CHARACTERISTICS OF CONCRETE WITH GROUNDNUT SHELL ASH AS A PARTIAL REPLACEMENT OF CEMENT WITH SISAL FIBERS

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ABSTRACT

Sisal fibres are the natural fibres which are used as the reinforcement in concrete. SisalFiber reinforced concrete is a concrete containing fibrous material which increases its structural integrity. The addition of sisal fibers to concrete considerably improves its structural characteristics such as compressive strength, tensile strength and bending strength. The sisal fibres added in various percentages such as 1%, 2% and 3%. This paper highlights about the behavior of concrete when Groundnut Shell Ash and sisal fiber are added in concrete. Groundnut Shell Ash has been used by replacing cement in percentages, and sisal fibers are added by volume of cement in different percentages. Based on a general analysis of the results as well as the logical comparison to the acceptable standard, a percentage replacement of 5% GSA and addition of 2% sisal fibers are suggested for sustainable construction. Then flexural strength of concrete beam was calculated with these percentages.

I.INTRODUCTION

Cement is not an environment friendly material from the standpoint of energy consumption and release of green-house gases leading to global warming. Furthermore, the resource productivity of Portland-cement concrete products is much lower than expected because they crack readily and deteriorate fast. Since global warming has emerged as the most serious environmental issue of our time and since sustainability is becoming an important issue of economic and political debates, the next developments to watch in the concrete industry will not be the new types of concrete, manufactured with expensive materials and special methods, but low cost and highly durable concrete mixtures containing largest possible amounts of industrial and urban by products that are suitable for partial replacement of Portland cement.

It is difficult to point out another material of construction which is as versatile as concrete. Cement replacement materials are special types of naturally occurring materials or industrial waste products that can be used in concrete mixes to partially replace some of the Portland cement. Cement replacement materials are frequently called fine minerals or pozzolans. Surprisingly, concrete with cement replacement materials can actually be stronger and more durable than concrete with Ordinary Portland Cement (OPC). This could be done by mixing other suitable material that are of near similar properties but cheaper than cement to cement to achieve economic housing for the masses. Some of these materials have been seen in some waste materials like agricultural waste, industrial wastes and other environmental wastes. In recent times, many waste materials like fly ash periwinkle shell ash, and ashes produced from various agricultural wastes such as palm oil waste, rice husk ash, corncob ash, millet husk ash, groundnut husk ash have been tried as pozzolanas or secondary cementitious materials. These supplementary cementing materials play an important role when added to Portland cement because they usually alter the pore structure of concrete to reduce its permeability, thus increasing its resistance to water penetration and water related deterioration such as reinforcement corrosion, sulphate and acid attack. The partial replacement of OPC with GSA in concrete production is a welcome development. The cost of GSA when compared with OPC is very low due to the availability of Groundnut shell in large quantities as agricultural farm wastes. The utilization of Groundnut shell will promote waste management at little cost, reduce pollution by these waste and increase the economic base of the farmer when such waste are sold thereby encourages more production. Also, GSA production required less energy demand compared with cement production and safe the needed foreign exchange spent on importation of cement or its constituents. Therefore the utilization of groundnut shell ash reduces the environmental problem resulting from the accumulation of the shells in a large quantity in a particular area.

The use of fibers as reinforcement is as old as human civilization. Traces of natural fibers such as flax, cotton, silk, wool and plant fibers have been located in ancient civilizations all over the globe. More recently, the use of natural fibers in construction has been limited to thin elements for roofing, cladding, and internal and external partitioning walls; these have been produced in an effort to develop low cost materials and as a substitute for asbestos. Regular concrete is a brittle material which possesses a high compressive strength but on the other side has a low tensile strength. The combined use of regular concrete and steel reinforcing bars was able to overcome that disadvantage leading to a material with good compressive and tensile strengths but also with a long post-crack deformation (strain softening). Unfortunately reinforced concrete has a high permeability that allows water and other aggressive elements to enter, leading to carbonation and chloride ion attack resulting in corrosion problems. Steel rebar corrosion is in fact the main reason for infrastructure deterioration. On the other hand, reinforced steel is a high cost material, has high energy consumption and comes from non renewable resource. Natural fibres are a renewable resource and are available almost all over the world.

