International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 4 Issue 6, June-2015, pp: (414-418), Impact Factor: 1.252, Available online at: www.erpublications.com

Experimental Study of Properties of Concrete with Waste Marble Powder/Granules

Pradeep Mehla[1], Prof. Ajay Kumar[2], Maninder Singh[3]

[1, 3]P.G Student of Civil Engineering at Shree Siddhivinayak Group of Institutions, Shahpur, (Distt. Yamuna Nagar) Kurukshetra University, Kurukshetra, Haryana
[2] Prof. of Civil Engineering at Shree Siddhivinayak Group of Institutions, Shahpur, (Distt. Yamuna Nagar), Kurukshetra University, Kurukshetra, Haryana

---

Abstract: Marbles and Granites, is one of the most thriving industry. Marble processing lines in factories produces huge amount of waste either as a solid waste or as a liquid waste. During the cutting process of marble blocks, smaller blocks are produced due to which 25% of the original marble is lost in the form of dust. Marble slurry generated during processing corresponds to around 40% of the dimension stone industry as a final product. The disposal of millions of tons of waste is the biggest environmental catastrophe facing India.The present study aims at the investigation of properties of concrete with waste marble powder and granules. For this purpose the waste marble powder procured from a marble dealer at Dhanas, Chandigarh was used to prepare mix of M30 grade and the properties have been compared with an equivalent mix of plane cement concrete. The various tests conducted for this purpose were Compressive Strength, Flexural Strength, Split tensile Strength and durability and workability of concrete. The concrete mix for different specimens was made by taking 15% against cement and sand individually and 30% against combined cement and sand.

Index Terms: OPC43, M30, Compressive strength, Split tensile strength.

INTRODUCTION

Concrete is most widely used Construction materials in the world. Due to the growing interest in sustainable development engineers, the Green Building concept is emerging in our country. Green Concrete as the name suggests is eco friendly and saves the environment by using waste products generated by industries. The present project describe the feasibility of using marble waste in the production of concrete by partial replacement of cement. The cement use for the experimental studies was 43 grade OPC conforming to the specifications of Indian Standard Code IS: 8112-1989.Total no of 24 cubes and 24 cylinder have been casted. The compressive and split tensile strength of cube and cylinder was measured for 7 and 28 days.

MATERIALS AND METHODS

Cement:

The cement use for the experimental studies was 43 grade OPC conforming to the specifications of Indian Standard Code IS: 8112-1989. It was fresh and without any lumps. The various test performed on the cement and their test values are shown in the Table 1

Table 1: Cement

Sr.No	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	32.5	---
2	Specific gravity	3.101	3.15
3	Initial setting time (minutes)	41	>30
4	Final setting time (minutes)	347	<600
5	Compressive strength (N/mm^2) (i) 3 days (ii) 7 days (iii)28days	 24.10 34.56 47.92	 >23 >33 >43
6	Soundness (mm)	1.00	≤10
7	Fineness of Cement (%)	0.50	≤10

Fine and Coarse Aggregates:

The fine aggregates were procured from the course of Gaggar River which flow in the foot hills of Shivalik range. The coarse aggregate and fine aggregates were crushed aggregates. The aggregates were procured from a crusher installed at a location Handesra near Ambala city. The lumps of clay and other foreign materials were separated out carefully. Fine aggregate was washed and dried before testing. The coarse aggregates were washed to remove dirt, dust and then dried to surface dry conditions. The finess modulud of Fine aggregate, Coarse aggregate (10mm and 20mm) are 2.86, 7.31, and 7.65 respectively.

Waste Marble Powder (WMP):

The waste marble powder (WMP) was procured from a marble dealer at Dhanas, Chandigarh and the properties of Waste Marble Powder are shown in Table 3.

Table 3: (WMP)

Properties	Values
Bulk Density (kg/m^3)	1118
Fineness Modulus	1.5
Specific Gravity	2.212
Dry moisture content (%)	1.59

Design of concrete mix:

In the present study, M30 grade concrete was used with mix design as per IS 10262-2009. The water/cement ratio adopted is 0.43.The target strength for mix design is 38.25 N/mm^2. The details of the mix used in the present study are shown in Table 4.

Table 4

Mix designation	Water	Cement	Fine aggregate	Coarse aggregate
MX0	186lt/m^3	432 kg/m^3	649.06 kg/m^3	1147.66 kg/m^3

Casting of specimens:
Total number 24 cubes and 24 cylinders were casted.Waste marble powder (WMP) is added in concrete in varying percentages i.e. 0%, 15% against sand, 15% against cement, 30% against 15% cement and 15% sand. For this percentage of WMP 3 cubes and 3 cylinder were casted for 7days and 28 days.

