To Study the Impact of Acid Attack and Sulphate Attack On Various Properties of MDP Concrete

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Abstract— The strength of concrete is determined by using the slump cone test and strength test of MDP-10 CONCRETE. The average compressive strength for MDP-0, MDP-5, MDP- 10, MDP-15 and MDP-20 concrete mixes were found to be 23.36, 24.59, 26.37, 25.19 AND 23.70 respectively for 7 days. Similarly, compressive strength obtained for 28 days was 34.81, 36.59, 38.37, 37.93 and 37.19 respectively indicating the maximum strength of MDP-10 concrete mix. The compressive &flexural strength also determine for M40 with mix sand mix basalt stone Equivalent down basalt dust stone, glass powder foundry sand using whose is the toughest material of stone and also available easily cheapest materials, samples were prepared by varying percentage 20, 30, 40, 50% of foundry sand as a part of the replacement of fine aggregates in mix design are prepared in different proportions. Cubes and beams are cast for determining compressive and flexural strengths respectively at 7 and 28 days but as same (BSD, GP+FS) 5+15, 10+20, 15+25 and 20+30% as respectively at 7 and 28 days. And compare to all condition Relationship between compressive strength and flexural strength is presented. The results clearly indicate the compressive strength of the 28 days material is higher as compared to 7 days material. We can say that age of concrete. The figure shows that the M20 with concrete with different dust compressive strength for the 7 & 28 days. The results clearly indicate the strength of the material is decreased with an increase in sand percentage in concrete. 40 % gives good result of concrete. The figure shows that the M20 material beams tested in the flexural test for the 7- & 28-days material. The flexural strength results clearly indicate the strength of the beam also 30% gives good result is higher than the other percentage mix of all waste dust material. To require more compaction required good workmanship and not bonding with each other.

Keywords: Slump Cone Test, Compressive Strength Test, Durability Tests

I. INTRODUCTION

Concrete is the most widely used construction material in the world delivered by utilizing locally accessible ingredients. It is a composite material composed of fine and coarse aggregate bonded together with cement paste which hardens with time and gains strength to form a rock-like mass. This strength of concrete is achieved due to the chemical reaction called hydration. The strength, workability, durability, and other characteristics of concrete depend upon the properties of its ingredients, the mix proportions, the method of compaction and other controls during placing, compaction, and curing. Marble is a metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite. Marble is commonly used for sculpture and as a building material.

Durability of concrete is defined as its ability to resist weathering action, chemical attack, abrasion, or any other process of deterioration while maintaining its desired engineering properties. It also includes the effects of quality and serviceability of concrete when exposed to chemical attacks.

II. MARBLE DUST POWDER (MDP)

Marble has been commonly used as a building material since the ancient times. Consequently, Marble waste as a by-product is a very important material which requires adequate environmental disposal effort. In addition, recycling waste without proper management can result in environmental problems greater than the waste itself. Marble dust is a waste product formed during the production of marble. A large quantity of powder is generated during the cutting process. The result is that about 25% of the original marble mass is lost in the form of dust. Leaving these waste materials to the environment directly can cause environmental problems such as increases the soil alkalinity, affects the plants, affects the human body etc. Marble powder can be used as an admixture in concrete, so that strength of the concrete can be increased. It is a solid waste material generated from the marble processing and can be used either as a filler material in cement or fine aggregates while preparing concrete. The production of cheaper and more durable concrete using this waste can solve to some extent the ecological and environmental problems. This paper highlights, the feasibility of the substitution of marble waste for cement to attain economy and environment Saving.

A. Environmental Problems Attributed to Marble Dust Powder (MDP)

- The WDP imposes serious threats to ecosystem, physical, chemical, and biological components of environment. Some of the problems encountered are:
- It adversely affects the productivity of land due to decreased porosity, water absorption, water percolation etc.
- When dried, it becomes air borne and cause severe air pollution. It introduces occupational health problems and affects the machinery and instruments installed in industrial areas.
- It affects the quality of water during rainy season and reduces storage capacities and damaging aquatic life.
- It adversely affects social and industrial activities of people since the heaps of powder remain scattered all round the country are an eye sore and spoil aesthetics of entire region.

