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Experimental Analysis of Addition of Marble Waste Dust Powder Partially Replacing Cement

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Abstracts - Cement is used extensively at worldwide level. From the research studies, it has been estimated that the cement is responsible for 3% greenhouse gases whereas, 55 for emission of CO2. When one ton of cement is produced, approximately 0.8 tons of CO2 is released into the environment waste material from various industries also threatens the world as they also imparts detrimental effects on the environment. Dumping or burning such material produces various gases and ashes which is damaging the environment in many ways. Therefore, there can be ways with which these materials can easily replace the cement in the production of concrete. It will produce eco-friendly concrete which will be a win-win situation for everyone. In present study, effect of percentage replacement of cement by marble waste powder at different proportions (from 0% to 20%) on different properties of concrete was studied. As marble powder is a waste product of marble industries therefore, it can be used as an eco-friendly material. Thus we found out the optimum percentage for replacement of marble powder with cement and it is almost 10% cement for both cubes and cylinders.

Keywords: Marble Dust Powder, cement Replacement.

1. Introduction

The demand of cement is rising with the development of infrastructures in the modern world. But the process of production of cement in the manufacturing units is detrimental to the environment as it generates the CO and imparts negative effect. Cement is used extensively at worldwide level. From the research studies, it has been estimated that the cement is responsible for 3% greenhouse gases whereas, 55 for emission of CO2. When one ton of cement is produced, approximately 0.8 tons of CO2 is released into the environment waste material from various industries also threatens the world as they also imparts detrimental effects on the environment. Dumping or burning such material produces various gases and ashes which is damaging the environment in many ways. Therefore, there can be ways with which these materials can easily replace the cement in the production of concrete. It will produce eco-friendly concrete which will be a win-win situation for everyone.

2. Objectives of the Study

The objectives of this study are:

- To study the effect of percentage replacement of cement by marble waste powder on different properties of concrete.
- To find the optimum percentage of marble powder for replacement of cement at which maximum strength is obtained.
- Provides safeguard to the environment by utilizing waste properly.
- To conduct compressive strength and tensile strength test and thus obtaining best results from them.
- Furthermore, as a part of research objectives, this study will draw conclusion and recommendations based on research findings indicate areas for further research work.

2. Material Used

Cement: Ordinary Portland Cement (OPC) of 43 Grade from a single lot was used for the study. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture. The physical

properties of the cement are listed. The physical properties of the cement as determined from various tests conforming to Indian Standard IS: 8112:1989 are listed in Table.

Table: 1. Physical properties of cement

Sr. No.	Properties	Observations
1	Fineness (90 micron IS Sieve)	4 percent
2	Initial setting time	45 minutes
3	Final setting time	470 minutes
4	Standard consistency	30 percent
5	Specific Gravity	3.07
6	28 days compressive strength	46.2 Mpa

Aggregates: Locally available aggregates were used and gradation of these aggregates was carried out. Fineness modulus of fine aggregates was found out to be 2.715 and specific gravity was 2.67. Fineness modulus of coarse aggregates was found out to be 7.3 and specific gravity was 2.80.

Table: 2. Gradation of Fine Aggregates.

S.No.	Sieve size	Mass retained (gm)	Percentage retained (%)	Percentage Passing (%)	Cumulative %ages retained, F
1.	4.75mm	1	0.1	99.9	0.1
2.	2.36mm	81	8.1	91.9	8.2
3.	1.18mm	244	24.4	75.6	32.6
4.	600µ	223	22.3	77.7	54.9
5.	300µ	258	25.8	74.2	80.7
6.	150µ	143	14.3	85.7	95.0
7.	Pan	39	3.9	Zone II	271.5

Table: 3. Gradation of Coarse Aggregates.

S.No.	Sieve size	Mass retained (gm)	Percentage retained (%)	Percentage passing (%)	Cumulative %age retained, C
1.	80mm	0	0	100	0
2.	40mm	0	0	100	0
3.	20mm	0	0	100	0
4.	12.5mm	2743	54.86	45.14	54.86
5.	10mm	1352	27.04	72.96	81.9
6.	4.75mm	896	17.92	82.08	99.82
7.	Pan	6	0.12	∑C	236.58

Marble Powder: Marble powder was collected from the dressing and processing unit in Rajasthan. It was initially in slurry form; after that it is dried by exposing in the sun and finally sieved by IS-90 micron sieve before mixing in concrete.

Figure 1. Marble Powder.

Water: Mixing water used for all the mixes was tap water which was supplied in the concrete laboratory. The water was clean and free from oil, acids, alkalis, salts and other substances harmful to concrete. Same water was used for curing also.

3. Results and Discussion

The quantities of various materials are as follows which were calculated from mix design:

Cement content: 322.22 Kg/m^3

FA content: 584 Kg/m^3

CA content: 1124.63 Kg/m^3

Water: 145 Kg/m^3

COMPRESSIVE STRENGTH RESULTS:

The Compressive strength of Cubes are increased with addition of waste marble powder up to 10%n replace by weight of cement and further any addition of waste marble powder the compressive strength decreases. The results of compressive strength have been represented in the table below.

Table: 4. Compressive Strength test Results for Concrete Mix

S.No.	Percentage (Marble)	Compressive strength at 7 days (N/mm^2)	Compressive strength at 28 days (N/mm^2)	Compressive strength At 56 days (N/mm^2)
1	0%	18.37	23.42	34.41
2	5%	18.56	26.95	38.2
3	10%	20.82	28.44	40.1
4	15%	18.10	20.30	33.12
5	20%	14.96	19.24	29.92

TENSILE STRENGTH RESULTS:

The Split Tensile strength of Cylinders are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the Split Tensile strength decreases. The results of tensile strength have been represented in the table below.

Table: 5. Compressive Strength test Results for Concrete Mix

S.No.	Percentage (Marble)	Tensile strength at 7 days (N/mm²)	Tensile strength at 28 days (N/mm²)	Tensile strength At 56 days (N/mm²)
1	0%	2.12	3.31	5.22
2	5%	2.22	3.50	5.27
3	10%	2.92	3.75	5.53
4	15%	2.64	3.49	5.37
5	20%	1.80	3.11	5.12

WORKABILITY

Table: 6. Slump Value for Concrete Mix

% Replacement	Slump Value
0	55
5	57
10	63
15	65

4. Conclusions

After evaluating the performance of normal and replacement concrete, the final conclusions drawn for the present experimental study are mentioned below:

1. The Compressive strength of Cubes are increased with addition of waste marble powder up to 10%n replace by weight of cement and further any addition of waste marble powder the compressive strength decreases.
2. The Split Tensile strength of Cylinders are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the Split Tensile strength decreases.
3. Thus we found out the optimum percentage for replacement of marble powder with cement and it is almost 10% cement for both cubes and cylinders.
4. We have put forth a simple step to minimize the costs for construction with usage of marble powder which is freely or cheaply available; more importantly.
5. We have also stepped into a realm of the environmental pollution by cement production; being our main objective as Civil Engineers.

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