International Jute Study Group (IJSG)

FICCI

NATIONAL JUTE BOARD

E-proceedings of International Conference on

Application and Commercialisation of Natural Fibres Composites (Jute and Kenaf) in Infrastructure, Construction, Housing and Automotive Sectors

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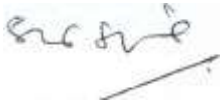
Message

Now days, the natural fibres especially jute, kenaf and allied fibres are being diversely used in the manufacturing of automobiles and infrastructures in the world as an optimum replacement of synthetic fibres. The use of natural fibres in technical composite applications has also recently been the subject of intensive research in the developed countries like Europe and USA. The natural fibre composites can contribute greatly to the automotive manufacturer's final goal constituting 30 per cent weight reduction and cost reduction of 20 per cent. Eco-friendly bio-composites from plant derived fibres and crop-derived plastics would be the novel materials of the 21st century not only as a solution to the growing environmental threat but also as a way out to alleviating the uncertainty of the petroleum supply which is expected to decline between 2010 to 2020.

International Jute Study Group (IJSG) as the International Commodity Body (ICB) for jute, kenaf and allied fibres is committed to search for excellence that would unfold new applications of natural fibres. To identify synergies through possible joint activities towards research, product development and market promotion, IJSG organized the International Conference on 'Application and Commercialization of the Natural Fibres Composites (NFC) in Automotive and Infrastructure Sectors' successfully on August 7, 2012 at FICCI premise in cooperation with Federation of Indian Chambers of Commerce and Industry (FICCI) and National Jute Board (NJB). I was glad to be present in the conference which was highlighted by the interesting presentations.

I am delighted to learn that International Jute Study Group (IJSG) is going to publish the e-proceedings of the conference. I believe that the publication will be an important reference material for betterment of industries of natural fibre composites.

I appreciate the initiative taken by the IJSG to publish the conference e- proceedings and wish their efforts a great success.



Mr. Shishir Jaipuria

Chairman

Textiles & Technical Textiles Committee

Federation of Indian Chambers of Commerce and Industry (FICCI)

New Delhi, India

Foreword

In recent days the natural fibres sector is in need of thrust for innovations and diversification to assure the regular use of natural fibres. It is a well-timed approach for harnessing the increasing trend of the natural fibres into the fields of the novel area of bio-composites especially automobile and infrastructure sectors in a sustainable manner for a green industrial economy. I firmly believe that Eco-friendly bio-composites from plant derived fibres would be the novel materials of the 21st century not only as a solution to the growing environmental threat but also as a way out to alleviating the uncertainty of the petroleum supply which is expected to decline between 2010 to 2020. Jute is the ultimate sustainable solution among other natural fibres for the bio-composites sector as it already proved its most economic, eco-friendly and biodegradable features in the market.

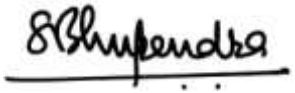
The 'International Conference on Application and Commercialization of the Natural Fibres Composites (NFC) in Automotive and Infrastructure Sectors' was organized by the IJSG on August 7, 2012 at New Delhi India with the objective for ensuring the optimum use and exploring lucrative trading options of natural fibres composite especially in the automotive and infrastructure sectors. This conference was actually a continuation of another International Seminar successfully organized by IJSG on 'Strengthening of Collaboration for Jute, Kenaf & Allied Fibres Research and Development' during June 8-9, 2011 in Bangladesh. The International bio-composite Conference assembled the eminent scientists, experts, and business personnel of international repute from various R&D organizations, government agencies, industries and market representatives of the

world. The conference addressed to the relevant issues confronting the development, applications and commercialization of the bio-composites through strengthening the public-private partnership.

The IJSG is delighted to publish the conference e-proceedings containing the research papers presented in the conference. The recommendations contained in various research papers and the presentations gives an unique opportunity to all development partners like the Governments, the industry and the non government actors to share the present state of knowledge and the future trends in bio-composite sector and may serve as guidelines for achieving the desired objectives in the sector.

I express my sincere thanks to the National Jute Board (NJB) for financial contribution and the Federation of Indian Chambers of Commerce and Industry (FICCI) for their great support in organizing this International Conference in New Delhi, India. I also convey my gratitude to all distinguished delegates, dignitaries, resource persons, representatives of the associate members of IJSG and the other participants for making the conference a success. I am also thankful to the IJSG projects and operations team that put in relentless work in conducting the conference and also bringing out this important publication.

We believe that this publication will play a pivotal role for the activities to be undertaken for the development of natural fibre composite sector in coming days.



