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Effect on Compressive Strength of Concrete on Partial Replacement of Cement by Marble Dust and Fly Ash

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Abstract- In this growing world of science and technology, the pollution is still a major problem across the globe, and construction industries play a vital role in air pollution and soil pollution. The use of marble stone in houses is on huge demand and because of this stone cutting and dressing, factories produces the dust in large quantity, which results in accordance of many problems when left freely in environment. So, keeping these problems in view, the reuse or recycle of this dust can help us in many ways. Hence, we used the marble dust as a cementitious material, by partially replacing cement in concrete, can help in reuse by large quantity. Also, the use of fly ash with cement in concrete was taken. The testing cubesof grade M10 were tested on accountability of marble dust and fly ash. The compressive strength of cubes was tested at duration of 7^{th} days. The positive and negative behavior of concrete with duration was noticed. The production of cubes is economic and environmental.

Keywords- Compressive Strength, Partial Replacement, Marble Dust and Materials.

1. INTRODUCTION

Cement concrete is a material synonymous with strength and longevity. The challenge for civil engineers in the near future is to realize the projects in line with the concept of sustainable development and involves the use of high performance impact [1].

The leading factor influencing the quality of cement-based composites and their appropriate adherence is ordinary Portland cement. The manufacturing of OPC requires a meaningful consumption of energy and the production of enormous greenhouse gas emissions, including carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOX), black carbon (BC), and sulphur dioxide (SO2), therefore contributing to environmental pollution. Global cement production is the third biggest source of carbon dioxide emissions. The average value of CO2 intensity emission from all worldwide cement production is 222Kg of CO2/ton of cement [1].

From an economic point of view, it may be considered appropriate to replace a portion of ordinary Portland cement with waste mineral dust. In addition, this treatment is an environmentally friendly solution. Due to an excessive amount of very fine particles in dust, the voids in cement based material could be thoroughly filled. Its particle size and chemical composition by product make this material regarded as an attractive additive in cement based materials technology [2].

Marble has been widely used as a building material in the civil engineering industry. During the mining process and in the polishing of marble stone, marble dust is perceived as a waste material. These by products are present in the environment and contribute to pollution. The utilization of marble dust reduces the cost of cement_ based material production and also decreases the costs of removing it from the environment [3].

Thermal power plants in India generate large quantities of fly ash which has a significant impact on the environment and living organisms. The use of fly ash in concrete can reduce the consumption of natural resources and also reduce the impact of pollutants in the environment. Fly ash is one of the residues that is produced in the process of combustion of coal.

1.1 OBJECTIVES

- To study the influence of partial replacement of cement with marble dust and fly ash to compare the strength of original mix.
- It can be economically use and decrease the cost of construction.
- To investigate the strength properties compressive strength at different ages of hardened concrete.

1.2 SCOPE OF THIS WORK

In this project our main objective is to study the partial replacement of cement with marble dust and fly ash. The compressive strength of OPC of concrete are obtained. Similarly, compressive strength was obtained for 0% and 5% replacement of cement with marble dust and fly ash by weight [4].

2. LITERATURE REVIEW

Jashandeep sing et al.2015 studied on partial replacement of cement with waste marble dust with M10 grade and concluded that up to 12% replacement of cement with waste marble dust there is an increase in all mechanical properties. The replacement of 12% of cement with waste marble dust attains maximum compressive strength. The optimum percentage for replacement of marble dust with cement is almost 12% for both cubes and cylinders. To minimize the cost for construction with usage of marble dust that is freely of cheaply available. To realm of saving the environment pollution by cement production being our main objective [5].

Pooja j., 2014 studied on "To study the behavior of marble dust as supplementary cementitious material in concrete" and concluded that compressive strength increases with increase of marble dust. The maximum 28 days split tensile strength was obtained with 45% marble powder replace with fine aggregate where as in case of compressive strength the strength was gained by replacement of 30% along with replacement of sand by 45-50%. The marble slurry utilization in black cotton soil is one of the best ways to improve soil properties and to protect the environment up to some extent from the harmful effects of disposal of marble slurry in land and water.

Chatterjee, 2011 report about 50% of fly ash generated is utilized with present efforts. He also reports that, one may achieve up to 70% replacement of cement with fly ash when high strength cement and very high reactive fly ash is used also with the sulphurated naphthalene formaldehyde super plasticizer. He reported improvement in fly ash properties could be achieved by grinding and getting particles in sub microcrystalline range.

