THE EFFECT OF M30 SCBA CONCRETE IN ACID ENVIRONMENT

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Abstract: *The usage of blended concrete becoming popular due to the less usage of cement, at the same time the disposal issue of industrial and agricultural wastes can also be reduced. In this experiment we analyze the impact of partial replacement of SCBA in ordinary Portland cement cured in various acidic environments. Bagasse ash has been replaced by 0%, 5%, 10%, 15% and 20% by weight of cement. The concrete specimens were cured for 28, 60 and 90 days in water and in concentrations of 1%, 3 % and 5% sulphuric acid and hydrochloric acid solutions. The tests conducted are compressive strength. The ideal percentage of SCBA replacement is around 10%. The presence of SCBA in concretedeveloped resistivity towards Acidic attacks.*

Keywords: *Compressive strength, durability, sugar cane bagasse ash, hydro chloric acid (HCL) and sulphuric acid (H_2SO_4).*

1. INTRODUCTION

In present situation all over the world are seeking on utilization of industrial waste in useful manner, by avoiding disposal problems and landfilling cost [1]. Utilization of various supplementary cementitious materials significantly influences fresh and hardened properties of mortar. Sugarcane bagasse ash is a by-product from sugar industries and can be used as supplementary cementitious material in concrete [2, 3]. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement [4]. Lakshmi Priya [5] investigated the impact of SCBA in concrete by partially replacing SCBA with cement in the ratio of 0%, 5%, 10%, 15%, 20% and 25% by weight for M25 grade of concrete. The experimental study examined the slump of the fresh concrete, compaction factor, compressive strength, split tensile strength, flexural strength, and modulus of elasticity. Vijaya Sehkar Reddy [7] conducted a study where the replacement is done at various percentages like 0%, 5%, 10%, 15% and 20% and its effect on properties of concrete was investigated.. Fresh and hardened properties were exercised with various replacement levels. The study indicated that sugarcane bagasse ash can effectively be used as cement replacement (up to 10%) without substantial change in strength.

Here, we used the sugar cane bagasse ash as a replacement by 0%, 5%, 10%, 15% and 20% by weight of cement improve quality and reduce the construction cost on materials. The concrete specimens were cured for 28, 60 and 90 days in water and in concentrations of 1%, 3 % and 5% sulphuric acid and hydrochloric acid solutions. The tests conducted are compressive strength. The main objective of this research is to study the durability of sugar cane bagasse ash blended concrete cured in H_2SO_4 and HCL solution.

2. METHODOLOGY

The materials used in this investigation are:

Cement: The most commonly used cement in concrete is ordinary Portland cement of 53 Grade confirming IS 12600- 1989 (2009).

Fine aggregate: Regionally available river sand, confirming to Zone II as per Indian standards 383-2016. The sand used must be free from clay, silt and other organic impurities. Specific gravity is about 2.6, water absorption is 1% and fineness modulus is around 2.99.

Coarse aggregate: The crushed aggregate used were 20mm to 12.5mm in size confirming to IS: 10262, IS: 383. Specific gravity is 2.8, water absorption is 0.5% and finenessmodulus is 7.26.

Water: The water that is available in our college campus confirming to the requirement of concreting and curing as per IS: 456-2009.

Sugar cane bagasse ash: The SCBA which is used in this investigation process was obtained from the KCP Sugar factory, Vuyurru, located in Krishna district, Andhra Pradesh. SCBA contains an approximate 25% of hemi-cellulose, about 25% of lignin and a 50% of cellulose. For each ton of the sugarcane it generates approximately 26% of bagasse at an approximate 50% of moisture content & approximately 0.62% of residual ash. The residue that is left after the combustion gives a chemical composition which is highly dominated by silicon dioxide (SO2). The specific gravity of SCBA was found to be 2.49

Table-1: *Physical properties of sugar cane bagasse ash*

S. No	Property	Test Results
1	Specific gravity	2.49
2	Particle shape	Spherical
3	Density	375 Kg/m^3
4	Specific surface area	420 /Kg

3.EXPERIMENTAL PROCEDURE

Mixing

Mixing is done in a pan mixer of 40 liters capacity. The cement materials are thoroughly blended and then to this, the aggregates were added and then completely mixed followed by the slow and gradual addition of water. The mixing has to be done properly until a mixture of uniform colour and consistency are achieved which is ready forcasting.

