POLYMER COMPOSITES FOR WASHABLE WALL PAINTS

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Lucrarea de față are ca scop optimizarea performanțelor peliculogene ale unor vopsele în dispersie apoasă aplicabilă la exterior, prin utilizarea de diferite compozite polimerice. Încadrarea pe domenii de utilizare s-a realizat în funcție de o serie de criterii pentru stratul suport şi pentru sistemele de protecție/dcorative.

The present work has as its main aim the optimization of several coating products; initially, these products containing polymer composites are aqueous dispersion. The domains for use have been defined according to various criteria, both for the supportive layer, as well as for the protective/decorative systems.

Keywords: water borne paint, physico-mechanical tests

1. Introduction

The modern trend in the development of paints and varnishes is the reduction of organic solvents consumption so that to prevent environmental pollution and fire risk. Organic solvents have their function, only in paints application and in film forming. Obviously, they don't have any contribution for the physico and/or mechanical properties of the dried paint film.

Total or partial replacing of the organic solvents with water is one of the most popular methods to solve this problem. Nowadays, water borne paints are used on a large scale.

The film forming systems have a significant role in the modern technology due to their application in most fields of the social-economic activity. Such coatings are heterogeneous multicomponent systems consisting in a solid phase (pigments or/and fillers), a binder and a solvent. The fillers (powder) are dispersed within the system [1].

Both components of the solid phase and of the liquid phase have a large influence on the properties which induce the subsequent properties of the liquid paint and of the dried film [2].

The film forming performances of a given system could generally be anticipated, provided that various aspects related to certain properties, as is the system rheology, are known.

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The properties of these products are specific for each system and depend on the binder type and nature, on the nature and ratio of pulverous materials, respectively; other variables are the pigment/binder/solvent ratios and the types of additives known as rheological additives.

Modern water borne systems are a special case of the film forming dispersions, taking into account that the polymer itself exhibits as fine particles dispersed in a continuous liquid phase, which in this case is water. It is already known that the viscosity of this kind of systems differs from that of the conventional ones in which the binder it is a polymer (or prepolymer) dissolved in the solvent.

In the present work we describe the synthesis and properties of new washable wall paints based on plasters containing acrylic and acrilic-styrene copolymers.

2. Experimental

Styrene and methyl methacrylate are easily submitted to emulsion copolymerization. Commercial lattices usually contain 40 ÷ 60 % of copolymer. In the present work, we have used two types of such products, commercially known as ORGAL PST 50 and LATEX DL 450, respectively as well as an acryl homopolymer in emulsion, named PRIMAL AC 337-ER.

The properties for these polymers are presented in Table 1.

Table 1

Properties of various polymer compositions

PROPERTIES	ORGAL PST 50	LATEX DL 450	PRIMAL AC 337-ER
Appearance	white, viscous liquid	white, viscous liquid	white, viscous liquid
Non-volatile content, %	50±1	50	45.5
Brookfield viscosity RVT 5/20, mPa s	5000-11000	9000	50-1500
pH	7.5-9.5	8.5	7.5-8.5
MFFT, ^{0}C	22	18	12-16

*MFFT=minimal film formation temperature

In our work, one main formulation has been used. The formulation is detailed in Table 2.

Table 2

Main formulation for polymer composite:

No.	Raw materials	Weight		
1	water	24.715	26.215	27.715
2	preservative - Preventol TP LXS 80050	0.2	0.2	0.2
3	dispersant - Calgon 322	0.1	0.1	0.1
4	dispersant - Lopon 890	0.3	0.3	0.3
5	defoamer - BYK 037	0.3	0.3	0.3
6	pigments and extenders: Tioxide RTC 90, Sipernat 820 A, Finntalc M 20 SL-KV, Omyacarb 2 XKA, Omyacarb 5 KA	58	58	58
7	thickener - Walocel XM *)	0.35	0.35	0.35
8	coalescent - Texanol	1	1	1
9	pH buffer - NaOH 50%	0.035	0.035	0.035
10	**RESIN**	**15**	**13.5**	**12**
	TOTAL	**100.00**	**100.00**	**100.00**

*) modified methyl-hydroxy-cellulose

As it can be noticed from Table 2, we have used three different resin concentration. The obtained washable wall paints were properly characterised and laid on different supports: concrete B 250 simple and primered, external wall thermal insulator system simple and primered and betonip simple and primered.

