Experimental Study of Concrete Additive Jute as Geotextile Material

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***Abstract* – Population of India is increases rapidly, but most of the population is not having a proper living environment due to lack of money for affording houses. The design of a durable and low cost house is a technological challenge in developing countries. By using the geo-textile materials we can manage the waste by using it as construction material. The geo-textile materials such as natural fibers (jute, coir, bamboo etc.) and synthetic materials like polymer, glass and some chemicals can be used for making appropriate strength of concrete. In eastern part of India production and availability of jute is considerably high. So we have selected jute as an ingredient of concrete for constructing affordable housing for people living in eastern India like East Bengal, Assam, and Bihar. As we know concrete is most essential material in construction and it comprises of cement, aggregates, water and sand. The strength of concrete is depends on the proportions of material taken for making of concrete. We use jute in concrete because it has good bonding property and it is a natural geo-textile material which is easily available in a very low cost. Geo-textiles also belong to a class of technical textiles that have varied applications in geotechnical engineering. The engineered fabric improves soil behavior through separation, filtration, drainage and reinforcement.**

Keywords – Geotextile, Hydrophilicity, Agglomeration

I. INTRODUCTION

In recent years, considerable research efforts are found to develop high-strength, natural fibers reinforced concrete composites, mostly for using as building and construction materials [1]. The fiber which found in the stems of the plant was used (e.g., jute). Primary treatment of jute was done in laboratory with alkali and some chemicals to reduce hydrophilicity and agglomeration. Then jute was cut into small pieces of size 2cm to 6cm. After that jute was used for concrete making. Mixing of other natural waste like coconut husk and wheat husk was done. Variant size of jute fiber was used to check the suitability and to remove agglomeration. Three cubes of size 150mm x 150mm x 150mm of concrete were made. All cubes were unmolded and put in water for curing and compressive strength was tested after 7, 28 days.

There are two prominent research issues associated with the use of jute fiber in cement concrete. First is the hydrophilicity of natural fiber. The high hydrophilicity of natural fiber makes the wet concrete stiff and non-workable due to gradual absorption of water from the wet concrete mixture. The second research issue is the agglomeration of the chopped jute fiber during concrete mixing leading to inhomogeneous fiber dispersion in the concrete mix. Hence the major challenges in this project are to reduce hydrophilicity of jute fiber by surface modification, to reduce fiber agglomeration in concrete matrix and to formulate a novel mixing technique and fabrication of jute fiber reinforced cement concrete/mortar having improved physical and mechanical properties.

II. LITERATURE SURVEY

Steel is the conventional reinforcing material in concrete. Although steel enhances the strength and modulus of concrete but it lacks the ability to absorb mechanical impact [2]. The steel makes the reinforced cement concrete (RCC) structure heavy and in due course of time as a result of water/moisture diffusion through micro crack developed in the RCC structure steel starts corroding leading to failure of the concrete. On the contrary, if the micro crack formation and propagation can be minimized by dispersion of short fibers, the mechanical properties as well as the durability of the concrete can be improved [3]. Such a system would be able to bear high level static as well as dynamic stress. Natural (cellulosic) fibers might offer the opportunity as a convenient reinforcing agent in concrete composite due to its low density and high tensile property. In recent years, considerable research efforts are found to develop high-strength, natural fibers reinforced concrete composites, mostly for using as building and construction materials. Natural fibers, isolated from plants, are classified into three categories, depending on the part of the plant they are extracted from. The first category is the so called fruit fiber (e.g., coir, cotton, etc.) which are extracted from fruits of the plant. The second category of the fiber is found in the stems of the plant (e.g., jute, flax, ramie, hemp, etc). Such fibers are known as best fiber. The third category is the fibers extracted from the leaves (e.g., sisal, date palm, oil palm, etc.). Polymer modified jute fibers have been decided to be used as reinforcing element in cement concrete in which polymer will chemically bridge jute in one side and cement on the other side [4]. Polymer modified jute fiber is expected to act as a flexible reinforcing agent in cement concrete enabling it to transmit both static and dynamic stresses to its surrounding bulk as well as absorb a portion of the stress by virtue of its flexible nature. An optimized weight fraction of polymer modified jute fiber in cement concrete may lead to excellent mechanical properties. It has been anticipated that modification of jute fiber with polymer will reduce degradation possibilities.

