ABSTRACT AND REFERENCES

ECOLOGY

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OBTAINING BIOGAS DURING FERMENTATION OF FATCONTAINING WASTES OF LEATHER PRODUCTION (p. 4-10)

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The possibility of biogas formation from wastes of fat-containing raw material, formed at different stages of the process of leather production was determined.

The influence of impurities, which are used in the production process, on the yield of biogas and content of methane in it was shown. Fatty wastes that contain a significant amount of salts, SAS, and antiseptics, have twice as low rate of biogas formation. Existence of soda contributes to the process of methane genesis due to stabilization of pH value. The yield of methane and biogas from pure fat of pigs was lower than that while using wastes, containing impurities of salts.

The rational parameters of fat-containing raw material for obtaining maximum yield of biogas and methane in it were determined. It was shown that the concentration of the substrate from wastes of treated skins pigs should not exceed 7.5 % or 13 g/dm^3.

Obtained laboratory results make it possible to develop the technology of anaerobic fermentation of fat-containing wastes of leather production, containing inorganic and organic impurities. The technology will enable us to solve environmental problems of waste disposal and to obtain the power carrier and a fertilizer.

Keywords: recycling of fat-containing wastes, biogas, anaerobic fermentation, recycling of wastes of leather production.

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NUMERICAL SIMULATION OF THE CREATION OF A FIRE FIGHTING BARRIER USING AN EXPLOSION OF A COMBUSTIBLE CHARGE (p. 11-16)

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The problem of protection of forests from fire became particularly important in recent years. The use of fire barriers restricts propagation of fire through vegetation. The establishment of fire barriers occurs nowadays due to the use of condensed explosives substances. The study considers the establishment of fire barriers produced by an explosion of double combustion charges. A combustion charge is a polyethylene membrane filled with a fuel-air mixture consisting of combustible gas and air. An increase in the efficiency of a shock wave occurs when we use combustion charges, due to increased pressure pulse, which makes possible to increase the width of a fire barrier to 8 m. People can stow created combustion charges safely and they are much easier than condense charges due to the specific heat of combustion hydrocarbon fuels increased in several times.

We conducted numerous studies to establish fire barriers by the explosion of double combustion charges. We established that purification of ground combustible material occurs at an excess pressure of about 1.2 atmospheres. We calculated fields of pressure, which arises in the explosion of combustion charges in a process of a numerical study. We determined the width of a fire barrier based on the analysis of maximum values of pressure reached at the front of a shock wave. We determined that the width of a fire barrier depends on a number of charges and energy of the explosion. They determine energy of the explosion. As a result of the study, we obtained the dependence of the width of a fire barrier on parameters of double charges. We substantiated the use of a double combustion charge in dependence on a type of vegetation.

Keywords: localization of natural fires, fire barrier, explosive method, combustion charge.

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THE USE OF NONLINEAR MONO KINETICS IN MODELING A MIXING AERATION TANK WITH A BIOFILM ON ADDITIONAL LOADING
(p. 17-23)

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The paper presents a theoretical substantiation and methods of calculating biological wastewater treatment against organic pollutants (OPs) in aerotanks-mixers with a suspended (freely floating) biocenosis in the form of flakes of active sludge and a fixed biocenosis in the form of a biofilm on the surface of additional loading.

A mathematical model is proposed in which the kinetics of the reactions of organic contamination extraction in aerotanks-mixers with suspended and fixed biocenoses are described by a nonlinear Mono equation. This model takes into account the provision of the oxidation process with a sufficient amount of oxygen and the peculiarities of the joint removal of organic pollutants by the biofilm that is formed on the surface of additional loading and the suspended biocenosis in the aerotank volume.

Numerical methods were used to have determined the concentrations on the external and internal surfaces of the biofilm, which help estimate the value of the influxes of pollutants at the entrance and exist of the tank and thus assess the possible effect of cleaning.

The numerical methods of purifying wastewater from organic pollutants in aerotanks-mixers, determined by numerical methods, show significant efficiency of the work of the purification structures due to the introduction of additional loading with a fixed biocenosis (biofilm). In this case, the possible technological and design schemes of the aerotank-mixer operation are considered, when the loading elements (nozzles, grids, etc.) can be located throughout the aerotank volume or more densely and compactly only in its specific areas.

Keywords: biological purification, organic pollution, aerotank-mixer, active sludge, biofilm, kinetics of reactions, Mono equation.