Bhupendra Singh

Secretary General

International Jute Study Group (IJSG)

Programme Schedule

International Conference on Application and Commercialization of the Natural Fibres Composites (NFC) in Automotive and Infrastructure Sectors

Venue	FICCI Federation House, Tansen Marg, New Delhi 110001, India
Date	August 7, 2012 (Tuesday)
09:30 – 10.00	Registration
10:00 – 10:30	Inaugural Session
10:00 – 10:10	Welcome address Mr. Bhupendra Singh, Secretary General International Jute Study Group (IJSG), Dhaka, Bangladesh
10:10 – 10:15	Address by Mr. Sujit Gulati, Joint Secretary Ministry of Textiles, Government of India
10:15 – 10.20	Introductory Remarks by Mr. Shishir Jaipuria, Chairperson Textiles and Technical Textiles Committee Federation of Indian Chambers of Commerce and Industry (FICCI) New Delhi, India
10:20 – 10:30	Address by the Chief Guest & Conference Inauguration Ms. Kiran Dhingra, Secretary Ministry of Textiles, Government of India
10:30 – 10:35	Vote of Thanks/Address by National Jute Board, Kolkata, India
10.35 – 11.35	Technical Session I - Applications and Commercialization of NF composites in Automobile Sectors

Chairperson: Dr. V K Kothari
Professor, Department of Textile Technology, IIT-Delhi, India

1. Development of the Car Components using Wood Flours/ Natural Fibers and a New Evolution in Biomaterials
   Dr. Takuya Nishimura
   Group Manager, Toyota Auto Body Co. Ltd., Japan
2. Technological Solutions to Compound High Quality Jute Reinforced Automotive Grades
   Presentation by Dr. Babu Padmanabhan
   Chief Knowledge Officer, STEER Engineering Pvt. Ltd., Bangalore, India

- Open discussion and recommendations

11.35 – 11.45 Tea Break

11.45 – 13.00 Technical Session II - Applications and Commercialization of NF composites In Infrastructure Sectors
Chairperson: Dr. Prabir Ray
Director, Indian Jute Industries' Research Association (IJIRA)

1. Development of Durable, Strong and Lightweight Jute Fiber Based Composite Material for Infrastructure: Effect of Radiation
   Dr. Mubarak Ahmad Khan, Director, Institute of Radiation & Polymer Technology, Bangladesh Atomic Energy Commission, Bangladesh
2. Application Of Jute Fibers In Automotive And Infrastructure
   Dr. A. K. Sharma, Director, Centre of Excellence (COE) for Composites, Ahmedabad Textile Industry's Research Association (ATIRA), India

- Open discussion and recommendations

13.00 – 14.00 Lunch

14.00 – 15.00 Technical Session III - Applications and Commercialization of NF composites in Automobiles and House Construction Sectors
Chairperson: Dr. Prabir Ray
Director, Indian Jute Industries' Research Association (IJIRA)

1. Extruded Natural Fibre Composites for House Construction Applications - Opportunities in Green Economy
   Mr. Markku Vilkki
   CEO, Conenor Ltd., Finland
- Open discussion and recommendations

15.00 – 15.10 Concluding Remarks by Dr. V K Kothari
Professor, Department of Textile Technology, IIT-Delhi, India

15.10 – 15.15 Vote of Thanks by FICCI

15.15 – 15.30 Refreshment

E-proceedings of International Conference of Natural Fibres Composite

Technical paper

Development of durable, strong & lightweight jute fiber based composite material for infrastructure

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ABSTRACT

Jute fiber (hessian cloth) reinforced unsaturated polyester (USP) resin composite was prepared by simple hand lay-up technique. Samples were made at room temperature and additives were used to increase mechanical and thermal properties. Jute fiber was subjected to chemical treatment with curing and coupling agent to improve the fiber-matrix adhesion. Composite was corrugated to improve their bending and impact strength. Jute content was varied throughout the formulation where 30% fiber containing samples showed the best results. Composite made of chemically modified jute fabrics showed better mechanical performances than that of the untreated or UV treated composites but post preparational treatment by gamma radiation led to enhanced mechanical performance. Storage and loss modulus as well as cantilever tests of the composites were performed. The sample showed 147MPa tensile strength, 150MPa bending strength, 68 kJm^{-2} impact strength and more than 50 years durability. The two treatments together provide a synergistic effect on the mechanical performances and facilitate to develop a strong, lightweight and durable infrastructural material with an affordable cost.

Keyword: Jute, Composite, Natural Fiber, Jutin, Constriction materials.

1. INTRODUCTION

Among destructive and terrifying natural calamities, earthquakes measuring intensity morethan 5.0 on the Richter scale can cause immense damage to the buildings and structures, dams, bridges, railways, communication systems etc [1]. Earthquakes are common in Japan, one of

the world's most seismically active areas. The country accounts for about 20 percent of the world's earthquakes of magnitude 6 or greater. Recently a temblor struck the region of the Pacific where a magnitude-9.0 quake hit on March 11, triggering a huge tsunami. At least 23,000 people were killed or left missing in those disasters, which destroyed hundreds of homes, offices and factories in northeastern Japan.As the occurrence of earthquakes, is unpredictable, there is an ardent need to design and construct the buildings and structures to reduce the damages, thus saving precious human lives. Conventional heavy and brittle building materials such as stones, bricks, mortar, granite etc. do not absorb shock waves but they amplify them, causing more destruction. The material of construction to be used in earthquake prone areas should be such that they absorb & reduce seismic energy [1].

