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DURABILITY STUDY ON SUGARCANE BAGASSE ASH AS POZZOLANA IN M30 GRADE CONCRETE

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Abstract:
The use of Sugarcane Bagasse ash as a cement replacement in concrete, which is a good solution to environment concerns that we are facing now. The effect of bagasse ash as a partial replacement of concrete has been investigated cement was replaced with 10% of bagasse ash concrete mix is designed for strength of M30and industrial waste like copper slag, steel slag, fly ash, coal bottom ash etc. The present study focuses on investigating the effect of Sugarcane Bagasse Ash (SCBA) as partial replacement of cement and Coal Bottom Ash (CBA) as partial replacement of fine aggregates in concrete. This study primarily deals with the characteristics of concrete, including compressive strength and workability. Moreover, this study also investigates the thermal stability of all concrete mixes at elevated temperature. Five mixes of concrete were prepared at different replacement levels of SCBA (0%, 5%, 10%, 15% & 20%)) with cement and CBA (0%, 10%, 20%, 30% & 40%) with fine aggregates. The water/cement ratio in all the mixes was kept at 0.55. The workability of concrete was tested immediately after preparing the concrete whereas the compressive strength of concrete was tested after 7, 14, and 28days of curing. Based on the test results, a combination of 10% SCBA and 10% CBA is recommended. This research also indicates that the contribution of SCBA and CBA doesn't change the thermal properties of concrete.

1.1 General

Nowadays, several studies have been performed in order to reuse industrial and/or agricultural wastes abundantly generated in society: this approach is in agreement with sustainable development principles. Among the waste materials generated bagasse ash, which is a byproduct of sugarcane industries is abundant and possess the required pozzolanic property. The disposal of the bagasse ash will be of a serious concern. The disposal of this material is already causing environmental problems around the sugar factories. The boost in construction activities in the country created shortage in most of concrete making materials especially cement, resulting in an increase in price. Using sugarcane bagasse ash as a cement replacement material is both environmentally and economically viable, since it reduces the problems of waste disposal and cement price hike. To utilize materials more effectively and reduce the cost in construction industry, Ternary Blended Concrete (TBC) that made with Portland clinkers and other two admixtures may be a better option because it presents several advantages over binary cements. The mostly used supplementary materials in ternary blends are silica fume, metakaolin, fly ash, Ground Granulated Blast furnace Slag (GGBS) etc. Among these GGBS is a better option since it has a higher proportion of the strength-enhancing calcium silicate hydrates (CSH) and is routinely specified in concrete to provide protection against both sulphate attack and chloride attack. So this study examined the potential use of sugarcane bagasse ash and GGBS as a partial cement replacement material.

SCBA Characterization:

The physical properties and compositions of SCBA vary with many factors, such as sugar cane varieties, growth, combustion temperature, combustion duration, purity of bagasse, bagasse ash collection location, cooling type, boiler equipment, bagasse ash collection methods and ash fineness For example, bagasse ash collected from the bottom of the boiler may be coarser and contain irregular particles, and the bagasse ash collected through a filtration system contains less carbon

Objectives:

The main objective of this study is to investigate the workability and compressive strength of concrete by using SCBA and CBA as combination. Moreover, this study also examines the effect of elevated temperature on thermal stability of all concrete mixes.

- Keeping above in view, the present study has been planned with the following objectives:
- The purpose of the work is to study and compare the strength and durability of concrete with partial replacement of cement using bagasse ash.
- The present study aims at mix design of M 30 grade of concrete and to find required constitutes of it.
- To study the compressive strength characteristic of concrete using sugarcane bagasse ash (as partial replacement of cement) and coal bottom ash (as partial replacement of fineaggregates).
- To study the workability characteristic of concrete using sugarcane bagasse ash and coal bottom ash.

To study the effect of elevated temperature on compressive strength of concrete using sugarcane bagasse ash and coal bottom ash

2.0 Literature review:

VinnyPushkaran, ManjulaUnni (2017)
The use of Sugarcane Bagasse ash as a cement replacement in concrete, which is a good solution to environment concerns that we are facing now. The effect of bagasse ash as a partial replacement of concrete has been investigated on the durability of concrete to sulphate attack and acid attack, the cement was replaced with 10% of bagasse ash.

Deepak.Sethuraman.R Ramesh (2016)
Durability of concrete and economy has made it the world's most used construction material. It is basically consists of four components: cement, water, aggregates and admixture Development of infrastructure necessity production of large quantities of cement and usage of natural resources. Initiatives are emerging worldwide to strike a balance between the developments in infrastructure and prevention of the environment from contamination by reusing the industrial wastes.

