

MECHANICAL PROPERTIES OF NATURAL FIBRE BASED HYBRID COMPOSITES: A REVIEW

¹Sukesh Gupta, ²Rajiv Kumar

¹Mtech scholar, ²Assistant Professor

¹school Of Mechanical Engineering, Shri Mata Vaishno Devi University, Katra, Jammu & Kashmir, India-182320

ABSTRACT: During Last Few Decades, The Natural Fibre Based Composites Are Replacing Synthetic Fibre Based Composites In Most Of The Applications. The Most Important Reasons For It Are Their Low-Cost, Ease Of Processing, Satisfactory Strength, Durability, Crack Propagation Resistance, Resistance To Impact Loading, Etc. Natural Fibres Are Being Used In Most Of The Commercial Applications Such As Automotive Industries, Household Applications, Etc. Nowadays Hybrid Composites Based On Natural Fibres Are Getting Attention. Shortcomings Of One Fibre Can Be Reduced By Adding Other Suitable Fibre. When Two Fibres Are Mixed Then, It Provides Some Certain Advantage Over The Use Of Single Natural Fibre. The Main Aim Of Using Different Natural Fibre Is To Get Eco-Friendly Materials In Automotive And Construction Sectors. The Present Work Surveys Crafted By Different Scientists On Mechanical Properties Of Regular Fibre Based Hybrid Composites

Keywords: Natural Fibre; Hybrid Composite; Polyester; Epoxy.

I. INTRODUCTION

As We All Know That The Population Is Growing Day By Day And The Use Of Resources Is Also Increasing Continuously With The Population. Use Of Non- Renewable Synthetic Fibre Such As Glass, Carbon, Etc. Has Been Reduced Due To Its Higher Cost As Well As Non-Eco-Friendly Nature [1,2]. We All Know That The Demand Of Natural Fibre Is Increasing Day By Day In Each And Every Field Such As Aerospace, Automobile, Defence, Etc. Natural Fibres Are Attracting Most Of The Researchers Over The Conventional Synthetic Fibres Due To Low Density, Low Cost, Eco-Friendly[3–6]. Natural Fibres Are Of Two Categories Such As Plant Based And Animal Based. Natural Fibre Such As Jute, Flax, Kenaf, Banana, Sisal, Oil Palm, Etc. Can Be Extracted From The Plants Comes Under Lingnocellulose. Silk, Wool Can Be Called As Animal Based Natural Fibre [5]. Composites In View Of Common Fibre Fortification That Have Produced Wide Research And Building Enthusiasm For The Most Recent Couple Of Decades Because Of Their Little Thickness, High Particular Quality, Ease, Lightweight, Recyclability And Biodegradability And Has Earned An Extraordinary Class Of The Green Composite [7]. The Principle Impediments Of Characteristic Filaments In Composites Are The Poor Similarity Amongst Fibre And Framework. Through Chemical Treatment Not Just The Grip Between The Fibre Surface And The Polymer Lattice Is Upgraded Yet Additionally The Fibre Surface And The Fibre Quality Is Moved Forward [8]. The Constituents Of Various Natural Fibres Are Shown In Table 1[9].

When Two Or More Than Two Different Fibres Are Mixed With The Polymer Then That Composite Is Termed As Hybrid Composite. Hybrid Composites Have Higher Mechanical Properties As Compared To Individual Fibre Based Composite. Holbery Et Al. [10] Studied That There Is The Fast Development Of Regular Fibre In The Car Advertise And At Display, It's Expanding At A Worldwide Level In Light Of Its Lower Cost And Execution Level And In Addition Its One Of A Kind Properties. There Are Some Challenges Involved With These Fibres; These Are Moisture Absorption, Poor Fibre Matrix Adhesion. These Factors Significantly Reduce Performance Of These Composites. These Issues Can Be Overcome By Chemical Or Some Other Treatment Of Natural Fibres. To Put It Plainly, The Advancement Of The Regular Fibre Composite Market Would Have A Beneficial Outcome On Ranchers And Entrepreneurs On A Worldwide Scale, Decrease U.S. Dependence On Outside Oil, Enhance Natural Quality Through The Advancement Of Practical Asset Inventory Network, And Accomplish A Superior CO₂ Adjust Over The Vehicle's Lifetime With Close To Zero Net Ozone-Harming Substance Emanations.