Jute has high cellulose content and low micro-fibril angle which are desirable properties of a fiber to be used as reinforcement in polymer matrices. Jute is one of the most common natural fibers having high tensile modulus and low elongation at break. If the low density (1.45 g/cm^3) of this fiber is taken into consideration, then its specific stiffness and strength are comparable to respective quantities of glass fiber [2, 3]. In spite of these above-mentioned advantages, jute fiber – like other natural fibers – exerts some difficulties while used as reinforcement in non-polar polymer matrices. Being polar and hydrophilic in nature, jute fiber exhibits poor interfacial adhesion with hydrophobic polymer matrices. To overcome these kinds of bottlenecks, many attempts, such as physical and chemical treatments, lead to changes in the surface structure and surface energy of the fibers. Such an effort was made to prepare a composite with improved mechanical properties using radiation induced jute-urethane polymer system. The resin matrix was prepared under gamma radiation using urethane acrylate in the presence of N-vinylpyrrolidone, ethyl hexyl acrylate and trymethylol propane triacrylate. Some additives such as acetic acid, acrylamide, urea, talc, and titanium oxide were incorporated into the formulation [4]. In this context, hessian cloth (jute product) was coated with urethane pre-polymer with different formulations in the presence of plasticizers under UV radiation. Tensile properties of the composites were found to increase. It is also indicative that simulated weathering and soil degradation tests show the biodegradable nature of the prepared composites [5]. A good correlation was found between composite impact damping and yarn toughness for the jute-epoxy composites [6]. Two monomers such as 2-hydroxy ethyl methyl acrylate (HEMA) and 2-ethyl hexyl acrylate (EHA) were successfully used as novel coupling agents for jute fabric (hessian cloth) polypropylene composite. The mechanical properties of the resulting composites increased as a result of surface treatment of the jute fabrics [7]. Polyester resin was used as matrix material for composite fabrication. The mechanical properties (tensile and bending strengths) of the surface modified jute fabrics reinforced polyester composites improved significantly [8]. The unsaturated polyester resin is quite useful for industrial and civilian world. As a low-cost, rigid, high strength-to-weight material, one can find its products in the form of mechanical parts, pipes, tanks, electronic gears, etc. They can be cured to give

insoluble, infusible solid plastics through a free radical curing process. Organic peroxides are employed as free radical initiators while tertiary aromatic amines and some organic metal salts, such as cobalt naphthenate, are used as curing promoters if needed Tertiary aromatic amine and cobalt naphthenate can significantly reduce the decomposition temperature of peroxides via chemical reduction processes [9]. The objective of this research work is to prepare low cost light weight, durable, earthquake and cyclone tolerance housing materials and so on likewise products with sustainable local technology.

2. MATERIALS AND METHODS

2.1. Materials

Jute fabric was used as the reinforcing agent. The matrix polymer was a commercial unsaturated polyester resin (EPOLAC G-153ALX) containing 1.5% cobalt napthenate solution, 6% cobalt catalyst as promoter, and 36% styrene as diluent. Methyl ethyl ketone peroxide (MEKP) and wax were used as curing agent and mold releasing agent respectively. REOLOSIL fumed silica (aerosealpowder) was used as filler. A substituted aromatic tertiary amine was used as coupling agent.

2.2. Methods

2.2.1. Surface Modification

Hessian cloth was cut into rectangles (12 ×10 cm^2) and temporarily fixed in a long square sized plate (50 ×50 cm^2) where UV radiation could be given together to six equal sized rectangular samples. Then the samples were subjected to UV radiation (254–133 nm) using an irradiator (UV minicure Me-200, ISTTechnik, Germany), which delivers apower strength of 2 kW. The speed of the manicure was 4 meter/minute for each pass of the substrate under the lamp by maintaining different UV radiation intensities expressed by number of passes.

2.2.2. Composite Fabrication

Composites were fabricated using a simple hand lay-up technique. The working surfaces were treated with releasing waxes to facilitate easy removal of samples from the mold surfaces. Cobalt napthenate (catalyst) and MEKP (curing agent) were mixed thoroughly with USP at various formulations before each operation. At the beginning of fabrication, a gel coat with 2% MEKP was uniformly brushed into the finished side of the male and female parts of the mold. After 1h, when curing of gel coat was completed, each layer of the fiber was pre-impregnated with formulations made of USP. The impregnated jute samples were then placed one over another as a sandwich. This sandwich was placed into a mould. Both parts of the mold were tightened by screw-bolt and allowed 3 h for total curing (composite

fabrication). The composites were cut into rectangular pieces of equal size ($120\times100\times3mm^3$) for different tests. All results are taken as the average of five samples for each testing.

2.2.3. Mechanical Tests

The tensile and bending strength of the composites were measured according to DIN 53455 and DIN 53452 standard methods by a universal testing machine (Hounsfield S Testing Series, UK) with an initial clamp separation of 20 mm and a cross-head speed of 10 mm/min. Charpy impact strength of the composite was determined by an impact tester (MT-3016) according to the DIN EN ISO 179 standard in the flat wise, un-notched mode. The test samples were conditioned at 25°C and 50% relative humidity for several days before testing and all the tests were performed under the same conditions. The result of each test is taken as the average value of five samples

2. RESULTS & DISCUSSION

The effect of jute content (%wt) on the mechanical properties of the resulting composites is studied here and shown in Figures 1 and 2. It was found shows poor mechanical properties due to poor fiber population and low load transfer capacity to one another. Levels of fiber content (such as 20%), the composite As a result, stress gets accumulated atcertain points of the composites and highly localized strains occur in the matrix. At intermediate levels of loading (30%), the population of the fibers is just right for maximum orientation and the fibers actively participate in stress transfer. So, the mechanical properties of the composite reaches maximum. At high levels (suchas 40%) of jute content, the non homogeneous fiber matrix adhesion becomes prominent which leads to agglomeration among the fibers and stress transfer gets blocked [10]. As a result, the mechanical properties of the composite again decreased. The composite of the optimized jute content (30%w/w) showed 205% increase in tensile strength (TS), 141% in tensile modulus (TM), 226% in bending strength (BS) and 195% in bending modulus (BM) than that of the resin based composite.

