REVIEW OF JUTE REINFORCEMENT FOR FIBER REINFORCED COMPOSITE MATERIAL

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Abstract Jute Composite is basically combination of Jute fibers with binder material to form a new material, which can replace conventional materials in various applications. The present paper deals with the review of jute reinforcement, which highlights efforts made in past for development of jute composite, feasibility of jute with different binders, effect of treatment on fibers, form of fibers, processes of manufacturing, feasibility as diversified product, hybridization with other FRP skins, properties and use of other natural fibers in formation of Fiber Reinforced plastic material.

Key Word: Jute Composite Treatment Properties

INTRODUCTION

In the recent era there has been an increasing interest in composite materials for its applications in the field of aerospace, sports, industries, medical, and in many other fields of mechanical and civil engineering. It is necessary to understand the mechanical characteristics of composite under different conditions such as proportion of fiber volume, feasibility of adhesion between matrix and reinforcement, environmental condition, process of manufacturing etc.

The advanced composites [1] were developed only for aerospace application because of combination of lightweight, high stiffness, and high strength properties. This achievement was due to reinforcement of carbon fiber (miracle material), which created a revolution in FRP materials in sixties. However FRP material can be utilized successfully based on optimum design, high performance production methods and testing possibilities. The need of replacing conventional material by FRP materials is also felt in other fields in order to take advantages of their attracting properties at the same time their need can be satisfied with even with low strength reinforcement, therefore the concept of optimum design opened the door of low strength fibers. The natural fibers are very big source of low strength reinforcement. Jute is also a natural fiber having good stiffness, which can also be utilized to form a Fiber Reinforced Composite material. Moreover in the era of ninety the United Nation Development Program also provided platform and support for research scientists of R&D institutes for application of jute in diversified products

POTENTIAL FOR JUTE & NATURAL FIBERS

R.M. Rowell [2] highlighted availability of natural fibers in the form of (1) bast or stem fibers (2) leaf fibers (3) core, pith or stick fibers (4) seed hair fibers (5) Other plant fibers. Jute, flax, hamp, kenaf, ramie, roselle, and urena are examples of bast fibers. While banana, sisal, henequene, abaca, pineapple, cantala, caroa, Mauritius, and phormium. Seed hair category includes coir, cotton, kapok, and milk weed floss.
The composites formed can be classified based on their use (1) geotextiles (2) filters (3) sorbents (4) structural composites (5) non structural composites (6) molded products (7) packaging (8) combination with other materials.

D.V. Plackett [3] viewed the need of wood and wood products in pacific rim and state the feasibility of jute reinforcement as well as bamboo, bagasse to form a composites and MDF boards

R.Davidson [4] highlighted the jute and other natural fibers as renewable source with good mechanical properties and low density including standard deviation of perhaps 50 % in fiber properties, with degradation at 160-200 ^{0} C. He also stated about use of jute composite in 1940's for tea chest.

R.N. Das & T.K. Majumdar JTRL [5] mentioned the feasibility of making particle-board from jute (stick.) composite.

Dr. B.C. Mitra [6] illustrated the feasibility of jute as reinforcing fiber in FRP material and even for the use of Hybrid composite. He patented his work for jute laminate as (Indian Patent N0: 170305, 1-1990.)

EFFECT OF CHEMICAL MODIFICATION

Dr.B.C. Mitra [6] stated about drawback of natural fibers to absorb moisture from atmosphere, which causes loss of adhesion or de-bonding, at fiber/matrix interface and reduction in strength. He tried to treat jute with NaOH, acrylonitrile (Process of Cyanoethylation) for developing coupling agent to improve fiber/matrix interfacial strength. physical & chemical bond and to protect fiber surfaces from environmental condition. The results obtained in formation jute polyester composite were:

- Increase in moisture content at increasing Relative Humidity
- Rise in reaction time reduces moisture content
- Rise in reaction time reduces water absorption and boiling water absorption.
- Rise in reaction time increases Tensile, Flexural strength.

P.K.Ghosh [7] tried the modification of jute through graft co-polymerization of acrylonitrile, methyl-methacrylate and phenol, resorcinol resins for jute polyester composite, which reveal that low degree of vinyl polymer grafting (10-20) % on jute imparts 30 % improvement in flexural strength, flexural modulus of jute composite. Moreover, minor modification by incorporating phenolic resin (4% resin uptake) imparts up to 40% improvement.

I.K.Verma [8] worked on alkali treatment on jute-epoxy composite. He took sodium hydroxide (liquor ratio 100:1, and varying it 5,10% w/v) and observed color change from pale yellow to brown. He found that by increasing alkali %, weight loss % increases and interfacial shear stress decreases i.e (Better bonding).

FEASIBILITY IF JUTE WITH DIFFERENT MATRIX

A.J. Bolton [9] tried the use of jute with phenolic and polyester resin and tested as per {BS:2782} for flexural properties and inter-laminar shear.

A.K.Rana [10] tried the use of jute with UF, PF, polyester and polypropylene or MDF boards, sheets and Decorative laminates

A.R. Sanadi [11] tried the use of jute with polypropylene as well as other reinforcement such as talc, mica, Caco3 to obtain low cost material for automotive, housing, furniture and packaging use.

