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Estimation Of Porosity Of Coatings Based On Sil Of Silicate Paint.

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ABSTRACT

Information on the properties of the sol of silicate paint is given. The difference in the porosity of the coatings on the basis of silicate and sol silicate paints is shown. It was established that the porous structure of coatings based on silicate paint is represented mainly by pores to 100 μm in size. It was revealed that the number of pores on 1 cm^2 on the surface of coatings based on sol of silicate paint is 6 times smaller compared to the coating based on silicate paint. Calculated relative pore area of various sizes. The fractal dimension of the pore structure of the coating was determined. An increase in the fractal dimension of the pore structure of coatings based on silicate paint is shown. The protective properties of the coatings are evaluated. A decrease in water absorption values was observed during capillary suction of mortar samples stained with sol by silicate paint in comparison with samples stained with silicate paint. An increase in the numerical values of the vapor permeability coefficient and the flow rate of water vapor through samples of coatings based on polysilicate binders has been established. Information on the properties of the sol of silicate paint and coatings based on it is given.

Keywords: liquid glass, polysilicate solution, paint, coating, porosity

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INTRODUCTION

In the practice of finishing works, silicate paints have proven themselves well. In order to increase the service life of silicate coatings, a modification of film-forming — liquid glass with polymer additives (polymer dispersions, organosilicon compounds, etc.) has been proposed [1–7]. Analysis of the patent and scientific literature suggests that one of the methods of modification is the introduction of silica sol into the composition of the binder, which provides higher performance properties of coatings. In [8-10], it was proposed to use polysilicate solutions having a silicate module from 4 to 25 as a binder in silicate paints.

We have developed a paint composition based on a polysilicate binder obtained by mixing liquid glass with silica sol [11-14]. It was found, that coatings based on polysilicate solutions are characterized by faster curing. The paint forms a coating characterized by a smooth, uniform matte surface. Resistance to static action of water at a temperature of 20 ° C is at least 24 hours.

In continuation of further research, we evaluated the surface quality of coatings based on sol-silicate paint.

METHODOLOGY

In this paper, the following research tasks: -to assess the permeability of coatings in accordance with GOST 33355-2015 (ISO 7783: 2011) “Paint and varnish materials. Characterization of vapor permeability. Cup method;

- to conduct a comparative analysis of the porous structure of the coating;
- assess the protective properties of coatings based on the sol of silicate paint.

We used potassium liquid glass with a module M = 3.29. Microcalcite brand MK-2 (TU 5743-001-91892010-2011), marshalite and talc of the brand MT-GShM (GOST 19284-79) were used as filler, and rutile titanium dioxide 230 (TU 2321-001-1754) was used as a pigment. -7702-2014). To obtain a polysilicate binder, Nanosil 20 and Nanosil 30 silicic acid sols, produced by PC Promglasscenter, were used.

To estimate the pore structure of the coatings, the cut-off island method was used. For the implementation of this method, the software complex (PC) “Identification and analysis of the porosity of building materials” was used, allowing to determine the total pore area of the composite under study, as well as the pore size distribution [15-18].

RESEARCH RESULTS

It was established that the vapor permeability coefficient of coatings based on potassium polysilicate binder, determined in accordance with GOST 33355-2015, is 175.48 g / m^2 day, and based on potassium liquid glass - 117.96 g/ m^2 day. In stationary conditions, the mass flow rate of water vapor through the sample of the coating based on potassium liquid glass is 0,0108 g / hour, and based on the potassium polysilicate binder - 0,0161 g / hour. The increase in the numerical values of the vapor permeability coefficient and the flow rate of water vapor through samples of coatings based on polysilicate binders indicate a change in their pore structure compared to coatings based on liquid glass.

