Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 15, Issue. 1 : 2024
ISSN : **1906-9685**

A STUDY ON THE STRENGTH PROPERTIES OF CONCRETE USING SISAL FIBRES

[1]K ANURADHA,[2]B FAYAZ, *[1]Student,[2]Assistant Professor Department Of Civil Engineering PVKKIT, Anantapur*

ABSTRACT

Concrete is strong in compression and 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 progess to find a substitute to this material. Many investigations proposed artificial fibres. In this project we would like to take the naturally available fibre named sisal fibre is taken as a substitute material to the reinforcement and studied the propertiesz. The results show that the composites reinforced with sisal fibres are reliable materials to be used in practice for the production of structural elements to be used in rural and civil construction. This material could be a substitute to the steel reinforcement which production is a serious hazard to human and animal health and is prohibited in industrialized countries. The production of sisal fibres as compared with synthetic fibres or even with mineral asbestos fibres needs much less energy in addition to the ecological, social and economical benefits.

INTRODUCTION

1.1 General

Natural fibres are prospective reinforcing materials and their use until now has been more traditional than technical. They have long served many useful purposes but the application of materials technology for the utilization of natural fibres as the reinforcement in concrete has only taken place in comparatively recent years. The distinctive properties of natural fibre reinforced concretes are improved tensile and bending strength, greater ductility, and greater resistance to cracking and hence improved impact strength and toughness. Besides its ability to sustain loads, natural fibre reinforced concrete is also required to be durable. Durability relates to its resistance to deterioration resulting from external causes as well as internal causes.

Earlier, mechanical characterization and impact behaviour of concrete reinforced with natural fibres were studied. Here an experimental study was done using sisal fibre in this investigation the mechanical strength properties such as compressive, split tensileand some of the transport properties like evaporation, absorption and moisture migration are studied.

1.2 Sisal Fibre

Sisal fibre is one of the most widely used natural fibres and is very easily cultivated. It has short renewal times and grows wild in the hedges of fields and railway tracks. Nearly 4.5 million tons of sisal fibre is produced every year throughout the world. Tanzania and Brazil are the two main producing countries. Sisal fibre is a hard fibre extracted from the leaves of the sisal plant (Agave sisalana). Though native to tropical and sub-tropical North and South America, sisal plant is now widely grown in tropical countries of Africa, the West Indies and the Far East. Sisal fibres are extracted from the leaves. A sisal plant produces about 200±250 leaves and each leaf contains 1000±1200 fibre bundles which is composed of 4% fibre, 0.75% cuticle, 8% dry matter and 87.25% water. So normally a leaf weighing about 600 g will yield about 3% by weight of fibre with each leaf containing about 1000 fibres.

1.3 Scope

Concrete is strong in compression and week in tension. To increase the tensile strength of the concrete we are adding sisal fibre. Also it resists the plastic shrinkage cracks.

This sisal fibre is a natural product that is available in the fields and if this could replace the reinforcement in the concrete it would be a gigantic change in the construction industry.

1.4 Objective

The main objective is to study the effect on utilization of sisal fibre in the concrete as the reinforcement and in this investigation the fibre is mixed in different proportions by cutting it into small pieces of size 3 to 5 cm.

- To study the mechanical and transport properies of concrete
- Compressive test on concrete cubes (150 × 150 × 150 mm)
- Split tensile strength on cylinders (Ø 100 mm & 200 mm long)
- Evaporation test on cubes (150 × 150 × 150 mm)
- Water absorption test on cubes (150 × 150 × 150 mm)
- Moisture migration test on cubes (150 × 150 × 150 mm)

LITERATURE REVIEW

2.1 Reviews on Natural Fibres

M.A.Aziz, P.Paramasivam and S.L.Lee 1984

Natural fibres are prospective reinforcing materials and their use until now has been more traditional than technical. They have long served many useful purposes but the application of materials technology for the utilization of natural fibres as the reinforcement in concrete has only taken place in comparatively in recent years. The distinctive properties of natural fibre reinforced concretes are improved tensile and bending strength, greater ductility and greater resistance to cracking and hence improved impact strength and toughness. Besides its ability to sustain loads, natural fibre reinforced concrete is also required to be durable. Durability relates to its resistance to deterioration resulting from external causes as well as internal causes.

S.K. Al-Oraimi and A.C.Seibi (1995)

Mechanical characterization and impact behaviour of concrete reinforced with natural fibres were studied by S.K. Al-Oraimi and A.C.Seibi (1995). Here an experimental study was conducted using glass and palm tree fibres on high strength concrete. Mechanical strength properties such as compressive, split tensile, flexural strengths and post cracking toughness were studied. It was concluded that natural fibres are comparable with glass fibres. A finite element analysis was also done using ANSYS software. Both analytical and experimental results were compared and acceptable.

G.Ramakrishna and T.Sundararajan (2002).

Rheological properties of coir fibre reinforced cement mortar were carried out by G.Ramakrishna and T.Sundararajan (2002). Flow value, cohesion and angle of internal friction were determined for three different mix ratios and four different aspect ratios and fibre contents. Based on the rheological properties of fresh mortar, it was recommended to use shorter fibres with low fibre-content for achieving workability and higher fibre content for better cohesiveness in wet state.

