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PARTIAL REPLACEMENT OF FINE AGGREGATE BY WASTE MARBLE POWDER IN CONCRETE

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Abstract— Rapid urbanization in developing countries such as India is creating a shortage of adequate housing in cities. Using artificial aggregates for quality concrete is a natural step to mitigating this problem. The worldwide consumption of fine aggregate in concrete production is very high, and several developing countries have been countered difficulties in meeting the supply of natural fine aggregate in order to satisfy the increasing needs of infrastructural development in recent years. The main objective of the present investigation is to evaluate the possibilities of using Marble dust as a replacement to fine aggregate. Present investigation aimed at to study, 0%, 10%, 20% and 30% of traditional fine aggregate was replaced with Marble dust. Compressive strengths and split tensile strength were found after 14 days and 28 days of curing. By adding or by substitution for the cementations and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties. Water is then mixed with this dry composite, which produces a semi-liquid that workers can shape (typically by pouring it into a form).

Keywords— **Fine aggregate, Cement, Coarse Aggregate, marble dust powder**

I. INTRODUCTION

The blast furnace slag is a by-product of the iron manufacturing industry. Iron ore, coke, and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500oC to 1600oC. The molten slag has a composition of about 30% to 40% SiO2 and about 40% CaO, which is close to the chemical composition of Portland cement. This brought pressures on researchers for the reduction of cement consumption by partial replacement of cement by supplementary materials. These materials may be naturally occurring, industrial wastes or by-products that are less energy intensive. These materials (called pozzalonas) when combined with calcium hydroxide, exhibits cementations properties. Most commonly used pozzalona are fly ash, silica fume, meta kaolin, ground granulated blast furnace slag (GGBS). This needs to examine the admixtures performance when blended with concrete so as to ensure a reduced life cycle cost. There are competing reasons, in the long term, to extend the practice of partially replacing cement with waste by products and processed materials possessing pozzolanic properties. Lately some attention has been given to the use of natural pozzolans like GGBS as a possible partial replacement for cement. Amongst the various methods used to improve the durability of concrete, and to achieve high performance concrete, the use of GGBS is a relatively new approach; the chief problem is with its extreme finesse and high water requirement when mixed with Ordinary Portland cement. The present paper focuses on investigating characteristics of concrete with partial replacement of cement with GGBS. The Blast-Furnace slag is a by-product of the iron manufacturing industry. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500 0C to 1600 0C. The molten slag has a composition of about 30% to 40% SiO2 and about 40% CaO, which is nearly similar to the chemical composition of Portland cement.

SCOPE OF THE PROJECT

To study the variation of compressive strength of concrete with replacing cement by marble powder at the percentages of 0%,10% ,20% & 30% for the grade of M25 mix proportions of 1:1.87:3.12 water cement ratio 0.5.

OBJECTIVE:

The present study is aimed at utilizing Waste marble powder as fine aggregate in concrete, replacing natural sand. Marble is one of the most important materials used in buildings since ancient times, especially for decorative purposes In order to determine the effect of the WMD with respect to the curing age, standard mechanical properties of concrete are to be analyzed at the curing ages of 14, 28 days

MATERIALS

The basic materials used are

- Cement
- Fine aggregates
- marble dust
- Coarse aggregates
- water

MARBLE POWDER

In natural stone processing plants large amounts of marble dust are generated with an important impact on environment and humans. This project describes the feasibility of using the marble sludge dust in concrete production as partial replacement of fine aggregate.

In INDIA, the marble and granite stone processing is one of the most thriving industry the effects if varying marble dust contents on the physical and mechanical properties of fresh and hardened concrete have been investigated.

Slump and air content of fresh concrete and absorption and compressive strength of hardened concrete were also investigated. Test results show that this industrial bi-product is capable of improving hardened concrete performance up to 10%, Enhancing fresh concrete behavior and can be used in architectural concrete mixtures containing white cement.

The compressive strength of concrete was measured for7 and 28 days. In order to evaluate the effects of marble dust on mechanical behavior, many different mortar mixes were tested.

Marble powder

TESTS ON CEMENT

Some important tests conducted on cement are as follows

- Standard Consistency test
- Initial and final setting time of cement
- Fineness
- Specific gravity

Standard Consistency Test

The standard consistency of a cement paste is defined as the consistency which will permit a vicat plunger having a 10 mm diameter and 50 mm length to penetrate to a depth of 5-7 mm from the base of the mould.

