Natural Fibers in Concrete – A Review

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Abstract. The latest thesis deals with the issues of natural fiber in order to observe the strength properties and even a reduction in the replication of the shrinkage crack problems in concrete. The organic fibers such as coir, palm, kenaf, jute, sisal, banana, pine, sugarcane and bamboo etc. Various researchers are studied as building materials that can be found in cement paste, mortar, concrete. It was observed that the results of few fiber are most promising and given below. The present work focuses to improve the ductility and strength properties of concrete on bringing out. The same proportions of different fibers cannot be changed by all the normal concrete. This research may include the characteristics, behaviors and consistency of the fibers between themselves. Finally, the study focuses solely on similarities and variations between all kind of natural fibers. The goal of this analysis is to provide an analysis of the factors influencing the overall performance and reliability. The proportions for comparisons and conclusion were studied.

Keywords: Natural fibers, Composites, Mortar, Compressive and Flexural strength.

1. Introduction

Fibers are string like materials which can be used for different purposes. Fibers delivered by plants (vegetable, leaves and wood), creatures and geological procedures are a normal fibers. The pattern of research on characteristic fiber strengthened solid composite is presently expanding due increment in cost of high vitality materials and furthermore accessibility of answers for improve toughness of normal strands in concrete. Now a days the plant fibres to replace conventional fibers as reinforcement in compositions due to environmental and ecological issues. It embraced fundamentally because the characteristics of eco-friendly like qualities, ease, and generally great properties, and so on[1].

In present days, due to simultaneously increment on condition and energy, expanding consideration paid to be normal filaments with a high energy and protecting environmental issues[2].Materials like jute, sisal, coir, rice husk, flax, bamboo, banana, oil palm, sugarcane bagasse and so on, however specialists and researcher have found an alternate kinds in concrete[3].Furthermore, it has observed the outcomes of sisal, coconut and bamboo are all the more promisingly accomplished its test condition and their low thickness, ease and bio-degradability. Natural fibers are cheap but it required greater skills in producing, placing and mixing does the conventional reinforced concrete and yet un proven long term performance and durability.
In this investigation of normal fiber, liken with characteristic inorganic filaments, vegetable filaments are more renewable, economical, eco-friend and the manufacturing cost is also very low [4]. In general, now a day’s coir and sisal are mainly using in the concrete. Mechanical properties and compressive test are the first part of focuses to determination.

2. Types of fibres
Since many forms such as organic and inorganic are recommended. Now the variant of the sustainable fibre that is used for natural fibre. Coir, Sisal, Sugarcane, Banana, Bamboo, Jute, Wood, Vegetables, Bagasse, Rice husk, Flax, Kenaf, etc., in these types of sisal, coir, bamboo, flax, banana, hemp, jute, are mainly use in concrete. It can use sustainable development[5]. There is no new way to use such fibres to enhance the power and toughness of delicate materials; for example, straw and horse hair are shown in the bricks and plaster. Which are suitable and readily available for concrete reinforcement. On slabs, reinforced with coir after completing number of samples.

![Figure 1. Stress strain curve for natural fiber in concrete][6]

3. Tests of Natural fibers
1. Compressive test
2. Tensile test
3. Slump test
4. Flexural test
5. Vee Bee degree test

4. Properties of Natural fiber
Fibres have high strength and have a poor elasticity of modulus. The disadvantages of using natural fibres differ significantly and contribute to volatile concrete properties[7]. Under stress and bending pressures, these concrete formulations gain final strengths of 12 and 25MPa. The use of coconut fibres is much stronger synthetic fiber in concrete[8]. Sisal fibres were applied to the concrete and the strength becomes lower than the concrete samples without fibres. Sisal and banana fibres with larger lengths compared to mountain oak and displayed a more robust fracture activity in this type of fibre in research, confirming that fibre length affects the mechanism by which load moves from equal form of matrix[9].

