

Study on Structural Behaviour of Marble Dust Powder in Concrete

K. Ayyappan and K. Thiruvengatasamy

Department of Harbor and Ocean Engineering, AMET University, 135 East Coast Road,
Kanathur, 603112 Chennai, India

Abstract: Concrete is one of the important construction material used in the world of all engineering works including the infrastructure development proved that, it is a cheap material and its constituents are widely available in nature. Due to wide spread usage and fast infrastructure development in all over the world there is shortage of cements. These materials are available with high cost to prevent this cement can be replaced with waste materials. In this project work cement will replaced by marble dust powder with various percentages of 0, 5, 10 and 15%.

Key words: Concrete, marble dust, structural behaviour, compressive strength, flexural strength, materials

INTRODUCTION

Marble dust is a heat resistance material, thus, it prevents the formation of cracks. With the increase in construction activities there is heavy demand on concrete and consequently on its ingredient like aggregate also (Sahu, 2016; Shirule *et al.*, 2012). However, our objective of the project is:

- To study and compare the strength behaviour of concrete using marble dust as a partial replacement of cement
- To minimize the utilization of the cement, marble dust powder used as cement. To study the properties of materials
- To study the compressive strength, split flexural strength and flexural strength with replacement of cement and different percentage of marble dust powder
- To indicate the replacement of concrete compared with conventional concrete

In this study, also described in preparation and characterization of the structural, optical, spectroscopic and electrical properties of Pr_2O_3 doped borate glass (Vasumathy *et al.*, 2016). Experimental study on partial replacement of cement with marble powder and fine aggregate with quarry dust and with addition of polypropylene fiber is discussed by Kavibala (2016). Synthesis and characterization of Yttrium stabilized zirconia nanoparticles is discussed by Maridurai *et al.* (2016).

MATERIALS AND METHODS

By substituting marble dust powder in various percentages with cement in concrete, the experiments were conducted and the test results are logged. Marble dust powder is added in the percentages of 0, 5, 10 and 15%. The 3 cubes and 3 beams are prepared with each of this different concrete mix. Finally, the compressive and flexural strength of these samples are tested and logged in the intervals of 7, 14 and 28 days. Figure 1 shows the sample marble dust powder taken for experiment and Table 1 and 2 lists out its chemical and physical properties respectively.

About 100 g of the marble dust powder contains 60 g of calcium oxide and another 40 g contains some chemical components, the exact composition is given in Table 1.

The physical properties like hardness and color of the marble dust powder is discussed in Table 2. Marble dust powder is nothing but a powder form of the waste marble obtained from the quarries.



Fig. 1: Marble dust powder sample

Table 1: Chemical properties of marble dust powder

Description	Percentage
SiO ₂	19.67
Al ₂ O ₃	5.19
Fe ₂ O ₃	3.69
CaO	62.91
MgO	2.49
Na ₂ O ₃	0.23
K ₂ O	0.89
SO ₃	2.77
LOI	0.96

Table 2: Physical properties of marble dust powder

Description	Specification
S. gravity	2.61
Color	White color
Source form	Powder
Type of odour	Odourless
Moisture content (%)	0.60
Sieve size	0.90 mm
Hardness of powder	3 (Mohr's scale)
Water absorption (%)	0.98

Table 3: Test results for compressive strength of cubes

Replacement (%)	Compressive strength (N/mm ²)		
	7 days	14 days	28 days
0	16.88	21.24	37.72
5	15.23	22.01	41.36
10	16.71	20.45	39.24
15	14.66	18.98	36.19

Table 4: Test results for flexural strength of beam

Replacement (%)	Flexural strength (N/mm ²)		
	7 days	14 days	28 days
0	3.46	4.28	5.86
5	3.9	5.96	7.67
10	4.46	4.77	6.83
15	3.7	4.12	5.97

RESULTS AND DISCUSSION

The mix design was prepared for the M₂₅ grade concrete and the concrete was cast and tested with partial replacement of cement by marble waste powder with various percentages of 0, 5, 10 and 15%. Table 3 shows the logs of compressive strength of cubes taken in the intervals of 7, 14 and 28 days and similarly Table 4 shows the test results flexural strength of beams.

The result shows that compressive strength increases gradually with inclusion of marble dust powder and at some point it starts reducing. Till 10% replacement the compressive and flexural strength are increasing and at 15% the values are reduced.

CONCLUSION

The various percentage of marble dust powder in concrete has the following conclusion. The maximum flexural strength for partial replacement of fine aggregate with marble dust powder be achieved by 5% is found to be greater than the conventional concrete. It achieved maximum compressive strength when there is partial replacement of fine aggregate with marble dust powder (5%). So, the optimum percentage of replacement of marble dust powder is 5%.

REFERENCES

- Kavibala, N., 2016. Experimental study on partial replacement of cement with marble powder and fine aggregate with quarry dust and with addition of polypropylene fiber. Intl. Conf. Current Res. Eng. Sci. Technol., 1: 39-42.
- Maridurai, T., D. Balaji and S. Sagadevan, 2016. Synthesis and characterization of yttrium stabilized zirconia nanoparticles. Mater. Res., 19: 812-816.
- Sahu, C., 2016. Partial replacement of cement with marble dust powder. Imperial J. Interdiscip. Res., 2: 97-104.
- Shirule, P.A., A. Rahman and R.D. Gupta, 2012. Partial replacement of cement with marble dust powder. Intl. J. Adv. Eng. Res. Stud., 1: 175-177.
- Vasumathy, D.A., P. Murugasen and S. Sagadevan, 2016. Preparation and characterization of the structural, optical, spectroscopic and electrical properties of Pr₂O₅ doped borate glass. Mater. Res., 19: 923-927.