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A Review on Coir Fiber Treated with natural rubber Latex as Concrete Reinforcement Material in cement Based Composites

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Abstract: ***Concrete is acknowledged to be a relatively brittle material and when subjected to normal stresses and impact loads, the tensile strength is one tenth of its compressive strength. Because of this characteristics, concrete flexural members could not support such loads that usually take place during their service life. There are two important aspects which is always to be considered in order to achieve durable concrete first is durability and other is impermeability. The overall goal of this research is to investigate the behavioral study of natural fiber when using with natural rubber latex in concrete structure. There are many types of natural fiber are available such as Sugarcane, Rice husk and Coir and they are easily available. These composites have high impact strength and they can be regarded as an environment friendly material. In this experimental study, coir fibre is treated with natural rubber latex. The presence of natural rubber latex in concrete improves the performance of concrete. There are some specimen of different size was constructed for different test and compare the properties of coir fiber reinforced concrete with conventional concrete such as compressive strength ,cylinder compressive strength , split tensile strength , modulus of rupture, modulus of elasticity and shear test.***
Keywords: Rubber latex, Coir fibre, Durability, Compressive strength, Modulus of Rupture.

I. INTRODUCTION

Civil Engineering structures made of steel reinforced concrete normally suffer from corrosion results in the failure of those structures. Therefore constant maintenance and repairing is needed to increase the life of those civil engineering structures. There are different ways to minimize the failure of the concrete structures made of steel reinforce concrete. The simple way to increase the life of structure is by using bond fiber polymer composites onto the structure. By this the tensile strength and the toughness of the structure increase and it also improve the cracking and deformation characteristics of the structure. But this method also have a negative point, which is prone to degradation. When these fibre composites is exposed to marine environment they are suffering from degradation because of surface blistering. Due to this degradation the adhesive bond strength is reduced and de-lamination of the composites occurs. Another way is to replace the steel bars with fibers to produce a fiber reinforced concrete and this is termed as FRC. Basically this type of reinforcing concrete alters the properties of the non-reinforced cement-based matrix which is brittle in nature, possesses little tensile strength compared to the inherent compressive strength. We have enough natural resources and we must keep on researching on these natural resources. Development of natural fiber composite has started to begin recently. Among the various natural fibers, bamboo fibers, coir fibers and jute fibers are of particular interest. These fibre composites have high impact strength but having moderate tensile and flexural properties and it can be regarded as an environment friendly material.
There has been growing interest in recent year in utilizing coir fiber as low cost building materials. There are many investigations carried out for the use of coir fibre in cement past, cement mortar, and cement concrete. The presence of fiber improves the ductility of mix, tensile and flexural strengths of mix, fracture roughness and crack inhibiting properties of the matrix. In this investigation different size of coir fiber is treated with natural rubber latex. The effect of fiber content, different fiber length, physical and mechanical properties of these composite have been analyzed.

II. APPLICATIONS OF FIBER REINFORCED CONCRETE

The inclusion of fibers in concrete is to delay and control the tensile cracking of composite material. Fibers thus transform an

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inherent unstable tensile crack propagation to a slow controlled crack growth. This crack controlling property of fiber reinforcement delays the initiation of flexural and shears cracking. It imparts extensive post cracking behavior and significantly enhances the ductility and the energy absorption capacity of the composite. Earlier fiber-reinforced concrete was used in pavements and industrial floors. But subsequently, Fiber Reinforced Concrete have wide variety of usages in structures such as heavy-duty pavements, Airfields, industrial floor, water retaining and hydraulic structures, parking structure decks, water and waste water treatment plants, pipes, precast roof and wall panels, and the techniques of shotcrete application.

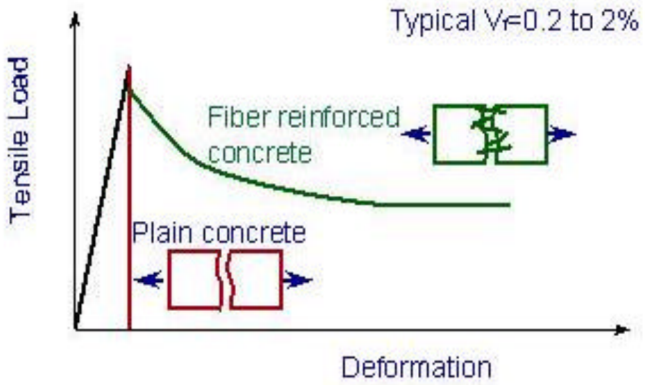

Figure 1: Tensile Load versus Deformation for Plain and Fiber Reinforced Concrete.