G.Ramakrishna, T.Sundararajan and Usha Nandhini (2002) compared the theoretical and experimental investigations on the compressive strength and elastic modulus of coir and sisal fibre reinforced concretes for various volume fractions. It was observed that both the experimental and analytical values of elastic modulus had shown 15% discrepancy, which can be regarded as comparatively small.

K.Bilba, M.A.Arsene and A.Ouensanga (2003)

Sisalfibre reinforced cement composites were studied by K.Bilba, M.A.Arsene and A.Ouensanga (2003). Various fibre-cement composites were prepared and influence various parameters on the setting of the composite materials were studied. Botanical components, thermal and chemical treatment of Sisalfibres were also studied.

Romildo D. Toledo Filho, Khosrow Ghavami, George L. England and Karen Scrivener (2003)

The natural fibre composites may undergo a reduction in strength and toughness as a result of weakening of fibres by the combination of alkali attack and mineralisation through the migration of hydrogen products to lumens and spaces. Romildo D. Toledo Filho, Khosrow Ghavami, George L. England and Karen Scrivener (2003) reported their study on development of vegetable fibre-mortar composites of improved durability. So, several approaches were proposed by the authors to improve the durability of vegetable fibre-cement composites. These include carbonation of the matrix in a CO2-rich environment; the immersion of fibres in slurred silica fume prior to incorporation in Ordinary Portland Cement matrix; partial replacement of

Ordinary Portland Cement by undensified silica fume or blast furnace slag. The performance of modified vegetable fibre-mortar composites was analysed in terms of effects of aging in water, exposure to cycles of wetting and drying and open air weathering on the microstructures and flexural behaviour. It was suggested that immersion of natural fibres in a silica fume slurry before the addition to the cement based composites was found to be effective means of reducing embrittlement of the composite in the environments. Also early cure composites in a CO2-rich approaches in obtaining natural fibres in improved durability.

Robert S.P. Coutts (2005)

Robert S.P. Coutts (2005) reviewed critically about the Australian research into natural fibre cement composites. It was mentioned that over the last three decades considerable research has been committed to find an alternative fibre to replace asbestos and glass fibres. V.Agopyan (2005) reported the developments on vegetable fibre-cement based materials in Brazil. Taking into account the mechanical properties, with an adequate mix design, it is possible to develop a material with suitable properties for building purposes. To overcome the drawback, it was suggested that durability of natural fibres can be improved by making alternative binders with controlled free lime using ground granulated blast furnace slag.

MATERIALS AND PROPERETIES

This chapter explains about the materials and its properties. It also includes mix proportions and mixing.

3.1 Cement

Ordinary Portland Cement of 53 Grade of brand name dalmia cements, available in the local market was used for the investigation. Care has been taken to see that the procurement was made from single batching in air tight containers to prevent it from being effected by atmospheric conditions. The cement thus procured was tested for physical requirements in accordance with IS: 12269-1989 and for chemical requirement in accordance IS: 4031-1988. Cement is the most important material in the concrete and it act as the binding material.

3.2 Aggregate

The basic objective in proportioning any concrete is to incorporate the maximum amount of aggregate and minimum amount of water into the mix, and thereby reducing the cementitious material quantity, and to reduce the consequent volume change of the concrete.

3.2.1 Coarse aggregate

Selection of the maximum size of aggregate mainly depends on the project application, workability, segregation, strength and availability. In this research aggregates that are available in the crusher near by was used. The maximum size of aggregate was varying between 26 -12.5 mm.

3.2.2 Fine aggregate

River sand locally available in the market was used in the investigation. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963.The sand was surface dried before use. The amount of fine aggregate usage is very important in concrete. This will help in filling the voids present between coarse aggregate and they mix with cementaneous materials and form a paste to coat aggregate particles and that affect the compactability of the mix. The aggregates used in this research are without impurities like clay, shell and organic matters. It is passing through 4.75mm sieve.

3.3 Sisal Fibre

Sisal fibre (Agave sisal fibreana) is an agave that yields a stiff fibre traditionally used in making twine rope and also dartboards. The term may refer either to the plant or the fibre, depending on context. It is sometimes incorrectly referred to as sisal fibre hemp because hemp was for centuries a major source for fibre, so other fibres were sometimes named after it.

The plant's origin is uncertain; while traditionally it was deemed to be a native of Yucatan; there are no records of botanical collections from there. Gentry hypothesized a Chiapas origin, on the strength of traditional local usage. In the 19th century, sisal fibre cultivation spread to Florida, the Caribbean islands and Brazil, as well as to countries in Africa, notably Tanzania and Kenya, and Asia. The first commercial plantings in Brazil were made in the late 1930s and the first sisal fibre exports from there were made in 1948. It was not until the 1960s that Brazilian production accelerated and the first of many spinning mills was established. Today Brazil is the major world producer of sisal fibre. There are both positive and negative environmental impacts from sisal fibre growing. Traditionally used for rope and twine, sisal fibre has many uses, including paper, cloth, wall coverings and carpets and here for get good values of flexural strength for concrete.