S.Sanchana Sri, T.Ramesh (2017)
Prediction of time to corrosion cracking is a key element in evaluating the service life of corroding reinforced concrete structures. Corrosion crack is usually used to define the end of functional service life where rehabilitation of a corroding structural element is required.

3.0 Methodology

This chapter briefly explains the materials used and methods adopted to conduct the study of workability and compressive strength of concrete containing SCBA and CBA.In present day scenario, one cannot imagine any structure without cement concrete. It is being extensively used for construction ranging from small scale to large scale as a key ingredient for fulfilling the aspect of strength and serviceability

Material used:

Cement

Cement is a binder that binds together the other materials. It has cohesive and adhesive properties in the presence of water. It is obtained by burning the mixture of calcareous and argillaceous materials. This mixture is properly intimated and fused in kiln at about 1450°C and a product called clinker is obtained. The clinker is cooled and the cooled clinker is mixed with a few percent of gypsum, then ground to get cement. Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to set in the presence of water.

Aggregates:

The aggregates are the essential constituents of concrete. The aggregates occupy almost 85 per cent of the volume of concrete. So, their effect on various properties such as compressive strength, shrinkage, creep etc. is undoubtedly considerable. Without the study of aggregates in depth and range, the study of the concrete is incomplete. But, to know more about concrete it is very essential that one should know more about the classification based on their sizes. Therefore, on the basis of their size, aggregates can also be classified on the basis of the size of the aggregates as coarse aggregates and fine.

Coarse aggregates:

The shape of coarse aggregates is an important characteristic since it affects the workability and strength properties of concrete. to improve the strength because of interlocking characteristics, while the rounded shape improves the workability characteristics because of lower internal friction.

Fine aggregates:

Aggregates most of which passes 4.75-mm BIS Sieve are known as fine aggregates

- Natural sand - Fine aggregates resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies.
- Crushed stone sand - Fine aggregates produced by crushing hard stone. .

Sugarcane bagasse ash:

Sugarcane bagasse ash is produced when bagasse is reutilized as a biomass fuel in boilers. When this bagasse is burned under controlled temperature, it results into ash. The ash obtained from the boiler of a sugar mill was used in this study shown in Figure. The collection of the ash was carried out during the boiler cleaning operation.

Figure 3.1: Sugarcane bagasse ash

Coal bottom ash:

Coal bottom ash is the waste product of coal fired power plant. It is a non-combustible material produced after burning of coal in furnace of coal fired thermal power plants. The CBA obtained from Thermal Plant was used in this study shown in Figure

Figure 3.2 : Coal bottom ash

4.0 RESULTS AND DISCUSSIONS:

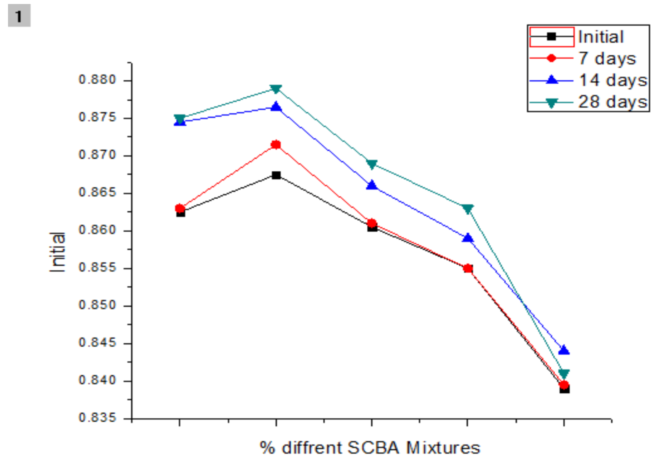
The M30 grade of OPC Concrete results with various proportions of sugarcane Bagasse ash was tested for compressive strength and split tensile strength Chloride Penetrability test and Water permeability test. Cement is the most important ingredient for the preparation of concrete and is produced in large quantities. Due to its enormous production, large amount of CO_2 is emitted which in turn affects the environment. Sugarcane Bagasse Ash (SBA) is a byproduct of sugar factories found after burning sugarcane bagasse, which itself is found after the extraction of all economical sugar from sugarcane. The present chapter deals with the results of tests conducted on materials used in research work. The performance of various mixes containing different percentage of SCBA and CBA is discussed. All the tests were conducted in accordance with the methods described in Chapter

