbon oxide (II), hydrogen sulfide and other impurities constitute up to 2 % of the biogas volume. Biotesting of the spent substrate to determine its toxicity for further use as a biofertilizer in agriculture and forestry was held. Modern methods of electron microscopy found that the average diameter of cells of blue-green algae Microcystis aeruginosa is 3.14 microns. The flow diagram of the blue-green algae biomass complex processing was proposed. It consists in removal of valuable components for medicine, cosmetics, phar-

maceuticals, production of technical detergents, mixtures of aliphatic alcohols as biofuels or additives to gasoline. Thus, it is possible to obtain more biogas by involving the spent activated sludge from sewage treatment facilities in methanogenesis. This will improve the treatment quality of wastewater of various productions. The similarity of the nutritional value of the blue-green algae spent substrate to the green biomass of plants in terms of the elemental composition was experimentally proved. The environmental, energy saving and agricultural efficiency of the cyanogen biomass use was proved.

**Keywords**: blue-green algae, methanogenesis, environment-friendly biotechnology, biofuel, biogas, biofertilizers.

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## DEVELOPING COMPOSITIONS BASED ON NANOPARTICLES FOR FINAL TREATMENT OF TEXTILE MATERIALS (p. 19-25)

**Dariia Matveitsova, Olga Paraska, Svitlana Karvan**

The study is aimed at developing a stable composition based on nanodimensional silicon dioxide, which may be used for final treatment of cotton and polyester textile materials in the processes of industrial and household washing of textile products in order to improve their properties (hydroscopicity, moisture yielding capacity, moisture absorption, humidity, water vapor permeability and soiling). As a result of the performed studies, four compositions based on nanodimensional silicon dioxide were formed.

The main advantages of the developed compositions are: a significant increase in indices of the properties of textile materials with different fiber composition after treatment; all the experiments were conducted at room temperature and low module processing, which indicates energy efficiency while using the developed compositions.

Stabilizing properties of surfactants and polymers were revealed, the expediency of their joint use with the purpose of increasing the sedimentation and aggregation stability of the suspensions based on silicon dioxide was substantiated.

Applying the methods of mathematical planning with the use of simplex centroid plan for q=3, compiled with relation to pseudo-components, allowed assessing the changes in properties in a limited area of composition components content: polymer from 0 g/l to 10 g/l, SAS from 0 g/l to 5 g/l, nanodimensional silicon dioxide of less than 10 g/l. We managed to optimize the ratio between components of the compositions using the Harrington function of desirability for maximum enhancement of properties of hydroscopicity, moisture yielding capacity, moisture absorption, water vapor permeability, humidity and soiling of the studied textile materials.

The assessment of sedimentation and aggregation resistance of the developed composition formulations was carried out and the compositions were obtained, the percentage content of nanoparticles in fractions in relation to the initial content of nanoparticles increases. In the bicomponent suspension, 17.1 % of nanoparticles remain in the solution, and with adding a mixture of stabilizers their amount increases by 11.5 % for composition No. 1, by 17,1 % for composition No. 2, by 16.5 % for composition No. 3, and by 6,24 % for composition No. 4. These results indicate the existence of features of monodispersity of compositions based on nanodimensional silicon dioxide. Characteristics of the compositions change by 1–3 % as a result of their redispersion after stilling for 30 days.

Negative impact of using compositions on the environment was studied by analyzing the waste solution as for the amount of surfactants. It was found that more than half of silicon dioxide remains in the waste solution. The solution to the problem of avoiding the above mentioned negative phenomena by reusing sediment was formulated. However, no specific conclusions regarding the recommendation of one of the four studied compositions were made.

The results of the research may be implemented in the production of textile materials. The composition may be used as a preparation for the final treatment of textile materials with the aim of improving their marketing prospects and consumer properties. It is possible to use the developed compositions at enterprises of household services (laundries) and for individual home washing. In these cases, the use of the composition as a conditioner for rinsing is implied.

**Keywords**: nanoparticles, surface active substance, textile materials, suspension, silicon dioxide, nanopreparation.

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## DETERMINATION OF THE EFFECT OF FILLERS ON THE INTUMESCENT ABILITY OF THE ORGANIC-INORGANIC COATINGS OF BUILDING CONSTRUCTIONS (p. 26-31)

**Pavlo Kryvenko, Juriy Tsapko, Sergii Guzii, Anastasiia Kravchenko**

The analysis of methods of determining the intumescent ability of fire-retardant coatings was performed, and the need to develop reliable methods for the study of the blistering process for the creation of new types of coatings was identified. Evaluation of the swelling ratio of inorganic and organic coatings, revealed the unreliability of the real values of the kinetics of decomposition of materials. The method for determining the kinetics of swelling of coatings was validated, and with the constant heat and mass transfer conditions during the test, the device was designed. Studies of the kinetics of swelling of organic-inorganic coatings by this method have shown that under prolonged exposure to high temperature, the swelling coefficient decreases due to the foam-coke burnout. The results of determining the intumescent ability of coatings when adding fillers showed that when exposed to high-temperature stream, the material burnout and the coating weight loss are reduced by more than half due to the formation of high-temperature compounds, and this increases the time to reach the limit temperature. As a result of thermogravimetric study, the weight loss of the coatings depending on the temperature was determined, the activation energy was investigated in the temperature expansion of the coatings and it was found that for organic-inorganic coating, it was 18.79 kJ/mol, and in the case of the introduction of fillers – tripled. These data suggest the feasibility of the use of fillers based on oxides and hydroxides to improve the efficiency of organic-inorganic coatings.