The Sisal fibre plants consist of a rosette of sword-shaped leaves about 1.5 to 2 meters tall. Young leaves may have a few minute teeth along their margins, but lose them as they mature. The sisal fibre plant has a 7–10 year life-span and typically produces 200–250 commercially usable leaves. Each leaf contains an average of around 1000 fibres. The fibres account for only about 4% of the plant by weight. Sisal fibre is considered a plant of the tropics and subtropics, since production benefits from temperatures above 25 degrees Celsius and sunshine.

3.4 Fibre Extraction

Fibre is extracted by a process known as Decortication, where leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibres remain. In India, where production is typically on large estates, the leaves are transported to a central decortication plant, where water is used to wash away the waste parts of the leaf. The fibre is then dried, brushed and baled for export. Superior quality sisal fibre is found in East Africa. Proper drying is important as fibre quality depends largely on moisture content. Artificial drying has been found to result in generally better grades of fibre than sun drying.

3.5 Water

Water acts lubricant for the fine and coarse aggregate and acts chemical with cement to form the binding paste for the aggregate water is used for curing the concrete after it has cast into the forms.

Water used for both mixing and curing should be free from contaminants. Portable water is generally considered satisfactory for mixing and curing of concrete. If water contains any sugar or an excess of acid, alkali it should not be used. Ordinary tap water used in the preparation of concrete.

Fig. 3.1 Cement

Fig. 3.2 Fine Aggregate

Fig. 3.3 Sisal Fibre

Fig. 3.4 Coarse Aggregate

Table 3.1: Physical properties of Cement

S.no	Particulars	Results
1	Specific gravity	3.05
2	Initial setting time	170 min
3	Final setting time	230 min
4	Consistency	25%
5	Fineness	298 m^2/kg
6	Compreesive Strength of cement@ 3, 7, 28 days	35, 46, 58 N/mm^2

Table 3.2: Chemical Properties of Cement

S.no	Particulars	Test results	Specification as per IS:12269:1987
1	LSF(Lime Saturation factor)	0.89	0.8-1.02
2	Alumina Modulus	0.83	Min 0.66
3	Insoluble residue (%)	1.48	Max 3.0
4	Magnesia (%)	1.46	Max 6.0
5	Sulphuric Anhydride (%)	2.06	Max 3.0
6	Loss on Ignition (%)	1.58	Max 4.0
7	Chloride Content (%)	0.009	Max 0.1

Table 3.3: Properties of coarse aggregates

S.no	Particulars	Results
1	Type	Crushed stone
2	Specific Gravity	2.6
3	Water absorption	0.8%
4	Fineness modulus	7.98
5	Size	20 mm (max)
6	Density	1.48

Table 3.4: Properties of fine aggregates

S.no	Particulars	Results
1	Type	River sand
2	Specific Gravity	2.4
3	Water absorption	1%
4	Fineness modulus	3.40
5	Grading	Zone-III
6	Density	1.57

Table 3.5: Physical Properties of Sisal Fibre

S.no	Particulars	Results
1	Diameter	0.2mm
2	Elongation	4.3%
3	Water absorption	3%
4	Cellulose	70%
5	Tensile Strength	300 Mpa
6	Density	1.450gm/cm^3

Table 3.6: Seive analysis of coarse aggregates

Weight of sample taken = 5000 gm

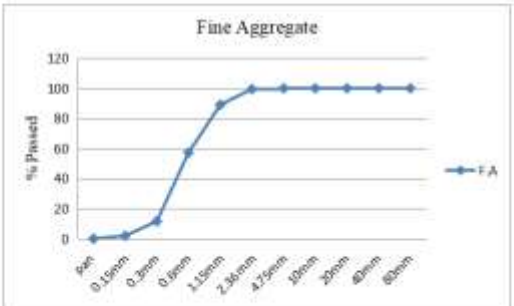
S.no	I.S.Sieve designation	Weight of sample retained	Cumulative weight retained	Cumulative % age retained	%age passed.
1	80 mm	0	0	0	100
2	40 mm	0	0	0	100
3	20 mm	980	980	19.6	80.4
4	10 mm	2972	3952	79.04	25.96
5	4.75 mm	1048	5000	100	0
6	2.36 mm	-	-	100	0
7	1.18 mm	-	-	100	0
8	0.6mm	-	-	100	0
9	0.3mm	-	-	100	0
10	0.15mm	-	-	100	0
11	Pan	-	-	100	0
Total			798.6		

Table 3.7: Seive analysis of fine aggregates
Weight of sample taken = 500 gm

S.no	I.S.Sieve designation	Weight of sample retained	Cumulative weight retained	Cumulative % age retained	%age passed.
1	80mm	0	0	0	100
2	40 mm	0	0	0	100
3	20 mm	0	0	0	100
4	10 mm	0	0	0	100
5	4.75 mm	0	0	0	100
6	2.36 mm	2.8	2.8	0.56	99.44
7	1.18 mm	52.15	54.95	10.99	89.01
8	0.6mm	159.1	214.05	42.81	57.19
9	0.3mm	227.95	442	88.4	11.6
10	0.15mm	48.5	490.5	98.1	1.9
11	Pan	9.5	500	100	0
	Total		340.86		

