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OLTURGUGURTLI BETONNING KIMYOVIY KORROZIYAGA CHIDAMLIGINI OSHIRISHDA AZOT STABILIZATORLARINING ROLI

Аннотация

Maqolada skanerlovchi elektron mikroskop (SEM) yordamida elementar oltingugurt va modifikatsiyalangan oltingugurtning mikrotuzilmasining qiyosiy tahlili keltirilgan. Tadqiqot davomida modifikatsiyalangan oltingugurtli betonning sovuqqa chidamliligi, xususan, 4 °C dan -18 °C gacha bo'lgan muzlash-eritish sikllarida uning fizik va mexanik xususiyatlari chuqur o'rganildi. Betonning asosiy komponentlari - oltingugurt, mineral plomba moddalari va plastifikatorlarning molyar nisbatlarining uning mustahkamligi, sovuqqa chidamliligi, zichligi va xizmat muddati kabi muhim ko'rsatkichlarga ta'siri eksperimental ravishda aniqlandi. Olingan natijalar modifikatsiyalangan oltingugurtli betonning oddiy oltingugurtli betonga nisbatan afzalliklarini ko'rsatadi. Xususan, ushbu material past haroratli iqlim sharoitida ishlatilishi mumkin bo'lgan ekologik toza, xavfsiz va uzoq muddatli qurilish materiali sifatida katta istiqbolga ega ekanligi isbotlangan.

Kalit so'zlar: melamin, oltingugurtli beton, modifikatsiya, kopolimer, korroziya, kislotali, ishqoriy, qum, plastifikatsiya, polimer, agressiv muhit, spektr, termogravimetriya, skaner, dispersiya.

РОЛЬ АЗОТОВЫХ СТАБИЛИЗАТОРОВ В ПОВЫШЕНИИ СТОЙКОСТИ СЕРНОГО БЕТОНА К ХИМИЧЕСКОЙ КОРРОЗИИ

Аннотация

В статье представлен сравнительный анализ микроstructures элементарной и модифицированной серы с использованием сканирующего электронного микроскопа (СЭМ). В ходе исследования подробно изучена морозостойкость модифицированного серобетона, в частности, его физико-механические свойства при циклах замораживания-оттаивания от 4 °C до -18 °C. Экспериментально определено влияние мольных соотношений основных компонентов бетона – серы, минеральных наполнителей и пластификаторов – на такие важные показатели, как его прочность, морозостойкость, плотность и срок службы. Полученные результаты показывают преимущества модифицированного серобетона перед обычным серобетоном. В частности, доказано, что этот материал имеет большие перспективы как экологически чистый, безопасный и долговечный строительный материал, который может использоваться в низкотемпературных климатических условиях.

Ключевые слова: меламин, серобетон, модификация, сополимер, коррозия, кислотная, щелочная, песок, пластификация, полимер, агрессивная среда, спектр, термогравиметрия, сканер, диспергирование.

THE ROLE OF NITROGEN STABILIZERS IN INCREASING THE RESISTANCE OF SULFUR CONCRETE TO CHEMICAL CORROSION

Annotation

The article presents a comparative analysis of the microstructure of elemental sulfur and modified sulfur using a scanning electron microscope (SEM). During the study, the frost resistance of modified sulfur concrete, in particular, its physical and mechanical properties during freeze-thaw cycles from 4 °C to -18 °C, was studied in depth. The effect of the molar ratios of the main components of concrete - sulfur, mineral fillers and plasticizers - on such important indicators as its strength, frost resistance, density and service life was experimentally determined. The results obtained show the advantages of modified sulfur concrete over ordinary sulfur concrete. In particular, it is proven that this material has great prospects as an environmentally friendly, safe and long-lasting building material that can be used in low-temperature climatic conditions.

Key words: melamine, sulfur concrete, modification, copolymer, corrosion, acidic, alkaline, sand, plasticization, polymer, aggressive environment, spectrum, thermogravimetry, scanner, dispersion.

Introduction. In concrete production technology, new additional modifiers are a mandatory component of the concrete mixture along with binders, fillers and water. Additives in concrete are used to improve the quality of concrete, give it specific properties, speed up construction work, and reduce the cost of the construction process. Currently, due to the increasing requirements for concrete used in construction projects, concrete with additives is increasingly being used [1]. Cement is an important component of the concrete mixture, which determines the mobility of the concrete mixture, the strength of concrete, its resistance to heat and cold, and other properties. Therefore, rheological studies of the effect of sulfur melamine modifier on cement mixtures with different mineralogical compositions and specific surfaces were conducted [2]. Concrete is made using cement, sand, gravel, and other products that are strong, resistant to frost and compressive strength, and have a long shelf life. Admixtures used to modify the properties of concrete mixtures are divided into 3 groups: The first group: additives added to improve the properties of ready-mixed concrete mixtures. These include standardizing, plasticizing, flow control additives, and macro- and micropore-forming additives. The second group: additives that control the acceleration and deceleration of the hardening of concrete mixtures,

increase their strength, reduce their permeability, and increase the chemical properties of steel reinforcement. The third group: additives that increase the properties of concrete mixtures such as frost resistance; dehydration; and resistance to salinity [3].

