

EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT AND SAND USING WASTE GLASS POWDER AND WASTE MARBLE POWDER IN CONCRETE

S Suthandra devi¹, Gunasekar², Arun Kumar³, SanjeevKumar⁴

¹Assistant Professor, Mahendra Institute of Engg and Tech, Namakkal

^{2,3,4}Students, Dept. of Civil Engg, Mahendra Institute of Engg and Tech, Namakkal.

Abstract - The study of the behaviour of concrete having partial replacement of cement with waste marble powder and sand with waste glass powder have been carried out and the effect on split tensile strength and compressive strength(25%) was studied. The result of the present investigation indicates that the replacement of 10%,20%,30% of sand with glass powder and 5%,10%,15%of cement with marble powder attains higher compressive and tensile strength. Tests are conducted on cubes and cylinders to determine the strength of cement in time periods of 7, 14, and 28 days. The ecological and environmental problems are solved to certain extent with the production of cheaper and highly durable concrete by replacing sand and cement with glass powder and marble powder respectively.

Key Words: Marble Powder, Glass Powder, Replacement, Compressive strength, Split Tensile Strength.

1. INTRODUCTION

Waste management is one of the departments where several beneficiary factors are present if used correctly. Industrial waste recycling has proven to have several environmental, economical and technical benefits. These industrial wastes which are cost effective one can also be used for replacing or partially replacing the constituents of the concrete such as cement and sand. Cement which is considered to be one of the major constituents along with sand can be used for producing concrete but it also produces dangerous substance co₂. It is estimated that one ton of co₂ is released during the production of one ton of cement/cylinder, Which is severely hazardous to the environment .Due to this one hazardous outcome, several researches had been carried out to either fully replace of partially replace cement with various other substances such as silica fume, fly ash, rice husk ash, ground granulated blast furnace slag etc. Sand which is also one of the major constituents of concrete has become quiet costly due to its less availability as a result this raises concern among construction industries. Several researches have been carried out to either fully replace or partially replace sand with other substance such as glass powder. The design of concrete was done with locally available materials here in this investigation we replace cement with glass powder.

Cubes of size 150X150X150 mm and cylinder of dimensions 150mm diameter and 300mm length were casted

for each % of replacement cement and sand are replaced with marble powder and glass powder by the ratio of 5%,10%,15% and 10%,20%,30% respectively. These cubes were casted for split tensile strength test and compressive strength test. The split tensile strength and compressive strength of concrete of all mixes was determined at the ages of 7, 14, and 24 days of curing.

2. Material study

2.1 Cement:

In this study the cement used is Portland Pozzolana Cement, which has specific gravity of 2.98.

2.2 Marble powder:

In this study locally available marble powder has been used as partial replacement of cement in concrete. Specific gravity of marble powder is 2.83.

2.3 Glass powder:

The specific gravity of glass powder is 2.5. Locally available waste glass powder is used as a partial replacement for fine aggregate.

2.4 Aggregates:

Aggregate gives the shape to the concrete, reduces shrinkage and effect economy. In this study aggregates which passes through 20 mm and retained in 10 mm sieve are used. The specific gravity of coarse aggregate is 3. Good quality natural river sand is used as fine aggregate. Its fineness and specific gravity is 2.7 and 2.64 respectively.

2.5 Water:

Water plays an important role in production of concrete. Among all the constituents of concrete water is easily available and are considered to be less expensive. Portable water is used for both mixing and curing.

3. METHOD AND TEST RESULTS

From the Indian standard (IS :10262-1982), Design Mix For M25 Grade of Concrete was prepared by Partially using Marble powder instead of Cement (5%,10%,15%) and by partially using Waste Glass Powder instead of sand

(10%,20%,30%).The cubes were casted in moulds of sizes 150 x 150 x 150 mm and the cylinders were casted in the moulds of sizes 150 mm dia and of height 300 mm. These concrete cubes and cylinders were De moulded after 24 hours and were placed in water for curing , which were later tested in 7th,14th,28thday respectively.

The tensile and compressive strength of concrete is tested on cylinder and cube by replacing cement and sand with (5%, 10%, 15%) and (10%, 20%,30%) of marble power and glass powder. The strength of concrete has been tested on cube and cylinder at 7 , 14, 28 days respectively. Here the 7th day test has been conducted to check the initial strength of the concrete, while the 14th day test has been conducted to test the intermediate strength and the 28th day test has been conducted to find out the final strength of the concrete. The compressive strength of concrete is found out by using compressive strength testing machine.

3.1. Compressive strength test:

All the characteristics of the concrete can be studied by performing this single test. With the help of this single test alone , one can decide whether the concreting has been done properly or not. In general construction, the Concrete Compressive strength Varies from 15 Mpa to 30Mpa and it goes higher in Industrial and commercial Structures. Compressive strength of concrete depends on several factors such as Quality control during production of concrete, Water-Cement ratio, Cement strength, Quality of Concrete etc., Cubes or Cylinders were used for performing this test.



Table No 1:Compressive strength test result

Marble powder	Glass Powder	After 7 Days	After 14 Days	After 28 Days
0%	0%	13 N/mm ²	17.2 N/mm ²	26.5 N/mm ²
5%	10%	11.3 N/mm ²	15 N/mm ²	25.2 N/mm ²
10%	20%	14.2 N/mm ²	18 N/mm ²	28.8 N/mm ²
15%	30%	12.6 N/mm ²	16.3 N/mm ²	24.1N/mm ²

3.2. Split tensile strength test:

Tensile strength of the concrete is determined using this Split tensile strength test. Cracks are developed in concrete due to the tensile force subjection. Thus it is important to carry out the tensile strength test, so that the crack occurrence due to particular load can be determined.



Table No 2 : Split Tensile strength test result

Marble powder	Glass Powder	After 7 Days	After 14 Days	After 28 Days
0%	0%	1.84 N/mm ²	2.41N/mm ²	3.12N/mm ²
5%	10%	1.6N/mm ²	2.1N/mm ²	2.9N/mm ²
10%	20%	2.1N/mm ²	3.18N/mm ²	4N/mm ²
15%	30%	1.7N/mm ²	2.56N/mm ²	3.4N/mm ²

4. CONCLUSIONS

The Suitability and Feasibility Of using Marble Powder (5%,10%,15%) (10%,20%,30%) and Waste Glass Powder (10%,20%,30%) as Replacement Material for Cement and Sand in M25 grade of concrete was Studied and as a result, the Characteristics of concrete namely the workability, strength and durability are also studied. From Experimentations performed following conclusions are obtained which are listed below

1. Workability:

After further level of replacements of marble powder, glass powder (10%, 20%) beyond there is a decrease in compaction factor

The slump value also decreased with the increase in level of replacement

2. Strength :

The compressive strength of concrete were waste marble powder and waste glass powder are used for replacing cement and sand is found to be 9% higher than that of normal concrete only in the replacement ratio of (10%,20%).

The Tensile strength of concrete were waste Marble powder and waste glass powder are used for replacing cement and sand is found to be 10.66% higher than that of normal concrete only in the replacement ratio of (10%,20%)

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