STRENGTH ANALYSIS OF GGBS CEMENT WITH COCONUT FIBER

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ABSTRACT

The infrastructure needs our country is increasing day by day & with Concrete is a main constituent of construction material in a significant portion of this infra-structural system, it is necessary to enhance its characteristics by means of strength & durability. When the cement is replaced with the GGBS, this GGBS provides the features like low heat of hydration, resistance to chemical attack, high compressive strength, better durability, and good workability and is also cost effective. This study shows the behaviour of GGBS based Concrete at the different molarity of NaOH like 4, 8, 10, 12, 14 etc and at different ratio of $Na_2SiO_3/NaOH$ 0.5, 1, 1.5, and 2 respectively. This project work mainly focuses on advantages of GGBS as compared to the usage of cement and justification of certain properties like sustainability and durability. Study shows the hardened and gaining strength in Concrete in ambient temperature. To bring into focus the use construction industry produces greenhouse gases directly or indirectly which contributes6-8% of the total emission of carbon dioxide. of coconut fibers in Concrete and experimental program me was planned to study the material characteristics. The primary objective of this investigation is to study experimentally the properties of fibers. The properties of Concrete namely, compressive strength, were studied

INTRODUCTION

1.1 Impact of Cement Industry on Environment

In construction industry, consumption of cement in order to make concrete is increasing day by day. Production of cement requires huge amount of raw material, energy and high temperatures for combustion of raw materials. As per World Business for Sustainable Development production of cement emits huge amount of carbon dioxide out of which 50% is generated by chemical reaction and 40% by combustion of fuel. Also EIA has found that one ton of cement generates 900 kg of carbon dioxide. The

The amount of energy required for production of cement depends on the size of plant, properties of raw materials used, itsmoisture content, specific caloric value of fuel, according to Stajanca and Estokovakiln throughout, clinker type and other parameters describes the energy consumption.For producing one tonne of cement 3000 - 6500 MJ per tonne of clinker is required thermal energy demand and demand for electricity ranges from 90 to 150 kWh per tonne.

Due to anthropogenic activities, CO_2 emission has increased resulting in global warming. The dust produced while manufacturing cement from rotary kiln and CO_2 emissions causes various health issues like respiratory diseases. Although cement industry has put some efforts to stop the emission of CO_2 but it cannot be avoided to great extent as the CO_2 emission is inherent part of calcination process of limestone. Increasing awareness among people about the ill effects of CO_2 emission has lead to look for alternative materials which will be eco-friendly.

1.2 Ground Granulated Blast Furnace Slag (GGBS)

GGBS is the by-product generated by blast furnace during iron extraction. Hawileh said that it is produced by combination of iron ore, coke and lime stone by heating in blast furnace at 1500˚C, generating molten iron & molten slag. The molten slag contains silicates & alumina, which has lower density than molten iron, thus it floats on molten iron &it becomes easy to separate slag from iron. The molten slag cools down under water jet pressure by quenching to form crushed particles of slag, where size of particles is less than 5 mm. These particles are dried and grinded in a ball mill in order to produce very fine powder of GGBS. CONCRETE gained popularity because of its rapid strength gaining ability upto 20 MPa after 4 hours of casting. BFS can be used in making CONCRETE. Mixtures of metal oxides and 7 silicon dioxide are basic elements of BFS. The cement and Concrete industry also make use of this slag. The improved workability of fresh Concrete, smooth finishability, high compressive and flexural strength and also enhanced resistance to chemical attack has been observed for CONCRETE. Various minerals are assorted to form a suitable GGBS for construction industries thus providing the components with different chemical composition like silica, alumina, calcium, magnesium etc. Generally GGBS has typical chemical composition which is shown in the table 1.2 below.

Table 1.1: Chemical Properties of GGBS

S No.	Chemical Name	Composition
1	Calcium Oxide (CaO)	40%-52%
2	Silicon Dioxide (SiO_2)	10%-19%
3	Iron. Oxide (FeO)	10%-40%.(70%-80% Fe2O220%-30% Fe2O3)
4	Manganese Oxide (MnO)	5%- 8%.

