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STUDY OF THE STRUCTURE OF ORGANO-MODIFIED PALYGORSKITE

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The object of research is a natural silicate with a layer-band structure - palygorskite of the Cherkasy deposit (Ukraine). One of the problematic areas in the technology of sorption purification of aqueous media using palygorskite is the absence of kinship of the mineral in anionic forms of pollution. Therefore, its use as a sorbent to extract ions Cr(VI), U(VI), As(V), which are in aqueous media in anionic forms, is ineffective.

In the course of the study, XRD methods, thermal analysis and a spectrophotometric method are used to study the sorption properties of synthesized materials.

The structures of palygorskite and modified samples are studied using-ray diffraction analysis (XRD). After treatment with Na-PG, changes in its crystal structure are observed. There is a shift of the peaks toward large angles 2θ . Comparison of the diffractograms OPG-1 and OPG-2 allows to conclude that the reflection with the same indices is not relatively displaced, but their intensity is different. In OPG-2, the intensity of most peaks is higher.

The thermal properties of palygorskite and the resulting composites are studied. According to the results of sorption studies, it is established that palygorskite modified at a ratio of CEC/surfactant=1 can remove up to 97.8 % of Cr(VI) ions. This is 16.2 times more than adsorbing natural palygorskite.

As a result of studies of the Cr(VI) adsorption on Na-PG, OPG-1 and OPG-2, it has been shown that modifying the palygorskite surface by GDTMA can increase the adsorption of Cr(VI) from 0.45 mg/g and 9.2 mg/g, respectively. And for the initial concentration of the solution is 100 mg/l to 4.2 and 12.3 mg/l, respectively.

Increasing the volume of practical use of natural silicate materials contributes to a comprehensive solution of environmental issues, resource saving and technology for the production of sorbents for the extraction of anionic forms of Cr(VI) and U(VI) from aqueous solutions.

Keywords: palygorskite, hexadecyltrimethylammonium bromide, cationic surfactant, Cr(VI) adsorption.

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JUSTIFICATION OF THE CALCULATION METHODS OF THE MAIN PARAMETERS OF VORTEX CHAMBERS

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The object of research is vortex dust collectors – apparatus in which hydrodynamic regimes are realized. Advantages of using vortex apparatus: work with gases of high temperature, high degree of purification; regulation of the process of gas cleaning from dust due to regulating the secondary air flow. Among the disadvantages of vortex dust collectors are: high hydraulic resistance, the need for powerful blowing apparatus, as well as difficult operation and installation. Apparatus for swirling the flow have a different design and, depending on the gas flow rate, pressure and physicochemical properties of the gas flow at the inlet to the cleaning apparatus, this or that hydrodynamic regime is created in it. When designing vortex chambers, the following design parameters must be observed: $D_s/D \approx 0.8$; $D_i/D_s \approx 0.5$; $D_w/D \approx 0.5 \div 0.8$; the inclination angle of the vortex blades at the inlet of the main flow is $\beta \approx 30 \div 60^\circ$; the inclination angle of the secondary flow nozzles is $\alpha \approx 30 \div 45^\circ$. When calculating and designing a vortex chamber, it is necessary to fulfill the conditions for the constancy of the tangential velocity of the total flow along the entire length of the working cavity of the apparatus, ensuring the maximum possible efficiency of its functioning.

Analysis of the obtained results for justification of the methods for calculating the basic parameters of the vortex chambers indicates the expediency of using such methods for calculating gas cleaning equipment.

When implementing the process of cleaning dust-gas flows in vortex apparatus, not only the processes of agglomeration of dust are observed, but also the destruction of gas toxicants.

Mathematical dependencies are considered to allow make predictive estimations to select the conditions of the dry dust removal process and to select the design parameters of the vortex chamber. This opens prospects for the introduction of vortex apparatus in order to reduce the industrial negative impact on the environment, namely the atmosphere.

Keywords: vortex apparatus, environment, disperse flow, gas flow, gas velocity.

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INFLUENCE OF THE INLET FLOW SWIRLER CONSTRUCTION ON HYDRODYNAMICS AND EFFICIENCY OF WORK

page 14–22

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The object of research is construction of a vortex dust collector. To solve the problem of increasing the efficiency of dust cleaning in a vortex apparatus with revealing the features of the mechanism and the destructive forces of the process, the features of the hydrodynamic regime of rotation of the gas-dust flow in the zone of the swirler and immediately after it are used.

