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PARTIAL REPLACEMENT OF CEMENT WITH WASTE MARBLE POWDER WITH M25 GRADE

Jashandeep singh, Er. R S Bansal
Civil Engineering Department
R.I.E.T Phagwara
Punjab, India
jashandeepsingharora@gmail.com

***Abstract*— The study the behaviour of concrete, having partial replacement of cement with waste marble powder M25 grade for which the marble powder is replaced by an experimental study was carried out and the effect on compressive strength and split tensile strength characteristics (0%, 4%, 8%, 12%, 16%, 20%) was studied. The result of this present investigation indicates that the replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength. The optimum percentage for replacement of marble powder with cement and it is almost 12%cement for both cubes and cylinders and it also minimize the costs for construction with usage of marble powder which is freely or cheaply available more importantly.**

Keywords:- Marble powder, slump, compressive strength and split tensile strength.

I. INTRODUCTION

Recycling of industrial wastes has actually environmental, economical and technical benefits. These benefits can be seen from two different angles, one from the point of the waste producer and the other from the user part. For the producer, the benefits of recycling industrial wastes are economical and environmental for the user additional technical benefits may be attained from recycling. For the producer, the environmental benefit can be attained as far as the waste is recycled. It is independent of where it is recycled. But the economical benefit is determined on the demand for the waste by different users. One of the greatest environmental concerns in construction industry is the production of cement which emits large amount of CO2 gas to the atmosphere. It is estimated that 1 tone clinker production releases 1 tone CO2 .Mixing of clinker to supplementary materials called blending is considered as a very effective way to reduce CO2 emission. It is estimated that the Rajasthan Marble Processing Enterprise produces 1800m3 (4500 tons) marble waste annually, which implies that using marble waste of The Rajasthan Marble processing enterprise as cement replacing material can indirectly reduce CO2emission to the atmosphere by 4500 tons annually. Recycling marble waste powder in substitution of sand also indirectly can reduce environmental problem related with sand production. The design of concrete (M25) was done with locally available materials. Cement was replaced with replacements levels of cement (0%, 4%, 8%, 12%, 16%, and 20%). Four numbers of cubes of 150 X 150 X 150 and cylinder 150 mm dia and 300 mm length were casted for each %age replacement. Hence 72 numbers of cubes were casted for each compressive and split tensile strength. The compressive strength and split tensile strength of concrete of all mixes was determined at the ages of 7,14 and 28 days of curing for the various replacement level of cement and addition of cement and addition of waste marble powder (0%, 4%, 8%, 12%, 16%, 20%) at the end of different curing periods.

II. LITERATURE REVIEW

A. A Study has been conducted by BabooRai et.al(2011) have done their research on Influence of Marble powder/granules in Concrete mix. They found that using marble powder and granules as constituents of fines in mortar or concrete by partially reducing quantities of cement as well as other conventional fines in terms of the relative workability & compressive as well as flexural strengths. Partial replacement of cement and usual fine aggregates by varying percentage of marble powder and marble granules reveals that increased waste marble powder or waste marble granule ratio result in increased workability and compressive strengths of the mortar and concrete.

B. A Study has been conducted by Vaidevi C (2013) have done their research on Study on the marble dust as partially replacement of cement in concrete. They found that the marble dust from marble processing is a waste utilized. The use of this waste was proposed in different percentages both as an addition to and instead of cement, for the production of concrete mixtures. In this study, the use of marble dust collected during the shaping process of marble blocks has been investigated in the concrete mixtures as cementitious material. The study showed that marble wastes, which are in the dust form, could be used as cementitious material in concrete mixtures where they are available and the cost of construction is lower than ordinary concrete materials. The concrete is prepared containing 5, 10, 15 and 20% waste of marble dust with cement compared to the total quantity of normal concrete. The prepared mixtures were then studied in terms of their properties both in fresh and in hardened state. In this particular, tests they conducted and cured at different times to find compressive strength and tensile strength with and without partial replacement of marble dust in cement concrete and for mortar also determined for 14 and 28 days.10% replacement gives the best result and for every 10 bags of cement, the addition of 10% of marble dust saves 1bag of cement and 1 bag cost.

