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INVESTIGATION THE PROPERTIES OF PAINT COATINGS MODIFIED BY CARBON NANOSTRUCTURES

У статті наводяться результати випробувань можливості застосування структурованих розчинників з використанням наномодіфікаторов для виробництва водоемульсійних і пентафталевих лакофарбових покриттів. В якості наномодіфікаторов застосовувалися суспензії вуглецевих наноструктур, отримані з відходів коксохімічного виробництва - коксового пилу, який уловлюється в установках беспилової видачі коксу.

The article presents the results testing the possibility of applying structured solvents using nanomodifiers for the production of water-based paints and pentaphthal. As nanomodifiers used suspensions of carbon nanostructures obtained from the waste by-product coke production – coke dust recovered from plants dust-free coke.

Introduction. Considerable interest in scientific and technological community to explore ways of obtaining, the structure and properties of nanoscale systems, due to diverse and unique options for their practical application. The small size of structural components – typically up to 100 nm – defines the difference between the properties of nanomaterials from the massive analogs [1].

Since any substance composed of discrete units called atoms, it was expected that this will in principle the possibility of constructing and designing the structure of the material atom by atom. For example, storage of information in small volumes, increasing data transmission rate – is just one of the reasons of growing interest to nanoscale systems and devices. Another reason is that nanomaterials exhibit new and often unique or higher performance properties than traditional materials. This, in turn, opens its new technological applications.

Carbon nanostructures (CNS) have a number of unique physical properties. Such CNS as multi-walled carbon nanotubes can exhibit a high electrical conductivity, mechanical strength, thermal stability, which is very promising for the creation of new types of functional composite materials [2]. The high degree of shape

anisotropy of nanotubes can significantly modify the properties of composite materials at very small volume the filled composites nanotubes – about 0,1 – 5 %.

At present, modification of carbon and metal nanoparticles of various industrial materials (varnishes, paints, concrete, abrasive suspensions and pastes, etc.) is an essential part of the market nanotechnology.

The purpose of this study was to investigate the possibility of suspensions of carbon nanostructures derived from coke feedstock for the production of coatings with improved properties.

Preparation nanomodifiers. Earlier studies the institute UKhIN's found that during thermal processing of coal into coke ovens produced and distributed in the products of coking various carbon nanostructures [3, 4].

CNS Formation occurs in coking chambers. This is evidenced by a higher content of the CNS in carbon deposits of coking chambers (pyrocarbon) (1,8 %) and dust from dust free pushing (DFP) unit (1,2 %). For comparison, the yield of nanostructures of coke is 0,1 %.

Dust from DFP unit is the most promising raw material for the CNS, as it is a large-capacity byproduct of coke production, which is the waste, which requires recycling and processing. For example, at JSC Alchevskcoke "every day is captured about 3 – 4 tons of dust. In contrast to the pyrocarbon dust from DFP unit does not require crushing.

Modifications of solvents for paints were prepared by adding suspensions of nanoparticles. For waterborne paint the aqueous suspension were prepared, and for pentaphthal – suspension on the basis of the organic solvent.

Preparation of suspensions was carried out by the method of separation of nanotubes from the cathode deposit [5]. Samples of dust from DFP unit treated with ultrasound for 30 minutes (the frequency of radiation – 22 kHz, power – 150 watts). Then the suspension was centrifuged (Rotor speed – 8000 rpm) for 60 min to remove amorphous carbon. The concentration of the CNS in the resulting suspension was 0,9 % wt.

Nanomodification of the paint coverings. For investigation of the possibility of applying structured solvents derived from nanomodifikators the waterborne paint WA-AK-111 and pentaphthal enamel PF-115 were selected. The structured water (for waterborne paint) and structured white spirit (for pentaphtalic enamel paint) as a solvent was used.

All tests were carried out in industrial laboratories LLC Donetskhim – Chemical Plant. Test results are given in tables 1 and 2.

Table 1

The results of tests for nanomodified water-based paint

Test	The rule in accordance with GOST 26196-89	Actual data	
		Check sample	Sample with nanomodifier
Drying time at 20 ºC, hour, max	1	1	0,5
Resistance to static effects of water at a temperature of 20 º C, hour	24	36	72

Table 2

Results of nanomodifier based on white-spirit for pentaphtalic enamel

Test	The rule in accordance with GOST 6465-76	Actual data	
		Check sample	Sample with nanomodifier
Drying time at 20 ºC, hour, max	24	18	12
Hardness of coating on the unit M-3, a.u., min	0,25	0,27	0,32

Test results showed that the properties of the modified waterborne paints compared with that prototype and the requirements of standard for its production are improving. Drying time decreased by 2 times. The resistance to the static action of water at a temperature of 20 º C increased by a factor of 2 when compared with the prototype, and 3 times for the standard requirements.

In investigating the properties pentaphtalic enamel PF-115 blue, with the introduction into it of a modified organic solvent was found that the drying time at 20 ºC decreasing by 1.5 times compared with the original enamel and a 2-fold when compared with the requirements of GOST. At the same hardness of the coating on the device M-3 increased by 18.5 % compared with enamel PF-115 and 28 % in accordance with GOST.

Conclusions. The test results the following conclusions:

1. Dust UBVK is a promising raw material for producing carbon nanomodifiers, which can be used effectively in various industries to improve the operational properties of materials, including and paint coatings.

2. The use of structured water, obtained using nanomodifiers significantly accelerates the drying time of waterborne paint and its resistance to static action of water.

3. The use of structured white spirit, obtained using nanomodifiers significantly accelerates the drying time pentaphtalic enamel and its hardness.

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ДОСЛІДЖЕННЯ НАНОСТРУКТУРИ КАЛЬЦІЙСИЛІКОФОСФАТНИХ СТЕКОЛ НА ПОЧАТКОВИХ СТАДІЯХ ЗАРОДКОУТВОРЕННЯ

В статті досліджено наноструктуру кальційсилікофосфатних стекол на початкових стадіях зародкоутворення. За результатами проведених досліджень встановлено, що наявність сферичних нано-та мікронеоднорідностей в дослідних стеклах призводить до крапельної ліквації, яка є більш вигідною, аніж стабільна кристалізація для реалізації тонкодисперсної кристалізації скла.

Nanostructure of calcium silicophosphate glasses on initial nucleation stages is investigated in the paper. According to the investigation results it is determined that presence of spherical nano- and micro nonuniformities in investigated glasses results in droplet liquation which is more favorable than stable crystallization for achievement of fine glass crystallization.

Вступ. Цікавість до наноматеріалів обумовлена можливістю модифікації, і навіть, принципової зміни властивостей відомих матеріалів при переході в нанокристалічний стан та новими можливостями, які відкриває нанотехнологія при створенні виробів із структурних елементів нанорозмірів [1, 2].