B. Sulphate Attack

Sulfate attack in concrete and mortar can be 'external' or 'internal'.

External: due to penetration of sulfates in solution, in groundwater for example, into the concrete from outside.

Internal: due to a soluble source being incorporated into the concrete at the time of mixing, gypsum in the aggregate, for example.

C. ACID Attack

Ordinary Portland Cement (OPC) is highly alkaline in nature with pH values above, When the cement paste meets the acids its components break down, this phenomenon is known as acid attack.

$$Ca(OH)2 + 2HCl ==> CaCl2 + 2H2O$$

III. OBJECTIVES OF STUDY

The following are the objectives of the current study"

- To study the various general properties of coarse aggregates, fine aggregates, and cement.
- To design M – 30 strength concrete mix using locally available materials.
- To study the effect of addition of marble dust powder (MDP) in varying percentage in concrete.
- To determine the optimum percentage of MDP in concrete.
- To compare the variation in properties of normal concrete and MDP concrete when exposed to acid and sulphate attack.

IV. METHODOLOGY

A. Tests on Aggregates

The following tests on aggregates were performed:

1) Impact Test

The aggregate impact test is carried out to evaluate the resistance to impact of aggregates. Aggregates passing 12.5 mm sieve and retained on 10 mm sieve is filled in a cylindrical steel cup of internal diameter 10.2 mm and depth 5 cm which is attached to a metal base of impact testing machine. The material is filled in 3 layers where each layer is tamped for 25 number of blows. Metal hammer of weight 13.5 to 14 Kg is arranged to drop with a free fall of 38.0 cm by vertical guides and the test specimen is subjected to 15 number of blows. The crushed aggregate can pass through 2.36 mm IS sieve. And the impact value is measured as percentage of aggregates passing sieve to the total weight of the sample.

2) Shape Test

Flakiness Index: The flakiness index of aggregate is the percentage of the mass of the aggregates whose least dimension is less than 0.6 times the mean dimension. The flakiness test is applicable to aggregates of size larger than 6.3 mm.

Elongation Index: The elongation index of aggregates is the percentage by weight of the particles whose longest dimension (i.e. length) is greater than 1.8 times the mean dimension

3) Specific Gravity and Water Absorption Test

The specific gravity and water absorption of aggregates are important properties that are required for the design of concrete and bituminous mixes. The specific gravity of a solid is the ratio of its mass to that of an equal volume of distilled water at a specified temperature.

4) Sieve Analysis

Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In this we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves.

B. Tests on Cement

The following tests on cement were performed:

1) Fineness Test

Fineness is nothing but the mean size of grains of cement. It is performed to measure the average size of cement grain. The finer the cement the more will be the surface area for hydration and hence more will be the strength of cement.

2) Consistency Test

Consistency test is performed to estimate the amount of water required to form a cement paste of normal consistency.

3) Setting Time Test

Cement has two types of setting time; one is initial setting time, and another is final setting.

Initial setting time of the cement is that state of cement when it starts to become stiff. Final setting time of the cement is that state when cement becomes fully non - workable.

4) Soundness Test

Soundness of cement is performed to check the volume change in cement after setting. Higher the changes in volume higher will be the cracks and other failure.

Strength Test

Compressive strength test of cement is performed on size 70.6*70.6*70.6 mm3 mold. Cement with higher compressive strength is better.

C. Construction of Concrete Mix

The concrete mix was constructed as per the design provided in chapter 4. The MDP concrete was obtained by thoroughly mixing the marble dust powder inside the dry concrete mix before addition of water by varying percentage of 5%, 10%, 15% and 20% with respect to the total weight of cement in the mix. The mixes were denoted as MDP-0 (0% marble dust powder), MDP-5 (5% marble dust powder), MDP-10 (10% marble dust powder), MDP-15 (15% marble dust powder) and MDP-20 (20% marble dust powder).

D. Tests on Concrete

The following tests on aggregates were performed:

1) Slump Cone Test:

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction.