It was established, that the pore structure of coatings based on silicate paint is represented mainly by pores to 100 µm in size (Fig. 1). The maximum pore size is 174 microns. Number of pores per 1 cm2 of the coating surface 564 pcs. The total area of pores on a 1 cm^2 coating is 1609526 µm^2. The relative area of pores with a radius of 0 to 10 µm is 0.02596%, pores with a radius of 10 to 50 µm — 0.67918%, pores with a radius of 50 to 100 µm — 0.65119%, pores with a radius of 100 to 200 µm, 0.25319% (Fig. 1)

The pore structure of coatings based on sol-silicate paint is represented mainly by pores of the same size, the maximum pore size is 156 µm. However, the number of pores per 1 cm2 of the surface of the coating is less and amounts to 90 pcs. The total pore area on a 1 cm^2 coating is 227,141 µm^2 (Fig. 2). The relative area of pores with a radius of 0 to 10 µm is 0.004%, pores with a radius of 10 to 50 µm are 0.09933%, pores with a radius of 50 to 100 µm are 0.07087%, and pores with a radius of 100 to 200 µm are 0.05294% (Fig. 2)

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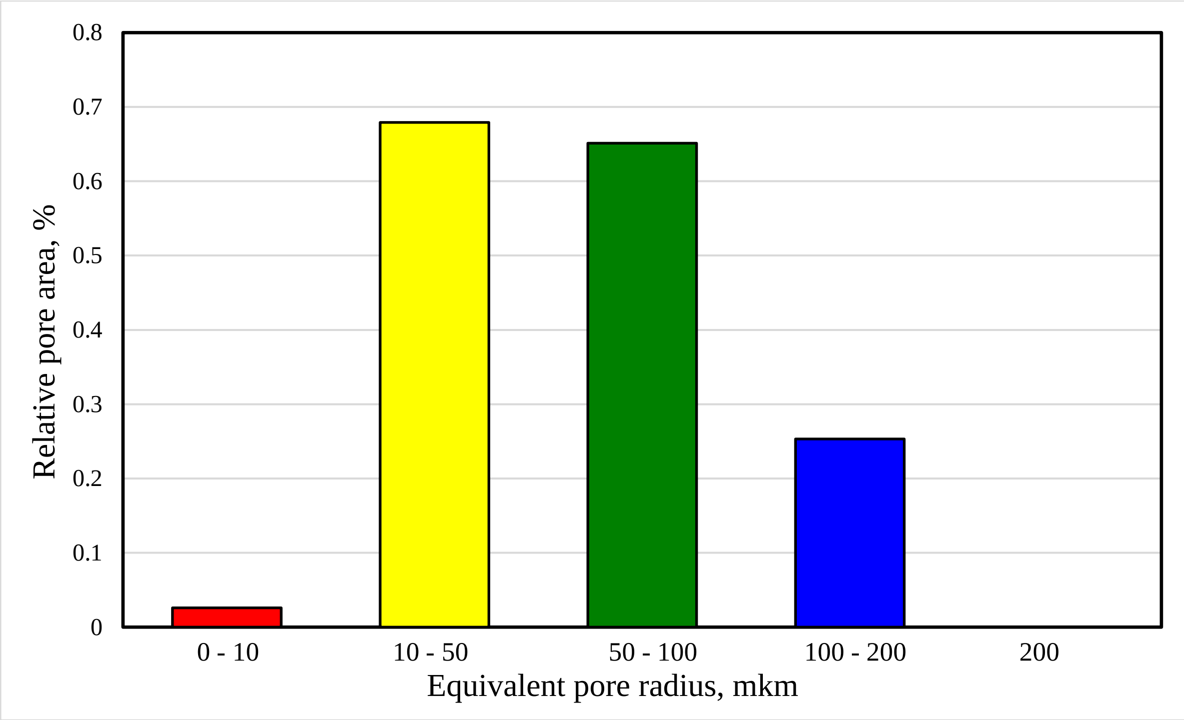


