Middle-East Journal of Scientific Research 24 (S1): 257-262, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.S1.52

Assessment of Sugarcane Bagasse Ash Concrete on Mechanical and Durability Properties

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Abstract: In this study, evaluation of sugarcane bagasse ash as a partial replacement in concrete. Sugarcane basgasse ash (SCBA) was take out from by burnt around 600°C to 800°C and collected from after passing through 45µm sieve. In this paper, SCBA has been partially replaced by 0%, 10%, 20%, 30% and 40% weight of cement in concrete. Performance of concrete with these replacements in part of workability, mechanical and durability are discussed in this paper. Slump cone and Compaction Factor tests were done to evaluate the workability properties. Similarly for mechanical properties, subsequent tests are made on concrete after 28 days curing compressive strength, split tensile strength, modulus of rupture, dynamic modulus. Durability behavior was assessed by four special methods in this study, such as sulphate attack, chloride attack, rapid chloride permeability and sorptivity test were done. From this research work, it is observed that behavior of durability properties in concrete improved by increasing the SGBA. Improved strength properties due to the pozzolanic reaction with cement mix.

Key words: Bagasse ash · Durability · Supplementary material

INTRODUCTION

Building development is unquestionably not another science or innovation but then it has experienced awesome changes over its history [1]. The business we see today is the after effect of a movement in science, innovation, procedure and business. Cement is likely exceptional in development in that it is the main material select to the business and in this way is the recipient of a reasonable extent of the innovative work cash from industry. In addition bond is the fundamental constituents of the solid, net concrete generation is relied upon to ascend from around 1.4 billion tones in 2000 to around 3 billion tones in 2010. The real increments will occur in India [2], more than 1300 million/tones are delivering every year. Not just is the assembling of Portland concrete very vitality escalated [3], it additionally is a huge donor of the nursery gasses. Generation of one tone of bond contributes around 1 ton of CO2 to the environment, together with minor measure of NOx and CH4 [4]. Parcel of examination work were done utilizing supplementary cementitious material as fly fiery remains and more over interest was expanding step by step for fly powder, so elective cementitious waste materials may required beating this.

Sugarcane bagasse is made by the by after effect of sugar and alcohol. In India, period of bagasse is around 92 thousand metric tones for every year. Sugarcane bagasse is generally used as fuel at the sugar modern offices. There are minimum studies were finished on the use of SCBA in concrete as a cementitious pozzolanic material. Reason of this [5] investigation is to utilize the bagasse blazing garbage as pozzolanic material for deficiently supplanting Portland bond with a particular final objective to convey superb cement and notwithstanding reduces negative biological effects and landfill volume [6], which is required for executing the abuse of powder. The basic objective of this paper is to demonstrate the SCBA as a supplementary cementitious material in bond in light of mechanical and quality properties besides choose the perfect estimations of SCBA. In this paper, SCBA were used as fragmented substitution of 10%, 20%, 30 % and 20% for bond in concrete. Effect of SCBA deficient supplanted concrete

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on the compressive quality, split unbending nature, modulus of break [7], component modulus, sulfate strike, chloride attack, brisk chloride permeability and sorptivity test were assessed to watch the effect of the SCBA in bond.

Experimental Programme

Materials

Cement: Common Portland cement of 53 evaluation, complying with IS 12269-1987 was utilized. Beginning and last setting tests, soundness tests and consistency tests were completed to decide the properties of bond.

Sand: Common waterway sand was utilized as fine total; the outcomes demonstrate that the sand adjusts to Zone II of IS: 383 – 1970. The properties of sand were dictated by directing tests according to May be: 2386 (Part-I).

Total: Pulverized rock stones got from nearby quarries were utilized as coarse total. The most extreme size of coarse total utilized was 20 mm. The properties of coarse total were controlled by leading tests according to Seems to be: 2386 (Part – III).