The influence of the swirler construction and the location of its installation in the gas duct for feeding the gas-dust flow on the efficiency of the vortex apparatus is studied. It is shown that the aerodynamic processes that determine the nature of the flow rotation and its flow in the flue after the swirler reach the maximum possible angular velocity of the gas flow rotation in the separation chamber for this construction. It is proved that the swirler construction under the appropriate conditions allows

a swirling flow leaving the duct to the separation chamber to reach the maximum possible angular velocity of the gas flow rotation for the given construction. The characteristic regimes of the gas-dust flow in the duct are established immediately after the swirler from its construction. It is shown that for a traditional vane swirler with a swirling flow in one direction, the most effective blade inclination angle corresponds to 45°. Its installation must be carried out in the duct from the end outlet to the separation chamber below by 1.4 ÷ 1.6 of the swirler diameter. Before the gas-dust flow flows into the separator, the flow is agglomerated with dust particles. At the exit of the gas-dust flow from the end of the flue to the separation space, the maximum value of the angular velocity of the flow in the separator is ensured. It is established that the blade vortex, which provides for the organization of coaxial turbulent flows in the flue, twisted in opposite directions, will allow more efficient agglomeration of dust particles. A basic construction of the vortex dust collector is developed, which makes it possible to increase the cleaning efficiency with a vortex device to 98–99 %.

Keywords: swirler construction, dust agglomeration, angular velocity of gas flow rotation.

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INVESTIGATION OF THE TREATMENT EFFICIENCY OF FINE-DISPERSED SLIME OF A WATER ROTATION CYCLE OF A METALLURGICAL ENTERPRISE

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The features of the water rotation cycle and the slime treatment system of the oxygen-converter shop of metallurgical production are investigated. During the audit, it is revealed that the concentration of suspended solids in the water cycle system varies in time up to 500 g/l for the condensed slime and up to 85 g/l in the pre-clarified water. It is established that the slimes of the metallurgical enterprise contain a finely dispersed solids fraction in the slime up to 93 % of a size of less than 20 µm and the residues of a cationic flocculant that impede effective treatment of the slime in the sedimentation tanks. This leads to the following drawbacks: a decrease in the slime treatment efficiency, removal of the fine fraction of solids together with clarified water of radial thickeners, regular replenishment of clean water, discharge of part of the flow into the slime collector. It is proposed to install an additional treatment module and use a more efficient anionic flocculant. It is recommended to monitor the efficiency of treatment and dosing of the flocculant depending on the solids concentration in the slime by continuous sampling and testing of slime flocculation. It is established that effective treatment up to 99 % can be achieved on the treatment module using anionic flocculant, thin-layer sedimentation tanks and sedimentation horizontal screw centrifuges.

Keywords: gas treatment of metallurgical enterprise, fine-dispersed slimes, gas treatment slimes, treatment module.

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INVESTIGATION OF FLOCCULATION EFFICIENCY IN TREATMENT OF WET GAS TREATMENT SLIME OF FERROALLOYS PRODUCTION

page 29–39

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The object of research is the process of wastewater treatment from suspended solids, formed as a result of wet gas treatment of the exhaust gases of ferroalloys production shop. As a result of the audit, it is revealed that the flocculation of slimes in the current water circulation cycle scheme does not occur with due

efficiency, since the dosing of the flocculant is made at one point in the slime water pipe, without adjusting its dose when the slime concentration, dispersion and chemical composition change. It is found that the gas treatment slimes have a high content of dissolved salts up to 26 g/l, a variable chemical composition and pH of 8 to 10, as well as a high proportion of fine particles of less than 40 μm in size. It is established that the peculiarities of mixing slimes with flocculant play an important role in flocculation. For effective treatment of slimes and elimination of these drawbacks, it is suggested to introduce flocculant not once but in two portions 35–40 % and 60–65 %, respectively, with a mixing time of up to 30 seconds of the first dose and about 10 seconds of the second dose. The possibilities of effective treatment of slime waters of wet gas treatment up to 0.35 g/l are established using sedimentation centrifugal plants. It is recommended to take the slime intake directly at the outlet from the ferrosilicon production shop with the solids phase fraction with a size larger than 40 μm in excess of 80 % and a concentration of up to 10 g/l.

Keywords: slime flocculation; fine slime, gas treatment slime, treatment module, ferroalloys production.

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FOOD PRODUCTION TECHNOLOGY

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RESEARCH OF THE EFFECTS OF TECHNOLOGICAL FACTORS ON THE QUALITY INDICES OF HIGH OLEIC SUNFLOWER OIL