Durability Study Fresh Concrete 30 Grade

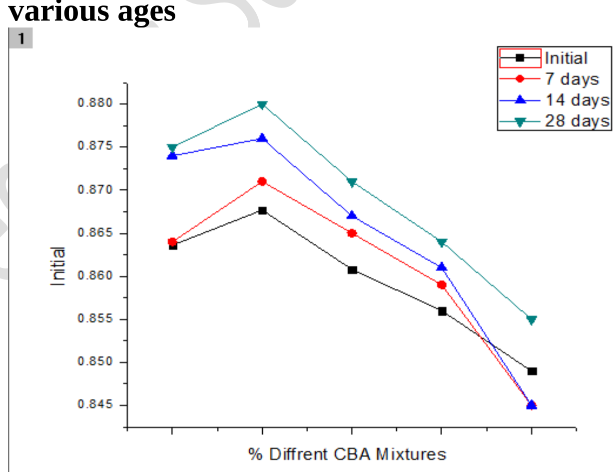
Concrete durability has been defined by the American Concrete Institute as its resistance to weathering action, chemical attack, abrasion and other degradation processes. Durability is the ability to last a long time without significant deterioration. A durable material helps the environment by conserving resources and reducing wastes and the environmental impacts of repair and replacement.

Durability Test:

Acid Resistance a) Durability results of different mix proportions of cubes subjected to acid environment two cubes each of size 15 cm X 15 cm X 15 cm were cast at mix proportions of 1:6.5:6.5 with various replacement level of cement by SCBA (0%, 5%, 10%, 15% & 20%) and CBA (0%, 10%, 20%, 30% & 40%). along with 10% addition of silica fume on all proportions. cubes were cured for 28 days for acid test



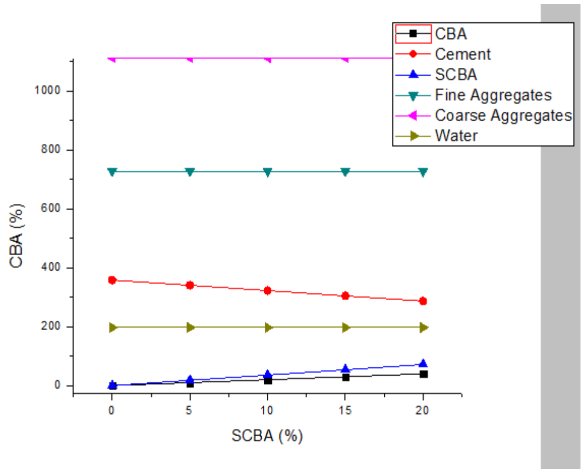
Graph: 4.1 Comparison of Average weight of Cubes for 1:6.5:6.5 mix subjected to Alkaline Environment at various ages



Graph: 4.2 Comparison of Average weight of Cubes for 1:6.5:6.5 mix subjected to Alkaline Environment at various ages

Table 4.11: Mix proportions of different concrete mixes

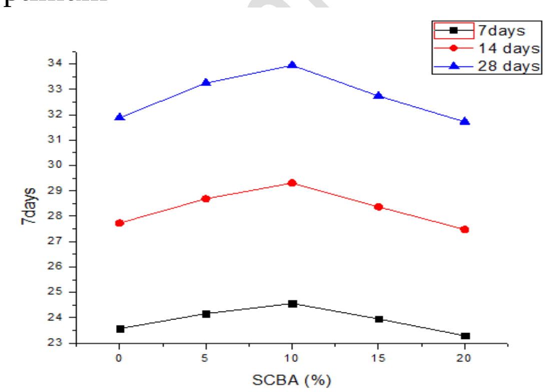
SCBA (%)	CBA (%)	Cement (Kg/m^3)	SCBA (Kg/m^3)	Fine Aggregates (Kg/m^3)	Coarse Aggregates (Kg/m^3)	Water (L/m^3)
0	0	358.47	0	728.20	1113.77	197.16
5	10	340.55	17.92	728.20	1113.77	197.16
10	20	322.62	35.85	728.20	1113.77	197.16
15	30	304.70	53.77	728.20	1113.77	197.16
20	40	286.78	71.69	728.20	1113.77	197.16



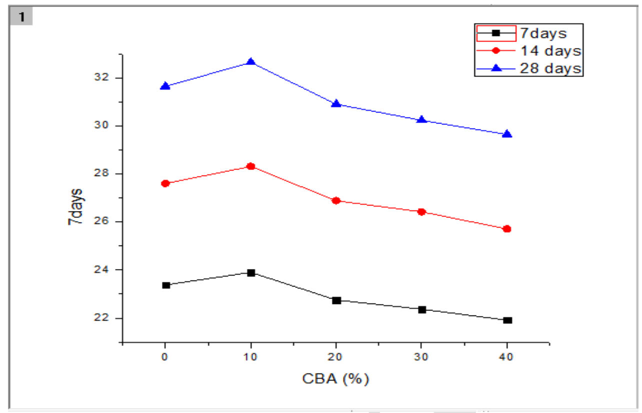
Graph 4.3: Mix proportions of different concrete mixes