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MODELING OF THE FILTRATION PROCESSES IN A RECTANGULAR AREA SOILS USING THE DARCY (p. 24-30)

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In the framework of the research described in this paper we implemented the numerical algorithm and the program for the implementation of the algorithm, which makes it possible to calculate pressure field in the examined region and established convergence of the iterative process at optimal selection of the relaxation parameter. The obtained results enable carrying out estimation of the ground water level and propagation patterns under conditions of appropriate environmental characteristics of flow in the presence of varying geometrical configuration of outflow zones through the examined surface.

The modelling of filtration processes in a rectangular plot of soil using the Darcy equations might also be used in the problems on estimating water quality, in the tasks on preventing flood waters, floods or mudflows. Such a simulation also makes it possible to explore the phenomena of fluid propagation in soils given the prospects of development of shale gas deposits in the regions of Lviv, Ternopil, Ivano-Frankivsk oblasts (Ukraine). Thus, the applied aspect of the use of the obtained scientific result is the possibility to improve the developed mathematical model of filtration processes through the inclusion of morphological characteristics of river and the river system. This is a prerequisite for obtaining operational data on a change in the level of soil and flood waters at a specified point in time in order to ensure ecological safety of the environment.

Keywords: software module, rectangular plot of soil, outflow zones, relaxation parameter.

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DECONTAMINATION OF METHYL PARATHION IN ACTIVATED NUCLEOPHILIC SYSTEMS BASED ON CARBAMIDE PEROXISOLVATE (p. 31-37)

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The study has specified the nucleophilic decomposition of methyl parathion (O,O-dimethyl-O-(4-nitrophenyl) thiophosphate) by an HOO^- anion generated from carbamide peroxysolvate in the presence of ammonium bicarbonate and boric acid. The revealed effect is the supernucleophilic reactivity of the diatheroxoborate anion $B(OH)_2(OOH)_2^-$, which is two orders of magnitude higher than the analogous value for the HOO^- anion. The tests have shown the principle possibility of using solid sources of hydrogen peroxide in degassing nucleophilic systems.

The value of the α-effect (k_{HOO^-}/k_{HO^-}) has been determined, which indicates an abnormally high reactivity of the HOO^- anion in the decomposition of toxic phosphorus compounds.

The obtained data show that the activation of hydrogen peroxide with ammonium bicarbonate and boric acid can be considered as a new approach to the creation of soft ecological systems of decontamination of nucleophilic and oxidative effects.

The results obtained can be used to develop long-term decontamination systems for decomposing highly toxic pesticides and active pharmaceutical ingredients of organophosphorus nature. Such systems can be used to eliminate the consequences of contamination with components of chemical weapons, toxic pesticides, and toxic active pharmaceutical ingredients.

Keywords: nucleophilic substitution, hydrogen peroxide, carbamide peroxysolvate, methyl parathion, peroxoborate, peroxocarbonate.

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SEDIMENTATION OF POLLUTANTCONTAINING AGGREGATES DURING PURIFICATION OF WASTEWATER FROM COKING PLANTS (p. 38-44)

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We performed the quantitative description of the process of purification of phenolic wastewater from resinous substances by methods of coagulation, flocculation and adsorption. We carried out the coagulation purification with the use of $Al_2(OH)_5Cl$ and $FeCl_3$ at a dosage of 50 mg/dm^3; we used the cationic Extrafloc P70 at a dosage of 4 mg/dm^3 as a flocculant; we used natural alkaline bentonite clay at a dosage of 100 mg/dm^3 as the adsorbent. The method of sedimentation analysis established the prevailed radii of pollutant-containing aggregates of the dispersed phase of phenolic wastewater, μm: after coagulation of $Al_2(OH)_5Cl$ – 30...90, after coagulation of $FeCl_3$ – 33...39, after flocculation of Extrafloc P70 – 60...80, after adsorption by bentonite clay separately – 23...27, after adsorption by bentonite clay with the addition of Extrafloc P70 – 70...90.

We showed experimentally that under conditions of the combined application of alkaline bentonite clay at a dosage of 100 mg/dm^3 with the addition of Extrafloc P70 at a dosage of 4 mg/dm^3, the disperse phase of phenolic waters forms the largest pollutant-containing aggregates, which precipitate at rate of 0.61 mg/s. This provides normative content of resinous substances in purified water – 10 mg/dm^3, and reduces duration of the purification process from 20 minutes up to 3 min. The rate of sedimentation of pollutant-containing aggregates formed under application of other methods of purification is an order of magnitude smaller, and is, mg/s: $Al_2(OH)_5Cl$ at a dosage of 50 mg/dm^3 – 0.017; $FeCl_3$ at a dosage of 50 mg/dm^3 – 0.024; Extrafloc P70 at a dosage of 4 mg/dm^3 – 0.05; bentonite clay at a dosage of 100 mg/dm^3 – 0.02.