Super Plasticizer: Conplast SP 430 confming to IS 9103 (1999) was used as super plastcizer. It is used to improve the workability properties.

Sugarcane Bagasse Ash (SCBA): The bagasse ash used is collected from the local sugar factory located near Arachulur. After bagasse is used as fuel for boiler, burnt in the range from 600°C to 800°C SCBA is deposited in the nearby land and mixed with water. Collected bagasse is kept in the oven upto 110°C for 24 hours to remove the water present in the SCBA. Collected SCBA was standardized by sieving and then it is grinded using ball mills with steel ball upto 2 hours. The ball mill is in closed circuit and rotates with a speed of 200 rpm. Sample collected from ball mills Was used as pozzolanic materials [8]. Table 1.0 shows the chemical composition of SCBA.

Table 1.0: Chemical composition of SCBA

Chemical Composition	Wt (%)
SiO_2	76.67
Al_2O_3	2.13
Fe_2O_3	3.78
CaO	5.59
Na_2O	0.12
K_2O	8.29
MgO	0.92
L.O.I	2-5

Mix Proportion and Casting of Specimen: Concrete mix was designed as per IS 10262 to achieve a grade of M30. The designed and adopted mix proportion was shown in table 2.0. Five different mix proin the portions were casted with 0%, 10%, 20%, 30% and 40% with partial replacement of cement with SCBA prepared with water binder ratio of 0.4 and in addition to that 1% super plasticizer is also added in the mix to improve the workability Concrete ingredients is mixed with a laboratory type concrete mixer machine was used. After mixing for five minutes the concrete was manually placed in the respective moulds [9]. All the specimens were well compacted. The specimens were demoulded after 24 hours and placed in curing for 28 days. Different mix proportions are shown in the Table 2.0.

Experimental work consists of nine cubes of sizes 150 mm x 150mm x 150 mm were casted from each mix of concrete to evaluate compressive strength of concrete, chloride attack and sulphate attack tests on concrete. For split tensile test 150 mm x 300 mm cylinder and 100mm x 100mm x 500 mm prism were casted. For RCPT and sorptivity tests, specimen of size 100 mm diameter and 50 mm height were casted. Three number of specimen were casted for each mix for different tests except cube.

RESULT AND DISCUSSION

Workability Properties: The performance of conventional concrete mix and SCBA replaced concrete mix under plastic stage were measured by means of slump cone and compaction factor. Table 3.0 shows the workability properties of various mixes. This was clearly noticed that the SCBA replaced concrete mix provided better workability than the conventional one. Workability properties of different concrete values were in accordable one. Lowest workability was acquired by the conventional mix.

Table 3.0: Workability properties

Mix Designation	Slump (mm)	Compaction Factor
CC	104	0.94
CC + BA 1	124	0.96
CC + BA 2	137	0.96
CC + BA 3	144	0.97
CC + BA 4	153	0.97

Compressive Strength and Split Tensile Strength: Three concrete samples were tested to evaluate the average value of the all concrete mixes after 28 days curing in water as per IS-9013 for compressive strength.

Split tensile strength was conducted on concrete cylinder after 28 days curing as per IS-5816. Figure 1.0 & 2.0 shows the Compressive strength and split tensile strength of different mixes.

