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Polymer Silicate Paints for Interior Decorating

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Abstract

Provides information about the properties of polymer silicate paint. The calculation of the paint formulation.

Keywords: an aqueous dispersion of sodium silicate, styrene acrylic dispersion, the viscosity, the concentration of pigment

Introduction

Silicate paints are widely used in the practice of painting and decorating. The aqueous dispersion of potassium silicate used for their preparation. The market well established silicate paints firm Degussa [1].

Results of the study

Given the scarcity of water dispersion of potassium silicate in the domestic market, offers colorful silicate composition based on a mixture of an aqueous dispersion of sodium silicate density of 1.15 g / cm^3 and styrene acrylic dispersions. Styrene acrylic dispersions Lakroten E-21 and Nowopole 110 used to develop formulations.

Minium iron oxide, chromium oxide, ocher was used in the development of the formulation as a pigment; colored sand deposits (Penza region, Kuznetsk district) – as a filler. Characteristics filler are shown in Table 1. Acrylic dispersion Lakroten E-41 was used to control the composition viscosity

Table 1

Fraction content,% (by volume)		
sandy 1-0,05 мм	dusty 0,05-0,005 мм	clay less 0,005 мм
77	12,33	10,67

The rheological properties of the compositions were evaluated in terms of the relative viscosity, determined using a viscometer VZ-4.

Figure 1 shows the dependence of the relative viscosity of the pigment volume concentration. As can be seen from the data, when filling in the range of 0 <φ <0,154 (pigment - minium iron), 0 <φ <0,023 (pigment - chromium oxide), 0 <φ <0,044 (pigment - ocher) viscosity increase slightly, the polymer matrix is only partially converted into a film state. A significant change in the ratio of bulk and film phases of the matrix occurs at later filling, there is a sharp increase in viscosity of the composition.

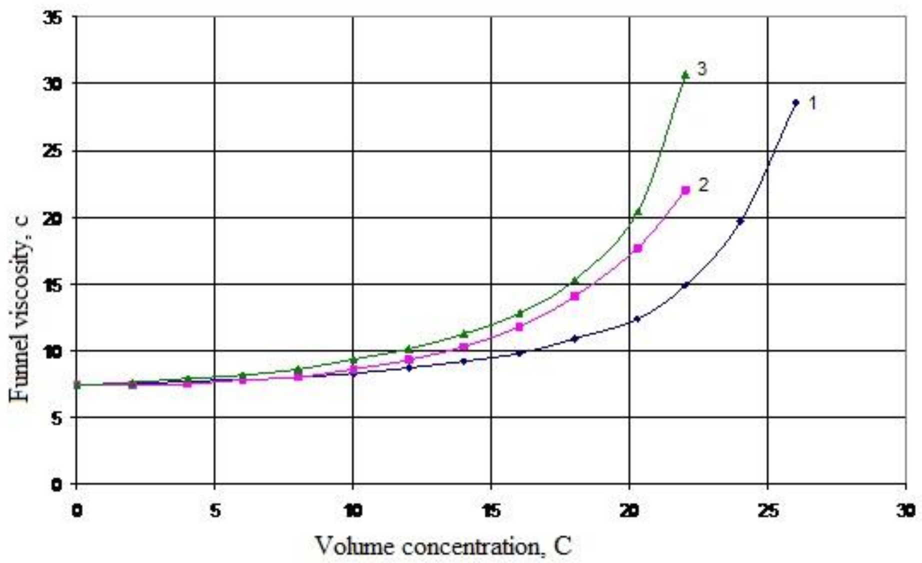

Fig. 1. Dependence of the relative viscosity of the pigment volume concentration: 1 - minium iron, 2 - chromium oxide, 3 – ocher

Figure 2 shows the dependence of the viscosity upon the volume fraction of the pigment in coordinates $\lg\eta$ - C (where C - the concentration of the pigment in the system). This relationship is a two intersecting lines. The point of intersection, projected on the x-axis, will be a critical pigment volume concentration (CPVC). The presence of inflection points in the curve lg η = f (C) indicates that the interaction of the filler in the filler interaction dominates in the filler-binder

