Effect of Sisal Leaf Extract as an Admixture in Concrete

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ABSTRACT

There are several additives and admixtures are used to change the composition of concrete or to accelerate or retard its hardening, curing, workability etc., Chemical and mineral admixtures commonly used in production of concrete are too expensive and also polluting the environment. Sisal is a fiber yielding plant whose botanical name is Agave Sisalana. It occupies sixth place among fiber plants, representing 2% of the world's production of plant fiber. A vast quantity of sisal leaf juice (Extract) is generated during processing of sisal leaves for fiber production, which remain unutilized. It has caused negative environmental impact from its disposal. Research programmes already done to utilize the sisal leaf extract in Medical industry, but not in the construction industry so far, even though it is produced large in quantity. This study aims to use the extract of Sisal leaf, as bio-admixtures in making concrete. The properties of concrete, namely workability, compressive strength, split tensile strength and flexural strength for the three grades viz., M20, M25 and M30 were determined in the presence of 0.50 to 2.0% of sisal leaf extract as admixture in concrete.

Key words: Agave Sisalana, Sisal leaf extract, Admixture, Workability, Compressive strength, Flexural strength, flexural strength.

INTRODUCTION

In India the construction industry is the second largest industry. In past years, attempts are being made to amplify the fresh state and characteristics of cement concrete (compressive and tensile strength) by addition of chemical admixtures. This use of chemicals in construction leads to many types of influences in environment and different levels of pollution. Our ancestors have used various plants as admixture in construction of more than 10000 years ago to improve overall performance of the structure. Herbal admixture will definitely improve strength and durability of the mortar as well as concrete but at the same time does not create any harmful toxics to our environment.

1.1 ADMIXTURE IN CONSTRUCTION

Admixtures are ingredients other than water, aggregate, hydraulic cement, and fibres that are added to the cement batch immediately before or during mixing. A proper use of admixture offers certain beneficial effects to concrete, including improved quality, acceleration or retardation of setting time, enhanced frost and sulphate resistance, control of strength development, improve workability, and enhanced finish ability. It is estimated that 80% of concrete produce these days contains one or more types of admixtures. According to a survey by the National Ready Mix Concrete Association, 39% of all ready-mixed concrete products use fly ash, and at least 70% of produced concrete contains a water-reducer admixture. In field there are two types of admixtures available such as chemical and mineral admixtures. Chemical admixtures are materials that are added to the constituents of a concrete mixture, in most cases, specified as a volume in relation to the mass of cement or total cementitious material. The admixture interacts with the hydrating cementitious system by physical and chemical actions, modifications one or more of the properties of concrete in the fresh and/or hardened states. The most common type of chemical admixtures are Air entertainers, water reducers (Super plasticizers), Accelerators and Retarders.

Mineral such as clay, shales, volcanic tuffs called pozzolanic materials, when it is added to cement concrete which is modifies the properties of cement concrete. It involves reduction of alkali aggregate reaction, lower costs and lower heat of hydration.

1.2. PROBLEMS ASSOCIATED WITH CHEMICAL ADMIXTURE

Though chemical admixtures used in the construction industry serve a great deal in modifying the essential properties of concrete thereby helping in an effective constructional practice, they possess certain environmental risks. Chemical such as lignosuitonic acids, Hydroxylatedcarboxylated acids, sulfonated melamine are used as water reducers. Calicum chloride, salts of formats, nitrates, nitrites, and thiocyanates are used as accelerators. Sulfonated melamine formaldehyde condensate, polyether-polycarboxylates is used as Super plasticizers.

All these chemicals through used in construction only, they find their way into the environment during any one of these stages such as production, Transport, Storage /handling, Use of the concrete admixture, Service life of the building, Recycle of concrete for demolition, disposal of building waste and residues etc. Possibly, also production wastewater and wastewater from construction sites can be relevant sources for construction chemicals in the environment. Most of the above construction chemicals are polar organic compounds. Considering their polarity, they are assumed to leach from concrete into the aquatic environment . These water soluble chemicals leach from concrete and mix with groundwater and in some cases when the structures are present near streams or oceans, they enter these water currents and turn them toxic thus mildly affecting fishes and other aquatic organisms. When these chemicals pollute groundwater they also have significant bearing on human health.

