EXPERIMENTAL INVESTIGATION OF PARTIAL REPLACEMENT OF CEMENT WITH KERAKOLL-BIOCEM AND FINE AGGREGATE WITH M-SAND IN CEMENT MORTAR

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Abstract - Utilization of these materials (Kerakoll-Biocem and M-Sand) in construction industry leads to several advantages including savings in the natural resources and green gases emissions. Hence, in this proposed work, experiments have been planned to study the effective utilization of these Kerakoll-Biocem and M-Sand in the construction industry by determining the Compressive strength with various percentages of Cement replacement with Kerakoll-Biocem and Fine Aggregate with M-Sand. M-Sand is available at all the crushing units as a by-product during production of 20mm and 10mm size aggregates, Kerakoll-Biocem is available by crushing the ceramics and tiles are admixed with cement mortar at various percentages by mass and studied for mechanical properties. About 19% increase in Compressive Strength is attained when cement is replaced with 10% Kerakoll-Biocem and Natural Sand replaced with 10% M-Sand.

Key words: Kerakoll-Biocem and M-Sand, Portland cement, Consistency, Setting time, Mechanical properties.

1. INTRODUCTION

The Natural Sand is being used as Fine Aggregate in Concrete making and is preferred as Fine Aggregate. It is mostly mined from the river beds and indiscriminate mining of Sand has caused damages to the environment. The global consumption of Natural Sand is very high, due to the extensive use of Concrete or Mortar. Now a day's, Sand is becoming a very scarce material, in this situation research began for inexpensive and easily available alternative material to Natural Sand. Out of the many available alternatives, crushed stone Sand has emerged as the most easily available material. This material is available at all the crushing units as a by-product during production of 20mm and 10mm size aggregates. Another form of crushed stone Sand is manufactured Sand (M Sand), which is better in terms of quality and fulfils the requirements of suitable material for use in Concrete. M Sand is manufactured by any of the methods- by crushing of coarse aggregates (20mm & 10mm) in separate Sand plants or using 3 stage VSI (Vertical Shaft Impact) crushers. Kerakoll-Biocem materials with high basic pH are naturally antibacterial and anti-mould, and ensure dry, healthy, disinfected environments, preventing bacteria and moulds from taking root and proliferating to the detriment of the health of the environments and the well being of the people in them.

2. MATERIALS USED

2.1 Cement

The Cement used for this study is Ordinary Portland Cement of 43 grade as per IS 12269-1987.

Fig -1: Ordinary Portland Cement

2.2 Sand

In this study, Grade I of particle size less than 2 mm and greater than 1mm for testing the strength of mortar was chosen. The zone of fine aggregate is based on the percentage of passing through the IS sieves. Zone of the fine aggregate used in this work is zone II.

2.3 M-Sand

M-Sand is crushed aggregates produced from hard Granite Stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river Sand. Manufactured Sand is popularly known by several names such as Crushed Sand, Rock Sand, Green Sand, UltraMod Sand, Robo Sand, Poabs Sand,

Barmac Sand, Pozzolan Sand etc. IS 383-1970 (Reaffirmed 2007) recognizes manufacture Sand as 'Crushed Stone Sand'. M-Sand can also be used for making masonry Mortar and shall conform to the requirements of IS 2116-1980 (Reaffirmed 1998) – "Specification of Sand for Masonry Mortars". In this project Karur crushed blue metal M-Sand was used.

Fig -2: M-Sand

2.4 Water

A tap water available in the concrete laboratory was used in preparation of the mortar. The qualities of water samples are uniform and potable. pH value lies between 6 to 8 and the water is free from organic matter and the solid content should be within permissible limit.

2.5 Kerakoll-Biocem

Kerakoll-Biocem Design was born, the new home design brand behind Cementoresina, the revolutionary, low environmental impact compound for joint-free surfaces that are perfect in eco-sustainable design. Kerakoll-Biocem is the leading manufacturer of green materials for designing, building, and living in harmony with the environment and in healthy spaces. Kerakoll-Biocem launched the new anti-earthquake and structural Strengthening system based on using matrices made from mineral and natural Geo-Mortars with Geo-Binder and Natural Lime NHL base.

