IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 3, June-July, 2015
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

Experimental Study On M30 Grade Fiber Reinforced Concrete Using Aluminium Slag And Recycled Aggregates

Shreyas Y S[1], Sharath N[2], Rajeeva S J[3]

[1,2]U G Student, Department of Civil Engineering, S J C Institute of Technology, Chickaballapura, Karnataka, India

[3]Assistant Professor, Department of Civil Engineering, S J C Institute of Technology, Chickaballapura, Karnataka, India

Abstract
Fiber Reinforced Concrete (FRC) is being utilized widely these days because of development of urbanization. Because of expansion being used of ordinary material like river sand and crushed stone total has expanded the expense of generation furthermore has negative impact on environment because of extreme mining. In the present work, an exploratory study was made by totally supplanting aluminum slag and recycled aggregate total rather than river sand and crushed stone total separately. Blend outline for M30 evaluation was done using 0.2% and 0.4% of steel scrap and steel fiber with aspect ratio of 60. Strength tests were done at 7, 14 and 28 days. Exploratory study showed palatable results when contrasted with traditional concrete.
Keywords: *Aluminium slag, Recycled aggregate, steel scrap, steel fiber.*

1. Introduction

Concrete is most widely used construction material in the world. Because of its ability to get cast in any form and shape, it has almost replaced old construction materials such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementetious material, aggregate and water and by adding some special ingredients. Hence concrete is very well suited for a wide range of applications. However concrete has some deficiencies as listed below, Low tensile strength, Low post cracking capacity, Brittleness and low ductility, Limited fatigue life, not capable of accommodating large deformations, Low impact strength. The quality and strength of concrete can be changed by rolling out fitting improvements in its ingredients.Concrete is appropriate for extensive variety of uses yet as the interest for materials is calm high in creating nations. The worldwide utilization of materials as additionally turn out to be extremely high.Therefore it is important to supplant the materials in cement by an option materials. Fiber Reinforced Concrete comprises of Portland concrete, coarse and fine aggregates alongside steel scrap and steel fiber as fortification material. River sand is favored for cement yet unreasonable mining of river sand has created natural debasement. In this way, hunt down different option for river sand has as of now started. Aluminum slag a by-productproduced during the manufacture process of aluminum. Because of the over utilization of coarse aggregate utilized as a part of development works, that outcomes in the exhaustion of rough mountains which influences the asthetic magnificence of nature.Due to that, unlawful mining, ecological impacts, wellbeing risks and so forth., may bring about a few issues. Subsequently it is important to supplant the coarse aggregate by recycled aggregates.Experimental investigations of past specialists have demonstrated that expansion of steel scraps and steel fibers upgrades quality properties of cement.

2. Problem Context and Definition

Concrete as a development material has a vast potential everywhere throughout the world and next just to the utilization of water. Totals contributing around 60-70% of solid mass, consequently there exists an unlimited interest for totals. The quick and tremendous infrastructural advancements in India request gigantic amount of river sand for concrete, as fine aggregate. Lessening sand assets in stream beds posture natural issue and thus government has forced confinement on the use of sand. The tremendous request because of quick advancement in base, shortage of river sand in stream informal lodging because of government confinement on quarrying of sand, have has prompted the increment in the expense of river sand. This not just has expanded the expense of the development additionally defers the development in few spots because of the non-accessibility of river sand. The crude material utilized for the production of bond has exhausting step by step. This inspires scrutinizes for option material to supplant the river sand. Substitution of crude materials constituents with choices is an essential eco effectiveness driver and is need of great importance. It decreases utilization of normal assets and counterbalance customary materials accordingly preserving non-renewable regular assets adding to economical development and taking into account the recuperation of both vitality and material from chose waste.

In this test examination, quality parts of fiber reinforced concrete is to be contemplated with aluminum slag as substitution to river sand and recycled aggregate as supplanting to crushed stone aggregate with fiber variations of 0%, 0.2% and 0.4% of steel scrap and steel fiber by weight of cementatious materials. The tests are directed keeping in mind the end goal to study strength factors, for example, cube compressive strength, split tensile strength and flexural strength. The outcome results will be analyzed between Conventional concrete and Fiber reinforced concrete.

