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A Study on Strength and Durability of Concrete Using Groundnut Shell Ash and Sisal Fiber

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Abstract— **Concrete is the foremost vital requirement of any development, without concrete no development industry may ever exist. Concrete comprises of Cement, Sand (Fine Total), Rock (Coarse Total), Water, Admixtures, Added substances. In this study partial replacement of cement is done by Ground Shell Ash in certain percentage (15%) replacement and with addition of various percentages of Sisal fiber (0%, 1%, 3%, 5% & 7%) in concrete.**

This research deals with common introduction on the concept of Use of Groundnut Shell Ash as Partial substitute of Cement with the addition of Sisal fiber in Concrete. Groundnut Shell Ash is waste material produced by local markets on shops, carts etc. A little research is done in this field to find the strength properties of Ground Shell Ash utilized concrete.

Since the plain, unreinforced concrete is a brittle material, with a low tensile strength and a low strain capacity. If the fibers like Sisal fibers which perfectly bonded to the material, permits the FRC to carry noteworthy stresses over a relatively large strain capacity in post cracking state.

Index Terms— **FRC (Fiber Reinforced Concrete), GSA (Ground Shell Ash), Sisal Fiber, Durability etc.**

I. INTRODUCTION

Concrete is the composition of coarse aggregate, fine aggregate, cement, sand and water. It may also have admixtures and other additives. It is the most popular building material in the world and used from prolong time. In concrete, aggregate is the major component after cement. The yearly production of cement is nearly 3 billion tons. The construction industry relies heavily on cement for production of concrete. Nearly 7% of the global CO2 emission is contributed by cement industries. Reducing the consumption of cement in the concrete will thus reduce the emission. Its great adaptability and relative economy in filling wide range of needs has made it a competitive building material. The demand of concrete for today's infrastructural expansion is increasing gradually.

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Since the plain, unreinforced concrete is a brittle material, with a low tensile strength and possess low strain capacity. Sometimes concrete structures have to survive in adverse conditions under chemical attacks like chloride attack, sulphate attack and acid attack. These chemical attacks interferes with the durability of concrete structure. For hardened reinforced concrete chloride attack is considered as a cause for corrosion. Chemicals percolate through the cracks developed in the concrete structures and corrode the reinforcement provided in the concrete and thus the deterioration of structure starts and the durability of structure get affected.

II. LITERATURE SURVEY

[1] T.C. Nwofor and S. Sule (2012) this study investigates the use of considerable volume of groundnut shell ash as the partial replacement for cement in concrete production. A total of 100 specimens of the GSA/OPC concrete was cured in cubes of 100mm dimension for 7, 14, 21 and 28 days and the compressive strength and density determined. The percentage replacement of Ordinary Portland Cement (OPC) varies to the control (0% replacement) about 40%. The results generally show a decrease in density and compressive strength as the percentage replacement with GSA increases suggesting less hydration with cement. Based on a general analysis of the results as well as the logical comparison to the acceptable standard, a percentage replacement of 10% is suggested for sustainable construction, especially in mass concrete constructions.

[2] Nadiminti Venkata Lakshmi, Polinati Satya Sagar (2017) this experimental investigation was carried out to evaluate the strength of concrete, in which cement was replaced with ground nut shell ash for cubes, cylinders, and Prisms with different percentages which vary from 0% to 30% at an interval of 5% were performed. Concrete was batched by

weight on adopting a ratio of 1:2:4 with water–cement ratio of 0.6. Concrete cubes of 150*150*150 mm in dimensions, cylinders of 150*300 mm in dimensions and 100*150 mm prisms are used. These Cubes, cylinders, and prisms were tested for 7, 14 and 28 days for compression, flexural and split tensile strengths. It is observed that 10% replacement of ground nut shell ash shown the highest strength values when compared with other percentages and for 15% replacement of ground nut shell ash the compressive and split tensile strength obtained the highest strength rather than other flexural strength.