The method of purification of phenolic wastewater by bentonite clay with the addition of Extrafloc P70 makes possible to remove 96 % of resinous substances, therefore we can used it to improve the purification process at coke-chemical enterprises.

Keywords: sedimentation analysis, bentonite clay, wastewaters of coke-chemical enterprises, resinous substances, coagulant, flocculant.

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RESEARCH INTO RECYCLING OF NICKELCOBALT-CONTAINING METALLURGICAL WASTES BY THE ECOLOGICALLYSAFE TECHNIQUE OF HYDROGEN REDUCTION (p. 45-50)

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We studied kinetic patterns of hydrogen reduction of the scale of a nickel-cobalt containing precision alloy at a temperature of 673–1573 K over a period from 0 to 180 minutes. The highest degree of reduction was achieved after thermal treatment at 1273 K – 99 %. This is predetermined by the intensification of reduction processes and a sufficient level of porosity, which ensures satisfactory gas exchange. It was discovered that the starting scale consists mainly of Fe_3O_4, Fe_2O_3 and FeO with atoms substituting their alloying elements. The target product of metallization had a sponge-like microstructure and consisted mainly of the solid solution of Co and Ni atoms in γ-Fe and the residual non-reduced Fe_3O_4 and FeO. The resulting phases had no noticeable susceptibility to sublimation.

This has ensured a reduction in the losses of alloying elements while receiving and using the highly-alloyed metallized scale, which was confirmed by experimental- industrial tests. At the same time, recycling of industrial wastes contributes to a reduction in the technogenic intensity of industrial regions and improves ecological safety of the environment.

Keywords: scale, precision alloy, hydrogen reduction, phase analysis, microstructure, resource saving, alloying.

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RESULTS OF EXPERIMENTAL RESEARCH INTO CORRELATIONS BETWEEN HAZARDOUS FACTORS OF IGNITION OF MATERIALS IN PREMISES (p. 50-56)

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We presented results of experimental research into dynamics of hazardous factors of the state of environment, as well as of their autocorrelations and pair correlations in a simulation chamber at various lags for early detection of ignition of combustible materials, such as alcohol, paper, timber and textiles. The study was carried out based of Pearson coefficient of lag correlation that possesses the best interpretability of results. It was found that dynamics of factors of the state of environment in space of the studied factors prior to ignition of materials is locally inhomogeneous and distributed with random transitions between local states. At ignition, in the studied environment, there occurs grouping of its distributed local states depending on material of ignition. It was established that the character of grouping can be used as an indicator of early detection of ignition and identification of the type of combustible material. In this case, early ignition causes a slight increase in constant of time of fluctuations of the studied factors of environment. However, this indicator has insufficient differentiability for early detection of ignitions. A more informative indicator is a degree of mutual correlation of fluctuations of environmental factors at zero lag. It was found that for alcohol, paper, timber and textiles, an effective indicator of early detection of their ignition is coefficient of pair correlation of CO and temperature, the module of which is close to 1, and for textiles – to –1.

Keywords: early ignition of materials, dynamics of hazardous factors of state of environment, autocorrelations of factors, pair correlations of factors.

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RESEARCH OF THE INFLUENCE OF DECOMPOSITION OF WASTES OF POLYMERS WITH NANO INCLUSIONS ON THE ATMOSPHERE (p. 57-64)

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We studied the processes of thermo-oxidative decomposition of polymer synthetic waste material with nanoparticles on the example of one of widely spread polymers – synthetic nitron fiber.

We carried out a study on the migration of decomposition products and nanoparticles into the environment on a simulation model. We heated the nitronic fibrous material in the temperature range of 150...300 °C in the presence of oxygen. We stretched the material under investigation until the appearance of fiber breaks. The time of the experiment varied from three to thirty minutes. The REM image of nitron nanofibres obtained by heating the material to 200 °C for 25 minutes demonstrates that fibers are densely packed nanothreads of different length with diameters from 50 to 150 nm. This indicates instability and fragility of the material obtained and the possibility of manifestation of quantum-dimensional effects.

We experimentally established gaseous substances, which were released during thermo-oxidative decomposition of polymers, and their concentration, depending on the process temperature on the example of a nitron. Thus, we can consider ammonia and hydrogen cyanide as substances-indicators of latent processes of combustion (smoldering) of materials in a body of a landfill. We need to have a high-precision method of gas analysis to prevent the development of an emergency, since the release of substances occurs already at 100 °C, but in low concentrations. We proposed a remote identification method with a use of a laser complex.

Keywords: waste nanomaterials, thermo-oxidative decomposition of polymer, atmospheric air, identification of toxic substances.

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