Fig. 1. The relative pore area on the coating based on silicate paint

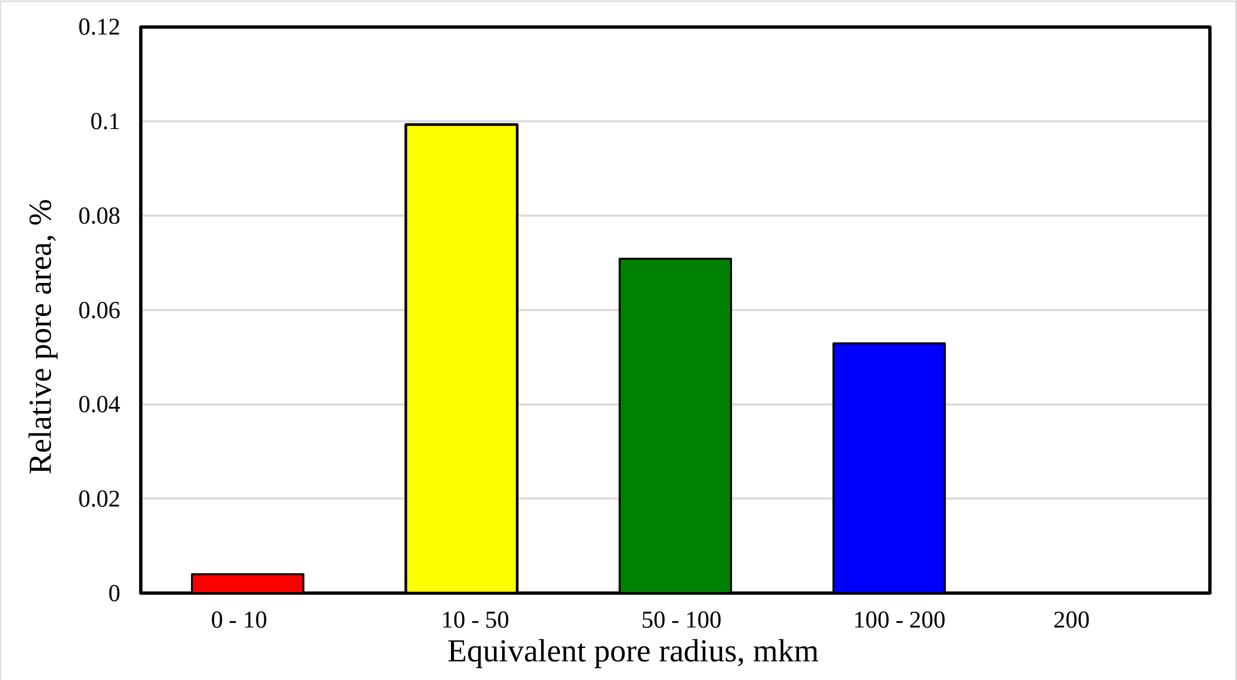
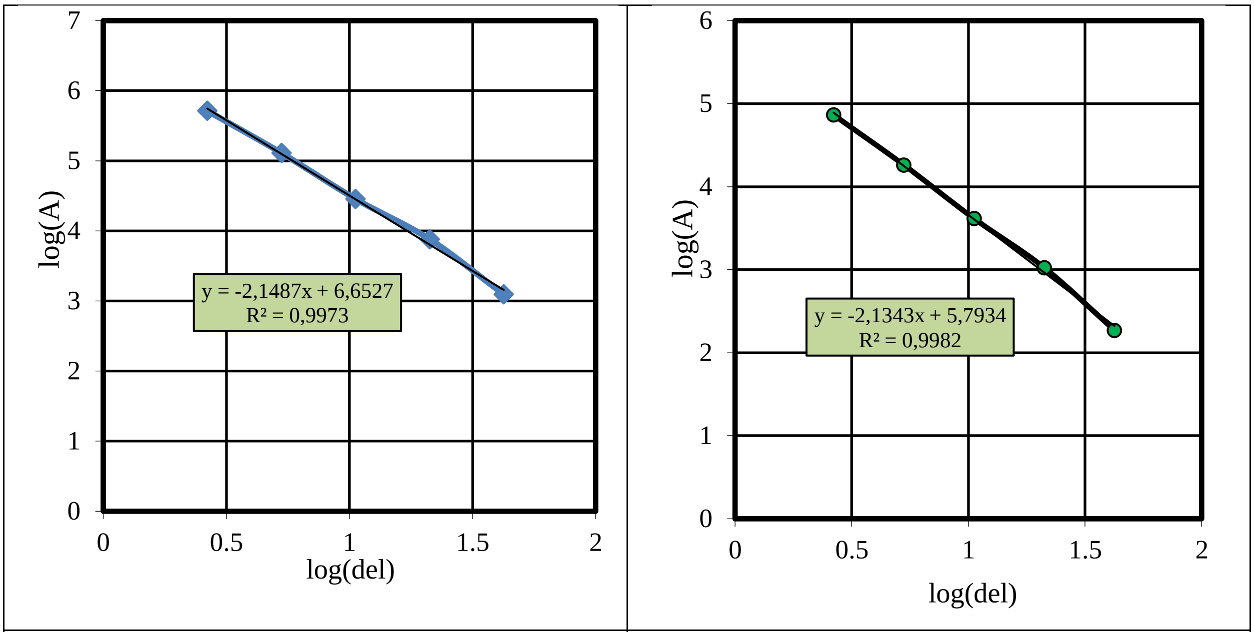


