ABSTRACT AND REFERENCES

MATERIALS SCIENCE

A RESEARCH ON TECHNOLOGICAL AND PHYSICOCHEMICAL LAWS OF MANUFACTURING VIBRATION-ABSORBING PRODUCTS BASED ON EPOXY-URETHANE POLYMER COMPOSITIONS (p. 4–8)

Anna Skripinets, Yuliya Dachenko, Aleksey Kabus'

The paper presents a research on the technology of manufacturing epoxy-urethane compositions for casting products and components in the systems of vibration protection. At the initial stage of epoxy-urethane composition curing, specific heat release, temperature of the mixture and, consequently, viability and curing rate proved to be largely dependent on the nature of the curing agent and the reactive oligomer as well as on the use of a filler. The experiment has shown that technological characteristics of epoxy-urethane compositions, i. e. viability, specific heat release, temperature of the reaction mixture and curing rate, correlate among themselves and can be used as criteria for regulating and managing the casting process. It is proved that at an increased composition weight that is required for manufacturing big-size products, the curing process takes place at higher temperatures, while the variation of temperature characteristics of the mixture during curing remains unchanged.

Keywords: casting compositions, exothermic reactions, composition viability, curing rate.

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HARDENING PECULIARITIES OF BLENDED CEMENTS WITH SILICATE ADMIXTURES OF DIFFERENT ORIGIN (p. 9–14)

Volodymyr Sokoltsov, Volodymyr Tokarchuk, Valentin Sviderskiy

The influence of silicate-containing materials of different origin on cement properties was investigated. Selected mineral silicate-containing admixtures have significant differences in the chemical and mineralogical composition.

It was found that the cement hardening rate is affected by the condition of silicate and aluminate admixture component. The presence of amorphous silica or glass in the admixture leads to a slow strength gain of cements in early hardening periods, and the introduction of heat-treated materials with high thermoactivated aluminate content into cements allows to significantly accelerate the process.

Using natural silicate-containing materials (flask, tripoli, zeolite) in the production of blended cements is limited by high values of normal cement density that indirectly affects the ultimate cement strength.

The study of the processes taking place in early hydration stages allows to evaluate the admixture effectiveness and predict cement properties. Kinetics of changes in pH of an aqueous solution of cements can be used as a criterion.

Thus, introducing several admixtures that would have a positive impact on the sample strength in early hardening periods and grade cement strength is advisable in selecting compositions of blended cements. It was proposed to use rock dump processing waste of coal mining as a mineral admixture in cement production.

Keywords: cement, mineral admixtures, acid-base balance, processing waste, normal density, hydration, hardening, properties.

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LOW-TEMPERATURE ROASTED WOLLASTONITE IN DESIGNINGEASILY MELTABLE GLAZES OF AN INCREASED HARDNESS (p. 14–18)

Olesia Shulypa, Yaroslav Vakhula, Zenon Borovets, Myron Pona, Ivan Solokha

The study explores the impact of wollastonite, synthesized by a two-stage technology of autoclave calcium hydrosilicate and its low-temperature roasting to silicate, on the process of melting ceramic glaze coatings, as well as on their surface properties, including microhardness.

The research findings reveal the temperature points for softening, melting and spreading of wollastonite-based glaze coatings within the temperature range of 840–1100 °C. We have studied how heated glaze melting processes depend on the amount of synthetic wollastonite and how the dynamics of diameter change in the cylindered samples due to the content of calcium silicate and the temperature of roasting.

The research shows that the added synthetic low-temperature wollastonite increases the microhardness of the glazed surface samples, which is important for production of facing materials that are vulnerable to abrasion. The findings show that the optimal content of synthetic wollastonite is 20–30 %, and the optimal roasting temperature for wollastonite-based glazes is 1050 °C.

The research has proved that synthetic wollastonite increases the microhardness of glazed surfaces more than the natural mineral equivalent.

Keywords: wollastonite, calcium hydrocilicates, tobermorite, glaze coatings/surfaces, melting property, microhardness.

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METHODS TO PREDICT LIQUID PASSAGE THROUGH POROUS MATERIALS (p. 19–23)

Ganna Shchutska

Based on data interpretation of macroexperiments on the liquid passage, a simplified model of the liquid passage through porous materials at the elementary level was built. On the grounds of regression analysis, the basic parameters characterizing the dynamics of the liquid passage through the porous materials were found. The dependence includes clear experimental data that can be obtained in macroexperiments and involves finding the liquid concentration in any part of the material. This model allows to predict the state of the porous material when it is moistened, determine the time of the liquid passage through the material and time of a total liquid accumulation. The data allow to predict the liquid passage through multilayer materials. The research results allow to define liquid absorption parameters of the material based on macroexperiments, boundary moisture content in the inner layer; time of the liquid passage through the material; determine the passage depth, time of comfortable work. The results allow to determine the hygienic properties of materials that include the ability to regulate the liquid passage.

