EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF PLAIN CEMENT CONCRETE REINFORCED WITH SISAL FIBRES

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Abstract: Cement concrete lends itself to a variety of innovative design as it can be cast to any desired shape. It possesses many desirable properties like high compression strength, stiffness, low thermal and electrical conductivity. But its characteristics such as weak in tension and brittleness at failure have limited its use for various applications. These limitations are overcome by placing steel bars in concrete, in regions where concrete is subjected to tension loading. Even though the concept of RCC has eliminated one of the major weaknesses of concrete (inability to resist tensile forces), it still falls short in many desirable properties like toughness, tension, ductility, controlling of cracking and energy absorption. In order to achieve all these properties, it is essential to distribute the reinforcement uniformly throughout the cross section. Such a way of reinforcing the brittle concrete matrix is possible by adding short fibers of small diameter.

In this research, sisal fibers are used in concrete since it has ultimate tensile strength and exceptionally durable in lower maintenance with minimal wear and tear. Mechanical properties such as compression strength and split tensile strength of M30 grade concrete is tested for various percentages of fibers from 0.3%, 0.6%, 0.9% and 1.2% by weight of cement and it is compared with the conventional concrete. Length of fibers is taken as 30mm obtained from literature survey.

Index Terms **– Sisal fibers, Hardened property, Concrete technology.**

1. INTRODUCTION

Fibre reinforced concrete is a two phase material consisting of a matrix which is reinforced with randomly oriented small diameter fibres to improve the mechanical properties of the matrix. Fibre reinforcement in concrete, mortar and cement paste can enhance many of the engineering properties of the basic materials such as fracture toughness, tensile strength, flexural strength and resistance to fatigue, impact and thermal shock. Fibres have always been considered as promising as reinforcement of cement based matrices because of their availability and low consumption of energy.

Natural Fibres develop or occur in the fibres shape and include those produced by plants animals and geological process. They can be classified according to their origin. Vegetable Fibres are generally based on arrangements of cellulose, often which lignin; examples include cotton, hemp, jute, flex, ramie, sisal, bagasse ash and banana.

Sisal is a straw-like plant fibre. It is a species of Agave, native to southern Mexico and now widely cultivated in many countries. The fine texture of Sisal takes dyes easily and offers the largest range of dyed colours of all natural fibres. Zero pesticides or chemical fertilizers used in sisal agriculture. It is a stiff fibre traditionally used in making twine, rope and also dartboards Sisal fibre is manufactured from the vascular tissue from the sisal plant (Agave sisalana).

2. MATERIALS USED

a. CEMENT

Portland pozzolana cement is used in our experimentation. It has been tested as per Indian standard specification IS: 1489 PART-1 1991.

b. FINE AGGREGATE

M Sand is used for experimental program. It has been tested as per Indian standard specification IS: 383-1970.

c. COARSE AGGREGATE

20mm size aggregates are used for experimental program. It has been tested as per Indian standard specification IS: 383-1970.

d. SISAL FIBRES

Figure 4.1: Sisal fibres

Table 4.1 Physical Properties of Sisal Fibres

Property	Value
Fiber length (mm)	30
Average diameter (mm)	0.5
Density (g/cm3)	1370
Specific Gravity	1.37

e. MIX PROPORTION

Mix proportioning is the process of selecting suitable ingredients for concrete and determining their relative quantities with the objective of producing a concrete of the required strength, durability, and workability as economically as possible. M30 grade concrete was designed as per the Indian standard specification IS: 10262-2009.

Table 4.2 Mix proportioning

Materials	Per m^3
Cement	438.13 kg
Fine aggregate	785.77 kg
Coarse aggregate	947.26 kg
Water	219 litres
W/C ratio	0.5

f. SPECIMEN DETAILS

The specimens like cubes, cylinders and beams are used to conduct the strength tests according to IS: 100086 – 1982.

- Compressive strength test - In this research, totally 30 cube moulds of size 150×150×150mm were tested for knowing the compressive strength of different mixes at 7days and 28days.
- Split tensile strength test - 30 cylindrical moulds of 150mm diameter at 300mm height were tested for knowing the tensile strength of different mixes at 7days and 28days.