Casting of specimen

The moulds are cleaned and oil is applied to the mould before concrete is poured into the mould. The moulds are then placed on the level platform. The thoroughly mixed green concrete is filled into the moulds by a vibration method with needle vibrator. Excess concrete was removed and top surface is leveled confirming to IS: 516-1969. Here number of cubes cast are 315, number of cylinders cast are 315 and number of beams cast are 315.

Curing the specimen

The specimens in the mould are left undisturbed for 24 hours in moulds and then de moulded. De moldings must be done carefully without breaking edges. They must be cured in water, H_2SO_4 and HCL solutions for required period confirming to IS: 516-1969.

Durability

The durability tests are conducted on sugarcane bagasse ash concrete against acids such as $H_2SO_4$and HCL. The response of H_2SO_4 and HCL attack on sugar cane bagasse ash concrete for various percentages were studied. For conducting this tests concrete specimens like cubes, cylinders and beams with different percentages were casted. The specimens were cured in 1%, 3% and 5% $H_2SO_4$and HCL solutions for different periods of 28, 60 and 90 days.

4. EXPERIMENTAL RESULTS

The following graphs shows the mechanical properties of concrete specimens with 0%, 5%, 10%, 15% and 20% weight replacement of cement with SCBA cured in normal water and different percentages of H_2So_4 and HCL solutionsfor 28, 60 and 90 days.

a. Compressive strength results for cubes cured inwater

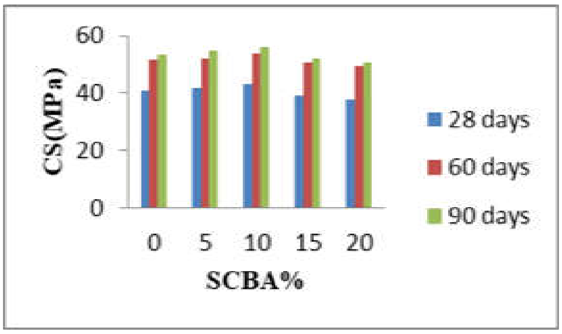

Chart-1: *CS of SCBA cubes cured in normal water*

The obtained results of SCBA replaced concrete cubes cured in water of all curing periods, the strength variation for 0% to 5% increased up to 2.99% for 28 days, 1.14% for 60 days, 2.3% for 90 days. For 5% to 10% strength increased up to 2.33% for 28 days, 2.81% for 60 days and 2.68% for 90 days. For 10% to 15% strength decreased up to 9.22% for 28 days, 5.47% for 60 days, 7.49% for 90 days and for 15% to 20% strength decreased up to 2.95% for 28 days, 2.4% for 60 days, 2.82% for 90 days. This shows that compressive strength results of SCBA replaced concrete cubes cured in water for all curing periods increase up to 10% replacement and a decrease in compressive strength is observed at 15%and 20% replacements.

b. Compressive strength results for cubes cured in 1% HCL solution

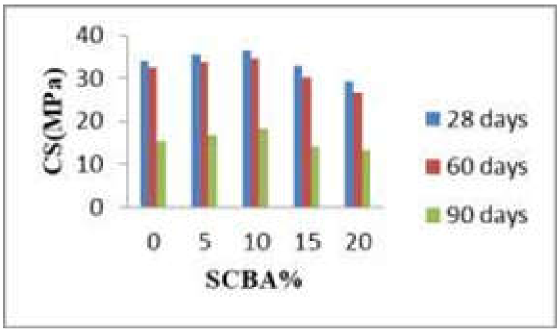

Chart-2: CS of SCBA cubes cured in 1% HCL solution

The obtained results of SCBA replaced concrete cubes cured in 1%HCL of all curing periods, the strength variation for 0% to 5% strength increased up to 4.38% for 28 days, 3.23% for 60 days and 8.7% for 90 days. For 5% to 10% strength increased up to 2.7% for 28 days, 2.4%for 60 days and 9.2% for 90 days. For 10% to 15% strength decreased up to 10.4% for 28 days, 14.09% for 60 days and 28.1% for 90 days and for 15% to 20% strength decreased up to 12.9% for 28 days, 12.6% for 60 days and 7.1% for 90 days. This shows that compressive strength results of SCBA replaced concrete cubes cured in 1%HCL for all curing periods increase up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