Keywords: liquid passage, porous material, macroexperiment, liquid accumulation, regression mathematical model.

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UTILIZATION OF GRANITE STONE EXTRACTION WASTE FOR MAKING SIDEWALK CONCRETE WARES (p. 24–28)

Olena Ivanenko, Mariya Zaharova, Olena Gozhulyan

Existing directions of processing the screening dust of stone crushing plants, mainly by using in concrete and asphalt concrete production in Ukraine do not allow a significant waste utilization. Using the washed screening dust in the production of sidewalk unreinforced concrete wares, including sidewalk tile is promising and suitable for plants, in case of constructing the processing line at the enterprise since the demand for this type of products has increased in recent years. Laboratory tests on determining the controlled parameters of sidewalk tile samples, such as compression strength of concrete products, tensile strength in bending, wearability, frost-resistance, and water absorption have shown its compliance with Ukrainian quality standards. The widespread introduction of producing sidewalk tile with the screening dust content of more than 40 % will lead to considerable reduction of the negative effects of accumulated waste on the environment, in particular, release land

under heaps, expand the enterprise work scope and reduce dustiness of atmospheric boundary layer.

Keywords: production waste, rubble, screenings, concrete, construction products.

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AN INFLUENCE OF CONDITIONS FOR OBTAINING THE NEW COAL TAR PITCH COMPOSITE MATERIALS ON THEIR HEAT RESISTANCE AND MECHANICAL STRENGTH (p. 29–35)

Viacheslav Kaulin

Coal tar pitch is a valuable product of high-temperature pyrolysis of coal – a non-renewable natural resource; therefore, skilled use of coal tar pitch is an actual problem.

Coal tar pitch is a unique product with a rich set of properties, including polymer. Using and managing the polymer properties of pitch allows to better exploit the chemical potential of the coal tar pitch by creating new competitive composite materials on its basis that can replace more expensive polymer and metal materials.

Modifying the coal tar pitch by active polymer additives in the low-temperature region allows to adjust and change the pitch properties, improve its heat resistance and mechanical strength. Introducing the filler into the pitch-polymer matrix significantly improves the technological and operating properties of the pitch composite.

Studies have shown that the influence of temperature and time conditions for obtaining the composite material on its properties appears significant due to the thermochemical transformations and structural changes in the pitch-active additives-filler system.

Using the mathematical modeling method, optimal process conditions, which allow to obtain the pitch composite with the bending strength of 42 MPa were determined.

The pitch composite, filled with asbestos refers to low-combustible materials, which is an undoubted advantage compared to many thermoplastic polymers.

Keywords: coal tar pitch, modification, filling, pitch composite, heat resistance, maximum bending stress.

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ESTIMATION OF FUEL RESISTANCE OF ASPHALT CONCRETE AND POLYMER MODIFIED ASPHALT CONCRETE (p. 35–38)

Rami Khamad

Asphalt concrete due to both of its high technological and service properties is a choice one material for road pavement construction. As asphalt concrete contains bitumen as a binding material it becomes vulnerable to the destructive effect of the fuels and lubricants. This disadvantage is very critical in places like airports, parking lots and car service centers. Polymer modified asphalt (PMA) concrete is considered to be more resistant to fuel than the traditional asphalt concrete.

In this study, changes in fuel resistance index were investigated for asphalt concrete and PMA concrete samples under simultaneous action of bending force and diesel fuel. The influence of bituminous binders consistency and technology of modification of bitumen by SBS polymer on fuel resistance of asphalt concrete and PMA concrete were analyzed.

Our research has found that bitumen modified with direct introduction of SBS polymer has a much higher fuel resistance than pure bitumen of similar consistency. On the other hand, modification of bitumen by mixing it with polymer-oil solution results in a significant drop of PMA concrete fuel resistance.

Keywords: bitumen, asphalt pavements, polymer modified bitumen, polymer modified asphalt, fuel, fuel resistance.

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DEFECT-IMPURITY COMPOSITION OF DIAMOND CRYSTALS GROWN IN MAGNESIUM-CARBON SYSTEM (p. 39–42)

Tetiana Kovalenko, Sergiy Ivakhnenko, Oleksandr Kutsay

In the Mg-C system at p≤8,2 GPa and T» 1800–2000 ºC, structurally perfect IIa+IIb type diamond single crystals were obtained, and the peculiarities of their defect-impurity composition were considered. Grown diamonds were studied using IR spectroscopy. As a result of the research, it was found that in this system, it is possible to obtain diamonds with low nitrogen impurity concentration due to limiting its receipt to the crystallization front owing to forming the Mg_3N_2 nitride at high pressures and temperatures. It was revealed that in the grown diamond crystals, the boron impurity is present in various forms: B-N complexes (D-centers) with a characteristic absorption band at 1290 cm^{-1} and uncompensated (single) boron (characteristic absorption bands – 2460, 2810 and 2920 cm^{-1}).