Graph 3.1: Sieve Analysis for Coarse Aggregate

Graph 3.2: Sieve Analysis for Fine Aggregate



3.6 Mix proprotioning

There are various methods of mix proportioning .Mix proportioning was based on the water cement ratio (water/cement) and the density of the concrete is 2400kg/m3. Quantity of water is taken according to slump of concrete 0.5 for economical purpose. The quantity of cement i.e; 350 kg/m3 used. Therefore quantity of water should be 175kg/m3. For fine and coarse aggregate absorption of water in additional 1 % and 0.8% of water was used. The quantity of aggregates is taken based on the aggregate grading curve is selected. The quantity of fine aggregates used is 646kg/m3, coarse aggregates is 1229kg/m3, the quantity of 20mm and 12mm are 502kg/m3 and 727kg/m3.

For the investigation purpose the fibre is added to the concrete to study the properties of the fibre reinforced concrete, the addition is about 0, 0.5, 1, 1.5, 2 percentages by weight of concrete for the relative mixes M1, M2, M3, M4 and M5 respectively.

Table 3.8: Mix Proportions

Mix	Cement	C.A 12 mm	C.A 20mm	Fine Aggregate	Sisal Fibre	W/C
M1	350	727	502	646	0	0.547
M2	350	727	502	646	1.75	0.547
M3	350	727	502	646	3.50	0.547
M4	350	727	502	646	5.25	0.547
M5	350	727	502	646	7.00	0.547

3.7 Specimen Details

The specimens like cubes, cylinders and beams that are used to conduct the strength tests are taken according to IS10086-1982.

Compression strength = cube moulds of 150mmX150mmX150mm are used.

Split tensile strength = cylindrical moulds of 100dia@200mm height are used.

3.8 Casting of specmens

After completion of the workability tests, the concrete has been placed in the standard metallic moulds in three layers and has been compacted each time by tamping rod. Before placing the concrete inside faces of the mould are coated with the machine oil for easy remval afterwards. The concrete in the moulds has been finished smoothly. The casted specimens are shown in Figure 3.5.

3.9 Curing Procedure

After casting the cubes and cylinders the specimensthe moulds are kept in air curing for one day and the specimen are removed from the moulds after 24 hours of casting of concrete specimens. Markings have been done to identify the different percentages of fibred specimens. Then specimens were kept for normal water curing until testing age.

Fig: 3.5 Cube Moulds

Fig 3.6 Specimen

Fig 3.7 Curing

EXPERIMENTAL INVESTIGATION

In this chapter it is detailed abouut the tests conducted on the concrete. Mainly they explain the basic strength properties and the transportation properties. The tests conducted in our investigstion are:

1. Compressive Strength Test
2. Split Tensile Strength Test
3. Evaporation test.
4. Absorption test.
5. Moisture migration test.

4.1 Compressive Strength Test

Compression test is done confirming to IS: 516-1953. All the concrete specimens that are tested in a 2000KN capacity Compressive-testing machine. Concrete cubes of size 150mm x 150mm x150mm and cylinders of size 100mm dia & 200mm height were tested for crushing strength, crushing strength of concrete was determined by applying load at the rate of 1400 N/cm2/min till the specimens fail. The maximum load applied to the specimens was recorded and divided the failure load with cross-sectional area of the specimens for compressive strength has been calculated.

Compressive Strength of concrete=Load/Area

Compressive strength test was conducted on cubes of 150mmX150mmX150mm cubes for the various mixes M1, M2, M3 M4 and M5 of concrete. The details about the loading and strength of the specimens are given in the table 4.1 and 4.2

4.2 Split Tensile Strength Test

The cylinders were subjected to split tensile tension by replacing them horizontally on the ailoure in the 2000KN CTM. The load is applied uniformly at a constant rate until failure by splitting along the vertical diameter takes place load at which the specimens failed is recorded and the splitting tensile stress is obtained using the formula based on IS: 5816-1970.

$$F_t = 2P/\pi DL$$

Where P = Compressive load on the cylinder

L = Length of the cylinder D = Diameter of the cylinder

Split tensile strength has done for the mixes M1, M2, M3, M4 and M5 of concrete for 1 day, 7 days and 28 days. The test has conducted on the cylinder of 100mmX200mm. The details about the loading and strength of the specimens are given in the table 4.3 and 4.4.

Figure 4.1Compreesion Test

Figure 4.2 Split Tensile Test

Table 4.1: Compressive strength load details

Compressive Load details of specimen of various mixes in KN							
Mix	cubes	3 days		7 days		28 days	
		Load	avg	Load	avg	load	avg
M1	1	260	260.33	500	513.33	525	545
	2	255		515		565	
	3	266		525		545	
M2	1	287	277	510	521.67	600	566.67
	2	272		520		600	
	3	272		535		500	
M3	1	267	277.67	550	540	610	595
	2	264		545		625	
	3	302		525		550	
M4	1	267	238.67	500	508.33	525	540
	2	199		515		550	
	3	250		510		545	
M5	1	200	195	400	390	495	473.33
	2	170		340		450	
	3	215		430		475	