Natural fibres are now considered as a suitable reinforcing material in concrete, due to their greater advantages, which include low cost, high strength-toweight ratio, and recyclability. The benefit of composite materials over conventional materials seams largely from their higher specific strength, stiffness and fatigue characteristics, which enable structural design to be more versatile. Natural fibres are expected to be the reinforcing materials and their use until now has been more traditional than technical. They have long served many functional purposes but the application of materials technology for the consumption of natural fibres as the reinforcement in concrete has only taken place in comparatively current years. Sisal fibre is obtained from the leaves of the plant ***Agave sisalana,*** which was originated from Mexico and is now mainly cultivated in East Africa, Brazil, Haiti, India and Indonesia. It is grouped under the broad heading of the “hard fibres” among which sisal is placed second to manila in durability and strength

OBJECTIVE

- To find out the potential use of GSA in concrete.
- To investigate the chemical and physical properties of Groundnut Shell Ash.
- To comparing the results of conventional concrete and sisal fibre reinforced GSA concrete in strength aspect an element is casted and tested.
- To reduce the density of concrete.
- To reduce the cost.
- To find the flexural strength of beam element and the result has to be discussed.

II. PROPOSED METHOD

In the first phase, the physical properties of ingredients of concrete and compressive strength of concrete cubes have been found and also a mix design for M_{25} gradeconcrete was calculated. In second phase, the flexural strength of concrete beam has been found.

Table 1 Sieve analysis on GSA

Sieve size in Microns	Retained		Cumulative retained	% passing
	Weight (g)	Percentage (%)		
1180	0.11	0.055	0.055	99.945
600	0.26	0.13	0.185	99.815
425	5.37	2.685	2.87	97.13
300	3.59	1.795	4.665	95.335
150	49.46	24.73	29.395	70.605
90	77.69	38.845	68.24	31.76
75	47.15	23.575	91.815	8.185
Pan	16.37	8.185	100	0.00
Total	200	100	-	-

Fineness modulus = 2.97

GSA is a good Pozzolanicmaterial which reacts with calcium hydroxide forming calcium silicate hydrate. The Pozzolanic activity of GSA increases with increase of time. The specific gravity of the GSA gotten was less than that of the OPC it replaced, this means that a considerable greater volume of cementitious materials will result from mass replacement. The compressive strength value of the GSA/OPC blended concrete at 10% replacement level performed better and would be acceptable and considered as a good development for construction of masonry walls and mass foundations in low-cost housing.

SISAL FIBRES Sisal fibres botanical name *Agavasisalana*is used as natural fibres in reinforcing concrete. It is traditionally used for rope, twine and has many other uses. Sisal fibres are derived from the leaves of the plant. It is usually obtained by machine decortications in which the leaf is crushed between rollers and then mechanically scraped. The fibres is then washed and dried by mechanical or natural means. The dried fibre represents only 4% of the total weight of the leaf. Once it is dried the fibres is mechanically double brushed. The lustrous strands, usually creamy white, average from 80 to 120 cm in length and 0.2 to 0.4 mm in diameter.

Sisal fiber is exceptionally durable and a low maintenance with minimal wear and tear. Its fibre is too tough for textiles and fabrics. It is not suitable for a smooth wall finish and also not recommended for wet areas. The fine texture of Sisal takes dyes easily and offers the largest range of dyed colours of all nature fibers. Zero pesticides or chemical fertilizers used in sisal agriculture. It is a stiff fiber traditionally used in making twine, rope and also dartboards sisal fiber is manufactured from the vascular tissue from the sisal plant (Agavasisalana). It is used in automotive friction parts (brakes, clutches), where it imparts green strength to performs, and for enhancing texture in coatings application.

PROPERTIES OF SISAL FIBRES

- Sisal Fiber is exceptionally durable with a low maintenance with minimal wear and tear.
- It is Recyclable.
- Sisal fibers are obtained from the outer leaf skin, removing the inner pulp.
- It is available as plaid, herringbone and twill.
- A sisal fiber is Anti static, does not attract or trap dust particles and does not absorb moisture or water easily.
- The fine texture takes dyes easily and offers the largest range of dyed colours of all natural fibers.
- It exhibits good sound and impact absorbing properties.
- Its leaves can be treated with natural borax for fire resistance properties.

III. EXTRACTION OF SISAL FIBRE : Fibre is extract by a process known as decortications, where leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibers remain. In East Africa,where production is typically on large estates, the leaves are transported to a central decortications plant, where water is used to wash away the waste parts of the leaf. The fiber is then dried, brushed and baled for export. Proper drying is important as fiber quality depends largely on moisture content. Artificial drying has been found to result in generally better grades of fiber than sun drying, but is not feasible in the developing countries where sisal is produced. In the drier climate of north-east Brazil, sisal is mainly grown by smallholders and the fiber is extracted by teams using portable raspadors which do not use water. Fiber is subsequently cleaned by brushing. Dry fibers are machine combed and sorted into various grades, largely on the basis of the previous in-field separation of leaves into size groups is fully biodegradable, green composites were fabricated with soy protein resin modified with gelatin. Sisal fiber, modified soy protein resin, and composites were characterized for their mechanical and thermal properties. It is highly renewable resources of energy.