3. PROPERTIES OF MATERIALS

Table -1: Properties of Cement

S.NO.	Property	Result
1	Initial setting time	34 minutes
2	Final setting time	340 minutes
3	Consistency	29%
4	Specific Gravity	3.14

Table -2: Properties of Kerakoll-Biocem

NO.	Property	Result
1	Initial setting time	32 minutes
2	Final setting time	290 minutes
3	Consistency	28%
4	Specific Gravity	2.14

Table -3 Physical properties of Sand

S.NO.	Property	Result
1	Specific Gravity	2.6
2	Fineness Modulus	2.52

Table –4: Physical properties of M-Sand

S.NO.	Property	Result
1	Specific Gravity	2.7
2	Fineness Modulus	3.25

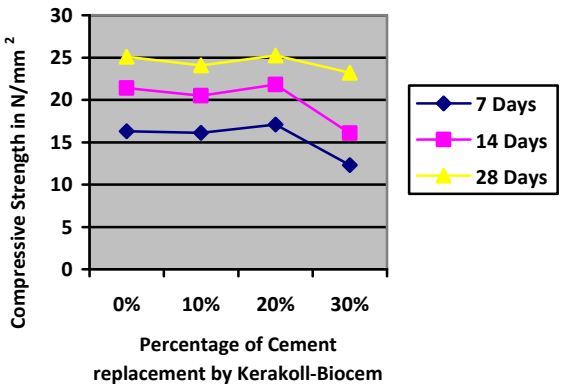
4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test of mortar cube

The Compressive Strength of the Cement Mortar was tested under 7 days, 14 days, 28 days curing period and their values are shown below

Table -5: Compressive Strength of Cement Mortar cube with Kerakoll- Biocem and M-Sand

% Of Addition Of Kerakoll-Biocem and M-Sand	Compressive Strength (f_{ck}) N/ mm^2		
	7th day	14th day	28th day
0%	16.30	21.39	25.10
10%	16.10	20.50	24.08
20%	17.08	21.80	25.26
30%	12.30	16.09	23.19



In 7days curing the Compressive Strength value for the Conventional Mortar was 16.3 N/mm² and Kerakoll-Mortar 10% was 16.1 N/mm² and beyond this percentage of replacement of cement Strength was gradually increasing and reaching 17.08 N/mm² for 20% replacement of percentage and beyond this percentage of replacement , the Strength was gradually reduced to 12.30 N/mm² for 30%.

In 14th day curing the Compressive Strength value for the conventional Mortar was 21.39 N/mm² and Kerakoll-Mortar -10% was 20.50 N/mm² and beyond this percentage of replacement of cement Strength was gradually increasing and reaching 21.80 N/mm² for 20% replacement of percentage and beyond this percentage of replacement, the Strength was gradually reduced to 16.09 N/mm² for 30%.

In 28th day curing the Compressive Strength value for the conventional Mortar was 25.10 N/mm² and Kerakoll-Mortar - 10% was 24.08 N/mm² and beyond this percentage of replacement of Cement Strength was gradually increasing and reaching 25.26 N/mm² for 20% replacement of percentage and beyond this percentage of replacement, the Strength was gradually reduced to 23.19 N/mm² for 30%.

About 19% increase in Compressive Strength is attained when Cement is replaced with 10% Kerakoll-Biocem and Natural Sand replaced with 10% M-Sand.

5. CONCLUSION

Based on the test results and discussions, the following conclusions could be drawn for the current study as follows:

Using Lime Water as a mixing solution delays both initial and final setting times for Portland cement based materials as well as mixes containing SF. The maximum delay was recorded for cement paste as 88 and 110 min for initial and final setting times for mixes P20LW and P30LW over the control mix P0W, respectively.

34.71% increase of the compressive strength was recorded for mix M30LW at 28th and 50 days age over the control mix which means 30% SF replacement instead of cement weight could be achieved and gives better enhancement in compressive strength when replacing tap water by LW in mixing.

60.96% increase of the tensile strength was recorded for mix M30LW at 28th and 50 days age over the control mix which means 30% SF replacement instead of cement weight could be achieved and gives better enhancement in compressive strength when replacing tap water by LW in mixing.

46.91% increase of the flexural strength was recorded for mix M30LW at 28th day age over the control mix which means 30% SF replacement instead of cement weight could be achieved and gives better enhancement in flexural strength when replacing tap water by LW in mixing.

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