Fiber reinforced concrete has been investigated extensively to make light weight corrosion free structural materials[5]. There are global attempts to use natural fibers as reinforcing agent in cement concrete matrices. The advantages of natural fibers over the conventional reinforcing fibers like glass, synthetic (e.g., polypropylene, polyethylene

and polyolefin, polyvinyl alcohol), carbon, steel etc., are: abundant availability, low cost, less abrasiveness, ability to absorb mechanical impact, easy to handle and process and environmental friendliness. These composites can be used in various fields of applications such as permanent frameworks, paver blocks, wall panels, pipes, long span roofing elements, strengthening of existing structures and structural building members. The natural fiber reinforced concrete composites present enhanced strength and are likely to encounter a range of static overload and cyclic loading due to possible wind or earthquake loading. When concrete matrix cracks under load, the fibers bridge the cracks and transfer the loads to its surrounding bulk as well as absorb a portion of the load by virtue of its flexible nature. Several investigations have been carried out with different lignocellulose fibers like, wheat straw, rice straw, coir, hazelnut shell, bagasse, oil palm residues, arhar stalks, etc., to find the potentiality of natural fibers as an effective reinforcement in concrete composites. But no report is found on the use of jute fiber as reinforcement in cement concrete. Based on the present scenario it has been anticipated that the jute fiber reinforced cement concrete may find potential application as structural items in construction industry. Being a potential agricultural product, the use of jute as reinforcing fiber in cement concrete will promote jute farming industries as well as produce better advanced composites.

III. REQUIREMENTS

Primary treatment of jute will be done in laboratory with alkali and some chemicals. Then jute will cut into small pieces of size 2cm to 6cm. After that jute will used for concrete making. Three cubes of size 150mm x 150mm x 150mm of concrete will make. All cubes are unmolded and put in water for curing and compressive strength, bulk density and flexural strength will be tested.

TABLE 1: Material Requirement and Its Analysis

Material and Equipment's required	Cost
1. One bag of Cement. 2. Coarse Aggregates(50Kg) 3. TD5 Jute (1Kg) 4. Polymers 5. Alkali solution 6. Sand (25-30Kg) 7. Cubic mould size of 150mm x 150mm x 150mm. 8. Tray and Hand gloves 9. CTM machine 10. Weighing machine 11. Vibrator	Rs.310 Rs.29 per Kg

IV. METHODOLOGY

- Initial process includes collecting of materials and resources as per need.
- Development of modified jute fiber: Modification of jute fiber with suitable chemical and polymer for its surface activation.
- Primary treatment of jute was done in laboratory with alkali and some chemicals to reduce hydrophilicity and agglomeration.
- Then jute was cut into small pieces of size 2cm to 6cm. After that jute was used for concrete making.
- Mixing of other natural waste like coconut husk and wheat husk was done.
- Variant size of jute fiber was used to check the suitability and to remove agglomeration.
- Three cubes of size 150mm x 150mm x 150mm of concrete were made. All cubes were unmolded and put in water for curing and compressive strength was tested after 7, 28 days.
- Slump test was also done to check the workability of concrete.
- Observations and calculations were done.

V. REASONS FOR PROPOSAL

The main prospective is to provide affordable houses and reduce the cost of concrete made houses by reducing its material cost and providing efficient strength of the structure. It is used for evaluating the suitability of short jute fiber as a reinforcing agent in cement concrete and also for modification of jute fibers with chemicals and polymers and characterization of modified jute fiber. Optimization of length of small jute fiber and its loading in cement mix. Mixing and casting of untreated and chemically modified jute fiber reinforced cement concrete/mortar.