[3] Jamilu Usman, Nasiru Yahaya et.al (2013) this paper presents the effect of groundnut shell ash (GHA) on the properties of cement paste. Cement pastes containing GHA as cement replacement in different proportions up to 50% by weight were prepared. At fresh state, the consistency and setting times of the pastes were checked, while at hardened state, soundness and compressive strength of the pastes were determined. In addition, the microstructure of the hardened paste was investigated using the Fourier Transformed Infrared (FTIR) technique. The results show that GHA increased water demand and delayed setting times, but improved soundness of cement paste. Moreover, compressive strength enhancement of hardened cement paste due pozzolanic reaction as evidenced by the microstructure analysis (FTIR) was observed with up to 10% GHA replacing cement.

[4] Adole, M. A., Dzasu (2011) the empirical investigation reported the effects of chemicals on the properties of concrete with cement partially replaced with Groundnut Husk Ash (GHA). The principal characteristic measured was the compressive strength of Ordinary Portland Cement (OPC) concrete and OPC/GHA concrete after curing in three chemical solutions (MgSO4, NaCl and H2SO4) at 14, 21 and 28 days hydration periods. The results revealed that the OPC/GHA concrete performed best in most of the chemical solutions at 28 days hydration period with compressive strength values of 21.05N/mm2 in MgSO4 solution and 22.55Nmm2 in NaCl solution. The study concluded that OPC/GHA concrete having proven resistant to magnesium sulphate and sodium chloride media would perform better in soils containing MgSO4 and NaCl.

[5] MALUGU RAVI PRASANTH (2019) The Compressive Strength and spilt tensile of Concrete is increased when the replacement of Cement with groundnut shell ash up to 10% replaces by weight of Cement. The Flexural Strength of Concrete is increased when the replacement of Cement with groundnut shell ash up to 15% replaces by weight of Cement.