Kabir Et Al.[11] Concluded That The Exhaustive Review Of Various Surface Medicines Connected To Normal Strands For Cutting-Edge Composites Applications. Hydrophilic Nature Of The Filaments Is Decreased And Attachment With The Lattice Is Enhanced Through The Substance Treatment. Pre-Medications Of Fibre Change Its Structure And Surface Morphology. By Utilizing Distinctive Compound Treatment Forms On The Fortifying Fibre There Us Huge Changes In The Mechanical Properties Of The Composites

table: cellulose, hemicelluloses and lignin weight percentage of different fibres [9].

S.NO	NAME OF THE FIBRE	CELLULOSE (Wt%)	HEMICELLULOSE (Wt%)	LIGNIN (Wt%)
1	Jute	59-71.5	13.6-20.4	11.8-13
2	Sisal	78	25.7	12.1
3	Banana	62-64	19	5
4	Bamboo	26-65	30	5-31
5	Flax	71	18.6-21.6	2.2
6	Kenaf	45-57	8-13	21.5
7	Coir	37	20	42
8	Palm	60-65		11-29
9	Hemp	57-77	14-22.4	3.7-13
10	Curaua	70.7-73.6	9.9	7.5-11.1
11	Piassava	28.6	25.8	45
12	Ramie	68.6-91	5-16.7	0.6-0.7
13	Cotton	82.7-90	5.7	<2
14	Abaca	56-63	20-25	7-13
15	Henequen	60-77.6	4-28	8-13.1
16	Alfa	45.4	38.5	14.9
17	Betelnut	53.20	32.98	7.20

II. Mechanical Properties Of Hybrid Composites

2.1 Sisal Based Hybrid Composites

Athijayaman Et Al. At The Point When Sisal Fibre Is Blended With Roselle Fibre By Adding Polyester To Shape Hybrid Composite This Unquestionably Improves The Mechanical Properties Of The Composite. As The Substance And Length Of The Fibre Are Expanded, It Prompts The Change In The Distinctive Mechanical Properties Of The Hybrid Composite, For Example, Pliable And Flexural Quality. After Preparing The Samples, There Is Certain Decrease In The Tensile And Flexural Strength Due To The Exposure To The Moisture Environment [1]. Khanam Et Al. When Sisal Fibre Is Mixed With Silk By Adding Polyester Forms The Polyester Based Hybrid Composite. The Alkali Treatment Is Done On The Composite Materials And Its Effects Are Studied In Enhancing The Mechanical Properties Of The Composite. Higher Strength Is Obtained In Case Of Treated Hybrid Composite Than Untreated Hybrid Composites [12]. Kumar Et Al. At The Point When Glass Fibre Is Added To Sisal Fibre With An Epoxy Grid Then It Frames An Epoxy-Based Half Breed Composite. Distinctive Properties Of The Half And Half Composite Are Inspected, For Example, Hardness, Affect Quality, And So On. Immediately Without Playing Out Any Treatment And Further More By Treating It With Dissolvable Base. Higher Mechanical Properties Were Gotten When Composite Is Dealt With When Contrasted With Untreated Composites[13]. Figure 1 shows use of sisal fibre[19]

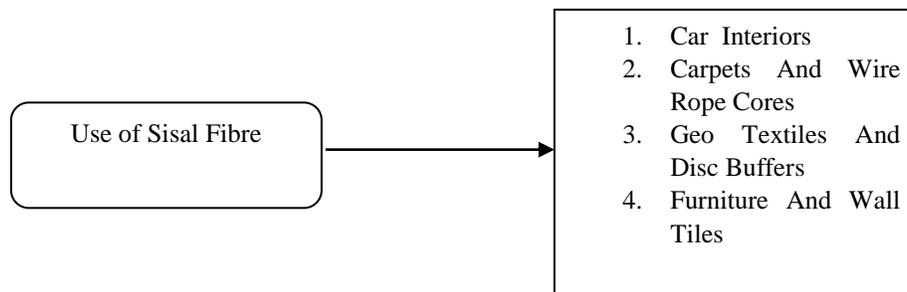


figure1: use of sisal fibre [19]

