International Journal of Civil Engineering and Technology (IJCIET)
Volume 8, Issue 8, August 2017, pp. 1271–1278, Article ID: IJCIET_08_08_137
Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=8&IType=8
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

STUDY ON INFLUENCE OF RECRON POLYESTER FIBERS AND SLAG SAND ON THE PERFORMANCE OF CONCRETE

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ABSTRACT

As construction activity is increased in recent days, requirement of construction materials such as cement, sand, aggregates etc. has also increased by leaps and bounds. But the builders are facing lot of problems in regard to unavailability of natural sand or unaffordable M-sand. So there is a need to find an alternative material at lower cost which can perform same as natural sand. Now a days there have been lot of efforts on various alternative materials such as quarry dust, saw dust, copper slag, crushed recycled aggregates, bagasse ash etc. to use as fine aggregates with satisfactory strength and durability properties of concrete. Also as plain concrete is weak in resisting tensile stress and flexural load with the development of cracks, use of various fibers such as steel fibers, carbon fibers, glass fibers, plastic fibers, coir fibers etc. can increase the load carrying capacity of concrete in tension and flexure. The present study involves use of polyester fiber for 0%, 1%, 1.25% and 1.5% of cement content and slag sand at 0%, 10%, 15% and 20 % as replacement of fine aggregates respectively. The test results revealed that there is an increase in the strength properties of the concrete containing fiber content of 1.25% and 15% slag sand as partial replacement of fine aggregates.

Key words: Polyester Fiber, Fiber Reinforced Concrete, Slag Sand, Compressive Strength.

Cite this Article: Revanasiddappa Madihalli, Naveen Kumar B M, Dr. H N Rajakumara and Priyanka, Study on Influence of Recron Polyester Fibers and Slag Sand on the Performance of Concrete. *International Journal of Civil Engineering and Technology*, 8(8), 2017, pp. 1271–1278
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=8

1. INTRODUCTION

Concrete is the composite material consists of cement, coarse aggregates, fine aggregates and water. Along with these conventional ingredients one can also use other alternative materials which can increase the strength and other properties of concrete, which in turn lead to better quality of any construction. Slag sand is the byproduct from steel industries having similar properties as that of natural sand and M sand. This slag sand can be used as replacement for fine aggregates in concrete. Recron polyester fiber can be used as secondary reinforcement used to arrest the formation of cracks. Polyester is a synthetic fiber derived from coal, air, water, and petroleum. Polyester has a relatively high specific gravity, leading to it dispersing well in water and a relatively high melting point making it a good all round choice for a variety of applications.

2. EXPERIMENTAL PROGRAMME

The prime objective of the study was to evaluate the structural properties of concrete containing polyester fiber and slag sand as partial replacement of fine aggregates. The details of the material used for study are enumerated below.

2.1. Cement

As per code conforming to IS 1489:1991 Portland cement having specific gravity of 3.5 was used for the study.

2.2. Course Aggregates

Locally available 20mm and 10mm down sized coarse aggregates were used for the study. Specific gravity of coarse aggregates is 2.64, water absorption is 0.5% and fineness modulus confirms to the requirements of IS: 383 – 1970.

2.3. Manufactured Sand

The manufactured sand having specific gravity 2.57, water absorption 3% with fineness modulus of 2.38 was used for the study.

2.4. Slag Sand

Slag sand is a by-product of steel industries which is obtained during the smelting process. Specific gravity is 2.89, water absorption is 1.32 and fineness modulus is 2.32.

Figure 1 Slag Sand

2.5. Polyester Fibers

Polyester fibers are used in concrete to study the effect on strength properties. It is from Reliance Industries Limited. It is 6mm length and white in color. Specific gravity is of 1.39.

Figure 2 Polyester Fibers

2.6. Water

As per IS: 456-2000 portable water is generally considered satisfactory for mixing and curing of concrete. Accordingly portable water was used for the concrete.

3. MIX DESIGN FOR M30 GRADE OF CONCRETE

As per the code IS 456:2000 and IS 10262:2009 guidelines mix design for M30 was calculated and required quantity of ingradients of concrete are mentioned below.