3. Previous Works

Experimental study on steel fiber reinforced concrete shows that the investigations conducted for compression test on fiber reinforced concrete specimens. The results shown the increase in strength of 6% to 17% compressive strength, 18% to 47% split tensile strength, 22% to 63% flexural strength and 8% to 25% modulus of elasticity respectively. Addition of steel fibers at 0.5% by volume of concrete reduces the cracks under different loading condition. The brittleness of concrete is also improved by addition of steel fibers. Since concrete is very week in tension, the steel fibers are beneficial in axial tension to increase tensile strength [1]. This paper presents a review of the aluminium salt slag chemical and mineralogical characteristics, as well as various processes for metal recovery, recycling of sodium and potassium chlorides content back to the smelting process and preparation of value added products from the final non-metallicresidue[2].Very few literatures are available regard to the use of aluminium slag. Presently no literatures are available on using of aluminium as fine aggregate and recycled aggregate as coarse aggregate. The present study examines the possibility of using aluminium slag and recycled aggregates as full replacement of fine aggregate and coarse aggregate respectively.

4. Materials Used

4.1 Cement

The cement used was ordinary Portland cement of 53 grade with specific gravity of 3.06, fineness 4% and normal consistency 36%. The initial and final setting time of cement was 35 minutes and 431 minutes respectively.

4.2 Fine Aggregate

In this study,Aluminium slag is used as replacement of river sand by constant 100% for all variations and is collected from the Jindal Aluminium limited located in Bellary, Karnataka. But for conventional concrete we have used river sand.

Table 1: Properties of fine aggregate

Particular	River sand	Aluminium Slag
Specific gravity	2.61	2.53
Sieve analysis	Zone II	Zone II
Absorption	1.75%	0.22%

4.3 Coarse Aggregate

In this study, recycled aggregate is used as replacement of crushed stone aggregate by constant 100% for all variations. But for conventional concrete we have used crushed stone aggregate.The aggregate of 20mm and below size were used.

Table 2: Properties of Coarse aggregate

Particular	Crushed stone Aggregate	Recycled Aggregate
Shape	Angular	Angular
Crushing Test	27.59%	35%
Impact Test	15%	16%
Specific Gravity	2.60	2.51
Water absorption	0.1%	0.73%

4.4 Fibers Used

In the present work, Steel scraps and Steel fibers (crimped)oflength13mm and 17mm respectively with aspect ratio 60 are used.

4.5 Water

Ordinary potable water was used for mixing and curing purpose.

4.6 Super Plasticizer

Rheo-build 1125 is used for the work. The percentage of super-plasticizer is 0.8% and 0.7%of total cementitious quantityfor Conventional concrete and Fiber Reinforced concrete are used respectively.

5. Methodology

Design mix concrete is preferred to nominal mix. Mix is designed following the stipulations laid down in IS 456:2000 with respect to minimum cement content, maximum water to cement ratio and minimum grade of concrete for various exposure conditions and guidelines. Mix is designed as per IS 10262:2009 - BIS method of Mix design.

Mix design for Conventional concrete:

Mix Ratio = C: FA: CA: w/c

Mix ratio **= 1: 2.14: 3.48**: 0.42 (0.8% of Super plasticizer)

Mix design for Fiber Reinforced concrete:

Mix Ratio = C: FA: CA: w/c

Mix ratio = **1: 2.19: 3.55**: 0.45 (0.7% of Super plasticizer)

6. Results and Discussions

6.1 Slump Test

Slump test was done for Conventional Concrete (CC) and Fiber Reinforced Concrete (FRC) as a full replacement for Aluminium slag in place of River sand and Recycled aggregate in place of Crushed stone aggregate for all variations of Fibers.

Table 3: Slump Value for Concrete Mixes

Mix	Slump in mm	% of SP
CC	70	0.80
FRC	65	0.70

6.1.1 Observation and Discussion on Workability

For the Conventional Concrete the slump worth was discovered to be 70 mm then when fibers were blended with concrete, the slump quality diminished. Workability of Conventional Concrete was discovered to be more when contrasted with Fiber Reinforced Concrete. The obliged slump worth is accomplished by shifting the rate of super plasticizer. The lessening in slump with the use of aluminum slag is because of the water retention by aluminum slag, since it has more water ingestion limit than river sand, which obstructs the hydration of concrete because of absence of water substance.

6.2 Compressive Strength

Compressive strength of concrete mixes with cube specimen of size 150x150x150 mm for Conventional Concrete and Fiber Reinforced Concrete with a varying percentages of 0% fiber, 0.2% &0.4% of steel scrap respectively and 0.2% & 0.4% of steel fiber respectively made with aluminium slag as fine aggregate and recycled aggregate as coarse aggregate by volume fraction of concrete was determined at 7, 14 and 28days.

