EFFECT OF M30 SCBA CONCRETE IN ALKALI ENVIRONMENT

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ABSTRACT Cement is the most versatile material as it acts as a binder in concrete. But there is a serious environmental problem in the production of cement. So we are trying to find an alternative to replace OPC which possess similar qualities as of cement. Here we made an attempt to replace the OPC with industrial waste Sugarcane Bagasse Ash. At the same time the disposal of industrial wastes is becoming a major problem today. The present paper deals with replacement of Ordinary Portland Cement with SCBA at different percentages of 0%, 5%, 10%, 15% and 20% by weight of cement. The mechanical properties of SCBA blended concrete were studied when subjected to alkali environment. M30 grade concrete was used. The concrete specimens were cured in normal water, sodium sulphate solution (1%, 3% and 5%) and Magnesium sulphate solution (1%, 3% and 5%) at ages of 28, 60 and 90 days. The SCBA blended concrete provides resistance against sulphate attack. We can successfully replace OPC with SCBA.

KEY WORDS: Compressive strength, Durability, Sugarcane bagasse ash, sodium sulphate and magnesium sulphate.

1. INTRODUCTION

Today the major problem we are facing in the construction world is the emission of carbon dioxide during the production of cement. Ordinary Portland cement is the binding material in the concrete. Many researches were been still going on to find the best alternative to find the best replacement to cement.

Sugar cane bagasse ash is the agro industrial by product (waste) we get from the sugar factory. Many investigations were conducted on SCBA to find its properties. The Workability of SCBA concrete was studied from [2, 13]. Setting time if found from [11]. The physical and chemical properties of the Bagasse ash were studied from [12].

After studying these papers we can partially replace cement with SCBA, at the same time the disposal issue of bagasse ash can also be solved. The durability studies and mechanical properties of SCBA concrete were studied from [3, 15]

The main objective of this research is to study the durability of sugar cane bagasse ash blended concrete cured in $Na_2SO_4$and $MgSO_4$ solution.

2. METHODOLOGY

The materials used in this investigation are:

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

2.2. 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 2.6, water absorption is 1% and fineness modulus is 2.99.

2.3.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 fineness modulus is 7.26.

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

2.5. Sugar cane bagasse ash: The SCBA used for this investigation was obtained from KCP Sugar factory, Vuyuru, located in Krishna district, Andhra Pradesh. SCBA contains approximately 25% of hemi-cellulose, 25% of lignin and 50% of cellulose. Each ton of sugarcane generates approximately 26% of bagasse (at 50% moisture content) and 0.62% of residual ash. The residue after combustion gives a chemical composition dominated by silicon dioxide. The specific gravity of SCBA was found to be 2.49

2.5.1. Physical properties of sugar cane bagasse ash [12]:

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

3.1. Mixing:

Mixing is done in a pan mixer of 40 litres capacity. The cementetious materials are thoroughly blended and then the aggregates are added and then mixed followed by the gradual addition of water. Mixing is to be done until the required consistency is achieved.

3.2. Casting of specimen:

The moulds are cleaned and oil is applied to the mould before concrete is poured into the mould. The moulds are placed on the level platform. Compaction is done on vibrator. Excess concrete was removed and top surface is levelled confirming to IS: 516-1969.

3.3. Curing the specimen:

The specimens in the mould are left undisturbed for 24 hours in moulds and then de moulded. De moulding must be done carefully without breaking edges. They must be cured in water, $Na_2SO_4$and $MgSO_4$ solutions for required period confirming to IS: 516-1969. Here, we casted 315 cubes, 315 cylinders and 315 beams.

3.4. Durability:

Here, the durability tests are conducted on SCBA concrete against acid and salts such as $Na_2SO_4$and $MgSO_4$. The response of $Na_2SO_4$and $MgSO_4$ attack on sugar cane bagasse ash concrete for various percentages was studied by observations like loss in mechanical properties. For conducting this tests concrete specimens like cubes, cylinders and beams with different percentages were casted. The specimens were immersed in 1%, 3% and 5% $Na_2SO_4$and $MgSO_4$ solutions for different periods of 28,60 and 90 days.

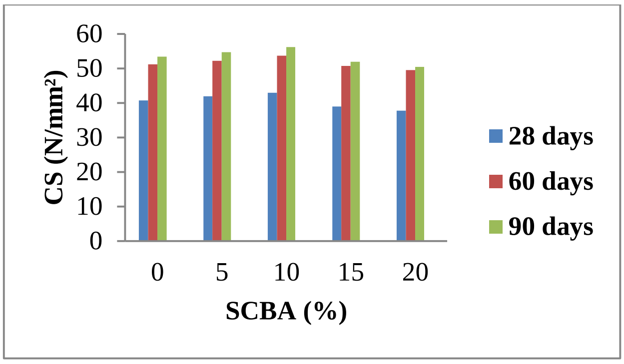
3.5. Problem of durability:

The problem of early detoriation of some of the reinforced concrete and pre stressed concrete structures has becoming a big challenge in today's world. Those structures built confirming to the latest specifications showing the early signs of distress and damage while some other structures built half a century ago are still in good condition. The exposure of concrete to acidic and salty environment may detoriate concrete in some countries. The seriousness of the problem is reflected with high cost of repairs in those countries.In the most of the advanced countries, nearly 40% of the construction industries budget is spent on repair, restoration and strengthening of the damaged concrete structures.The durability tests have been conducted to check the durability parameters to withstand for the environmental attacks.