Table 1 Material Properties

cement Kg/m^3	coarse aggregates	fine aggregates	water liters	admixture Kg/m^3	w/c
345	1098.98	786.84	185	2	0.45

3. RESULTS AND DISCUSSIONS

The cubes were tested for the compressive strength, beam specimens were tested for flexural strength and split tensile strength test was conducted on cylinder specimens to study the influence of polyester fibers and slag sand on mechanical properties of plain and reinforced concrete. The test results obtained are given below.

3.1. Compressive Strength

Figure 3 Compression Testing of Cube Specimen

Table 2 Compressive Strength Results

% of polyester fiber and slag sand	Notations	For 7 days N/mm^2	For 28 days N/mm^2
0% fiber, 0% slag sand	M1	26.09	32.25
1% fiber, 10%slag sand	M2	29.94	35.93
1.25% fiber, 15%slag sand	M3	31.51	37.57
1.5% fiber, 20%slag sand	M4	30.07	33.96

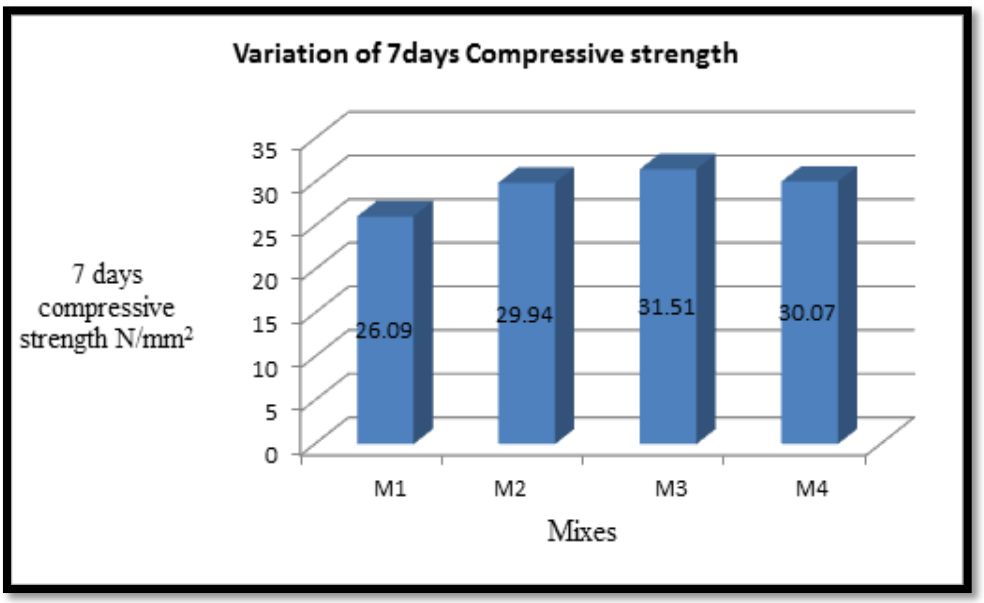

Figure 4 Variation of 7 days Compressive Strength

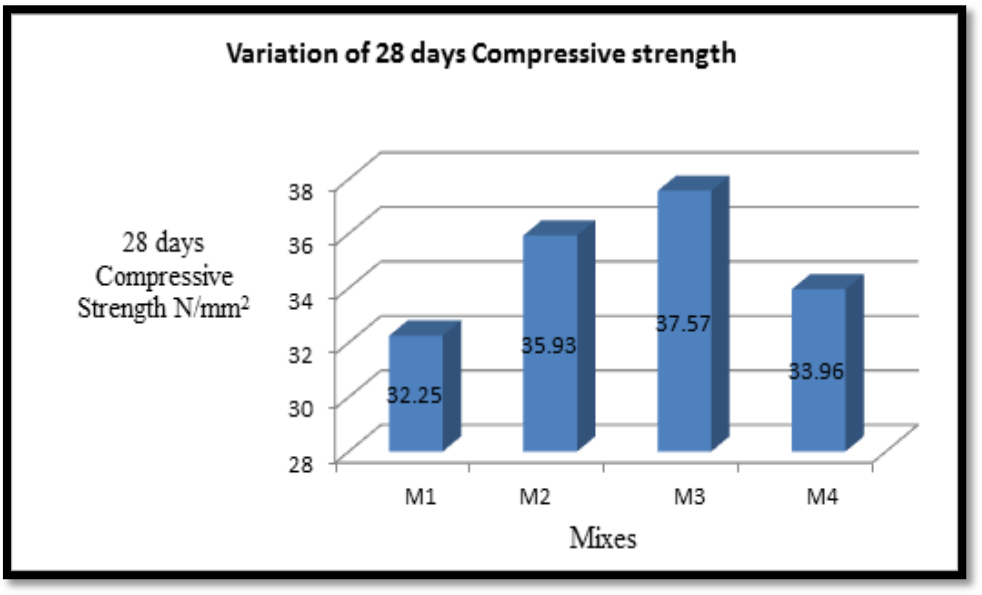

Figure 5 Variation of 28 days Compressive Strength

3.2. Split Tensile Strength

Figure 6 Split Tensile Strength test on Cylinder Specimen

Table 3 Split Tensile Strength Results

% of polyester fiber and slag sand	Notations	For 7 days N/mm^2	For 28 days N/mm^2
0% fiber, 0% slag sand	M1	1.76	2.48
1% fiber, 10%slag sand	M2	2.29	2.91
1.25% fiber, 15%slag sand	M3	2.52	2.98
1.5% fiber, 20%slag sand	M4	2.44	2.89