Table 4: Compressive Strength Results in N/mm^2

Curing Period	**CC**	**0% FIBER**	**STEEL SCRAP**		**STEEL FIBER**	
			0.2%	**0.4%**	**0.2%**	**0.4%**
7 DAYS	26.01	37.35	39.38	29.64	33.57	30.67
14 DAYS	33.71	40.70	42.15	32.26	35.75	34.11
28 DAYS	37.20	42.87	44.03	37.49	41.42	38.07

CC = CONVENTIONAL CONCRETE
(ALL VALUES ARE IN N/mm^2)

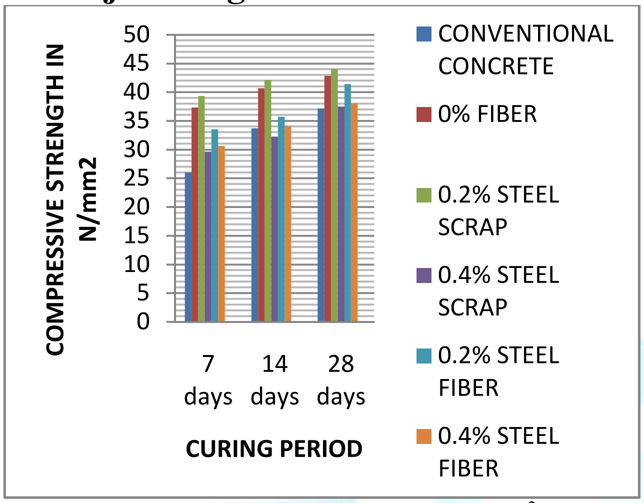

Fig. 1 Compressive strength test results in N/mm^2

6.2.1 Observation and Discussion on Compressive Strength

The compressive strength of the conventional concrete at 28 days was discovered to be 37.20 N/mm2. The most astounding compressive strength was gotten for 0.2% steel scrap which was 44.03 N/mm2. There is increment in compressive strength by the addition of steel scrap and steel fibers. The compressive quality somewhat increments with addition of distinctive proportions of fibers. By addition of 0.2% steel scrap we accomplished more quality contrasted with different varieties of fibers. The quality acquired by fiber reinforced concrete is 10% more than the conventional concrete.

6.3 Split Tensile Strength

Split strength of concrete mixes with cylinder specimen of size 150mm diameter and 300mm in height,for Conventional Concrete and Fiber Reinforced Concrete with a varying percentages of 0% fiber , 0.2% &0.4% of steel scrap respectively and 0.2% & 0.4% of steel fiber respectively made with aluminium slag as fine aggregate and recycled aggregate as coarse aggregate by volume fraction of concrete was determined at 7, 14 and 28days.

Curing Period	CC	0% FIBER	STEEL SCRAP		STEEL FIBER	
			0.2%	0.4%	0.2%	0.4%
7 DAYS	2.12	2.30	2.63	2.96	2.65	2.98
14 DAYS	3.34	3.24	3.96	4.10	3.67	3.82
28 DAYS	4.15	3.6	4.25	4.52	3.92	4.35

Table 5: Split Tensile Strength Results in N/mm^2

CC = CONVENTIONAL CONCRETE
(ALL VALUES ARE IN N/mm^2)

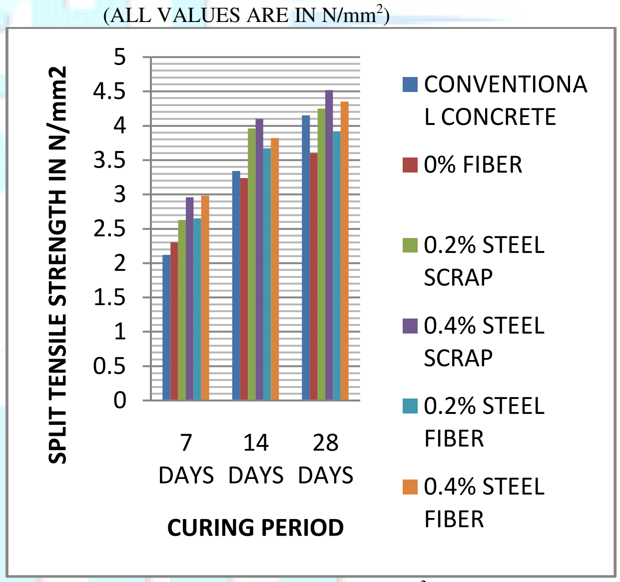

Fig. 2 Split tensile strength test results in N/mm ^{2}

6.3.1 Observation and Discussion on Split Tensile Strength

IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 3, June-July, 2015
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

The split tensile strength for CC was acquired as 4.15 N/mm2 at 28 days. For fiber reinforced concrete, quality expanded by 3% for 0.2% steel scrap, 8% for 0.4% steel scrap and 5% for 0.4% steel fiber. However 0.4% steel scrap has yielded more quality when contrasted with different varieties of fibers. The split tensile strength of the concrete increments with expansion in rate of aluminuim slag. Concrete is powerless in pressure consequently by the addition of fibers we could accomplish more strength than conventional concrete.