Materials and methods of research. M.V. Rilyov [4] conducted studies on the mechanism of interaction of elemental sulfur with dicyclopentadiene. His research suggests that the interaction of elemental sulfur with dicyclopentadiene occurs as an intermediate step in the formation of cyclic polysulfides through the formation of linear polysulfides. The results of the above-mentioned scientific data on the interaction between DSPD and sulfur have already been obtained, and the authors [43] discussed the data on these issues in their studies, where they noted that the calculated number of sulfur atoms per elementary unit in the polysulfide composition was found to be 6.75. The results of these studies also correspond to the conclusions made by the authors in [44]. The results of the research indicate the possibility of using the obtained product in the future in the production of road and building materials. [6].

The dissertation [8] studied the process of interaction of DSPD with sulfur to obtain vulcanizers for the tire industry. In these scientific research works, the obtained substance was used as a modifier in an amount of at least 15% relative to the mass of sulfur. As a result, it was found that a mixture of linear and partially crosslinked polymers with different lengths of polymerized sulfur-sulfide bonds, low molecular weight sulfides and elemental sulfur was formed. It was stated that the amount of crosslinked copolymers affects the brittleness of the material. It was shown that high concentrations of the modifier and long duration of the reaction make the process unsuitable. It was noted that it is necessary to study the mechanisms of interaction of sulfur with the modifier at low concentrations, the transition conditions of the process, and the properties of the final product formed in the process. In [9]ning ilmiy tadqiqotlarida elementar oltingugurt asosidagi organik va noorganik polisulfidlarining hosil bo'lish jihatlarini keltirilgan. Organik polisulfidlar masalasi bo'yicha modifikatorlar sifatida to'yinmagan bog'lanishlarga ega birikmalardan foydalanish taklif etilgan. Bu o'zaro ta'sir paytida vodorod sulfidining chiqarilishini oldini olishga imkon berishi to'g'risida fikrlar bildirilgan.

The study of the reaction of polysulfide formation was carried out on the example of the interaction of unsaturated higher fatty acids with sulfur. The results are aimed at obtaining road construction materials for use in the production of asphalt mixtures. All of the above options for the formation of polysulfides are characterized by a low content of sulfur atoms in the monomer unit (up to 8) and require the use of a large amount of modifier - more than 20%. Polysulfide materials of this type are not used as binders in the production of sulfur-containing concrete mixtures (the largest area for the sale of additional sulfur), therefore they do not allow solving the problem of excess sulfur accumulation.

Results and discussions. The structure of the outer surface layer of the sulfur-melamine modifier was observed using scanning electron microscopic analyses. Samples of sulfur-melamine modifier with different sizes are presented in Figure 3.6. (A and B) 10 μm ; (C) 50 μm and (D) 100 μm . As can be seen from the results obtained, the sulfur-melamine modification has a structure with more porosity and there are no crystalline forms in the modifier structure. Therefore, the sulfur-melamine modifier has an amorphous structure. The sulfur-melamine modification powder is the main component of concrete. The increased porosity and amorphous performance of the sulfur-melamine modifier increases the performance of sulfur-based concrete. The SEM microstructure of elemental sulfur is presented in Figure 1 below for comparison with modified sulfur.

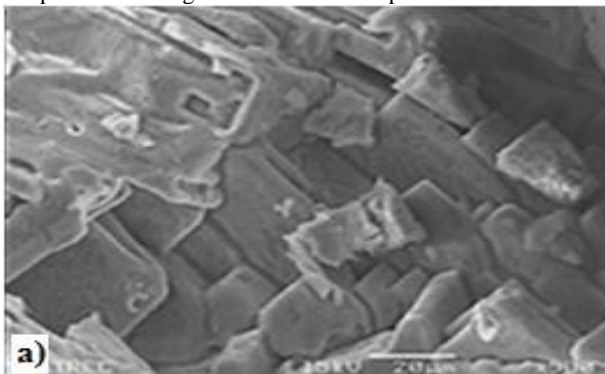


Figure 1. SEM microstructure of elemental sulfur (a)

