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Effect on Concrete Properties after Substituting Fine Aggregate by Crushed Groundnut Shells and addition of Sugarcane Bagasse Ash

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ABSTRACT

Infrastructure development is prime need of any country for development. The Infrastructure development has increased the demand of cement and fine aggregates. The cement production industry creates environmental problems such as pollution and global warming due to emission of various hazardous gases. And natural sand is expensive and not available easily so overcome these problems researches are more focusing towards utilizing agricultural and industrial waste material. Sugarcane Bagasse Ash (SCBA) is left-over industrial byproduct from sugar factory's captive power plant which is used for partial replacement of cement and Groundnut Shells (GS) are agricultural waste product which is used for partial replacement of sand.

In this paper SCBA has been chemically and physically categorized and partially replaced in the ratio of 2% & 5% by weight of cement and Crushed Groundnut Shells partially replaced in fixed ratio of 5% by weight of fine aggregates in M25 grade concrete mix. There are total of 36 specimens of the Combination of SCBA and GS /OPC concrete cubes of 150 mm size were tested for compressive strength at 7, 14, 21 and 28 days after immersed curing. The results show that the compressive strengths of the standard mix and those of other percentage combinations increases with curing age but decreases with increased SCBA and GS percentage. It can be concluded that the satisfactory concrete with replacement of 5% of SCBA and 5% replacement of GS content.

Keywords: *Ordinary Portland cement, Sugarcane Bagasse Ash, Groundnut Shells, Compressive Strength, Concrete*

I. INTRODUCTION

In infrastructure development of country, concrete is the important building constituent that is mixture of cement, fine-aggregates, course-aggregates, and water in appropriate proportion. Cement is an very important construction material for all infrastructure development projects. Demand of cement is increasing day by day. Cement production is responsible for emitting of CO2 on large scale. For manufacturing process of Portland cement requires significant amount of energy to have the temperature up-to 1500 °C [1] but also the key reaction itself is the breakdown of calcium oxide and CO2. Due to this there are various environmental problems like air pollution, global warming. The cement is the third largest industrial source of pollution, emitting more than 5 lach tons per year [13] of sulphur-dioxide, nitrogen oxide and carbon-monoxide, these causes environmental as-well-as health problems. To reduce this problem to some extent; I replaced some percentage of the cement by sugarcane bagasse ash.

The global consumption of natural sand is too high due to its extensive use in concrete. The demand for natural sand is quit high in developing countries for infrastructure. But natural sand is expensive and not available easily so overcome this problem we replace

the fine aggregate in small percentage by crushed groundnut shell without losing its strength. In this project we are going to combine the properties of sugarcane bagasse ash and crushed groundnut shell both and try to reduce the cost, environmental issues and replace the fine aggregate by crushed groundnut shell and cement by sugarcane bagasse ash in various percentage, to get optimum strength.

II. OBJECTIVES

The main objective of this study is to determine the percentage of Sugarcane bagasse ash as partial replacement for cement and 5% of fine aggregate by crushed ground nut shells [10] in concrete replacement without much effect on strength.

III. MATERIAL PROPERTIES

The materials used in this investigation are:

A. Cement

The cement is used as a binding material. In this study, the cement used as OPC 53 grade cement availablefrom BirlaShakti Vasudatta Cement Company and it conforming as per IS 12269-1987.

B. Fine Aggregate

Aggregates for the concrete were obtained from approved suppliers conforming to the specifications of IS 383 - 1970 and were chemically inactive (inert), spotless and robust. The fine aggregate was tested as per the limits which is specified in IS: 2386 (Part-3):1963. In this study, fine aggregate having a fineness modulus of 3.1 which is carried out by using sieve analysis and it confirming to zone 1.

C. Coarse Aggregates:

The crushed aggregates used were 20mm size in angular shape and are tested asper Indian standards and results are within the permissible limit. (IS: 10262, IS: 383). The specific gravity and bulkdensity of 20 mm aggregate is 2.79 and 1438 kg/m3 respectively.

D. Water

Good potable water available in the lab used for the construction purpose which conforming to the requirements of water for concreting and curing as per IS: 456-2009.

