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Cement Replacement in concrete with Marble Dust Powder

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Abstract – *The requirement for locally manufactured building material has been emphasized in many countries. Environmental problems can be issued due to dumping of waste materials. Waste can be used for production of new products as an admixture so that natural resources are used more efficiently and the environment is protected from waste deposits. The industrial marble stone generate both solid waste and stone slurry. Stone slurry generated from industries up to 15-20% of total final products during processing. There are several reuse and recycling solution for industrial waste. The industrial wastes are dumped to the ground for improving their fertility property of soil. In this study total 42 cubes were casted. Marble product are mixed in concrete mix M-20 in different percentage (5%, 10%, 15%, 20%, 25%, and 30%) by weight. The cement was replaced by marble powder. After curing (7 and 28 days), cubes were tested. The replacement of cement with 10% of marble powder gives the maximum compressive strength at both 7 days and 28 days curing period. It was found that marble dust available at every processing plant in huge quantity and its cost is very less compared to cement. So with the replacement of cement by marble dust a cost effective concrete can be achieved.*

Key Words: **Marble dust, Cement, Concrete, Stone slurry, Compressive Strength.**

1. INTRODUCTION

The advancement of concrete technology is reducing the consumption of natural and energy resources, and reduces the environmental pollution by the industrial waste. The large amounts of marbles are generated in stone processing plant which pollute the environment and effect the humans. The project describes the feasibility of using marble dust with partial replacement of cement. Total 42 cubes were casted by using marble dust with partial replacement of cement in various percentage of (5%, 10%, 15%, 20%, 25%, and 30%) and compressive strength test were done after 7 days and 28 days.

1.1 Main Ingredients

Portland pozzolana cement is used in this experimental work. Crushed granite 20mm coarse aggregate has been used. The specific gravity of coarse aggregate is 2.64 and fineness modulus of coarse aggregate is 6.816, natural sand which is easily available was used. Sand is used from Arpa River. Marble dust was collected from processing plant in bilaspur (C.G.). Water is used as per requirement.

1.2 Method of mixing

The various ingredients are mixed as per IS code. In the mixing procedure the ordinary Portland cement, dust, sand and aggregate were used. In this work sand is taken from Arpe river Bilaspur. As an aggregate 20 mm sized marble chips was used and the powder of crushed marble is used as a cement replacement material. All the material are taken as per requirement and mixed properly by manual method of mixing. Mixing should be in such a way that there should not be any segregation and bleeding.

2. Test on Ingredient

Cement- The following tests consistency, initial setting time and final setting time were conducted on cement to know the physical properties of cement. The test is conducted on cement as well as replaced cement with dust percentage.

Table -1: Consistency Test on Cement

Cement	% of cement replaced with marble dust powder			
	5%	10%	15%	20%
30%	35%	37%	39%	40%

Table -2: Initial Setting Time of cement

Cement	% of cement replaced with marble dust powder			
	5%	10%	15%	20%
34 min	40min	43min	44min	48min

Table -3: Final Setting Time of cement

Cement	% of cement replaced with marble dust powder			
	5%	10%	15%	20%
9h 10 min	8h 10min	7h 15 min	7h 5 min	6h 48 min

Marble chips- In this work aggregate impact value, abrasion value and flakiness index value of marble chips was find out.

Table -4: Test result on marble chips

Impact Value	Abrasion Value	Flakiness Index
7.63%	17.2%	20.67%

3. Test on Cube

In this study total 42 cubes were casted. Marble dust in different proportion as a replacement of cement were used for the manufacturing of concrete mix of M-20 grade. The compressive strength of cube of size 150 mm x 150 mm x 150 mm were determined after 7 days and 28 days curing period in compression testing machine. Table 5 shows the test result on cube after 7 days curing period whereas Table 6 shows the test result after 28 days curing period. Fig 1 shows compression test machine used to determine compressive strength of concrete.