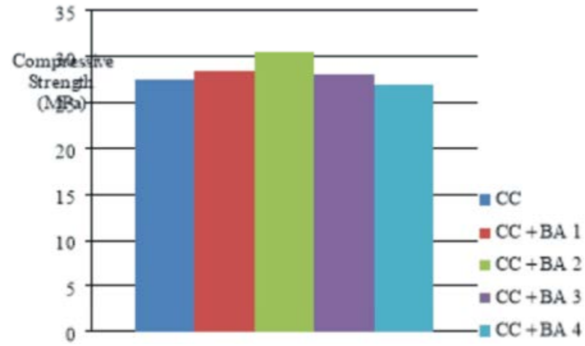

Fig. 1.0: Compressive strength of concrete after 28 days curing

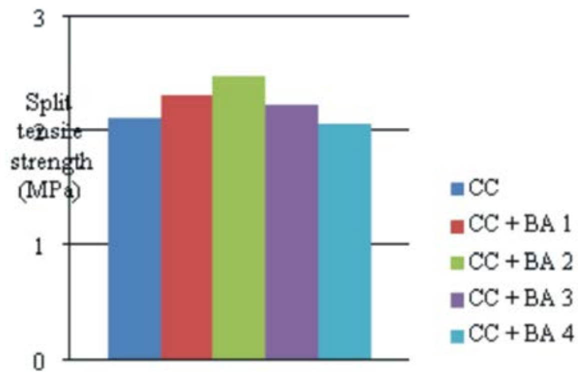

Fig. 2.0: Compressive strength of concrete after 28 days curing

Table 2.0: Mix Proportions

				Quantities (kg/m^3)				
Mix Designation	SCBA (%)	W/Binder	SP	Water	Cement	SCBA	Sand	Aggregate
CC	0	0.4	1%	136.4	341	0	728	1230
CC + BA 1	10	0.4	1%	122.76	306.9	34.1	728	1230
CC + BA 2	20	0.4	1%	109.12	272.8	68.2	728	1230
CC + BA 3	30	0.4	1%	95.48	238.7	102.3	728	1230
CC + BA 4	40	0.4	1%	81.84	204.6	136.4	728	1230

Compressive strength and split tensile strength for different percentage bagasse ash replaced concrete was determined after 28 days curing under room temperature and compared with conventional concrete. It is renowned that 15% SCBA replacement exhibit higher result and also a special attention to be made[10]; up to 10% the strength is increased and for 15% the strength starts decreased but it was greater than conventional mix. This similar in the case of split tensile strength

Modulus of Rupture and Dynamic Modulus: Following 28 days, solid crystals were set in all inclusive testing machines and the load is to be connected without stun until the example comes up short and the most extreme burden connected to the example amid the test is to be recorded. Like the other mechanical properties examined above 10% SCBA supplanted example demonstrated the better results in modulus of crack than the all different mix. Looked at results are shown in the Figure 3.0.

The dynamic modulus of versatility is the proportion of anxiety to strain under vibratory conditions and it is a key parameter for the basic examination of solid structures under element conditions like seismic loadings. The resounding recurrence and ultrasonic heartbeat speed (UPV) strategies are two non-damaging testing methods which have been generally used to decide the dynamic modulus of versatility in this work UPV was utilized to decide the dynamic modulus of SCBA cement.

Dynamic modulus = 4 x E-15 n^2 L ρ

where n is the resonant frequency, L is the length of specimen in mm, ñ is the density of concrete in kg/m^3, E is the modulus of elasticity in N/mm^2. Figure 4.0 shows the modulus of burst and element modulus of cement following 28 days curing. Dynamic modulus of different blends were seen, there is exceptionally least varieties in the outcomes. 10% SCBA substitution display somewhat superior to alternate blends. Which demonstrated that there won't be any adjustments in the interior CSH gel arrangement, when SCBA were supplanted?.

