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Experimental Studies on Concrete made by using Stone Dust with Polypropylene Fiber

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Abstract: ***The demand of natural sand is quite high as there is an extensive use of concrete in world. This demand is being fulfilled by excessive instream sand mining which causes the degradation of rivers and creating ecological imbalance. Due to this reason, instream sand mining has been banned in most of the river. This retards the progress in construction field. It is needed to investigate the suitable alternative material for sand like stone dust. Stone dust is one of the alternatives of natural sand. It is a waste material and obtained from boulder crusher plants. When it is used in concrete, the problem of dumping is solved. The properties of concrete has been investigated with the partial replacement of natural sand by 0%, 10%, 20%, 30%, 40% and 50% of stone dust. Compressive strength of concrete increases with partial replacement of sand by stone dust increases up to 40% after both 7 days and 28days and beyond 40% starts decreasing.***
Concrete is known for high compressive strength but is weak in tension. Weak tensile strength of concrete along with its brittle behaviour results in the sudden tensile failure without warning which is not desirable for any construction material for the safety purpose of human life. To compensate this weakness of concrete, polypropylene fibers has been used as a material for reinforcement in concrete. Use of polypropylene fiber also changes mode of failure from brittle to ductile and also reduces crack widths and control the crack width tightly, thus improving durability. It also improves freeze thaw resistance of concrete.
Keyword: Stone dust, Polypropylene fiber, Slump Value, Compressive Strength, Split Tensile, Flexure Strength.

I. INTRODUCTION

Concrete is the commonly used construction material due to its structural stability, durability and strength. The demand on concrete is increasing day by day due to growing population, urbanization, transportation and industrialization. Due to the scarcity of naturally obtainable fine aggregate (natural sand) required for making concrete and on other side speedy growth of industrialization contributed to excessive instream sand mining which causes the degradation of river and creating ecological imbalance. So it is needed to investigate the suitable alternative material for sand like stone dust. It is a waste material which is obtained from boulder crushing plants. So the objective of this thesis is to stipulate the appliance of stone dust in combination in concrete as fine combination and scrutiny this concrete with standard concrete.

II. MATERIALS AND METHOD

The following material were used in the present study

1) Materials Used: Details are presented in the table below

Table no: 1 Details of materials used

Name of materials	Source of materials
Cement	PSC manufactured by ACC Cement
Fine aggregate	Zone II obtained from Barakar river ,Jharkhand
Coarse aggregate	Obtained crush stone from crusher plant, Baliapur Jharkhand
Stone Dust	Obtained from crusher plant, Baliapur Jharkhand

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A. Cement

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials are binding them together. Selection of the type of cement will depend on the overall requirements for the concrete, such as strength, durability etc. Cement used in the concrete was Portland slag cement with trade name ACC cement. Physical properties of the cement have been obtained from the tests carried out in the concrete laboratory of B.I.T Sindri as per specification laid down in I.S:455-1989.

Table: 2 Physical and mechanical properties of cement

Sl. No	Name of experiment of cement	Results	Standard limit (IS:455 1989)
1.	Standard consistency	32%	----------
2.	Initial setting time	130 minute	>30 minutes
3.	Final setting time	400 minute	<600 minutes
4.	Specific gravity	3.04	----------
5.	Soundness test	3mm	<10mm
6.	Fineness	97%	>90%
7	Compressive strength at	In MPa	MPa
	3 days	18.60	>16
	7 days	27.30	>22
	28 days	37.00	>33

B. Aggregate

For production of concrete, the aggregates used are coarse aggregates and fine aggregates. The fact is that, the aggregate occupy 70-80% of the volume of concrete. The properties of aggregate impact on various characteristics of concrete.

Table No: 3 physical and mechanical properties of aggregate

Sl no	Properties	Natural fine aggregate	Coarse aggregate
1.	Specific gravity	2.62	2.68
2.	Water absorption (%)	1.2	0.4
3.	Moisture content (%)	0.40	NIL
4.	Fineness modulus	2.567	6.95
5.	Gradation	Zone-II	--------
6.	Coefficient of uniformity	6.8	---------
7.	Coefficient of curvature	2.35	---------
8.	Flakiness index (%)	--------	13.6
9.	Elongation index (%)	--------	18.4
10.	Crushing value (%)	--------	29.23

C. Stone Dust

Table No: 4 Properties of Stone Dust computed in laboratory

Sl No	Material	Test result
1.	Gradation Test	----------
2.	Specific Gravity	2.63
3.	Moisture Content(%)	0.20
4.	Water Absorption (%)	1.10
5.	Fineness Modulus	2.95

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D. Design Mix Concrete

IS: 456-2000 has designated the concrete mixes into a number of grades as M10, M15, M20, M25, M30, M35 and M40. In this designation the letter M refers to the mix and the number to the specified 28 day cube strength of mix in N/mm².