E. Sugarcane bagasse ash

Foremost crops grown in all over countries and its entire production is over 1500 million tons [14]. After the extraction of all efficient sugar from sugarcane, large fibrous excess is obtained called Bagasse. Each ton of sugarcane produces around 25.65% of bagasse (at a moisture content of 50%) and 0.61% of residual ash [9]. When bagasse is burnt in the boiler for heating the sugarcane juice of cogeneration power plant under controlled conditions, sensitive amorphous silica is formed due to the combustion process and is present in the remaining ashes known as Sugarcane Bagasse Ash. This amorphous silica content makes bagasse ash as a useful cement replacement material in concrete. In this study sugarcane bagasse is collected from Rajgad Sugar Factory, bhor, pune.

F. Crushed groundnut shell

Groundnut shells are also waste product in agriculture. Some properties of groundnut shell are same as a fine aggregate. so after crushing groundnut shell by household mixer or Grinder and sieve analysis, we can partially replace it to fine aggregate in concrete.

In this study groundnut shells are collected from khopi village, Pune.

Table no.1 Physical properties of cement

SR. NO.	PHYSICAL PROPERTIES	VALUE
1	Grade of cement	53 grade of cement (OPC)
2	Specific gravity	3.15
3	Normal consistency	29%

Table no.2 Sieve analysis for fine aggregates

Sieve Size	Weight Retained in gms	Percent Weight Retained in gms	Cumu. Weight Retained in gms	Percent passing
10 mm	0.0	0	0	100
4.75 mm	2.0	0.2	0.2	99.8
2.36 mm	180.0	16.0	16.1	83.9
1.18 mm	666.0	59.0	75.2	24.8
600 mm	88.0	7.8	83.0	17.0
300 mm	52.0	4.6	87.6	12.4
150 mm	38.0	3.4	91.0	9.0
75 mm	22.0	2.0	92.9	7.1
Pan	80.0	7.1	100.0	0.0
Total	1128.0			

Table no.3 physical properties of fine aggregates

SR NO.	PROPERTIES	VALUE
1	Grading	Zone - I
2	Specific gravity	2.67
3	Fineness modulus	3.5

Table no.4 Physical properties of coarse aggregates

SR. NO.	PROPERTIES	VALUE
1	Size of Aggregates	20 mm
2	Specific gravity	2.68
3	Fineness modulus	5.7

Table no. 5 Physical properties of sugarcane bagasse ash

SR. NO.	PROPERTIES	VALUE
1	specific gravity	2.20
2	colour	black
3	Fineness modulus	2.1

Table no. 6 Physical properties of Groundnut shells

SR. NO.	PROPERTIES	VALUE
1	Specific gravity	2.3
2	colour	Brownish

IV. EXPERIMENTAL WORK

In this experimental work, a total of 36 numbers of concrete samples were casted. The typical size of cube 150mm×150mm×150mm is used. The mix design(procedure) of concrete was done according to Indian Standard Guidelines for M25 grade and water cement ratio is 0.60. Based upon the quantities of component of the mixes, the numbers of SCBA and GS combination for 0, 2%, and 5% replacement by weight of cement and fixed replacement of crushed groundnut shells of 5% by weight of Fine aggregate were estimated. The ingredients of concrete were thoroughly mixed in mixer machine till uniform consistency was achieved. Before casting, machine oil was smeared on the inner surfaces of the cast iron Mould. Concrete was poured into the Mould and compacted carefully using table vibrator. The top surface was over by means of a trowel. The specimens were removed from the Mould after 24hours and then cured under water for a period of 7, 14, 21 and 28 days. The samples were taken out from the curing tank just prior to the test. The compressive test was conducted using a 1000kN capacity compression testing machine. This test was lead as per the relevant Indian Standard specifications.

