Evaluate the Properties of Concrete Prepared using Waste Marble Dust

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Abstract

Production of residues from industries and construction sectors has increased during last few years. Much of this wasteland has been land filled, without seeing its possibility for reuse or recycling. In the ceramic industry, nearly 15%-30% production goes as waste. The replacement of cement with Ceramic Waste Powder (CWP) or Marble Dust Powder (MDP) produces a substantial modification in compressive strength, making them suitable for the fabrication of concrete. In this research study the Ordinary Portland Cement (OPC) has been replaced by MDP accordingly in the reach of 0%, 5%, 10%, 15%, by weight of M-20 grade concrete. Concrete mixtures were tested and compared in terms of compressive strength of the conventional concrete at 14 days and 28 days. The aim of this research study is to study the behavior of concrete durability in comparison by partial replacement of cement with MDP.

Keywords: Cement Concrete, Industrial Waste, Marble Waste, Ceramic Waste

1. Introduction

Marble is one of the non-foliated changeable rock which is made out of recrystallized carbonate mineral that is most ordinarily calcite or dolomite. Geologists utilize the term marble as the transformed limestone; stonemasons utilize the term all the more comprehensively to incorporate it as metamorphosed limestone. Marble is generally utilized as a part of model furthermore as building material.

In this project a control mix of concrete of grade M20 grade has been prepared and 3 sample each with partial replacement with cement of 5%, 10%, 15% respectively has been caste whose various strength are checked after 14 days, 28 days respectively. The result of the above studies with an aim of finding the optimum value of replacement has been shown in the study.

2. Material and Methods

The various type of material used in casting process of concrete are: fine aggregate, course aggregate, cement, water and marble dust. The properties of every material have been tested in the laboratory. The physical and chemical properties of the marble dust have been tested and results are shown below.

Table 1: Physical Properties of Marble

Sr. No.	Properties	Result
1	Color	White
2	Form	Powder
3	Odor	Odorless
4	Moisture Content (%)	1.59

Table 2: Chemical Properties of Marble

Sr. No.	Oxide Compounds	Marble Dust (Mass %)
1	SiO2	28.35
2	Al2O3	0.42
3	Fe203	9.70
4	CaO	40.45
5	MgO	16.25
6	Density (g/cm3)	2.80

Table 3: Proportion of Material Used

Mix Design (M_{20})

Water (liters/m^3)	Cement (Kg/m^3)	Fine Aggregate (Kg/m^3)	Coarse Aggregate (Kg/m^3)
191.6	407.65	538.09	1194.4
0.47	1	1.32	2.93

