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Partial Replacement of Cement By Marble Dust Powder

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Abstract*-Marble Dust Powder (MDP) is a developing composite material that will allow the concrete industry to optimize material use, generate economic benefits and build structures that will strong, durable and sensitive to environment. In this research work, the waste MDP passing through 90 microns has used for investigating of hardened concrete properties. In this experimental study, cement is replaced with MDP with varying percentage like 0%, 5%, 10%, etc. replacement and paver blocks is made from that concrete and then test them on Compression Testing Machine (CTM) at 7 & 28 days. The focus of our project will be strengthening paver blocks made of replaced cement concrete with MDP in the most economical way.*

Keywords-Waste Marble Dust Powder (MDP), Compression Testing Machine (CTM), Compressive strength.

I. INTRODUCTION

Nowadays, concrete made with Ordinary Portland cement is certainly the most widely used man made material in the world. Despite this fact, concrete production is one of the major concerns worldwide that has impact on the environment such as global warming due to CO2 emission during production of cement. It is estimated that cement production is responsible for about 3% of the global anthrogenic greenhouse gas emission and for 5% of the global anthrogenic CO2 emission. As about 50% of the CO2 released during cement production is related to the decomposition of limestone during burning, mixing of clinker with supplementary materials called blending is considered as a very effective way to reduce CO2 emission. Blending cement with industrial waste may reduce carbon emission from concrete production & eventually helps in technical, economical and environmental benefits. Environmentally, when industrial wastes are recycled not only the CO2 emissions are reduced but residual products from other industries are reused and therefore less material is dumped as landfill and more natural resources are saved.

The inert by-products and waste materials have been used in concrete and mortar production as inert filler. Among these, marble waste powder which is a by-product of marble processing factory was studied by many researchers for its use in concrete and mortar production as sand replacing or cement replacing material. Most of the researches showed positive results and benefits of this filler. However as the by-product i.e. the powder differs chemically depending on the parent marble rocks which depends on the locality, degree of metamorphism and other factors; and also as the physical characteristics of the by product depends on the polishing work, it is necessary to conduct similar research in our country to incorporate it in concrete and cement production for reduction of environmental pollution and sustainable use of natural resources. As marble is the derivative of limestone with similar constitution with that of limestone, and as in marble industry.

II. LITERATURE REVIEW

2.1 "Effect Of Marble Powder On Cement When Partially Replaced" Hassan A. Mohamadien(2012)[6]

Investigates the effect of marble powder and silica fume of different percentages as partial replacement for cement on mortar. By replacement ofmarble powder and silica fume with cement content separately at 0%, 5%, 10%, 15%, 20%, 30% and 50 % by weight were investigated. Different mechanical properties of mortar were measured in terms of compressive strength at 7 and 28 days curing periods. It was observed that at 15% replacement ratio for each the marble powder and silica fume increase the compressive strength of concrete at 7days and 28days test. It showed that compressive strength was increased by 31.4%, 48.3% at 7, and 28 days respectively at 15% replacement ratio of silica fume with cement content and also in replacement of marble powder with cement content the compressive strength increased by22.7%, 27.8% at 7, and 28 days at 15% replacement ratio of marble powder with cement content respectively.

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2.2 "Feasibility Using Marble Powder" Prof. P.A. Shirule, AtaurRahman ,RakeshD.Gupta(2012)[5]

Presented the feasibility of using the marble dust in concrete production as partial replacement of cement . Different properties of hardened concrete have been investigated at 7days and 28 days curing periods by the replacement of 0,5,10,15and 20% marble powder by weight of cement. It was observed that upto 10% replacement of marble powder by weight of cement enhanced the Split tensile strength and compressive strength of concrete M20.

2.3 "Significance of partial replacement of cement by marble powder" A. Manju Pawar et.al (2014)[1]

A Study has been conducted 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 Concrete are increased with addition of waste marble Powder up to12.5 % replace by weight of cement and further any addition of WMP the compressive strength decreases. The Tensile strength of Concrete are increased with addition of waste marble powder up to 12.5 % replace by weight of cement and further any addition of WMP the Tensile strength decreases. Thus they found out the optimum percentage for replacement of MDP with cement and it is almost 12.5 % cement for both compressive & tensile strength.

2.4 "Study on marble dust as partial replacement of cement in concrete" Vaidevi C (2013)[4]

Vaidevi C found that 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. The showed the cost of these cementitious material decreases cost of construction when replaced by different percentages of MD compressive test and tensile test were conducted. 10% replacement gives the best result and for 10 bags of cement, the addition of 10% of marble dust saves 1 bag of cement and 1 bag cost.

III. MATERIALS

3.1 Marble Dust Powder (MDP)

One of the major wastes produced in the stone industry during cutting, shaping, and polishing of marbles is the MDP. During this process, about 20-25% of the process marble is turn into the powder form. India being the third (about 10%) top most exporter of marble in the world, every year million tons of marble waste form processing plants are released. Due to the availability of large quantity of waste produced in the marble factory, this project has been planned and preceeded.

The marble powder used was already described in section. A varying volume fraction i.e.5%, 10%, 15% ,20% ,25% & 30% of cement was replaced by marble powder in this investigation. In this present investigation the marble powder used is obtained from Makrana which is located in Nagaur District of Rajasthan, India.

