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A Study on Structural Characteristics of Sisal Fibre Reinforced Concrete

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***Abstract*- Concrete is strong in compression but weak in tension. So we will provide the reinforcement to the concrete. Majorly steel is used as the reinforcement. Many of the researches are in progress to find a substitute to this material. Many investigations proposed artificial fibres. The study focuses on the compressive strength, split tensile strength, performance of the blended concrete containing Na2CO3 treated sisal fibre. In this project study of Na2CO3 treated sisal fibres for 5 days on the strength parameters normal concrete had been carried out by varying percentages of 0%, 0.5%, 1%, 1.5%and 2% for M30 grade of concrete design by using IS10262-2009. Concrete cubes and cylinder are tested at the age of 7, 14, and 28 days of curing. From the experimental investigations, it has been observed that, the optimum percentage of Na2CO3 treated sisal fibre is 1% for M30 grade.**

Keywords- Natural fibre reinforced cement (NFRC), Sisal, Manufactured sand, Sodium carbonate (NA2C03)

I. INTRODUCTION

The use of unconventional building materials (green materials) is rapidly increasing for the construction of sustainable buildings. Special attention is given to concrete blocks reinforced by vegetable fibers, which stand out because of their low cost and large availability in many emerging countries. Vegetable fibers enhance the mechanical properties of concrete, control opening and propagation of cracks, usually increase tensile strength, toughness and ductility of the elements in which they are used, allowing relatively large deformations without any loss of integrity.
Many authors investigated how adding vegetable fibers to building materials affects their mechanical properties: exhaustive reviews on this subject have recently been carried out by Pacheco-Torgal and Jalali and by Ardanuy et al. . According to these surveys, cellulosic or vegetable fibers enhance the mechanical, thermal and physical performances of cement-based m composites when added to the cementitious matrix, as they increase their flexural strength, toughness and impact resistance, reduce shrinkage on drying and thermal conductivity, and increase sound absorption.

Natural fibres, on the other hand, can improve the sustainability of cement composites by being renewable and are considerably less costly. There has been a growing interest in recent years in utilizing natural fibres in low-cost construction. Natural fibre-reinforced concrete (NFRC) constitutes a new and distinct group of building materials which exhibit almost the same performance as that of conventional concrete composites reinforced with metallic, organic or synthetic fibres. Due to the high alkalinity of concrete it as always is susceptible to acid attack. Hence in this investigation an attempt was made in order to know the behaviour of standard concrete of M30 grade specimen curing with acid such as Na2Co3.The most aggressive chemicals that affect the long term durability of concrete structures are the chlorides and sulphate. This paper presents results of the durability characteristics properties of M30 grade of with and without supplementary cementing materials.

Previous research revealed that sisal fibre reinforced concrete has improved the characteristics of concrete such as strength, durability, and workability. The addition of the fiber in small amounts will increase the tensile strength .addition of fibers not only increases the tensile strength but also increases the bound strength, decreases permeability. Toughness of concrete also increases by the addition of the fiber[1]. The result obtained by Jianqiang wei [2] showed that . Na2CO3 surface treatment for seven days were shown to have the potential of improving the durability of sisal fibers with less potential hazards. Fibers were treated with alkali solutions to partially remove the lignin, hemicelluloses and other residues from the fiber surface [3].

Therefore as a research effort on the development of green materials in civil engineering, this paper describes an experimental study of a improve the corrosion resistance of sisal fiber in the alkali environment of concrete and the durability of natural fiber reinforced-concrete in aggressive environment by Na2CO3 treated for varies percentage of sisal fiber. Mechanical behavior of the fibers is determined for the Na2CO3 treated sisal fiber

II MATERIALS AND PRODUCTION METHOD

A. Materials

1. Cement

Cement is a blend of composites completed by burning limestone & clay composed at very high temperature ranging from 1400 to 1600oc.53 grade Ordinary Portland cement is used as binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. The different grades of cement is used they are, 33, 43, 53 grade. The cement specific gravity of cement

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=3.15 Initial setting time=30minutes.

2. M-Sand

The rock crushed to the required grain size distribution is termed as manufactured sand (M- sand).in order to arrive at the required grain size crushed in a special rock crusher and some of the crushed materials is washed to remove fines. The M-sand used as a fine aggregate. Thus, increased quality and durability of concrete. M-Sand is cubical in shape and is manufactured using technology like High Carbon steel hit rock.

3. Fine aggregate

Manufactured sand is also called as mechanical sand. It possesses similar properties as similar grading as per the river sand. Due to this reason, manufactured sand normal sand. Mechanical sand contains can be used in the region where normal sand limited in availability.

4. Sodium carbonate solution

Utilizing the water absorption of sisal fibre, Na2Co3 solution was introduced to soak the dry fibre. After treatment in sodium carbonate saturated solution for seven days, there will be a large number of Na+ and Co32- ions deposited on the fibre surface. When fibres are added to fresh concrete, there will be a chemical reaction on the fibre surface, due to the Ca2+ in the cement.