1.3. SCOPE AND OBJECTIVE

The objective of the project is to study the feasibility of Sisal Leaf Extract as an admixture in making eco-friendly concrete. The properties like workability, compressive strength (cube and cylinder),

split tensile strength and flexural strength of M20, M25 and M30 grades of concrete using sisal leaf extract at 0.5 to 2.0 % by weight of cement as admixture in concrete were studied.

LITERATURE REVIEW

2.1 GENERAL

In this chapter, the work carried out by various Investigators (in India and abroad) on the use of Plants and its Extracts for improving the mechanical properties of concrete are reviewed and presented.

2.2 PREVIOUS WORK ON ORGANIC PLANTS AND EXTRACTS

Luu and Getsinger (1990) quantified the amount of carbohydrates in the Water Hyacinth plant sample extract and it could be chosen as a new and promising candidate for admixture [1].

Uchikawa et al (1997) Some phyto based organic admixtures could induce physical effects which modifies the bonds connecting particles and could act on the chemical processes such as hydration, principally on the crystal growth and nucleation [2].

Faroogi et al (1997) were said that Plants have always been recognized as source of naturally occurring compounds, some are with rather complex molecular structures and also have varying physical, chemical and biological properties [3].

Arum.C and A.O. Olotuah (2006) Plant extracts contain a wide range of organic components. Extracts of plant based materials have been used as admixtures in altering the various properties of cement as an alternative to calcium chloride component in cement [4].

Juana-Bosco Hernandez-Zaragoza et.al (2007) were found that increase in compressive strength of mortar modified with cactus gum. Cactus gum at 1.5g gives increase in compressive strength at 65% high that of reference concrete [5].

Abdul Rahman A.S. et.al (2011) were found that Concrete resistivity is 40% higher when 2% bamboo leaf extract is used than that of control condition [6].

Abdeljaleel N.S. et al., used cleanest kind of gum Arabic, which is extracted from (Hashab) trees. Gum Arabic liquid is used to concrete mixes at various proportions with respect to cement content. Addition of gum Arabic at 0.4% of cement content to the concrete mixes has showed improvement in compressive strength [7].

A.A Torres-Acosta, et.al (2012) were found that , adding Nopal or Aloe vera at concentration between 1% and 2% by mass of cement , might be suitable for durability enhancing applications in alkaline media, especially in concrete structures [8].

Shi Qiang Fang et.al (2014) were found that the lime mortar used in ancient building contains organic matters in mortar and the same was recorded in ancient documents [9].

A.Sathya et.al (2014) investigated that the compressive strength and setting time of cement are influenced by the bio admixture hydro extract and bio fine powder of water hyacinth. The initial setting times are 14 min and 10 min more in case of extract and powder replacement respectively. The compressive strength at 20% replacement of extract gives 1.33 times more that of reference mortar. The compressive strength at 20% replacement of bio powder gives 1.20 times more than that of reference mortar [10].

Otoko G.R. et al., investigated on usage of palm liquor as concrete admixture and set retarder. The results obtained shows that palm liquor shows improvement in honey combing, compaction and increases the workability of concrete with maximum performance at replacement of 16% water by palm liquor [11].

Abraham Mengesha Woldemariam et.al (2015) were found that blue gum extract at all replacement level (5%, 10% and 15%) give less and no cracks in all exposed condition, such as direct sunlight,

away from sunlight in all curing period. The plant extract decreased shrinkage and hence blue gum extract can be used as shrinkage reducing admixture in concrete [12].

R.Amaran and R.ravi (2016), were found that use of cactus in the cement improves the plasticity, workability and strength of the concrete [13].