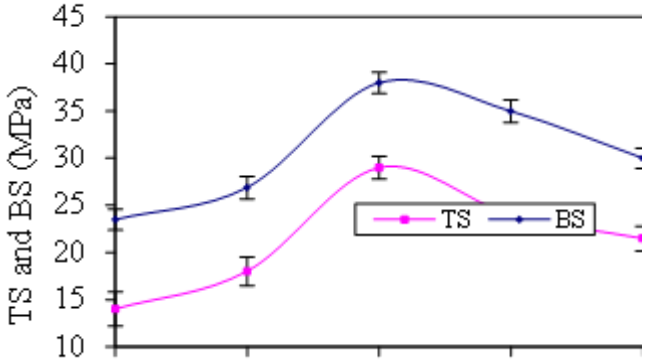

Figure 1: Effect of jute content on tensile and bending

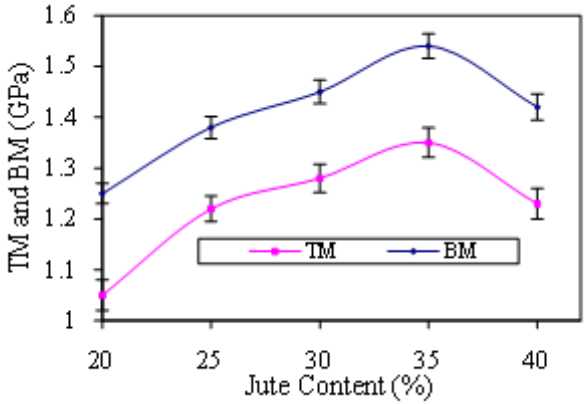

Figure 2: Effect of jute content on tensile and bending

The effect of UV radiation on the mechanical properties of jute based composites was investigated and presented in Figures 3 and 4. Jute content in the UV treated composite is maintained at about 30%. The UV intensities of different passes (200-400 pass) were exposed to jute surfaces.1 UV pass indicates 1 metre of UV exposure in the machine. It was found that UV intensity of 200 pass showed the highest mechanical properties. Mechanical properties, such as tensile and bending properties increase up to 200 pass, which gives 68% increase in TS, 78% in TM, 58% in BS, and 57% in BM relative to untreated jute-based composites. The TS, BS, TM and BM of the control composite were found 29.45 MPa, 38.35 MPa, 1.35 GPa and 2.54 GParespectively. The increase of mechanical properties of the composite with increasing UV radiation may be due to the intercross-linking between the neighboring cellulose molecules, which results in the strength of jute fabrics. It is observed from Figures 3 and 4 that mechanical properties of the composite increase with UV pretreatment up to a certain limit and then decrease due to the two opposing phenomena, namely, photo cross-linking and photo degradation that take place simultaneously under UV radiation. At lower doses, free radicals are stabilized by a combination reaction and, as a result, photo cross-linking occurs. The higher the number of active sites generated on the polymeric substrate, the greater the grafting efficiency. But at higher radiation, the main chain may be broken-down and polymer may degrade into fragments and, as a result, mechanical properties were found

to decrease after certain UV doses. An intense radiation results in a loss of strengths and a reduced degree of polymerization is observed [10].

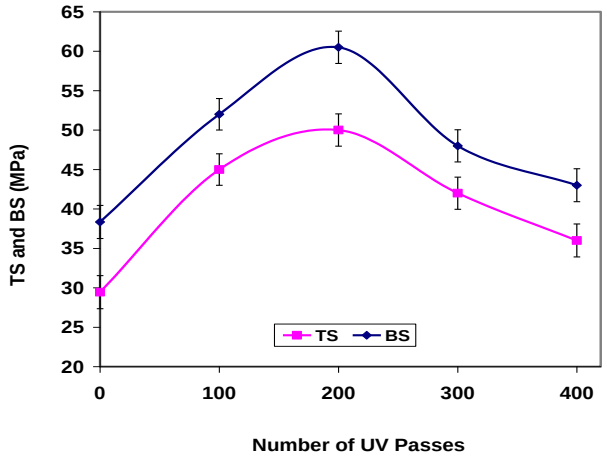

Figure 3: Effect of UV radiation on tensile and bending strength of jute-based composites

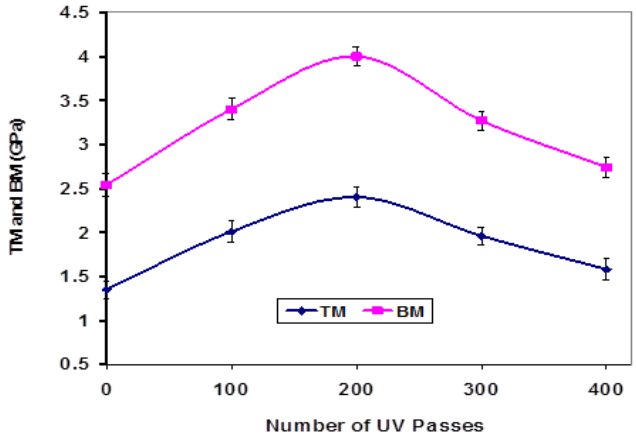

Figure 4: Effect of UV radiation on tensile and bending modulus of jute-based composites

Jute fabrics were further treated with a coupling agent (0.1 to 2.0 %) at the stage of pre-impregnating the fibers with USP resin to show its effect on to the composites. Figs 5 and 6 show the effect of coupling agent on the properties of the composites. The coupling agent with a concentration of 1.0 % performed the best of mechanical properties. It is also indicative that coupling agent treated composite showed much better mechanical properties than that of the control composite. It was found that 1.0% coupling agent treated composite showed 90, 74.7, 77.77 and 57.48% higher TS, BS, TM and BM values than that of the control composite.

