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Laws of Formation of Quality of Appearance of Paint Coverings of Cement Concrete

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Abstract: The data on the effect of the rheological properties of the paint, cement substrate porosity in the coating quality. The quality of the substrate, namely the degree of homogeneity, the presence or absence of contaminants on its surface, its porosity have a significant impact on the quality of the appearance of the coatings formed that defines their durability in operation. Determined that recovery time the paint structure depends on the substrate porosity and on the paint rheological properties, At increase of the surface tension paint quality coating decreases. With a decrease in the value of the dynamic viscosity roughness coating increases. For each kind of the paint there is an optimal value of the contact angle of wetting which provides its flow forming the minimal surface roughness value. The influence of the cement substrate porosity on the quality of coatings.

Key words: Porosity, paint, viscosity, quality, laws of formation

INTRODUCTION

The coating surface appearance quality is determined by the paint flow property (Loganina, 2014a, b). According to the floe property is consideredas rheologic process which can be described by the following expression Eq. 1:

$$h = \frac{b^2 f}{8\sigma} \quad (1)$$

Where:
h = Height of a stroke
b = Width of a stroke
f = Paint strain yield
σ = Paint surface tension

The following experiment was conducted to assess the effect of bottling on quality appearance of coatings.

MATERIALS AND METHODS

The definition of the applied with a brush paint flow property was estimated with the help of the method when we drew five pairs of parallel lines and defined the flow degree by the number of the lines run into one. The lines were drawn with a special device. The flow degree was graded on a 10-point scale.

We estimated quality of appearance of coverings a parameter of a roughness We used the following paints: alkyd enamel PF-115, oil-bound paint MA-15, nitrate cellulose enamel NC-123, acrylate paint Universal, acryl water dispersed (facade) paint. We used glass and sand-cement backing boards. The results are shown in Table 1.

The analysis of the data shown in Table 1, testifies that it takes longer time for the paints to recover when they are applied on a mortar with a porous surface. So, for example, it takes 3 min for paint PF-115 torecoveron a glass board while 5 min on a cement board though the flow in both cases is satisfactory. Undoubtedly, the paint structure recovery time depends both on the board porosity and on the paint rheological propertiesthe paints (Mandelbrot, 1988).

The results of the coating structure profile estimation testify, that as the paint surface tension increases the surface appearance quality decreases. So, at surfacetension of acrylate paint Universal equal to 36,13 m Dgh m^{-2}, the coating surface roughness makes R_α = 2.4 μ. The similar rules are observed on the other kinds of coatings.

RESULTS AND DISCUSSION

The researched paints were applied on the cement board in two layers with 20-40 min intermediate drying depending on the paint structure. Before paint applying a prime coating was applied on the board. To carry out the test we used cement samples with porosity of 24, 28 and 32%. To reduce the surface porosity some samples were

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Table 1: The influence of the paint rheological properties on the coating appearance quality

The name of a paint	Coating surface roughness (Ra, m km)	Paint surface tension (σ, mH m^{-2})	Paint dynamic viscosity Pas	Paint flow property (min)
Alkydenamel PF-115	0.58	19.35	7.92	Not>5
	0.4	18.37	6.86	Not>5
				Not>3
	0.21	16.67	5.8	Not>5
				Not>3
Oil-boundpaint MA-15	0.8	17.48	23.68	Not>5
				Not>3
	0.69	16.93	14.8	Not>5
				Not>3
	0.46	16.18	10.36	Not>5
				Not>3
Nitratecellulo seenamel NC-123	0.78	27.09	14.02	Not>5
				Not>3
	0.6	24.08	7.38	Not>5
				Not>3
	0.32	22.12	6.39	Not>5
				Not>3
Acryl water dispersed (facade) paint	3.01	37.37	40.04	>15
				>15
	2.55	34.96	30.8	>15
				>15
	1.85	31.88	21.56	>15
				>15
Acrylatepaint universal	2.4	36.13	33.44	>15
				>15
	1.77	33.87	24.32	>15
				>15
	1.44	30.96	15.2	>15