III. REVIEW ON NATURAL FIBRES

Natural fibers are prospective reinforcing materials and their use until now has been more traditional than technical. They have served many useful purposes but the application of materials technology for the utilization of natural fibers as the reinforcement in concrete has only taken place in comparatively in recent years. The distinctive properties of natural fiber 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 fiber reinforced concrete is also required to be durable. Durability relates to its resistance to deterioration resulting from external causes as well as internal cause.

IV. MATERIALS

A. Cement

Ordinary Portland cement of 43 grade conforming to IS 8112-1989 was used. Tests were conducted on various natural (physical) properties of cement and the results are shown Table 1.

Physical Properties	Value of OPC used	Requirement as per IS 8112-1989
Standard Consistency	29.2%	-
Initial Setting Time	45 Minutes	Minimum of 30 Minutes
Final Setting Time	265 Minutes	Maximum of 600 Minutes
Specific Gravity	3.15	-
Compressive Strength in N/mm^2 at 3 days	29	Not less than
Compressive Strength in N/mm^2 at 7 days	38.5	Not less than
Compressive Strength in N/mm^2 at 28 days	48	Not less than

Table.1 Physical Properties of Cement

B. Fine Aggregate

Natural river sand was used as fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part- I). The results are shown in

Physical properties	Values
Specific Gravity	2.6
Fineness Modulus	2.83
Water Absorption	0.75%
Bulk Density (kg/m^3)	1654
Free Moisture Content	0.1%

Table.2 Physical Properties of Fine Aggregate

C. Coarse Aggregate

Granite stones are generally used as a coarse aggregate in concrete mix. These stones are found in local queries. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests as per IS: 2386 (Part – III).

Physical properties	Values
Specific Gravity	2.6
Fineness Modulus	2.73
Water Absorption	0.5%
Bulk Density (kg/m3)	1590
Free Moisture Content (%)	0.2%
Aggregate Impact value (%)	11.2
Aggregate Crushing value (%)	25.12

Table.3 Physical Properties of Coarse Aggregate

D. Water

Portable water free from salts was used for casting and curing of concrete as per IS: 456 – 2000 recommendations.

E. Fibers

Coir is an inexpensive fiber among the natural fibers available in the most part of the world. Furthermore, it possesses the advantages of a lignocelluloses fiber.

Color	Brown
Fiber length mm	10-200
Fiber diameter mm	0.2-0.35
Bulk Density, kg/m^3	140-150
Ultimate tensile strength, N/mm^2	80-120
Modulus of elasticity, N/mm^2	18-25
Water absorption, %	30-4

Table 4. Typical Properties of coir fiber

F. Latex Rubber

Latex is the stable dispersion (emulsion) of polymer micro particles in an aqueous medium. Latex may be natural or synthetic. It can be made by polymerizing a monomer such as styrene that has been emulsified with surfactants.

Latex as found in nature is a milky fluid found in 10% of all flowering plants. It is a complex emulsion consisting of proteins ,alkaloids, starches, sugars, oils, tannins, resins, and gums that coagulate on exposure to air. It is generally exuded after tissue injury. In most plants, latex is white, but some have yellow, orange, or scarlet latex.