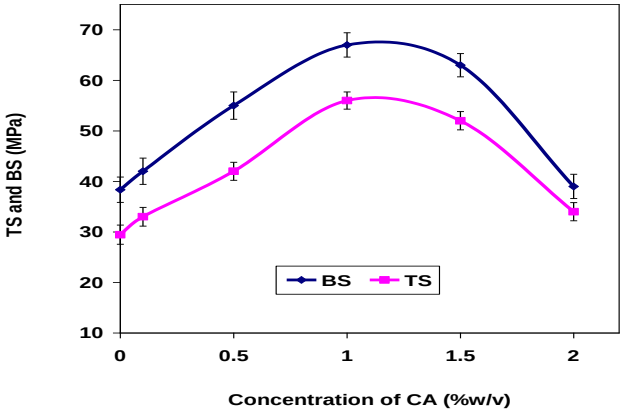

Figure 5: Effect of coupling agent on tensile and bending strength of composites

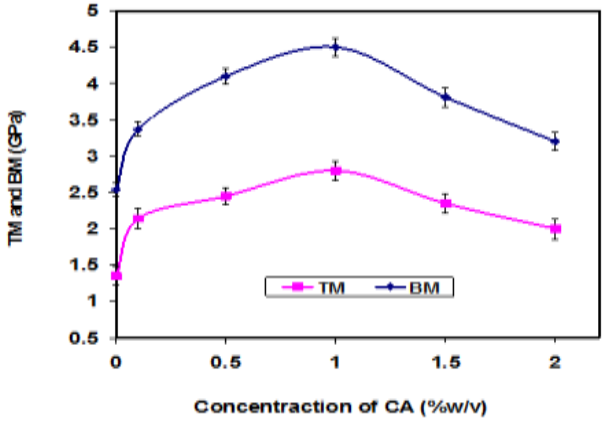

Figure 6: Effect of coupling agent on tensile and bending modulus of composites

Table 1 shows the synergistic effect of the two treatments – coupling effect and UV treatment – on the properties of the composite. It was found that TS, BS, TM and BM values of UV+CA treated composite were 96 MPa, 117 MPa, 4.2 GPa and 5.5 GPa respectively. The values are about 226, 205, 211and 116% higher than that of the control composite. The free radical and cross linking mechanisms of the two effects (UV +CA) may be mainly responsible for the increase of mechanical properties of the composite.

Table 1.The effect of UV+CA on the properties of composite

Sample	Properties			
	TS (MPa)	BS (MPa)	TM (GPa)	BM (GPa)
UV+CA treated composite	96 ± 2.2	117± 2.5	4.2 ± 0.11	5.5 ± 0.15

The charpy impact strength (IS) of the control and treated composites were studied here. The IS values of UV, CA and UV+CA treated and control composites were found 35, 39 and 44 and 20 kJ/m^2 respectively. The effect of glass fiber (GF) in the mechanical properties of UV + CA treated jute fabrics composites was investigated and is shown in Figures 7 and 8.

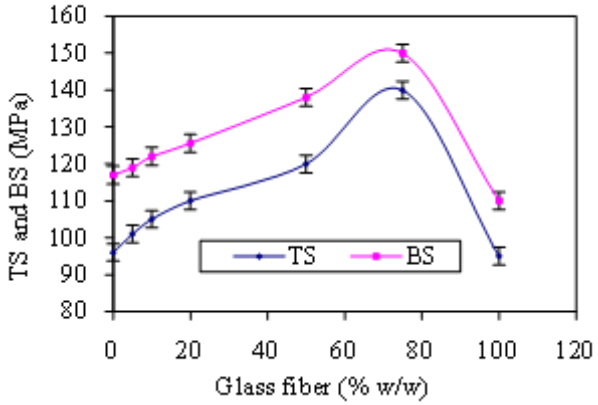

Figure 7: The effect of glass fiber content on tensile and bending strength of jute/GF hybrid composite

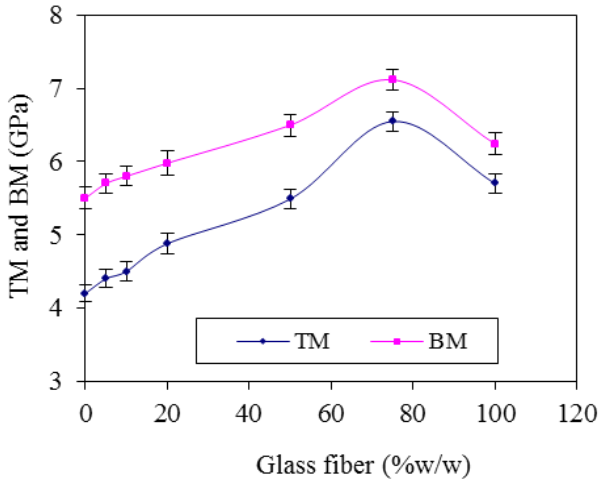

Figure 8: The effect of glass fiber content on tensile and bending modulus of jute/GF hybrid composite

