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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF CEMENT BY MARBLE DUST POWDER IN CONCRETE

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Abstract - The present study is aimed to utilize Waste marble powder as partial replacement of cement and comparing it with conventional concrete. This experimental investigation is carried out by M30 grade of concrete is produced by replacing cement with 0%,5%,10%, 15%&,20% of Marble Powder. It is found that the studies of concrete made of waste marble powder increases the workability reduction at 10% and 20% respectively. Therefore the waste marble powder should be used in construction works and then the natural resources would be used efficiently. The waste generated from the industries cause environmental problems. Hence the reuse of this waste material can be emphasized. Marble Dust Powder (MDP) is a developing composite material that will allow the concrète industry to optimise materiel use, generate economic benefits and build structures that will strong, durable and sensitive to environnement. MDP is by-product obtained during the quarrying process from the parent marble rock; which contains high calcium oxide content of more than 50%. The potential use of MDP can be an ideal choice for substituting in a cementitious binder as the reactivity efficiency increases due to the presence of lime. In this research work, the waste MDP passing through 90 microns, has used for investigating of hardened concrete properties. Furthermore, the effect of different percentage replacement of MDP on the compressive strength, splitting tensile strength (Indirect tensile strength) & flexural strength has been observed. In this experimental study, the effect of MDP in concrete on strength is presentedWater/cement ratio (0.43) was kept constant, in all the concrete mixes. Compressive strength, split tensile strength & flexural strength of the concrete mixtures has been obtained at 7 and 28 days. The results of the laboratory work showed that replacement of cement with MDP increase, up to 10% for compressive strength, & up to 15% for split tensile strength & flexural strength of concrete.

Key Words: Concrete, Marble powder, Quarry dust, Glass fibre, Compressive Strength, Split tensile strength.

1. INTRODUCTION

Concrete is a widely used vital material in the construction world. Producing cement in huge amount in factories directly influences the green house gases emission. Reductions in getting good quality limestone directly affect the production of good quality cement. Higher cement content of High Strength Concrete significantly affects the quality at the hardened state due to shrinkage and greater evaluation of heat of hydration. The cost of construction also gets escalated and also leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Blended cements based on the partial replacement of Portland cement clinker (PC) by wastes have been the subject of many investigations in recent years. The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment.The use of the replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment. These materials participate in the hydraulic reactions, contributing significantly to the composition and microstructure of hydrated product. All these problems can be minimized by partial substitution of industrial waste such as marble dust in cement and also Marble stone industry generates both solid waste and stone slurry. Whereas solid waste results from the rejects at the mine sites or at the processing units, stone slurry is a semi liquid substance consisting of particles originating from the sawing and the polishing processes and water used to cool and lubricate the sawing and polishing machines. Stone slurry generated during processing corresponds to around 40% of the final product from stone industry.It has proved to be beneficial from the following points.

- Faster construction
- Improved durability
- Easier placing
- Better surface finish
- Greater freedom in design
- Reduction in site manpower
- Reduce void content in concrete
- Safe working environment

2. MATERIAL USED

2.1 Cement

Ordinary Portland cement 53 grade, commercially available in the market was used for the precast study and it

is having a specific gravity of 3.37 and normal consistency 28% conforming to the requirements of IS: 12269-1987 specifications.

2.2 Fine Aggregate

If the aggregate is less than 4.75mm. Then it is called as fine aggregate. In this study locally available M sand is used which having the specific gravity of 2.51 and water absorption of 0.58%.

2.3 Coarse Aggregate

The coarse aggregate of 20mm size was used for this present study and its having the specific gravity of 2.52. The aggregate were tested as per IS 2386 – 1963.

2.4 Normal Water

The water which if suitable for drinking have to be used for making concrete. The water should be clean and free from harmful, impurities such as alkali, acids and oil etc.

2.5 Marble dust powder

It is a metamorphic rock composed recrystallized carbonate minerals, most commonly calcite or dolomite. It basically used to make arcyclic modelling paste glue base gesso, etc. It made from PH neutral basic calcium carbonate. The specific gravity 2.65 , and moisture content 0.60 .in the Marble dust powder was used as a replacement of cement. It was purchase from Raja tiles and marble factory, salem,tamilnadu, India.

3. EXPERIMENTAL PROGRAMME

3.1 Preparation Of Plant Extract

The leaves were obtained from the plant in the neighbour hood and thoroughly washed with water to remove dust and green layer of aloe Perfoliata.The white flesh is collected from aloe Perfoliata, and grained it is a gel.