Mix proportion of material, at 0.44 w/c ratio, as per IS 10262:2009.The concrete for M-30 grade has been selected for this test.

Table No: 5 The raw material used in design mix

Ingredients	Kg/m^3
Cement	435.41
Coarse aggregate	1122.69
Fine aggregate	636.52
Water	201.22
W/C Ratio	0.44

III. EXPERIMENTAL RESULTS

With different percentage of sand replacement with stone dust ,the properties of green concrete as well as harden concrete were determined by which optimum percentage of stone dust to be used is 40% .The process consists of testing the essential materials within the laboratory. The grade of concrete adopted for investigation is M30. The proportion of concrete mixes with conventional and different percentage of FSA is done as per IS10260-2009.

Table No: 6. Properties of concrete with replacement of natural fine aggregate by stone dust.

Sample	% of stone dust	Cement (Kg/m^3)	Natural F.A (Kg/m^3)	Natural C.A (KG/m^3)	Water (Kg/m^3)	Slump value (mm)	Compressive strength at 7 days (N/mm^2)	Compressive strength at 28 days (N/mm^2)
M_1	0%	435.41	636.52	1122.69	201.22	70	27.85	39.40
M_2	10%	435.41	572.86	1122.69	201.29	62	28.74	40.74
M_3	20%	435.41	509.21	1122.69	201.36	56	29.03	41.33
M_4	30%	435.41	445.56	1122.69	201.41	51	29.18	42.52
M_5	40%	435.41	381.90	1122.69	201.48	48	29.48	43.19
M_6	50%	435.41	318.25	1122.69	201.56	44	29.33	42.67

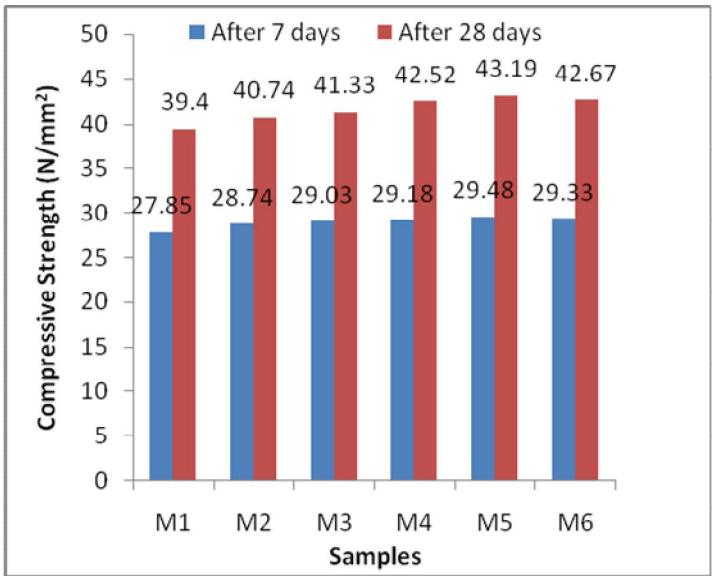

Fig No 1 Compressive Strength of concrete with Stone dust

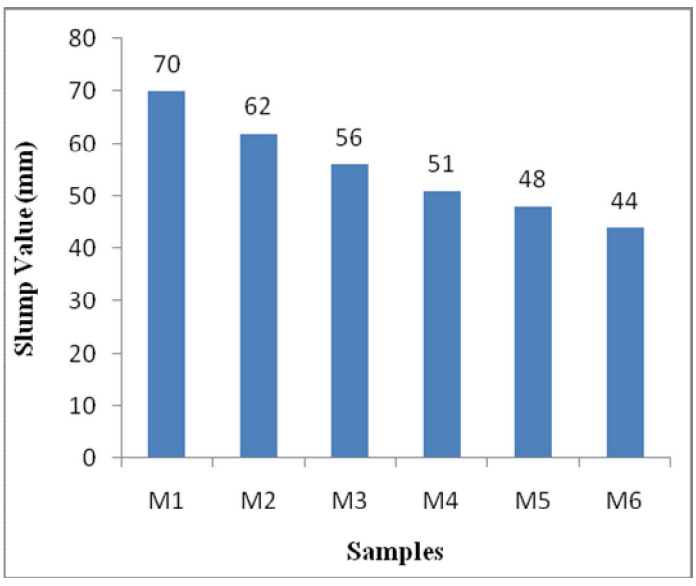

Fig No 2 Slump Value of concrete with Stone dust

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IV. CONCLUSIONS

Based on the experimental investigation the following conclusion may be drawn.