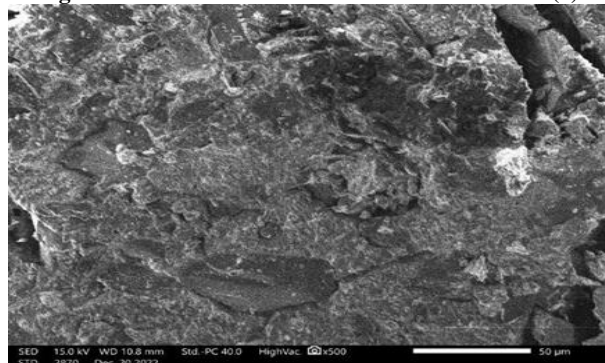


Figure 2. SEM microstructure of modified sulfur

The period of operation of a commercial product made of sulfur concrete in natural atmospheric conditions at sub-zero temperatures is one of the main factors determining the successful operation of this product. The anti-freezing test of the obtained sulfur concrete was studied on prismatic samples 100×100×400 mm according to the ASTM C666 procedure. For each case, a simultaneous study was conducted on four samples. The relative dynamic elastic modulus of the samples was measured after every

50 and 100 cycles. Each cycle lasted 4 hours, and the temperature was repeated 300 times in the range from 4 °C to -18 °C. The study was completed after 300 cycles.

Sulfur modifiers improve the microstructure of concrete. They reduce porosity in the concrete and slow down the absorption of liquid by concrete. As a result, the freezing process of liquids in concrete slows down. Sulfur modifiers increase the resistance of concrete to temperature changes.

However, since these surface and microcracks are much smaller in sulfur concrete, the results of such effects are much lower.

According to the experimental results, the freezing stability of sulfur-containing materials is 25-50 cycles [10]. Therefore, the freezing stability of sulfur-containing materials can be significantly increased by adding various organic modifiers to the composition of sulfur-containing materials. Thus, according to the experimental results, the freezing stability of sulfur-containing concrete depends on many factors. In particular, it depends on the size of the sample, the type and amount of filler, water saturation conditions, cycle duration, type and amount of modifier, freezing temperature and other factors.

The results obtained were supplemented with the data in Table 1 below.

Sulfur concrete composition	Freezing temperature, t°	Environment	Stability coefficient cycles		
			50	100	300
Melamine	-18 °C	water	0,98	0,95	0,90
2,4-dinitro-phenylhydrazine	-18 °C	water	0,98	0,96	0,91

Table 1. Freezing stability of modified sulfur concrete (temperature range from 4 °C to -18 °C)

The external appearance of the studied samples practically did not change at a given minus temperature for 50 cycles. After 100 cycles, the samples showed a slight darkening, and the edges of the samples retained their condition even after 300 cycles. As can be seen from the data in the table, the antifreeze stability of the modified sulfur concrete gave a higher indicator in all cycles for the sample with 2,4-dinitrophenylhydrazine, the main reason for this can be explained by the presence of nitro groups in the 2,4-dinitrophenylhydrazine molecule and the presence of an aromatic ring in the molecule. Compounds containing an aromatic ring are considered stable compared to other aliphatic series compounds, and its dinitro derivatives are part of the composition of strong compounds with a crystalline structure.

The studied composition for obtaining sulfur concrete was tested in various experimental and factory installations. Based on the results obtained, it is concluded that modified sulfur concrete fully meets all the requirements of the construction industry and regulatory documents for building materials, and the use of these organic nitrogen-containing compounds allows the use of sulfur concrete modified with these organic nitrogen-containing compounds as a building material in various sectors of the national economy [11].

In our research, the effect of the molar ratios of substances on the yield of the product in the production of sulfur concrete modified with organic nitrogen-containing compounds was studied. The results obtained are presented in Table 2 below.

№	Mole ratios	One, %
1	1:1:1	26,2
2	1:0,5:2,74	37,3
3	1:0,5:1	47,4
4	1:1,5:2,74	54,3
5	1:1:2,74	56,5
6	1:1:1	35,5
7	1:0,5:2,74	60,5

Table 2. The effect of molar ratios of substances on product yield

Table 2 shows the effect of various factors on the yield of the sulfur-melamine modifier: the molar ratios of the initial substances. Therefore, derivatives of polyhydric alcohols are of particular importance in studying the modifying effect of mono-, di-, etc. As can be seen from the results obtained, the highest yield of the obtained modifier was found when the molar ratios of sulfur and melamine were 1:1:2.74 and the process lasted 3 hours.

Conclusion. A method for obtaining polymeric sulfur-containing binders was proposed based on the modification of elemental sulfur, which is a waste product of the oil and gas industry, with nitrogen-containing organic compounds - melamine, 2,4-dinitrophenylhydrazine.

A technology for obtaining sulfur-containing concrete based on sulfur-containing modifier - gravel, barren sand was developed and its economic efficiency was studied.

The stability of sulfur concrete against corrosive environments was tested by various methods. The corrosion resistance of concrete samples was observed in 10% H₂SO₄, HCl, HNO₃, H₃PO₄ solutions, 10% Na₂SO₄, NaCl solutions and various aggressive environments.

It was found that after 24 hours of pouring the modified sulfur concrete, its compressive strength increased from 80 to 95%. It was proposed to set the mass ratio of polymer sulfur concrete and filler materials to 1:2 for the preparation of concrete with high compressive and flexural strength.

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