ABSTRACT AND REFERENCES

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SYNTHESIS OF HIGH-EFFECTIVE STEEL CORROSION INHIBITORS IN WATER-OIL MIXTURES (p. 6–11)

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It is a relevant and practically important task for environmental protection to devise effective means to protect metals against corrosion in aggressive media containing water, petroleum products, carbolic acids, and mineral salts. To stop corrosion, corrosion inhibitors are used that must be constantly improved and whose composition must be properly adjusted. The main drawback of the highly effective inhibitors based on alkyl imidazolines, a mixture of alkyl imidazolines with alkyl pyridinium and/or quaternary ammonium compounds soluble in a methanol medium, is their high prices at relatively significant consumption in the corrosive environment. This paper reports the synthesis of steel corrosion inhibitors in oil-containing aqueous environments that meet the stricter ecological and economic requirements. It has been shown that increasing the level of water mineralization improves the corrosive activity of aqueous environments relative to unalloyed steels. The presence of carbon dioxide, hydrogen sulfide, or carboxylic acids leads to the oxidation of water-oil mixtures resulting in the increased rate of steel corrosion. We have studied the effectiveness of the synthesized inhibitors based on oil and polyethylene polyamines containing imidazolines. At a temperature of 80 °C, the mixture that contained 200 $cm^3$of a 3 % sodium chloride solution, 800 $cm^3$of oil, and at the concentration of acetic acid of 0.5 and 3.0 g/dm^3 at the inhibitor dose of 50 mg/dm^3, has reached the degree of protection of steel against corrosion at the level of 90–92 %. Based on a full factorial experiment, the regression equation has been derived that makes it possible to easily enough calculate an optimal dose of the steel corrosion inhibitor in water-oil mixtures. It has been shown that the synthesized inhibitor shows prospects for protecting metals against corrosion both in the mineralized waters containing oil and in the presence of petroleum products containing water.

Keywords: corrosion inhibitor, imidazoline, mineralized waters, optimal dose.

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STUDY OF THE Mn^{2+} IONS INFLUENCE IN THE DEPOSITION ELECTROLYTE ON THE ELECTROCHROMIC PROPERTIES OF OBTAINED $Ni(OH)_2$ FILMS (p. 12–17)

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An attempt was made to co-deposit nickel and manganese hydroxide films to be used as anodic electrochrome. Cathodic template method with polyvinyl alcohol was used for this. Deposition was conducted in the galvanostatic regime from the solution containing nickel and manganese nitrates in an 8:1 molar ratio.

As a result of the work, two films were deposited: one from pure nickel nitrate and one from nickel and manganese nitrate solutions. Analysis of the synthesized films; revealed significant differences in structural, electrochemical and optical properties. The film deposited from the pure nickel nitrate solution was composed of a single α-like form $Ni(OH)_2$. On the other hand, the film deposited from the manganese-containing solution was composed of two phases. Morphology comparison revealed that the surface of the undoped film is rather flat, with small bumps up to 160 nm. The Mn-doped film had many ridges of up to 1200 nm.

Electrochemical properties of the film deposited in the presence of Mn were inferior to the film deposited from the pure solution. This is manifested in lower current densities and lower specific capacities of oxidation and reduction processes. Electrochromic properties of the film deposited in the presence of manganese were somewhat worse as well.

A mechanism explaining the decrease of specific characteristics of the film in the case of using such deposition method was suggested. The mechanism lies in the formation of the second manganese-containing phase. This phase is rather inert and decreases the content of electrochemically active $Ni(OH)_2$ in the film.

The authors also suggested possible uses of the resulting structure.

Keywords: electrochromism, nickel hydroxide, layered double hydroxide, dopant, manganese, polyvinyl alcohol, electrodeposition, cycling.

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PATTERNS IN THE SYNTHESIS PROCESSES AND THE CHARACTERISTICS OF SILICATE-SPINAL CERAMIC PIGMENTS WHEN INTRODUCING MINERALIZERS (p. 18–24)

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The synthesis of ceramic pigments is conventionally carried out at a high temperature (not less than 1,200 °C). Its reduction implies using mineralizing additives, which have a different mechanism of action on the starting components of pigment charges. The effectiveness of the mineralizers is determined by their nature, content, degree of dispersion in the activated reagent. Thus, searching for the most effective mineralizers in the synthesis, in particular, of silicate-spinel ceramic pigments is an important scientific and practical task.

We have investigated the effect of various mineralizing additives (B_2O_3, $Na_2B_4O_7$, Na_2O, NaF) on the processes of forming the crystal-phase composition of slag-containing ceramic pigments and the change in their color indicators. A direct dependence has been established between the melting point of the mineralizers and the efficiency of their influence on the formation of spinel phases, which are color carriers in such pigments. The tangible effect of the introduction of sodium fluoride, which has the highest melting point among the examined additives, is achieved as a result of the firing of pigments at a temperature not lower than 1,150 °C. The effect of sodium oxide is effective starting at a temperature of 1,100 °C. The most expedient to apply are the boron-containing compounds. Their introduction makes it possible to lower the firing temperature of slag-containing pigments to 1,050 °C while completely binding the starting components in the spinel solid solutions. The ceramic pigments that are thus synthesized enable the formation of glazed coatings, which, in terms of qualitative indicators, are not inferior to coatings obtained with the addition of high-temperature pigments (a firing temperature of 1,200–1,250 °C). The formation of silicate phases (diopside and wollastonite), which are not color carriers in the examined pigments, undergoes effective mineralized action from the supplements of NaF and B_2O_3.

