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Partial Replacement of Cement with Sugarcane Bagasse Ash

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ABSTRACT:

It's 21st century and the entire world is heading towards modernization and development. The world needs to be sustainable such that not only we but also our future generation is not deprived off, the various sources which we are using now. On other hand development and modernization should not have an adverse effect on environment. One such problem is manufacturing of cement which damage lot of environment on daily basis as there is lot of emission of oxides of carbon and other harmful gases. Thus this research paper describes how an agricultural waste material such as Sugarcane Bagasse Ash (SCBA) can be partially replaced with cement in concrete as a secondary binding material in order to decrease the cement requirement which in turn will have a positive effect on environment. Having high silica content, SCBA can be easily used in place of cement at some fixed proportion. The sugarcane bagasse ash used for the research is obtained from The "ShriramSahakar Shaker karkhana Ltd. Mouda." Which grinded and sieved through sieve of size 150 micron and the residue of ash after receiving, were used in concrete as a partial replacement of concrete as a partial replacement of cement in the ratio 5%, 10%, 15% and 20% By weight of cement pozzolona Portland cement 53 grade cement used in study. The effect of replacement of cement by SCBA on the compressive strength of concrete at the age of 7 Days, 14 Days and 28 Days were determined.

Keywords:- Sugarcane Bagasse Ash, Cement, Compressive strength

I. INTRODUCTION

Cement either OPC or PPC is the major construction material. It's manufacturing process is responsible for emission of CO_2 for about 6-9% globally. There more demand of cement will directly increase the environment problem various researchers as well as cement producing industries are investigating hard to get alternatives to produces green building materials, alternative industrial waste like slag from blast furnace, GGBS, fly ash, silica furnace etc. are used in place of cement with some replacement proportion. In this project, an attempt to replace the agricultural waste i.e. SCBA with cement in concrete is done. Sugarcane crop is one the highly produce agricultural product in the entire world. Last year statistics shows that approximately 170.81 million metric tons of sugar were produced in the world wide which means huge no. of bagasse were also produced with it. Proper disposal of sugarcane bagasse ash is another major issue. But according to current research the sugarcane bagasse ash which is obtained from burning the bagasse under control condition, it gives ash having amorphous silica (SiO_2) which has pozzolanic properties. Although the sugarcane bagasse can be used for variety of purpose like production of paper, animal food, compost, manure and other various other purpose. Statics shows that about more than 1 million tons extra of ash, obtained from Sugarcane Bagasse, gets no proper disposal site in India itself. Statistics also shows that the production of sugar is increasing day by day which in-turn is increasing the quantity of SCBA due to which disposal of SCBA might become a major problem. After having various test of SCBA in various problem of the world for its use as cement replacement material. It was found that the ash obtained had some properties which improved the compressive strength of the concrete. The main reason was higher silica content in the bagasse ash. This paper analyses the effect of SCBA in concrete by partial replacement of 0%, 5%, 10%, 15%, 20%. by weight. The main ingredient consist of Pozzolona Portland Cement, Sugarcane Bagasse Ash (SCBA), River Sand, Coarse aggregate and Water. Mix design for M30

was calculated. After mixing, concrete specimen were casted and subsequently all the specimens were cured in water and were tested at an interval of 7, 14, 28 Days.

II. MATERIALS

The materials selected for this experimental study includes normal natural coarse aggregate, river sand as fine aggregate, cement, portable drinking water and sugarcane bagasse ash. The physical and chemical properties of each ingredient has considerable role in the desirable properties of concrete like strength and workability.

Material should be used

i. Cement
ii. Aggregate
iii. Water
iv. Sugarcane bagasse ash

i. Cement

A cement is basically a binding material, a substance used for construction that sets and bind them together. Cement is rarely used on its own, but rather to bind sand and gravel (aggregate) together. Cement is basically used with fine aggregate (sand) and coarse aggregate (gravel) to produce concrete.

ii. Aggregate

Aggregateis basically a material used for mixing with cement, bitumen, lime, gypsum, or other adhesive to form concrete or mortar. Aggregate is one of the most important construction materials which not only gives volume to the construction but also gives proper stability and controls wear and tear as well as erosion of the construction. Commonly used aggregates include sand, crushed or broken stone, gravel (pebbles), broken blast-furnace slag, boiler ashes (clinkers), burned shale, and burned clay. Aggregate basically acts as inert filler, which accounts for 65 to 85 percent of the volume and 75 to 90 percent of the weight of concrete. Although aggregate is considered inert filler, it is a necessary component that defines the concrete's thermal and elastic properties and dimensional stability. Following are the two types of the aggregate:-

a. Fine Aggregate
b. Coarse Aggregate

iii. Water

Water should be free from acids, oils, alkalis, vegetables or other organic impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix. Firstly, it reacts chemically with the cement to form the cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Secondly, it acts as a lubricant in the mixture of fine aggregates and cement.

iv. Sugarcane Bagasse Ash

Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the industries. After the incineration process the residual ash left shows pozzolanic property which can be easily used as a cement replacement material. The sugarcane bagasseash consist of approximately 54% of cellulose, 26% of hemicellulose and 20% of lignin. Each ton of sugarcane generates approximately 28% of bagasse, 0.625% of residual ash. The residue after incineration presents a chemical composition dominates by silicon (SiO_2).