Table 4.2: Compressive strength details

Compressive Strength Details of Specimens in KN/mm^2							
Mix	cubes	3 days		7 days		28 days	
		Load	avg	Load	avg	load	avg
M1	1	11.56	11.57	22.22	22.81	23.33	24.22
	2	11.33		22.89		25.11	
	3	11.82		23.33		24.22	
M2	1	12.76	12.31	22.67	23.19	26.67	25.19
	2	12.09		23.11		26.67	
	3	12.09		23.78		22.22	
M3	1	11.87	12.34	24.44	24.00	27.11	26.44
	2	11.73		24.22		27.78	
	3	13.42		23.33		24.44	
M4	1	11.87	10.61	22.22	22.59	23.33	24.00
	2	8.84		22.89		24.44	
	3	11.11		22.67		24.22	
M5	1	8.89	8.67	17.78	17.33	22.00	21.04
	2	7.56		15.11		20.00	
	3	9.56		19.11		21.11	

Table 4.3: Split Tensle Load details

Split Tensle Load details of specimen of various mixes in KN							
Mix	cylinders	3 days		7 days		28 days	
		Load	avg	Load	avg	load	avg
M1	1	29	30.29	54	55.67	72	74.22
	2	31		57		76	
	3	30		56		75	
M2	1	34	33.56	63	61.67	83	82.22
	2	30		55		73	
	3	37		68		90	
M3	1	35	36.01	65	66.17	87	88.22
	2	37		68		90	
	3	36		66		88	
M4	1	31	29.93	58	55.00	77	73.33
	2	30		55		73	
	3	29		53		70	
M5	1	26	24.94	48	45.83	63	61.11
	2	24		45		60	
	3	24		45		60	

Table 4.4: Split Tensile Strength details

Split Tensile Strength Details of Specimens in KN/mm^2							
Mix	cylinders	3 days		7 days		28 days	
		Load	avg	Load	avg	load	avg
M1	1	0.94	0.96	1.72	1.77	2.29	2.36
	2	0.99		1.81		2.42	
	3	0.97		1.78		2.38	
M2	1	1.08	1.07	1.99	1.96	2.65	2.62
	2	0.95		1.75		2.33	
	3	1.17		2.15		2.86	
M3	1	1.13	1.15	2.07	2.11	2.76	2.81
	2	1.17		2.15		2.86	
	3	1.14		2.10		2.80	
M4	1	1.00	0.95	1.83	1.75	2.44	2.33
	2	0.95		1.75		2.33	
	3	0.91		1.67		2.23	
M5	1	0.82	0.79	1.51	1.46	2.02	1.95
	2	0.78		1.43		1.91	
	3	0.78		1.43		1.91	

Table 4.5: Evaporation in different mixes

Evaporation in weight									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	7.86	7.84	7.83	7.82	7.82	7.81	7.79	7.75	7.71
M2	7.73	7.71	7.69	7.67	7.65	7.63	7.61	7.58	7.55
M3	7.48	7.45	7.41	7.39	7.36	7.35	7.34	7.32	7.29
M4	7.56	7.52	7.48	7.46	7.42	7.38	7.36	7.31	7.28
M5	7.69	7.65	7.6	7.58	7.56	7.51	7.48	7.41	7.36

The above table shows the variation of the weights that had been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the weight recorded is in the units of kilo grams.

Table 4.6: Evaporation percentage in different mixes

Evaporation in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.259	0.389	0.519	0.519	0.649	0.908	1.427	1.946
M2	0	0.265	0.529	0.795	1.06	1.325	1.589	1.987	2.384
M3	0	0.412	0.96	1.235	1.646	1.783	1.92	2.195	2.606
M4	0	0.549	1.098	1.374	1.923	2.473	2.747	3.434	3.846
M5	0	0.543	1.222	1.495	1.766	2.446	2.853	3.804	4.484

The above table shows the evaporation percentages that are calculated from the weights in table 4.5 and have been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the values recorded are in percentages.

Table 4.7: Water Absorption in different mixes

Water Absorption in weight									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	7.71	7.76	7.79	7.81	7.83	7.86	7.9	7.95	8
M2	7.72	7.78	7.82	7.86	7.89	7.93	7.97	8.05	8.11
M3	7.82	7.88	7.94	7.96	7.98	8.04	8.08	8.16	8.22
M4	7.79	7.89	7.94	7.96	7.99	8.05	8.06	8.17	8.22
M5	7.86	7.98	8.05	8.11	8.14	8.18	8.23	8.3	8.36

The above table shows the variation of the weights that had been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the weight recorded is in the units of kilo grams.

Table 4.8: Water Absorption percentage in different mixes

Water Absorption in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.625	1	1.25	1.5	1.875	2.375	3	3.625
M2	0	0.74	1.233	1.726	2.096	2.589	3.082	4.069	4.808
M3	0	0.73	1.459	1.703	1.946	2.676	3.163	4.136	4.866
M4	0	1.217	1.824	2.068	2.433	3.163	3.284	4.622	5.231
M5	0	1.435	2.272	2.99	3.349	3.827	4.425	5.263	5.98

The above table shows the water absorption percentages that are calculated from the weights in table 4.7 and have been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the values recorded are in percentages.

