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Study on Concrete by replacing cement by SCBA using 100% M-Sand as fine aggregate

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Abstract: *A study is conducted to determine the engineering properties viz. Compressive Strength, split tensile strength and flexural strength by the replacement of river sand and partial replacement of ordinary Portland cement. In recent days the demand for river sand is increasing due to its lesser availability. Hence the practice of replacing river sand with M-Sand and partial replacing of ordinary Portland cement with sugarcane bagasse ash (SCBA) is taking a tremendous growth. It is also inferred from the literature that replacement of normal sand with M-Sand and ordinary Portland cement with SCBA possible up to some percentage. The concrete are made using 100% replacement of M-Sand and partial replacement (0%, 5%, 10%, 15%, and 20%) of SCBA, as fine aggregate and ordinary Portland cement respectively. The standard specimens of concrete are made for compressive strength, split tensile strength test, flexural strength test using M30 grade of concrete with 0.45 W/C ratio for 3days, 7days and, 28days of normal curing. It was found that 0% and 5% gives higher compressive strengths, 15% gives higher split tensile strength and flexural strength will decrease due to addition of M sand and SCBA when compared with conventional concrete. These results compare favorable with those of conventional concrete. The concrete was found to be suitable for use as structural members for buildings and related structures.*

Keywords: *Natural Sand, M- Sand, Cement, SCBA*

1. INTRODUCTION

Concrete is the most widely used construction material in the world. It is a composite construction material made primarily with aggregate, cement and water. The word concrete comes from the Latin word “concretes” (meaning compact or condensed), the perfect passive participle of “concrescere”, from “con”- (together) and “crescere”- (to grow). Concrete solidifies and hardens after mixing with water and placement due to a chemical process known as hydration. The water reacts with the cement, which bonds the other components together, eventually creating a robust stone-like material. There are many formulations of concrete, which provide varied properties and concrete is the most-used man-made product in the world.

Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material. It has been known that the worldwide total production of sugarcane is over 1500 million tons. Sugarcane consists about 30% bagasse whereas the sugar recovered is about 10%, and the bagasse leaves about 8% bagasse ash (this figure depend on the quality and type of the boiler, modern boiler release lower amount of bagasse ash) as a waste, this disposal of bagasse ash will be of serious concern. Sugarcane bagasse ash has recently been tested in some parts of the world for its use as a cement replacement material. The bagasse ash was found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica content in the bagasse ash was suggested to be the main cause for these improvements. Although the silicate content may vary from ash to ash depending on the burning conditions and other properties of the raw materials including the soil on which the sugarcane is grown, it has been reported that the silicate undergoes a pozzolanic reaction with the hydration products of the cement and results in a reduction of the free lime in the concrete.

Sand is a vital ingredient in making two most used construction materials viz. cement concrete and mortar. Traditionally River sand, which is formed by natural weathering of rocks over many years, is preferred as fine aggregate. The economic development fuelling the growth of infrastructure and housing generates huge demand for building materials like sand. The indiscriminate mining of sand from riverbeds is posing a serious threat to environment such as erosion of riverbed and banks, triggering landslides, loss of vegetation on the bank of rivers, lowering the underground water table etc. Hence, sand mining from riverbeds is being restricted or banned by the authorities. Controlling extraction along rivers has caused the illegal activities to spread into hillside and farmlands, creating public hazards such as landslide, deep ponds, and hanging cliffs. This sand extracted from fields (popularly known as filter sand), in addition to

depleting the fertile top soil, impairs the quality of concrete / mortar. Manufactured sand, which is obtained by crushing the rock, is emerging as a viable alternative to river sand. This material is in use for quite some time in developed countries. The use of this sand (also called artificial sand, M-Sand, Robo Sand etc.,) is picking up in India in major cities. Use of scientifically produced Manufactured Sand as an alternative to river sand is the need of the hour and will provide a long term solution to Indian Construction Industry. Manufactured sand is crushed fine aggregate produced from a source material and designed for use in concrete or for other specific products. Only source materials with suitable strength, durability and shape characteristics should be used. Production generally involves crushing, screening and possibly washing. Separation into discrete fractions, recombining and blending may be necessary.

2. Materials

2.1 Cement

Ordinary Portland cement, 43Grade conforming to IS: 269 – 1976.Ordinary Portland cement, 43Grade of Coromandel cement was used for casting all the Specimens.

2.2 Fine Aggregate

River sand

The river sand is used as a fine aggregate conforming to the requirements of IS:383. The river sand is washed and screened, to eliminate deleterious materials and over size particles.

M sand

Manufactured sand is produced by rock-on-rock or rock-on metal Vertical Shaft Impactor (VSI) in which the process that produced alluvial deposits is closely simulated. manufactured sand shall conform to the requirements of Zone-II (in most of the cases) as per IS 383-1970 (Reffirmed in 2007) and a particles finer than 75 µm shall not exceed 15 %.we are brought M sand from M/S ANDRAL INDUSTRIES which is located in Tavargare near Kalaburgi.