M.Pradeep Kumar et.al (2016) investigated that 5% of kadukkai with plain concrete gives 1.832 times and 1.369 times increased compressive strength and flexural strength respectively than that of ordinary concrete. It is acted as retarders in concrete, so it can be used in hot climatic condition at the same time without affecting the strength of concrete [14].

P.Vijay Prabhu et.al (2016) were found that both in lime and cement mortar the compressive strength increase with increase in jaggery water irrespective of curing period. 100% jaggery water admixture in lime mortar and cement mortar gives 1.24 and 1.88 times higher strength than of reference mortar in 28 days respectively [15].

E.F. Hernandez et.al (2016) investigated that the compressive strength of concrete with combination of cactus mucilage and seaweed extract increased strength at 120 days by 20% with respect to control mix [16].

Magendran Subramani., studied on effects of addition of palm oil fiber on density workability, compressive and flexural strength of concrete. On addition of palm oil fibres at 0.5% of cement to concrete, an increase in the flexural and compressive strength was observed [17].

G.D.O.Okwadha, et al. are found that the water hyacinth extract can be used as a super plasticizer in a SCC mix, since it satisfies the flow test. Increase in setting time. Retards hydration rate and hardening process of concrete [18].

Sara Abdullatief Ali Satti et.al discussed that Acacia seyal, Taleh gum (TG) at a dosage level of 0.8% by cement weight has been proved to be dual function concrete admixture, namely a setting accelerator (SA) and normal water reducer (WR) [19].

Shobha M.S., examined on the addition of natural rubber latex into the Metakaoline blended concrete to increase the performance of the normal concrete. The study concludes with the optimum dosage of natural rubber latex to be 1% by weight of cement in the concrete [20].

Ravindra R were investigated that the average water content reduction can be made up to 10% when rain tree pod extract plasticizer used. For boiled and fermented solution concrete compressive strength increased by 12.65% for 0.1% dosage. For soaked and fermented solution concrete compressive strength increased 12.77% for 0.1% dosage [21].

R.De Gutierrez investigated that Fique plant juice at 10% replacement of water to obtain normal consistency with W/C ratio of 0.208 where as it is 0.237 in case of without admixture. Hence Fique plant extract can be used as plasticizer water reduction admixture. The addition of 2% Fique admixture increases the strength in order of 25% for cement pastes and 50% for cement mortar [22].

Nkunya were found that majority of the compounds extracted from plants find their use in traditional applications [23].

2.3 NECESSITY OF BIO-ADMIXTURE

Still, the uses of naturally available compounds are of primary interest, owing to their cheap and abundant availability and more over, as they are eco-friendly. On account of these advantages, extracts and phyto-chemical residues of some commonly available plants and plant products have been tried as concrete and cement admixtures for imparting and maintaining the strength of the structures. It is not precisely known about the exact period from when the use of admixtures in cement and concrete began but it could be ascertained that some of the ancient civilizations used admixtures. For example, the Roman civilization used milk, lard and blood, eggs were used as admixtures by Europeans in the middle ages, the Chinese employed rice paste, Laccures, tund nil, molasses and boiled bananas as admixtures; Cactus Juice, latex were utilized by the people of America and Peru; extracts of barks were in use for Mayans as admixtures.

EXPERIMENTAL INVESTIGATIONS

3.1. GENERAL

In this chapter, the experimental investigations to study the properties of materials used for finding out the slump values for various grades of concrete and compressive strength of cement concrete using sisal leaf extract as an admixture are presented.

3.2. PROPERTIES OF MATERIALS USED

Cement, graded coarse aggregate (CA) of maximum size of 20mm, fine aggregate (FA) sand conforming to Zone –II based on Is; 383-1970 and Sisal Leaf Extract (SLE) are the various materials used in this study. The basic properties of the above materials are given below.

3.2.1. Cement

43 grade OPC (Coromandel) is used and the required quantity was procured a single batch, stored and used throughout the whole programme. The physical properties of cement obtained and used are given in Table 1.

