Analytical Study For Different Grades of Concrete on Partial Replacement of Cement By Marble Dust Powder (MDP)

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Abstract- *Concrete is the most widely used construction product because of its high structural strength and stability. Its main constituents are cement, sand, aggregates and water. Nowadays it has been comes in miscellaneous researches that to bypass these conventional ingredients in the evolution of sustainable development. These dissertation work covers the experimental study to observe the behavior of marble dust powder on replacement with cement for M25, M40 & M50 grade concrete, in this process we replace cement with marble dust powder at 0% to 15% with a constant interval of 2.50%, we made 7 batches including the batch of conventional mix also, the concrete was design mix for M40 & M50 grade, while M25 grade concrete was nominally mix, further we compare the properties of fresh concrete such as workability etc. observations were made that initial setting time and workability both increases for fresh concrete for all mixes, on the other hand when Physical properties of concrete were tested & compressive, flexural and split tensile strength achieved at 10% replacement of cement for M25 & M40 concrete, while this replacement limited up to 5% for M50 grade concrete, with this results we could say that this replacement is limited up to a small extent for high performance concrete. All specimens were tested at 7, 14 & 28 days curing age. It can be conclude that we can limit the use of cement content up to a certain extent to save both environment and economy, the later is very vital for any developing country.*

I. MATERIAL USED

a. Cement

The cement used is OPC 43 grade confirming to IS 269, Water – cement ratios were as per design and workability requirement, this was free from lumps and not older to three months all the physical requirements were achieved, quantity acquired was too huge so in this regard I custom distinct brands, we know that the basic inert parts of cement, and well known by its properties and functions of the same, the main character of this to part well binding to join other elements to form a unique matter.

b. Sand

Sand is a naturally occurring coarse material collected from finely separated rock and mineral particles. It is defined by size, being finer than gravel and coarser respect to silt. Sand refer as a textural class of earth either category; i.e. posses greater to a value 85% sand-like molecules. The composition of sand vary, depend on the local rock source and situation, other than the most frequent constituent of sand in inland continental settings and non-tropical coastal setting is silica usually in the form of quartz, this nature of sand is very useful because it repel the several cracks in concrete and keep a large amount of moisture surrounding to this. In point of particle size treated by geologists, sand sizes in diameter as of 625 micron to 0.2 cm. single grain in this territory size defined for sand grain. River sand was assembling for this motive.

c. Aggregate

Aggregate is crucial supplement for concrete. This embodied strength for concrete, and provide cost cutting purposing where required. Aggregates obtained from stone quarries, after successive processing. Metal composed concrete mass should be hard and tough enough to resist the external forces and subsequent wear tear phenomenon, & makes heavier. Due to good draining behavior it has vast uses. In this regards here well shaped and sampled stone were add-on.

d. Marble Dust Powder (MDP)

This is the waste generated in the stone manufacturing industries during, shaping, cutting and cleaning of marbles stones. Through this process, about 20-25% of the procedure marble is turn into the powder variety. India being the third (about 10%) Prime most exporter of marble in the

world, every year million tons of marble waste forms processing plants is released. Because of the accessibility of huge amount of waste formed in the marble plant, this assignment has been intended and preceded.

Table: Physical properties of marble dust powder

S. No.	Properties	Result
1	Specific gravity	3.04
2	Color	White
3	Form	Powder
4	Odour	Odourless
5	Fineness	3.1%

Table: Salient chemical properties of marble dust powder

S. No.	Chemical Compound	Test value of MDP in %	Standard of Natural Cement Content (%)
1	Calcium oxide (CaO)	55.08	32-58
2	Silica dioxide (SiO2)	0.47	23-28
3	Magnesium oxide (MgO)	0.41	1.4-2.6
4	Iron oxide (Fe2O3)	0.13	1.4-3.3
5	Aluminium dioxide (Al2O3)	0.16	5.1-8.2
6	Lost on ignition in %	44.45	-
Total amount		100	-

II. OBJECTIVE OF PROJECT

In the present Experimental Investigation the following objectives are aimed.

