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EXPERIMENTAL STUDIES BY USING INDUSTRIAL SAND WITH FIBRE REINFORCED CONCRETE

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ABSTRACT: Generally, river sand is used as fine aggregate for construction. Due to the unremitting mining of sand from stream bed lead to the exhaustion of river sand and it became inadequate material. Also, sand withdrawal from river bed caused a lot of ecological issues. So, as a alternate to river sand in the concrete mix, INDUSTRIAL SAND (manufactured sand) has been used also with 1% of Galvanized Iron Fibers.

In this present experimental study, a comparative study has been carried out to check the usage of INDUSTRIAL SAND in the place of river sand. This study involves determination of some major properties of concrete like compressive strength, tensile strength and durability in water made of both the river and m sands.

KEY WORDS: Fine Aggregate, Construction, River Bed, Experimental Study, Industrial Sand, Compressive Strength, Tensile Strength and Durability.

INTRODUCTION:

Concrete is the most prominent part in the structural construction, Construction consisting of cement, fine aggregate, coarse aggregate, water and some admixtures in required proportion for a quick and better results in different conditions.

The construction industries consumed the large quantity of concrete worldwide.Using natural sand conventional concrete is produced from river beds that as fine aggregate in India.The environmental problem is decreasing natural sources so that there is a restriction on sand quarrying resulted in scarcity and so that its cost is high. There are no normally particles are present in river sand indesired quantity. It is danger to the environment to dig excess amount of sand from river bed. It affects the water level in ground. So alternative material must be found. The easy and cheap way of getting substitute for natural sand is obtained from granite stone quarries, lime stone and crushing stone quarries. This is known the manufactured sand. In this study, the scope of research will be contemplated on the use of INDUSTRIAL SAND as a normal sand with and without steel fibres in concrete.

Before going to the discussion, we need to something about rocks. Mainly we have three different types of natural rocks like Igneous rocks, Sedimentary rocks, and Metamorphic rocks.

The use of fibres: For effective utilization of fibres in hardened concrete.

- Fibres should significantly stiffer than the matrix i.e. have much more modulus of elasticity than the matrix.
- Fibre length must be sufficient.
- Fibre content by volume must be adequate.
- There must be a good fibre-matrix bond.

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- Fibres must have a high aspect ratio, i.e. they must be long relative to their diameter.

TYPES OF FIBRES:

1.Galvanized iron fibres.
2.Synthetic fibres.
3.Glass fibres.
4.Asbestos fibres.
5.Nylon fibres.
6.Natural fibres.
7.Carbon fibres.

DETAILS OF MIX PROPORTIONS:

M25 mix concrete

Water content: 186 liters

W/C Ratio	Cement (kg/m³)	Fine aggregate (kg/m³)	Coarse aggregate (kg/m³)
0.48	387.5	727.85	1106.39
Proportion	1	1.87	2.85

EXPERIMENTAL INVESTIGATION AND TEST RESULTS:

Cement:

A.C.C. Ordinary Portland cement of 53 GRADE was used. The physical and chemical properties ofcement is presented in following tables 4.1 & 4.2.

Table 4.1 physical properties of cement

S.NO	PARTICULARS	RESULTS	BIS SPECIFICATIONS (IS 12269-2013)
1.	Specific Gravity	3.1	-
2.	Normal Consistency	33%	-
3.	Fineness of Cement (m^2/kg)	289	225 min
4.	Setting Time(minutes): a. Initial setting b. Final setting	 125 185	 30 min 600 max0
5.	Sound Ness: Le-chatleir expansion (mm)	 1.0	 10 max

Table: chemical properties of cement

S.NO	PARTICULARS	RESULTS	BIS SPECIFICATIONS (IS 12269-2013)
1.	Soluble Silica (%)	19.96	-
2.	Alumina (%)	5.20	-
3.	Iron Oxide (%)	5.65	-
4.	Lime (%)	60.79	-
5.	Magnesia (%)	1.72	Not more than 6.0 %
6.	Insoluble Residue	0.96	Not more than 4.0 %
7.	Sulphur Calculated as SO_3 (%)	2.61	Not more than 3.5 %
8.	Loss On Ignition (%)	1.47	Not more than 4.0 %
9.	Lime Saturation Factor	0.92	In between 0.80 & 1.02
10.	Proportion Of Alumina To Iron Oxide	0.92	Not less than 0.66
11.	Chloride (%)	0.006	Not more than 0.1 %

DETAILS OF CUBE SPECIMENS:

Table 3.1 Details of Different Cube Specimens

S.NO	Mix Proportion	N.S	M.S	Fibres	No. of cubes	Size of cube(m^3)
1.	MS – 0	100%	0%	0%	6	0.15×0.15×0.15
2.	MS – 25	75%	25%	0%	6	
3.	MS – 50	50%	50%	0%	6	
4.	MS – 75	25%	75%	0%	6	
5.	MS – 100	0%	100%	0%	6	
6.	MS – 0 – 1	100%	0%	1%	6	0.15×0.15×0.15
7.	MS – 25 – 1	75%	25%	1%	6	
8.	MS – 50 – 1	50%	50%	1%	6	
9.	MS – 75 – 1	25%	75%	1%	6	
10.	MS – 100 – 1	0%	100%	1%	6	

Manufactured Sand (INDUSTRIAL SAND):

The size of manufactured sand (INDUSTRIAL SAND) is less than 4.75mm.Manufactured sand is the sand manufactured in the stone quarries. It is a substitute for the river sand used in the construction. Manufactured sand or crusher dust obtained from local granite crushers was used as partial replacement of fine aggregate in the presentinvestigation to cast the concrete cubes. The fineness modulus of Manufactured sand is 3.02. The specific gravity of Manufactured sand is 2.62 respectively.

Fig 1: Sample of INDUSTRIAL SAND

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Table : sieve analysis of manufactured sand

S.NO	IS Sieve	Weight Retained	% Weight Retained	Cumulative % Weight Retained	% cumulative weight	% of finer
1.	4.75 mm	6.0	1.2	6.0	1.2	98.8
2.	2.36 mm	93	18.6	99	19.8	80.2
3.	1.18 mm	124	24.8	223	44.6	55.4
4.	600 µ	44	8.8	267	53.4	46.6
5.	425 µ	61	12.2	328	65.6	34.4
5.	300 µ	108.5	21.7	436.5	87.3	12.7
6.yu	150 µ	44.5	8.9	481	96.2	3.8
7.	75 µ	16	3.2	497	99.4	0.6

properties of Coarse aggregate

S.NO	PARTICULARS	RESULTS
1.	Specific Gravity	2.59
2.	Fineness Modules	3.70
3.	Flakiness Index	18.50 %
4.	Elongation Index	23.7 0%
5.	Crushing Value	15.82%
6.	Impact Value	6.9%
7.	Water Absorption	0.4 %

properties of galvanized iron fibres

S.NO	PARTICULARS	RESULT
1.	Density of fibres (kg/m³)	7850
2.	Diameter (mm)	1.00
3.	Aspect Ratio = L/D	30
4.	Modulus of elasticity (Gpa)	200.00
5.	Tensile strength (Gpa)	1.0 – 3.0
6.	Ultimate strength (Mpa)	395
7.	Failure strain (%)	3.0 – 4.0

TEST RESULTS AND DISCUSSION:

Table : Compaction factor values recorded for each mix batch

S.NO	Nomenclature	C.F value with 0% fibres	C.F value with 1% fibres
1.	INDUSTRIAL SAND – 0%	0.957	1.0
2.	INDUSTRIAL SAND – 25%	0.967	0.89
3.	INDUSTRIAL SAND – 50%	0.914	0.80
4.	INDUSTRIAL SAND – 75%	0.899	0.81
5.	INDUSTRIAL SAND – 100%	0.919	0.74

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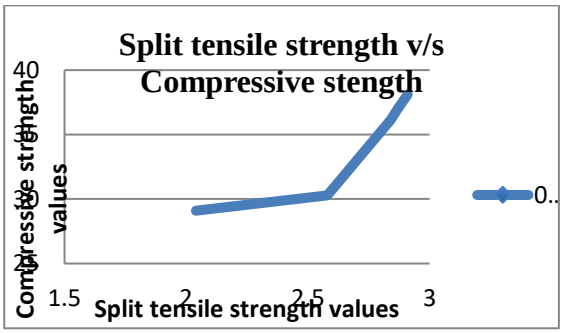
5.	INDUSTRIAL SAND – 100%	0.919	0.74

Table : Compressive Strength value recorded for each mix batch with 1% fibres (7-days)