S.No.	**Quantity of water**	**Immersion of plunger**
1	25%	27mm
2	27%	11mm
3	29%	7 mm

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Standard consistency test values

INITIAL AND FINAL SETTING TIME OF CEMENT

S.No	Time (min)	Reading (mm)
1	7	0
2	15	3
3	20	4
4	25	4
5	31	5

Initial setting time of cement values

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PROPERTIES OF CEMENT

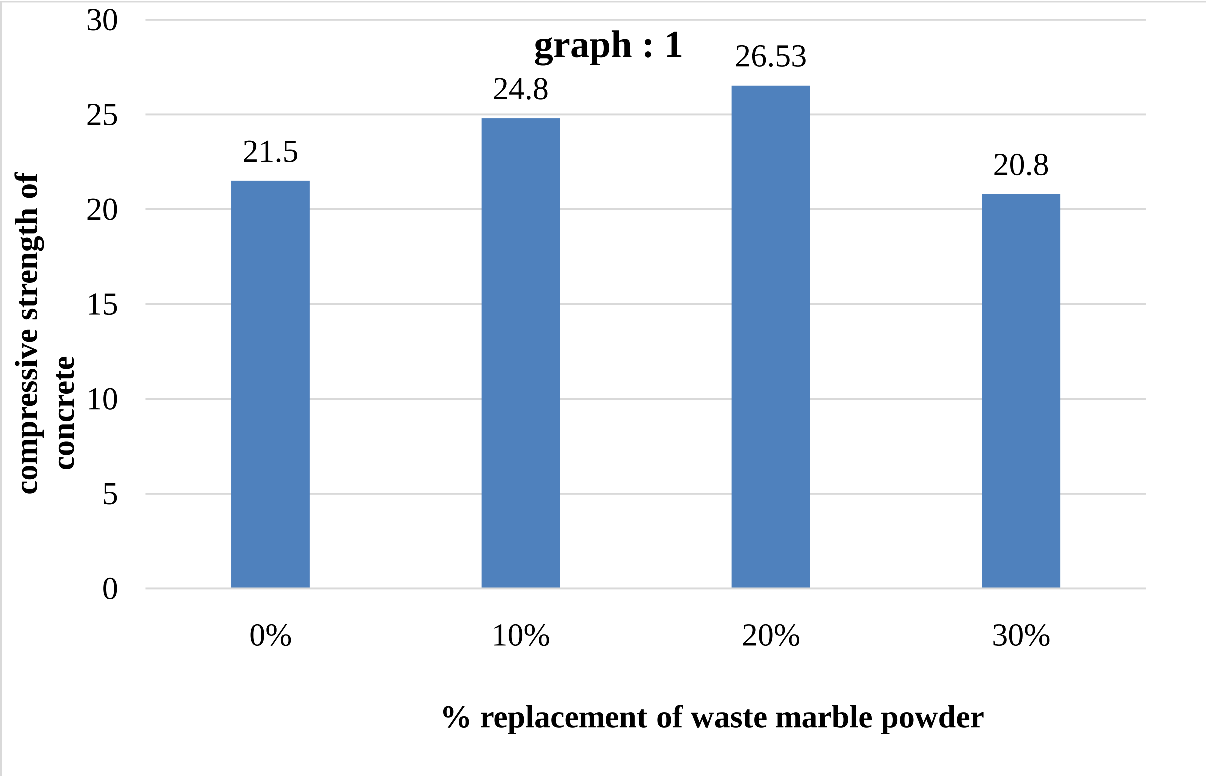
S.No	**Test**	**Result**
1	Specific gravity	3.15
2	Standard consistency	29%
3	Initial setting time	32min
4	Final setting time	600min
5	Fineness of cement	5.5%