2) Compressive Strength Test:

- To determine the compressive strength and durability effects of concrete, 150 mm
- × 150 mm × 150 mm size concrete cubes were cast and tested in accordance with IS: 516-1959.
- All strength tests were conducted using 2000 kN compression testing machine. Cube moulds of size 150x150x150 mm were used.

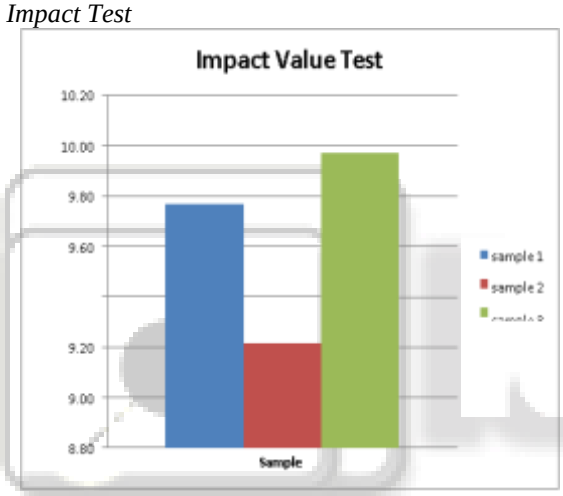
E. Durability Tests

5% V/V solutions of H2SO4 and MgSO4 were made. All types of concrete mixes were immersed in this solution for 30 and 60 days after the curing period of 28 days. Before the immersion of cubes each cube was marked and weighed. After the end of the immersion period the cubes were tested for their reduction in compressive strength.

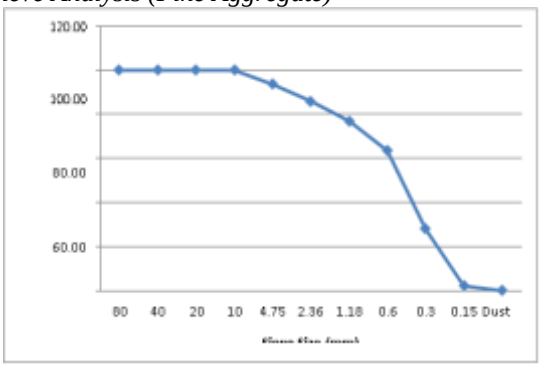
V. TEST RESULTS

A. Test on Aggregate

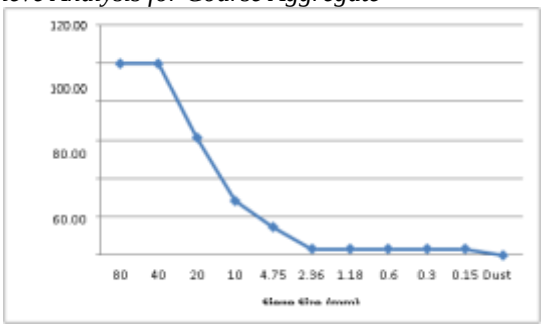
1) Impact Test



2) Sieve Analysis (Fine Aggregate)



3) Sieve Analysis for Coarse Aggregate



4) Specific Gravity and moisture content

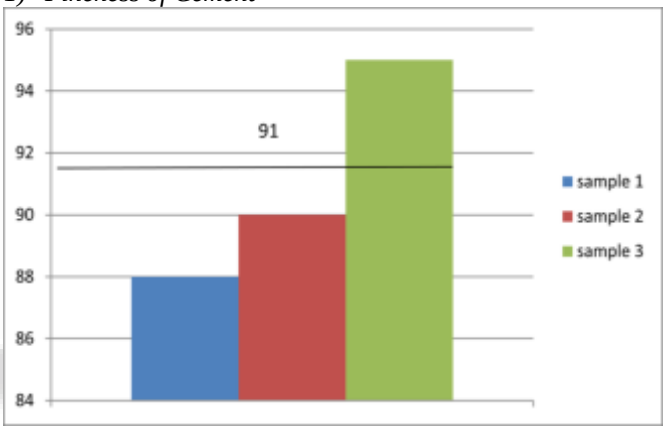
Weight of sample in SSD condition	2160 gm
Weight of Empty Bucket in water	1580 gm
Weight of Bucket and sample in water	2870 gm
Weight of Empty pan	370 gm
Weight of Pan + Oven dried sample	2420 gm
A= weight of oven-dry test sample in air	2050 gm
B= weight of saturated-surface-dry test sample in air	2160 gm
C= weight of saturated test sample in water	1290 gm
Bulk Specific Gravity,	2.36
Apparent Specific Gravity	2.70
Bulk SSD Specific Gravity	2.48
Moisture Content	5.37 %

