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Construction Hydrophobizer Based On Silicon-Organic Compounds And Its Comparative Analysis

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Abstract: The article presents the synthesis of an organosilicon water repellent based on vinylethynylmagnesium bromide for building materials. The reduction in water absorption as a result of the influence of a water repellent on the material is also scientifically substantiated. A comparative analysis of the synthesized water repellent with existing water repellents is described.
Key words: hydrophobization, cement, ceramic material, vinylethynylmagnesium bromide, tetraethoxysisilane, water repellent.

The world pays great attention to the production of moisture protection products based on modern technologies and their use to increase the moisture resistance of building materials and structures. The creation of chemical materials that increase hydrophobicity and their inclusion in the composition of building materials is a pressing problem in all respects [1,2].

Therefore, it is important to create a new generation of complex chemicals based on innovative technologies in the creation of moisture-resistant hydrophobic materials and their use in various fields.

In view of the above, it is possible to obtain a new type of polymer compounds based on tetraethoxysilane to expand the range of currently most widely used organosilicon compounds. Vinylethynylmagnesium bromide and tetraethoxysisilane were used according to this procedure for the synthesis of vinylethynyltriethoxysilane. The interaction of tetraethoxylane and vinylethynylmagnesium bromide in equimolecular ratios is accompanied by the formation of vinylethynyltriethoxysisilane according to the following scheme: [3,4,5].

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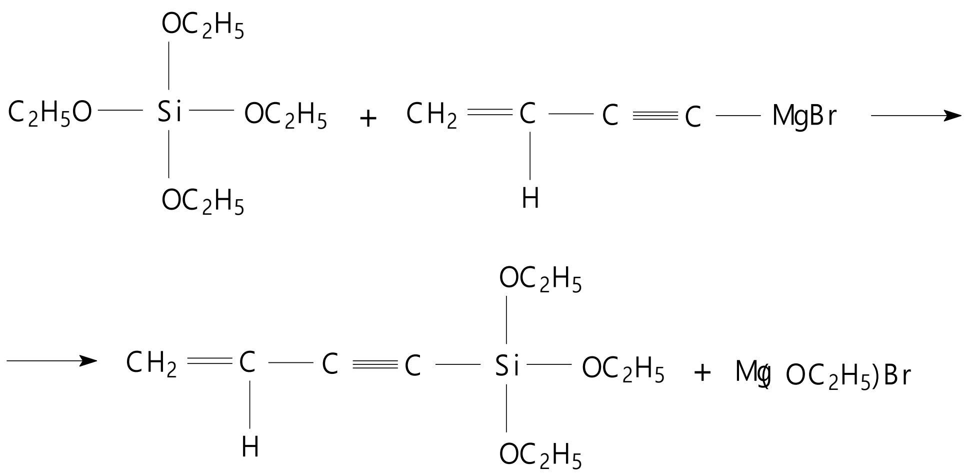
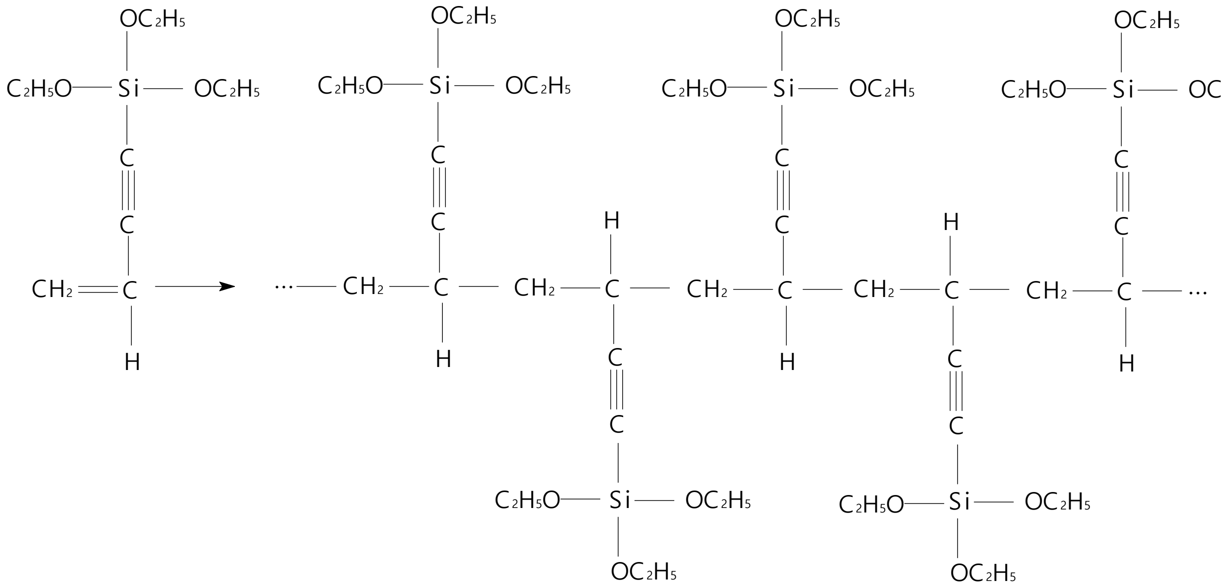


Unlike dry ether and benzene, the reaction yield is low in reactions carried out in toluene, dioxane and other solvents.

The most common method of polymerization of organosilicon monomers is the method of thermopolymerization of these monomers.