Properties of cement

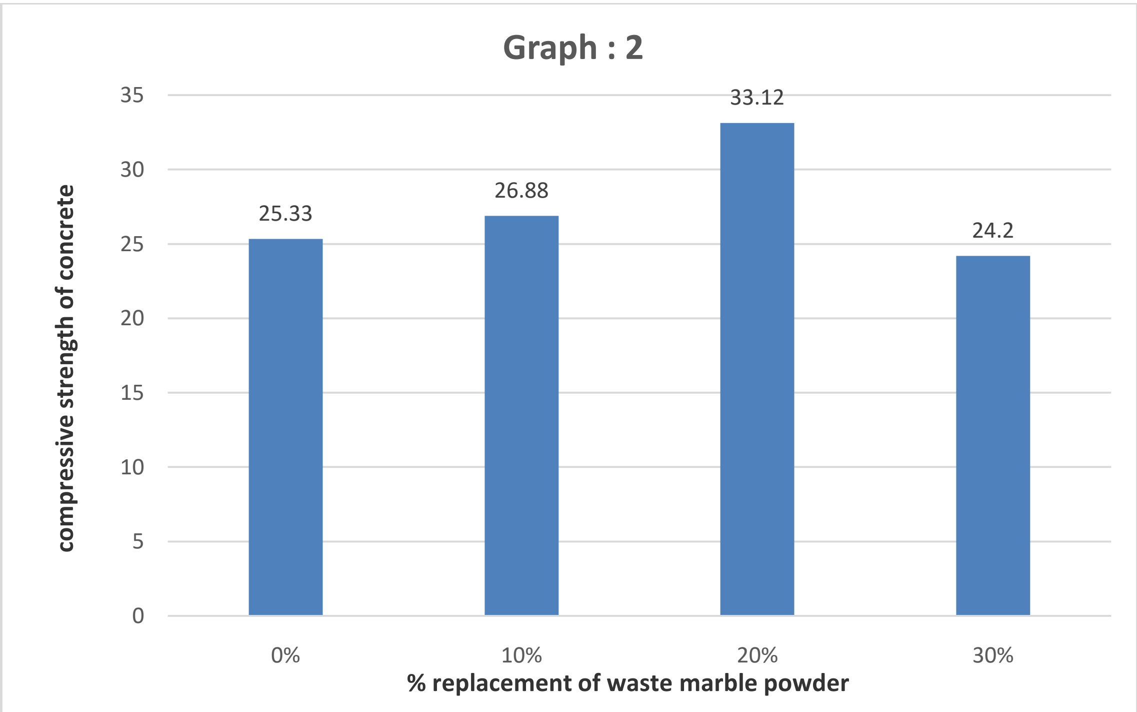
COMPRESSIVE STRENGTH VALUES

S.No	Test samples	14 days	28 days
1	0%	21.5	25.33
2	10%	24.8	26.88
3	20%	26.53	33.12
4	30%	20.8	24.2

COMPRESSIVE STRENGTH OF CUBES AT 14 DAYS



COMPRESSIVE STRENGTH OF CUBES AT 28 DAYS



SPLIT TENSILE TEST

Apparatus:

1) Split tensile testing machine

Preparation of Cylinder Specimens

The proportion and material for making these test specimens are from the same concrete used in the field of the mixed proportion of M30 mix is 1:1.26:2.09.

Specimen

The cylindrical mould shall be of 150mm diameter and 300mm height conforming to IS 10086- 1982.

Mixing

Mix the concrete either by hand or in a laboratory batch mixer.

Sampling

- Clean the moulds and apply oil
- Fill the concrete in the moulds in layers approximately 5cm thick
- Compact each layer with not less than 35strokes per layer using a tamping rod(steel bar 16mm diameter and 60cm long, bullet pointed at lower end)
- Level the top surface and smoothen it with a trowel.

Curing

The test specimens are stored in moist air for 24hours and after this period the specimens are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test.

Procedure for Testing

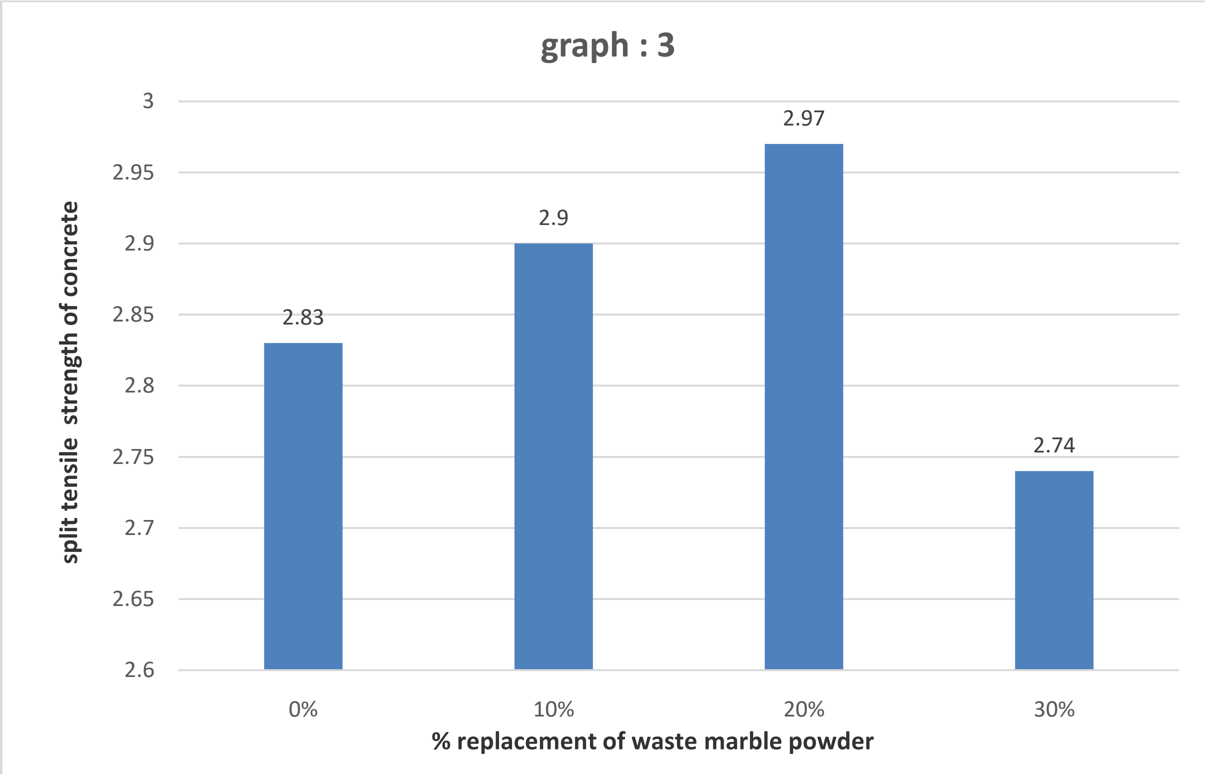
The specimens should be tested at 14and 28 days