COMPRESSIVE STRENGTH TEST : Compressive strength is often measured on a universal testing machine. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive strengths are usually reported in relationship to a specific technical standard. The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some material fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load.

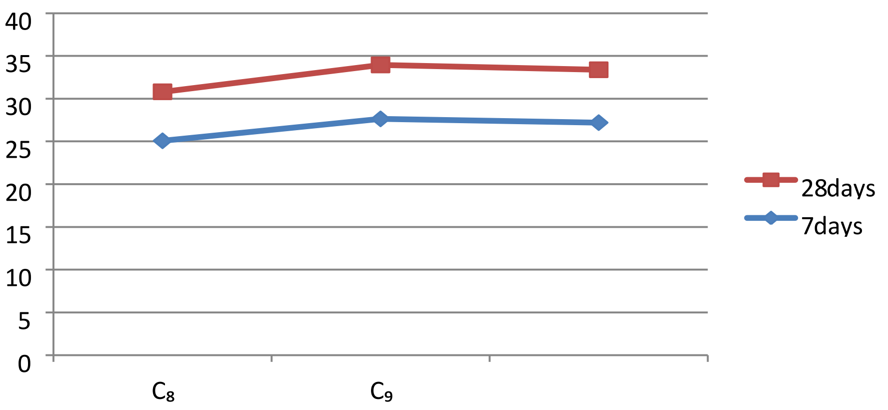

Fig. 1 Compressive strength of concrete cubes with Sisal fibres and 5% of GSA

DESIGN OF BEAM

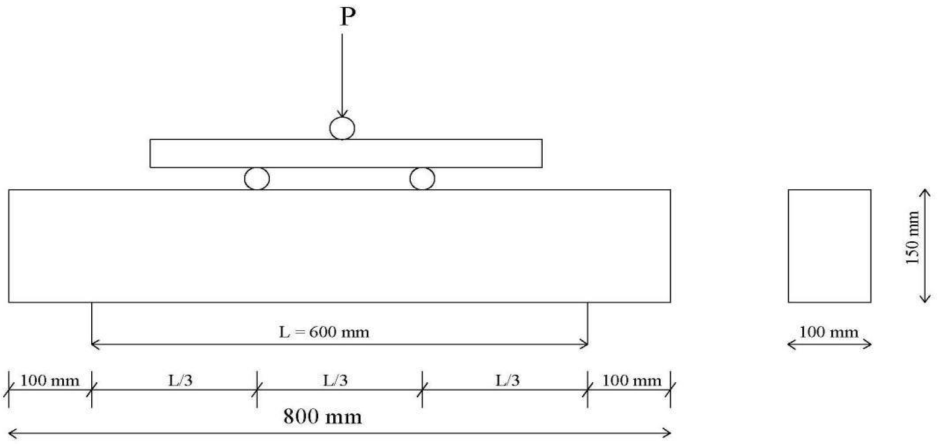

Fig. 2. Beam with two point loading at one-third of its span

Table2 Experimental Results for Conventional Concrete Beam

Sl. no.	Load (KN)	L/2 Deflection (mm)	Remarks
1	5	0.17	-
2	10	0.33	-
3	11.7	0.51	Initial crack
4	15	0.65	-
5	20	0.9	-
6	25	1.37	-
7	30	1.75	-
8	35	2.38	-
9	40	2.86	-
10	44.2	3.18	Ultimate load

IV. CONCLUSION

- Based on this experimental investigation, it is found that Groundnut Shell Ash can be used as alternative material to the Ordinary Portland Cement.
- The physical and chemical properties of Groundnut Shell Ash satisfy the requirements of Ordinary Portland Cement.
- Using of Groundnut Shell Ash in concrete reduces the cost.
- Sisal fibers are economical and it is easily available, it can be easily mixed with concrete.
- Normal concrete is liable to internal cracking due to certain reaction. But this is eliminated as in the case of sisal fibres.
- The results show that the composites with sisal fibres are reliable materials to be used in practice for the production of structural elements to be used in civil construction.
- The compressive strength of concrete reaches the satisfactory value at a replacement level of 5 % of Groundnut Shell Ash and 2 % of sisal fibres.
- From all the optimum results achieved from compressive strength test, the flexural members were casted and their behaviours were studied.

V. REFERENCES

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