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Durability Study on Sugarcane Bagasse Ash as Pozzolana in M30 Grade Concrete

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ABSTRACT: The purpose of experimental study is to find the effect of Nano sugarcane bagasse ash on strength properties of concrete. A partial substitution of cement by an industrial by-products and bagasse ash are utilized as a replacement of cement. It is proposed to study the cement is partially replaced the material of 5 %, 10 %, 15 % and 20 % of Nano Sugarcane Bagasse ash. The impact shared utilization of Nano Sugarcane Bagasse ash on compressive strength, split tensile strength, Chloride Penetrability test& Water permeability test of M30 grade of concrete is studied. The investigated test after effect of concrete prepared utilization the different extents of Bagasse ash as compared there upon of controlled concrete. The different in different test results of Nano sugarcane bagasse ash (A1, A2, A3, A4 & A5) as compared to Micro sugarcane Bagasse ash (X1, X2, X3, X4 & X5) as shows the similar fashion. The XRD & SEM analysis is carried out to know the bond characteristics in the concrete specimens.

KEYWORDS: Sugarcane Bagasse ash, Partial replacement, Ultrasonic pulse velocity.

1. INTRODUCTION

Cement, the most important construction material in the world. However the environmental impact of cement has become a growing concern, as cement is one of the primary producers of carbon dioxides and major greenhouse gases. One effective way to reduce the environmental impact is to replace the cement content from the concrete. Utilization of agro – industrial waste as a partial replacement of cement in concrete, which will have the potential to reduce costs, minimization of waste and conserve energy. Bagasse is the waste produced after juice extraction in sugarcane industry, which is usually used as a fuel for boilers in the sugar mills which produce high amount of ash annually.

2. MATERIALS AND METHODS

In present investigation the collected materials are 53 grade OPC cement, Nano SCBA, Natural sand, crushed granite aggregate were used in concrete.

Cement: Ordinary Portland cement of 53 grade manufactured by Zuari Cement Company confirming to IS 12269-1987 is used. Natural sand confirming to zone II, with specific gravity of 2.65, fineness modulus 2.88 and 20mm crushed granite aggregate with specific gravity of 2.7 were used.

Nano Sugarcane Bagasse Ash: Nano sugarcane bagasse ash was obtained from KBD Sugars & Distilleries Pvt Ltd, Mudipapanapalli (V), Sugalimitta (P), Punganuru (M). The specific gravity of Nano sugarcane bagasse ash is 1.8 and the surface area is 901.77 m2 /kg .the sugarcane bagasse ash particle size is calculated by using XRD test analysis for the samples. From the analysis Nano sugarcane Bagasse ash size is Nanometers. XRD of sugarcane bagasse ash is shown in table.

PARTICULAR	VALUES
Grade	M 30
Specific Gravity	3.15
water-cement ratio	0.50
Standard Consistency	
Coarse Aggregate	0.4%
fine Aggregate	1.0%

MIX PROPORTIONING:

In present investigationM30 grade of concrete is used with a water-cement ratio of 0.45. The M30 grade of concrete mix design is done as per IS 10262:2009 with mix proportions 1:2.95:1.72.concrete mixtures were prepared by varying percentage of replacement with SCBA by 5%, 10%, 15% and 20%

3. METHODOLOGY:

It is important that the constituent material of concrete remain uniformly distributed within the concrete mass during the various stages of handling and that full compaction is achieved, and making sure that the characteristics of concrete which affect full compaction like consistency, mobility and compatibility are in conformity with relevant codes of practice. The tests were carried out in accordance with relevant IS Standards. The aggregates were tested for physical properties such as specific gravity and particle distribution test.

All the mixes were prepared by mixing the concrete in laboratory mixer with water Based upon the quantities of ingredient of the mixes, the quantities of SCBA for 5, 10, 15 and 20% replacement by weight and 10% of bagasse was added additionally were estimated. The ingredients of concrete were thoroughly mixed manually 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 thoroughly using tamping rod. The top surface was finished by means of a trowel. The specimens were removed from the mould after 24hr and then cured under water for a period of 5, 10 and 15 days. The specimens were taken out from the curing tank just prior to the test.

