Experimental Studies on Fresh & Hardened Concrete by Incorporating the Marble Powder, Brick Powder & Metakaolin in Cement

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Abstract— Making and utilizing of a sustainable concrete has become an important requirement day by day. To reduce the environmental effect, several of supplementary cementing and pozzolonic materials are introduced and they are partial replacement of cement in the concrete. In this work I am using three materials, namely brick powder, marble powder and metakaolin as partially replacing with cement. Marble powder and brick powder are cheaply available in the India. Cement production creates environmental problems. So Marble powder, brick powder & metakaolin as partial replacement with cement in concrete. This Project reports the results of fresh and hardened properties of the concrete with partial replacement of marble powder & brick powder as well as metakaolin, at various percentages at different curing periods ,tests to be performed are destructive as well as non destructive and producing a good comparative results with these partial supplements in the mixture of concrete.

Keywords: Fresh & Hardened Concrete, Marble Powder, Brick Powder & Metakaolin in Cement

I. INTRODUCTION

In this experimental study, we are supposed to introduce the low cost materials that are useful for the preparation of cement concrete ,the partial supplements are marble powder, brick powder and met kaolin in the cement concrete with various percentage replacements .This study is reference for us for future experimental analysis on concrete .we found out finally the tensile ,compressive and nondestructive results on the concrete cubes and cylinders obtained satisfactory results .

II. LITERATURE REVIEW

ONG, CHEE HUAT (2006) the study focuses on the compressive strength performance of the blended concrete containing different percentage of metakaolin. The cement is replaced accordingly with the percentage of 5 %, 10%, 15%, 20%, and 30% by weight. Concrete cubes are tested at the age of 1, 3, 7, and 28 days. In addition, the effect of calcination temperature to the strength performance is included in the study. Finally, the strength performance of metakaolin-concrete is compared with the performance of concrete blended with silica fume and slag.

BAI, JIPING, GAILIUS, ALBINAS Development of a multivariate statistical model for consistency parameter prediction including slump, compacting factor and vebe time for concrete incorporating FA and MK is described. The models constructed provide an efficient, quantitative, and rapid means for obtaining optimal solutions to consistency prediction for concrete mixes using PC-FA-MK blends as binder. A.K.MULLCK (2007) Described among the many factors that govern the durability and performance of concrete in service, type of cement receives greater attention. In his paper he describes the characteristics of cementitious systems required to meet the diverse requirements of strength and durability of concrete and highlights the advantages of part replacement of OPC by fly ash, granulated slag and silica fume- either singly or in combination in ternary blends.

JELICA ZELI, IVANA RADOVANOVI, DRA`AN JOZI [7] Investigated the deterioration of concrete structures due to the presence of sulfate in soils, groundwater and marine environments is a well-known phenomenon. The use of blended cements incorporating materials such as natural pozzolona, fly ash, or silica fume have an important role in the long-term durability of concrete exposed to sulfate attack.

III. EXPERIMENTAL PROGRAM

1) Formulation Title & Thesis
2) Selection of Materials & Testing
3) Casting of Cubes & Cylinders
4) Testing of Cubes & Cylinders
5) Data Interpretation

A. Physical properties of used materials

1) Cement:

S. No.	Property	Value
1	Fineness of cement	4.52 %
2	Specific gravity	3.05
3	Normal consistency	33 %
4	Setting time Initial setting time Final setting time	 40 Mins 6 Hours
5	Compressive strength at 3 days 7 days 28 days	 34 N/mm^2 44.8 N/mm^2 59 N/mm^2

2) Marble Powder:

S. No	Property	Value
1	Physical state	Fine powder
2	Odor	Odorless
3	Appearance	Free flowing
4	Color	Pure white
5	PH (5% solution)	6. 0
6	specific gravity	2. 6
7	Moisture	Below 0. 5%
8	Oil absorption ml/100gm	18. 20
9	Particle size	Below 90 microns

3) Meta Kaolin:

S.No.	Property	Value
1	Specific Gravity	2.54
2	Accelerated pozzolanic active index, % of control	89
3	Residue on 45 micron sieve, %	1.31
	Chemical analysis	

4	Loss on Ignition	0.70
5	Silica (SiO_2)	52.24
6	Iron Oxide (Fe_2O_3)	0.60
7	Aluminum (Al_2O_3)	43.18
8	Calcium Oxide (CaO)	1.03
9	Magnesium Oxide (MgO)	0.61

4) Fine aggregate:

S. No.	Property	Value
1	Specific Gravity	2.60
2	Fineness Modulus	3.77
3	Bulk Density Loose Compacted	 14.67 KN/m^3 16.04 KN/m^3
4	Grading	Zone II

B. Mix Design:

THE MIX DESIGN IS CARRIED OUT ACCORDING TO CODE BOOKS

1) IS 10262-2009
2) IS 456-2000

IV. MIXING PROCEDURE OF CONCRETE

After proportioning all concrete ingredients their mixing is done. The mixing process should ensure homogenous mass uniform color. Segregation should not take place during the mixing operation.