2.3 Coarse Aggregate

Locally available crushed blue granite stones conforming to graded aggregate of nominal size 12.5 mm as per IS: 383 –
1970.

2.4 Sugarcane Bagasse Ash

SCBA was collected from K.P.R Sugar Mills Pvt Ltd, Almel, TQ Sindagi Dist Vijayapur, Karnataka; The entire material is made free from impurities & IS sieve of 90 micron.

2.5 Water

Casting and curing of specimens were done with the potable water that is available in the college premises.

3. PROPERTIES OF MATERIALS

3.1. Cement

Table 3.1.: Physical Properties Of Cement

S.NO	PROPERTY OF CEMENT	VALUE
1	Fines of cement	7.16%
2	Grade of cement	43Grade(OPC)
3	Specific gravity of cement	3.15
4	Initial setting time	34min
5	Final setting time	550min
6	Normal consistency	33%

3.2. SCBA

Table 3.1.1: Physical Properties Of SCBA

S.NO	PROPERTY OF SCBA	VALUE
1	Fines of SCBA	28%
3	Specific gravity	2.36

3.3. Fine Aggregate

3.3.1 River sand

Table .3.2.1: Properties River sand

S.NO	PROPERTIES	VALUE
1	Specific Gravity	2.65
2	Fineness Modulus	2.25
3	Water absorption	1.3%

3.3.2 M Sand

Table.3.2.2: Properties Of M Sand

S.NO	PROPERTIES	VALUE
1	Specific Gravity	2.80
2	Fineness Modulus	2.84
3	Water absorption	1.8%

3.4 Coarse Aggregate

Table.3.3: Property of Coarse Aggregate

S.NO	PROPERTY	VALUES
1	Specific Gravity	2.68
2	Size Of Aggregates	20mm
3	Fineness Modulus	3.1
4	Water absorption	0.8%
5	Impact Test	15.2%
6	Crushing Test	22.5%

4. Results And Discussions

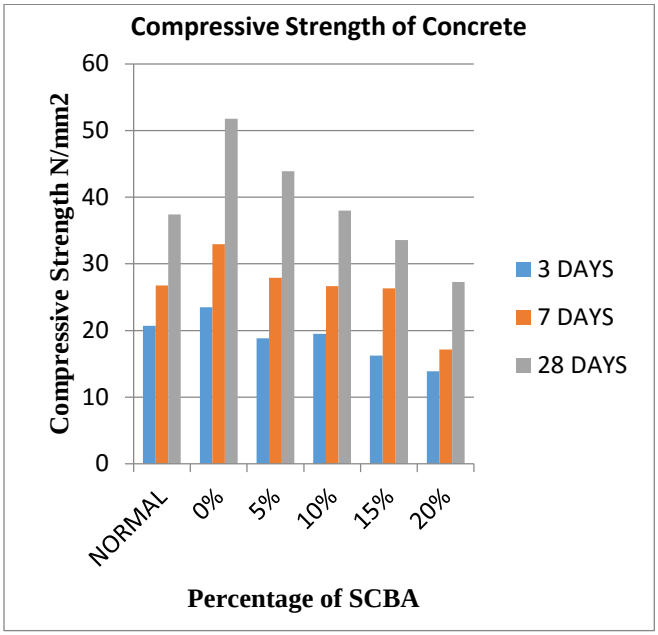
All concrete mixes for M30 grade with M Sand and different proportion of SCBA were cast and tested under suitable testing apparatus. The tests like compressive strength, spite tensile strength and flexural strength were studied. Their test results and related discussions are given in tables in detail below

1. Compressive Strength Test:

Tests results and its comparison with controlled mix are as shown in the below table.

Table-4.1 : Compressive Strength for Cube

Mix	Percentage of SCBA	Strength for 3days	Strength for 7days	Strength for 28days
1	0%	23.49	32.96	51.78
2	5%	18.84	27.89	43.89
3	10%	19.5	26.67	38.00
4	15%	16.22	26.33	33.58
5	20%	13.89	17.13	27.26
Conventional	-	20.71	26.73	37.47