Table: 1 Physical properties of OPC

Sl.No.	Property	Results
1	Normal consistency	29%
2	Initial setting time	158minutes
3	Final setting time	221minutes
4	Specific gravity	3.15
5	Compressive strength(*)	
	3 days	26.88 N/mm^2
	7 days	35.03 N/mm^2
	28 days	46.08 N/mm^2

Note: (*) Standard sand is used

3.2.2. Coarse Aggregate (CA)

Graded coarse aggregate (crushed granite stones) of maximum size of 20mm is used. Table 2 shows the properties of the above CA.

Table 2 Properties of Coarse Aggregate

Sl.No.	Property	Results
1	Specific gravity	2.69
2	Water absorption	0.65%
3	Particle shape	Angular

3.2.3 Fine Aggregate (FA)

Sand conforming to grading Zone – II of IS : 383-1970 is used as fine aggregate (FA). Its properties are given in Table 3.

Table 3 Properties of Fine Aggregates

Sl.No.	Property	River Sand	M Sand
1	Specific gravity	2.61	2.77
2	Water absorption	1.05%	0.75%
3	Fineness modulus	2.674	2.856

3.2.4 Sisal Leaf Extract

Sisal leaves were harvested from Neyveli, Tamilnadu is used in this project. These leaves were cleaned in running water to get cleaned well and hanged for one hour so as to wipe off water. Then Sisal leaf extract is extracted with the help of sugarcane juice extracting machine and filtered and stored for analysis.

The physical properties of leaves like leaf length, width, thickness, weight, extract quantity, pulp etc., were found out. The leaves of equal length of 1.35m were taken for analysis. The leaves were marked at an interval of 0.15m along their length starting from tip-end to butt-end and cut using chisel. The transversal area at every 15cm of leaf was found out by making impression on a white paper using stamp pad and scanning their true images using Auto CAD and shown in Fig.1. The quantity of sisal leaf extract and fibre with pulp were found out and are given in Table 4.

The method of extraction of the SLE from sisal leaf is given in Fig. 2. The extract of sisal leaf was subjected to Gas Chromatography-Mass Spectrometer analysis (Fig. 3) to know the components present in it and its physical properties are given in Table 5 and Table 6.

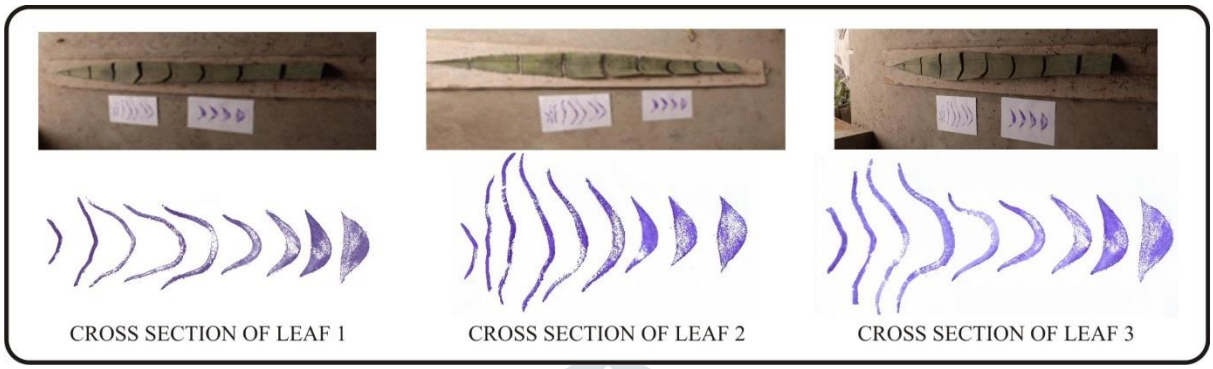

Fig. 1 CROSS SECTION DETAILS OF CROSS SECTION

TABLE 4 WEIGHT AND % OF EXTRACT OF SISAL LEAF

Sl.No	Description and Length	Total Weight (kg)	Weight of Juice (Extract) (kg)	Weight of Fibre + Pulp (kg)	%of Extract	% of Fibre + pulp
1	Leaf(1) – 1.35 m	0.960	0.275	0.685	28.65	71.35
2	Leaf(2) – 1.35 m	1.060	0.295	0.765	27.83	72.17
3	Leaf(3) – 1.35 m	1.075	0.300	0.775	27.91	72.09
	Average	**1.032**	**0.290**	**0.742**	**28.13**	**71.87**

