Int. J. Chem. Sci.: 6(3), 2008, 1646-1652

A STUDY OF PLASTER OF PARIS AS AN ADDITIVE ON SOME PROPERTIES OF MAGNESIUM OXYCHLORIDE FLOORING COMPOSITION (MAGNESIA CEMENT)

R. N. YADAV

Centre for Applied Research, Department of Chemistry,
R. R. Govt. (P. G.) Autonomous College, ALWAR (Raj.) INDIA

ABSTRACT

Magnesia cement (Magnesium oxychloride flooring composition) has many superior properties to those of portal and cement[1-3]. Investigation with this cement after admixing plaster of paris in the matrix has shown encouraging results.

Key words: Plaster of Paris, Magnesia cement, Magnesium oxychloride, Additive.

INTRODUCTION

The chemical composition of plaster of Paris available in commercial grade is $CaSO_4$. ½ H_2O. The authors have investigated the effect of plaster of Paris on magnesia cement purposefully. The basic reason behind this was that the compound itself is associated with cementing characteristics with very low setting periods[4]. The experimental investigation with plaster of Paris as an additive were therefore carried out in orders to find out its effect on strength and durability of magnesia cement.

EXPERIMENTAL

Material and methods

The raw material used in the present study along with their characteristics are–

Magnesia – Commercial grade magnesia used in the study was of Salem origin. It had the following characteristics : (i) Bulk density 0.85 Kg/L, (ii) 95% passing through 75 micron (200 mesh) IS sieve, (iii) Magnesium oxide 90%, (iv) CaO < 1.5% and (v) Ignition loss at 110^0C – 2.5 + 0.5 percent.

Dolomite – Inert filler (dolomite) of under given grading was used : (i) 100% passing through 150 micron IS sieve, (ii) 50% retained on 75 micron IS sieve, (iii) CaO 28.7%, (iv) MgO 20.8 (v) Insoluble and other sesquioxide contents were less than 1.0%., and (vi) Loss on ignition 50%.

Magnesium chloride – Magnesium chloride ($MgCl_2.6H_2O$) used in the study was IS grade 3 of IS : 254-1973 with following characteristies : (i) Colourless, crystalline, hygroscopic crystals, (ii) Highly soluble in water, (iii) Magnesium chloride minimum 95% and (iv) Magnesium sulphate, calcium sulphate and alkali chlorides (NaCl) contents were less than 4%.

A study of plaster of Paris on setting and strength characteristics of magnesium oxychloride flooring composition (magnesia cement) were conducted by incorporation it in different amounts in the dry mix. (1 : 2 dry mix. was prepared by weight of Magnisia and dolomite) on the basis of following methods :

(i) Setting time investigations

(ii) Weathering effects

(iii) Moisture ingress (steam tests)

(iv) Compressive strength tests

(v) Soundness (Le-Chatelier's test).

Setting periods – Initial and final setting period of wet-mixes prepared by gauging 1 : 2 fry mixes separately with the gauging solutions of diverse composition were determined by adopting the standard procedure[5-7]. Result are summarised in Table 1.

Weathering effects – Investigations were made by recording the variation in weights of the setting time blocks with time after 24 hrs, 7 days and 30 days, respectively[6]. Weights of the test blocks may increase or decrease due to different weathering effects promoted by the admixture. Experimental findings are recorded in the Table 2.

Moisture ingress (Steam test) – To find out the effect of plaster of Paris on magnesium oxychloride flooring composition, standard blocks prepared from Vicat Mould were used[8,9]. These were subjected to steam tests after one month's curing under identical condition. These blocks were exposed constantly to steam and boiling water in a closed steam bath. Relative water vapour transmission (Moisture ingress) so caused were expressed as a function of time (hr.) required for development of cracks in the trial blocks.

Less is the water vapour transmission, more is the soundness. Observed results are summerised in the Table 3.

Table 1 : Effect of plaster of Paris on setting characteristics of magnesia cement.

Gauging Solution : 22º BC Temperature : 30ºC

Dry-mix composition : 1 : 2* Humidity : Above 75%

Observations	Composition of dry mix (% additive)				
	0	**5**	**10**	**15**	**20**
Volume of gauging solution (mL)	60	58	58	59	59
Initial setting time (min.)	150	140	125	125	170
Final setting time (min.)	285	280	280	285	320
Nature of blocks					
(i) Glossiness	Yes	Yes	Yes	Yes	Yes
(ii) Volume Change	----------Insignificant----------				

Table 2 : Effect of plaster of Paris on weathering of magnesia cement.

Gauging Solution : 22º Be Dry-mix composition : 1 : 2*

Observations	Composition of dry mix (% additive)				
	0	**5**	**10**	**15**	**20**
Weight after 24 hr. (g)	263	265	170	275	275
Weight after 7 days (g)	260	262	269	274	272
Weight after 30 days (g)	250	250	265	265	265

* One part by weight of magnesia and two parts by weight of dolomite

Table 3: Effect of plaster of paris on moisture ingress (steam test) in the trial blocks

Gouging solution : 24° Be Dry-mix composition : 1 : 2^x

Observations	Composition of dry mix (% additive)				
	0	**5**	**10**	**15**	**20**
10 hrs.	N. E.	N. E.	N. E.	N. E.	N. E.
15 hrs.	"	"	"	"	"
20 hrs.	"	"	"	"	"
25 hrs.	"	"	"	"	"
30 hrs.	C	"	"	"	"
35 hrs.	C	C	C	C	C

* One part by weight of magnesia and two parts by weight of dolomite

NE: No effect; C - Cracked

Compressive strength – Influences of plaster of Paris on comprehensive strength of the product was studied with the help qf standard 50 cm^3 cubes prepared from the I.S. consistency paste having plaster of Paris in varing amounts. These cubes were allowed to be cured under indentical conditions for one month and were subjected to compressions just sufficient for their repture[10]. Experimental findings are recorded in the Table 4.