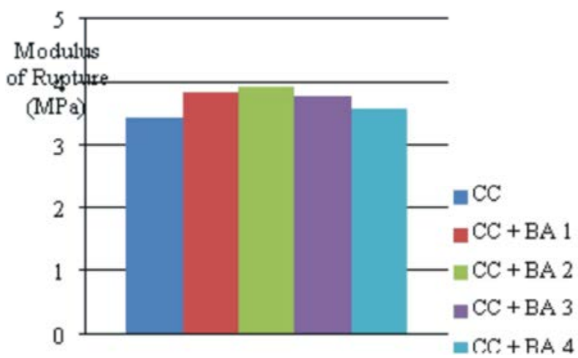

Fig. 3.0: Modulus of Rupture of concrete after 28 days curing

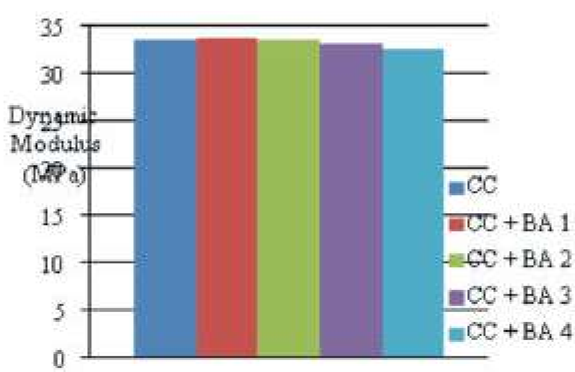

Fig. 4.0: Dynamic Modulus of concrete after 28 days curing

Chloride Attack and Sulphate Attack: A non – permeable holder is chosen and chloride arrangement has been set up by including 3.5% sodium chloride of refined water. This arrangement is blended well so that all the sodium chloride salts gets broke up in the arrangements. Solid 3D shape is take from the 28 days curing beginning weights of this 3D square are found. They are then inundated in a chloride arrangement. Following 90 days curing example were taken out from the chloride arrangement, drying it in room temperature changes in weight was found furthermore the compressive quality of solid shapes was additionally found.

At the point when cement is presented to environment containing forceful chemicals, it prompts disintegration of solid which can be evaluated as far as terms of misfortune weight of cement. To think about the corrosive resistance of cement, the 3D squares of cement were cured and afterward drenched in 3 % H2So4 arrangement up to 28days. Following 28 days submersion the examples were taken out and outwardly watched for the disintegration of cement because of sulfate assault. The examples were weighted by and by and the weight is contrasted and the ordinary cement with a specific end goal to figure the rate of misfortune in cement furthermore the loss of quality was found. Figure 5.0 demonstrates the example under corrosive curing.

After effects of chloride and sulfate assault are depicted in figure 6.0 and figure 7.0 separately. There was a fantastic change against the corrosive assault in SCBA 5%, 10% and 15 % substitutions. It is extremely intriguing to observe around 20% substitution of SCBA solid, it demonstrates the exceptionally poor results when contrasted and the other substitution concrete however it indicates better resistance against acids assault to some reach out against tradition blend.

Fig. 5.0: Specimens under chloride and sulphate attack

Rapid Chloride Permeability and Sorptivity Test: The strategy for RCPT test in ASTMC 1202-was received in this study. The entire test design is as appeared in Figure 8.0. The measure of charge went through the solid example, as an electrical sign of chloridepermeability, is monitored during 6 hour test duration readings were taken at every 30 minutes. After 28 days of curing, 100x50 mm concrete cylinders casted were used in this test. The concrete Specimen is assembled with two applied diffusion cells. During the test, a potential difference of

60 V DC is maintained across the diffusion cells. The upstream cell (cathode) is filled with 5% sodium Chloride (NaCl) solution and downstream one (anode) is filled with saturated with 0.3M of Calcium hydroxide solution. Figure 9.0 shows the charges passed in the specimen.

RCPT test was made on the all the five different mixes, the following observations are made. Charge passed in convention mix is higher than the SCBA replaced mixes. Among all the mix the 10% replacement exhibited better performance against chloride penetration.