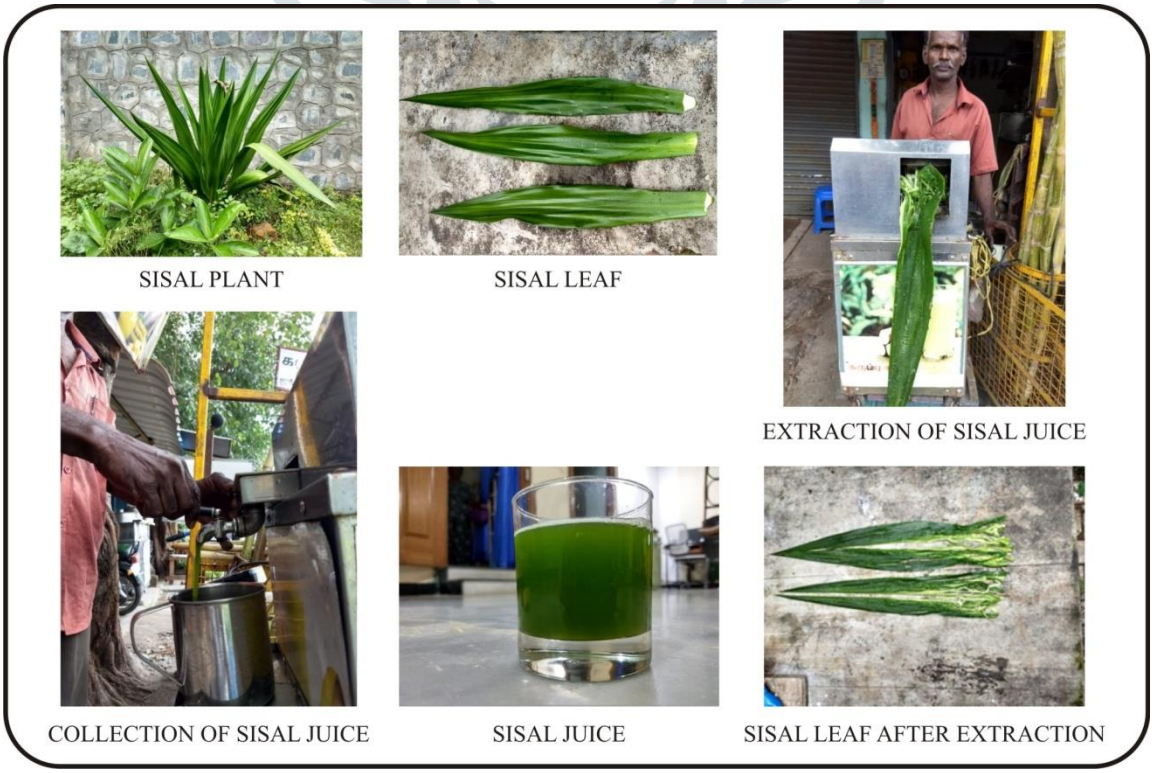

Fig. 2 EXTRACTION OF SISAL JUICE

TABLE 5 COMPOSITION OF SISAL LEAF EXTRACT USING GCMS ANALYSIS

Sl. No	Compound Name	Formula	Component RT	Component Area (%)
1	1-Dimethy (isopropyl)silyloxypropane	$C_8H_{20}OSi$	5.653	12.674
2	3-Piperidinol,1-ethyl-6-methyl	$C_8H_{17}NO$	7.673	0.504
3	n-Decanoic acid	$C_{10}H_{20}O_2$	8.458	8.309
4	7-Tridecanol, 7-ethyl	$C_{15}H_{32}O$	10.558	0.585
5	Imidazo(4,5-b)pyridin-2-one,2,3-dlhydro-6-iodo-3-methyl	$C_7H_{61}N_3O$	12.080	0.049
6	Ketone,isopropylidenecyclopropyl methyl	$C_8H_{12}O$	12.167	1.387
7	Hexadecanoic acid,methyl ester	$C_{17}H_{34}O_2$	13.405	21.574
8	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	13.873	26.917
9	Dihexyverine	$C_{20}H_{35}NO_2$	13.882	2.887
10	Heptanoic acid,3,7-dimethyl-2,6-octadienyl ester,(E)	$C_{17}H_{30}O_2$	15.850	1.111
11	4-Nonenoic acid, methyl ester	$C_{10}H_{18}O_2$	15.934	4.990
12	9-Octadecenoic acid(Z), methyl ester	$C_{19}H_{36}O_2$	15.945	15.278
13	4H-Pyrrolo[3,2,1-ij]quinoline-6-carboxaidehyde, 1,2-dihydro-4-oxo-	$C_{12}H_9NO_2$	16.296	0.459
14	2,7-Octadien-1-ol	$C_8H_{14}O$	16.444	2.548
15	2H-1,2-Oxaborin, 2,3,3-triethyl-3,6-dihydro	$C_{10}H_{19}BO$	16.808	0.727

TABLE 6 PHYSICAL PROPERTIES OF SISAL LEAF EXTRACT

