Potential Application Of Alkali Activated Materials As Protection Coatings For Plaster Board

Maria Antony Sebastin Vimalan P, Lavanya G

Abstract : In this paper, the formulas of alkali activated materials (fly ash, metakaolin, GGBS) were prepared by mixing Sodium hydroxide (14 M) and Sodium silicate with suitable mix ratios. The glass fibred (3%) gypsum board and plain gypsum cubes were casted and coated with alkaline activated materials. The mechanical and physical properties were investigated. The cube compression specimen coated with AAMK was 12.96 MPa and the control mix has value 23.7 % lesser than the AAMK.

Keywords: Alkaline activated material, Gypsum, Coating, Glass fibre.

1. INTRODUCTION

The alkali activation of waste materials is a chemical process that allows the user to transform glassy structures (partially or totally amorphous and /or metastable) into very compact well-cemented composites. (AAMs) over traditional Portland cements is the much lower CO_2 emission associated with AAM production. AAMs are among several alternative binders which are being discussed at present with a view towards obtaining environmental savings in the construction industry; others include calcium aluminates, sulfoaluminates, supersulfated cements, and magnesium-based binders. Gypsum-based composites are receiving more and more extensive application in the development of new-type wall body materials. The main objective of this work is to evaluate the physico–mechanical properties of the plaster which are coated with Alkali activated materials.

2. PREPARATION OF ALKALINE LIQUID

Sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) were used as alkaline liquids. The molarity of NaOH used for the present study was 14M. For particular ratio of alkaline liquid to materials (fly ash, Metakaolin, GGBS) and sodium silicate to sodium hydroxide ratio were taken.

3. CASTING OF SPECIMENS

Gypsum plaster boards of size 250 x 250 x 20 mm were casted and coated with AAM. To determine compressive strength, 50 x 50 x 50 mm gypsum mortar cube specimens were tested. The specimens used in split tensile process were 50 mm diameter x 100 mm height long gypsum cylinders.

4. RESULTS AND DISCUSSIONS

Table 1 *Experimental results*

Mix	Compressive strength (N/mm^2)		Split tensile strength (N/mm^2)		Tensile strength (N/mm^2)	Water Absorption (%)
	7days	28days	7days	28days		
REF	6.24	9.88	0.85	1.363	0.35	15.8
AAF	6.53	10.88	1.44	1.65	0.41	19.1
AAMK	8.98	12.96	1.28	2.35	0.754	7.95
AAGGBS	7.22	10.20	0.954	1.584	0.22	8.56

TENSILE STRENGTH TEST

The tensile strength for the board containing gypsum plaster with the w/b ratio coated with various alkali activated materials shown in the above graph. The specimen AAMK GF gave the maximum strength of 0.754 MPa. The AA GGBS specimen has the least strength of 0.22 MPa. AAF specimen has given strength 92.5% higher strength than the AAGGBS. The incorporation of glass fiber has increased the tensile strength value of the AAMK GF specimen than the AAMK by 116.3 %.

- *Department of Civil Engineering, St. Mother Theresa Engineering College Vagaikulam, Thoothukudi, Tamilnadu, India. vimalan14@gmail.com, vimalan14p@gmail.com*
- *Department of Civil Engineering, University College of Engineering(Anna University Ramanathapuram Campus), Ramanathapuram, Tamilnadu, India. charulavanya@gmail.com vimalan14p@gmail.com*

COMPRESSIVE STRENGTH

The compressive strength for the gypsum mortar cube size of 50 mm containing w/p ratio 0.6 was found to be 9.88 MPa. The cube specimen coated with AAMK was 12.96 MPa and for the AAF specimen it was found to be 10.88 MPa. From the above results it was concluded that the control mix has given 23.7 % lesser compressive strength than the AAMK coated specimen. AA GGBS has yielded 10.2 MPa and this show that AAF and AAGGBS has nearly given the same compressive strength

SPLIT TENSILE STRENGTH

The split tensile specimen size height 100 mm and diameter 50 mm were casted with the w/p ratio 0.6.The results of split tensile test have shown that the gypsum specimen coated with AAMK yielded good strength of 2.35 MPa. AAF and AA GGBS had given nearly the equivalent

strength, which is slightly higher than the plain gypsum mortar. The AAMK specimen has split tensile strength 2.34 MPa which 69.2 % higher than the control specimen. When compared with the AAMK specimen, the AAF and AAGGBS have strength 30.4 % lesser.

WATER ABSORPTION

The specimen size of 50 mm cube containing gypsum plaster in the w/b ratio 0.6 werecoated with various alikali activated materials and tested for water absorption. The control gypsum mix absorbs 15.8 % water. The AAF coated specimen absorbs more water which contributes to 19.1 % which is higher than the control mix by 20.8 %. This shows that the AAF could not be used for work area containing more humidity. AAMK absorbs water by 7.95% and this value is lesser than the gypsum by 49.8 %..

CONCLUSION

1. The SiO_2/Na_2O ratio has significant effect on compressive strength. SiO_2/Na_2O 2% with Sodium hydroxide 14 M was used in the entire work. Alkali liquid /Binder ratio 1.2 and Na_2SiO_3 / NaOH ratio 1.3 were the optimum ratios in preparing alkali activated metakaolin coating material.
2. The cube specimen coated with AAMK had compressive strength 12.96 MPa and for the AAF specimen it was found to be 10.88 MPa. The AAMK specimen has split tensile strength 2.34 MPa which 69.2 % higher than the control specimen.
3. AAMK absorbs water by 7.95% and this value is lesser than the gypsum by 49.8 %.

REFERENCES

[1] Ali.M.A and Grimer J, “Mechanical Properties of Glass Fibre- Reinforced Gypsum‟, Journal of Materials science, Vol.4, pp.389-395.

[2] Bernal usan and Provis John „Engineering and durability properties of concretes based on alkali-activated granulated blast furnace slag/metakaolin blends‟, Construction Building Material, Vol.33, pp.99–108.

[3] Bakkali.H and Ammari.M, “NaOH alkali-activated class F fly ash: NaOH molarity, Curing conditions and mass ratio effect‟, J. Mater. Environ.

[4] Chiara Ponzoni and lavia Bollino, ”Inorganic polymers from alkali activation of metakaolin: Effect of setting and curing on structure‟

[5] Granizo and L Blanco, “Alkaline activation of metakaolin -An isothermal conduction calorimetry study‟, J. Therm. Anal, Vol.52,No.3, pp.957-96.

[6] Granizo ML, Blanco-Varela and artinez Ramirez, “Alkali activation of metakaolin: parameters affecting mechanical, structural and microstructural properties‟, J ater ci, Vol 4 , pp 4–43.

[7] Kuenzel C, Grover LM, Vandeperre L, Boccaccini AR and Cheeseman CR “Production of nepheline/quartz ceramics from geopolymer mortars‟,

[8] Laura Sele, Diana Bajare, Girts Bumanis and Laura Dembovska (2015), „Alkali Activated Binders Based on etakaolin‟, Environment Technology. Resources, Vol.1, pp.200-204.