- Analysis for strength of concrete by using Marble Dust Powder MDP.
- Evaluate compressive strength, flexural strength and split tensile strength of the Concrete made by using MDP as a part replacement of cement.
- To study the properties of fresh concrete using marble dust powder, and its effect on strength characteristics of concrete.
- To find the optimum percentage of marble dust powder for obtaining the maximum strength of concrete.

III. METHODOLOGY

Methodology involves the formulation of experimental work, and this section include the adoption of appropriate amount of quantity of different ingredients, which will be further consume in making concrete of different grades and for subsequent testing approaches.

Estimation of quantities for M-25 grade concrete mix-

Quantity of material for making concrete will further include the separate quantities of cube, beam and cylinder specimen. This will be calculated on the basis of the formulation based on the conventional mixing ratio of M-25 grade concrete as 1:1:2, and the water/cement ratio taken as 0.5 for fair workable mix and strength criteria too, then the quantities for each specimen will be tabulated further.

Calculation of Quantities of Ingredients for M-25 Grade Concrete:

Nominal Mix Design of M-25
Grade Concrete Mix Proportion 1:1:2
Quantity of concrete for 1 cubic meter volume
Dry volume of 1 cum. Concrete 1.52
Ratio for individual materials = 1.52/1+1+2
= 1.52/4 = 0.38
Quantity of cement = 0.38 Cum.
Quantity of Sand = 0.38 Cum. / 13.41Cubic ft.
Quantity of Sand = 0.76 Cum. / 26.82 Cubicft.
Water Cement Ratio = 0.5

IV. EXPERIMENTAL WORK

a. Fineness test:

The fineness of cement is measured by sieving it on standard sieve. The proportion of cement of which the grain sizes are larger than the specified mesh size is thus determined.

Apparatus Required: I.S. Sieve No. 9 (90 micron), Weighing balance, tray, Cement.

Theory: This test performed either by sieving or by determination of specific surface by air-permeability apparatus. Specific surface is the total surface area of all the particles in one gram of cement.

Procedure: This test is carried out to check proper grinding of cement. The finer cement will have fast chemical reaction with water and thus gives early strength.

Figure – 90 micron IS Sieve

The cement weighing 100 grams is taken and placed in I.S. Sieve No. 9 and sieved continuously for a period of 15 minutes. The residue is then weighed. The residue by weight should not be more than 10% of original weight.

b. Consistency test

The purpose of this test to determine the appropriate amount of water to be supply for mixing to make a proper concrete mix which has good workability, mobility and it should be a homogeneous mass.

c. Initial and final setting time tests

The initial setting time is determined by taking the height between the mixing of water to cement and the stage once needle stops to penetrate totally. The time should be about 30 to 35 minutes for OPC. Repetition process followed until the annular ring makes an impression on the top of sample.

d. Aggregate Impact Value (AIV)

The property of a material to resist impact is known as toughness. Due to movement of vehicles on the road the aggregates are subjected to impact resulting in their breaking down into smaller pieces, the aggregates should therefore have sufficient toughness to resist their disintegration due to impact. Aggregate impact value is a measure of resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load.

V. RESULT

Fineness test of cement

Table: Fineness test of cement as per IS 4031:1988

Results for Avg. of 3 samples from each bag		Wt.of Each Sample taken = 100 gms.	
Sample No.	Wt. of material passing	Wt. of material retained	% of retained
1	97	2	2
2	97.5	1.4	1.4
3	91.3	7.5	7.6
4	94.3	6.6	6.7
5	95.5	3.4	3.4
6	94.4	5.1	5.1
7	98.4	1.7	1.7
8	98.7	1.6	1.4
9	96	3	3
10	94	7	7
11	92.8	8.1	8.2
12	96	4	4
13	92.4	7.2	7.4
14	96	4	4
15	92.4	8.5	8.1