Table 4.9: Moisture Migration in different mixes

Moisture Migration in weight									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	8.03	8.05	8.07	8.08	8.09	8.1	8.12	8.15	8.18
M2	7.76	7.78	7.79	7.8	7.81	7.83	7.85	7.89	8.04
M3	7.73	7.75	7.78	7.79	7.8	7.83	7.85	7.96	8.06
M4	7.4	7.43	7.43	7.45	7.46	7.48	7.52	7.64	7.72
M5	7.86	7.89	7.91	7.93	8.01	8.04	8.08	8.16	8.21

The above table shows the variation of the weights that had been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the weight recorded is in the units of kilo grams.

Table 4.10: Moisture Migration percentage in different mixes

Moisture Migration in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.244	0.489	0.611	0.733	0.855	1.1	1.467	1.833
M2	0	0.249	0.373	0.497	0.621	0.87	1.119	1.619	3.482
M3	0	0.248	0.62	0.744	0.868	1.24	1.488	2.853	4.094
M4	0	0.389	0.388	0.647	0.777	1.036	1.554	3.108	4.145
M5	0	0.365	0.609	0.852	1.827	2.192	2.67	3.654	4.263

The above table shows the mosture migration percentages that are calculated from the weights in table 4.9 and have been recorded as the durations that are mentioned, the values are recorded by taking the weight of the specimen continously. All the values recorded are in percentages.

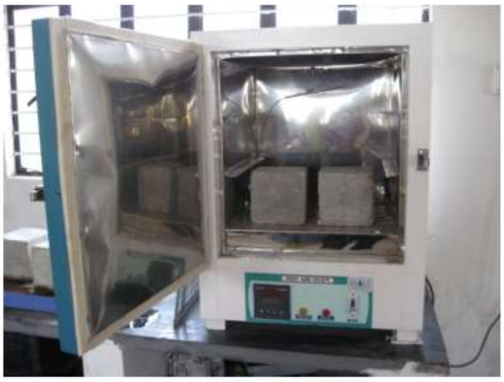
Table 4.11: Moisture Migration recorded in mm for different mixes

Moisture Migration in mm									
MIX	0min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	20	24	28	29	31	35	40	48
M2	0	22	27	32	34	36	38	45	51
M3	0	26	36	39	42	46	50	53	55
M4	0	30	41	42	46	49	51	57	59
M5	0	30	40	43	45	48	52	58	62

Figure 4.3 Moisture Migration Test

Figure 4.4 Absorption Test

Figure 4.5 Evaporation Test



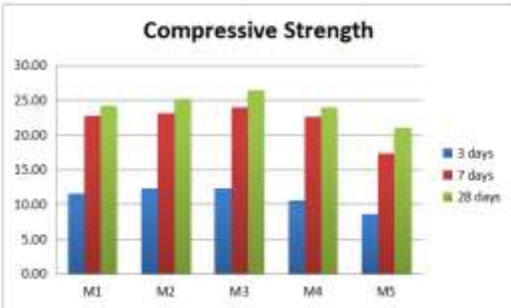
RESULTS AND DISCUSSIONS

5.1 COMPRESSIVE STRENGTH

Table 5.1 Compressive Strength of different mixes

Compressive strength N/mm^2			
Mix	3days	7 days	28 days
M1	11.57	22.81	24.22
M2	12.31	23.19	25.19
M3	12.34	24.00	26.44
M4	10.61	22.59	24.00
M5	8.67	17.33	21.04

Graph 5.1 Compressive Strength of different mixes



Compression test is most commonly conducted test as it is the most desirable characteristic property of the concrete that is to be achived.In this investigation totally 45 cube moulds of size 150*150*150 were tested for knowing compressive strength of different mixes at 3 days , 7days, and 28 days.

- Comparision between the strengths of different mix proportions:
- The compressive strength has been increasing till the mx percentage is upto 1% and then the strength started decreasing.
- At 0% of fibre the strengths were 11.57 and 12.23Mpa when it was 1% then it increased to 12.34 at 1.5%.
- The strength has been reduced when 1.5% fibre is added. This has been repeated in all the periods of testing.
- As the strength parameters in the 7 days test had been increasing till the fibre was 1.5% and then the strength reduced when fibre is added by 1.5% and 2%.
- The results at 7 days for 0% and 1.5% have increased the strength from 22.81mpa to 24 mpa.
- In this investigation it shows that the strength parameters of the 28 days had been finally made small variations in the mix proportions 0% and 1.5%.
- The results at 28 days for have been increased in the mix ratio upto 1.5% and then it has been decreased.
- As the 28 days strength should achieve 20mpa and in the results we can observe that the strenth of the entire mix ratios when fibre is added whether it has been achieved the strength of the M20 grade mix.
- We can observe that the strength in the concrete has been increased by the addition of the fibre.

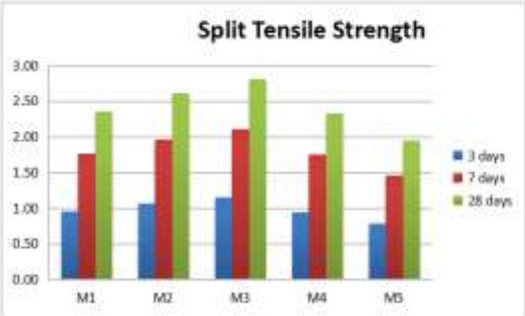
As it is mentioned as fibre can be used in concrete in the partial replacement to the reinforcement to some extent as it does not affect the strength property.