3. MATERIAL USED

3.1 CEMENT:
OPC is used in the Project work, as it is readily available in the local market. The cement used in the project work has been tested for varies preparation as par IS:1489-1991. The specific gravity was 3.05 [6], [7], [9].

3.2 FINE AGGREGATE:
The natural sand is used as fine aggregate for the study purpose [6], [7], [9], [14].

3.3 COARSE AGGREGATE:
The fraction of 20mm is used as coarse aggregate [6], [7], [9], [14].

Fig.1-Coarse Aggregate

3.4 WATER:
Water which has free form salt is generally considered for making concrete [6], [7], [9].

3.5 MARBLE DUST:
Marble dust was used as partial replacement of cement at 0 to 10% [6], [7], [9]. Red Marble Dust (RMD) and White Marble Dust (WMD) are used as partial replacement of cement.

3.6 FLY ASH
Fly ash is used as a supplementary cementitious material in the concrete [6], [7], [9].

4. TEST CONDUCTED ON MATERIALS

4.1 Cement: - Initial & final setting time, standard & normal consistency, specific gravity [10], [11].

4.2 Fine & coarse aggregate: - specific gravity, moisture content, partial size distribution [11].

4.3 Concrete: -

Fresh concrete: slump test, compaction factor, vee-bee consist meter.

Harden concrete: compression test, split tensile test, flexural test [11], [16].

5. INTERLOCK MOULD ESTIMATION FOR MATERIAL QUANTITY

- Area of interlock mould=27580mm^2
- Height of interlock mould=3.3cm=80mm
- Volume of interlock mould=27580*80=2206400mm^3=0.00221m^3
- Dry volume of concrete=1.54/m^3
- Ratio of M10=1:3:6

1. Quantity of cement=Pc*D. V/∑P=1*1.54/(1+3+6)=0.154m^3
Quantity for 0.00221m^3=0.154*0.00221=0.00034m^3
1cum=28.8 bags of cement
0.00034cum=28.8*0.00034=0.0098bags
1bag=50Kg
So, 0.0098*50=0.491Kg
Quantity of cement in 1 interlock=0.491Kg

2. Quantity of fine aggregate=3*0.491=1.473Kg

3. Quantity of coarse aggregate=6*0.491=2.946Kg

M10 concrete ratio for 1 interlock=0.491:1.473:2.946

Table-1 mix proportion

Cement	43 grades
Type of cement	OPC
Grade of Concrete	M10
Proportion	1:3:6
Quantity/Mould	1. Cement=0.491 kg 2. Fine Aggregate=1.473 kg

	3. Coarse Aggregate=2.946 kg
Maximum size of aggregate	20mm passing
Max. water cement ratio	0.53
Workability	Good

Fig.2 Concrete casting of interlock

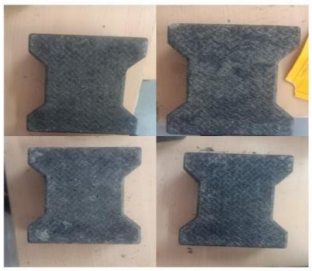

Fig.3 Interlock after curing

6. RESULTS AND DISCUSSION

6.1 Compressive Strength:

The test result is also presented in table 3. By increasing the marble dust, the compressive strength values of concrete tends to increase at each curing age. This trend can be attributed to the fact that marble dusts posses cementing properties. It is also as much effective in enhancing cohesiveness due to lower fineness modulus of the marble dust. Furthermore, the mean strength of concrete mixes with marble dust was 5-10% higher than the reference concretes. However, there is a slight decrease in compressive strength value concrete mix when 30% marble dust is used as compared with that of 20% marble dust mix [12], [17].

Table 2- compressive strength test results

Trials	*% of red marble dust*	*% of white marbledust*	*% of fly ash*	*Mean compressive strength of cube specimen in N/mm^2*		
I	0%	0%	0%	9.42		
II.	5%	5%	5%	RMD	WMD	FA
				6.5	11.6	8.7

In above table:

RMD means Red Marble Dust

WMD means White Marble Dust FA means Fly Ash

7. CONCLUSION

In this paper main emphasis was on the compressive strength of concrete. The initial compressive strength of concrete casted using marble dust is more than concrete casted using fly ash. Also it is found that as the quantity of marble dust increases the workability of concrete decreases.

By the use of marble dust the cost of manufacturing concrete decreases because marble dust is freely or cheaply available and saving the environmental pollution by cement production as the release of green house gases decreases.

Based on this work following research gap identified:

1. The scrap marble may be used in concrete after converting into powder form
2. This present research on marble dust based concrete is based on theoretical analysis and laboratory tests but it can be done in field also.

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