**Keywords**: intumescent coatings, oven temperature, coating swelling kinetics, refractory fillers, coating efficiency.

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## A DECISION TREE IN A CLASSIFICATION OF FIRE HAZARD FACTORS (p. 32-37)

**Nataliia Pashynska, Vitaliy Snytyuk, Viktor Putrenko, Andriy Musienko**

Today in Ukraine there is an increased level of natural and technogenic threats and fire hazards. Therefore, an important task in identifying and assessing risks and threats is to determine fixed and variable factors that affect the potential for fires and to classify them by the available features. To solve the problem of classifying numerous factors of fires, we suggest using the method of building decision trees, which is a method of presenting rules in a hierarchical consistent structure where each object corresponds to a single node through which the decision is made. The use of the C4.5 algorithm helps build a branched decision tree and classify factors of fire danger. Three main classes of permanent environmental factors have been distinguished, which include land cover, topography, and climatic resources; the variable factors are the indices NDVI, DMP, and SWI. They, in turn, are divided into subclasses.

The calculated weights can be used for simulating a fire hazard. The obtained values range from 0 to 1, where a value of 0 prevents natural fires (e. g., water surfaces), but values close to 1 indicate a high hazard potential of natural fires.

The decision trees, obtained in the process of classification, are important for planning measures to prevent natural fires. They can also be used for zoning in terms of fire hazards in spatial modeling of fires, mathematical modeling of their effects, as well as in further monitoring and prediction of natural fires.

**Keywords**: fire risk factors, data mining, classification algorithm C4.5, decision tree.

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## EFFICIENCY OF ALKALI ACTIVATED HYBRID CEMENTS FOR IMMOBILIZATION OF LOW-LEVEL RADIOACTIVE ANION-EXCHANGE RESINS (p. 38-43)

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Immobilization by cementation of anion-exchange resins is closely associated with high pH-values of a cement matrix as a result of compositional build-up of the cements used as binding agents. At high pH values the anion-exchange resins with acid reaction (pH<5) start recycling in a body of the hardening cement compound resulting in its destruction. The paper covers the results on efficiency of the hybrid alkali activated cements as binding agents which at the initial stage of hydration have high pH values of the cement stone (pH>12), thus providing a required strength gain. Later, pH values tend to lower (pH<10), thus retarding the process of resin recycling to the values which do not affect negatively durability of the resulted solidified waste forms. The examples of hybrid alkali activated cements compositional build up are provided together with physico-mechanical properties of the resulted solidified waste forms. These results show that these properties are superior to those specified in the standards of the P. R. China, these are: GB 7023 and GB 14569.

**Keywords**: cementation, low-level radioactive wastes, immobilization, anion-active resins.

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**EXPLORING CORRELATION BETWEEN HYDROBIOLOGICAL INDICATORS OF AERATION TANKS AND THE CONCENTRATION OF PHOSPHATES IN PURIFIED WASTEWATERS (p. 44-49)**


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The results of measuring chemical and hydrobiological indices of wastewater in real conditions of the sewage treatment plant of DP “Chernihivvodokanal» (Ukraine) were analyzed, and coefficients of correlation between phosphates concentration after biological purification of wastewater and the hydrobiological indices were calculated. It was established that the informativeness of indices as for the quality of the process of water purification from phosphates decreases in the series: the number of the hydrobiont species CSW – silt volume – the silt index – silt dose; correlation coefficients vary from $K_{cor.}$=–0,39381 to $K_{cor.}$=–0,0485.

Using the method of fluctuation smoothing with the help of SMA – simple moving average – we identified the trend: the influence of season on the number of hydrobionts and phosphates concentration in wastewater. A change in phosphates concentration in the wastewater purified by biological way occurs mainly simultaneously in antiphase to the change in the number of hydrobiont species, characteristic for satisfactory performance of silt. The use of obtained data allows giving preference in the analysis of the course of the process to one or several indices that would contribute to operational control of purification process.



**Keywords**: wastewater, phosphates, hydrobionts, silt volume, silt dose, the silt index.


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## THE ANALYSIS OF METALS BIOTRANSFORMATION BY ALPINE NIVICOLOUS MYXOMYCETES FROM SUBSTRATES (p. 50-57)

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The contents of 11 elements (Al, Ca, Cd, Cu, Fe, Mg, Mn, Ni, Pb, Si, Zn) in the fruit bodies of 9 myxomycetes species collected in the French and Italian Alps were analyzed. The comparison of the elements concentrations in Diderma alpinum, D. fallax, D. globosum, Lamproderma arcyrioides, L. echinosporum, L. pseudomaculatum, Physarum alpestre, Ph. vernum, Trichia decipiens and substrates was made to determine the accumulative properties of myxomycetes. The highest concentration was found for Ca, Fe, and Mg in the fruit bodies of five species of myxomycetes. In most of the analyzed nivicolous myxomycetes species, the capacity for accumulation of highly toxic heavy metals Cd and Pb, as well as Zn in the three members of the genus Diderma was found. The tendency to accumulate moderately toxic heavy metal Cu was noted. The coefficient of transition of elements from substrates to myxomycetes in 8 % of specimens exceeded 100 units, in 25 % of samples had a $K_t$ value from 10 to 100, 45 % – from 1 to 10, and in 22 % of samples $K_t$ was less than one. It was found that micromycetes play a role of bioconcentrators, and their capacity for bioaccumulation is due to species-specific morphological and physiological characteristics and ecological features. The properties of the studied nivicolous myxomycetes to accumulate heavy metals can be used for bioindication and bioremediation of the environment.

**Keywords**: heavy metals, micromycetes, nivicolous species, bioaccumulation, monitoring, environmental safety, certification

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