Sl.No	Property	Value
1	Dry material content	93.80%
2	Ash content	0.19%
3	Relative Density	971 Kg/m^3
4	Chlorine Ion Content (as Cl)	301.1mg/L
5	pH value	3.66
6	Specific Gravity	0.971
7	Viscosity @ 27^{0}C	0.40 cSt

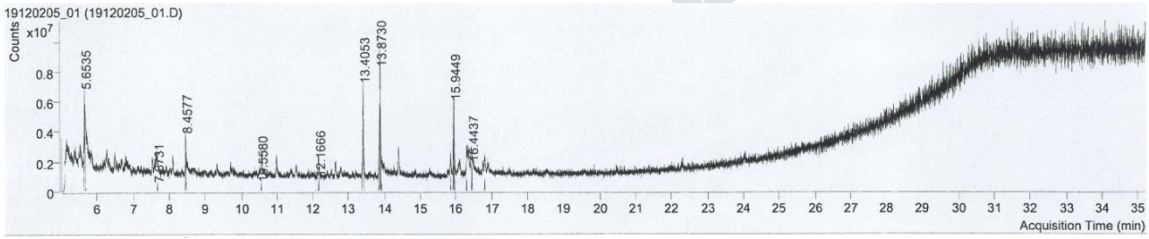

Fig. 3 GCMS analysis of Sisal Leaf Extract

3.2.5 Water

Ordinary potable tap water available in laboratory was used for making concrete and for curing purposes.

3.3 MIX PROPORTIONING OF CONCRETE

3.3.1 Mix Proportioning

The mix proportioning for M20, M25 and M30 grades were arrived by adopting IS method of mix design. The details of mix proportions are given in Table 7, 8 and 9.

TABLE 7 MIX DESIGN – M20

Sl.No	Extract % as Admixture	W/C	Cement (kg)	F.A (kg)	C.A (kg)	Water (litre)	Sisal Extract (kg)
1	0	0.50	315	744	1251	158	0
2	0.5%	0.50	315	734	1235	158	1.575
3	1.0%	0.50	315	733	1233	158	3.150
4	1.5%	0.50	315	731	1230	158	4.725
5	2.0%	0.50	315	730	1227	158	6.300

TABLE 8 MIX DESIGN – M25

Sl.No	Extract % as Admixture	W/C	Cement (kg)	F.A (kg	C.A (kg)	Water (litre)	Sisal Extract (kg)
1	0	0.45	350	706	1239	158	0
2	0.5%	0.45	350	704	1235	158	1.750
3	1.0%	0.45	350	703	1234	158	3.500
4	1.5%	0.45	350	701	1230	158	5.250
5	2.0%	0.45	350	699	1227	158	7.000