VI. PROPOSED PROJECT WORK PLAN

The following work plan was formulated keeping in view the above objectives:

- Chemical modification of jute fiber
- Characterization of unmodified and chemically modified jute fiber
- Curing and testing of cubes
- Observations and results

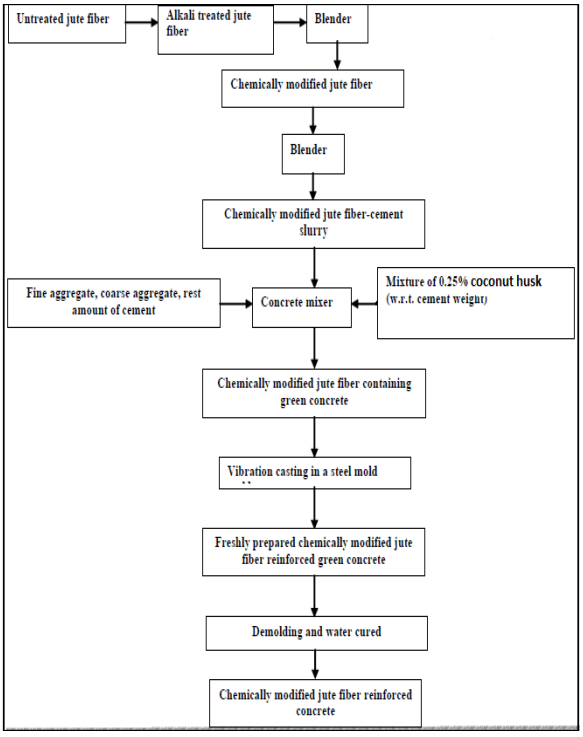

Fig 1: Project Plan

VII. RESULTS AND DISCUSSION

TABLE 2: Cube casting material variation

Materials	Concrete (without jute)	Concrete (with 20gm jute of size 5-6cm	Concrete (with 20gm jute of size 2cm)
Cement	4.20kg	2.70kg	2.68kg
Sand	6.30kg	4.50kg	4.50kg
Aggregate	12.60kg	8.10kg	8.10kg

TABLE 3: Compressive Strength for 2-3 cm (N/mm^2)

No. of Days	Cubes(without jute)	Cubes(with 20 gm untreated jute of size 2-3 cm)	Cubes(with 20 gm treated jute of size 2-3 cm)
7	8.33	12.45	13.39
28	24.66	36.21	37.48

TABLE 4: Compressive Strength for 5-6 cm (N/mm^2)

No. of Days	Cubes(without jute)	Cubes(with 20 gm untreated jute of size 5-6 cm)	Cubes(with 20 gm treated jute of size 5-6 cm)
7	8.33	10.66	11.27
28	24.66	32.59	34.63