The weight fractions of glass fiber content in the jute/GF hybrid composites varied from 5 to 100%. The incorporation of glass fiber into jute fabrics up to 75% helps the hybrid composites show better mechanical properties over the other treated composites. The values of TS, BS, TM, BM and IS of the hybrid composites at 75% GF content were found 140 MPa, 150 MPa, 6.55 GPa, 7.12 GPa and 68 kJ/m^{2}respectively. The incorporation of GF increases the reinforcement of jute fibers into the matrix. In a hybrid composite, the mechanical properties of composites are mainly dependent on the modulus and percentage elongation at break of individual reinforcing fibers. The increase in

mechanical properties through the addition of glass fiber to jute can be explained on the basis of higher modulus and elongation at break of the glass fiber [11], whereas the extensibility of glass is low compared to the jute fiber.

4. Comparative Studies

Figures 9 and 10 shows the comparative data of different treatments on the properties of jute and jute/GF based composites. It was found that the glass fiber on the UV + CA treated jute based composite performed the best mechanical properties.

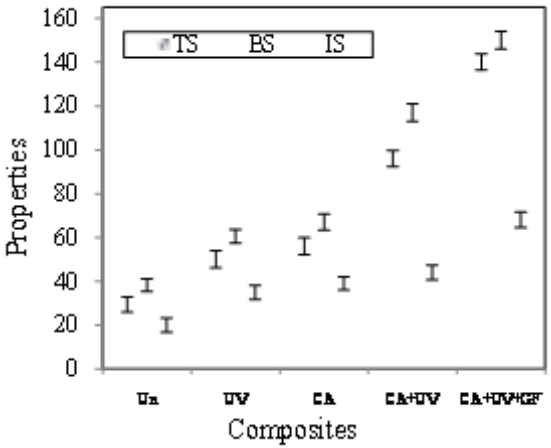

Figure 9: The effect of different treatments on the strength of composites

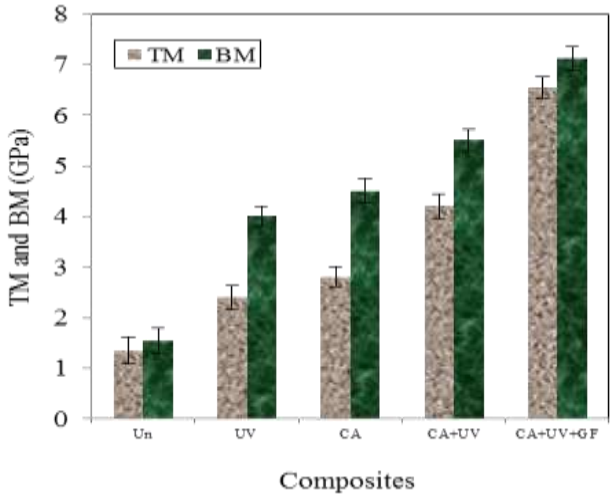

Figure 10: The effect of different treatments on the modulus of composites

5. Aging properties of Composite (JUTIN)

5.1. Thermal aging

Table 2.The effect of thermal aging on tensile strength of JUTIN

Sample	Room temp.	Tensile strength (MPa) 15 days			
		OºC	4ºC	50ºC	70ºC
Jutin	96	116±2.0	99.8±1.9	93±1.82	78±1.8

The JUTIN was subjected to undergo different temperature treatments at 15 days time periods to investigate the effect of thermal aging on tensile strength of JUTIN. It was found that the strength of composite increases with the decrease of temperature. The TS decreased to about 19.0 % and 3.0 % at aging temperature of 70ºC and 50ºC respectively. Whereas at 4ºC and 0ºC, TS increased about 4.0% and 21.0% respectively.

5.2. Water aging

There is very negligible amount of water uptake (<1%) within 3 months. There is no change in mechanical properties within 3 months.

5.3. Normal weathering aging

The mechanical properties increased up to 7-10% within 6 months and remain unchanged up to 12 months.

5.4. Accelerated weathering aging

To study the weathering effect on the mechanical properties of Jutin, the samples of jutin were exposed under simulated weathering tester from Q-panel Co. (model QUV, USA). The weathering testing was performed in alternating cycles of sunshine over 4h (65º±2ºC) and condensation for 2h (45º±2ºC). This aging test was carried out for 600 h. Owing to this test the losses of mechanical properties more or less zero up to 300 hours and about 10% up to 600 h.

6. Conclusion

The tensile strength of the prepared composites composite is 150 MPa, bending strength is 147 MPa and impact strength is 68 kJm^{-2} and it will be stable up to 50 years. This jute-based polymer composite shows extra-ordinary features which are very promising to make jute based polymer composite as an effective alternative of metallic or plastic materials. It is rust proof, saline resistant, lightweight, heat resistant, sound proof, environmental friendly, Very low thermal expansion, and damaged area can be sealed very easily. In contrast, lightweight jute made composite boards fixed on steel frames with bolts & nuts are more flexible allowing lateral movements of the structures. They absorb and reduce seismic energy. The usage of natural fiber (jute) based products in post disaster management of

rehabilitation & rebuilding, would become cost competitive compared to other building materials. Thus, all the properties of composite claim its position as an ideal building material.

