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ADHESION OF CEMENT PAINT TO OLD SURFACES

by

JOSEPH GEORGE & S. M. SINGH

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Adhesion of Cement Paint To Old Surfaces

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Joseph George & S. M. Singh
Central Building Research Institute, Roorkee.

Cement Paint consists essentially of white cement, pigments, accelerator & water repellent. It is packaged in powder form and prior to application it is mixed with water. The paint hardens through the setting of the cement. The eondition of the painting surface or substrate and the proper curing of the paint film are of primary importance for the formation of a hard film with good adhesion on drying. Old plasterwork whether being painted for the first time or being repainted often gives trouble. With age the water retaining capacity of the substrate is considerably decreased and it is invariably covered with a film of calcium hydroxide and carbonate and sometimes also with water soluble salts. If the film is not removed eompletely it will interfere with the adhesion of the cement paint. Under these circumstances the paint film remains soft and weak and is liable to rapid crosion.

For setting of the cement, proper wetting of the dry powder with water is important. Water repelling compounds such as metal stearates and non-saponifiable oils, which are added to cement paints, present difficulty in mixing the dry powder with water. The fine particles agglomerate and floc up on the surface. Stearate soaps, in amounts greater than 0.2% by weight of cement, cause excessive frothing. They are also reported to reduce the rate of hydration of cement[1]. They higher alcohols and their amines, on the other hand, improve the mixing and wetting properties of cement paints[2]. (Fig I)

A study has been carried out on the suitability of a few additives to bring about quick hardening and better adhesion of the paint film to old surfaces. The effect of these additives on the mixing and wetting characteristics of the dry cement paint powder was also observed and the results obtained are presented in this paper.

Six different cement paints were formulated to study the effect of additives. The compositions of these additives are given in Table 1.

Table 1

Composition of Paint formulations

Ingredient	Formulation number					
	1	2	3	4	5	6
Clinker	92	96	91	96	91	84.5
Gypsum	4	—	—	—	—	4
Al stearate	1	1	1	1	1	1
Ca chloride	3	3	3	3	3	3
Ca hydroxide	—	—	—	—	—	7.5
Sodium sllicate	—	—	5	—	5	—
Octyl alcohol	—	—	—	0.3	0.3	—

Since the study was concerned with the cementing part of the paint, pigments and extenders were not incorporated. A commercial cement clinker was the basic constituent. Its analysis is given in Table 2.

Table 2

Chemical analysis of clinker

Chemical constituent	Per cent
Silicon dioxide (SiO^2)	21.71
Iron and aluminium oxide (R^2O^3)	10.83
Calcium oxide (CaO)	63.31
Magnesium oxide (MgO)	2.29
Soluble sulphate	Nil
Free lime	0.42

All the ingredients were weighed separately then mixed and ground in a ball mill to a surface area of 3493 sq.cm./g., as dctermined by Blain's Air Permeability aparatus. The consistency, and initial and final setting times of the different compositions were determined aecording to IS:269 and the values are given in Table 3.

Table 3

Initial and Final Setting Times of Paints

Formulation No.	Consistency as percentage of water to be used for gauging cement paste for setting time test	Initial setting times (Min.)	Final setting time (Min,)
1.	32	22	110
2.	31.8	15	107
3.	32	14	112
4.	28	14.5	86.5
5.	28	15	100
6.	27	—	—

The paints were applied on A.C. sheets and subjected to abrasion resistance test by Gardener's Abrasion and Washability testing machine after 48 hours of aging. All the tests were carried out along the grain. The sheets were cleaned of dirt and algae and soaked in water for 24 hours prior to the application of paint. In a second series of tests they were further rubbed with carborundum and treated with dilute hydrochloric acid (1:10) followed by a washing with water. Two coats of each treatemənt were applied at 24 hours interval. Water was sprinkled on the painted surfaces during the day to provide sufficient water for the hydration of cement. The abrasion test results are given in Table 4.