The tests for compressive, split tensile strength were conducted using a 2000KN compression testing machine. Concrete had significantly higher compressive strength and split tensile strength compared to conventional concrete. It is found that the

cement could be advantageously replaced with SCBA up to maximum limit of 15% keeping as constant in M30 concrete. Although, the optimal level of SCBA content was achieved with 10% replacement. Partial replacement of cement by SCBA and CF increases the workability of fresh concrete; therefore use of super plasticizer is not substantial. The density of concrete decreases with increase in SCBA content, low weight concrete produced in the society with waste materials (SCBA).

4. EXPERIMENTAL INVESTIGATION

Compressive Strength Test:

The compressive strength of concrete (150 mm × 150 mm × 150 mm) are tested by means of compressive testing machine according to ASTM C39. All proportions were tested after 7 days, 14 days and 28 days curing period at standard 20 ± 2°C.

Split Tensile Strength Test: Split tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. Spilt tensile strength of concrete is as prescribed by IS 5816 - 1999 is conducted. Specimens of 150mm diameter × 300mm height were used for this test. The specimens were tested for 7, 14, 28 and 60days.

Rapid Chloride ion penetration test: According to ASTM C1202 test, a water-saturated, 50 mm thick, 100 mm diameter concrete specimen is subjected to a 60v applied DC voltage for 6 hours using the RCPT apparatus. In one reservoir is a 3.0% NaCl solution and in the other reservoir is a 0.3 M NaOH solution. The total charge passed is determined and this is used to rate the concrete according to the criteria included.

Water permeability test: The determination of water penetration depth is specified by BS EN- 12390-8:2000. In this test, water was applied on the face of the 150mm concrete specimen under a pressure of 5 to 10 kg/cm2 . The constant pressure maintained for a period of 72h. After the period, the specimen were taken out and split into halves. The water penetration contour in the concrete surface was marked and then maximum depth of penetration value has to be recorded as water penetration. This test will be conducted after 60 days water curing of concrete cubes.

5. EXPERIMENTAL RESULTS:

The M30 grade of OPC Concrete results with various proportions of sugarcane Bagasse ash was tested for compressive strength and split tensile strength Chloride Penetrability test and Water permeability test.

Table: percentages of SCBA used for M30 grade concrete

Mix Designation	Binding materials
A1	100 % Cement
A2	5 % SCBA+ 95% Cement
A3	10 % SCBA+ 90 %Cement
A4	15 % SCBA+ 85 % Cement
A5	20 % SCBA + 80% Cement

The results obtained from compressive strength test for all the mixes are given in figure It can be seen from the figure that the compressive strength results of specimens at 30% replacement of Admixtures were higher than those of other sample mixtures

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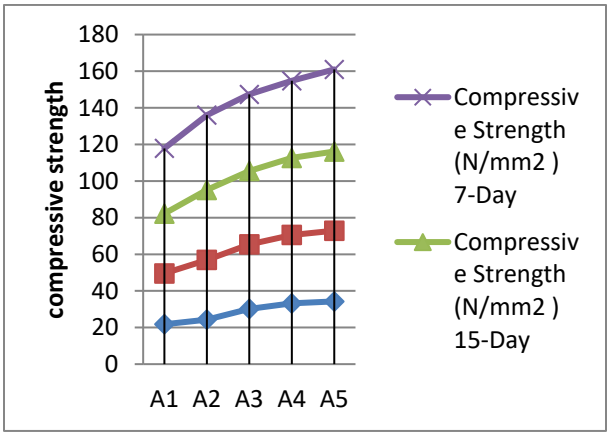
and the strength obtained was greater than 30Mpa (M30). Further increase in percentages results in decreasing compressive strength along with significant fall in properties of fresh concrete It is also indicated that the rate of increase of strength of mixes with admixtures is higher at later days that maybe due to pozzolanic properties of Admixtures.