S.No.	Property	Rubber latex
1.	Color	White
2.	Total Solid Content (% By Weight)	61.5 Max.
3.	Dry Rubber Content (% By Weight)	60 Min.
4.	Non Rubber Solid Content	1.50 Max.
5.	KOH Number	0.55 Max.
6.	Ammonia Content, NH_3%	0.70 Max.
7.	Mechanical Stability Time	600 To 1200
8.	Volatile Fatty Acid Number	0.10 Max.
9.	Magnesium Content	8
10.	P_{11}	10.4 Min.
11.	Coagulum Content, % By Mass	0.01 Max.
12.	Sludge Content % By Mass	1.01 Max.
13.	Copper Content as PPM	5
14.	Iron Content as PPM	8
15.	Particle Size of Rubber latex	0.2µm
16.	Specific Gravity of Rubber latex	0.94

Table 5. Physical properties of Rubber latex

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V. METHODS

Coir is an inexpensive fiber among the natural fibers available in the world. Furthermore, it possesses the advantages of a lignocelluloses fiber. In the present study brown coir fiber is used. The important properties of the Coir fiber and Latex rubber are listed in the Table 4 and Table 5.In this experiment M25 grade concrete is used. Concrete was made with 43 Grade cement with river sand and 20mm and down coarse aggregate. The quantity of materials used as per mix design as follows. Cement = 383 Kg/m^3, fine aggregate = 571Kg/m^3, coarse aggregate = 1241Kg/m^3, Water = 191.6 Kg/m^3, water/cement ratio =0.45

VI. PREPARATION OF COMPOSITES

Coir pith and other undesirable materials are separated from the coir fiber. It is then chopped to about different length of 20mm, 25mm and 30mm and subjected to chemical treatments. Coir fibers are soaked in sodium hydroxide solution for 48 hours. Fiber were taken out, repeatedly washed with water and dried in the air. Latex compound is prepared by mixing 70% of natural rubber latex and 10% of sodium hydroxide solution and 20% of water. The latex compound and the resign solution were agitated to achieve homogenization. Then the coir fiber is dipped in the mixture about 15minutes and dried.

VII. CASTING OF SPECIMEN AND TESTING

All the beams specimens were cast in steel moulds. Laboratory type mixer machine was used to mix the ingredients of concrete. To avoid balling effect of fibers, the following procedure was followed in casting. First, aggregates and cement were put and allowed to mix for one minute and water was added within two minutes. Then, fibers were uniformly dispersed throughout the mass with slow increment. Finally, concrete was allowed to mix for three minutes. All the specimens were well compacted using table vibrator. The specimens were remolded after one day and then placed in a curing tank for 28 days of curing. For 12 hours prior to the testing, the specimens were allowed to air dry in laboratory. For **cube compressive strength** specimens of size 150 mm with 58 mixes were casted and tested. Three volume fractions were considered for coir fiber of three different lengths. For **cylinder compressive strength** specimens of size 150 mm diameter and 300 mm height with 58 mixes were casted and tested. For **split tensile strength** specimens of size 150 mm diameter and 300 mm height with 58 mixes were casted and tested. For **modulus of rupture** specimens of size 500 mm x 100 mm x 100 mm with 58 mixes were casted and tested. For **modulus of elasticity** specimens of size 150 mm diameter and 300 mm height with 58 mixes were casted and tested. For **shear strength** 'L' shaped specimens with 58 mixes were casted and tested. Three volume fractions were considered for coir fiber of three different lengths.

PROPERTIES	CONCRETE TYPE	VOLUME FRACTION (V_F) IN %	ASPECT RATE(I/D)	FRI(V_{F*}I/D)	EXPECTED STRENGTH (MPA)
COMPRESSIVE STRENGTH	CC	-	-	0	27.33
	CFC	1.0%	90	.90	30.54
CYLINDRICAL COMPRESSIVE STRENGTH	CC	-	-	0	21.56
	CFC	1.0%	90	.90	24.67
SPLIT TENSILE STRENGTH	CC	-	-	0	2.86
	CFC	1.0%	90	.90	3.98
MODULUS OF RUPTURE	CC	-	-	0	4.06
	CFC	1.5%	90	1.35	5.44
MODULUS OF ELASTICITY	CC	-	-	0	21.06
	CFC	1.0%	90	0.90	24.88
SHEAR STRENGTH	CC	-	-	0	6.12
	CFC	1.0%	90	0.90	8.91

VIII. RESULT AND DISCUSSION

There are six important characteristics are discussed such as cube compressive strength, cylinder compressive strength , split tensile strength ,modulus of rupture , modulus of elasticity and shear strength. Different size of specimen are casted for discussing its different characteristics.