5. Sisal fiber

Sisal fibre is species of Agava sisilana. The material is mainly used for applications like rope manufacture in marine and construction industry. As it possesses high strength compared to other fibre materials, this fibre is selected for the present research work. Concrete paste is done with the help of cement, filler materials, aggregates is prepared. Here, Sisal Fibres are used as reinforcing agent for cement.

B. Production of specimens

Basic material tests were conducted the materials such as cement, fine aggregates, coarse aggregates and fibers. Based on the materials test values cement, fine aggregate, coarse aggregate and sisal fiber using IS10262-2009 we design for M30 grade concrete. In order to improving the degradation resistance of sisal fibers are immersed in Na_2Co_3 solution for 5 days. With varying percentage of Na2Co3 treated sisal fibers such as 0%,0.5%,1.0%,1.5%&,2.0%.cubes and cylinders are casted for 7 days,14 days and 28 days. Compressive strength and tensile strength are determined for the above casted cubes &cylinders

.Based on the compressive and tensile strength, we will find out the optimum dosage of Na_2Co_3 treated sisal fibers. Durability tests are conducted for the Na_2Co_3 treated sisal fibers cubes and cylinders. The durability tests are acid test, sulphate attack test and chloride test.

C. *Result And Discussion*

Preliminary test results are given below Table 1. Physical Properties of cement

Sl.No	Test Conducted	Result
1	Fineness	1.587%
2	Normal consistency of cement	35%
3	Initial setting time of cement	55min
4	Final setting time of cement	600min
5	Specific Gravity	2.9

Table 2. Physical properties of Fine Aggregate

Sl.No	Test conducted	Result
1	Specific Gravity	2.7
2	Water Absorption	4.8%

Table 3. Physical properties of Coarse Aggregate

Sl.No	Test conducted	Result
1	Specific Gravity	2.65
2	Water Absorption	1%

Table 3. Sieve analysis of Fine Aggregates

IS sieves	Weight retained	Cum. weight retained	% retained	%passing
10	0	0	0	100
4.75	0	0	0	100
2.36	8	8	0.4	99.6
1.18	448	456	22.8	77.8
0.60	540	996	49.8	50.2
0.30	704	1700	85	15
0.15	236	1936	96.8	3.2
pan	64	2000	100	0

Table 4. Sieve analysis of coarse Aggregates

Is sieve s	Weight retaine d	Cumulae percentae retained	Percent age finer	Cumulati ve finer
26.5	_	_		
20	352	17.6	82.4	82.4
16	1118	73.5	26.5	108.9
12.5	385	92.7	7.3	116.2
10	106	98	2	118.2
6.3	34	99.7	0.3	118.5
4.75	2.385	99.819	0.181	118.681
Pan	3.615	100	0	118.681

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Table 5. Mix Proportions

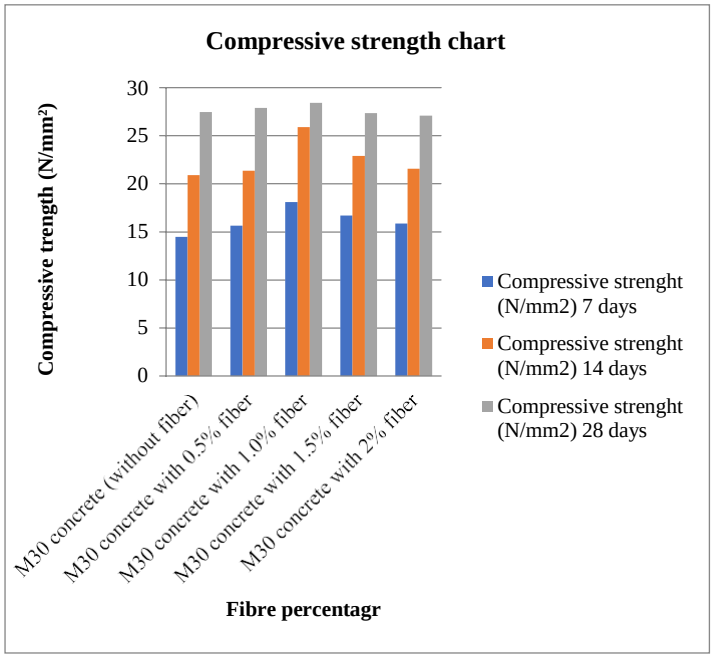
Materials	Quantity (kg/m^3)
Fine Aggregate	653.5
Coarse Aggregate	1043.46
Cement	438
water	240.5 lit

