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Issue Article

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STUDY OF SULFUR MODIFICATION WITH UNSATURATED COMPOUNDS

***Abstract**: In this article, a study of the physicochemical properties of sulfur modifications on the basis of compounds containing compounds, as well as the use of a product in the production of server concrete. The surface area and the composition of concrete were analyzed using SAM and elemental analysis.*

***Key words**: sulfur, crotonaldehyde, elemental analysis, SEM analysis*
***Language**: English*
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Introduction

Today, the world pays special attention to the creation of new modified sulfur binders. In this regard, modified sulfur concrete can be used to produce products that are resistant to industrial, climatic and other types of aggressive environments.

Structural properties of unmodified and modified gray concrete beams with steel reinforcement subjected to air-water curing. The sulfur concrete contained fly ash as a filler, while dicyclopentadiene and dipentene were used as modifiers[1-5]. Unmodified concrete beams have shown increased strength, stiffness and ductility as they age when cured in a dry environment. Modified concrete beams have shown improved performance over unmodified beams, but even when dry they have shown a loss of strength as they age and their long-term stability is questionable. The stability of sulfur concrete beams can only be guaranteed if they are unmodified and dry. In wet mode, sulfur concrete cannot be stable and durable [6-8].

Sufficient sulfur is recovered as a by-product in refineries and natural gas processing plants. The amount of sulfur currently produced exceeds the global demand for sulfur[9-10].

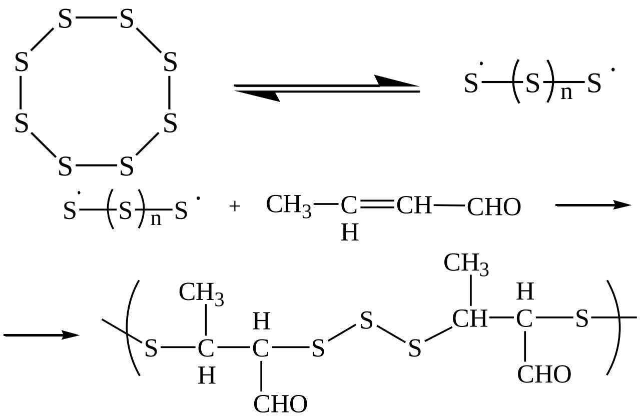
2. Experimental part
2.1.1. Materials and methods

Sulfur - used the production of the Mubarek gas processing plant. Under normal conditions, sulfur S is odorless yellow brittle crystals, easily soluble in carbon disulfide CS2. Physical constants: Mr = 32.066; Density - 2.07 g / cm3 (rhombic), 1.96 g / cm3 (monoclinic), T.melt. - 119.3 ° C, b.p. - 444.674 °C.

Crotonaldehyde-used by the production of Navoiazot LLC. The croton fraction contains from 57.0 to 67.0% crotonaldehyde, up to 10% acetone, up to 25% paraldehyde, up to 2.0% acetaldehyde, water, etc.

2.1.2 Modification of sulfur with crotonaldehyde and production of sulfur concrete.

Sulfur was heated in a glass beaker to 185°C in a thermostatically controlled oil bath with constant stirring until a transparent viscous orange molten sulfur phase was formed. Crotonaldehyde was then directly added to the molten sulfur phase. The resulting mixture was stirred at 185–190°C for 60–70 min, which led to some decrease in the viscosity of the reaction medium and the formation of black and yellow products for crotonic aldehyde comonomers with sulfur, respectively. The resulting products upon completion were taken directly from the beaker with a spatula and allowed to cool to room temperature. The reaction scheme for the polymerization of crotonaldehyde with sulfur is shown in Scheme 1.



Scheme 1. Scheme for the synthesis of polymeric sulfur.

The resulting sulfur copolymer was heated to 180–190°C in a stainless steel beaker equipped with a mechanical stirrer in a thermostatically controlled oil bath until a molten phase formed. Sand, crushed stone, fly ash were added to the molten medium of modified sulfur, and the resulting mixture was additionally heated at this temperature to form a homogeneous admixture of concrete with constant stirring in a molar ratio of 1:2.5 (polysulfide copolymer: sand, crushed stone, fly ash). The viscous mixture was placed in a self-made mold, and then immediately placed in an oven heated to 180–190 °C, held for 30 minutes, cooled to room temperature, and carefully removed from the mold.

3. Results obtained and their discussion.

On fig. 3.1. It can be seen that with the addition of 5 g of crotonaldehyde per 100 g of sulfur, the particle sizes of the dispersed phase increase significantly from -0.1 to 0.5 μm, while with the addition of 3 g of crotonaldehyde per 100 g of sulfur, there is no similar effect. observed. If crotonaldehyde is added to plasticized polymeric sulfur, then a significant increase in the size of the dispersed phase occurs in direct proportion to the increase in the content of the modifying additive.

Figure 3.2. shows the percentage of carbon, oxygen, sulfur, silicon, nitrogen, sodium and aluminum in the composition of sulfur concrete.