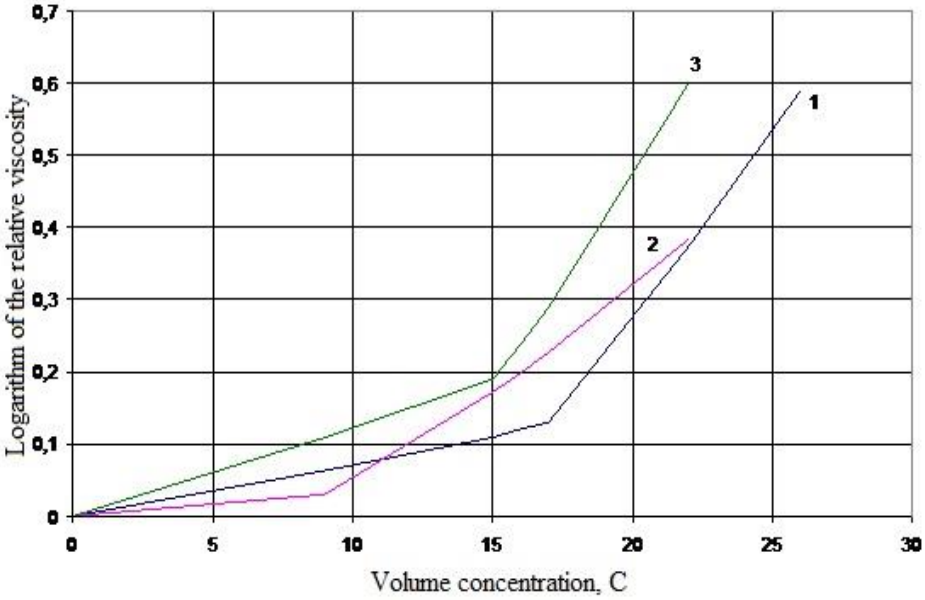

Fig. 2. The logarithm of the relative viscosity of the bulk pigment content: 1 - minium iron, 2 - chromium oxide, 3 - ocher

The optimum content of the filler and the pigment was calculated by two methods.

In the first case, the flow of pigment (filler) was calculated by the following formula [2].

$$V_{нап} = \frac{1}{\alpha}, \tag{1}$$

$$V_{пл} = 1 - \frac{\rho_{нас}}{\alpha \rho_{ист}} \tag{2}$$

$$V_{мон} + V_{пл} = 1; \tag{3}$$

$$V_{мон} = V_{нап} - V_{нап} V_{Пнап}, \tag{4}$$

where $V_{нап}$ - the amount of the pigment particles (filler) volume units.;

$V_{пл}$ - volume of the solution of the film former, volume units;

α - coefficient move apart pigment particles (filler);

$\rho_{нас}$ - bulk density of the pigment (filler), kg / m^3;

$\rho_{ист}$ - true density of pigment (filler), kg / m^3;

$V_{мон}$ - the volume of monolithic pigment particles (filler) volume units.;

$V_{Пнап}$ - the volume of interparticle voids pigment (filler) volume units.

$$V_{Пнап} = 1 - \frac{\rho_{нас}}{\rho_{ист}}. \tag{5}$$

Coefficient move apart pigment particles (filler) was determined by the formula:

$$\alpha = \left(\frac{d+h}{d}\right)^3, \tag{6}$$

wherein d - an average particle size of the pigment (filler), m;
h - the average thickness of the interlayer film former is 1.4 microns.
The second method of calculation based on a formula

$$\varphi = \frac{\rho_{нас}}{\rho_{ист}\left(\frac{hS_{уд}\rho_{ист}}{6} + 1\right)^3}, \tag{7}$$

where $S_{уд}$ - a specific surface area of pigment (filler), m^2 / g.
The average particle size was determined by the formula

$$d = \frac{6}{S_{уд}\rho_{ист}}. \tag{8}$$

Consumption pigment (filler) in both cases were the same. The main properties of the pigments and fillers, as well as the results of the theoretical calculations are shown in Table. 2.

The values obtained for the pigment volume concentration (PVC) of various kinds of pigments were used in the development of future formulations colorful compositions.

Application of ink only in the formulation of colored sand, although it creates a color gamut, but these compounds are prone to sedimentation in spite of the presence of additives Lakroten E-41. In this regard, a filler in the color developing ink formulations used as replacement parts pigment. Fig. 3, 4 presents the results of experimental studies of the relative viscosity and the logarithm of the viscosity of colorful compositions from a mixture of pigment content (minium iron) and filler (sand color).