REFERENCES

[1] Soumitra Biswas, Atul Mittal & G Srikanth, Gujarat Earthquake - Composite Materials towards Re-building & Rehabilitation

[2] Bogoeva-Gaceva G., Avella M., Malinconico M., Buzarovska A., Grozdanov A., Gentile G. and Errico M.E. (2007). Natural fiber eco-composites.*Polymer Composite*;**28**: 98-107.

[3] Joshi S.V., Drzal L.T., MohantyA.K.andArora S. (2004). Are natural fiber composites environmentally superior to glass fiber reinforced composites? *Composites:Part A*; **35**: 371-376.

[4] Khan M.A., Ali K.M. I., Balo S.K. and Ahmad, M.U. (1998). Effect of additives reinforcement of radiation induced jute urethane polymer composites. *Journal of Applied Polymer Science*; **67**:79-85.

[5] Khan M.A., Uddin M.K. and Ali K.M.I. (1997). Degradable jute plastic composite.*Polymer Degradation and Stability*; **55**:1-7.

[6] Gassan J. and Bledzki A. K. (1999). Possibilities for improving the mechanical properties of jute/epoxy composites by alkali treatment of fibers.*Composites Science and Technology*; **59**:1303-1309.

[7] Khan M.A., Hinrichsen G. and Drzal L.T. (2001). Influence of novel coupling agents on mechanical properties of jute reinforced polypropylene composites. *Journal of Materials Science Letters*; **20**:1711-1713.

[8] Mohanty A.K, Khan M.A. and Hinrichsen G. (2000). Influence of chemical surface modification on the properties of biodegradable jute fabrics-polyester amide composites. *Composites:Part A*; **31**:143-150.

[9] Khan M.A., Ganster J. and Fink H. P. (2004). Natural and man-made cellulose fiber reinforced hybrid polypropylene composites.5th Global Wood and Natural Fiber Composites symposium, in Kassel, Germany, April 27-28.

[10] KuangW. and Richardson, A. (2007).A New Amine Promoter for Low-temperature Cure of MEKP Initiated Unsaturated Polyester Resin Systems. *Composites Research Journal*; **1**(4): 9-13.

[11] Abdullah-Al-Kafi, Abedin M. Z, Beg M. D. H, Pickering K. L and Khan M. A (2006). Study on the Mechanical Properties of Jute/Glass Fiber-reinforced UnsaturatedRadiation Polyester Hybrid Composites: Effect of Surface Modification by Ultraviolet Radiation. *Journal of Reinforced Plastics and Composites*; 25: 575-588.

[12] Khan, M. A. and Hasan, M. M. (2004). Surface Modification of Natural Fibers by Photo-grafting and Photo-curing, In: Mital, K. L. (ed.), Polymer Surface Modification: Relevance to Adhesion, VSP, Vol. 3, pp. 263–283.

Summary

The latest invention of the Natural Fibre Composites (NFC) and their commercialization was one of the mostly discussed topics of the International R&D Seminar held in Dhaka during June 8-9, 2011 organized by the International Jute Study Group (IJSG). In this backdrop, an International Conference on "Application and Commercialization of the Natural Fibres Composites in Infrastructure and Automotive Sectors" was organized by the IJSG on August 7, 2012 in collaboration with Federation of Indian Chambers of Commerce and Industry (FICCI) and National Jute Board (NJB), India. This international conference deliberated to understand the usability and future aspects of bio-composites in the areas of NFC especially in infrastructure, construction, housing and automotive sectors and explore the real-time approaches for commercialization of the existing NFC. The conference also highlighted the necessity of development a specific disposal and marketing protocol for the bio-composites through strengthening the public-private partnership.

This conference facilitated the jute industries, manufacturers, traders, exporters, R&D institutions in scaling up not only the marketing of bio-composites but also improve the networking among public-privates partners in the Jute and Allied Fibre (JAF) sector. The programme comprised of five presentations on sustainable technologies, marketing, pricing and standardization of bio-composites from Bangladesh, India, Japan and Finland. The conference successfully achieved its objectives of exchanging, sharing and developing the business ideas and commercial procedures of NFC across the global markets.

The Chief Guest, Ms. Kiran Dhingra, Secretary, Ministry of Textiles (MoT) of Government of India, inaugurated the international seminar. Mr. Bhupendra Singh, Secretary General of IJSG, Mr. Atri Bhattachrya, Secretary, National Jute Board (NJB), India and Mr. Shishir Jaipuria,

Chairperson (Textiles and Technical Textiles Committee), Federation of Indian Chambers of Commerce and Industry (FICCI), India were present at the inaugural session as Special Guests. The inauguration started presenting the green certificates of plantation to the chief and special guests by Mr. Jaipuria.