Note. The Specimens were taken out from curing tank at the age of 7 and 28 days of moist curing and were then tested. The compressive strength of specimen was found out by applying gradually increasing load without any shock and increased at constant rate of 14 N/mm²/minute until failure of specimen took place. The crushing loads were noted and average compressive strength is determined in Table 5.

Table 5: Cube test results

Mix Designation	Average Compressive strength(at 7 Days) (N/mm²)	Average Compressive strength(at 28 Days) (N/mm²)
MX0(Control mix)	25.3	39.16
MX1(15% against Fine aggregate)	27.85	43.25
MX2(15% against Cement)	27.77	43.85
MX3(15% against Fine aggregate and Cement each)	21.70	36.14

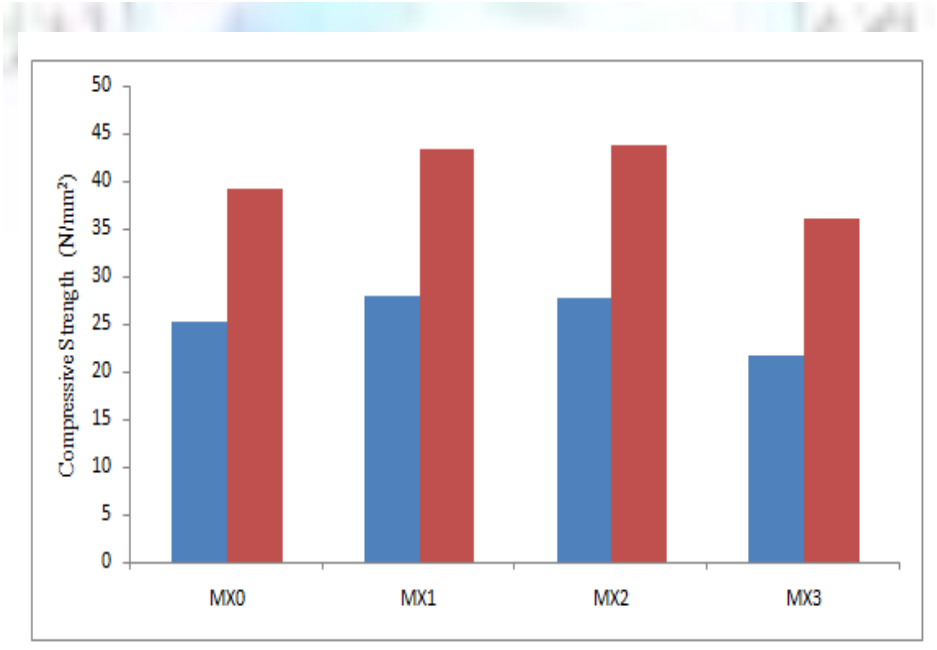

Fig. 1: Blue and Red represent Average Compressive strength after 7 and 28 days respectively.

The Split Tensile Strength of specimens were tested on compression testing machine 200 tonnes capacity bearing the requirement given in IS 516. The load was applied gradually without any shock and increased at constant rate of 2.4 N/mm²/minute until failure of specimen took place. The crushing loads were noted and average split tensile strength is determined in Table 6.

Table 6: Cylinders test results

Mix Designation	Average Split Tensile strength(at 7 Days) (N/mm^2)	Average Split Tensile strength(at 7 Days) (N/mm^2)
MX0(Control mix)	3.18	4.03
MX1(15% against Fine aggregate)	3.62	4.47
MX2(15% against Cement)	3.77	4.35
MX3(15% against Fine aggregate and Cement each)	2.75	3.53

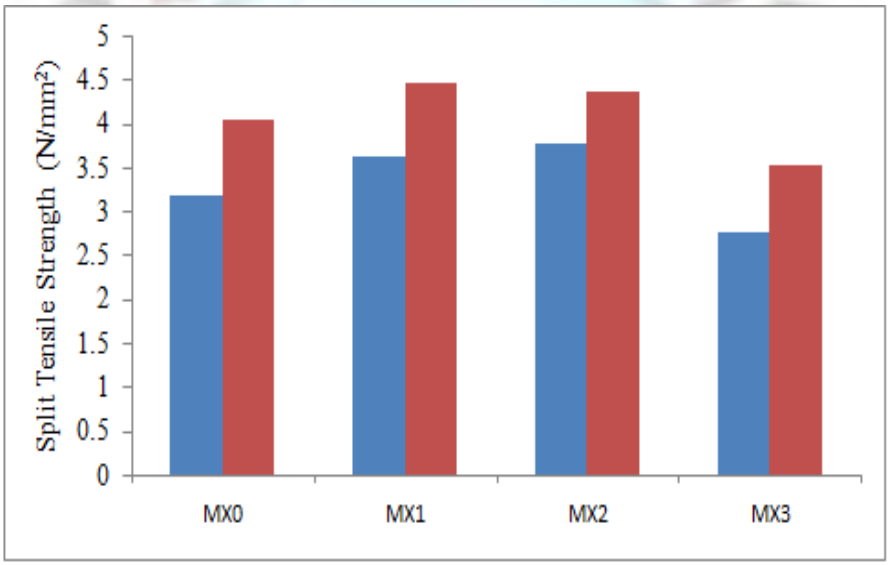

Fig. 2: Blue and Red represent Average Split Tensile strength after 7 and 28 days respectively.