S.NO	Percentage mix	Load (KN)	Compressive strength (N/mm²)	Average compressive strength (N/mm²)	% of difference in compressive strength
1.	INDUSTRIAL SAND– 0% – 1% 0% replacement	550	23.44	27.6	+0.80%
		550	24.74		
		750	33.63		
2.	INDUSTRIAL SAND–25% – 1% 25% replacement	775	345.54	29.43	+7.91%
		550	23.44		
		655	30.01		
3.	INDUSTRIAL SAND–50% – 1% 50% replacement	750	32.33	33.20	+21.78%
		820	37.44		
		665	22.50		
4.	INDUSTRIAL SAND–75% – 1% 75% replacement	875	34.88	36.67	+35.28%
		720	32.77		
		900	40.23		
5.	INDUSTRIAL SAND–100%–1% 100% replacement	850	36.77	41.27	+52.57%
		950	41.22		
		1000	44.04		

Table : Split tensile-Strength value recorded for each mix batch with 1% fibres (7-days)

S.NO	Percentage mix	Load (KN)	Split tensile strength (N/mm²)	Average split tensile strength (N/mm²)	% of difference in split tensile strength
1.	MS – 0% –1% 0% replacement	170	2.5	2.63	+33.50%
		190	2.6		
		200	2.2		
2.	MS 25% – 1% 25% replacement	200	2.5	2.82	+43.14%
		200	2.81		
		200	2.2		
3.	MS–50% – 1% 50% replacement	210	2.57	2.87	+45.68%
		200	2.32		
		200	2.72		
4.	MS–75% – 1% 75% replacement	200	2.62	3.06	+55.32%
		230	3.45		
		220	3.21		
5.	MS–100%–1% 100% replacement	250	3.53	3.43	+74.11%
		230	3.25		
		250	3.53		



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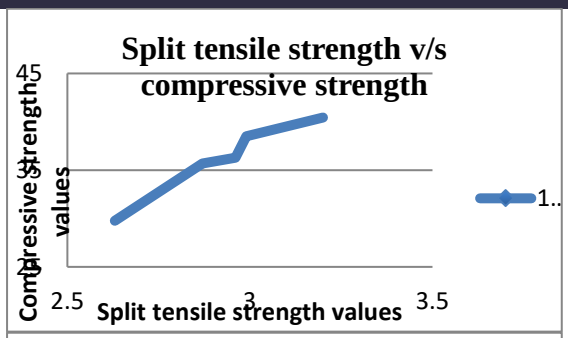

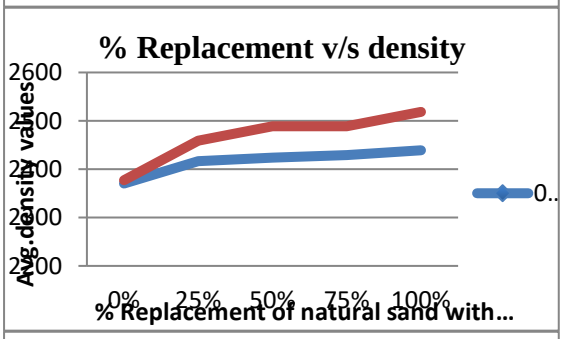

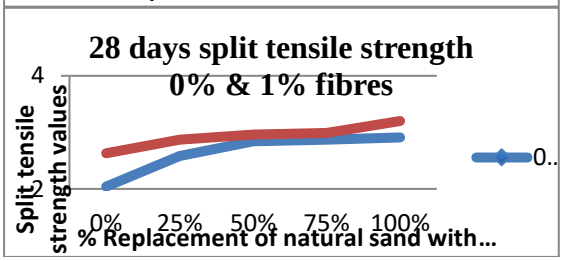

CONCLUSION:

1.The compressive strength of concrete mix increased when the replacement of natural sand with manufacturing sand increases gradually up to 100% by 40.25% and the addition of galvanized fibres increases the compressive strength by 48.78%.

2.The split tensile strength value ofconcrete mix increased when the replacement of natural sand with manufacturing sand increases gradually up to 100% by 47.71% and by the addition of galvanized fibres that increases the split tensile strength by 62.43%.

3. Workability of concrete mix decreased with replacement of natural sand with manufacturing sand. But up to some extent even replaced concrete mix batches got optimum results. At the same time after 75% replacement of natural sand the workability of concrete mix decreases gradually.

4. By considering all the above parameters like slump cone value, compaction factor value, compressive strength value & split tensile strength value it is recommended that is better to limit the replacement of natural sand with manufacturing sand up to 75% only for better fresh and hardened concrete.

5. Failure pattern of cube moulds and cylindrical moulds is almost similar for both natural sand and manufacturing sand.

6. This whole study is mainly to make awareness about the resources like manufacturing sand and galvanized iron fibres to use in the present structural construction works.

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