III. RESULT AND DISCUSSION

Slump Test

Table No. 1 Slump for Control mix of M30 Grade

S. No.	Control Mix	Slump (mm)
1	M30	90

Table No. 2 Slump with 15% GSA and Sisal Fibre

S. No.	Sisal Fiber %	M30
1	0.0	80
2	0.5	78
3	1.0	74
4	1.5	71
5	2.0	70

Compressive Strength of Concrete

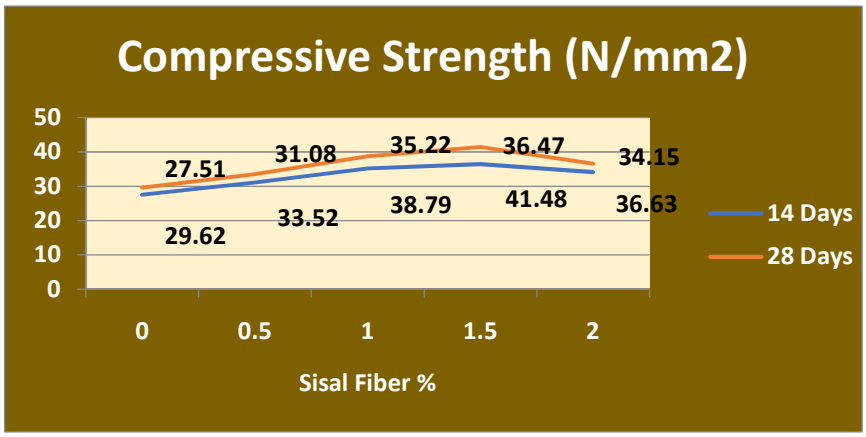

Fig 1 Comparative Compressive Strength of M30 Grade

Split Tensile Strength of Concrete

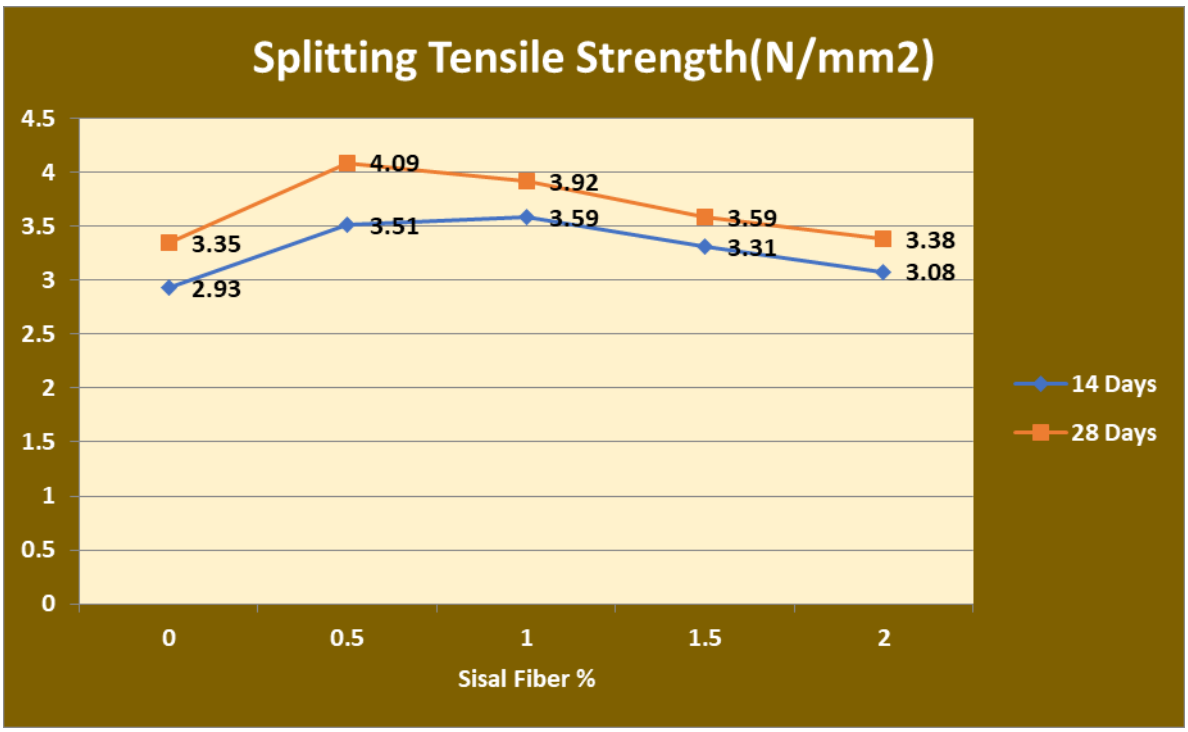

Fig 2 Comparative Splitting Tensile Strength of M30 Grade

Flexural Strength of Concrete

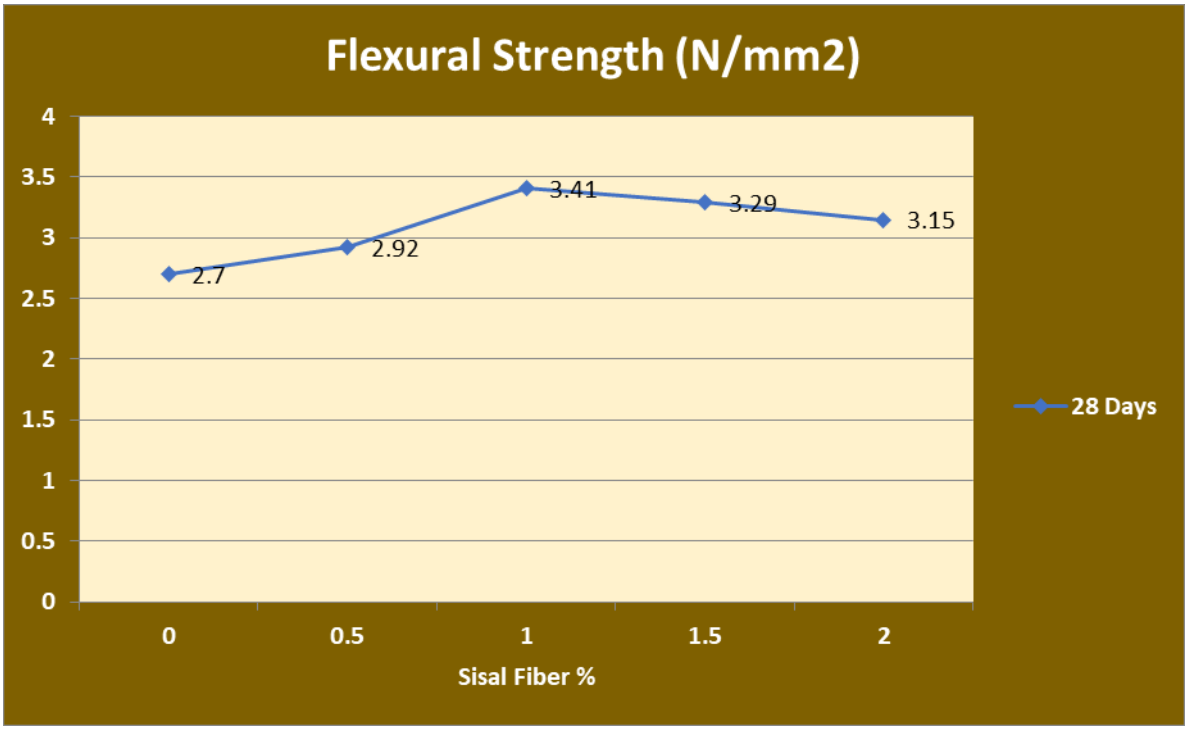

Fig 3 Comparative Flexural Strength of M30 Grade

IV. CONCLUSION

The review of research papers has been carried out in the area of strength properties based analysis of modified Sisal fiber concrete to investigate and find out current challenges and scope of work in the area. After the review, three issues were found in the literatures which were based on experimental approach. Study of literature was carried out in depth of common findings of research works, strengths and weaknesses and gaps to build problem statement and objective.

General Experimentation Result

In the project work these Experimental Scenarios were considered during experimentation.

- Accomplish Compressive strength test, split tensile test and flexural strength on concrete having different Percentage (0%, 0.5%, 1.0%, 1.5% and 2.0%) of Sisal fiber.

V. RESULTS

In this experimental work, Mix-Design of M-30 grade concrete; reference IS 10262: 2019, having water-cement ratio 0.45 is considered. Percentage of Sisal fiber (0% to 2%) is added in concrete. Total 60 specimens of Sisal Fiber Reinforced Concrete were casted with great precision and were cured for 14 days and 28 days. During concreting/casting of cubes, compaction factor test and slump test on fresh concrete were conducted for verification of workability with above percentage (%) addition of Sisal fiber i.e. (0% to 2%). After completion of maturity period of concrete Compressive strength test, split tensile test and flexural strength test were conducted on all the specimens with respective date of casting. From the study it was observed that compressive strength increased as increase the percentage (%) of Sisal fiber (0% to 1.5%) after 1.5% of SF compressive strength decreases for both 14 days & 28 days cube strength. it was also observed that optimum percentage increment in compressive strength of concrete was 32.3% for 14 days curing and 39.6% after 28 days curing (from 0% to 1.5% addition of Sisal fiber).