C.A Study has been conducted by V. M. Sounthararajan et.al(2013)have done their research on Effect of the Lime Content in Marble Powder for Producing High Strength Concrete. They found that the waste marble powder up to 10% by weight of cement was investigated for hardened concrete properties. Furthermore, the effect of different percentage replacement of marble dust on the compressive strength, splitting tensile strength and flexural strength was evaluated. It can be noted that the influence of fine to coarse aggregate ratio and cement-to-total aggregate ratio had a higher influence on the improvement in strength properties. A phenomenal increase in the compressive strength of 46.80 MPa at 7 days for 10% replacement of marble powder in cement content was noted and also showed an improved mechanical property compared to controlled concrete

D. A Study has been conducted by Manju Pawar et.al (2014) have done their research on Periodic Research, The Significance of Partial Replacement of Cement With Waste

Marble Powder. They found that the effect of using marble powder as constituents of fines in mortar or concrete by partially reducing quantities of cement has been studied in terms of the relative compressive, tensile as well as flexural strengths. Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concrete .Leaving the waste materials to the environment directly can cause environmental problem. Hence the result The Compressive strength of Cubes are increased with addition of waste marble Powder up to 12.5 % replace by weight of cement and further any addition of waste Marble powder the compressive strength decreases. The Tensile strength of Cylinders are increased with addition of waste marble powder up to 12.5 % replace by weight of cement and further any addition of waste marble powder the Tensile strength decreases. Thus they found out the optimum percentage for replacement of marble powder with cement and it is almost 12.5 % cement for both cubes and cylinders.

III. EXPERIMENTAL PROGRAMME

A. Concrete Mix Design (M25)

Design Stipulations

(1) Characteristic comp. strength required
In the field at 28 days 25Mpa
Level of quality control Good

(a) Test Data for Materials

(1)Specific Gravity Of Cement 3.15

(2)Comp. Strength Of Cement at 7 days Satisfies the requirement.

Table 1: Properties of aggregates

Aggregates	**Fine Aggregates**	**Course aggregates**	**Aggregates**
Type	**River sand (zone II)**	**Crushed granite**	**Type**
Maximum nominal size	--------	20mm	Maximum nominal size
Specific gravity	2.88	2.80	Specific gravity
Bulk density	1.659	1.654	Bulk density
Fineness modulus	2.095	6.218	Fineness modulus
Free surface moisture(per cent)	2.0	1.0	Free surface moisture(per cent)

Adjustment (ratio and specific gravity of material)

	Water	**Cement**	**Fine aggregate**	**Coarse aggregate**
Ratio	0.40	1	1.73	3.14
Specific gravity	1	3.15	2.88	2.80

Preparation and Curing Of Specimen

72 Standard cubic specimens of size 150 mm and 72 standard cylindrical moulds for size 150 x 300mm (four for each percentage of marble powder) were cast. Concrete cube were cast for compressive and split tensile strength of concrete was undertaken at 7, 14 days &28 days of age. All specimens were removed 24 hrs.

IV. RESULT AND DISCUSSIONS

A. Mix Proportions

A mix M25 grade was designed as per Indian Standard method and the same was used to prepare the test samples.

% Replacement	Slump Value (mm)
0%	28mm
4%	27mm
8%	27mm
10%	27mm
12%	26mm
16%	25mm

Table 2: Test value of slump value

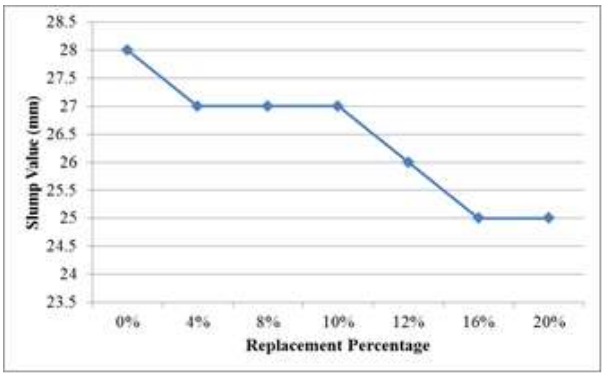

Figure1: Test value graph of slump value

Table 3: **Partial replacement of cement by marble waste powder(cubical moulds)**