A. Slump value of concrete with partial replacement of natural fine aggregate by stone dust decreases as increase in the percentage of stone dust from 0% to 50%.

B. Compressive strength of concrete with partial replacement of natural fine aggregate by stone dust increases up to 40% at both 7 days and 28days and beyond 40% starts decreasing.

C. The compressive strength of concrete attained maximum at 40% of stone dust. The increase in the compressive strength is 5.85% and 9.62% at 7 days and 28 days respectively.

D. Hence it is concluded that stone dust is suitable as an alternative material for conventional fine aggregate.

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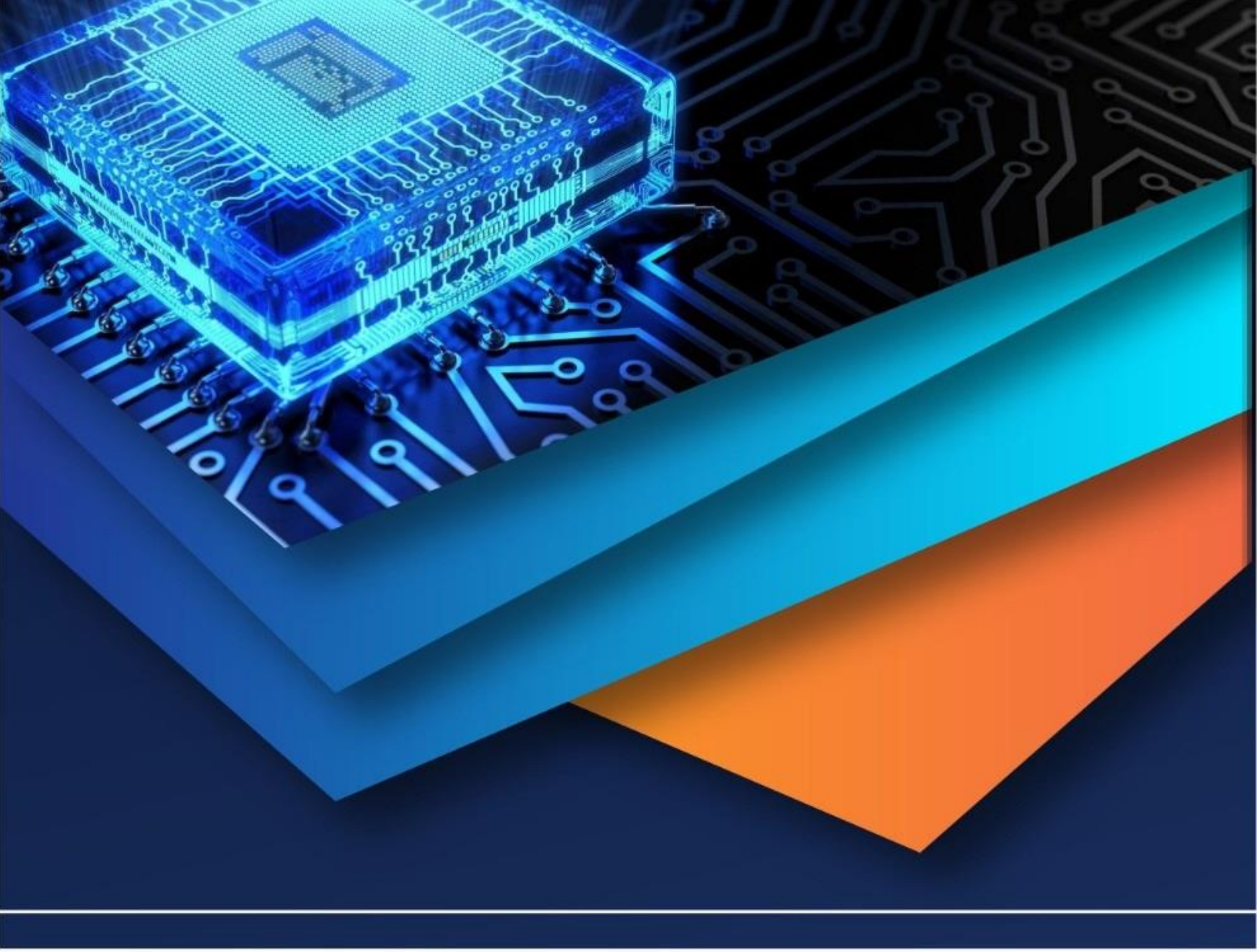

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