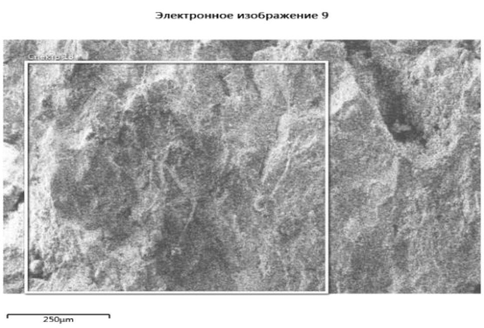


Figure 3.1. Micrograph of sulfur concrete.

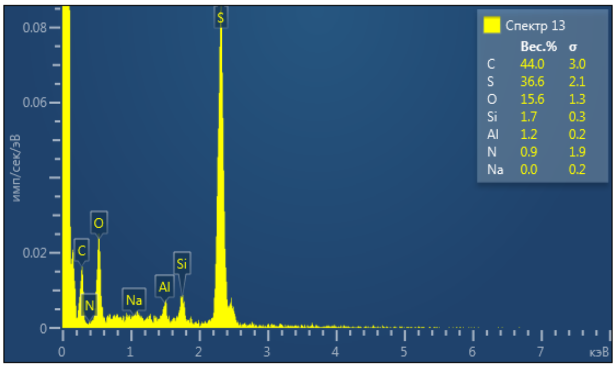


Figure 3.2. Elemental analysis data for sulfur concrete.

Data on the physicochemical characteristics of modified sulfur concrete (modified with sulfur by crotonaldehyde) are presented in Table 3.1.

Table 3.1. Physicochemical parameters of the synthesized oligomers

Properties	Indicators of modified sulfur concrete
Density, g/cm3 GOST 15139-69	2,158
T_{melt} °C	124
η_{hv}	0,065
Solubility	Insoluble
Appearance and color	Gray powder

In the IR spectrum of sulfur concrete in the regions of 2850-1470 cm^{-1} there are absorption bands, confirming the presence of $-CH_2-$ groups, and absorption bands in the region of 1650 cm^{-1}, confirming the presence of the -COH group in the free state. The IR spectrum contains absorption bands in the region of 3400 cm^{-1}, corresponding to primary –COH groups and absorption bands in the regions of 3300-3440 cm^{-1}, corresponding to secondary –COHR groups. The bending vibrations of all active groups appear as strong narrow bands between the usual bending vibration bands $–CH_2–CO–$ in the region of 1400 – 1405 cm^{-1}. The absorption bands at 800 and 1600 cm-1 confirm the presence of –CHO groups. The presence of groups containing S=O and S–C in the region of 1050–1015 cm-1 is confirmed by a wide intense band and sulfur-containing compounds in the regions of 462-779 cm^{-1}, 1040-1060 cm^{-1} and 1100-900 cm^{-1} [108; c. 202-205].

In addition, narrow low-intensity bands containing bonds of sulfur-containing compounds appear on the IR spectra in the regions of 1460 cm^{-1} and 648-779 cm^{-1}. When considering the IR spectra of sulfur concrete, it differs from modified sulfur by a strong intense $-CH_2-S-$ group with dimer indices of 1400-1440 cm^{-1}. (Fig.2.5.) [108; c. 202-205].

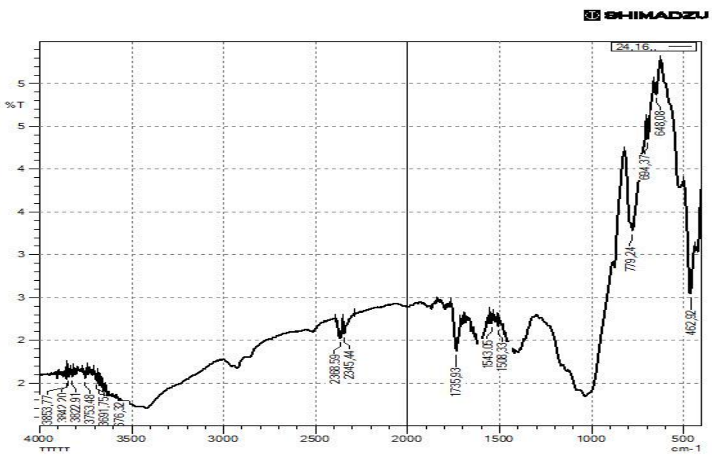


Figure 3.3. IR spectrum of modified sulfur concrete.

Conclusion.

It has been proved by IR spectroscopy that the presence of groups containing S=O and S–C in the region of 1050–1015 cm^{-1}, and a wide intense band and sulfur-containing compounds in the regions of 462-779 cm^{-1}, 1040-1060 1100-900 cm^{-1} confirms the reaction of sulfur with unsaturated compounds. A method is proposed for obtaining modified sulfur with high deformation strength and adhesive properties as a result of sulfur modification with the help of crotonaldehyde.

Crotonaldehyde was first used as a sulfur modifier and the optimal conditions for the copolymerization reaction were determined. The resulting compositions proved to be stable during storage and are recommended for the production of sulfur concrete.

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