TABLE 12 MIX DESIGN – M30

Sl.No	Extract % as Admixture	W/C	Cement (kg)	F.A (kg)	C.A (kg)	Water (litre)	Sisal Extract (kg)
1	0	0.40	394	673	1234	158	0
2	0.5%	0.40	394	672	1231	158	1.970
3	1.0%	0.40	394	670	1228	158	3.940
4	1.5%	0.40	394	668	1224	158	5.910
5	2.0%	0.40	394	666	1220	158	7.880

3.4 TESTS ON WET CONCRETE

3.4.1 Workability of Concrete

Workability test on three grade of concrete (M20, M25 and M30) were conducted with Sisal leaf Extract as admixture at 0.50%, 1.0%, 1.5% and 2.0% by weight of cement. The standard test

procedure was adopted for conducting the slump test and the results of slump values are given Table 13.

3.5 TESTS ON HARDENED CONCRETE

Compressive strength on cube and cylinder, Split tensile strength on cylinders and Flexural strength on prism were conducted on hardened concrete after 28 days of normal immersed curing. 150 x 150 x 150 mm cubes and 150 mm dia. x 300 mm height cylinders for determining compressive strength; 100 mm dia. X 200 mm height cylinders for split tensile strength and 100 mm x 100 mm x 500 mm beam specimen for determining Flexural strength were casted for each combination of mix proportions are given in Tables 14 and 15. Compressive and Split tensile strength tests were carried out on 3000 KN and 1000KN capacity compression testing machine respectively. Whereas, Flexural strength tests were carried out on 100 KN flexural testing machine under two point loads (the point loads are applied at 1/3 of span). All the above tests were carried out in accordance with the standard IS methods.

TABLE10 WORKABILITY ON WATER – SLE REPLACEMENT CONCRETE (SLUMP VALUE) IN MM

Sl.N o	Grade	*Reference*	*0.5%*	*1.0%*	*1.5%*	*2.0%*
1	M20	15	20	30	45	60
2	M25	20	25	40	50	65
3	M30	20	30	45	60	75

TABLE 11 COMPRESSIVE STRENGTH OF CONCRETE

Description and Replacement level	Compressive strength (Mpa)			Ratio of Cyl.To Cube Comp. strength
	Cube		*Cylinder*	
	7 days	*28 days*	*28 days*	
M20				
Ref	14.06	26.13	19.01	0.728
0.5%	18.32	28.76	20.84	0.725
1.0%	**19.34**	**32.51**	23.78	0.731
1.5%	18.56	30.05	20.39	0.679
2.0%	15.95	29.01	20.11	0.693
M25				
Ref	19.65	32.16	22.77	0.708
0.5%	22.70	37.50	26.70	0.712
1.0%	24.13	37.61	28.32	0.734
1.5%	**25.92**	**40.01**	30.69	0.767
2.0%	22.06	37.83	28.48	0.753
M30				
Ref	23.87	39.46	29.99	0.760
0.5%	27.30	44.72	34.93	0.781
1.0%	30.70	46.37	36.63	0.790
1.5%	31.36	49.85	39.98	0.802
2.0%	**33.20**	**50.67**	41.14	0.812

TABLE 12 SPLIT TENSILE AND FLEXURAL STRENGTH OF SLE- CONCRETE

Sl. No	**Description and replacement level**	**M20**		**M25**		**M30**	
		Split tensile strength	***Flexural strength***	***Split tensile strength***	***Flexural strength***	***Split tensile strength***	***Flexural strength***
1.	Ref	2.375	3.656	2.452	4.168	2.782	4.388
2.	0.5%	2.795	4.001	2.712	4.198	3.009	4.476
3.	5.0%	2.835	4.106	2.850	4.305	3.285	4.662
4.	7.5%	2.612	3.910	2.952	4.504	3.465	4.807
5.	10.0%	2.590	3.816	2.650	4.105	3.550	4.953

4 RESULTS, DISCUSSION AND CONCLUSIONS

4.1 GENERAL

In this chapter, results of the various tests conducted on three grades of concrete M20, M25 and M30 considering sisal leaf extract as bio-admixture at 0.50% to 2.0% by weight of cement are presented.

