A STUDY ON GEO POLYMER CONCRETE USING SUGARCANE BAGASSE ASH: A BRIEF REVIEW

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Abstract: **The basic objectives of the sustainable development are the preservation of natural resources, reduction of environmental pollution and appropriate utilization of waste materials. In case of concrete construction, these objectives can be fulfilled by partial replacement of cement and aggregates with agro waste like sugarcane bagasse ash, rice husk ash etc. and industrial waste like copper slag, steel slag, fly ash, coal bottom ash etc. This paper introduces the concept on high performance of concrete of cement using sugarcane bagasse ash (SCBA) in replace of cement with different percentage value. Sugarcane bagasse ash, fly ash, glass used as mineral intermixtures in Portland cement to improve the tensile strength, compressive strength, flexural strength of concrete by replacing of cement. As we noticed, use of Portland cement is very common in all type of construction, if construction increases the availability of Portland cement also increases, so we are consuming the natural materials to replace it by cement. It can also cause environmental advantages like minimizing in energy consumption or in greenhouse gas emissions and decrease of waste emissions. We also reduce carbon dioxide (CO_2) emissions with these admixtures. Consequently, sugarcane bagasse powder (SCBA) can be utilized as mineral admixture because of high silica (SiO_2) content. In this experimental study, we reduced cement ratio and used sugarcane bagasse ash (SCBA) with 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%. The indicates that the SCBA had highly flexural strength, compressive strength and split tensile strength as compare to normal concrete. The outcomes demonstrate that Sugarcane Bagasse gives increment in the workability of concrete when contrasted with conventional cement. The outcomes show that SBA can be utilized 15% substitution as compared to normal concrete.**

Keywords: **Sugarcane bagasse ash (SCBA), Fly ash, Portland Pozzolana Cement [PPC], Concrete**

INTRODUCTION

Concrete is the world's most consumed construction material because of its excellent mechanical and durability properties. Worldwide, the concrete industry produces over 10 billion tons of concrete annually [Meyer 2006]. At present, concrete industry is cursed with the scarcity of the aggregate sand environment pollution from cement production. The cement industry has a significant contribution in global warming because combustion of fuel in the cement kiln and the electricity used for grinding the clinker, emit large amount of CO_2. Cement industry is responsible for about of 5% of global CO_2 emissions [Worrelletal 2001]. Furthermore, the natural resources of aggregates are depleting gradually due to development in infrastructure all around the world. The ban on mining in some areas is further increasing the problem of availability of natural aggregates. Therefore, it becomes very essential and more significant to find out the substitutes for both cement as well natural aggregates. Apart from it, the continuous growth of agro and industrial waste is the principle cause of many environmental concerns and burdens which can be reduced by using these wastes in concrete construction. It is well known that mineral intermixtures are very effectively implement as harmonious materials in Portland cement. Rise husk ash, sugarcane bagasse used as mineral intermixtures in Portland cement to improve the, tensile strength, compressive strength, flexural strength of concrete by replacing of cement or sand. Portland cement is being used extensively for almost every construction. Each structure has its particular needs, so Portland cement requires some change in the properties to meet these needs. The broad research on concrete demonstrates that mineral admixture to be utilized as concrete substitution to expand workability. As we noticed, use of Portland cement is very common in all type of construction, If construction increases the availability of Portland cement also increases, so we are consuming the natural materials to replace it by cement. Sugarcane bagasse ash [SCBA] is the most extensively material used in place of cement. Brazil is the no.1 country in the world to be known for producing sugarcane at large number of scale, which at 720 million tons grows over 40% of world crop. After Brazil, India is the second largest production of sugarcane in the world. Uttar Pradesh, Maharashtra and Karnataka are three largest states in India. India's 2017-2018 sugar production likely to touch 30 million tons. One ton of burned bagasse ash produce 25 kg of ash. Fineness modulus of bagasse ash is 0.6 to 1.2mm.

With expanding interest and usage of concrete, analysts and researcher are looking for eco-friendly and make contributions closer to for higher use. In this subject matter SCBA has been artificially and physically defined and efficiently update with the share of 0% to 35% by using weight of cement in concrete. The prevailing examination turned into finished on SCBA in update of Portland cement. On this experiment we lower the burden of cement by zero to 35% and replace it with the aid of sugarcane bagasse ash respectively. It shows that up to 20% of conventional Portland cement can be replaced with well-consumed bagasse ash remains with eco-friendly impact on the alluring properties of concrete, for example, the improvement of split tensile strength, high early strength and decreased water penetrability, decreased chloride infiltration, all of which have a direct bearing on the solid structures. For example, high temperature fragmented burning that occur in the mills, and its impact on the reactivity of SCBA. These components influence the level of crystallinity of the silica in the bagasse ash, and the nearness of contaminations, for example, carbon and its emissions. Such properties could restrain the contact between Calcium Hydroxide [CH] and receptive silica and keep them from framing stable mixes.