5.2 SPLIT TENSILE STRENGTH

Table 5.2 Split Tensile Strength for different mixes

Split Tensile Strength N/mm^2			
Mix	3 days	7 days	28 days
M1	0.96	1.77	2.36
M2	1.07	1.96	2.62
M3	1.15	2.11	2.81
M4	0.95	1.75	2.33
M5	0.79	1.46	1.95

Graph 5.2 Split Tensile Strength of different mixes



Direct measuring of the tensile strength of concrete is difficult. Neither specimen nor testing apparatus have been designed which can assure uniform distribution of pull is applied to the concrete. Many tests are made by finding out the flexural strength by making the beam moulds. In the present case the tensile stength is found by and indirect method that is Cylinder Split Tension Test.

Split Tensile test is conducted on the cylinders of the sizes in ratio 1:2 to the diameter and length of the specimen. In this investigation totally 45 cylinderical moulds of size 100mm*200 mm were tested for knowing Split tensile strength of different mixes at 3 days , 7days, and 28 days.

Comparision between the strengths of different mix proportions:

- As we know that concrete is strong in compression and weak in tension.
- Generally it is noted that Tensile strength must achieve 10% of compressive strength, as all the results have achieved the result.
- At 0% of fibre mix the strength is 0.96 when it was 0.5% then it increased to 1.07.

- As the strength parameters in the 7 days test had been increased in the mix upto the fibre was 1.0% and then it start decreasing.
- This affect made n the concrete may be due to the agglamiration of the fibre content.
- In this investigation it shows that the strength parameters of the concrete can be increased by adding the fibre content to the concrete.
- In all the periods and when the fibre is added to the concrete the split tensile strength has been increased.
- As there are many fibres present in the present world we made a research on the natural fibre.

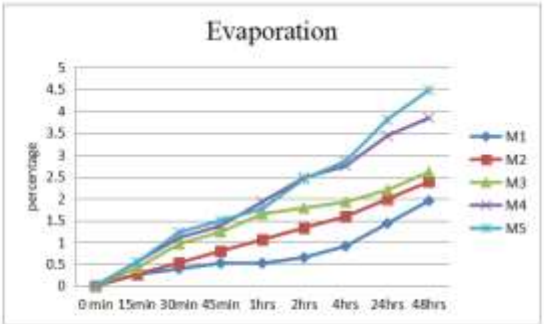
We can make use of the fibres to increase the tensile property of the concrete and it can also serve as the substitute naterial for the steel provided in the reinforced cement concrete.

5.3 EVAPORATION TEST

Table 5.3 Evaporation percentage in different mixes

Evaporation in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.259	0.389	0.519	0.519	0.649	0.908	1.427	1.946
M2	0	0.265	0.529	0.795	1.06	1.325	1.589	1.987	2.384
M3	0	0.412	0.96	1.235	1.646	1.783	1.92	2.195	2.606
M4	0	0.549	1.098	1.374	1.923	2.473	2.747	3.434	3.846
M5	0	0.543	1.222	1.495	1.766	2.446	2.853	3.804	4.484

Graph 5.3 Evaporation percentages in different mixes



Evaporation is the basic property to know about the transport property of the oncrete and that may affect the concrete if the conrete is having the large amounts of the water evaporation as the durability of the concrete may be affected.

Discussion between the evaporation occurred between the mix prportions of the slag.

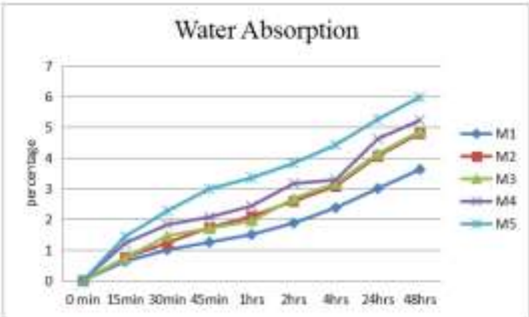
- The results that show in the table are made for all the mix proportions to make the variation that evaporation may vary by adding fibre to concrete.
- We can observe that in the early stages of the cube placed in the oven the evaporation is more from the specimens.
- Such that in the observations from the graph we can make a statement that the evaporation is increased by increasing the percentages of fibre.
- As the fibre is a natural dried weed material it will be having some percentage of water absorption.
- We can check the results absorbed from the 48 hrs test that has been conducted for the different types of the mixes of fibre.
- It has been noted as1.94, 2.38, 2.60, 3.84 and 4.48 for the fibre percentages of 0, 0.5 1, 1.5 and 2 respectively.
- We can observe the percentage evaporation is increased with the increase in the fibre percentage.
- So we can state that fibre has the property of the absorption
- That absorption of the water by the fibre should be calculated and the amount of the water percentage that is required should be added to it