Result: - Fineness of cement is found to be **4.79 %.**

Table: Consistency test of cement as per IS: 4031-1995

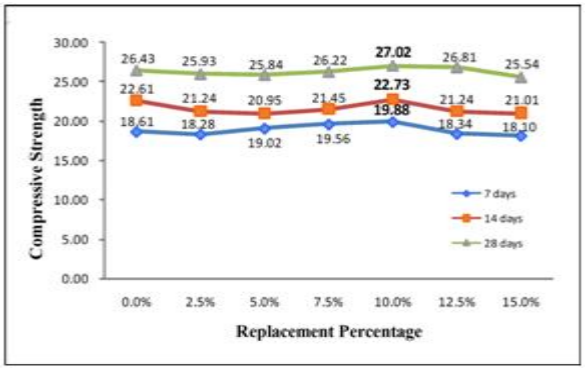
S. No.	Wt. of Cement (in gms.)	Quantity of Water added (in gms.)	Penetration (in mm) from bottom	% of Water
1	400	120	16	30%
2	400	140	10	35%
3	400	152	6	38%

Table: Setting time test results

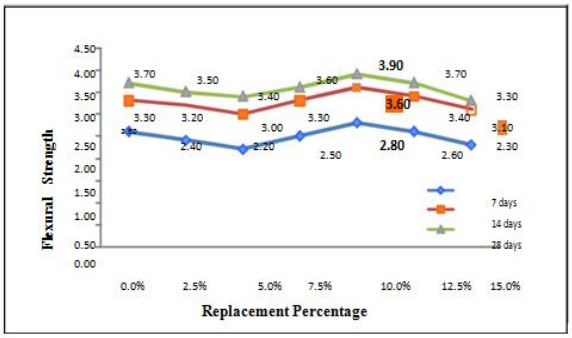
Sample No.	Setting time (in minutes)		Depth of Penetration (in mm)
	Initial setting time	Final setting time	
1	31	582	5
2	32	591	5
3	32	592	5

Result: -

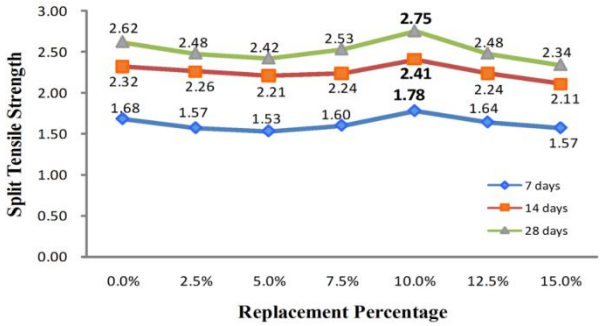
1. The initial setting time of the cement sample is found to be **33 minutes.**
2. The final setting time of the cement sample is found to be **592 minutes.**



Graph: Compressive Strength for M-25 grade concrete in graphical form



Graph: Flexural Strength for M-25 grade concrete in graphical form



Graph: Split Tensile Strength for M-25 grade concrete in graphical form

VI. CONCLUSION

Following conclusions were made:

Physical properties Viz. Compressive strength, Flexural strength &Split tensile strength test were performed and results analyzed. These compliances achieved for concrete on partial replacement of cement by MDP at 0%, 2.5%, 5%, 7.5%, 10%, 12.5% & 15%, for M25, M40 &M50 grades. & maximum values of results were found & highlighted. From the results it is conclude that the MDP can be pertinent part alternative for cement or may be use as a filler substance. The rate of strength increase in Marble powder concrete is remarkable, these conclusions had been revealing. Marble dust is a convenient waste product for partial replacement of cement to bypass this kind of prevailing conventional material. Workability of concrete increases as proportion of marble powder increases up to a limited extent, further it is observed that the workability was highly increases but concrete was not remain in position of gaining proper binding and setting, this was evident by conducting setting time and consistency tests for appropriate mixture of cement & marble dust powder which reveal that marble dust powder is found highly flow able on mixing with very less quantity of water and setting time was also elapsed.

Maximum compressive strength was observed when cement replaced by Marble powder at 10% for M25 & M40 grade and at 5% for M50 grade.

Maximum flexural strength was observed when cement replaced by Marble powder at 10% for M25, M40 &M50 grade.

Maximum split tensile strength was observed when cement replaced by Marble powder at 10% for M25, M40 &M50 grade.

Replacement of cement for high performance concrete is limited, because binding of marble powder particle

with other constituents of concrete arises predominantly and this resists the concrete to attain a homogeneous mass.

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