% Replacement	**0**	**4**	**8**	**12**	**16**	**20**
Cement (kg)	6.08	5.837	5.59	5.35	5.10	4.86
Sand (kg)	10.48	10.48	10.4	10.4	10.4	10.4
Coarse aggregate(kg)	19.08	19.08	19.0	19.0	19.0	19.0
Marble powder (kg)	00	0.243	0.48	0.72	0.97	1.21
w/c Ratio	.40	.40	.40	.40	.40	.40

Compressive Strength

Compressive strength of concrete is tested on cube at different percentage of marble powder content in concrete. The strength of concrete has been tested on cube at 7 days,14 days curing and 28 days.7 days test has been conducted to check the gain in initial strength of concrete, 14 days test has been conducted to check the gain in median strength of concrete and 28 days test gives the data of final strength of concrete at 28 days curing. Compression testing machine is used for testing the compressive strength test on concrete. At the time of testing the cube is taken out of water and dried and then tested keeping the smooth faces in upper and lower part.

The strength of concrete is very much dependant up on the hydration reaction .The type and amount of cement used in concrete determines the hydration reaction. In this experiment, in all cases, i.e. for 0 to 20 % replacement of cement by marble waste powder the test results, as shown in Table and show that the seventh, fourteenth and twenty eighth days compressive and split tensile strengths of specimens with marble waste powder are less than that of the corresponding control specimens. The reduction of the strength increased with increasing percentage of marble waste powder. These

decreases in strength mainly occur due to replacement of Portland cement with powder addition causing dilution of C3S and C2S which is responsible for strength.

