© 2019 IJSRSET | Volume 6 | Issue 4 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology
DOI : 10.32628/IJSRSET19644

Impact, Hardness and Water Absorption Properties of Natural Fibres (Banana, Hemp and Sisal) Hybrid Composite Material

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ABSTRACT

Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The natural origin of these materials causes, in general, a wide range of variations in properties depending mainly on the harvesting location and conditions, making it difficult to select the appropriate fibre for specific applications. Natural fibres as effectively as possible to produce good quality fibre- reinforced polymer composites forvarrious engineering applications .In the experiments of tensile, flexural and impact tests were carried out for sisal, fibre hemp fibre hybrid- reinforced epoxy composites. And it able to replace the synthetic fibres that it has the eminent benefits of like low density, small manufacturing cost, its availability, ease of manufacture, low development energy, non-abrasive, worthy acoustic proper biodegradability, reasonable mechanical strength, renewability. Composite were made-up by hand lay-up method with the bidirectional natural fibres and epoxy resin in a mould and cured under gradual pressure. In this research paper mechanical behaviour such as tensile, flexural, indentation capacity and reinforced hybrid composite materials (BHSHC) studied. The purpose of this work to investigate, the mechanical characterization of the hybrid composite material. Sample was prepared and tested accordance to the ASTM standards. Characterization of hemp fibres was carried out with fibres obtained with low handling damage and deliberation damage to get an indication of how strong cellulose based fibres that can be produced from hemp.

Keyword-Banana, Hemp and Sisal (BHS) Fibre Reinforced Epoxy Composite Laminate Hand-layup.

I. INTRODUCTION

Natural fibre composites include coir, jute, baggage, cotton, bamboo, hemp. Natural fibres come from plants. These fibres contain lingo cellulose in nature. Natural fibres are eco-friendly; lightweight, strong, renewable, cheap and biodegradable [1]. Different fibres can be used in polymer matrix to enhance the mechanical properties which includes synthetic fibre and natural fibre. Synthetic fibres like, carbon, glass or kevlar fibre are used in high strength application. But the cost involved in these composites is very high. On the other hand, natural fibres are very cost effective [2].Natural fibre reinforced polymeric composites are found in countless products including aerospace, civil, automotive, marine and textile applications. As a result, increasing attention has been devoted to research on Natural Fibre banana, hemp and sisal composite (BHSHC)[3]. Hemp fibre is having better reinforcement property in the aspect of tensile and toughness. Jabir et al investigated the property of hemp fibre reinforced composites. Due to

environmental conditions the properties of hemp fibre will be affected. The chemically treated fiber gives better surface finish. At the same time untreated fibers are having better tensile properties [4]. Hemp fibre/epoxy resin composite exhibits more tensile strength than coir fiber/ epoxy resin composite and coir finer/epoxy resin composite exhibits more bending strength than hemp fiber/epoxy resin composite. Narendra[5].Fibres reinforced polymer matrix composites have wide applications including aerospace, nuclear and automobile industries[6].Composite materials are increasingly important for the production of light and stiff constructions for various applications. However, apart from the favourable mechanical properties, composites have some shortcomings. Primarily, the recycling of components turns out to be difficult and a large amount of composites end up in dumps or incinerators [7]. High specific properties with lower prices of natural fiber composites are making it attractive for various applications [8]. Natural fiber composites are very cost effective material especially in building and construction, packaging, automobile and railway coach interiors and storage devices[9]. The centre of study on natural fibres as substitute reinforcement in polymeric composites has created a vast attention of many researchers and scientists[10].After the composite development to meet the challenges of aerospace sector, researchers have focused to cater to needs of domestic and industrial applications. The abundant availability of natural fibers such as jute, coir, sisal, pineapple, ramie, bamboo, banana etc[11].In recent years, there has been an increasing environmental consciousness and awareness of the need for sustainable development, which has raised interest in using natural fibres as reinforcements in polymer composites to replace synthetic fibres such as glass[12].