Keeping in mind the end goal is to deliver SCBA with pozzolanic content, which will give undefined silica, low carbon substance and controlling the temperature.

Decrease of molecule size of SCBA by granulating likewise has a critical impact on the pozzolanic action. The substitution of cement with a ultrafine, ground SCBA, delivered by vibrating granulating, takes into consideration the generation of superior cement with the same mechanical reaction as the solid arranged exclusively utilizing Portland bond. In rundown, SCBA is a pozzolanic that can mostly replace clinker in concrete and thusly, its utilization have a tendency to lessen emanations of CO2 into the air. SCBA is an agro-modern build-up accessible in a few nations.

The mix of lime in addition to sieved SCBA, lime and cement were utilized as a part of the adjustment of compacted cubes. The tests were tried for flexural, compressive strength and split tensile strength. At long last, vitality utilization, CO2 emanations further more, vitality in transportation of the materials were assessed.

It ought to be noticed that the molecule state of bagasse slag is totally not the same as that of fly ash. It has been accounted for that supple particles are related with incompletely consumed pieces of coal [carbon] coming about because of fragmented ignition.

OBJECTIVE

1. To accomplish that the SCBA had highly strength for flexural, compressive and split tensile as compare to normal concrete.
2. To accomplish that the Sugarcane Bagasse gives increment in the workability of concrete when contrasted with conventional cement.
3. Reduce the cost of concrete.

MATERIALS AND METHODS

This chapter briefly explains the materials used and methods adopted to conduct the study of workability and compressive strength of concrete containing SCBA

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 within the presence of water. Hydraulic cements which include OPC set and end up adhesive due to a chemical response between the dry components and water. The chemical response results in mineral hydrates that aren't very water-soluble and so are pretty long lasting in water and safe from chemical assault. The special varieties of cement as classified by using BIS are OPC, Portland Pozzolana Cement [PPC], rapid hardening Portland cement, portland slag cement, hydrophobic portland cement, low heat portland cement and sulphate resisting portland cement. The OPC is the commonly used in concrete construction. It is more suitable than other cements, for use in general concrete construction where there is no exposure to sulphates in the soil or in ground water. It is classified into three grades namely 33 grades, 43 grades and 53 grades. This classification depends upon the compressive strength of cement at 28 days. Cementations material used was Portland cement. This is the main ingredient used in for bonding of concrete. The usage of other cement is possible but depends on local availability. Supplementary cementations material is replaced with bagasse ash at about 5%, 10%, 15%, 20%, 30% and 35% with cement.

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. Almost all natural aggregates materials originate from bed rocks which are classified into three categories namely igneous rocks, sedimentary rocks and metamorphic rocks. Aggregates can be classified on the basis of their size and weight. On the basis of their weight, aggregates are classified as normal weight, light weight and heavy weight aggregates. But, to know more about concrete it Could be very important that one ought to realize more approximately the class based on their sizes. Consequently, on the premise in their size, aggregates also can be classified on the idea of the dimensions of the aggregates as coarse aggregates and best aggregates.

Coarse Aggregates

Aggregates most of which is retained on 4.75-mm BIS Sieve are known as coarse aggregates. The various types of coarse aggregates described as:

i) Uncrushed gravel or stone which results from natural disintegration of rock.

ii) Crushed gravel or stone when it results from crushing of gravel or hard stone.

iii) Partially crushed gravel or stone when it is a product of the blending of above two.

The form of coarse aggregates is an critical feature because it impacts the workability and strength houses of concrete. The form of aggregates is very tons influenced by means of the kind of crusher and the discount ratio i.E. The ratio of size of material into crusher and the size of finished product. The coarse aggregates can be classified on the basis of their shape as rounded, irregular or partly rounded, angular and flaky.

Fine Aggregates

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

i) Natural sand - Fine aggregates resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies.

ii) Crushed stone sand - Fine aggregates produced by crushing hard stone.

iii) Crushed gravel sand - First-rate aggregates produced by crushing natural gravel. Consistent with size, the fine aggregates can be defined as coarse, medium or best aggregates. Depending upon the particle length distribution, the first-rate aggregates are divided into 4 grading zones as consistent with BIS: 383-1970. The grading zones come to be finer from grading zone It grading sector IV. The sand conforming to area i used to be used on this observe. The houses of first-rate aggregates inclusive of unique gravity, fineness modulus and water absorption had been decided. 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 in to ash. The ash obtained from the boiler of a sugar mill was used in this study. Shown in Figure 3.1.Thesugar mill is situated at Kawardha area which falls at a distance of about 100 kms from Raipur [Capital of Chhattisgarh]. The collection of the ash was carried out during the boiler cleaning operation.