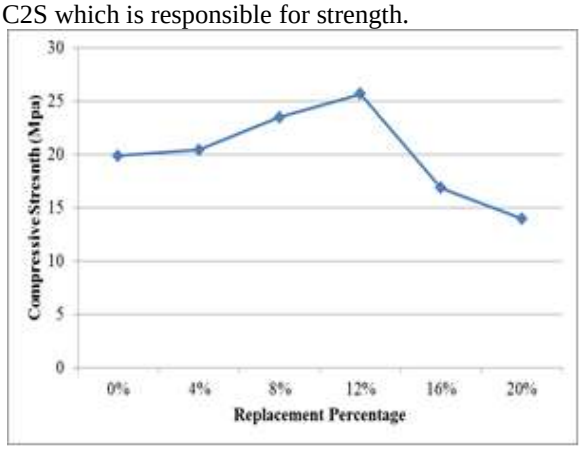

Figure 2: Test result of Compressive strength of 7 days

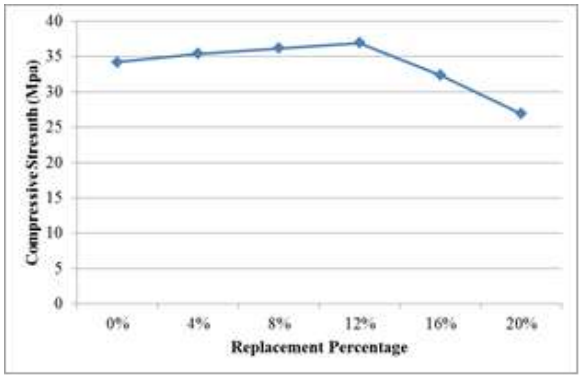

Figure 3: Test result of Compressive strength of 14 days

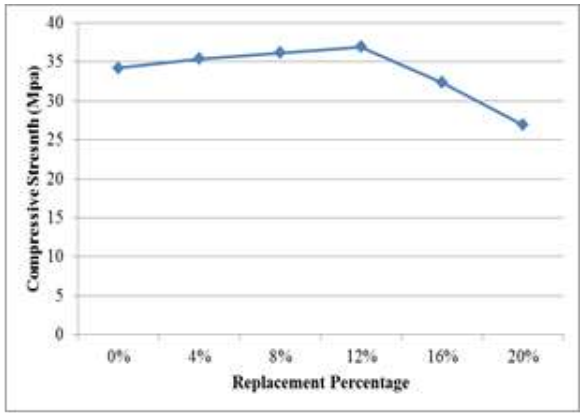

Figure 4:Test result of Compressive strength of 28 days

B. Split tensile strength

Split Tensile strength of concrete is tested on cylinders at different percentage of marble powder Content in concrete. The strength of concrete has been tested on cylinder at 7 days curing,14 days and 28 days. 7days test has been conducted to check the gain in initial strength of concrete. 28 days test gives the data of final strength of concrete at 28 days curing .Compression testing machine is used for testing the Split Tensile strength test on concrete along with two wooden boards. At the time of testing the cylinder taken out of water and dried and then tested.

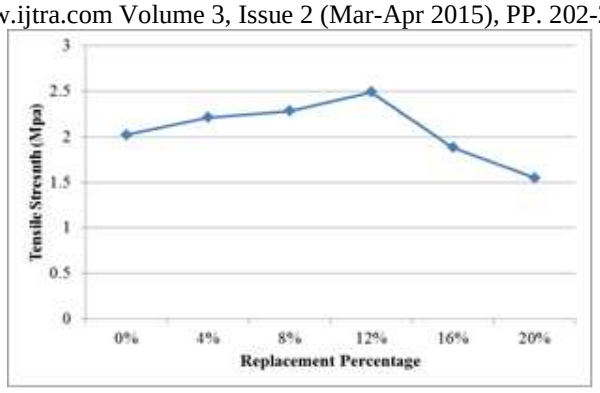

Figure 5: Test result of Tensile strength of 7 days

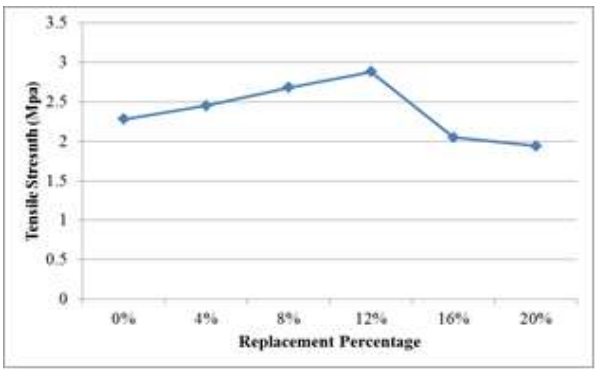

Figure 6: Test result of Tensile strength of 14 days

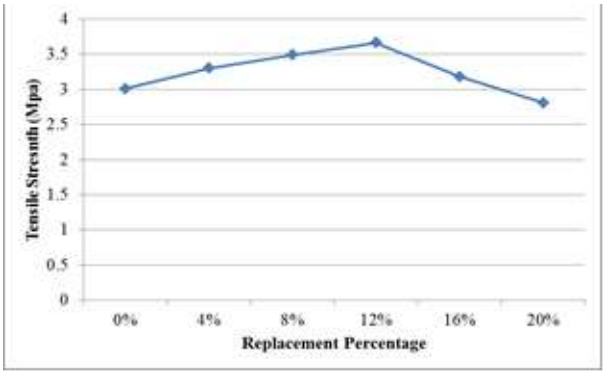

Figure 7: Test result of Tensile strength of 28 days

From the figures, it can be seen that marble powder improves the compressive and split tensile strengths of concrete. As the percentage replacement of cement with marble powder increases, the compressive and split tensile strengths increase, reach a maximum value and then decrease.

Figure 8: Compaction of cube with tamping rod during casting

Figure 9: Testing the specimens

I. DISCUSSION

1. With the inclusion of Marble powder the strength of concrete gradually increases up to a certain limit but the gradually decreases.
2. With the inclusion of Marble powder up to 12%the initial strength gain in concrete is high.

II. CONCLUSIONS

1) Up to 12% replacement of cement with waste marble there is a increase in all mechanical properties.
2) The replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength.
3) The optimum percentage for replacement of marble powder with cement and it is almost 12% cement for both cubes and cylinders.
4) To minimize the costs for construction with usage of marble powder which is freely or cheaply available; more importantly.
5) To realm of saving the environmental pollution by cement production; being our main objective as Civil Engineers.

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