5.4 WATER ABSORPTION TEST

Table 5.4 Water Absorption percentage in different mixes

Water Absorption in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.625	1	1.25	1.5	1.875	2.375	3	3.625
M2	0	0.74	1.233	1.726	2.096	2.589	3.082	4.069	4.808
M3	0	0.73	1.459	1.703	1.946	2.676	3.163	4.136	4.866
M4	0	1.217	1.824	2.068	2.433	3.163	3.284	4.622	5.231
M5	0	1.435	2.272	2.99	3.349	3.827	4.425	5.263	5.98

Graph 5.4 Water Absorption percentages in different mixes



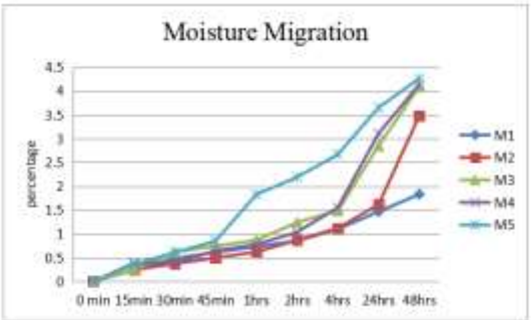
Water Absorption Test is conducted to find out the transport property of the concret and this is not tested on the shorter periods of time from the casting. In this investigation we had observed the absorption property of the specimens after the cubes are cured for the period of 28 days after they have casted. The cube used for this test is 150mm*150mm*150mm of size.

5.5 MOISTURE MIGRATION TEST

Table 5.5 Moisture Migration percentage in different mixes

Moisture Migration in %									
MIX	0 min	15min	30min	45min	1hrs	2hrs	4hrs	24hrs	48hrs
M1	0	0.244	0.489	0.611	0.733	0.855	1.1	1.467	1.833
M2	0	0.249	0.373	0.497	0.621	0.87	1.119	1.619	3.482
M3	0	0.248	0.62	0.744	0.868	1.24	1.488	2.853	4.094
M4	0	0.389	0.388	0.647	0.777	1.036	1.554	3.108	4.145
M5	0	0.365	0.609	0.852	1.827	2.192	2.67	3.654	4.263

Graph 5.5 Moisture Migration percentages in different mixes



Moisture migration is made in accordance with the water absprtion in the absorption test the specimen is immersed totally into the water where in this the bottom surface is touched to the water and then water is made to migrate to the top direction of the surfaces.

When the materials are closely packed and have the property of absorption the moisture migration will be occurred more. In some of the researches that are made the materials that are added as replacement of the ingradients or additional strength inducing elements will make more varitions in the transport propeerties.

CONCLUSION

All the material tests, strength test such as compression, split tensile and the transport properties like evaporation, water absorption and moisture migration had been carried out in the laboratory and as per code provison only.Results of experiments on different properties of different mixes in which fibre is added with different percentages

- The following conclusions are drawn from the investigation
- One day strength results are not to be estimate for the fibre content as the increase in the fibre percentage the setting time of the concrete is delayed.
- Freshly prepared Sisal fibre contain some gelatinous chemical reagents which may affect the chemical properties of cement in concrete
- When the percentage of fibre is increased by more than 1% reduction in mechanical properties is observed.
- Reduction in strength is due the increase in the fibre percentage and that may leads to porous structure by the agglamaration.
- Increase in strength up to 1% is due to utilisation of water present in fibre for chemical reaction at time of curing and less concentration of fibre created densily compacted medium in cement concrete
- The addition of the fibre in small amounts will increase the tensile strength.
- Addition of fibres not only increases tensile strength but also increases bond strength, decreases permeability.
- Toughness of concrete also increases

FUTURE SCOPE

- The sisal fibre used is taken from 3 to 5 cm But the exact length is to be known for its toughness
- Some reactions are taken at the time of curing that is to be observed
- The chemical reactions between sisal fibre and cement must be tested.
- The one day strength is not estimated the reasons to be traced out.
- The moisture is present it more thsn 24 hrs reasons must be known.
- Solution is to be made to control the agglamiration of the fibre at mixing.
- The structure and the surface texture of fibre to be observed.
- by the addition of the fibre.

REFERENCES

- M.A.Aziz, P.Paramasivam and S.L.Lee 1984-Natural fibres are prospective reinforcing materials and their use
- S.K. Al-Oraimi and A.C.Seibi (1995)-Mechanical characterization and impact behaviour of concrete reinforced with natural fibres
- G.Ramakrishna and T.Sundararajan (2002)-Rheological properties of coir fibre reinforced cement mortar
- K.Bilba, M.A.Arsene and A.Ouensanga (2003) - Sisalfibre reinforced cement composites
- Text book on properties of concrete by Nevielle
- Text book on concrete technology by M.S Shetty
- Text book on concrete technology by Ghambhir.

- IS: 383-1970 “Specification For Coarse And Fine Aggregates From Natural Sources For Concrete”
- IS: 456-2000 “Code Of Practice For Plain And Reinforced Concrete”
- IS: 516-1959 “Methods Of Testing For Strength Of Concrete”
- Splitting tensile stress is obtained using the formula based on IS: 5816-1970.
- Compression test is done confirming to IS: 516-1953.
- The specimens like are used to conduct the strength tests are taken according to IS10086-1982