1) Mixing is done by two following methods
2) Hand mixing
3) Machine mixing

V. TESTS ON MATERIALS

The tests that are conducted on hardened concrete are

1) Compressive strength.
2) Split tensile strength.
3) UPV test

VI. RESULTS

Compressive Strength Test of Metakaolin + Brick Powder + Marble Powder for 7 days

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			7DAYS
0 %	0 %	0 %	30.15
5%	5%	5%	31.80
10%	10%	10%	31.89
15%	15%	15%	31.91
20%	20%	20%	31.91

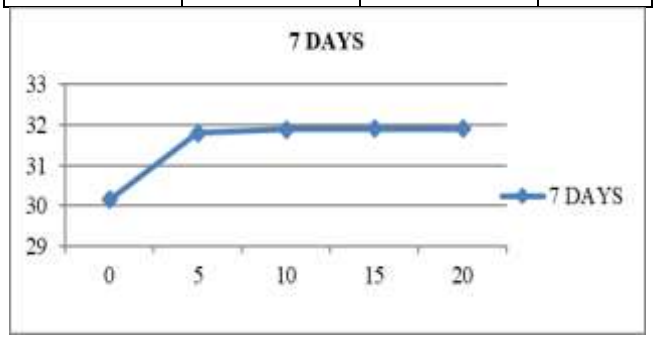


Fig. 1: Compressive Strength Test of Metakaolin + Brick Powder + Marble Powder for 28 days

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			28 DAYS
0 %	0 %	0 %	48.00
5%	5%	5%	49.3
10%	10%	10%	49.32
15%	15%	15%	50.12
20%	20%	20%	50.4

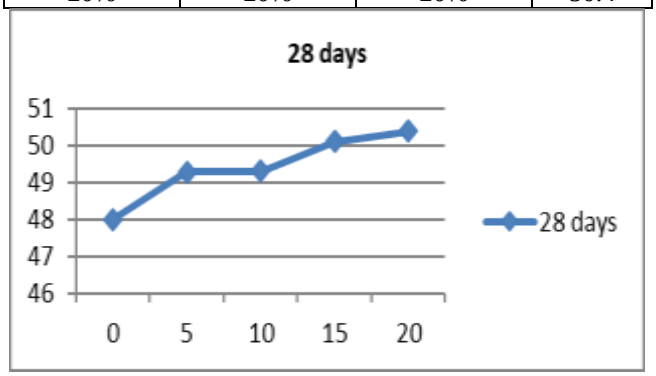
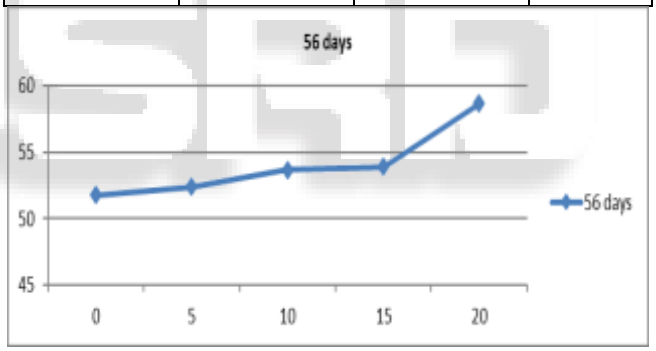


Fig. 2: Compressive Strength Test of Metakaolin + Brick Powder + Marble Powder for 56 days

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			56 DAYS
0 %	0 %	0 %	51.8
5%	5%	5%	52.4
10%	10%	10%	53.7
15%	15%	15%	53.9
20%	20%	20%	58.7



VII. SPLIT TENSILE STRENGTH TEST RESULTS:

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			7 DAYS
0 %	0 %	0 %	4.91
5%	5%	5%	5.46
10%	10%	10%	5.84
15%	15%	15%	5.98
20%	20%	20%	6.13

A. 28 days

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			28 DAYS
0 %	0 %	0 %	7.41
5%	5%	5%	7.86
10%	10%	10%	7.89
15%	15%	15%	7.94
20%	20%	20%	8.12

B. 56 days

% of METAKAOLIN + BRICK POWDER + MARBLE POWDER			56 DAYS
0 %	0 %	0 %	8.41
5%	5%	5%	8.48
10%	10%	10%	8.79
15%	15%	15%	8.9
20%	20%	20%	9.4

C. UPV Test:

S NO	% OF METAKAOLIN +BRICK POWDER+MARBLE POWDER	Obtained average velocity(m/s)	Quality of Concrete
1	0	4570	Excellent
2	5	4579	Excellent
3	10	4794	Excellent
4	15	4798	Excellent
5	20	4800	Excellent

VIII. DISCUSSIONS

The following conclusions have been arrived from the study:

1) Metakaolin is an effective pozzolona and results in enhanced early strength and ultimate strength of concrete.
2) The compressive strength of young concrete, i.e., 7 days is improved by blending the OPC with 10%, 15 %, 20 % of metakaolin by weight.
3) The 10% replacement with metakaolin is the most optimum replacement, enhancing the concrete's compressive strength at all ages.
4) The 28-days compressive strength of concrete was improved by partial replacements of OPC by metakaolin in the range up to 10% by weight, and was at the 20% level still maintained. The highest 28-days strength improvement of concrete can be expected at partial replacements in the 10-15% range.
5) The combined use of metakaolin and a super plasticizer allowed increasing the aforementioned partial replacement levels, i.e. to 20% in the case of maintaining strength.
6) Ternary blending by Metakaolin in combination with BRICK,& marble powder was found leading to further technical improvements to concrete strength.
7) Brick powder is low cost material which is useful to cast concrete slabs and further when combined with the ternary blends.
8) The split tensile strength results are also satisfactory when replacements of MATERILAS (METAKAIOLIN, BRICK POWDER, & MARBLE POWDER)
9) Non-destructive test also gives the optimum results when tested
10) Overall performance of the concrete is very good with three replacements.
11) Only disadvantage is three partial supplements for fine aggregate.

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