Table 2

Name	Specific surface $S_{уд}$, m^2/kg	Average particle size $d \cdot 10^{-6}$, m	Bulk density $\rho_{нас}$, kg/m^3	True density $\rho_{ист}$, kg/m^3	Factor move apart particles	The volume of the pigment particles (filler) $V_{нап}$, volume units.	The volume of monolithic pigment particles (filler) $V_{мон}$,, volume units	Volume of the solution of the film former $V_{пл}$, volume units	Volume content φ
minium iron	510,0	3,72	1265	3163	2,607	0,384	0,153	0,847	0,152
chromium oxide	975,9	1,33	927	4635	8,648	0,116	0,023	0,977	0,023
ocher	1171,6	1,78	720	2885	5,702	0,175	0,044	0,956	0,044
sand color	67,9	33,20	1516	2527	1,132	0,833	0,530	0,470	0,533
Sand colored ground	506,5	4,73	870	2527	2,177	0,459	0,164	0,836	0,162

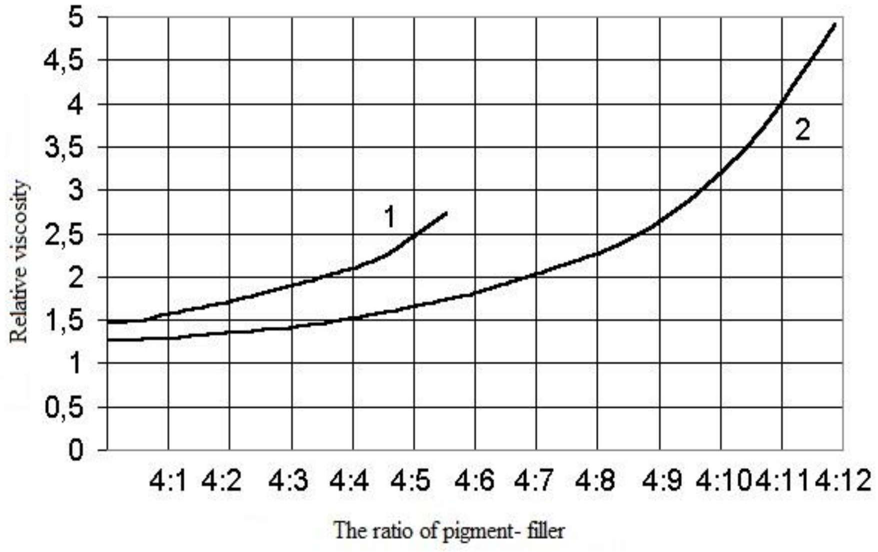

Fig. 3. Dependence of the relative viscosity of the content of the mixture of pigment and filler:

1- by volume content of pigment 0.142;

2- by volume content of pigment 0.132.

The experimental results show that the replacement of the pigment filler, an increase of the critical pigment volume content (Figure 4)

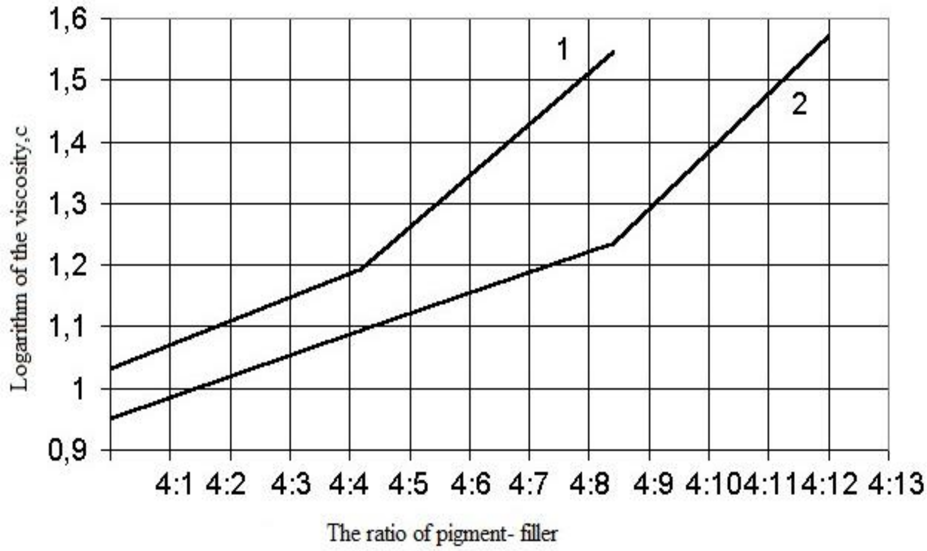

Fig. 4. Dependence of the logarithm of the viscosity of the content of the mixture of pigment and filler:

1- by volume content of pigment 0.142;

2 -by volume content of pigment 0.132.

Conclusion

Developed paint based on an aqueous dispersion of sodium silicate and styrene acrylic dispersion. Studies indicate that the coatings have sufficient adhesion to cement substrate constituting 1.4-1.8 MPa, bottling is 4-5 min. The compositions are used only for internal painting works. Coatings are highly decorative expressiveness. Use as a filler local material (colored sand) will expand the resource base, reduce the economic costs of production of paint.

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