Table -5: Compressive strength test result of concrete cubes after 7 days curing

Percentage of marble powder	1	2	3	Avg. compressive Strength in N/mm²
0	18.66	18.88	19.77	19.10
5	20.00	20.44	20.66	20.36
10	20.44	20.66	20.44	20.51
15	18.66	18.44	19.11	18.73
20	16.00	15.55	16.00	15.85
25	13.77	13.33	13.77	13.62
30	12.44	12.00	12.00	12.14

Table -6: Compressive strength test result of concrete cubes after 28 days curing

Percentage of marble powder	1	2	3	Avg. compressive Strength in N/mm²
0	18.66	24.88	25.33	24.73
5	28.00	26.66	27.55	27.40
10	30.22	30.66	28.88	29.92
15	24.88	24.00	24.44	24.44
20	23.55	23.11	22.22	22.96
25	20.44	19.11	20.88	20.14
30	17.77	18.66	17.77	18.07

Fig-1: Compression Test Machine

Fig -2: Marble dust Powder available in processing plant

Marble dust used in this project was procured from marble Processing plant Bilaspur. These dust are very harmful for human health as well as animal and plants. With the use of these waste material the quantity of waste material can be minimize. Hence it is a waste optimization technique. With the replacement of cement by marble dust powder we can achieve a greener construction. Fig 2 shows marble dust powder available in processing plant whereas fig 3 shows the

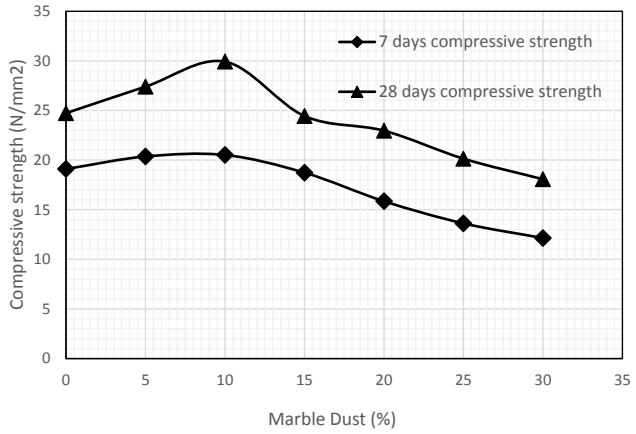
concrete cube manufacture by replacement of cement with dust and fig 4 shows the crushed granite which is used in this study.

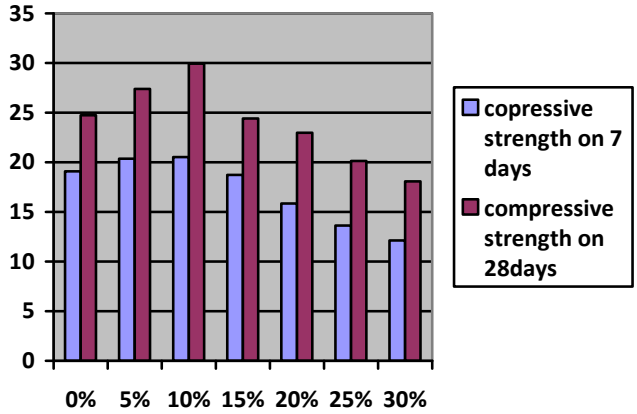
Fig -3: Marble dust Concrete Cube

Fig-4: Crushed granite

Graph : Compressive Strength of Cubes on 7 & 28 days in N/mm^2 of replacement of cement with marble dust powder in different %(0%,5%,10%,15%,20%,25%,30%)

According to this graph the highest compressive strength were achieved by 10% replacement of cement with marble dust powder and then adding extra percentages of marble dust powder then the compressive strength were starts to decreases.





CONCLUION

- The consistency of cement increased by replacement of cement percentage with marble dust powder increased, and if the consistency of cement increases the water consumption in concrete increases, which produce bleeding of concrete.
- If percentage of replacement with marble dust powder is increased, the initial setting times of cement will also increased. And if the initial setting times of cement increased than the final setting times of cement will decreased, which is dangerous for concrete for gaining strength.
- If percentage of cement replaced with marble dust power is more than 10%, than the compressive strength on concrete will start to decrease. it is showing in the graph that the compressive strength of concrete is increased by replacement of cement with marble dust powder up to 10%, and after than adding extra percentage of marble dust powder by replacement of cement, the compressive strength of concrete is start to decrease.
- According to this study, the replacement of cement up to 10% with marble dust powder in M-20 grade of cement concrete cube the compressive strength of the cubes increased and then further increase the replacement of cement with marble dust powder there was decrease the strength.

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