The viscosity of the initial samples (according to SR EN ISO 2555:2003) was determined with a viscosimeter Haake VT500.

The nonvolatile-matter (according to SR EN ISO 3251:2003) of the initial samples was measured by using an thermoweighter with IR dryer Mettler-Toledo LP 16.

The density (according to SR EN ISO 2811-1:2002/AC: 2006) of initial samples was determined with a pyknometer, a presure cup pyknometer and a weighter Mettler-Toledo.

The pH (according to SR ISO 10523:1997) of initial samples was appreciated with a portable pH-meter WTW pH 330.

The hiding power (according to SR-ISO 6504-3-2003) of initial samples (as well as whiteness index and yellowness index) were determined with a spectrophotometer Byk Gardner.

The gloss (according to SR ISO 2813+C1/C3: 2003) of the samples laid on different supports was established with a TRI – GLOSSMASTER.

The pendulum damping test (according to SR EN ISO 1522 : 2007) of the samples laid on different supports was performed with the Persoz Pendulum.

The pull-off test for adhesion (according to SR EN ISO 4624: 2003) of the samples laid on different supports was carried out with a pull-off test equipment.

The wet-scrub resistance and wash resistance (according to DIN EN 13300: 2001+AC: 2003; SR EN ISO 11998: 2007) for the samples laid on different supports was determined with Wet Abrasion Scrub Tester.

The liquid-water transmission rate (according to SR EN 1062-3: 2001) of the samples laid on different supports, was measured by using an immersion tank with water, a heat chamber and a weighter type AV 4101 DM.

The water-vapour transmission rate (according to SR EN ISO 7783-1;2: 2002) of the samples laid on different supports was determined with a permeability cups and a weighter Mettler Toledo AB 304-S.

The Sagging-levelling of the samples laid on different supports was determined with a sagging-levelling appliers, type 1118.

The abrasive resistance of film Ericksen (according to STAS 2188/1:74) of the samples laid on different supports was assessed with an Ericksen equipment.

The impact resistance tests (according to SR EN ISO 6272-1: 2004) of the samples laid on different supports was determined with an impact equipment with mobile mass.

The dry film thickness (according to SR EN ISO 2808:2002) of the samples laid on different supports was determined with Byko – test 1500.

The salt spray tests corrosion - tests in artificial atmospheres (according to SR EN ISO 9227:2007) of the samples laid on different supports was ascertain within a salt fog cabinet.

The environmental testing – change of temperature and dampness (according to SR EN 60068-2-33;38:2002) of the samples laid on different supports was established with a salt fog cabinet set on dampness and a refrigerator.

The environmental testing – at low temperature (according to SR EN 60068-2-1:1996) of the samples laid on different supports was determined with a refrigerator.

The environmental testing – cold resistance – thaw (according to STAS 3518-89) of the samples laid on different supports was determined by using a refrigerator and an imersion tank with water.

3. Results and discussion

The results obtained in the measurements performed on the products are presented in Table 3. Physico-mecanical determinations performed on the resulted films, laid on different supports are presented in Table 4; we have also listed the results obtained on films under various climatic conditions.

The evaluation of the data from Table 3 shows regarding viscosity, density, pH, film thickness that all the samples have comparable values, and the differences among them are very low. With regard to the content in nonvolatile-matter – the values are close, the best values are for the maximum resin concentration.

Regarding the hiding power, whiteness and yellow index, the products based on PRIMAL AC 337-ER gave films with the best hiding power, high whiteness index and low yellow index, for the outdoor series at the concentration of 12 % and 13.5% resin. The products based on LATEX DL 450 gave usual values, namely at concentration of 12% resin and 13,5%, while those based on ORGAL PST 50 gave the lowest values at the all resin concentrations.

The analyse of the data presented in Table 4 exhibits the following:

Gloss – all the samples have comparable values, frosted films were obtained, the lowest values resulting for the maximum concentration of the resin. Hardness – the products based on ORGAL PST 50 gave the hardest film. Pull-off test for adhesion – the products based on ORGAL PST 50 present the highest pull off adhesion from the scale on concrete and primered concrete and average for other types of support. Those products based on PRIMAL AC 337-ER present the highest pull off adhesion from the scale on simple and primered external wall thermal insulator system but average for other types of surfaces. These based on LATEX DL 450 present average values on all types of supports.