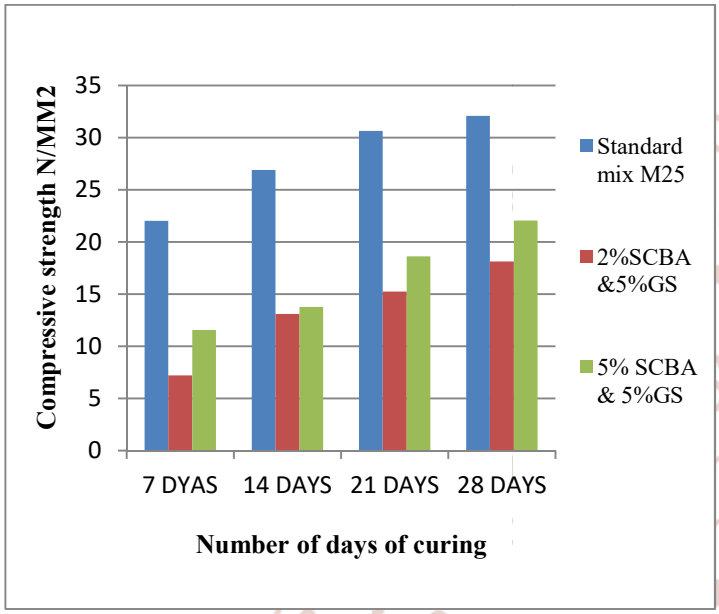
Table no.7 Slum cone test result

SR NO.	PROPORTION	SLUME VALUE IN mm
1	Standard mix M25	90
2	M1[2% SCBA & 5% GS]	55
3	M2[5% SCBA & 5% GS]	40

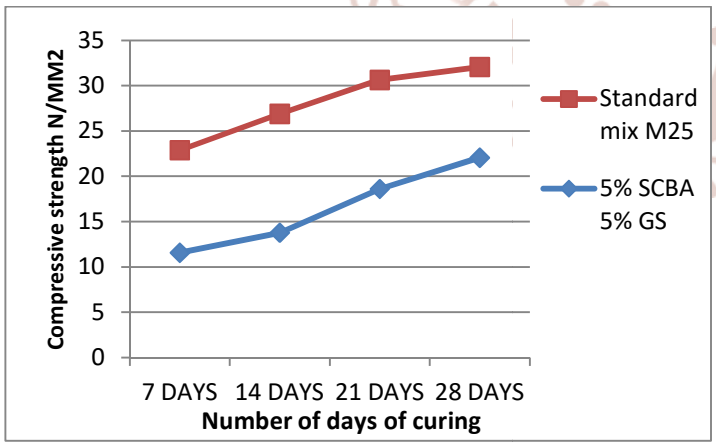
Table no. 8 Compressive test result for concrete

SR NO.	PROPORTION	CURING DAYS			
		7 DAYS	14 DAYS	21 DAYS	28 DAYS
1	Standard mix M25	22.01	26.89	30.63	32.07
2	M1[2% SCBA & 5% GS]	7.19	13.1	15.24	18.12
3	M2[5% SCBA & 5% GS]	11.57	13.78	18.61	22.05

Graph no 1 showing compressive strength of samples



Following graph represent comparison of result of 0% SCBA & GS And 5% SCBA replacement with cement And 5% groundnut shells replacement with fine aggregates.



Graph no 2 Comparison between Standard mix M25 and 5% SCBA and 5% GS replacement

The ghaph above shows that Compressive strength for the Standard mix M25 was 22.01N/MM2, 26.89N/MM2,30.63 N/MM2 and 32.07N/MM2 for 7, 14 ,21 and28 days respectively while it was 11.57N/MM2, 13.78 N/MM2, 18.61N/MM2 and 22.05N/MM2 for 5% SCBA for cement And 5% Groundnut shells for fine aggregates replacement.

V. CONCLUSION

Based on the study, following conclusions can draw:

1. It can also be concluded that the use of combination of groundnut Shell and SCBA in concrete reduces the concretes workability due to the high absorption of water by the groundnut shell and SCBA.
2. It is observed that by increasing SCBA from 2% to 5% there is increase in compressive strength of concrete for all day tests.
3. Due to non-availability of natural sand at sensible cost, searching the alternate material is necessary so the based on the rate of absorption and particle size distribution of the groundnut shells, groundnut Shells are suitable for use as fine aggregate replacement.
4. Concrete containing groundnut shell and SCBA could be used in non-load bearing panels where structural Strength is not of importance. It can be used as; non load bearing partition walls, floor panels, Noise barriers etc
5. According to experiment the calculated target mean strength was not achieved. This may be as a result of some factors like mode of mixing, duration ,compaction and the reactivity of the SCBA and crushed Groundnut shell
6. Based on the above observations the combination of the properties of sugarcane bagasse ash and crushed groundnut shell both try to reduce the cost, environmental issues and replace the fine aggregate by crushed groundnut shell and cement by sugarcane bagasse ash in various percentage, to get optimum strength.

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