Table: Compressive test results for Sugarcane Bagasse ash

Mix Designations	Compressive Strength (N/mm2)			
	5-Day	10 - Day	15- Day	7-Day
A1	21.78	27.78	32.67	35.60
A2	24.32	32.59	38.23	40.86
A3	30.17	35.23	40.10	41.80
A4	33.21	37.34	42.06	42.15
A5	34.25	38.64	43.24	44.84

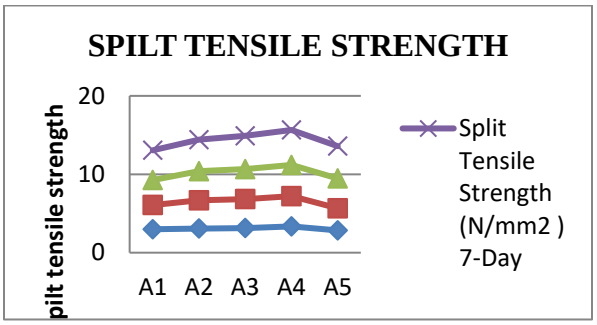


Graph: Compressive test results for Sugarcane Bagasse ash

Split tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. Spilt tensile strength of concrete is as prescribed by IS 5816 - 1999 is conducted. Specimens of 150mm diameter × 300mm height were used for this test. The specimens were tested for 5,10, 15 and 20 days. The test is conducted on automatic compression testing machine of capacity 3000kN as shown in fig. The cylinder is placed horizontally between the loading surfaces of compression testing machine and the load is applied till failure of the cylinder. During the test the plates of the testing machine should not be allowed to rotate in a plane perpendicular to the axis of cylinder Split tensile strength= 2P/ (ΠDL) P = ultimate load, L= span of the specimen, D= width of the specimen.

Table: Split Tensile strength results for SCBA

Mix Designations	Split Tensile Strength (N/mm2)			
	5-Day	10 - Day	15- Day	7- Day
A1	2.99	3.09	3.18	3.80
A2	3.08	3.60	3.71	4.02
A3	3.14	3.69	3.83	4.24
A4	3.35	3.86	3.98	4.46
A5	2.84	2.82	3.81	4.12



Graph: Split Tensile strength results for SCBA

The RCPT of M30grade concrete mixes replacing OPC by Nano SCBA at 5%, 10%, 15% and 20% is investigated. The results of

RCPT of A1, A2, A3, A4and A5 concrete mixtures tested at 20 days are represented in table A graphical representation age versus RCPT is represented in table

Mix no.	Proportion of Binding Materials	Rapid chloride permeability test, mAh (20days)
A1	Conventional mix	332.1 (very low)
A2	95% Cement+5% SCBA	1390.05(Low)
A3	90 % Cement+10 % SCBA	1906.4 (Low)
A4	85% Cement+15% SCBA	1581.3 (Low)
A5	80 % Cement+20% Nano SCBA	993.6(Very low)

CONCLUSION

The results of the present investigation show that Nano sugarcane bagasse ash can be used as a pozzolanic material in concrete.

1. The compressive strength of concrete of Nano sugarcane bagasse ash concrete (A1, A2, A3, A4 & A5) increases with increase in bagasse ash at by age.
2. As for refereed many research journals the M30 grade concrete(X1, X2, X3, X4 & X5) with 10% of bagasse ash has gives maximum strength at 60 days which 16.35% more than conventional concrete.
3. For tensile strength of Nano sugarcane bagasse ash (A1, A2, A3, A4 & A5) with 15 % increases with increases in bagasse ash at by age.
4. For M30 grade of concrete with 10% of bagasse ash (X1, X2, X3, X4 & X5) shows that the tensile strength at 7 days, 14 days, 28 days and 60 days.
5. So, Utilization of SCBA is a pozzolanic material that the potential to be used as partial replacement material and can help to the environmental sustainability.
6. Many researches had the results at the age on the compressive strength of concrete. In SCBA (X1, X2, X3, X4 & X5) of M30 grade of concrete shows maximum compressive strength gives up to 15% replacement level of SCBA. The value of Compressive strength was 24.7 N/mm2 , 22.12 N/mm2 & 24 N/mm2 at 15% of SCBA at the age of 28 days.
7. In Nano sugarcane bagasse ash (A1, A2, A3, A4 & A5) gives up to the values of 34.25 N/mm2 , 38.64 N/mm2 , 43.42 N/mm2 & 44.84 N/mm2 are the 20% of optimum results compared to conventional concrete at the age of 60 days.

So, those Nano materials will give great strength as compared to the normal materials. In this study Nano bagasse ash was used in cement concrete it gives better results in sugarcane bagasse ash. The results shows that the SCBA concrete had significantly higher compressive strength compare to that of the Conventional concrete. It is found that the cement could be advantageously replaced with SCBA up to maximum limit of 15%. Although, the Partial replacement of cement by SCBA increases workability of fresh concrete.

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