III. LAB TEST

This include determination of chemical composition of sugarcane bagasse ash (SCBA), Physical test on aggregate and SCBA concrete. Test carried out include the following test: gradation test/ sieve analysis, specific gravity test by pycnometer, water absorption capacityand moisture content, bulk density, slump test and compressive strength test. Chemical test to determine the composition on SCBA was also conducted at Department of Chemistry, LIT, Nagpur. The method adopted was atomic absorption spectrometric method of analysis.

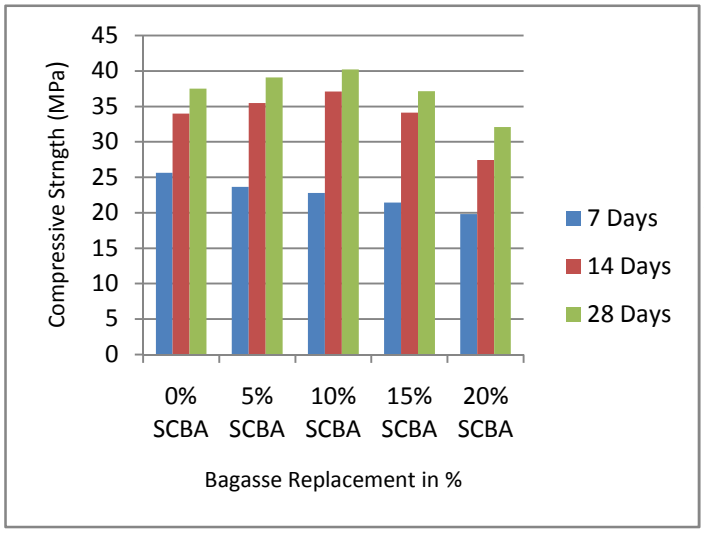
OBSERVATION TABLE AND RESULT

Compressive strength of concrete

Table 1 : Comparison between Compressive Strength of M30 Concrete cube with differentpercentage of addition of SCBA

Curing Days / Concrete With	7 Days Compressive Strength (MPa)	14 Days Compressive Strength (MPa)	28 Days Compressive Strength (MPa)
0 % SCBA	25.63	34	37.49
5 % SCBA	23.67	35.46	39.08
10 % SCBA	22.81	37.08	40.21
15 % SCBA	21.45	34.13	37.15
20 % SCBA	19.82	27.43	32.08

Comparison Graph



IV. RESULTS

From the compressive test which had been performed on concrete
cube (150 mm x 150 mm x 150 mm), following results are obtained.

i. Compressive Strength of concrete cube with 0% SCBA for 7 days has been obtained as 25.63 MPa
ii. Compressive Strength of concrete cube with 0% SCBA for 14 days has been obtained as 34 MPa.
iii. Compressive Strength of concrete cube with 0% SCBA for 28 days has been obtained as 37.49 MPa
iv. Compressive Strength of concrete cube with 5% SCBA for 7 days has been obtained as 23.67 MPa
v. Compressive Strength of concrete cube with 5% SCBA for 14 days has been obtained as 35.46 MPa
vi. Compressive Strength of concrete cube with 5% SCBA for 28 days has been obtained as 39.08 MPa
vii. Compressive Strength of concrete cube with 10% SCBA for 7 days has been obtained as 22.81 MPa
viii. Compressive Strength of concrete cube with 10% SCBA for 14 days has been obtained as 37.08 MPa
ix. Compressive Strength of concrete cube with 10% SCBA for 28 days has been obtained as 40.21 MPa
x. Compressive Strength of concrete cube with 15% SCBA for 7 days has been obtained as 21.45 MPa
xi. Compressive Strength of concrete cube with 15% SCBA for 14 days has been obtained as 34.13 MPa
xii. Compressive Strength of concrete cube with 15% SCBA for 28 days has been obtained as 37.15 MPa
xiii. Compressive Strength of concrete cube with 20% SCBA for 7 days has been obtained as 19.82 MPa
xiv. Compressive Strength of concrete cube with 20% SCBA for 14 days has been obtained as 27.43 MPa
xv. Compressive Strength of concrete cube with 20% SCBA for 28 days has been obtained as 32.08 MPa.

V.CONCLUSION

The experimental result shows that the strength of concrete increases with the help of SCBA Therefore, with the use of SCBA in partially replacement of cement in concrete, we can increase the strength of concrete as well as reduce the consumption of cement. This was all due to high silica content in the SCBA. However it was observed that 10%replacement of cement with SCBA give the maximum compressive strength after 28 days or final setting time.

Based on the limited study carried out on the compressive strength behavior of concrete cubes, the following conclusions are drawn.

i. By increasing the percentage of SCBA in concrete mix, there is gradual decrease in compressive strength of 7 days.
ii. The compressive strength of concrete cube at the age of 14 days, will increase upto 10% replacement of cement with SCBA. Further increase in the quantity of SCBA shows gradual fall in the compressive strength of concrete cubes.
iii. Comparative study of the compressive strength of concrete cubes with 5% SCBA at the age of 14 days is greater than 15% SCBA at the same age.
iv. Similarly the compressive strength of concrete cube at the age of 28 days, increases upto 10% replacement of cement with SCBA. Further addition of SCBA shows gradual decrease in the compressive strength of the concrete cubes.
v. It can be concluded that the final compressive strength obtained is highest with 10% replacement of cement with SCBA. Hence maximum upto 10% SCBA can be replaced with the cement in the concrete.

VI. REFERENCES

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