5) Shape Test

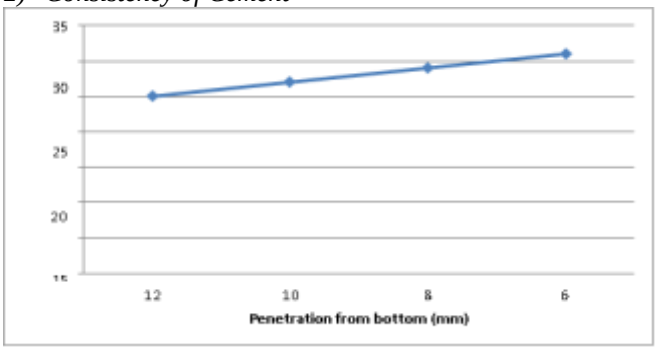
Flakiness Index = 12.27%
Elongation Index = 16.25%
Flakiness + Elongation = 28.52%

B. Test on Cement

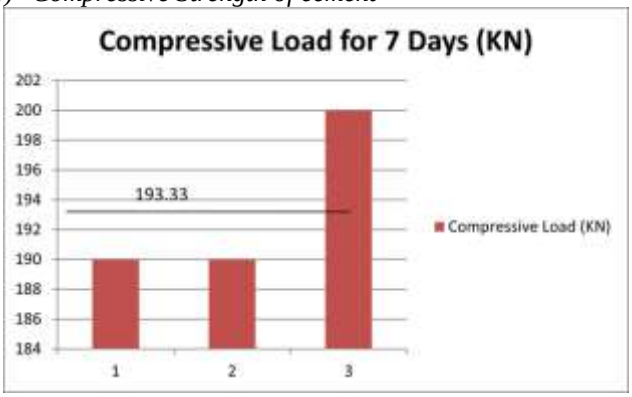
1) Fineness of Cement

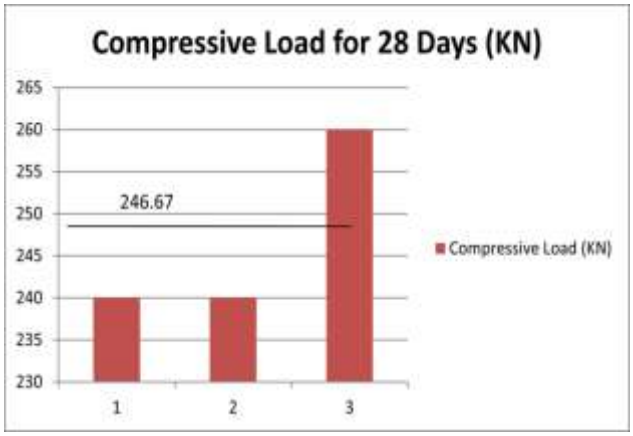


2) Consistency of Cement

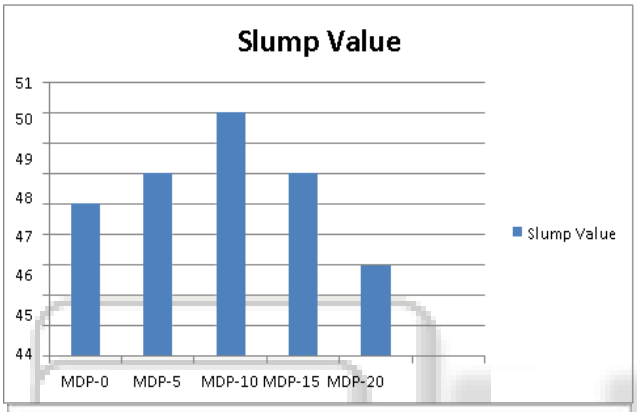


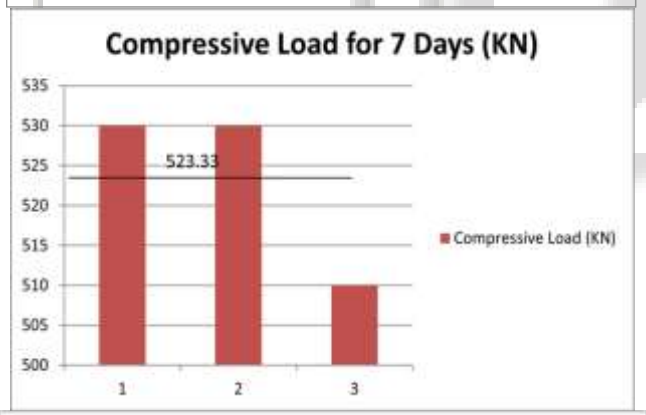
3) Compressive Strength of cement

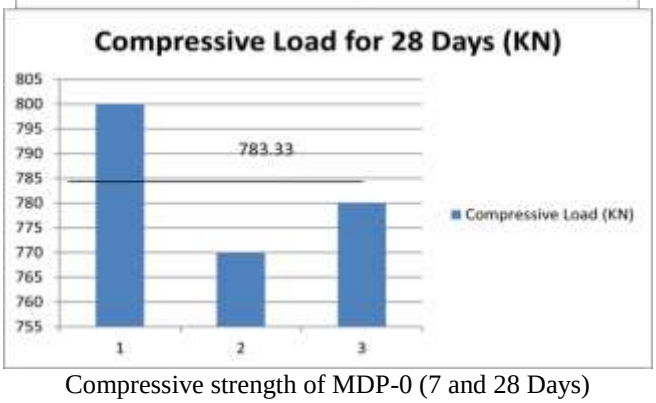




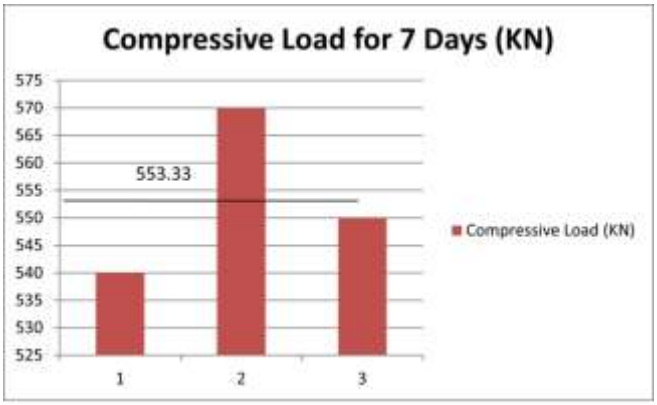
C. Test on Concrete

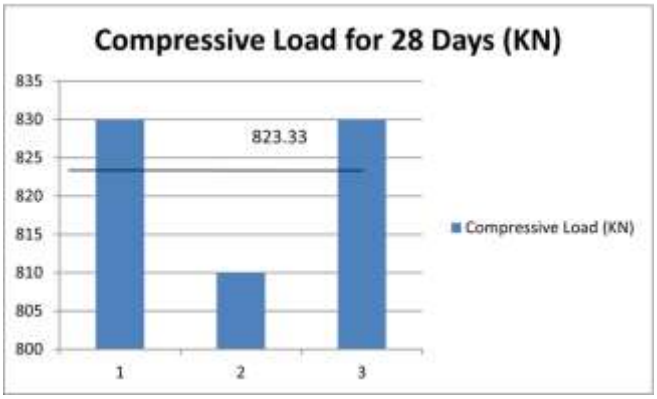






Compressive strength of MDP-0 (7 and 28 Days)





Compressive strength of MDP-5 (7 and 28 Days)

VI. Conclusion

After the conclusion of the experimental work the following conclusions were drawn:

The average compressive strength for MDP-0, MDP-5, MDP-10, MDP-15 and MDP-20 concrete mixes were found to be 23.36, 24.59, 26.37, 25.19 AND 23.70 respectively for 7 days. Similarly, compressive strength obtained for 28 days were 34.81, 36.59, 38.37,37.93 and 37.19 respectively indicating the maximum strength of MDP-10 concrete mix.