3.2 Casting

M30 Grade of concrete is used. Ordinary Portland cement of 53 grade is used and M sand passing through 4.75mm sieve. 20mm size of coarse aggregate is used. Portland water was used for both mixing and curing. The 0.4 water cement ratio used.

And cement content was 480Kg/m3 sand used was 529.81Kg/m3 and coarse aggregate content used was 1144.76Kg/m3 with 20mm maximum nominal size.

3.3 Compression Strength

Compressive testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. Compressive strength or compression strength is a capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstand loads tending to elongate. compressive strength resists compression, whereas tensile strength resists tension.

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150mm size cubes tested at 28 days.

The compressive strength is calculated from failure loaded divided by cross section area resisting the load and reported in units of pound-force per square inch.

Compressive strength of concrete = P/A

Where,

P = Compressive Load

A = Cross Sectional Area

3.4 Split Tensile Strength

The tensional strength is an indirect method. A measure of the ability of material to resists a force that tends to pull it apart each value was taken as the average of these samples. Test results were obtained for specimens cured for 28 days. The concrete develops cracks when subjected tensile forces, the splitting tensile strength of the strength as follows,

$$T = 2P/\pi LD$$

4. RESULTS AND DISCUSSIONS

Table -1 compressive strength comparison between 7 days and 28 days

Sl no	%of marble powder	Compressive strength test (n/mm^2)			Average Of compressive strength (n/mm^2)
		7 Days	14 Days	28 Days	
1	0%	23.55	32.88	11.55	22.66
2	5%	36.4	36.00	19.11	30.51
3	10%	22.4	41.33	18.66	27.4
4	15%	24.00	29.33	15.55	22.96
5	20%	19.11	31.55	18.66	23.10

4.1 Compressive Strength

The compressive strength tested on cube for different percentage of aloe perfoliata in M30 concrete for 7 days,14 days and 28days. The strength of concrete is gradually increased with respect to increasing the percentage of marble dust powder. When adding the marble dust powder the strength of concrete is increased compared to conventional concrete.

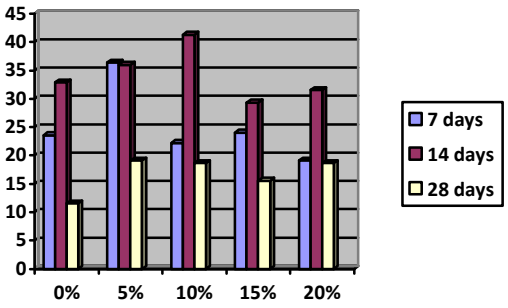

Chart 1: Compressive Strength Analysis

4.2 Split Tensile Strength

The split tensile strength tested on cylinders for different percentage of aloe perfoliata in M_{30} concrete for 7days and 28days having more or less equal strength compare to conventional concrete.

Table -2: split tensile strength comparison between 7 days ,14 days and 28 days

Sl no	% of marble dust powder	Split tensile strength in (n/mm^2)			Average split tensile strength (n/mm^2)
		7 days	14 days	28 days	
1	0%	3.11	2.97	3.253	3.11
2	5%	3.125	2.26	2.83	2.73
3	10%	3.39	2.28	2.55	2.74
4	15%	3.67	2.40	2.405	2.825
5	20%	2.51	2.505	1.41	2.153

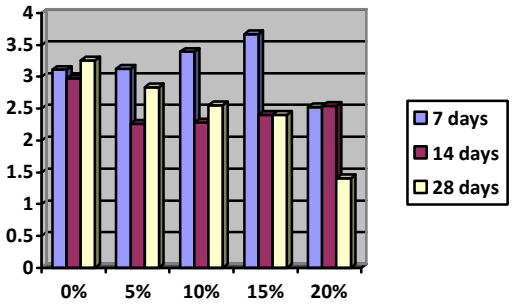

Chart -2: Split Tensile Strength Analysis

5. CONCLUSIONS

The usage of MDP in concrete improved its quality in terms of strength. The following conclusions were based on the study on the test result.

a) The Compressive strength of Concrete increases up to 10% replacement of cement by MDP and further increasing of percentage of MDP leads to decrease in compressive strength of concrete.

b) The Split tensile strength of concrete increases up to 15% replacement of cement by MDP & further increasing of percentage of MDP leads to decrease in Split tensile strength of concrete.

c) The Flexural strength increases up to 15% replacement of cement by MDP and further increases in the percentage of MDP leads to decrease in flexural strength.

d) It is concluded that the MDP can be used as a replacement material of cement, and 10% replacement of cement with MDP gives an excellent result in strength, as compared to the normal concrete.

e) Use of these waste material leads to sustainable development in construction industry.

f) To save the environment, MDP may be used as better partial substitute as a replacement of cement in concrete.

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