3.1.1 Advantages of Marble Powder

The following are the few advantages of marble powder

- Marble powder is used for replacement of any other material and saves the material.
- Marble powder used in concrete may Increase the strength of the concrete.
- Marble powder can be obtained by paying nominal or free of cost.
- Marble powder can also be used as filler in flooring of aesthetic tiles.
- Binding property of marble powder is very good.
- It is used in paints because it is a good filler material & extender.

3.1.2 Disadvantages of Marble Powder

The following are the few advantages of marble powder

- Marble powder increases the soil alkalinity.
- Marble powder affects the plants.
- Marble powder affects the human body.

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3.2 Cement

Ordinary Portland cement (OPC-53 grade) of Cement Corporation Of India Limited from a single batch was used through out the course of the investigation.

3.3 Fine Aggregate

Locally available Bhima river sand from Shahpur taluka is used for the present work.The preliminary tests were conducted in the laboratory such as specific gravity , fineness modulus, bulk density & sieve analysis.

3.4 Coarse Aggregate

In the present investigation, locally available crushed basalt stone aggregates of 20mm down size was used. It was obtained from M/s Lahoti stone crushers located on the out skirts of Gulbarga city.

IV. TEST RESULT

4.1 Following are the physical test for various materials which have taken during project work;

Table 1.1
Physical Properties Of Fine Aggregate

Sr. No	Test	Result Obtained In Laboratory	As per conforming to IS:383-1970
1.	Specific gravity	2.64	2.6-2.8
2.	Fineness Modulus	2.92	2.8-3.2
3.	Bulk density	1.725kg/cu.m	1815kg/cu.m

Table 1.2
Physical Properties of Cement

Sr. No	Test	Properties
1.	Fineness - residue on 90 micron Sieve, percent (max)	3.00
2.	Soundness - by Le – chatelier's Apparatus	2.00 mm
3	Initial Setting Time Final Setting Time	103.00 min 305.00 min
4.	Specific Gravity	3.15

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Table 1.3
Physical Properties of Marble Powder

Sr.No	Test	Result Obtained in Laboratory	As per Confirming to IS:12269 -1987
1.	Fineness - residue on 90 micron Sieve, percent (max)	3.00	Not more than 10%
2.	Soundness - by Le–chatelier's Apparatus	1.00 mm	Not more than 10 mm
3.	Initial Setting Time Final Setting Time	110.00 min 315.00 min	Not less than 30 min Not less than 600 min
4.	Specific Gravity	3.45	-

Table: 1.4
Physical properties of Coarse Aggregate

Sr.No	Test	Result Obtained in Laboratory	As per Conforming to IS:383 -1970
1.	Specific Gravity	2.66	2.6-2.8
2.	Fineness Modulus	6.65	6.5-8.5
3.	Bulk Density	1705kg/cu.m	1885kg/cu.m

4.2 Compressive Strength Test (IS: 516 – 1959)

The compressive strength of concrete is one of the most important and useful properties of concrete. In most structural application concrete is implied primarily to resist compressive stress. In this experimental investigation, concrete paver blocks are used for testing compressive strength for different variations of cements being replaced by marble powder. The block casted, cured & tested for 7 & 28 days in a compression testing machine of loading capacity 200T, the blocks were kept under the testing machine & simultaneously load. The load at which the control specimen ultimately fail is noted, compressive strength is calculated by dividing load by area of specimen.

$fc = P/A$ N/mm2

Where fc = block compressive strength in N/mm2

P = block compressive load causing failure in N

A = Cross sectional area of block in mm2

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Table 1.5
Compressive strength test of paver blocks at 7 days for M25 grade

Percentage Variation (%)	Size (mm)	Weight (Kg)	Density (kg/cumtr)	Load (KN)	Compressive Strength N/mm2
0	245 X 124 X 80	5.140	2114.87	300.10	9.87
5	245 X 124 X 80	5.584	2297.56	320.24	10.54
10	245 X 124 X 80	5.865	2413.18	325.60	10.71
15	245 X 124 X 80	5.680	2337.0	350.42	11.53
20	245 X 124 X 80	5.770	2374.09	380.52	12.52
25	245 X 124 X 80	5.901	2428.0	322.31	10.60

Table 1.6
Compressive strength test of paver blocks at 28 days for M25 grade

Percentage Variation (%)	Size (mm)	Weight (Kg)	Density (kg/cumtr)	Load (KN)	Compressive Strength N/mm2
0	245 X 124 X 80	5.052	2078.67	500.10	16.46
5	245 X 124 X 80	5.511	2267.53	520.14	17.12
10	245 X 124 X 80	5.800	2386.44	535.40	17.62
15	245 X 124 X 80	5.550	2284.0	550.50	18.12
20	245 X 124 X 80	5.695	2343.24	650.20	21.40
25	245 X 124 X 80	5.550	2283.57	538.42	17.72

V. CONCLUSION

From the test result it is observed that the usage of MDP in concrete improved its quality in terms of strength. The Compressive strength of Concrete increases up to 20% replacement of cement by MDP and further increasing of percentage of MDP leads to decrease in compressive strength of concrete. Use of these waste material leads to sustainable development in construction industry. To save the environment, MDP may be used as better partial substitute as a replacement of cement in concrete. Through this research cost of paver blocks is reduced as compared to original cost and is very economical.

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