c. Compressive strength results for cubes cured in 3% HCL solution

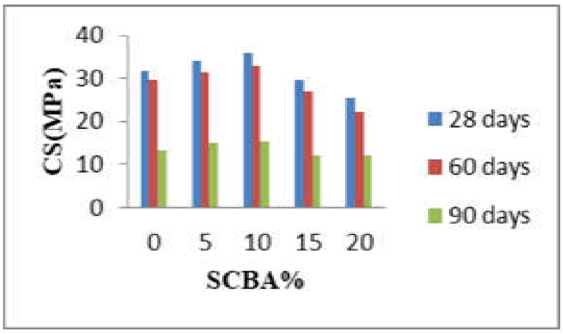

Chart-3: *CS of SCBA cubes cured in 3% HCL solution*

The obtained results of SCBA replaced concrete cubes cured in 3%HCL of all curing periods, the strength variation for 0% to 5% strength increased up to 7.04% for 28 days, 5.8% for 60 days and 11.9% for 90 days. For 5% to 10% strength increased up to 4.99% for 28 days, 4.93% for 60 days and 2.47% 90 days, for 10% to 15% strength decreased up to 20.9% for 28 days, 22.77% for 60 days and 26.17% for 90 days and for 15% to 20% strength decreased up to 16.7% for 28 days, 21.47% for 60 days and 1.67% for 90 days. This shows that compressive strength results of SCBA replaced concrete cubes cured in 3% HCL for all curing periods increase up to 10% replacement and a decrease incompressive strength is observed at 15% and 20% replacements.

d. Compressive strength results for cubes cured in 5% HCL solution

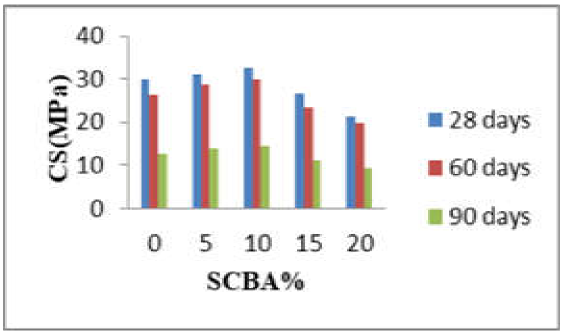

Chart-4: *CS of SCBA cubes cured in 5% HCL solution*

The obtained results of SCBA replaced concrete cubes cured in 5%HCL of all curing periods, the strength variation for 0% to 5% strength increased up to 4.12% for 28 days, 8.5% for 60 days and 9.3% for 90 days. For 5% to 10% strength increased up to 4.7% for 28 days, 4.4% for 60 days and 4.6% for 90 days. For 10% to 15% strength decreased up to 22.3% for 28 days, 28.07% for 60 days and 29.2% for 90 days and for 15% to 20% strength decreased up to 24.6% for 28 days, 18.5% for 60 days and 20.88% for 90 days. This shows that compressive strength results of SCBA replaced concrete cubes cured in 5% HCL for all curing periods increase up to10% replacement and a decrease in compressive strength isobserved at 15% and 20% replacements.

e. Compressive strength results for cubes cured in 1% H_2So_4 solution

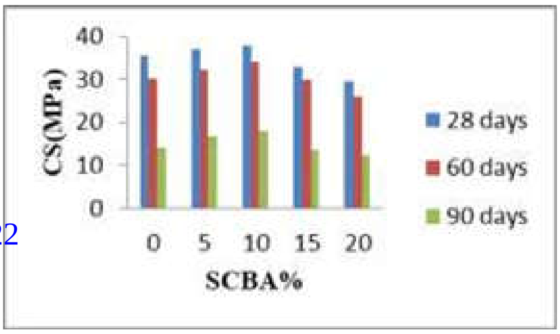

Chart-5: *CS of SCBA cubes cured in 1% H_2So_4 solution*

The obtained results of SCBA replaced concrete cubes cured in 1% H_2So_4 of all curing periods, the strength variation for 0% to 5% strength increased up to 4.13% for 28 days, 6.47% for 60 days, 19.94% for 90 days. For 5% to 10% strength increased up to 2.64% for 28 days, 5.92% for 60 days and 6% for 90 days. For 10% to 15% strength decreased up to 13.72% for 28 days, 12.23% for 60 days, 24.69% for 90 days and for 15% to 20% strength decreased up to 9.95% for 28 days, 13.17% for 60 days, 7.97% for 90 days. This shows that compressive strength results of SCBA replaced concrete cubes cured in 1% H_2So_4 for all curing periods increase up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