Keywords: diamond single crystals, magnesium-based system, boron, B-N complexes, uncompensated boron, IR spectroscopy.

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RESEARCH OF INFLUENCE OF TEMPERATURE AND MECHANICAL STRESSES ON MAGNETOELASTIC CHARACTERISTICS OF STRUCTURAL STEEL CORES (p. 43–48)

Maciej Kachniarz, Roman Szewczyk, Adam Bieńkowski, Igor Korobiichuk

The research results of the effect of temperature and tensile stresses on the magnetic properties of structural steel 13CrMo4-5 were presented in the paper. Before the measurements, the cores of the test material were subjected to the step-cooling test, simulating the influence of the time flow and environmental conditions on the material. For the tests, three cores, each differing by the step-cooling test process duration were used. The paper also describes the step-cooling test process. Management of computer measurement system, designed specifically for research was described. Measurements results, which indicate that the temperature has little effect on the magnetic properties of the material under investigation were presented. However, a significant effect of tensile stress on the magnetic characteristics of the material, which indicates the possibility of using magnetoelastic phenomenon when studying non-destructive testing of structural steels was revealed.

Keywords: non-destructive testing, magnetoelastic characteristics, ferromagnetic structural steel, stress measurement, thermal performance.

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DURABILITY PROPERTIES OF HIGH VOLUME FLY ASH SELF-COMPACTING FIBER REINFORCED CONCRETES (p. 49–53)

Mykhaylo Stechyshyn, Myroslav Sanytskyy, Oksana Poznyak

The paper shows the possibility of obtaining self compacting concrete containing a large number of additional cementing materials, including fly ash. The research results of rheological properties of self compacting fiber reinforced-concrete mixes with high volume fly ash and additives regulating viscosity and fluidity of concrete mixes were shown. It was found that the replacement of 55, 70 and 85 mass. % binder fly ash allows to obtain self compacting concrete mixes with a class for slump flow SF2, viscosity T_{500}=5 s and air entraining 0.4 %. It is shown that replacing 55 mass. % fly ash cement making and administration of 0.5 % basalt fiber allows a self compacting concrete strength of 41.8 MPa after 28 days of curing in normal conditions, and concrete containing 85 mass. % fly ash as part of a binder is characterized by strength of 25.4 MPa. The results showed a positive effect of basalt on high volume fly ash self compacting fiber reinforced concrete, including increased strength, reduced relative strain at constant stress, increased strength and reduced prism Poisson's ratio. Self compacting concrete technology allows faster and safer shape construction projects compared with the use of conventional concrete properties.

Keywords: self compacting concrete, basalt fiber, fly ash, abrasion resistance strength, abrasion, modulus of elasticity, Poisson's ratio.

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ASSESSING THE QUALITY OF LEATHER WITH HYDROPHOBIC COATING (p. 54–60)

Natalia Lysenko, Natalia Omelchenko, Marina Martosenko

Light industry has an important task of intensifying the production of leather materials with enhanced hydrophobic properties, which is aimed at providing consumers with high-quality functional and safe products. An attempt to produce materials with desirable properties must be based on a comprehensive assessment of their quality since it is natural that the newly created material may be in some respects better or worse than similar materials. Quality assessment determines whether the goods or products meet specific requirements.

We have researched the quality of leather coated with water repelling alkene-maleic composition to assess the leather quality and to prove the feasibility of launching the leather into production. Our research was based on a complex assessment of the test samples with a generalized desirability index. The complex quality assessment included: (1) analysis of the nomenclature of the current quality parameters for leather used in shoe coating, (2) choice of the nomenclature of indices for the consumer properties, (3) identification of significant individual indices in the general nomenclature hierarchy, (4) research on the consumer properties, (5) grading the indices of the consumer properties––"poor", "satisfactory", "good", and "excellent", (6) building xyd-nomograms and the tables of transition from natural performance properties x to dimensionless desirability parameters d, and (7) calculation of a complex quality index based on the generalized desirability function.

We have calculated complex quality indices for leather with hydrophobic coating under the designed technology of hydrophobic emulsion-fattening with alkene-maleic composition. These indices make up 0.812 and 0.810 respectively, which considerably exceeds the value of a complex quality index for traditionally fattened leather that comprises 0.656. The calculation results have proved the advantage of leather with hydrophobic coating over traditionally fattened leather due to the studied individual indices of the consumer properties. We have determined that parameters that largely decrease the quality of leather with hydrophobic coating include ultimate tensile strength in case of stretching and lengthening under the pressure of 10 MPa.

Keywords: complex quality assessment, quality gradation, desirability parameter, nomogram, rate of quality/quality rate.

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