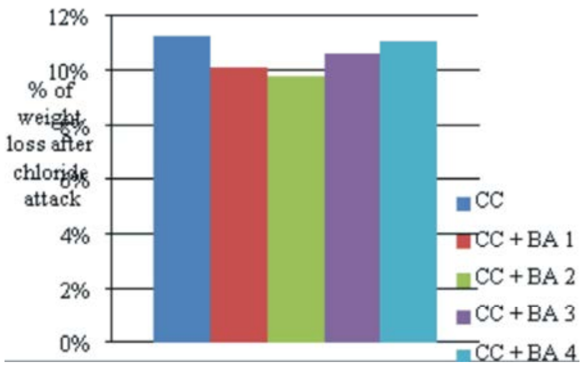

Fig. 6.0: Percentage of weight loss after chloride attack

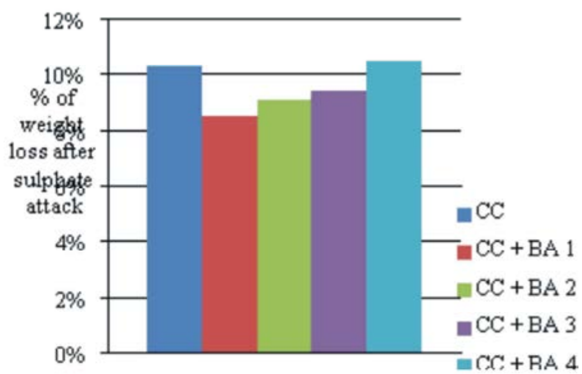

Fig. 7.0: Percentage of weight loss after sulphate attack

Sorptivity is a measure of the capillary forces exerted by the pore structure causing fluids to be drawn into the body of the material. The specimen is put on free access of water at the base surface.

The water level is kept not more than 5mm over the base of the example. Weights of the examples are noted, after, in the wake of wiping off any abundance water with a clammy tissue. The amount of retained water amid the time period from 0 to 240 minutes was measured at regular intervals interim. Figure 10.0 demonstrates the SCBA example subjected to sorptivity test and Figure 11.0 demonstrates the outcomes contrasted and different blends. Which obviously disclosed that like RCPT 10% substitution give better execution, however all different blends performedsuperior to the tradition one.

Fig. 8.0: RCPT test setup

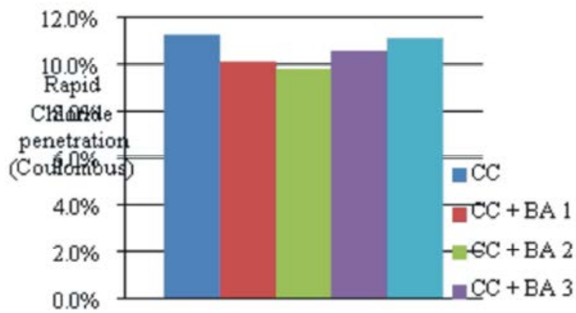

Fig. 9.0: Rapid Chloride Penetration Test

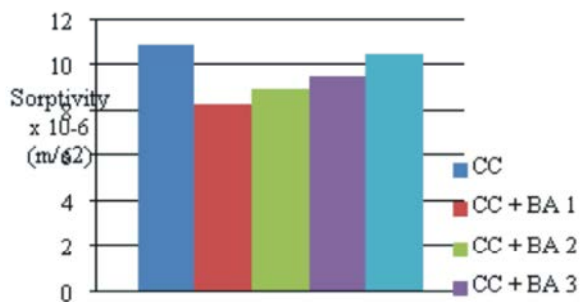

Fig. 10.0: SCBA concrete under sorptivity test

Fig. 11.0: Sorptivity tests

CONCLUSION

- In this study, SCBA supplanted concrete with 5%, 10%, 15% and 20% were readied and afterward were subjected to point by point appraisal on their mechanical and solidness properties. The conclusions from the above examination are as per the following,
- Workability increments with expansion in RHA content
- Concrete supplanted with bagasse fiery debris showed hardly preferable more noteworthy over control solid blend in the mechanical properties. The outcomes obviously call attention to that solid of the same evaluation can be supplanted SCBA up to 10% substitution of concrete.
- Durability execution SCBA based cement against corrosive assault, RCPT and sorptivity were analyzed with five distinctive blends. Resistance of cement against corrosive assaults, chloride entrance and sorptivity sensibly expanded with expansion in bagasse fiery remains substitution.

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