Table 4

Abrasion Test Results

Formulation No.	Number of strokes required to abrade an area of 10 sq. mm.	
	Untreated A. C, sheets	Treated A. C. sheets
1.	128	596
2.	169	1000 (not failed)
3.	90	1000 ,,
4.	1000	1000 ,,
5.	496	1000 ,,
6.	187..	1000 ,,

Discussion :

Hardening and strength development of cement paint film is due to cohesion of the cement particles and their adhesion to the grains of pigments, extenders and to the substrate over which it is applied. Abrasion resistance value for well rubbcd and acid treated sheets are far greater than for shose of the untreated ones (Table 4). It shows that by rcmoving the film of lime and calcium carbonate present on the surface of the substrate. adhesion is improved.

The water repellents which form a film around the grains of the cement and other constituents, interfere with cohesion and adhesion of the particles. Octyl alcohol which is a strong wetting agent increases the rate of hydration. This is supported by the experimental values of setttng times and abrasion resistance of formulations 4 and 5 compared with 2 and 3 respectively. The final setting times are shorter and the abrasion resistance higher when octyl alcohol is used. By the addition of octyl alcohol the water requirement of cement paints is also decreased for the same consistency (see Table 2). This might be a contributory reason for their high abrasion value.

The metal stearate added to cement paint as water repellent adversely affects the setting of cement and can be expected to act as a retarder as well. This is born out by the setting times for compositions 1 & 2. It is also seen that abrasion value for the composition not containing gypsum retarder is slightly higher than for the ones containing gypsum. The use of both retarder and water repellent in cement paint formula-

tions is therefore not desirable. The latter serves both as a retarder and as a water repelling agent.

Comparing the abrasion test values of formulations 1 and 6, it is observed that lime addition gave better adhesion and strength to the paint film. Lime addition is known to affect the plasticity and water retaining power of cement and to reduce the water cement ratio for the same consistency. Addition of lime to cement paints also reduces drying shrinkage. But exposure tests have shown that lime content in excess of 15 to 20 per cent causes chalking in the early stages of exposure[3]. Sodium silicate which acts as an accelerator to eement at high concentrations appears to have hardened the film without increasing its adhesion to the substrate.

Conclusions :

(1) Thorough rubbing of the surface and treatment with dilute hydrochloric acid increases the adhesion of the paint film to the substrate.

(2) The addition of octyl alcohol faeilitates mixing of the cement paint powder with water and wetting of the cement grains.

(3) The metal stearate incorporated in the cement paint as water repellent acts also as a retarder of the set of cement. Gypsum can therefore be omitted from such cement paint formulations.

(4) The addition of lime to cement paint is benefical at low levels.

Acknowledgement :

The subject of this paper forms part of the normal programme of rescarch at the C. B. R. I. and the paper is being published with the permission of the Director.

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2. Jones, K. W. and P. J. Jackson— **U. S. Patent** No. 2,934,445 (1960).

3. Singh, S. M. —**Unpublished work.**

Legend for Illustration

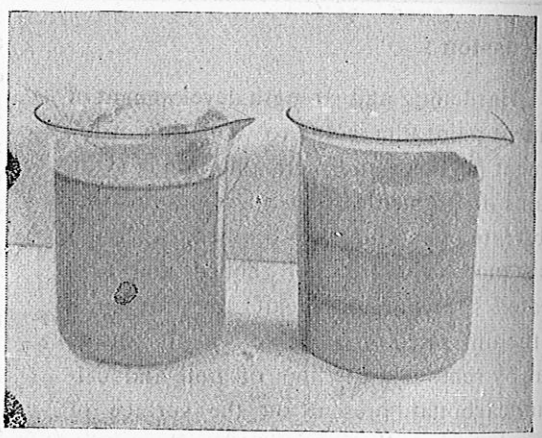

Fig. 1: Mixing characteristics of cement paints with (left) and without (right) wetting agent.

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