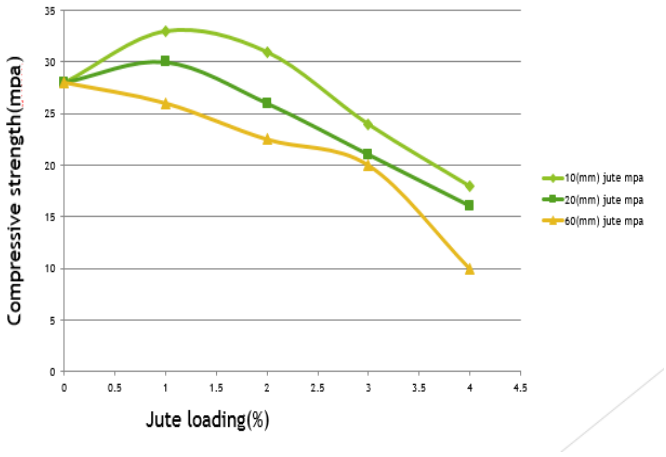

Fig.2: Variation of compressive strength with amount of jute

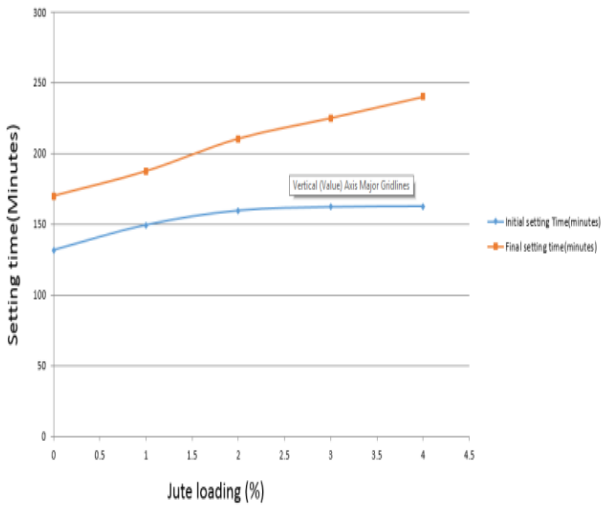

Fig.3: Variation of setting time of cement with amount of jute

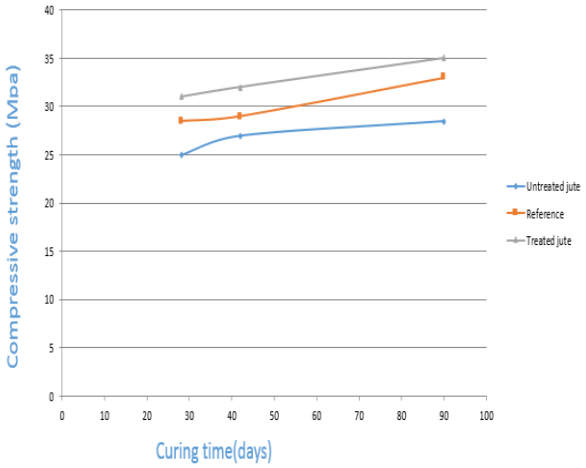

Fig.4: Variation of compressive strength with curing time

VIII. CONCLUSION

- Compressive strength of chemically treated jute fiber reinforced cement concrete are improved by 23.63%.
- Helps in making of low cost houses.
- Reduction in use of cement and steel by using jute.
- Jute is also used in construction of road pavement.
- Jute is also used for control of erosion, consolidation of soil and stabilization of slopes (embankments).

REFERENCES

[1] Mohanty A. K., Misra M., Hinrichsen G.: Biofibers, biodegradable polymers and biocomposites. An overview. Macromolecular Materials and Engineering, 276–277, 1–24, (2000)

[2] A comparative experimental investigation of concrete, reinforced-concrete and steel-fibre concrete pipes under three-edge-bearing test, Tefaruk Haktanir, Kamuran Ari, Fatih Altun, Okan Karahan, Department of Civil Engineering, Faculty of Engineering, Erciyes University, 38039 Kayseri, Turkey

[3] Evaluation of Fiber-Reinforced Asphalt Mixtures Using Advanced Material Characterization Tests. Kamil E. Kaloush, Ph.D., P.E., Associate Professor Arizona State University. Department of Civil and Environmental Engineering, Waleed A. Zeiada, Krishna P. Biligiri, Maria C. Rodezno, Jordan Reed, Arizona State University. Department of Civil and Environmental Engineering

[4] Puglia D., Biagiotti J., Kenny L. M.: A review on natural fibre-based composites- part II: Application of natural reinforcements in composite materials for automotive industry. Journal of Natural Fibers, 1, 23–65 (2005)

[5] Durability of precast concrete pipe, American Concrete Pipe association, e-mail: Info@concrete-pipe.org. www.concrete-pipe.org