RESULT AND DISCUSSION

Cube:

- The Compressive strength of the concrete increases for replacement of 15% W.M.P (against fine aggregates) and 15% W.M.P (against cement) as compared to conventional mix and decreases for replacement by 30% W.M.P (against 15% fine aggregates and 15% cement both).
- The experimental investigation at 7 days shows that by 15% partial replacement of fine aggregates by WMP, the compressive strength increases by 10.7% and when the cement is partially replaced by 15 % WMP the compressive strength increases by 9.76% but when fine aggregates and cement was replaced by 30% of waste marble powder (against 15% each), the compressive strength decreases by 14.23% as compared to reference mix without marble powder.
- The experimental investigation for compressive strength at 28 days show that by 15% partial replacement of fine aggregate by WMP, the compressive strength increases by 10.44 % and when the cement is partially replaced by 15 % the compressive strength increases by 11.98% but when fine aggregate and cement was replaced by 30% of waste marble powder (15% against both), the compressive strength decreases by 7.71% as compared to reference mix without marble powder.

Cylinders:

- The Split Tensile Strength of the concrete increases for replacement by 15% W.M.P (against fine aggregates) and 15% W.M.P (against cement) as compared to conventional mix and decreases for replacement by 30% W.M.P (against 10% fine aggregates and 10% cement both).
- The experimental investigation at 7 days shows that by 15% partial replacement of fine aggregate by WMP, the split tensile strength increases by 13.83 % and when the cement is partially replaced by 15 % the compressive strength increases by 18.55% but when fine aggregate and cement was replaced by 30% of waste marble powder (15% against both), the split tensile strength decreases by 13.52% as compared to reference mix without marble powder.

- The experimental investigation at 28 days show that by 15% partial replacement of fine aggregate by WMP, the split tensile strength increases by 10.91 % and when the cement is partially replaced by 15 % the compressive strength increases by 7.94% but when fine aggregate and cement was replaced by 30% of waste marble powder (against each), the split tensile strength decreases by 12.4% as compared to reference mix without marble powder.

ACKNOWLEDGEMENTS

The Authors thanks the management of Shree Siddhivinayak Group of Institutions, Jagadhri, Yamuna Nagar, India for providing him the opportunity to carry out his research.

REFERENCES:

[1] Mishra A., Pandey A., Maheshwari P., Chouhan A., S.S. Suresh and Das S. (2013) "Green Cement For Sustainable Concrete Using Marble Dust" International Journal of ChemTech Research CODEN (USA): IJCRGG ISSN : 0974-4290, Vol.5, No.2, pp. 616-622, April-June.
[2] Sharma I.C. (2012) "Marble Slurry" International Journal Of Civil Engineering And Technology (IJCIET), ISSN 0976 – 6308 (Print), ISSN 0976 – 6316(Online), Volume 3, Issue 2, July- December (2012), pp. 01-06.
[3] Kandekar S. B., Mehetre A.J., Auti V.A. (2012) "Strength of concrete containing different types of fine aggregate" International Journal of Scientific and Engineering, 3, pp.1-3
[4] Hamza R.A., Salah El-Haggar, Khedr S.(2011) "Marble and Granite Waste: Characterization and Utilization in Concrete Bricks" International Journal of Bioscience, Biochemistry and Bioinformatics , 1, pp.286-291
[5] Hebhoub H., Aoun H., Belachia M., Houari and Ghorbel E. (2011) "Use of waste marble aggregates in concrete" Construction and Building Materials, 25, pp. 1167–1171.
[6] Indian Minerals Yearbook (2011), Part II, 50th Edition issued by Controller General, Indian Bureau of Mines
[7] Rai B., Khan N. H., Kr A., Rushad T. S. and Duggal S.K. (2011) "Influence of Marble powder/granules in Concrete mix" International Journal of civil and Structural Engineering, Volume 1, No 4, pp.827-834.
[8] Shetty. M.S. (1991) "Concrete Technology Theory and Practice" 3rd edition S. Chand Company limited, New Delhi.
[9] Pareek S. (2001) "Gainful Utilization of Marble Waste. An effort towards protection of ecology and environment" and http.//www.cdos-india.com/papers, accessed on 22-08-2007.
[10] Celik T. and Marar K. (1996). "Effects of crushed stone dust on some properties of concrete" Cement and Concrete Research, 26, pp. 1121–1130.