Graph 1: Compressive strength of concrete

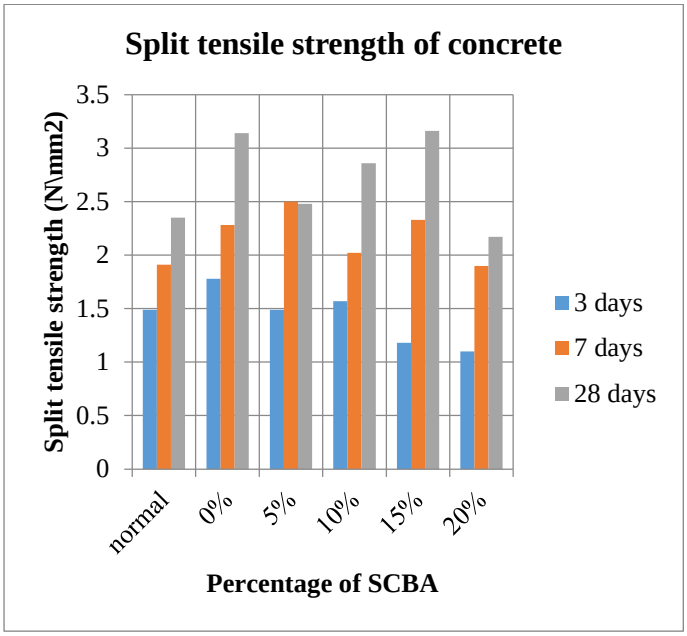
The compressive strength of cubes with SCBA gives a higher strength compared to conventional concrete cube. These strength were increased with increase in SCBA up to 10 percentage and it will further decreases with increase in SCBA.

2. Split Tensile Strength Test:

Table-2 Split Tensile Strength for Cylinder

Mix	Percentage of SCBA	Strength for 3days	Strength for 7days	Strength for 28days
1	0%	1.78	2.29	3.14
2	5%	1.49	2.32	2.48
3	10%	1.57	2.01	2.86
4	15%	1.18	2.32	3.16
5	20%	1.1	1.9	2.178
Conventional	-	1.49	1.91	2.35

Tests results of tensile strength test and its comparison with controlled concrete cube are as shown in the below table.



Graph 2: Split tensile strength of concrete

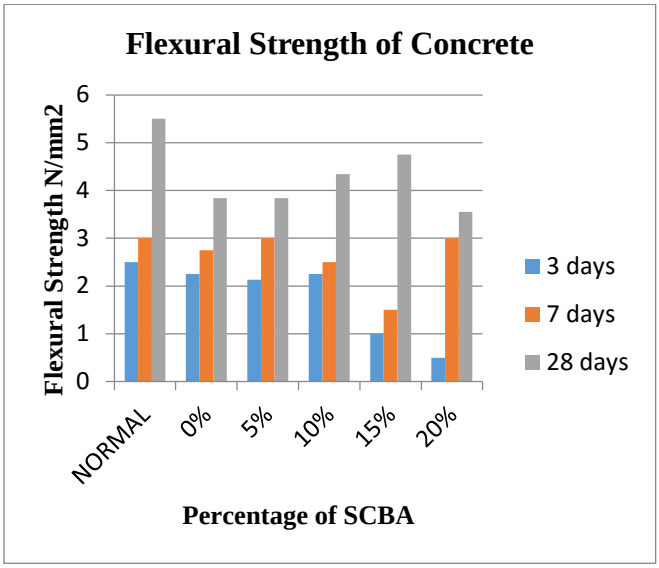
The Split tensile strength of cubes with SCBA gives a higher strength compared to conventional concrete cube. These strength were increased with increase in SCBA up to 15 percentage for 28 days and it will further decreases with increase in SCBA..

3. Flexural Strength:

Tests results of tensile strength test and its comparison with controlled concrete cube are as shown in the below table.

Table 3.Flexure strength of concrete for prism

Mix	Percentage of SCBA	Strength for 3days	Strength for 7days	Strength for 28days
1	0%	1.78	2.29	3.14
2	5%	1.49	2.32	2.48
3	10%	1.57	2.01	2.86
4	15%	1.18	2.32	3.16
5	20%	1.1	1.9	2.178
Conventional	-	1.49	1.91	2.35



Graph 3: Flexural strength of concrete

The Flexural strength of cubes with SCBA gives a lower strength compared to conventional concrete cube. These strength were decreased with increase in SCBA percentages.

5. CONCLUSIONS:

1. The compressive strength is increased at 0%, 5% & 10% of strength value as 51.78, 43.78 & 38 kN/mm^2 respectively. Compared to conventional concrete of strength as 37.47 kN/mm^2 of 28 days normal curing. As percentage of SCBA increased strength got increased upto 10% as compared to conventional concrete and maximum value was observed for 0% SCBA with 100% M-sand.
2. The split tensile strength is increased at 0%, 5%, 10% & 15% of strength as 3.14, 2.48, 2.86 & 3.16 KN/MM^2 respectively. Compared to conventional concrete of strength as 2.35 KN/MM^2 of 28 days normal curing. As percentage of SCBA increased strength got increased upto 15% as compared to conventional concrete and maximum value was observed for 15% SCBA with 100% M-sand.
3. The flexural strength is decreased with increase in SCBA as Compared to conventional concrete of strength of 28 days normal curing.
4. Slump value is decreased with increase in SCBA as compared to conventional concrete.
5. Specific gravity, Fineness modulus, water absorption of M-SAND shows good results with comparison to river sand.
6. SCBA can be used up to 10% replacement for cement with 100% M-Sand for structural purpose.

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