2.2 Banana Based Hybrid Composite

Venkateshwaran Et Al. When Sisal Fibre Is Added To Banana Fibre With An Epoxy Forms A Epoxy Based Hybrid Composite. After Composite Is Prepared Testing Is Performed And Examines The Different Mechanical Properties Of An Epoxy Hybrid Composite Material. When Sisal Fibre Is Added To Banana Fibre There Is An Increase In Mechanical Properties And Decrease In Moisture

Absorption Property [4].Thiruchitrambalam Et Al. At The Point When Kenaf Fibre Is Blended With Banana Fibre Unsaturated Polyester Shapes The Unsaturated Polyester Based Half Breed Composite. In This, The Impact Of A Soluble Base And SLS (Sodium Lauryl Sulfate) Treatment On Banana/Kenaf Hybrid Composites And Woven Cross Breed Composites Is Explored. These Composite Were Manufactured By A Trim Procedure. There Is A Change In Mechanical Properties (Malleable, Flexure And Effect Quality) Because Of Antacid Treatment Of The Composites. At The Point When The Surface Change Is Performed By SLS At That Point, There Is Much Change In The Mechanical Properties When Contrasted With The Soluble Base Treatment[3]. Boopalan Et Al. When Jute Fibre Is Mixed With The Banana Fibre By Adding Epoxy In Order To Form An Epoxy Based Reinforced Hybrid Composite. This Shows That When Both Fibres Are Mixed Up To 50% By Weight Form A Composite Then It Shows That There Is Increase In Different Properties Such As Mechanical As Well As Thermal Properties Of The Composite And There Is Certainly Decrease In Moisture Absorption. There Is Poor Interfacial Bonding Between Fibre And Matrix Which Can Be Improved By Chemical Treatment/Treatment With A Coupling Agent[6].Liu Et Al. At The Point When A Two-Advance Expulsion Technique Is Utilized To Set Up The Composite By Blending HDPE/Nylon-6 Mixes With Banana Fibre Brings About A Change In Moduli And Quality Of Definite Composites By Expanding The Baf Stacking Level, While Affect Durability Was Brought Down. WA Estimation Of Composites Is Expanded Within The Sight Of SEBS-G-MA, Both Included Nylon-6 And Expanded Baf Stacking Levels[18]. Figure 2 shows use of banana fibre:

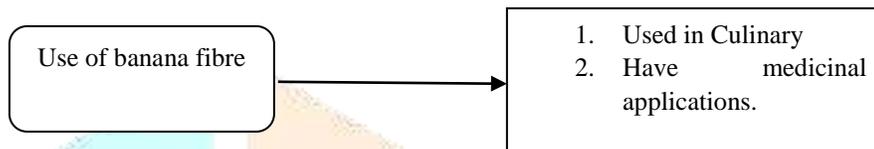


figure 2: use of banana fibre[19]

2.3 Jute Based Hybrid Composite

Jawaid Et Al. At The Point When Oil Palm EFB And Jute Fibre Are Blended Utilizing Epoxy Sap And Epoxy Hardener Then The Mechanical Execution Of Mixture Composites Was Assessed Utilizing Flexural And Effect Testing. As For The Weight Division Of Fibre, The Flexural Properties Of The Cross Breed Composite Are Higher Though The Unadulterated EFB Composite Has Higher Effect Quality[14]. Shanmugam Et Al. The Salt Treated Ceaseless Palmyra Palm Leaf Stalk Fibre (PPLSF) And Jute Filaments Were Utilized As Support In The Unsaturated Polyester Framework And Their Static And Dynamic Mechanical Properties. Ductile And Flexural Properties Of The Hybrid Composites Are Expanded When There Is An Expansion In The Jute Fibre Stacking And The Low Effect Quality Of The Hybrid Composites Was Watched[15]. Akil Et Al. Pultruded Jute And Jute /Glass Are Mixed Together With Polyester To Form The Hybrid Reinforced Unsaturated Polyester Composites. At High Temperature, Hybrid Composite Shows Superior Properties As Well As High Retention Of Various Mechanical Properties As Compared To Jute Fibre[5].Chaudhary Et Al. When Jute/Hemp/Flax/Epoxy Hybrid Composite Is Formed By Using The Hand Lay-Up Technique Then It Has Been Calculated That The Different Mechanical Properties Of The Material Such As Tensile, Flexural Etc Are Being Enhanced As Compared To Any Other Composite. Reinforced Composite Which Shows Lower Mechanical Properties Is Hemp As Compared To Jute/Flax Fibre. Flexural Modulus, Flexural And Impact Quality Of The Mixture Composite Which Goes About As A Solitary Segment Are Upgraded[16]. Figure 3 shows the use of jute fibre:

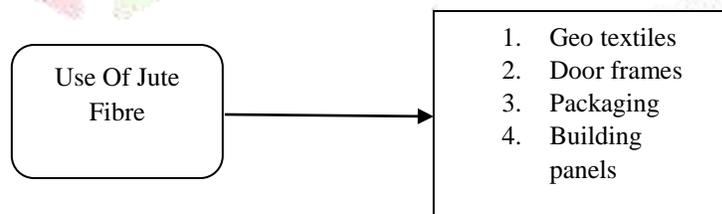


figure 3: use of jute fibre[20]

2.4 Kenaf Based Hybrid Composite

Yusoff Et Al. The Kenaf/Glass Fibres Reinforced Epoxy Composites Were Prepared With Both Untreated And Treated Methods. At The Point When Fortification Of Epoxy With Treated Kenaf/Glass Fibre At That Point There Is An Expansion In The Flexural Quality By 36%, While The Flexural Quality Of The Untreated Fibre Is Expanded By 20%. Because Of The Chemical Treatment (Naoh) On The Interfacial Grip Of The Strands Upgrades And The Porosity Of The Composites Additionally Enhanced Which Keeps The Debonding, Separations Or Haul Out Of Filaments. At The Point When Kenaf/Glass Fibre Is Blended With Polypropylene Expands The Ductile And In Addition Flexural Quality Of The Composite Because Of Its Higher Holding Amongst Fibre And Grid.

This Composite Exhibits Higher Toughness. When Polypropylene Is Added To The Kenaf/Glass Fibre Then The Water Absorption Properties Of The Composites Is Decreased. Improvement In Mechanical Properties Can Be Observed Through The SEM Which Clearly Shows That The Fibre And Matrix Have Surpassing Interaction[17]. Figure 4 shows use of kenef fibre:

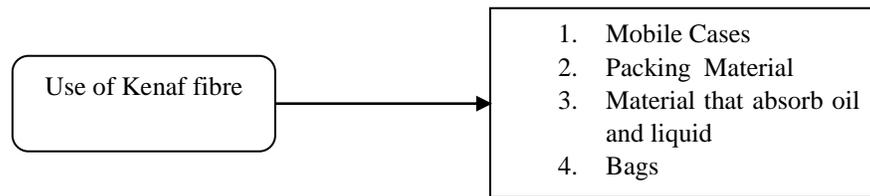


figure 4: use of kenef fibre[20]

2.5 Coir Based Hybrid Composite

Khanam Et Al. At The Point When The Coir Fibre Is Blended With Silk By Including Polyester Frames The Unsaturated Polyester Based Hybrid Composites. Expanding The Fibre Length Of Both The Strands Then The Hybrid Composites Which Have Experienced The Chemical Treatment Process Would Have The Higher Quality[2].

III. Conclusion

Significant Work Is Being Carried Out By Various Researchers In The Field Of Hybrid Composite. Researchers Have Shown More Interest In Banana And Jute Fibre Due To Their Easy Availability And Excellent Performance. Minimal Increments In Different Properties Are Because Of Poor Interfacial Holding Amongst Fiber And Grid. It Will Be Enhanced By Synthetic Treatment/Treatment With Coupling Specialist. There Is Lot Of Scope In Future For Researchers In The Field Of Hybrid Composite As Customization Of Properties Of Composites Can Be Carried Out.

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