P.K. Sengupta [12] worked with short jute fibers with LDPE as extruded material as a film or sheet. He observed that addition of 20 % uncoated jute in LDPE reduces tensile strength and elongation value drops sharply, while addition of 30% uncoated jute gives high tensile strength than virgin LDPE.

Under the condition copolymer coating 20% jute addition gives equivalent tensile strength as of vergin LDPE while 30% jute addition gives 10% rise in tensile strength. He also studied thermal behavior by TGA. The experiments under nitrogen atmosphere resulted that LDPE found to be quite stable at least up to 350^{o} C. Addition of 20% jute bring down the stability around 140^{o} C & decompose around 210^{o} C. Copolymer coated jute addition increases stability up to 350^{o} C.

R. Chandra [13] tried jute with polyester (**isophthelic** acid base) composite with some co-monomers and they were tested for tensile {ASTM D-638} & split tear {IS-664;1972} properties. Using DMA & creep curves using TGA. He observed initial decomposition temp range (355.5 – 389.1) ^{o} C, final decomposition range from (414.1 – 470.2) ^{o} C., split tear strength range (6.10 – 12,75) kg/cm2, and maximum tensile strength of 29.20 MPa with maximum elongation of 21.60 %.

APPLICATION AREAS

A.J. Bolton: applied his attempt for jute with phenolic and polyester resin to form MDF boards

A.K.Rana : worked on jute with PF resin to form MDF board & compared with interior grade MDF boards of specification {IS 12406-1988}.He observed properties of jute board:

- better in tensile strength
- more screw withdrawal strength,
- less water absorption.

He also found feasibility of replacing paper corrugated board by jute with polypropylene

B.C. Mitra: [14] found feasibility of jute to replace block board, particle board, hard board, high density and medium density fiber boards, laminates and molded products. The testing of physical properties were carried out as per {IS: 3087(1985) & 2380(1977)}as it is a requirement for composites for replacement of wood. While for replacing hard board with high-density jute board as per {IS 1657-1977} For replacing particle-board with jute stick board as per {IS 1658-1977} For replacing MDF board by jute MDF as per {BIS 12406 - 1980}.

M.D. Koli [15] viewed feasibility of jute based composites for flexible containers, corrugated and solid board from laminates

N.R. Bose [16] observed replacement feasibility of GRP by JRP

M.K. Das: [17] observed use of JRP as a core material and GRP as a skin material to form hybrid composites

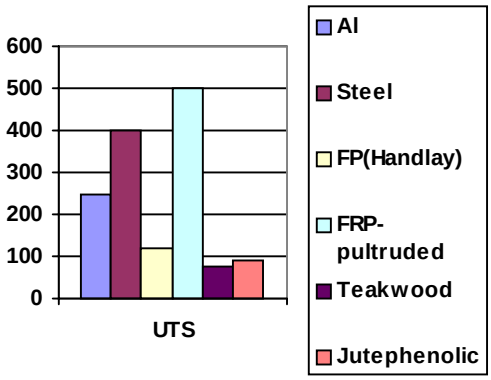
S.S. Raje [18] illustrated the feasibility to replace wood, compressed wood and metallic parts of textile machinery to achieve material cost reduction, machining cost reduction and energy conservation by reduction of moving parts weight.

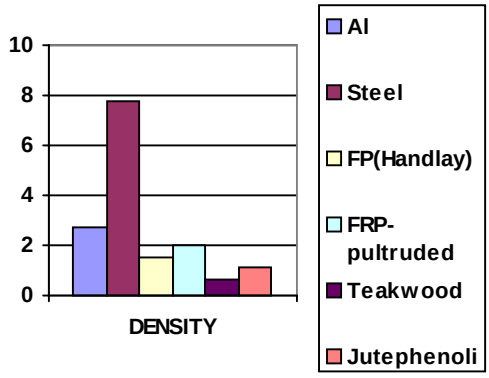
A.A. Shaikh [19] worked to develop molded parts using jute composite for replacing textile machinery parts to test them under industrial condition and observed positive results.

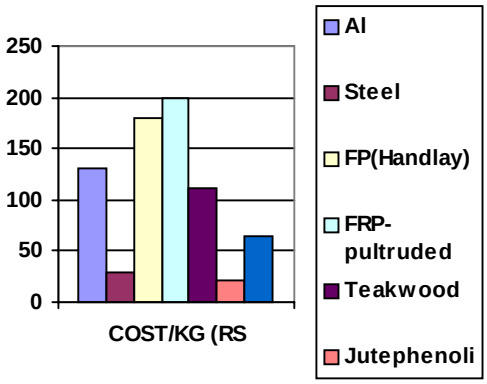
A.A. Shaikh [20] worked to replace high density compressed wood of textile machinery part under condition of dynamic loading and observed improved results than conventional material by treated fibers and proper (wound layer technique) manufacturing process.

COMPARATIVE STUDIES

S. Thakkar [21] from Tipco polymer Co. compared physical properties as well as cost evaluation commercially as below.







SCOPE OF OTHER NATURAL FIBERS FOR REINFORCED PLASTICS

Ref [22-25] highlights feasibility of coir, sisal, oil-palm-empty-fruit-branches, pineapple and agro-based reinforcement for reinforced plastics, as a low cost alternative material.

CONCLUSION

Jute is a feasible reinforcement to form reinforced plastic as an alternative material at low cost. It is feasible to replace conventional wood based, plastic and FRP components.

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