Effect of Mineral Admixtures on Properties of Concrete

Incorporation of mineral admixtures, particularly industrial waste products. Because of the spherical shape and small size of the glassy particles, the industrial by product admixtures tend to fill the void space between relatively large cement grains which is otherwise occupied by water. In the water filled capillaries, the admixtures undergo pozzolanic reaction with Ca[OH], released during cement hydration. As a result, pore refinement occurs as larger size pores are transformed into smaller size pores. There is also a marked decrease in the volume of pores and as a consequence of both the physical and pozzolanic effects of these add mixtures, properties of concrete in both fresh and hardened state are affected. The extent of influence on concrete properties, however, depends on the type and amount of add mixture used, concrete mix proportions, addition of chemical add mixtures such as super plasticizer and air entraining agents, combined use of mineral admixtures, and many other factors.

Hydration of Sugarcane Bagasse Ash Cement

While a few percentage of cement is changed with Sugarcane bagasse ash, the formation of C-S-H gell will increase, that formed throughout hydration in traditional concrete. The primary content material of Sugarcane bagasse ash is Silica and with a percent of 63, and alumina with a percent. As we're replacing some percent of cement with Sugarcane bagasse ash, and conventional concrete is ready by means of O.P.C, the primary chemical response that happens in hydration, chemicals which lead for energy gaining are C3S [Tri calicium Silicate] – Hydrates and hardens swiftly, chargeable for initial set and early energy. C2S [Di calcium Silicate] - Hydrates & hardens slowly Contributes to later age.

Setting Time

Addition of mineral admixtures to Portland cement typically outcomes in set retardation. This is specifically real for low calcium fly ashes with excessive carbon content. The high calcium fly ashes, which are normally low in carbon and excessive in reactive components, sometimes showcase contrary behaviour. Not all high calcium fly ashes cause short putting. The addition of SF to concrete inside the absence of a water reducer or splendid plasticizer is pronounced to cause delay in placing time, compared to non SF concrete of same power, specifically while the SF content material become excessive. From the previous research addition of 5% to ten% SF to either extremely good plasticized or non super plasticized concrete with W/[C + SF] ratio of 0.4 did now not show off any substantial growth in placing time. But, when 15% SF changed into introduced with a excessive dose of brilliant plasticizer, both the initial and very last placing instances were not on time by approximately 1 and 2 hours, respectively. The discovered delay was mainly attributed to the fairly excessive dose of fantastic plasticizer wished for the excessive amount of SF introduced to the concrete.

Methods of Concrete Mix Design

The technique of choosing suitable substances of concrete and determining their relative amounts with the goal of producing a concrete of the required power, durability and workability as low-priced as possible, is termed the concrete mix layout. In present study mix design was done by BIS mix design method which is based on BIS: 10262- 2009.In this experiment, we used standard size of cubes with dimension of 150mm×150mm×150mm. From 10262-2009 code, we designed a mix proportion of concrete. We used M40 grade of concrete. Ratio of cement, sand and aggregate is 1:1.56:2.42 with water cement ratio of 0.464. SBA replaces cement with ratio of 0% to 35%. The elements of concrete were completely blended in blender machine till we get uniform consistency of concrete. Machine oil was spread on the inward surfaces of cubes before casting. Concrete was filled with the cube and compacted altogether utilizing table vibrator. The surface was finalized by method of trowel. The cubes were separated after 24 hours and cured submerged for 7 and 28 days. The samples were taken out from the curing tank only before the test.

DISCUSSION

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. It indicates that SCBA provided highly flexural strength, compressive strength and split tensile strength as compare to normal concrete. The outcomes demonstrate that Sugarcane Bagasse gives increment in the workability of concrete when contrasted with conventional cement. The outcomes show that SBA can be utilized 15% substitution as compared to normal concrete.

CONCLUSION

As geo-polymer concrete technology is a new one, there is lot of scope to work in this topic. In the present study we used sugarcane baggase ash as a binder. We recommended extending this topic by using by products like rice husk ash, GGBS, pulverized fuel ash etc .And also**, i**nvestigation of Long term properties like durability, creep, drying shrinkage may also gives the suitability of geo-polymer concrete in the field. To implementing such a method the durability can be increased and strength of the material can also be increased. The most important thing is that cement can be made to increase the sticking property of the materials can be increased in proper quantity.

1. Reduce the cost of concrete.
2. SBA reduces the CO_2 emissions from the environment.
3. SBA used as a admixture in different countries to reduce cement production and its usage in concrete.
4. The outcomes demonstrate that Sugarcane Bagasse gives increment in the workability of concrete when contrasted with conventional cement.
5. The outcomes show that SBA can be utilized 15% substitution as compared to normal concrete.

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