The **Chief Guest, Ms. Kiran Dhingra, Secretary, Ministry of Textiles (MoT) of Government of India**, remarked it is estimated that the market size of bio-composite will increase from US$2.1 billion in 2010 to US$3.8 billion in 2016. A study indicates that there is scope for about 20 kg of natural fibres to be used in approximately 60 to 70 million vehicles being produced globally each year. Natural fibres especially jute, kenaf and allied fibres are being used in the manufacturing of automobile and infrastructure globally as an optimum replacement of synthetic fibres such as glass, carbon, aramid, electrical or e-glass and polyethylene (PE) fibres, the Secretary, MoT affirmed. In India, around 3.5 million mill workers are directly employed in the jute packaging process. However, this has invariably led to restricted use of high-end technology in the process of packaging. Ms. Dhingra also declared that to leverage the jute, kenaf and allied fibres industry it is important to re-visit the Jute Packaging Act and amend the Act to enable the industry to induct modern technology.

At the occasion, **Mr. Bhupendra Singh, Secretary General of IJSG**, welcomed the honorable Chief Guest, respectable speakers, representative from auto and infrastructure industries and distinguished participants to the International conference. Mr. Singh affirmed the fibre-based composites can contribute greatly to the automotive manufacturer's final goal constituting 30 per cent weight reduction and cost reduction of 20 per cent. Eco-friendly bio-composites from plant derived fibre and crop-derived plastics would be the novel materials of the 21st century not only as a solution to the growing environmental threat but also as a way out to alleviating the uncertainty of the petroleum supply which is expected to decline between 2010 to 2020. New process development for bio-composite fabrications for commercial applications is the real challenge of research at the current level of technology so far developed for bio-composites. The Secretary General concluded with a request to implement the mission like the "Eco-efficient Technologies and Products Based on Natural Fiber composites project (ECOFINA)" or the "Clean Sky" or the "Biocomp" for stepping ahead of commercialization of the products.

Mr. Atri Bhattachrya, Secretary, National Jute Board (NJB) hoped the effective translation of the gathering to meet its goal appropriate market penetration of the composite products.

Mr. Shishir Jaipuria, Chairman, Textiles and Technical Textiles Committee, FICCI, emphasized that there is a need to intensify research and development in the sector and create awareness about the application and commercialization of natural fibre composites. He stated that the industry at present faces a challenge in the form of lack of standardization

A total of 100 participants were present in the inaugural session. There were three technical sessions in the day long International Conference where five presentations on applications and commercialization of bio-composites in automobiles and house construction, infrastructure sectors have been made. The distinguished resource persons were from Bangladesh, India, Finland and Japan.

In light with the Secretary, MoT words, the traditional applications of jute or other natural fibres, packaging, are not inclining and the industry needs thrust for innovations and diversification to assure the regular use of natutal fibres. Other issues of adoption of extrusion technology than injection moulding, utilization of waste and recycled materials, feasibility of the product in autos and constructions, costing of the materials and final product, ensure fair pricing of farmers etc were the highlighted in the conference.

Mr. Markku Vilkki, CEO, Conenor Ltd., Finland explained the advantages of the extrusion method for the bio-composites. The fibre content of the final product in extrusion method is higher upto 80 percent where the maximum fibre content achieved in injection molding is 60 percent. The benefits of multi layer and size customization are also made the newer technology suitable alternative for the bio-composites of housing and constructions. He also remarked one of the major issues - price of raw materials available in market. The industry will not be convinced to buy natural fibres cost USD 200-250 per tonne; on the contrary, the polypropylene is available only of USD 100/tonne. Ensure fair pricing of raw materials at the producer and market end that has to be resolved Mr. Vilkki emphasized.

The possible applications of natural fibres in housing and constructive sector at the susceptible geographic conditions particularly the earthquake prone areas as the fibre inherences the good elasticity had come from the participants of India. In reply, Mr. Vilkki stated considering the tensile strength, fragilely and other hybrid characteristics, the natural fibre composites are the better alternative than cement or brick. The NFC will be more cheap and risk-free for the disaster prone areas.

Use of refined fibre in the bio-composite and market availability of the refined fibre was questioned by another participant from India. Dr. A. K. Sharma, Director, Centre of Excellence (COE) for Composites, Ahmedabad Textile Industry's Research Association (ATIRA), India shared the similar success story of hemp in the automobile sector in France and Germany.

Dr. Mubarak Ahmad Khan, Director, Institute of Radiation & Polymer Technology, Bangladesh Atomic Energy Commission commented that numbers of papers published, meeting convened on the same topic every year. But the ratio of published paper and hand-on technology in the market is really insignificant. He requested the industry stakeholders to look at the issue and accelerate the market promotion of the developed products and technologies.

Mr. Syed Zaheer Abbas, Technical Advisor, Pakistan Jute Mills Association, opined that there should be a local solution. Bangladesh, India and Pakistan cover the world most production, consumption and export of jute, kenaf and allied fibres and their products. But, the R&D innovations are dependent on the European buyer's or manufacturer for its implementation. He demanded the effective R&D solutions which will be adopted locally in the producing countries where raw material is available.

Pictorial

The delegates in the Inauguration Ceremony of the International Conference

The Chief Guest, Ms. Kiran Dhingra, Secretary of Ministry of Textiles, Govt. of India visiting the exhibition

Dr. Takuya Nishimura presenting his paper in Technical Session - I

Dr. Mubarak Ahmad Khan presenting his paper in Technical Session - II

Mr. Markku Vilkki presenting his paper in Technical Session - III

Resource Persons at Plenary Session

Participants of the Conference

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