5	Aluminium Oxide (Al_2O_3)	1%-3%.
6	Phosphorous Pentoxide (P_2O_5)	0.5%-1%.
7	Magnesium. Oxide (MgO)	0.5%-10%.
8	Sulphur (S)	<0.1%
9	Metallic. Fe	0.5%-10%.

By increasing the Calcium Oxide content of slag the basicity inlifted and as result compressive strength increase.The Magnesium Oxide and Aluminium Oxide content show the same tendency up to 10-12% and 14% respectively, after such limit

here are many general advantages of coconut fibers e.g. they are moth-proof, resistant to fungi and rot, provide excellent insulation against temperature and sound, not easily combustible, flame-retardant, unaffected by moisture and dampness, tough and durable, resilient, springs back to shape even after constant use, totally static free and easy to clean.

2. METHODOLOGY AND EXPERIMENTAL PROGRAM

2.1 Proposed methodology

Various tests have been performed on GGBS like consistency, initial setting time and final setting time in order to check the feasibility of using GGBS for making coconut fiber GPC. To determine the consistency of GGBS instead of water alkali activator has been used, prepared by compounds of hydroxide and silicate. There is a specific ratio in which hydroxide and silicate compounds are mixed while preparing alkali activator solution. From the above literature review it was found that most optimum concentration of sodium hydroxide solution is found to be 12 M. Trails have been taken keeping the varying from 0.5, 1, 1.5 and 2 as observed from literature review.

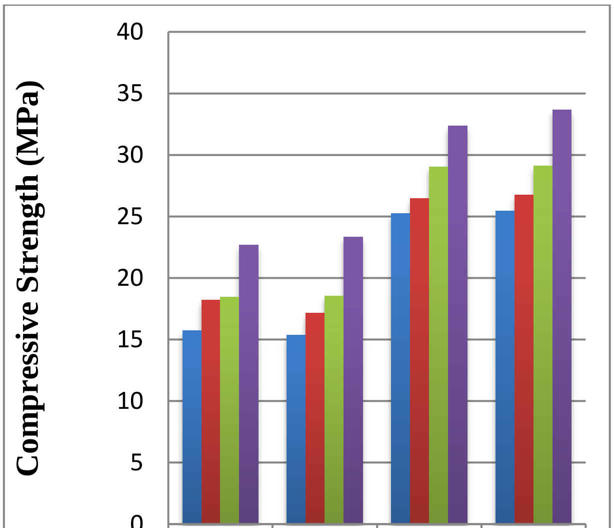
Table 2.1: Physical Properties of GGBSObtained from Jindal Steel and Power Limited, Raigarh, C.G.

S No.	Physical Parameters	Values
1	Shape	Rounded/sub rounded
2	Colour	Off grey
3	Coarse sand (%)	0
4	Medium sand (%)	0
5	Fine sand (%)	7
6	Silt and Clay (%)	93
7	Uniformity coefficient, Cu	5.89
8	Coefficient of curvature Cc	1.34
9	Specific Gravity, G	2.73

10	Plasticity Index	Low-plastic
11	Bulk density (Kg/m^3)	1200
12	Fineness (m^2/kg)	369.22

3. RESULTS AND DISCUSSION

The results and discussion of various tests which have been performed on GGBS and GGBS based coconut fiber GPC. For GGBS consistency, initial and final setting test; and for GGBS based coconut fiber GPC slump cone test to check its workability and compressive strength test are described below:



	7 days accelerated curing	7 days ambient curing	28 days accelerated curing	28 days ambient curing
0.5 Ratio	15.74	15.35	25.23	25.45
1.0 Ratio	18.19	17.16	26.47	26.73
1.5 Ratio	18.44	18.55	29.04	29.1
2.0 Ratio	22.69	23.33	32.36	33.66

Figure 3.1: Compressive strength of GPC subjected to accelerated and ambient curing

From figure 4.7 it is observed that for 12M NaOH solution as the ratio of Na_2SiO_3/NaOH increases from 0.5to 2, the compressive strength of GGBS based coconut fiber Concrete increases gradually for both seven and twenty eight days curing. But after Na_2SiO_3/NaOH ratio 2, the compressive strength is decreased for ratio 2.Thus it can be concluded that Na_2SiO_3/NaOH ratio 1 is the best ratio from compressive strength point of view. Also, this ratio has achieved the target compressive strength of 33.66 MPa for both accelerated curing and ambient curing. Thus it can be concluded that GGBS based coconut fiber Concrete can be prepared without accelerated curing as the difference in the strength of concrete cubes subjected to accelerated and ambient curing is negligible for all the cases in which the ratio varies from 0.5 to 2.