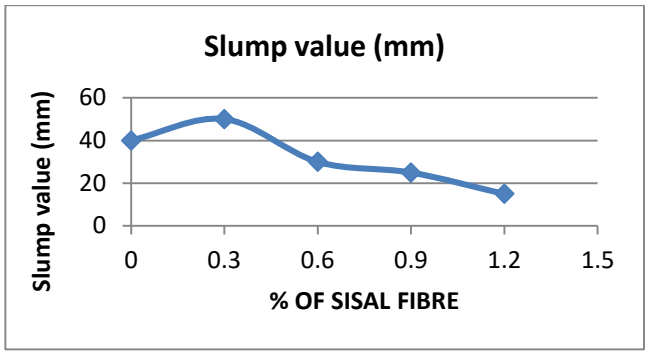
3. RESULTS AND DISCUSSIONS

a. WORKABILITY OF CONCRETE

i. Slump test

The slump value increases up to 0.3% of sisal fibres addition and then it gradually decreases. The graphical representation is shown in figure 5.1.

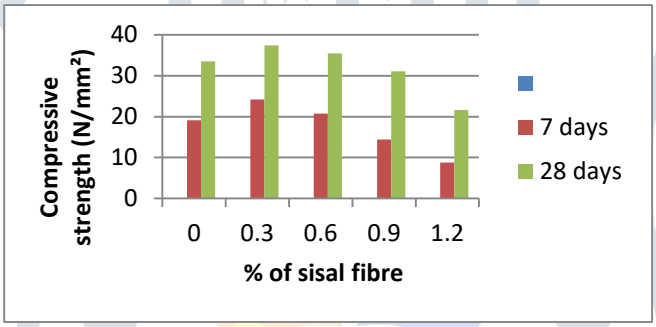
Table 5.1 Slump value of concrete mix for varied % of sisal fibres



b. COMPRESIVE STRENGTH TEST

The compressive strength results of 7th and 28th day are tested and results are represented graphically as shown in figure 5.2.

Table 5.2 7th and 28th day compressive strength results

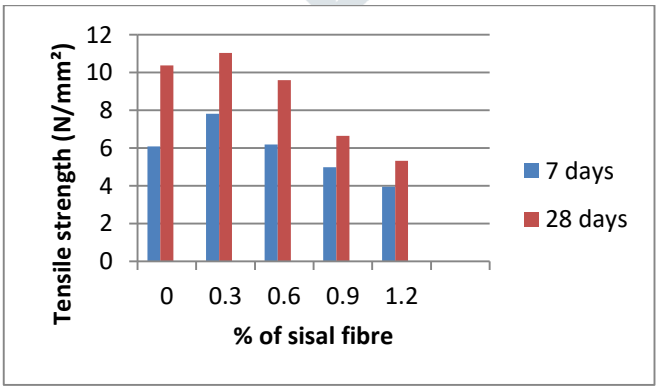


- The compressive strength of concrete has been increasing until the percentage of mix is up to 0.6%.
- Strength of concrete decreases for 0.9% and 1.2% compare to conventional concrete.
- Compressive strength of 0.3% mix is the highest and hence it can be considered as optimum dosage.

c. SPLIT TENSILE STRENGTH TEST

The tensile strength results of 7th and 28th day are tested and results are represented graphically as shown in figure 5.3.

Table 5.3 7th and 28th days split tensile strength results



- We know that, concrete is weak in tension. By adding sisal fibres tensile strength of concrete can be increased.
- The highest increase in tensile strength is for the mix percentage 0.3%. Therefore 0.3% can be considered as the Optimum dosage of fibres.
- For 0.9% and 1.2% tensile strength of concrete is decreased than conventional concrete.

4. CONCLUSION

- The result obtained from basic material testing are within the limit and satisfactory.
- The compressive strength of concrete in which 0.3% of sisal fibres are added is increased by 11.8% compare to conventional concrete.
- The tensile strength of concrete in which 0.3% of sisal fibres are added is increased by 6.26% compare to conventional concrete.
- As the percentage of sisal fibre increases strength of concrete decreases.
- By observing the above results, we can conclude that up to 0.3% of sisal fibre can be added to obtain the desired compressive strength. Further increase in percentage of sisal fibres, compressive and tensile strength is decreased.

5. REFERENCES

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