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Investigation on Waste Plastic Fibre Reinforced Concrete Using Manufactured Sand as Fine Aggregate

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Abstract-*Concrete is the main construction material in the world. It consist of cement, fine aggregate, coarse aggregate and water as main ingredients. Now days due to high global consumption of natural sand, sand deposit are being depleted and causing serious threat to environment as well as society. River sand is becoming a scarce commodity and hence an exploration alternative to it has become imminent. Manufactured sand is the good alternative to river sand and it is purposely made, fine crushed aggregate produced under controlled conditions from a suitable sand source rock. Plastics are non biodegradable common environmental polluting materials. These are going to affect the fertility of soil. In present study the detailed experimental investigation is carried out on plastic fibre reinforced concrete by partial replacement of natural sand by manufactured sand with different percentages(0%, 20%, 40%, 60%,80%,100%) and adding fixed percentage (0.5% of weight cement)) of plastic fibres. The mechanical properties of concrete like compressive strength, tensile strength and flexural strength are studied here.*

Key Words: *Fibre reinforced concrete, manufactured sand, compressive strength, split tensile strength, flexural strength*

1. INTRODUCTION

Concrete is most widely used construction material in world. It is manmade building material it can be mould into any shape. Concrete is composite material having properties of high compressive strength , low tensile strength , low post cracking capacity, brittleness and low impact strength. These properties can be improved by addition of fibre in the concrete. The fibres are dispersed and distributed randomly in the concrete during mixing and this improves certain properties like tensile strength, flexural strength etc. Fibre reinforced concrete can be defined as composite materials consist of cement based matrix containing an ordered or randomly distributed of fibres. The common fibres used in the concrete are steel, glass, asbestos, jute, coir, polypropylene, nylon.,[9] The technical term for sand as fine aggregate require in bulk state for various civil engineering works but availability of construction sand allows environmental pressure to reduce extraction of sand from rivers the use of manufactured sand as a replacement is increasing with the ban of sand mining implemented by different states, with the increasing demand for river sand for construction works, many civil engineers have expressed the need to promote use of manufactured sand in the construction industry, as per reports manufactured sand widely used as around the world and technicians of major projects around the world insist on the compulsory use of manufactured sand because of its consistent gradation and zero impurity. The uses of plastic fibres in the concrete are going to improve the mechanical properties of concrete.

Prakash Rao and Giridhar Kumar (2004) carried detail investigations on concrete mixes with stone crusher dust as fine aggregate. They conclude stone crusher dust has a good alternative material for river sand [2]. R.Kandasamy reported that with addition of domestic plastic fibres in the concrete there is appreciable increase in compressive strength [4].Mahendra and R.Chitalang reported that using manufactured sand and steel fibres in concrete going to produce improved results compared to conventional concrete[3]. Balasubramanianm.M reported that by using 1% of E-plastic in concrete produces 2.5% of incremental strength compared to conventional concrete [10].

2. RESEARCH SIGNIFICANCE

The main objective of present investigation is to study the properties of fibre reinforced concrete by replacing the fine aggregate by manufactured sand at different percentages (0%, 20%, 40%, 60%, 80%, and 100%) with addition of plastic fibres. The study was carried out on M40 grade concrete with 0.4 water cement ratio.

3. MATRIALS AND METHODOLOGY

3.1 Cement

In this experimental investigation Portland pozzolona cement (PPC) was used for all concrete mixes, the cement used was fresh and without lumps. The testing of cement was done as per IS 8112-1989.The specific gravity of cement was found to be 3.15.

3.2 Water

Portable tab water is used for preparation of specimens and curing of specimens.

3.3 Fine aggregate

As per IS 383-1970, table4 sand used for experimental program was locally produced and was conforming zone-II. The specific gravity of fine aggregate was found to be 2.6.

3.3.1 Manufactured sand

Manufactured sand used for experimental program is obtained from local resource SB Hukkeri construction (P) Ltd. It was conforming zone II. The specific gravity of manufactured sand is 2.8.

3.4 Coarse aggregate

Locally available coarse aggregate passing from 20mm sieve and conforming IS 383-1970 were used in present work. The specific gravity of coarse aggregate was found to be 2.9.

3.5 Plastic fibres

Low density polyethylene is used as fibres. Generally these made by cutting the water bottles in to laminar shaped fibres are used and thicknesses of fibres are varying from 0.125 to 0.150mm. By trail mix results 0.5% (by the weight of cement) is added in the concrete of present experimental work.

3.6 Admixture

Commercially available conplast SP-430 super plasticizer is used to enhance the workability of fresh concrete.

3.7 Mix design

The mix was designed as per IS 10262:2009 for M40 grade concrete with 0.4 water cement ratio. Concrete mixes are prepared by partial replacement of natural sand by manufactured sand with different percentages (0%, 20%, 40%, 60%, 80%, 100%) respectively and adding fixed percentage of plastic fibres (0.5% of weight of cement) for every mix. The materials of each mix are given in table1.

3.8 Test specimens and test procedure

Cement, sand and aggregate were taken in mix proportion 1:2.05:2.89 which correspond to M40 grade of concrete respectively. The 150mm size concrete cubes, cylinder of size 150mm diameter and 300mm height and concrete beam of size 100mm×100mm×500mm were used as test specimens to determine the compressive strength, split tensile strength and flexural strength respectively.