II. METHODS AND MATERIAL

Banana fibre

Banana plant or plantain plant not only gives the delicious fruit but it also provides textile fibre the banana fibre. Banana fibre is natural fibre. When grown in tropical areas, banana plants rarely require fertilizers or pesticides. The crops the fibres come from are often from smaller farms, in which the farmer owns the land. Banana paper is made from the extracted pulp fibres banana yarn, or cloth is made by a slightly different process. The production process for banana textiles is a sustainable, eco- friendly one. Banana fibre*s* are eco-friendly former and women are extracting fibre from banana stem. Stronger than Jute, Shining & Softness are key features of fibre*.* Women are also making different kind of handicraft items from banana fibre*.* Afterwards, the threads can be dyed or weaved. This biodegradable natural fibre from the bark of the banana plant is so durable that if we make currency notes from it, the notes can be used for more than a hundred years. It can be used to make silk grade saris and just as it can be used in car tyres. The production process for banana textiles is a sustainable, eco- friendly one. When grown in tropical areas, banana plants rarely require fertilizers or pesticides. Appearance of banana fibre is similar to that of bamboo fibre and ramie fibre, but its fineness and spin ability is better than the two. The chemical composition of banana fibre is cellulose, hemicelluloses.

Figure 1(a)- Banana fibre before cutting

Figure 1(b)- Banana fibre after cutting

Chemical compositions of banana fibre [13]

Some chemical compositions of banana fiber are given below-

(i) Extractive- 10.5%
(ii) Holocellulose- 80.5%
(iii) Lignin- 73.4%
(iv) Ash- 2%
(v) Alpha-celluloge- 10.5%

Hemp fibre

Hemp fibres are one of the strongest and most durable among all of the natural textile fibers. Hemp fibre shows similar properties like all of the natural best fiber and excels in fibre length, durability, strength, absorbency, anti-mildew and anti-microbial properties.The soil must be well drained, rich in nitrogen, and non-acidic. Hemp prefers a mild climate, humid atmosphere, and a rainfall of at least 25-30 in (64-76 cm) per year. It is a plant similar to jute, grown in many countries. Hemp fibres are one of the strongest and most durable among all of the natural textile fibres. Hemp fibre shows similar properties like all of the natural best fibre and excels in fibre length, durability, strength, absorbency, ant mildew and anti-microbial properties. Hemp fibre is purchasing from Experts India Private Limited Gorgon West Mumbai. Hemp, or industrial hemp typically found in the northern hemisphere, is a strain of the Cannabis. Hemp fiber is a lustrous fiber, has characteristic nodes and joints of linen, but the central canal is wider. The cells are blunt-ended when the fiber is viewed under a microscope. The Hemp fibres vary widely in length, depending upon their ultimate use. Hemp has the best ratio of the heat capacity of all fibers giving it superior insulation properties. As a fabric, Hemp provides all the warmth and softness of other natural textiles but with a superior durability seldom found in other materials.

Figure 2 (a)- Hemp fibre before cutting

Figure 2 (b)- Hemp fibre after cutting

Chemical compositions of hemp fibre [13]

Some chemical composition of hemp fiber are given below-

(i) Cellulose - 70%
(ii) Lignin - 8-10%
(ii) Pectin- 2.9%
(iv) Fat-Wax- 0.9%
(v) Mineral- 1.8%

Sisal fibre

The term sisal may refer either to the plant's common name or the fibre, depending on the context. It is sometimes referred to as "sisal hemp", because for centuries hemp was a major source for fibre, and

other fibre sources were named after it. Plant Fibres - Sisal (Agave sisal Ana) Sisal is a hard fibre extracted from the leaves of sisal plants which are perennial succulents that grow best in hot and dry areas. Sisal is an environmentally friendly fibre as it is biodegradable and almost no pesticides or fertilizers are used in its cultivation. We purchasing sisal fibre from, Matlock Sisal Fibre Company Ltn have made a name for itself in the list of top suppliers of Paper & Paper Boards. We used 80 gm sisal fibre in mixture of hemp and banana. The length of sisal fibre is between 1.0 and 1.5 m and the diameter is about 100–300mm The fibre is actually a bundle of hollow sub-fibres. Their cell walls are reinforced with spirally oriented cellulose in a hemi-cellulose and lignin matrix.