3. Result and Discussion

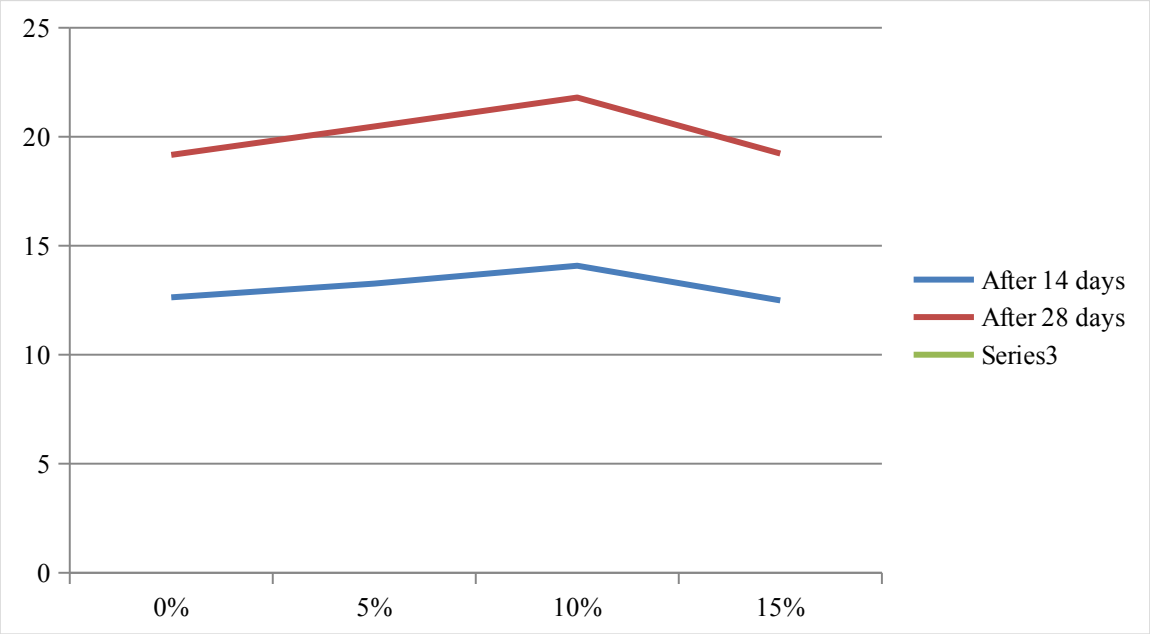
3.1 Compressive Strength Test

Test specimens of size 150 *150 * 150 mm were prepared for testing the compressive strength concrete. The concrete mixes with varying percentages (0%, 5%, 10% and 15%) of waste marble dust as partial replacement of cement were cast into cubes and cylinders for subsequent testing. In this study, to make concrete, cement and fine aggregate were first mixed dry to uniform colour and then coarse aggregate was added and mixed with the mixture of cement and fine aggregates. Water was then added and the whole mass mixed. The interior surface of the moulds and the base plate were oiled before concrete was placed. After 24 hours the specimens were removed from the moulds and placed in clean fresh water at a temperature of 270° C. The specimens so cast were tested after 14 and 28 days of curing measured from the time water is added to the dry mix. For testing in compression, no cushioning material was placed between the specimen and the plates of the machine. The load was applied axially without shock till the specimen was crushed. Results of the compressive strength test on concrete with varying proportions of Waste marble dust replacement at the age of 14 and 28 days are given in the Table 4.

Table 4: Compressive Test Result

Mix (%)	0	5	10	15
Average Compressive Strength after 14 days	12.63	13.26	14.08	12.49
Average Compressive Strength after 28 days	19.17	20.47	21.8	19.23

Figure 1: Comparison of Compression Test According to Days



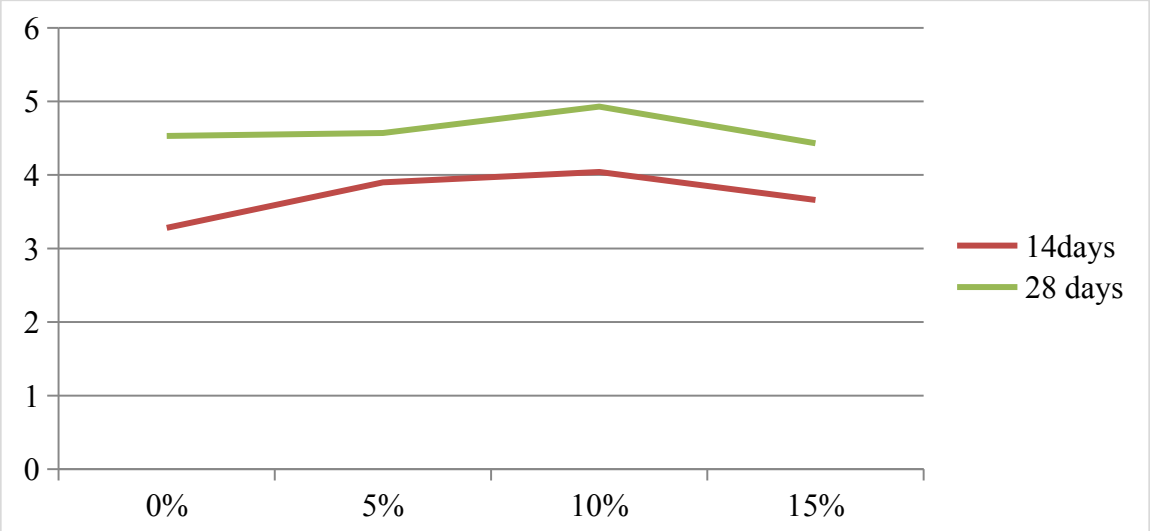
3.2 Split Tensile Strength Test

Test specimens of size 100 * 200 mm were prepared for testing the split tensile strength of concrete. The concrete mixes with varying percentages (0%, 5%, 10% and 15%) of Waste marble dust as partial replacement of cement were cast into cylinders for subsequent testing. In this study, to make concrete, cement and fine aggregate were first mixed dry to uniform colour and then coarse aggregate was added and mixed with the mixture of cement and fine aggregates. Water was then added and the whole mass mixed. The interior surface of the moulds and the base plate were oiled before concrete was placed. After 24 hours, the specimens were removed from the moulds and placed in clean fresh water at a temperature of 27° C. The specimens so cast were tested after 14 and 28 days of curing measured from the time water is added to the dry mix. For testing in tension, no cushioning material was placed between the specimen and the plates of the machine. The load of 2 KN was applied axially without shock till the specimen was crushed. Results of the split tensile strength test on concrete with varying proportions of Waste marble dust replacement at the age of 14 and 28 days are given in the Table 5. The cylinder strength results of concrete mix are also shown graphically in Figure 5. The tensile strength increases as compared to control mix as the percentage of Waste marble dust is increased.

Table 5: Split Tensile Strength Test Result

Mix (%)	0	5	10	15
Average Compressive Strength after 14 days	3.28	3.90	4.04	3.66
Average Compressive Strength after 28 days	4.53	4.57	4.93	4.43

Figure 2: Comparison of STS



4. Conclusion

1. The compressive strength increases as compared to control mix as the percentage of waste marble dust is increased. After adding 5% waste marble dust in the mix, there is an increase in the strength of the cube after 14 days and 28 days; there is enormous increase in strength as compared to the control mix.
2. The optimum value of compressive strength comes at 10%.
3. There is no much change observed in the STS even up to 10%, but decrease in the strength is observed on adding 15%.

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