The average percentage compressive strength reduction of MDP-0, MDP-5, MDP-10, MDP-15 and MDP-20 concrete mixes in MgSO4 solution for 30 days were found to be 4.25, 3.64, 2.32, 3.52 AND 4.38 respectively. Similarly, average percentage compressive strength reduction for 60 days was 7.66, 6.07, 4.25, 5.47 AND 6.37 respectively indicating minimum reduction of strength in MDP-10 concrete mix in MgSO4 solution.

The average percentage compressive strength reduction of MDP-0, MDP-5, MDP-10, MDP-15 and MDP-20 concrete mixes in H2SO4 solution for 30 days were found to be 9.36, 8.50, 5.79, 7.03 and 8.37 respectively. Similarly, average percentage compressive strength reduction for 60 days was 12.34, 10.53, 8.49, 9.77 amd 10.76 respectively indicating minimum reduction of strength in MDP-10 concrete mix in H2SO4 solution.

Because of results obtained from compressive strength test and durability tests against chemical attack the optimum percentage of marble dust to be added can be concluded to be 10%.

REFERENCES

[1] Shetty MS. Concrete technology. S. chand & company LTD. 2005 May:420-53.
[2] Gambhir ML. Concrete technology: theory and practice. Tata McGraw-Hill Education; 2013.
[3] Gambhir ML. Concrete manual: laboratory testing for qualifying control of concrete. Dhanpat Rai. & sons, New Delhi. 1987.
[4] Sudheer, K. S., Kumar, P. P. S., Reddy, M. A. K., & Rao, V. R. A Study on Durability of Concrete by Partial Replacement of Cement with Bentonite. 2017,10(6): 898-904.
[5] Vyas C M, Patel I, Bhatt Dr. Durability Properties Of Concrete With Partial Replacement Of Natural Aggregates By Recycled Coarse Aggregates. Research and Development (IJCSEIERD). 2013 Jun; 3(2):125-34.
[6] Kumar T K, Priyanka N. Experimental study on properties of strength and durability of concrete by partial replacement of fine aggregate with copper slag and cement with egg shell powder for M30 and M40 grade concrete. International Journal of Professional Engineering Studies 2017 May; 8(4):94-103.
[7] Swaroop AH, Venkateswararao K, Kodandaramarao P. Durability studies on concrete with fly ash & Ggbs. International Journal of Engineering Research and Applications. 2013 Jul; 3(4):285-9.
[8] Shah DS, Pitroda J. An experimental study on durability and water absorption properties of pervious concrete. International Journal of Research in Engineering and Technology. 2014 Mar;3(03):439-44.
[9] Karakoç MB, Türkmen İ, Maraş MM, Kantarci F, Demirboğa R. Sulfate resistance of ferrochrome slag based geopolymer concrete. Ceramics International. 2016 Jan 1;42(1):1254-60.
[10] Daisy Angelin P, Ravi Kishore P. Durability Studies on Concrete with Manufacturing Sand As A Partial Replacement of Fine Aggregate In HCL Solution. International Journal of Engineering Research and Development. 2015; 7:44-50.
[11] Haldive SA, Kambekar AR. Experimental study on combined effect of fly ash and pond ash on strength and durability of concrete. International Journal of Science and Engineering Research. 2013 May 9; 4(5):81-6.
[12] Midhu Jolly and Prof. Praveen Mathew A Study on Durability Properties of Scc And Conventional Concrete with Recycled Coarse Aggregate. IOSR Journal of Mechanical and Civil Engineering. 2016 Sep-Oct; 13 (5):35-41.
[13] Almograbi M. Durability study of lightweight concrete material made from date palma seeds (DPS). High Performance Structures and Materials V. 2010 Jul 1;112:69