The scheme of thermal polymerization of vinylethynyltriethoxylane monomer at a temperature of 30-40 oC can be presented as follows:



The resulting product is rectified for the presence of water, ethyl alcohol and unreacted monomer in polyvinylethylenetriethoxylane, resulting in a product with polyvinylethylenetriethoxylane in 150 ml (50%) or benzene in 140 ml (48%), n_{20} D 1,456 1,0183. n_{20} D1,4560; d420

The proposed hydrophobization of building materials is the production of a hydrophobic material, the determination and justification of optimal technological parameters by including in

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building materials substances that increase humidity based on local raw materials and organosilicon polymers, and the formation of chemical bonds with them. At the same time, as a result of processing building materials with inorganic compounds, an organosilicon polymer enters the material, partially fills voids, reduces porosity and makes it possible to obtain a material with hydrophobic properties while maintaining hygienic properties [6,7].

During the synthesis process, various chemical reagents were used to create a technology for the production of moisture-resistant building materials according to the prepared method.

The technology for the production of hydrophobic building materials using these substances includes the following steps.

- Purification of relevant reagents and preparation of working solutions;
- Synthesis of hydrophobic polymers.
- The polymer formed at the stage of preparation (mixing) of the building material is added.

In this case, the polymer (in an amount of 0,3% of the total mass) is included in the building material, allowing it to form a hydrophobic building material by binding to the material and partially filling the pores.

For material types, the maximum porosity is about 0.1-0.5 mkm for small holes, but for cement-lime sand samples, a maximum of 10-50 mkm is mixed with a large hole area and 90% of the total cavity volume for ceramic samples 0.1-10 mkm in an equal area, i.e. the porous structure of ceramic samples is even greater [8,9,10].

The visible structure of cement-lime sand samples is characterized by a more developed specific surface area with a smaller volume of porosity compared to ceramic samples.

Research has shown (Table 1) that an increase in the concentration of working polymer solutions in the studied range does not affect the amount of solution impregnated and, therefore, the depth of penetration into ceramic and cement-lime sand samples.

Table 1

Sample performance before and after treatment

Material shape	Before treatment, porosity volume, % and interval distance, mkm					Porosity after treatment in % and spacing in mkm				
	<0,1	0,1-1	1-10	10-50	50-250	<0,1	0,1-1	1-10	0-50	0-250
Ceramic material	5,31	39,01	51,00	2,27	2,41	5,15	37,8	49,47	2,2	2,33
Cement-sand mixture	21,91	7,73	5,73	55,27	9,36	21,25	7,47	5,56	53,6	9,08

The solution consumption is on average 2.8 l/m² for ceramic samples and 3–3,2 l/m² for cement-lime sand samples. The absorption rate in cement-lime sand samples is much higher than in ceramic samples, which is more than 1 minute and more than 4 minutes for ceramic materials, which is explained by the denser structure of ceramic samples and therefore less absorption of the solution [11,12].

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According to the table, the minimum water absorption in hydrophobic ceramic samples is 1.7 cm with a working solution concentration of up to 2.4% when using a standard solution and a consumption of the active substance of 67 g/m².

Treatment of ceramic materials in samples with concentrated solutions is ineffective, since the degree of water absorption in ceramic materials increases from 2,4 to 3,86%, which is on average 2-5 times higher than that of a polymolecular organosilicon layer [13,14].

A study of the hydrophobic process of solid cement and ceramic materials showed that the effectiveness of hydrophobic treatment depends not only on their compositional properties, but also on their adsorption activity towards water repellent molecules on a porous surface. The higher this activity, the more concentrated the solution must be under these conditions. Under these conditions, the concentration does not affect the structural nature of the material being processed, that is, the swelling of the hydrophobic solution [15,16].

The scientific results obtained provide effective protection of building structures and materials from the effects of salts and water, coatings based on local raw materials, which were used in the construction of standard residential buildings and industrial buildings. When using 3% working solutions of poly (oligo) mayor based on liquid glass, water absorption led to a reduction of 50% for cementitious materials and 60% for ceramic materials[17,18,19]. It was also noted that due to the plasticizing properties of the polymer used, this leads to an increase in the grade of cement due to a slowdown in the cementing process by 35%. Methods for increasing the moisture resistance of building structures and materials, using hydrophobic substances, highly dispersed inert fillers, and creating modified mixtures are substantiated (Table 2).

The following indicators were noted in comparison with various currently used water repellents.

Table 2

Description of water repellents

Technical specifications						
Indicators	Control water repellents					Proposed composition
	Tiprom У	Tiprom У1	Tiprom К Lux	Tiprom К	Tiprom Д	
Waterproofness, mm	120	120	50	50	50	47
Penetration degree, mm Lifetime	up to 35 mm	up to 35 mm	up to 10 mm	up to 10 mm	up to 18 mm	throughout the entire volume
Consumption, g	150-350	150-350	150-300	50-75 (1:3 diluted with water)	50-75 (1:24 diluted with water)	Used as a 3-5% solution
Operating temperature, °C	from 0°C to +30°C	from 20°C to +30°C	from +5°C to +30°C	from +5 °C to +30°C	from +5 °C to +30°C	from +5 °C to +45°C
Start time of	24	24	24	24	24	3

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water resistance, hour						
Lifetime	10	10	10	10	6	During building operation

Thus, a water repellent for building materials has been created based on new organosilicon compounds, and the possibility of obtaining a building material with hydrophobic properties by adding it to the mixture has been described. According to the test results, a reduction in the porosity of cement and ceramic materials treated with hydrophobic compounds was achieved, as well as a reduction in water absorption due to the use of water-insoluble compounds. At the same time, excessive plastic deformation under the influence of moisture was prevented due to water absorption. A comparative analysis of existing water repellents with synthesized water repellents was carried out.

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