6.4 Flexural Strength

Flexural strength of concrete mixes with beam mould of size 700x150x150 mm, for Conventional Concrete and Fiber Reinforced Concrete with a varying percentages of 0% fiber, 0.2% &0.4% of steel scrap respectively and 0.2% & 0.4% of steel fiber respectively made with aluminium slag as fine aggregate and recycled aggregate as coarse aggregate by volume fraction of concrete was determined at 7, 14 and 28days.

Table 6: Flexural Strength Results in N/mm^2

Curing Period	CC	0% FIBER	STEEL SCRAP		STEEL FIBER	
			0.2%	0.4%	0.2%	0.4%
14 DAYS	3.95	3.70	3.68	3.89	3.77	3.95
28 DAYS	4.90	4.95	5.03	6.12	5.98	6.25

CC = CONVENTIONAL CONCRETE
(ALL VALUES ARE IN N/mm^2)

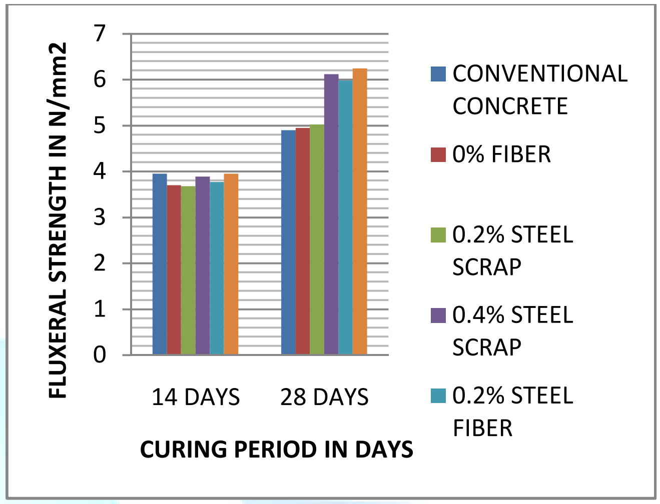

Fig. 3 Flexural strength test results in N/mm^2

6.4.1 Observation and Discussion on Flexural Strength

The flexural strength for CC was gotten as 4.90 N/mm2 at 28 days. For fiber reinforced concrete, strength expanded by 23% for 0.4% steel fiber, 11% for 0.2% steel fiber and 17% for 0.4% steel scrap. The flexural strength of concrete increments with increment in rate of aluminum slag. The ideal substitution level of aluminum slag is up to 100%. The increment in flexural strength is a result of the expansion of steel fibers a steel scrap alongside aluminum slag.

7. Conclusions

The test results obtained can be concluded as:

- The workability of fiber reinforced concrete has been decreased with the increment in rate of aluminum slag.
- By expansion of 0.2% Steel scrap by weight of bond to concrete builds the compressive strength for 28 days curing.
- By expansion of 0.4% Steel scrap by weight of bond to concrete builds the split tensile strength by totally supplanting river sand by aluminum slag.
- The flexural strength of concrete kept up great result up to 100% supplanting with aluminum slag alongside expansion of 0.4% steel fiber.

• By the expansion of steel scrap, compressive strength and split tensile strength has expanded

• Flexural strength has been enhanced marginally because of expansion of steel fibers.

References

[1] Bonfiring International of Industrial Engineering and Management ScienceVol.2 No.4, December 2012: Experimental Study on Behaviour of Steel and Glass Fibre Reinforced Concrete Composites.
[2]Journal of Hazardous Materials 217-218(2012)1-10:Aluminium salt slag characterization and utilization.
[3]Nakagawa H., Akihama S., and Suenaga T. (1989), in their paper entitled “Mechanical properties of various types of fibre reinforced concrete”.
[4] E.M.M. Ewais, N.M. Khalil, M.S. Amin, Y.M.Z. Ahmed and M.A. Barakat, “Utilization of aluminium sludge and aluminium slag (dross) for the manufacture of calcium aluminate cement”, Ceramics International, Vol. 35, pp. 3381-3388, 2009.
[5] V. Vytlacilova, Fibre concrete with recycled aggregates as a full substitution of natural aggregates, Dissertation, Prague, 2009.
[6] B. Schnůtgen, L. Vandewalle, Test and Design Methods for Steel Fibre Reinforced Concrete – Background and Experiences, in proceeding of the RILEM TC 162-TDF Workshop, Bochum, 2003