4.2 RESULTS AND DISCUSSION ON WORKABILITY OF WATER – SLE IN CONCRETE

The results of the various tests conducted on three grades of concrete M20, M25 and M30 considering at various percentage of sisal leaf extract ranging from 0.5% - 2.0% are discussed in detail.

4.2.1 Sisal leaf extract

The quantity of sisal leaf extract available is arrived 28.13% i.e. 281.30 kg of extract is produced per ton of sisal leaf. The annual production of sisal fibre is 281 thousand tons and the fiber content is estimated only 4%. It means nearly 2000 thousand tons of sisal leaf extract is produced annually. About 15 components were identified in GCMS analysis. Compounds belonging to ketones, aldehydes, alcohols and fatty acids were recorded. Out of these, the components highlighted at Sl. No7, 8 and 12 namely; Hexadecanic acid, Octadecadienoic acid (common name Linoleic acid) are also identified. The possible components identified are presented in Table 6. Chromatogram of GCMS analysis of sisal leaf Extract is presented in Fig.3.

4.2.2 Workability of fresh concrete

Results of the above tests are given in Table 3.5 and 3.6. From the above results, it can be inferred that the slump values are increases with increases in SLE percentage in all the three grades of concrete of concrete M20, M25 and M30.

4.2.3 Compressive strength of concrete

Compressive strength (cube and cylinder) of reference and SLE cement concretes (for 4 different percentage) for M20, M25 and M30 are given in Table 13. From the above results, it can be seen that the compressive strength at 28 days of SLE cement concrete yields maximum strength than that of reference concrete, for all SLE percentage and for all grades of concrete M20, M25 and M30. It was further inferred that Sisal leaf extract can be used as admixture at 1.0% for M20, 1.5% for M25 and 2.0% for M30 grade to get maximum compressive, split and flexural strength than the reference

concrete. This clearly shows that sisal leaf extract can be safely used as water reducing and accelerating admixture in making concrete.

4.2.4 Split Tensile and Flexural Strength

The results of the above tests for various percentage of SLE and three grades of concrete are given in Table 15. It is seen that like compressive strength (cube and cylinder) both Split tensile strength and Flexural strength were more than that of reference concrete at all percentage of SLE in all the three grades of concrete considered in this project.

In general lignin, cellulose and hemi cellulose improves the binding and cementing of the grains of cement compounds as observed in the scanning electron micrograph of concrete cubes at maximum replacement level with SLE for different grade of concrete (M20, M25, M30). The SLE of sisal leaf could contain dissolved small fragment of lignocelluloses which could have partially dissolved in water could multiply the binding effect of these compounds on cement. According to Hewlett (1988), lignin is a water reducing agent but accelerator of setting of cement due to increased binding [24].

4.4 CONCLUSIONS

Based on the extensive experimental investigations carried out on SLE-Cement concrete the following conclusions are drawn.

As the SLE percentage increases, workability increases in all the three concrete grades M20, M25 and M30.

Compressive strength (cube and cylinder) of SLE cement concretes for all four percentage (0.50%, 1.0%, 1.5%, 2.0%) at 28 days, yields more strength than that of reference concrete, for all grades of concrete M20, M25 and M30. It is due to presence of lignin, cellulose and hemi cellulose that improves the binding properties and cementing of grains of cement compounds of concrete cubes

when sisal leaf extract is used as admixture. This clearly shows that sisal leaf extract can be safely used as water reducing and accelerating admixture in concrete

Like compressive strength (cube and cylinder) both Split tensile strength and Flexural strength were maximum at all percentage of SLE in M20, M25 and M30 that of reference concrete.

The environment pollution due to sisal leaf waste will be minimized due to usage of SLE as Bio-admixture in concrete.

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