IX. CONCLUSION

Using coir fiber in civil engineering structure is very useful in many aspects

A. Using of coir fibre reduces the environmental pollution and save the important minerals
B. It also improves the many properties of concrete such as compressive strength and shear strength
C. It also increases the modulus of elasticity and modulus of rupture.
D. It increases the resistance against sulphate attack.
E. It also reduces the micro cracks which are usually developed in the conventional concrete.

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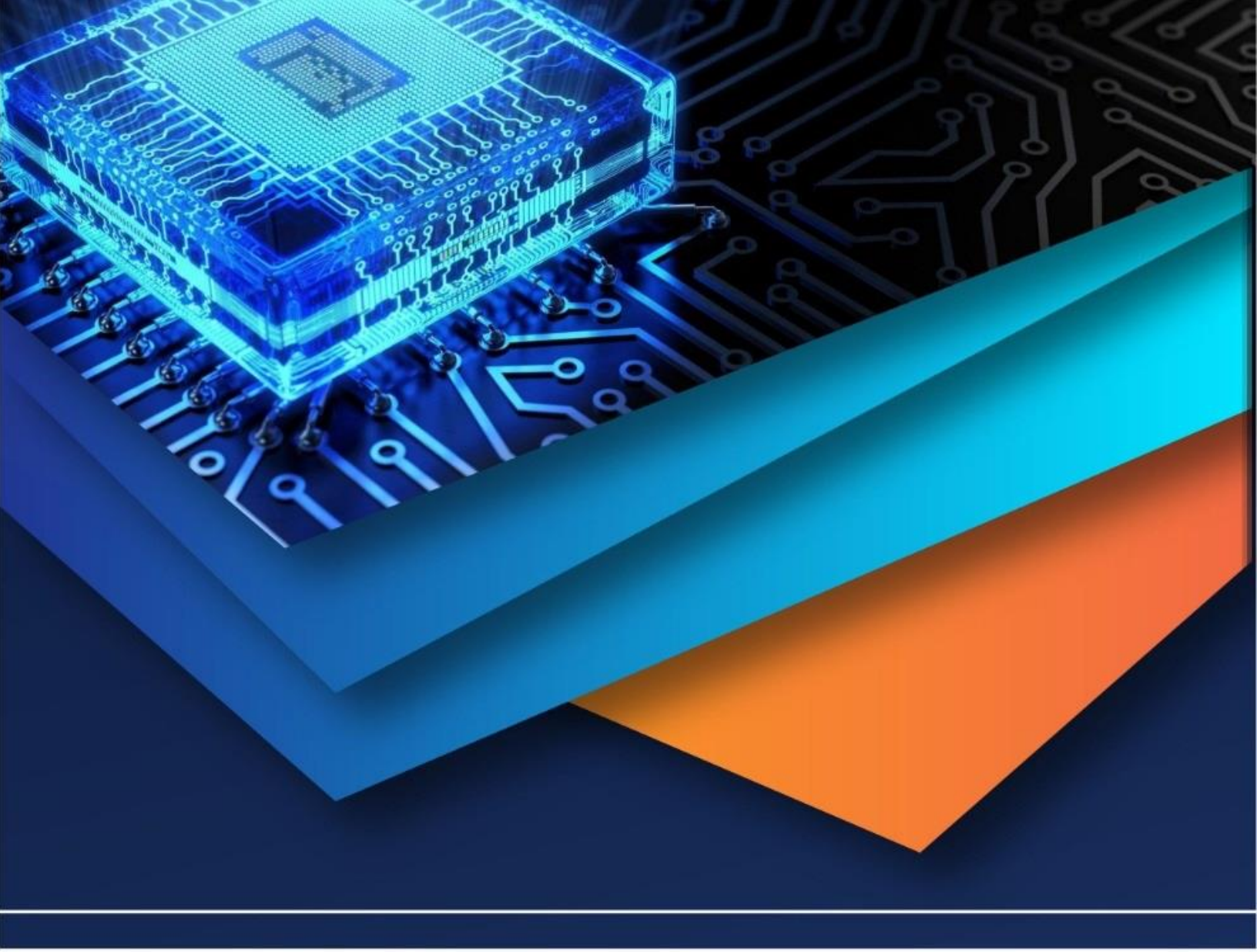

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