- The bearing surfaces of the supporting and loading rollers shall be wiped clean, and any loose sand or other material removed from the surfaces of the specimens where they are to make contact with the rollers.
- Place the specimen on the supporting roller and load will be acting until failure of the specimen

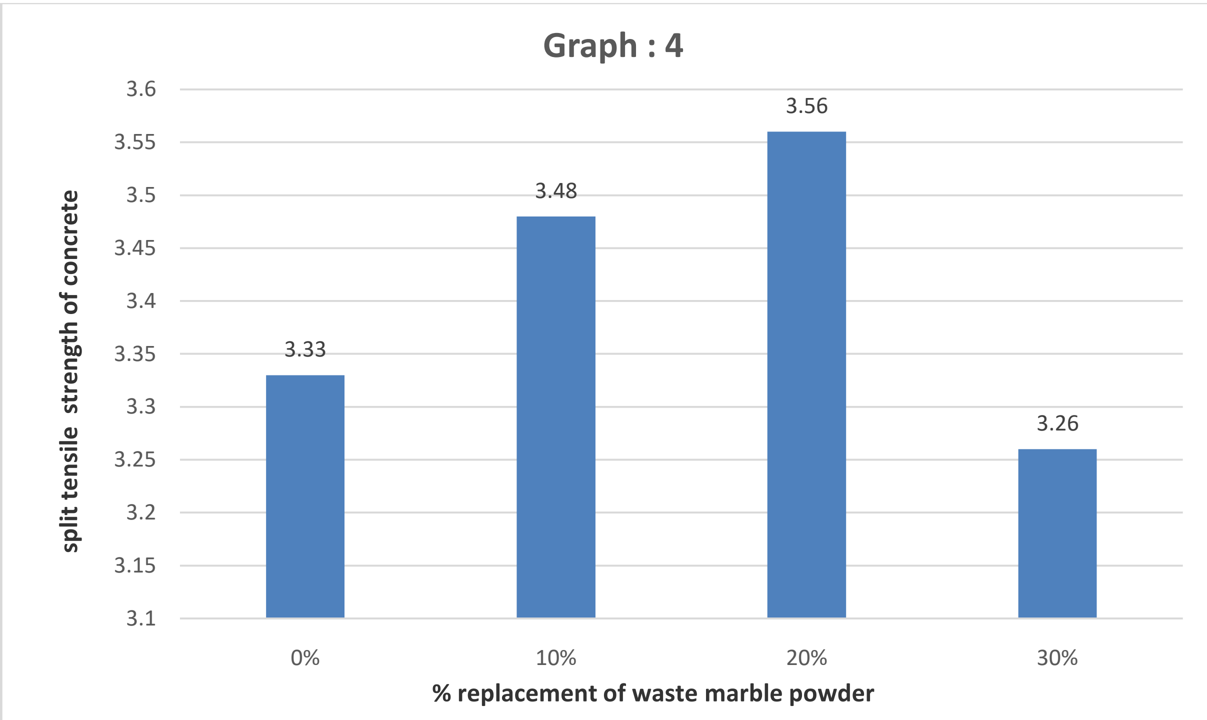
SPLIT TENSILE TEST VALUES

S.No	Test samples	14 days	28 days
1	0%	2.83	3.33
2	10%	2.90	3.48
3	20%	2.97	3.56
4	30%	2.74	3.26