The optimum percentage increment in split tensile strength was 22.19% for 14 days curing at 1.0% SF and 23.69% for 28 days at 0.5% SF.

It was also noted that flexural strength of concrete increase gradually with addition of Sisal fiber and minimum flexural strength was obtained at 0% (2.7 N/mm2). 3.35 N/mm2 optimum flexural strength was obtained with addition of 1.0% Sisal fiber after 28 days of curing.

VI. Conclusion

Result revels that the Sisal fibers (SF) reduce early age shrinkage and moisture loss of the concrete mix even when low volume fractions of SF are used. From the result of this research, it was found that the use of fiber in the concrete decreases the workability of the fresh concrete. It was concluded that the increasing percentage volume of fiber added into the concrete would lead the workability decreased. High volume dosage rate above 1.5% showed that the concrete was significantly stiff and difficult to compact and strength also decreases. However, it also reduced the bleeding and segregation in the concrete mixture. Compressive strength of concrete increases with increase in fiber dosage up to 1.5%, then it starts decreasing. The addition of Sisal fibers at low values actually increases the 28 days compressive strength but when the volumes get higher than the 1.5 % SF decreases from original. The tensile strength increases about 23.73 % up to 1.0% after which it decreases. There is about 25.28% increase in flexure strength by adding 1.0% fibers in concrete after which strength starts reducing with further increment in fiber ratios. There is a remarkable increase in load carrying capacity up to first crack appears.

The concrete mix became economical by using Ground Shell Ash in replacement of cement at 10% by weight of cement. It has been seen that the concrete mix having Ground Shell Ash became economical (approximate ₹150/m^3) than plain concrete mix.

References

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