Compressive strength of concrete:

The compressive strength of all concrete mixes was measured at the age of 7, 14 and 28days. The results of average compressive strength and the percentage loss or gain in compressive strength are given in Table respectively. The compressive strength of SCBA concrete mixes as compared to control concrete mix when cement was replaced up- to 0% 5%, 10%, 15% and 20% respectively. Nevertheless, the replacement of 15% of SCBA still improves the compressive strength of concrete as compared to the control concrete but for much better results, the 10% of SCBA seems to be the optimum



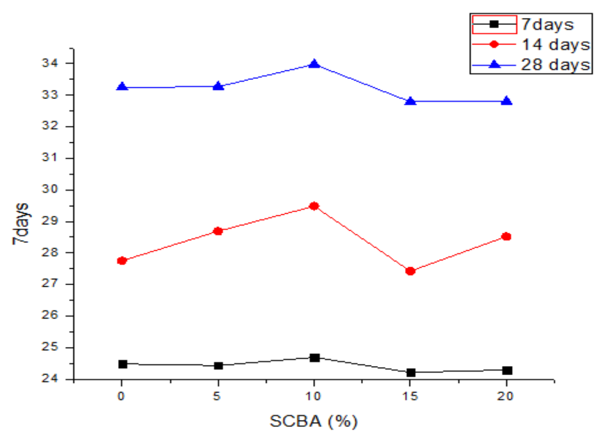
Graph:4.4 Compressive strength of concrete with different replacement levels of cement with SCBA



Graph 4.5: Compressive strength of concrete with different replacement levels of cement with CBA

Spilt tensile strength of concrete:

A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter It is an indirect method of testing tensile strength of concrete The Spilt tensile strength of all concrete mixes was measured at the age of 7, 14 and 28days. The results of average Spilt tensile strength and the percentage loss or gain in Spilt tensile strength are given in Table respectively. The Spilt tensile strength of SCBA concrete mixes as compared to control concrete mix when cement was replaced up- to 0% 5%, 10%, 15% and 20% respectively.



Graph 4.6: Spilt tensile strength of concrete with different replacement levels of cement with SCBA

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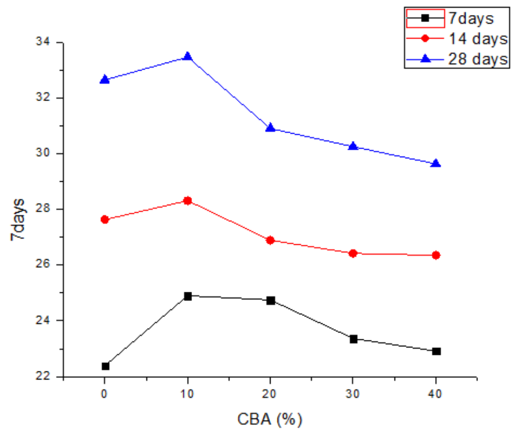

Graph 4.7: Spilt tensile strength of concrete with different replacement levels of cement with CBA

Conclusion:

In the present study, the workability characteristics, strength characteristics and thermal stability of concrete containing SCBA and CBA has been investigated. Twenty five concrete mixes were prepared each with 0.55 w/c ratio by replacing the cement with SCBA (0 to 20% increment of 10 %) and fine aggregates with coal bottom ash (0 to 40% increment of 10%).To investigate the effect of SCBA and CBA on compressive strength and split tensile strength of cubes 15 cm X 15 cm X 15 cm in size were prepared by varying percentage of SCBA and CBA The compressive strength of concrete increases as SCBA content increases for all curing ages The maximum improvement in compressive strength and split tensile strengths at 10% of SCBA but beyond 10% replacement of SCBA, strength starts reducing. There is a significant reduction in compressive strength at 20% replacement of SCBAAs combination cement can be replaced with SCBA up to 10% while fine aggregates can be replaced with CBA up to 10% without any loss in strength of concrete. The combination of 10% SCBA and 10% CBA is recommended to obtain higher strength and acceptable workability Finally the analysis of SCBA and CBA significantly affects the 7, 14 and 28 days both tests. On the basis of cost analysis, it is recommended to use these waste materials in concrete which provides potential environmental as well as economic benefits for concrete industries.

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