Mix proportion ratio

W/C ratio	Cement	Fine aggregate	Corse aggregate
0.54	1.0	1.49	2.38

Table 6. overall results of compressive strength values

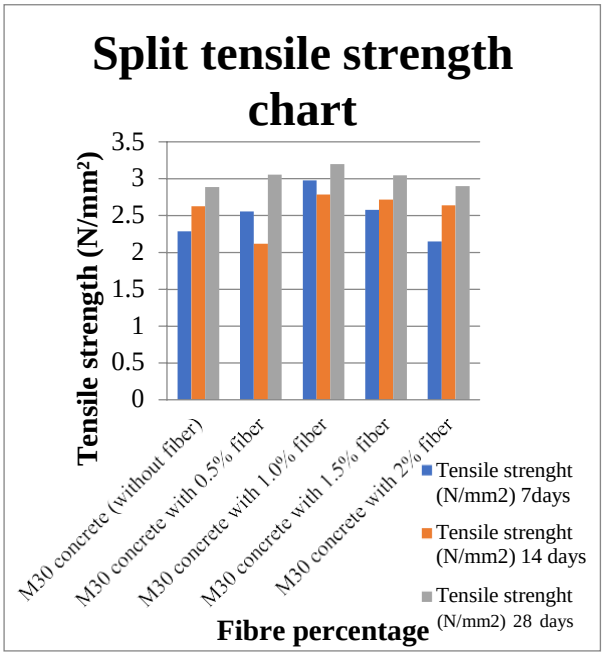
Mix designation M30	Compressive strength (N/mm^2)		
	7 days	14 days	28 days
0% fibre	14.49	20.91	27.46
0.5% fibre	15.66	21.37	27.89
1.0% fibre	18.11	25.89	28.44
.5% fibre	16.70	22.89	27.37
2% fibre	15.89	21.56	27.11



From the above bar chart it was observed that, the compressive strength test results of sisal fibre reinforced concrete, the sisal fibres are added to the concrete in varying percentage of 0%, 0.5%, 1%, 1.5% and 2% of Na2co3 treated sisal fibres for 7, 14 and 28 days are represented in table and its graphical representation as shown in figure. Result shows that with added 0.5% sisal fibre to the concrete compressive strength is 27.89N/mm2 at the age f 28 days, 1% of sisal fibre added the compressive strength is 28.44N/mm2, 1.5% of sisal fibre added the compressive strength is 28.78N/mm2 and 2% of sisal fibre added the compressive strength is 27.11N/mm2. From the above test results it has been observed the compressive strength of concrete goes on increases up to 1% and then further increasing the percentage of fibre decreases the compressive strength of concrete

.Table 7. Overall results of Tensile strength values

Mix designation M30	Tensile strength (N/mm^2)		
	7 days	14 days	28 days
0% fibre	2.29	2.63	2.89
0.5% fibre	2.56	2.12	3.06
1.0% fibre	2.98	2.79	3.20
1.5% fibre	2.58	2.72	3.05
2% fibre	2.15	2.64	2.90



From the above bar chart it was observed that, the From the test results it has been observed that for M30 grade concrete the split tensile strength at the age of 7, 14 and 28 days are represented

in table and its graphical representation as shown in figure. Result shows that with added 0.5% sisal fibre to the concrete tensile strength is 3.06N/mm2 at the age of 28 days, 1% of sisal fibre added the tensile strength is 3.20N/mm2, 1.5% of sisal fibre added the tensile strength is 3.05N/mm2 and 2% of sisal fibre added the tensile strength is 2.90N/mm2. From the above test results it has been

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observed the tensile strength of concrete goes on increases up to 1% and then further increasing the percentage of fibre decreases the tensile strength of concrete.

III. CONCLUSION

- Natural fibers are considered as possible replacement for synthetic fiber in fiber/polymer composite. Natural fibers have significant advantages over synthetic fibers, in terms of the positive environmental impact, low cost, low density and their biodegradability.
- In this Paper Na2CO3 treated sisal fibres on the strength parameters normal concrete had been carried out by varying percentages of 0%, 0.5%, 1%, 1.5%and 2% for M30 grade of concrete design by using IS10262-2009.
- From the experimental investigation 1% of Na2CO3 treated sisal fibre is added to concrete. The compression strength is increased up to 3.5% than the conventional concrete.
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- From this experimental investigation 1% of Na2CO3 treated sisal fibre is added to concrete. The split tensile strength is increased up to 11% than the conventional concrete.
- When adding 0.5% and 1% of fibre content, compressive strength and tensile strength of sisal fibre reinforced concrete will increase. When 1.5% and 2% of sisal fibre was added strength will decrease.
- A layer consisting of calcium carbonate sediments, which protects the internals of a fibre from the strong alkali solution formed in the cement hydration process and also improve their corrosion resistance and durability and hence reduces the detrimental effects of Na+ ions on concrete.
- From the test results, 1% concentration of sisal fibre is found to be the optimum dosage for this experimental investigation.

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