The cement composites tested were enhanced by long sisal fibres mounted in 5 layers at the maximum length of a steel mould. The performance of cement composites is also influenced by the vegetable fibres, because eucalyptus-based one improved mechanical output over pinus-based after 200 ageing cycles. The sieve research apparatus conducts the physical properties of concrete values of the thin module of the aggregate[10]. The Pycnometers provided the basic gravity of the sand and the coarse aggregate; the values are shown in the Table.1
5. Compressive strength
Under natural dry condition in concrete mixture in immersions[5]. The amount of admixtures 0.20% were used in this type. The maximum shortfall of hemp and coir were produced in the percentage of good amount and in calcium hydroxide medium for water, in the reduction of sisal and jute was standard, respectively. By mass, the cement was substitute in the number of various percentages [12]. In newly added, the san and hemp give a good characteristic strength in nature with the help of admixtures. The result of this both are reduced slightly in fly ash mixtures. In this content, the number of fibers was decreased in the various percentages. Sisal varied a specific amount of weight[13].

![Figure 2. Overall percentage of fibers[12]](image)

The cement ratio (0, 0.30, 0.55, 0.75, 1, and 3) by weight of concrete[14]. The ratio of durability was in higher content and its gradually lower by the way of ratio. In admixtures, the jute fiber was added in two ways (treated or non-treated). The fiber was replaced by 1% weight. The fiber changed into through 1% weight of cement. It was concluded by the way of content in treated and non-treated, respectively. Using 1-7% of coir in the mix and the overall percentage of fiber is in higher state[15]. It became goes on decreasing with a growing within the fiber content material of the mix. The result has varied by the combination of content.

| Table 2. Fiber Content[13] |
|-----------------------------|
| Addition of content | Increase in strength (N/mm²) |
|                       | For M20 | For M25 |
| 0.5%                  | 0.168   | 4.36    |
| 1.0%                  | 30.83   | 38.33   |
| 1.5%                  | 50.53   | 52.51   |
6. Tensile strength
The various types of natural fiber in the concrete combination beneath natural dry situation and with water after exposure, sodium and forms of immersion. Maximum discount in tensile strength become located because of the impact of saturated lime on sisal, jute and hibiscus cannabin’s. After 60 days of exchange wet and dry in saturated lime and fibers were absolutely destroyed, while, coir around certain percent of its initial strength could be preserved.

![Figure 3](image-url)

**Figure 3.** Different fiber percentages[13].

The cement by other constituents with some percentage through mass. San fiber delivered in extraordinary possibilities in concrete mixture. The compounded energy with percent of fibre attached for some admixture's configuration adjusted to a part of fibres. Compared to some mixes of concrete, there has been a decline in the percentage growth. Various scales factor of fibre has blended.

| Content (F/c) % | Durability (N/mm²) |
|----------------|--------------------|
| 0              | 6.4                |
| 0.25           | 5.6                |
| 0.5            | 7.1                |
| 0.75           | 7.5                |
| 1.0            | 8.6                |
| 1.5            | 9.2                |

Table 3. Different F/c ratio[14].

7. Flexural Strength
The sugarcane bagasse increased the flexural strength marginally 3%. It defined that the raw jute is applied to concrete with the help of 1 percent cement weight, then the concrete dice's flexural strength improved and with the addition of 4.5% adjusted jute flexural strength growth. In the concrete blend, 3%, 5% and 7% (by cement weight) of fiber was used.[15]. The main result of using concrete is to improve the bend modulus, as a participant makes the concrete paintings extra effective.

They innovated that reinforcement of coconut fibre enhanced the flexural properties of epoxy polymers, and this change is better with the reinforced concrete glass and carbon fibre[16]. Coir are composite becomes 20% extra than that of refer at equal. It is also stated that compound made with some leaves like mountain oak has 17% better rupture modulus is compared to the concrete[17].
They used polypropylene and kenaf with overall percent. Class fly ash became additionally brought in sure mixes with 0% and 30% as cement alternative. It turned into founded that resulted in the lowest percent of water absorption because of the purpose of polypropylene is a hydrophobic kind of fiber which does no longer soak up water[18]. They used coir in normal concrete. While increase within the contentfrom 1% to more, it is truely visible that, the water absorption free is being accelerated[19].Synthetic and natural fibers consisting of anti-reflecting glass[20]. In concrete, the foamed lightweight of fiber is presented in it for the certain amount of rate.