Thus from this study it is observed that there is no need of accelerated curing in GGBS based coconut fiber Concrete for achieving desired compressive strength. Seven and twenty eight days compressive strength of ambient cured samples at varying ratios of Na_2SiO_3/NaOH 0.5, 1, 1.5 and 2 are shown in the figure 4.8.

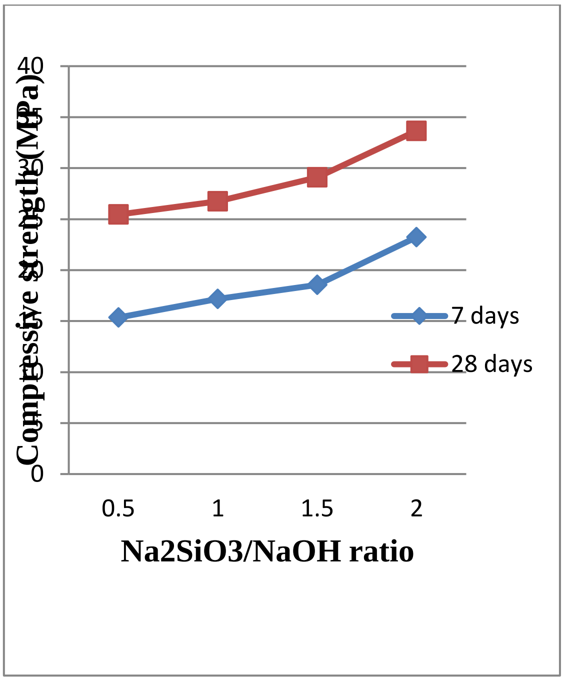


Figure 3.2: Compressive Strength Variation of Different Samples at ambient curing

Hence, by practicing this approach of making concrete, the energy consumption required for making GPC, incurred in accelerated curing is eliminated. This has lead to a mix design in which no cement in required for making GPC.

4 CONCLUSION

The study has resulted in generating a mix proportion for GGBS based coconut fiber Concrete of M25 grade of concrete. This shows that GGBS is a competent material in making GPC and helps is disposing of BFS sustainably. The study has following conclusions:

1. There is change in compressive strength by varying the ratio of Na_2SiO_3 to NaOH. Maximum compressive strength is achieved when12M NaOH solution is used with Na_2Sio_3/NaOH ratio as Also it is observed that workability increases by reducing the Na_2Sio_3 to NaOH ratio.
2. It is observed that slump of GGBS based coconut fiber GPC Concrete is always zero and the mix can be made workable by adding extra water.
3. The GPC so produced has the limitation of poor workability, which can be rectified by making use of super plasticizers or retarders like Borex.
4. The proposed mix design has eliminated curing of concrete in water or accelerated curing at elevated temperatures. The desired compressive strength is obtained at ambient temperature.
5. The study resulted in successful replacement of cement (OPC/PPC) by GGBS completely without compromising required compressive strength of concrete for making coconut fiber GPC.
6. The maximum 28 day cube compressive strength obtained was accelerated curing and ambient curing as 32.66 and 33.66 MPa for a mix with fiber length of 40mm and fiber content of 0.25% by weight and increase in strength.
7. The 7 day compressive strength of GGBS based coconut fiber GPC Concrete was found

to be accelerated curing and ambient curing as 22.69 and 23.33 MPa.

5 Future Scope of study

The study can be further extended by:

1. Durability testing of the GGBS based coconut fiber GPC produced in this study needs to be worked out.
2. Further study can be extended by changing the Molarity of NaOH solution to study their variation in compressive strength.
3. Impact on properties of geopolymer made with different pozzolanic material.
4. Workability of GGBS based coconut fiber GPC can be improved by using various superplasticizers.
5. By preparing Na_2SiO_3 free GPC as it has improved workability.
6. In this investigation the work can be carried out by using higher grades of Concrete.

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