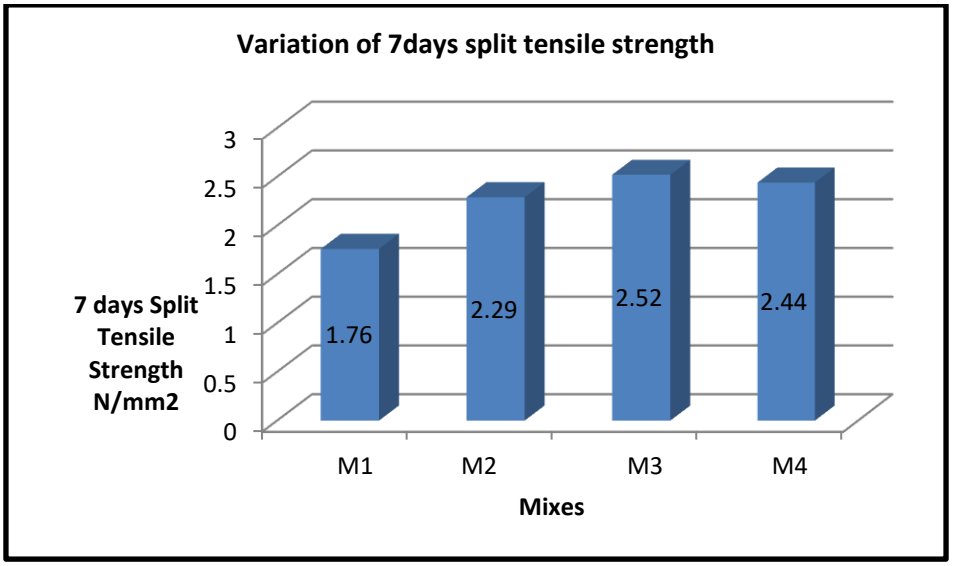

Figure 7 Variation of 7 days Split Tensile Strength

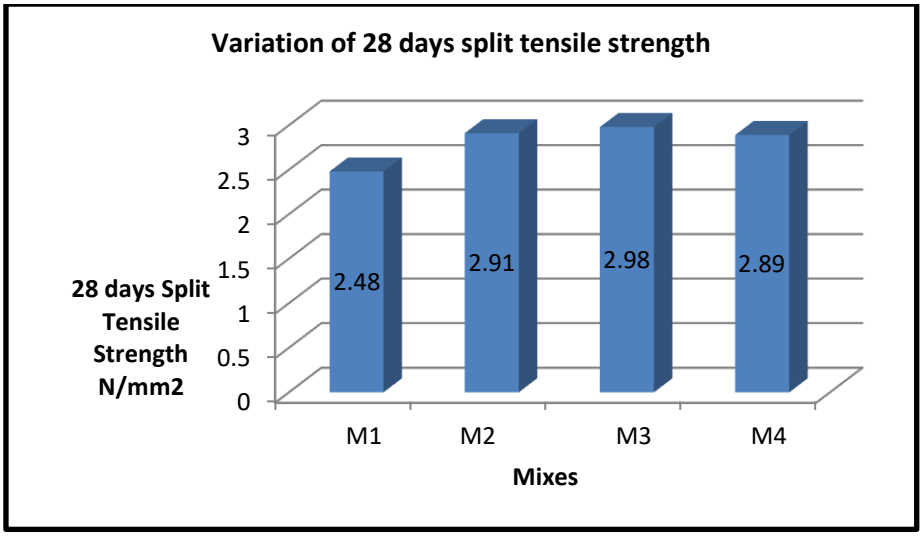

Figure 8 Variation of 28 days Split Tensile Strength

3.3. Flexural Strength

Table 4 Flexural Strength results

% of polyester fiber and slag sand	Notations	Flexural Strength N/mm^2
0% fiber,0% slag sand	M1	17.33
1% fiber, 10%slag sand	M2	18.38
1.25% fiber, 15%slag sand	M3	21.33
1.5% fiber, 20%slag sand	M4	18.91

Figure 9 Reinforcement for beams

Figure 10 Casted Beam Specimens

Figure 11 Flexural Strength testing of Beams

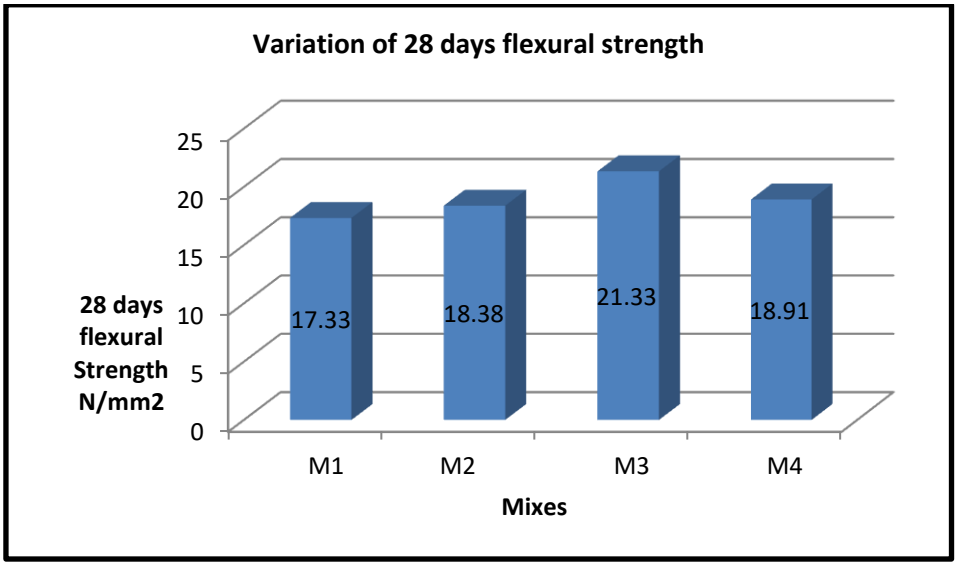

Figure 12 Variation of Flexuaral Strength at 28 days

From the experimental results it can be observed that as the percentage of fibers increases up to 1.25% there is an increase in the compressive strength and split tensile strength of the plain cement concrete. Also there is an enhancement of the flexural strength of the reinforced

concrete members with the variation of polyester fibers up to 1.25%. Further increase in the percentage of polyester fibers shown decrement in the strengths of both plain and reinforced concrete.

From the test results it is also observed that there is increase in the mechanical properties of the plain and reinforced cement concretes containing slag sand as partial replacement of fine aggregates up to 15%. Further increase in the slag sand has decreased the strength.

4. CONCLUSIONS

Form the experimental investigations it can be concluded that the reinforced concrete and the plain cement concrete containing 1.25% of polyester fibers and 15% of slag sand as replacement of fine aggregates gives maximum compressive strength, split tensile strength and flexural strengths, which can be taken as optimum mix proportions for practical applicability.

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