9. Currently using natural fibers

9.1. Hemp
It is utilized in a few applications, for example, material, paper, for composites, seed nourishment, oil, wax, pitch, mash, biofuel, etc and its utilization for the most part relies upon the evaluation/nature of the hemp plant. The normal tallness of mechanical hemp is 10 ft and the width are regularly exceptionally tight as the plants are become firmly together. It is investigated purchase a few Hierarchical association of hemp and its group size. It has been accounted for that the breadth of the normal fiber pack is 25 mm and the length of the normal group is 25 mm. The fiber substance of cellulose is to change from 70.2% to 74.4%. High quality and firmness are additionally utilized in the solid. The family of plants originates in eastern countries and is considered to have reached[21]. It is used in a various applications, including fibres, cloth, carbon, food for plant species, oil, wax, resin,
pulp, biofuel, etc., and its use is primarily dependent on the value / consistency of the entire plant[22]. As these are planted closely together, the average industrial hemp height is around 12 feet and the width is usually very narrow[23]. Many uses are used as insulation in concrete structures because of their high rigidity[24]. The diversity of the chemical product is regarded to many factors that lead to toughness difficulties[25]. Multiple microstructures and biological processes of fibres have been shown to result in vegetation types developed under various growing conditions[26].

9.2. **Coir**

Brown coconut fibre generated from refined coconut and white coconut fibre generated from premature coconut. This is fairly water resistant and one which the synthetic fibers that are resistant to saltwater damage[27]. The hardness and split tensile strength are achieved using different coir fibre lengths of 25mm, 30mm and 35mm respectively with different percentages of 1% in this 28-days of experimental sample. The fibrous layer of harden surface presented in coconut between inner and outer coat[28].

![Figure 6. Coir fiber](image)

9.3. **Bamboo**

Flakes derived from natural bamboos are used, and fibres harvested from agricultural waste from oil palm trees can be used to manufacture cement-bonded particle for sustainable housing industries and road construction applications[29]. A board meeting the specifications of durability and dimensional stability is developed with the ratio of 1:3 and 3% with aluminium sulphate. The palm oil, on average thick and long. Cement replacement products like fly ash, rice husk and latex were used in this combination with admixture to minimise the significant impact on the filtration properties of concrete mix for the development.

9.4. **Sisal**

This plant was investigated in terms of botany, production and consumption[30]. It grows to between 1.5 m tall and 25 mm thick, with 150 and 200 leaves. The leaves are green, stiff, fibrous, hairy-shaped and husks-grown. String fiber are intermediate fibres that are derived from the periphery of the leaf from transmitting materials. The measurements and its material performance have been studied. [31]. Many researchers where described the methods of sisal derived from concrete[32]. The functional group of chemicals are described. These fibres in polymers are commonly used as stabilization. Growing fiber is isolated and grouped according to the length of the fiber. Segregation and facing before the aspects are varying elements[33].
9.5. Kenaf Fiber
This is a kind of regular fiber and is included the fortified solid section to improve the structure quality and ductility. For this investigation, three sorts of blends were set up with fiber volume division of 0.1% and 2%, separately. 20 MPa was considered and hence it has compressed in the structure. In temperate regions, it is grown mainly for seed oil. Bio composites of good environmental issues of new crop have been produced. Under environmental conditions, they grown up to 12 cm a day[25]. It can yield up to 5,000 kg / per year for fast-growing varieties and up to 35,000 kg /per year for the newest varieties. The bark consists of around 45% of the plantation and the fibres are derived from it. And it has a clear crystalline fiber orientation, while the undifferentiated pattern is in the basic content of natural crops [34].

10. Conclusions

- Present work of usage to explore the coir, sisal, jute and bamboo fibers as an additional material in concrete to improve its strength, durability and load carrying capacity.
- Coir delays and control the composite materials in tensile cracking. In present days it increases the durability and strength of concrete was achieved for the additional of 1.5% weight of cement and it was found to be optimum percentage.
- Concluded that the 10% of replacement of micro silica induces the strength and workability.
- Fibers give the higher properties of sisal and coir fiber in concrete structures.

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