SPLIT TENSILE TEST OF CYLINDERS AT 14 DAYS



SPLIT TENSILE TEST OF CYLINDERS AT 28 DAYS



DETAILS OF SPECIMEN CASTING

Curing period	**14 days of curing**		**28 days of curing**	
% of replacement	Cubes	Cylinders	Cubes	Cylinders
0%	3	3	3	3
10%	3	3	3	3
20%	3	3	3	3
30%	3	3	3	3
Total	12	12	12	12

MIX PROPORTIONS OF CONCRETE FOR 0%, 10%, 20%&30%REPLACEMENT OF FINE AGGREGATE BY MARBLE WASTE PER 3 CUBES

%of replacement for M25 grade of concrete	**Cement (kg)**	**Fine aggregate(kg)**		**Coarse aggregate(kg)**	**Water (lit)**
		Sand	**Marble**		
0%	5.06	9.470	0	15.78	2.53
10%	5.06	8.523	0.947	15.78	2.53
20%	5.06	7.576	1.894	15.78	2.53
30%	5.06	6.629	2.841	15.78	2.53
Total	20.24	32.198	5.682	63.12	10.12

MIX PROPORTIONS OF CONCRETE FOR 0%, 10%, 20% & 30% REPLACEMENT OF FINE GGREGATE BY MARBLE WASTE PER 3 CYLINDERS.

% of replacement for 25 grade	**Cement (kg)**	**Fine aggregate (kg)**		**Coarse aggregate (kg)**	**Water (lit)**
		Sand	**Marble waste**		
0%	6.708	12.54	0	20.92	3.354
10%	6.708	11.29	1.254	20.92	3.354
20%	6.708	10.03	2.508	20.92	3.354
30%	6.708	8.78	3.762	20.92	3.354
Total	26.832	42.64	7.52	83.68	13.416

Compressive strength

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal water-cement ratio of the mix.The other factor affecting the strength of concrete at a given age and cured at a prescribed temperature is the degree of compaction. According to Abraham's law the strength of fully compacted concrete is inversely proportional to the water-cement ratio.

Workability

The degree of workability required depends on three factors. These are the size of the section to be concreted, the amount of reinforcement, and the method of compaction to be used. For then arrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved with a reasonable amount of effort. This also applies to the embedded steel sections. The desired workability depends on the compacting equipment available at the site.

Durability

The durability of concrete is its resistance to the aggressive environmental conditions High strength concrete is generally more durable than low strength concrete. In the situations when the high strength is not necessary but the conditions of exposure are such that high durability is vital, the durability requirement will determine the water-cement ratio to be used.

Maximum nominal size of aggregate

In general, larger the maximum size of aggregate, smaller is the cement requirement for a particular water-cement ratio, because the workability of concrete increases with increase in maximum size of the aggregate. However, the compressive strength tends to increase with the decrease in size of aggregate.

IS 456:2000 and IS 1343:1980 recommend that the nominal size of the aggregate should be as large as possible.

Grading and type of aggregate

The grading of aggregate influences the mix proportions for a specified workability and water cement ratio. Coarser the grading leaner will be mix which can be used. Very lean mix is not desirable since it does not contain enough finer material to make the concrete cohesive.

The type of aggregate influences strongly the aggregate-cement ratio for the desired workability and stipulated water cement ratio. An important feature of a satisfactory aggregate is the uniformity of the grading which can be achieved by mixing different size fraction

CONCLUSIONS

- The physical properties of Marble dust are satisfying the requirements of fine aggregate. The cost of concrete made with marble dust is less than conventional concrete because the availability Marble dust at less cost.
- Nowadays construction activities increasing day by day and therefore demand of concrete ingredients increases.
- As the Natural river sand is only source of fine aggregate it is serious threat to environment. On other side industrial waste also causes disposal problem and harsh the environment due to its improper disposal.
- Therefore to minimise the negative impact on environment river sand (natural source) should be used minimum and reusing of some other material or industrial waste in concrete can lead pollution free environment.
- Main aim of the research work is to produce economical and eco-friendly concrete with considering its desired properties.
- The maximum compressive strength and split tensle test occurred at 20% replacement of fine aggregate and it was observed as 33.12MPa and 3.56Mpa respectively.
- Based on this experimental investigation, it is found that Marble dust can be used as an alternative material to the natural river sand in future

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