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The object of research is high oleic sunflower oil (HOSO) and refined deodorized sunflower oil (RDSO) as a control. The distinguishing characteristic of HOSO consists in the changed fatty acid composition, has a high content of triglycerides of oleic acid more than 89%. HOSO has the following characteristics: ($\rho=915...920 \text{ g/cm}^3$, $\eta=0.0180\pm 0.0009 \text{ Pa}$, $t_{(\text{solidification})}=0...-6 \text{ }^\circ\text{C}$, refractive index 1,466...1,468; $TbN=0.0100\pm 0.0003 \text{ mg MA/1000 g}$, $PN=0.83\pm 0.02 \text{ mmol } \frac{1}{2} \text{ O/kg}$, $SN=184...194 \text{ mg KOH}$, $AN=0.112\pm 0.003 \text{ mg KOH/g}$; $IN=105\pm 5 \%$ I_2 ; $E 1 \%$ $/1 \text{ cm}=3.00\pm 0.09$). One of the most problematic places for using oils is that they are faster than solid fats, refreshing products has less shelf life. In the course of the study, the influence of technological factors on the HOSO properties and the scientific basis for the HOSO use as a prescription component of food systems is determined. It is proved that during the storage HOSO is more resistant to processes in comparison with RDSO, since glycerides of polyunsaturated fatty acids oxidize faster than monounsaturated, confirming the experimental data of physicochemical parameters, fatty acid composition and dynamics of the content of tocopherols. HOSO stability for oxidation processes under conditions of prolonged thermal action in comparison with RDSO (control) by functional numbers (acid, peroxide, iodine, thiobarbituric) is studied. It is found that the oxidation rate in HOSO is lower than in the RDSO (control) by 2 times at the beginning of the heat treatment and by 1.23 times with the maximum duration of heat treatment. The coefficient of extinction grows to the limit of maximum permissible values at 6 hours in RDSO and 18 hours in HOSO, which confirms the HOSO thermal stability that is 3 times greater. Essential changes in the fatty acid composition and in the complex of tocopherols of oils under heat treatment conditions, the nature of which depends on the type of oil and the duration of heat treatment, are also shown, which also indicates a greater stability of HOSO for oxidation processes in comparison with

RDSO (control). On the basis of the research, recommendations are developed on the HOSO use in the technology of custard products and as a medium for frying. Rational conditions of the brewing process are $t=95...100 \text{ }^\circ\text{C}$, $\tau=(3...5)\times 60 \text{ s}$, hydromodule «HOSO-water» – 1:2.5. Recommended parameters for the HOSO use as a medium for frying, in particular deep-fried: $t=160...180 \text{ }^\circ\text{C}$, duration of continuous use $\tau=(0...18)\times 60^2 \text{ s}$, ratio «HOSO – semi-finished product» is 4:1, HOSO storage time is 24 months.

Thus, HOSO use will ensure the use of domestic raw materials; the maximum realization of the functional and technological properties of HOSO with obtaining high-quality products; reduction of energy costs and labor intensity of the process; introduction of resource-saving technologies using the newest principles of food production.

Keywords: high oleic sunflower oil, fatty acid composition, thermal effect, custard dough.

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PROCESSING OF DAIRY RAW MATERIALS IN HEALTHY FOOD PRODUCTS

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The object of research is whey-based beverages. The most problematic areas are the limited shelf life of beverages and the risk of product stratification during storage.

In the course of the study, whey pasteurization regimes are used: 84 ± 2 °C, waiting time 15–20 s, so the shelf life of beverages is limited, since sterilization of whey beverages is impossible due to loss of biologically active substances. To prevent delamination of the beverages during the storage of the formulation, pectin is added and an additional operation – homogenization is introduced.

Whey beverages with functional properties for individuals controlling body weight are obtained with improvement of organoleptic characteristics of the product. The resulting beverage is suitable, as a result of the introduction of plant components, to improve the metabolism in the body, block the synthesis of fat in adipose tissue, reduce the absorption of carbohydrates and fats in the digestive tract and remove excess fluid, accelerate the cleavage of fat molecules and transform fat into free energy. This is confirmed by the activation of pancreatic lipase. The activity of pancreatic lipase increases in 3.8...4.0 times in comparison with the control (whey).

Components of the whey, as the basis of beverages, have low energy value and high biological value. L-carnitine, α -lipoic acid,

stevia, gingerol and bromelain stimulate the breakdown of fats. Cinnamon increases metabolism in the body. This helps to accelerate the breakdown of fat.

To increase the nutritional value and biological activity to the beverages, the introduction of fruit and berry juices (lemon, cranberry, orange, pumpkin, yostaberry juice). Biologically active substances of juices show antisclerotic, antistress, tonic, immunostimulating, antioxidant effect. Antisclerotic action of juices is associated with the antioxidant properties of vitamins C, E, β -carotene. Juices reduce the oxidation degree of the most dangerous fraction of lipoproteins, thereby slowing the growth process of atherosclerotic plaques in the vessels. Antistress, tonic, immunostimulating and antioxidant effects of juices are due to the content of polysaccharides, sulfur-containing proteins, minerals, vitamins A, E, C, group B, bioflavonoids.

Whey beverages for people who control body weight are not toxic, their frequent consumption does not lead to addiction. Beverages do not contain substances prohibited by the Ministry of Health of Ukraine. Shelf life of beverages is 14 days. Beverages can be made on traditional equipment using traditional technology.

Keywords: cottage cheese whey, vegetable raw materials, recipes for new beverages, quality indicators, storage regimes.

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