4. EXPERIMENTAL RESULTS

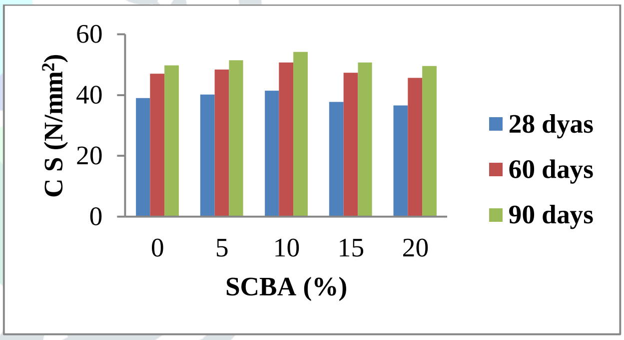
The following graphs shows the mechanical properties of concrete specimens with 0%, 5%, 10%, 15% and 20% weight replacement of cement with SCBA cured in normal water and different percentages of $Na_2SO_4$and $MgSO_4$ solutions for 28, 60 and 90 days.

4.1 Compressive strength results cured in water:



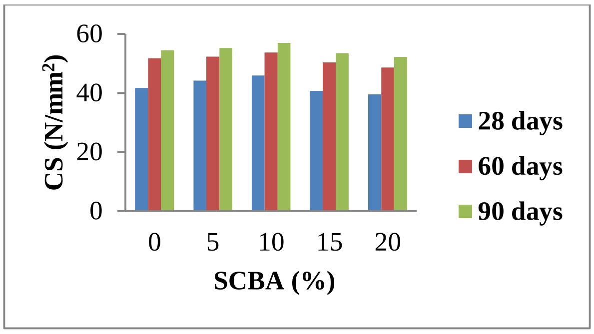
It is observed that, for 0% to 5% strength increases up to 2.99%, 1.4%, 2.3% at 28, 60, 90 days, for 5% to 10% the strength increases up to 2.3%, 2.8%, 2.7% at 28, 60, 90 days, for 10% to 15% strength decreases to 10.2%, 5.8%, 8.1% at 28,60, 90 days and for 15% to 20% strength decreases to 3.04%, 2.4%,2.9% at 28,60, 90 days. The graph shows that the compressive strength of SCBA replaced concrete cubes cured in water, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.2 Compressive strength results cured in 1%Na_2SO_4 solution:



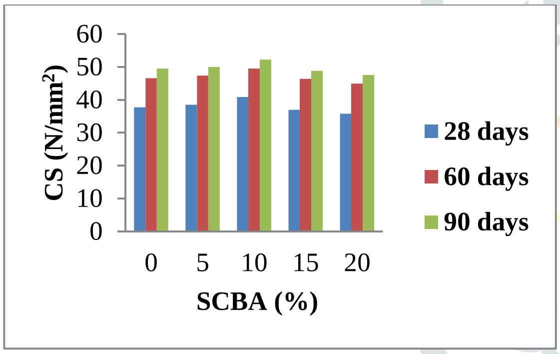
It is observed that, for 0% to 5% strength increases up to 3.21%, 2.95%, 3.49% at 28, 60, 90 days, for 5% to 10% the strength increases up to 3.03%, 4.76%, 5.28%at 28,60, 90 days, for 10% to 15% strength decreases to 9.84%, 6.75%, 6.34% at 28,60, 90 days and for 15% to 20% strength decreases to 3.23%, 3.63%, 2.4% at 28,60, 90 days.The graph shows the results for SCBA concrete cubes cured 1% Na_2SO_4solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.3 Compressive strength cured in 3% Na_2SO_4solution:



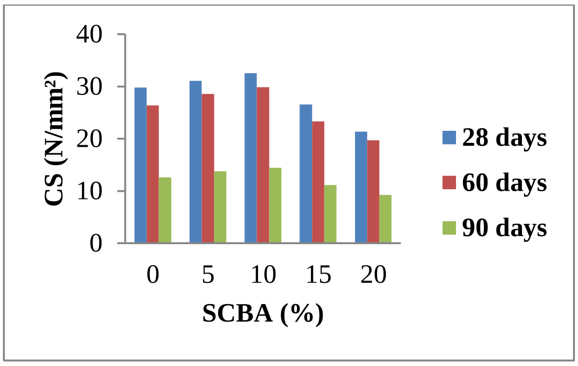
It is observed that, for 0% to 5% strength increases up to 5.91%, 1.04%, 1.33% at 28,60, 90 days, for 5% to 10% the strength increases up to 3.91%, 2.71%, 3.11% at 28, 60, 90 days, for 10% to 15% strength decreases to 11.29%, 6.38%, 6.02% at 28,60, 90 days and for 15% to 20% strength decreases to 3.04%, 3.41%, 2.37% at 28,60, 90 days. The graph shows the results for SCBA concrete cubes cured 3% Na_2SO_4solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.4 Compressive strength results cures in 5% Na_2SO_4solution:



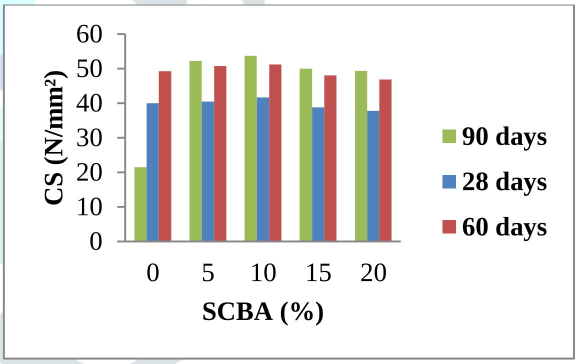
It is observed that, for 0% to 5% strength increases up to 1.9%, 1.58%, 0.98% at 28,60, 90 days, for 5% to 10% the strength increases up to 6%, 4.67%, 4.43% at 28,60, 90 days, for 10% to 15% strength decreases to 9.51%, 6.4%, 6.54%at 28,60, 90 days and for 15% to 20% strength decreases to 3%, 3.17%, 2.5% at 28,60, 90 days. The graph shows the results for SCBA concrete cubes cured 5% Na_2SO_4solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.5 Compressive strength results cured in 1% $MgSO_4$ solution:



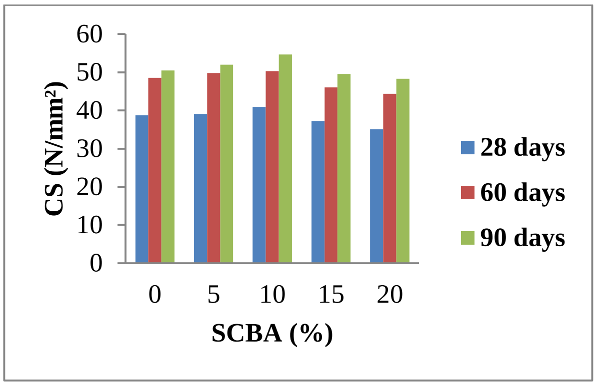
It is observed that, for 0% to 5% strength increases up to 1.22%, 2.9%, 1.44% at 28,60, 90 days, for 5% to 10% the strength increases up to 3.04%, 1%, 2.8% at 28,60, 90 days, for 10% to 15% strength decreases to 7.61%, 6.5%, 7.3% at 28,60, 90 days and for 15% to 20% strength decreases to 2.5%, 2.6%, 1.36% at 28,60, 90 days. The graph shows the results for SCBA concrete cubes cured 1% $MgSO_4$ solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.6 Compressive strength results cured in 3% $MgSO_4$ solution:



It is observed that, for 0% to 5% strength increases up to 3.5%, 2.8%, 2.26% at 28,60, 90 days, for 5% to 10% the strength increases up to 1.62%, 1.12%, 2.56% at 28,60, 90 days, for 10% to 15% strength decreases to 6.4%, 5.4%, 5.8% at 28,60, 90 days and for 15% to 20% strength decreases to 4.3%, 2.9%, 2.7% at 28,60, 90 days. The graph shows the results for SCBA concrete cubes cured 3% $MgSO_4$ solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

4.7 Compressive strength results cured in 5% $MgSO_4$ solution:



It is observed that, for 0% to 5% strength increases up to 0.98%, 2.5%, 2.95% at 28,60,90 days, for 5% to 10% the strength increases up to 4.7%, 1.08%, 5.23% at 28,60, 90 days, for 10% to 15% strength decreases to 9.8%, 9.4%, 10.4% at 28,60, 90 days and for 15% to 20% strength decreases to 6.4%, 3.7%, 2.5% at 28,60, 90 days. The graph shows the results for SCBA concrete cubes cured 5% $MgSO_4$ solution, for all curing period strength increases up to 10% replacement and a decrease in compressive strength is observed at 15% and 20% replacements.

5. CONCLUSIONS

- The replacement of sugarcane bagasse ash in concrete with cement increases the compressive strength when compared to normal concrete.
- The optimum level in replacement of SCBA with cement is 10% by weight of cement when cured in 3% Na_2SO_4 and $MgSO_4$ solution.
- Sugarcane bagasse ash concrete specimens provide sulphate resistance towards alkaline attack with improved compressive strength, when compared to normal concrete.
- Sugarcane bagasse ash concrete can be used in places vulnerable to sulphate environment.
- It is recommended that further research should be conducted to assess the use of SCBA in concrete for several properties of concrete such as modulus of elasticity, drying, shrinkage etc.

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