<15Note:*Coating roughness was estimated on a glass backing board

Table 2: Roughness of coverings depending on rheological properties of paint

The name of a paint	The surface tension (σ, mH m^{-2})	Dynamic viscosity η, (Pa·s) 10^3	The contact angle of wetting (θ°)	Coating roughness, R_a (m km)
1	2	3	4	5
PF-115				
1	22.30	0.00100	14.7	1.14
2	20.80	0.00065	13.2	1.36
3	20.00	0.00026	7.00	1.58
MA-15				
1	23.10	0.00260	62.5	1.20
2	22.40	0.00200	48.2	1.56
3	18.30	0.00140	42.0	2.02
Water dispersible				
1	36.37	0.03470	74.8	2.50
2	33.50	0.02317	65.1	3.37
3	29.10	0.01300	56.1	4.35

evened with a putty coat. The paints rheological properties were estimated according to their relative dynamic viscosity parameter and the surface tension. The paints flow was estimated according to the value of the contact angle of wetting and paint flow. The results are shown in Table 2.

The data analysis Table 2 testifies that for all researched paints is true that when the surface roughness value increases the dynamic viscosity value decreases (the board with a putty coat). Thus the surface roughness of the paint PF-115 based coating is 1.14 m km at dynamic viscosity value 0.001×10^3 Pas while it is 1.58 m km at dynamic viscosity value 0.00026 10^3 Pas. For each kind of the paint there is an optimal value of the contact angle of wetting which provides its flow forming the minimal surface roughness value. Thus the optimal value of the contact angle of wetting for the paint MA-15 is 62.2°, for the water-dispersible paint is 74.8°.

According to ISO 1302 there are 12 classes of the surface roughness (from N1 up to N12). The data analysis, shown in Table 3, testifies, that high coating surface appearance quality (roughness class N2) can be obtained for the board porosity Π = 24 of only when applying alkyd paint PF-115 with dynamic viscosity $\eta = 0.001\times10^3$ Pas. At other viscosity values of the paint PF-115 at the given porosity, coatings of roughness class N3 are formed. The cement boards with porosity Π = 32% does not provide coatings with roughness class N2 irrespective of the paint rheological properties.

For aqueous colourful structures is observed decrease of a parameter of a roughness with increase in a superficial tension up to the certain value within the limits of 48-55 m Dgh m^{-2}. The further increase in a superficial tension (dissolution paints water) promotes increase in a roughness, i.e., reduction in quality of appearance of a covering.

Table 3: The coatings appearance quality in correlation with the relative dynamic viscosity and board porosity

Porosity (%)	The name of a paint: PF-115 (Dynamic viscosity (η, Pas)) η_1	η_2	η_3	MA-15 (Dynamic viscosity (η, Pas)) η_1	η_2	η_3	Water-dispersible (Dynamic viscosity (η, Pas)) η_1	η_2	η_3
24	0,98 (N2)	2.05 (N3)	2.7 (N3)	3.53 (N3)	4.14 (N4)	4.54 (N4)	2.87 (N3)	3.13 (N3)	3.38 (N3)
28	1,7 (N2)	2.26 (N3)	3.0 (N3)	5.61 (N4)	6.5 (N4)	7.56 (N4)	3.1 (N3)	3.,37 (N3)	3.55 (N3)
32	2,38 (N3)	2.86 (N3)	3.5 (N3)	7.76 (N4)	8.99 (N5)	9.,26 (N5)	3.,32 (N3)	3.55 (N3)	4.2 (N4)

In brackets surface roughness class values are shown. PF-115 η_1 = 0,001×10^3, η_2 = 0.00065×10^3, η_3 = 0.00026×10^3; MA-15 η_1 = 0.0026×10^3, η_2 = 0.0026×10^3, η_3 = 0.0014×10^3; Water-dispersible η_1 = 0.0347×10^3, η_2 = 0.02317×10^3, η_3 = 0.013×10^3

The obtained results of the study confirm the surface roughness of the coatings on the assumption that the quality of the substrate, namely the degree of homogeneity, the presence or absence of contaminants on its surface, its porosity have a significant impact on the quality of the appearance of the coatings formed that defines their durability in operation (Karjakina, 1980).

CONCLUSION

The received results of research of a roughness of a surface of coverings confirm the assumption that quality of a substrate, namely the degree of its (her) uniformity, presence or absence of pollution on its (her) surfaces, its (her) porosity render essential influence on quality of appearance of formed coverings that defines (determines) their stability (resistance) while in service.

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