f. Compressive strength results for cubes cured in 3% H□So□ solution

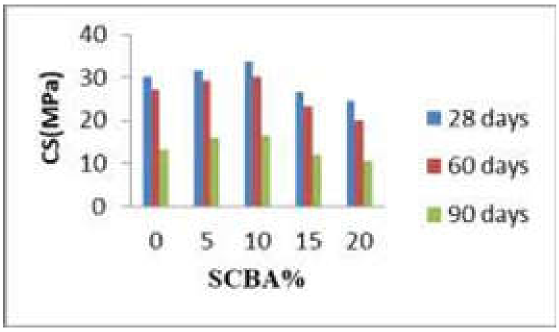

Chart-6: *CS of SCBA cubes cured in 3% H_2So_4 solution*

The obtained results of SCBA replaced concrete cubes cured in 3% H_2So_4 of all curing periods, the strength variation for 0% to 5% strength increased up to 4.85% for 28 days, 7.04% for 60 days, 19.12% for 90 days, for 5% to 10% strength increased up to 6.73% for 28 days, 3.56% for 60 days and 4.04% for 90 days, for 10% to 15% strength decreased up to21% for 28 days, 22.89% for 60 days, 26.67% for 90 days and for 15% to 20% strength decreased up to 8.28% for 28 days, 13.51% for 60 days, 12.84 % for 90 days. This shows that compressive strength of SCBA replaced concrete cubes cured in 3% H_2So_4 for all curing periods increase up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

g. Compressive strength results for cubes cured in 5% H2So4 solution

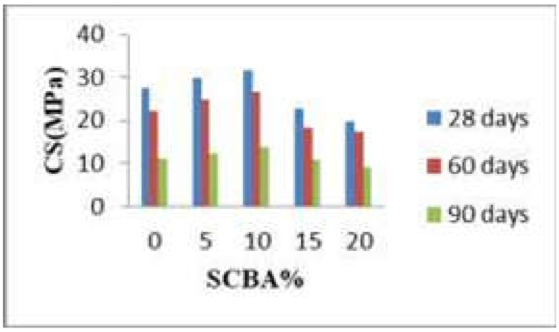

Chart-7: *CS of SCBA cubes cured in 5% H_2So_4 solution*

The obtained results of SCBA replaced concrete cubes cured in 5% H_2So_4 of all curing periods, the strength variation for 0% to 5% strength increased up to 9.2% for 28 days, 11.73% for 60 days, 9% for 90 days. For 5% to 10% strength increased up to 5.09% for 28 days, 7.76% for 60 days and 13.57% for 90 days. For 10% to 15% strength decreased up to 27.75% for 28 days, 31.35% for 60 days, 21.16% for 90 days and for 15% to 20% strength decreased up to 13.07% for 28 days, 4.67% for 60 days, 18.26% for 90 days. This shows that compressive strength of SCBA replaced concrete cubes cured in 5% H_2So_4 for all curing periods increase up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

5. CONCLUSIONS

- It was observed that due to the presence of high amount of silica in SCBA, the concrete blended with 10% SCBA by weight of cement has more strength when compared to ordinary concrete in all curing conditions.
- There is a decrease in strength and increase in slump after addition of SCBA beyond 10% SCBA replacement by weight of cement.
- The strength increased in SCBA concrete specimens cured in 1% hydrochloric acid and sulphuric acid solution when compared with specimens cured in normal concrete at 90 days.
- SCBA replaced concrete specimens produced maximum compressive strength when cured in both sulphuric acid and Hydrochloric acid when compared with normal concrete.
- The presence of SCBA in concrete developed resistivity towards Acidic attack.

6. REFERENCES

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