Fig.2. The relative pore area on the coating based on sol silicate paint

The magnitude of the fractal dimension was determined from the angle of inclination of the graph of changes in the pore areas from their perimeters, built in double logarithmic coordinates log (A (∂)) - logP (∂)) (Fig.3).

D=-log(N(∂))/log(∂)



a	b

Fig. 3. The relationship between perimeter and pore area

a - coating based on silicate paint;
b - coating based on sol silicate paint

From the analysis of the obtained data, it can be seen that the relationship between the perimeter and the pore area obtained by scanning the studied surfaces with different resolutions of 4800 Dpi is described by a linear relationship with the coefficient of determination R^2 = 0.9973 - 0.9982 (Fig. 3).

Analysis of data on the fractal dimension indicates a more developed pore structure of coatings based on silicate paint. The fractal dimension of the pore structure of the coating based on silicate paint is D = 2,1487, and the fractal dimension of the pore structure of the coating based on the sol of silicate paint is 2.1343.

The different porosities of silicate based coatings and sol silicate paints determine their various protective properties. Thus, when assessing the water-protective properties of coatings, it was found that water absorption during capillary suction of mortar samples painted with a sol of silicate paint is 4.4%, and those painted with a silicate paint is 4.6%

In tab. 1 shows the values of the properties of the sol of silicate paint and coatings based on it.

Table 1–Properties of paint composition and coatings based on it

Name indicators	Values
Portability	good
Class of quality of appearance of coatings	IV
Viscosity to B3-4.[c]	17-20
Shrinkage, the presence of cracks	no
Viability, [day]	more 90
Dryingtime, [min], todegree 5	15-25
Adhesion, [points]	1
Adhesion, [MPa]	1,1-1,3
Coefficient of vapor permeability, [mg / m * hPa]	0,00878

Relative hardness	0,47
Impact strength [kgcm]	50
Washability, [g / m^2]	No more 2
Water resistance (appearance after 24 hours in water)	Absence of white matte spots, flaking, rashes, bubbles and other damages
Frost resistance, brand	F35

CONCLUSION

The use of polysilicate solution as a film-forming agent in silicate paints helps to increase the protective properties and durability of coatings. According to its properties, the sol silicate paint and coating based on it meet the requirements for coatings for exterior finishing of buildings, have a higher adhesion, sufficient vapor permeability.

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