Table 4: Effect of plaster of Paris on compressive strength of magnesia

Gauging Solution : 24º Be Dry-mix composition : 1 : 2*

% Additive	0	5	10	15	20
Compressive strength (Kg/cm^2)	480	500	520	540	530

* One part by weight of magnesia and two parts by weight of dolomite

Soundness test (Le-Chatelier's test) - To find the soundness (Durability) of the products, Le-Chatelier's test were conducted as per the standard procedure[7,8,11-13]. The

observed results are summarized in the Table 5.

Table 5: Effect of plaster of Paris on soundness of magnesia cement (Le-Chatelier's test)

Gauging Solution : 24^0 Be Dry-mix composition : 1 : 2*

Observations	Composition of dry mix (% additive)				
	0	**5**	**10**	**15**	**20**
Weight of cement composition (g)					
(i) Magnesia	13	13	13	13	13
(ii) Dolomite	26	24.7	23.4	22.1	20.8
(iii) Additive	Nil	1.3	2.6	3.9	5.2
Use of $MgCl_2$ Solution (mL)	11.5	12	12	13	13
Distance between two pointers before starting (cm.)	1.8	1.7	2.4	1.8	1.8
Distance between two pointers after 7 days (cm)	2	2.1	2.6	1.9	1.9
Time is water at 27ºC to 32ºC (hr)	48	48	48	48	48
Distance between two pointers before boiling (cm)	2.2	2.5	3.1	2.5	2.2
Distance between two pointers after boiling (cm)	2.3	2.5	3	2.5	2.2
Expansion of cement (cm)	0.1	0	-0.1	0	0

RESULTS AND DISCUSSION

The Table 1 describes the effect of plaster of Paris on setting characteristics of magnesia cement. Volume of the gauging solution required for I.S. consistency remains almost constant even in the presence of plaster of Paris in varging proportions. This shows indifference the additive at the stage of formation of the wet mix. Rather finally powered additive reduces internal friction among the filler particles. This slight decrease in the amount of the gauaging solution for the some consistency is to be excepted. It is interesting to note that initial setting time decreases with increasing proportions of the additive upto a

certain extent (upto 15%). This may owe to rapid hydration of the additive to form a cementing compositon in increasing amounts (Equation 1). After that limit, the additive consumes so much water from the gauging solution that even the formation of magnesium oxchloride (main cementing composition) is hindered. Hence, initial and final setting times are found to increase sharply beyond that limit. It may be noted that once the additive has been hydrated rapidly, the resulting compositons remains almost indifferent towards the processes involved in the final setting. Accordingly, final setting periods are found almost constant upto a certain limit. Insignificant volume changes show indifference of the additive towards the normal setting mechanism.

Effects of plaster of Paris on weathering of magnesia cement have been recorded in the Table 2. At the primary stage of setting, most of the uncombined water is kept included in the three dimensional system of interlacing crystalline phase (Sorel's and Keen's phases) Accordingly, rate of decrease in weight with time of the blocks due to evaporation of free water is very low. It appears that these interlocking crystalline system, confer favourable effects on the bulk texture of the products. Accordingly, it is noted that incorporation of plaster of paris improves their watertightness as well as compressive strengths (Table 3 and 4). Le-Chatelier's tests pertaining to influences of plaster of Paris as additive on soundness of magnesia cement (Table 5) give firmfooting to the above discussion. As argued earlier plaster of Paris inactivates impurities like active lime responsible for large expansion and contributes watertightness. Accordingly, it is noted that volume changes of final stage of testing users almost absent.

Slight expansion at initial stage testing may be due to increase in exothermicity of the setting process and bigger size of sulphate ions replacing smaller chloride ions in the inter-crossing system of oxychloride and oxysulphate.

Plaster of Paris reduces initial setting time and is indifferent for final setting upto a certain limit (15%). Its incorporation under this limit improves the strength and watertightness of the product to some extent.

REFERENCES

1. S. T. Sorel, Comp. Rend., **65**, 102 (1867).
2. J. J. Beaudin and V. S. Ramchandra, Chem. Concer. Res., **5(6)**, 617 (1975).
3. J. J. Beaudin, V. S. Ramchandra and R. F. Feldman, Am. Cer. Soc. Bull, 424 (1977)

4. Encyclopedia of Chemical Technology, Sec. Edi. **4,** 14, **17** 690, 770 , **6** ; 784; **7**, 301; **15,** 509; **16,** 158; **21**, 613;
5. Indian Standard (1982), 10132.
6. Y. K. Gupta, M. P. S. Chandrawat and R. N. Yadav, Res. Ind., **35**, 191 (1990).
7. Y. K. Gupta, M. P. S. Chandrawat and Rama Nand Yadav., Proc. Nat. Acad. Sci. India, **64(A)II**, 200 (1994).
8. M. P. S. Chandrawat, R. N. Yadav and Ritu Mathur, Res. Ind., **39**, 18 (1994).
9. R. N. Yadav, Ph. D. Thesis, University of Rajasthan, Jaipur (1989)
10. Indian Standard (1958) p. 269.
11. British Sandard (1963) p. 12.
12. Indian Standard (1962) p. 712
13. B. L. Gupta, Conc. Tech., Standard Publication, New Delhi (1976) p. 18.

Accepted : 27.06.2008