4. RESULTS AND DISCUSSION

The compressive strength results of different mixes are given by fig1. In the present investigation compressive strength of concrete produced by replacing natural sand by manufactured sand with addition of plastic fibre is goes on increasing up to 100% replacement of M-sand. The percentage increase in the compressive strength at this 100% replacement of M-sand found to be 10.38% as seen in table 2 and fig1. Similarly for split tensile strength increases up to 100% replacement of M-sand. The increased percentage of split tensile strength for 100% replacement of M-sand found to be 19.52% which is shown in table2 and fig2. For flexural strength also 100% replaced manufactured sand concrete possess higher strength compare to all other mixes. The increased percentage of flexural strength found to be 14.24% which is shown in table2 and fig3.

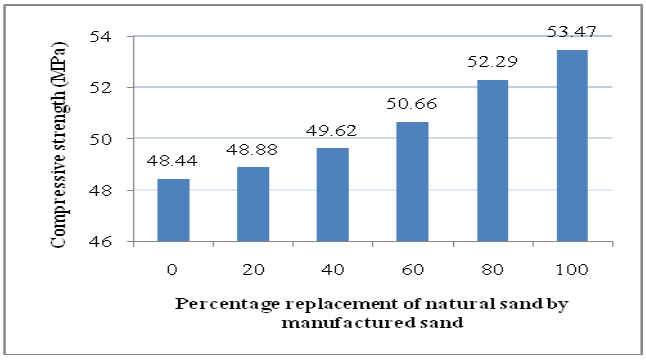

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Fig1: Variation in Compressive strength of concrete

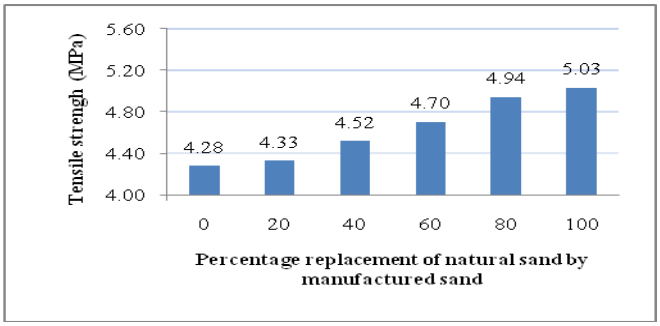

Fig 2: Variation in split tensile strength of concrete

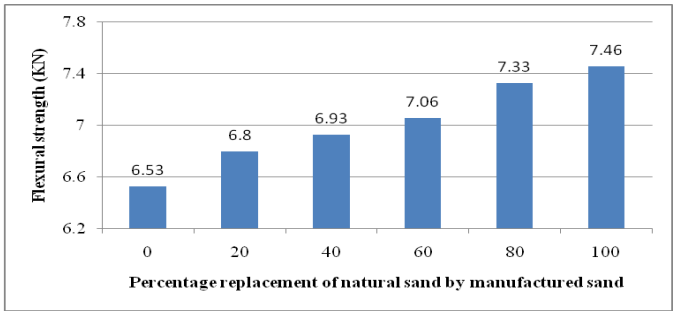

Fig3: Variation in Flexural strength of concrete

5. CONCLUSION

Based on the test results from table 2, following conclusions are drawn

1) Concrete produced by replacing natural sand by manufactured sand with addition of 0.5% of plastic fibres imparts higher compressive, flexural and split tensile strengths due to sharp edges and better interlocking of M-sand particles and good bonding with other materials.
2) The compressive strength of 100% replaced manufactured sand concrete with 0.5% of plastic fibres is 10.38% more than reference mix (0% replaced mix).
3) The split tensile strength of 100% replaced manufactured sand concrete is 19.52% more than the split tensile strength of reference mix.
4) The flexural strength of 100% replaced manufactured sand concrete is 14.24% more than the flexural strength of reference mix.
5) The results of this experimental work establishes that river sand can be completely replaced with manufactured sand and with the addition of plastic fibers does not have any adverse impact on the mechanical characteristics of the concrete.

Table 1: Concrete Mix Details

S.No	Cement (kg)	Fine aggregates		Coarse aggregate 20mm down (Kg)	Water (litres)	Super plasticizer (conplast SP 430 in Kg)	Plastic fibres (Kg)
		Natural sand (Kg)	M-sand (Kg)				
Mix A (0% M –sand, Ref mix)	400	823.00	----	1159.53	157.60	4.00	2.00
Mix B(20%M-sand)	400	658.47	175.92	1159.53	157.60	4.00	2.00
Mix C(40% M - sand)	400	493.80	351.85	1159.53	157.60	4.00	2.00
Mix D (60% M-sand)	400	329.20	527.78	1159.53	157.60	4.00	2.00
Mix E (80% M-sand)	400	164.60	703.71	1159.53	157.60	4.00	2.00
Mix F (100% M-sand)	400	----	879.65	1159.53	157.60	4.00	2.00

Table 2: Test Results of concrete

Percentage replacement of natural sand by manufactured sand	Compressive strength (MPa)	Percentage increase of compressive strength w.r.t ref. mix	Split tensile strength (MPa)	Percentage increase of tensile strength w.r.t ref. mix	Flexural strength (MPa)	Percentage increase of flexural strength w.r.t ref. mix
Mix1(0%M-sand,0.5% PF) Ref.mix	48.44	0.00	4.28	0.00	6.53	0.00
Mix 2(20% M-sand,0.5% PF)	48.88	0.91	4.33	1.16	6.8	4.13
Mix 3(40% M-sand,0.5% PF)	49.62	2.44	4.52	5.60	6.93	6.13
Mix 4(60% M-sand,0.5% PF)	50.66	4.54	4.70	9.81	7.06	8.12
Mix 5(80% M-sand,0.5% PF)	52.29	7.94	4.94	15.92	7.33	12.25
Mix 6(100% M-sand,0.5% PF)	53.47	10.38	5.03	19.52	7.46	14.24

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