Keywords: ceramic pigments, mineralizers, firing, crystal-phase composition, color indicators, glaze coatings.

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STUDYING THE KINETICS OF EXTRACTION TREATMENT OF RICE HUSK WHEN OBTAINING SILICON CARBIDE (p. 25–31)

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Silicon carbide is characterized by a wide range of beneficial electrophysical, anti-corrosion, and strength properties. A promising raw material for the synthesis of silicon carbide is the waste of rice production, which includes compounds of silicon and carbon-containing organic substances. The cheapness and availability of such raw materials necessitate the development of technologies to obtain silicon carbide from it. An important direction in silicon carbide synthesis technology is to obtain a high purity product. To remove impurities from rice husks, it is necessary to carry out its pre-extraction treatment. It has been established that the extraction treatment of rice husks with acid solution makes it possible to clean the raw materials from metal compounds and the excess amount of carbon-containing components. To remove impurities of metal compounds and the excess amount of carbon-containing compounds from rice husks, it has been proposed to perform the extraction with an aqueous solution of the mixture of 10 % sulfur and 15 % acetic acids. We have derived the time dependences of the degree of extraction of cellulose from rice husks. Two temporal sections of the process have been identified. It is shown that the extraction of cellulose from rice husks obeys a pseudo first-order reaction. We have calculated the constants of speed and activation energy in the course of extraction for the two time sections of the process. The activation energy of extraction over a first period is 10.75 kJ/mol; over a second period, the activation energy value is 26.10 kJ/mol. It has been established that an increase in the extraction temperature from 20 to 100 °C leads to a two-fold improvement in the process efficiency. It is shown that silicon carbide, synthesized from rice husk after its extraction treatment, is a pure crystalline material whose particles' size is from 1 to 20 micrometers.

Keywords: rice husk, extraction, cellulose, silicon carbide, speed constant, activation energy.

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A RESEARCH OF CHEMICAL NATURE AND SURFACE PROPERTIES OF PLANT DISPERSE FILLERS (p. 32–41)

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Chemical nature and surface properties of plant disperse fillers are investigated: buckwheat (BH) and oat (OH) husk, wood (WF) and conifer flour (CF). Using IR spectroscopy, it was found that oxygen-containing atomic groups –OH, –C–O–, –C=O prevail in the filler components. It was found that a hydroxyl-hydrate layer of functional groups is present on the surface of air-dry fillers. By potentiometric titration of aqueous suspensions using the Parks–Boby-renko method, it was determined that all fillers are of the «polyfunctional solid» type. It is shown that the hydroxyl-hydrate surface layer consists of functional groups with similar values of acid-base characteristics. Functional groups of acidic nature were additionally found on the surface of the fillers: groups with $pK_a \approx 4.37–5.66$ on the BH surface, groups with $pK_a \approx 4.49–4.90$ on the CF surface and groups with $pK_a \approx 3.91–4.30$ on the WF surface. As a result of potentiometric titration, it was shown that the surface acidity of the fillers decreases in the WF>CF>BH>OH series, which coincides with the one in which the total cellulose and lignin content decreases, and the resistance of fillers to thermal-oxidative breakdown increases. It was found that

the rate of hydrolytic processes in aqueous suspensions at the interface decreases in the OH>CF>BH>WF series and inversely depends on the concentration of functional groups on the surface of the fillers, and also that the change in the rate of hydrolytic processes at the interface depending on the content of fillers is described by step functions. It is revealed that for the effective use of the studied disperse waste in composite materials and as adsorbents for the extraction of pollutants, dispersion media with the following ranges of the hydrogen index are required: for BH – pH>4.4; OH – pH>6.4; WF – pH>3.9; CF – pH>4.5. The results obtained make it possible to predict and control acid-base interfacial interactions, as well as reasonably approach the development of new effective technologies.

Keywords: plant waste, surface, chemical nature, functional group, acid-base characteristics.

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SYNTHESIS OF CAMELINA OIL ETHYL ESTERS AS COMPONENTS OF JET FUELS (p. 42–49)

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Unrefined Camelina oil was transesterified on an alkaline catalyst with the application of commercial fuel ethanol of high hygroscopicity. It was shown that the rise of moisture content in alcohol up to 1 % leads to the low output of ethyl esters. The technological scheme of production of a pilot batch of Camelina oil ethyl esters in laboratory conditions was proposed. The scheme includes: preparation of catalyst solution, transesterification of oil with ethanol, sedimentation, alcohol stripping, separation, washing, drying and filtration. This allows obtaining products with the content of esters of about 92–93.5 %. The chromatographic analysis of the products of Camelina oil transesterification was done. The obtained products contain mostly unsaturated esters of fatty acids with the carbon chain length of 18 atoms.

The comparative analysis of the fatty acid composition of the obtained ethyl esters of Camelina oil and ethyl esters of rapeseed oil, studied during previous researches of the authors, was done. The fatty acid composition allows forecasting lower viscosity, pour and freezing point of Camelina ethyl esters compared to rapeseed oil ethyl esters. The proposed assumption was proved by experimental data of researches of the basic physical-chemical characteristics of methyl and ethyl esters of rapeseed and camelina oils. The obtained experimental data proves the perspectiveness of using products of Camelina oil transesterification as components of jet fuels. In the future, compounding of synthesized fatty acid ethyl esters of Camelina oil with jet fuels will allow obtaining biofuels with improved quality parameters compared to biofuels with rapeseed oil esters.

Keywords: Camelina oil, transesterification, ethyl esters, jet fuel biocomponent.

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