Wet-scrub resistance and wash resistance – the products based on LATEX DL 450 or on ORGAL PST 50 present the best wet-scrub resistance from the scale, class 3, with tendency of increase in class 2 of washability at a maximum concentration of resin. Those based on PRIMAL AC 337-ER present the lowest wet-scrub resistance from the scale, class 3, with tendency of decreasing in class 4 of washability at a minimum resin concentration.

Liquid-water transmission rate - the products based on LATEX DL 450 present both from the point of view of entrance of the bearing and of the total coefficient, the best resistance. The products based on PRIMAL AC 337-ER present medium values, while those based on ORGAL PST 50 taking into account the total coefficient, present the lowest resistance. Water-vapour transmission rate – the product based on PRIMAL AC 337-ER form the most permeable film to water vapours, those based on LATEX DL 450 give average ones, and those based on ORGAL PST 50 form less permeable films. Sagging–levelling - all the products don’t flow at application until 300 μm, but levels.

Abrasive resistance of film (Ericksen) – the products based on PRIMAL AC 337-ER present the best resistance with the smallest loosing on the film thickness. Those based on ORGAL PST 50 present a medium resistance, and those based on LATEX DL 450 present the smallest abrasive resistance, with the higher loss on the film thickness. Impact resistance – the products based on LATEX DL 450 present the best resistance to impact resistance, those based on

ORGAL PST 50 give average values, and those based on PRIMAL AC 337-ER give the lowest values.

The analyse of the data obtained after climateric tests on the laid film exhibits the following: The salt spray tests corrosion - tests in artificial atmospheres – the products based on PRIMAL AC 337-ER present the best resistance on all surface types, those based on LATEX DL 450 give average values for all surface types, while those based on ORGAL PST 50 give the lowest values on all surface types.

The environmental testing – change of temperature and dampness – the products based on PRIMAL AC 337-ER present the best resistance on all surface types, those based on LATEX DL 450 give average values for all surface types, and those based on ORGAL PST 50 give the lowest values on all surface types.

The environmental testing – damp heat, steady state – the products based on PRIMAL AC 337-ER present the best resistance on all surface types, those based on LATEX DL 450 give average values for all surface types, and those based on ORGAL PST 50 give the lowest values on all surface types.

The environmental testing – low temperature – the products based on PRIMAL AC 337-ER present the best resistance on all surface types, those based on LATEX DL 450 give average values for all surface types, and those based on ORGAL PST 50 give the lowest values on all surface types.

The environmental testing – cold resistance – thaw – the products based on PRIMAL AC 337-ER present the best resistance on all surface types, those based on LATEX DL 450 give average values for all surface types, and those based on ORGAL PST 50 give the lowest values on all surface types.

4. Conclusions

The products **„OUTDOOR WALL PAINTS”** can be used for indoor and outdoor treatments, related to the weathering class (cf. C170), in the weathering class 1b (very low weathering), 2b (low weathering) and 3b (average weathering, only aggressive gases from A group), respective rural climate, alpine climate, sea and city climate with certain restrictions. The products are not recommended for indoors with industrial aggressiveness or pollutants from B and C groups. In case of the betonip surfaces, the maximum agreed class will decrease with one unit due to the low resistances on this type of surface [3].

Maximum agreed weathering class was selected in order to provide a minimum 5 years resistance for indoor/outdoor for the studied products, the normal life of the decorative products [4].

This framing was selected thus the protection laid on reinforced concrete surfaces, external wall thermal insulator system, lime cement plasters, “rigips” boards, bricks ensure in the maintenance of all the performances according with the users’ requests, the quality systems and technical criterion for constructions stipulated in the Law no10/1995.

The performed tests showed the highest quality level for the products based on **PRIMAL AC 337-ER** resin**,** followed by the ones based on **LATEX DL 450** and, finally by those based on **ORGAL PST 50** resin, at maximum concentration with resin 15 %.

R E F E R E N C E S

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[4] INCERC - Bucuresti „Normativ privind criteriile de performanta pentru protectia anticoroziva a constructiilor supuse actiunii mediilor industriale NP-039, 2005**.**