Figure 3(a)- Sisal fibre before cutting

Figure 3(b)- Sisal fibre after cutting

Chemical compositions of sisal fibre[13]

Some chemical composition of sisal fiber are given below-

(i) Cellulose- 65%
(ii) Hemicelluloses- 12%
(iii) Lignin- 9.9%
(iv) Waxes- 2%
(v) Total- 100%

Epoxy resin

Epoxy is an organic compound. It is made up of chains of carbon linked to other elements such as hydrogen, oxygen, or nitrogen. The term epoxy can also be used to refer to the epoxy resins that appear after curing. First all we epoxy is procured by Union Carbide Corporation, New York Araldite LY 556 epoxy manufactured by Huntsman. Epoxy Hardener as preserving agent The proper mixing of epoxy with hardener HY 951 provide better performance. High adhesive strength and high mechanical properties are also enhanced by high electrical insulation and good chemical resistance. Resin, in the most specific meaning of the term, is a hydrocarbon secretion of many plants, particularly coniferous trees. It is distinct from other liquid compounds found inside plants or exuded by plants. Epoxie*s* find uses as adhesives, caulking compounds, casting compounds, sealants, varnishes and paints, as well as laminating resins for a variety of industrial applications.

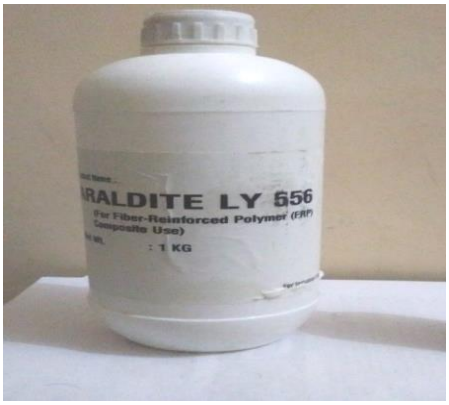

Figure 4(a) - Araldite LY 556

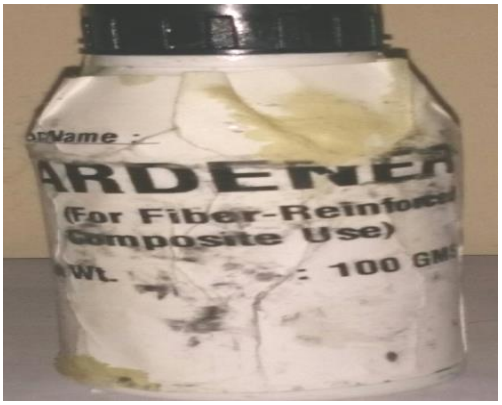

Figure 4.(b) - Hardener HY 95

III.FABRICATION

In fabrication method, we make a frame of dimension (300x250x6) mm which is made of wood. And a mould tool is required to give the unformed resin/fibre combination its shape prior to and during cure we mixed 100gm banana ,100gm and 80gm sisal. A release gel (wax) is used to scattered on the impurities .We mixed in proper ratio of banana, hemp and sisal in a pot After proper mixing epoxy we are mixed hardener in 10:1 ratio. And mixed it properly. After 5-6 minute it goes being too hard. After we pulled into the mould and proper fill the material into the mould after than we removing the air bubble from the mould. And finally we apply pressure on it .C clamp is used with the mild essential layer is stacked. We kept it for 24 hours to being hard. Fabricated composite part is taken out from the mould at 53% humidity at room temperature. It is characterized by the different mechanical parameters like tensile, flexural and impact test. After complete duration our final sheet is obtained.

Figure 5- Wooden frame

Figure 6- Mould

Finally, the hybrid composite sheet is prepared having a dimension of (350×250×6) mm. It is characterized by the different mechanical parameters like tensile and Flexural test. It is cut by the diamond tip hand cutter.

Figure 7- Final sheet

Figure 8- Side view of the final sheet

IV. RESULTS AND DISCUSSION

Impact Test

The notched test specimen is broken by the impact of a heavy pendulum or hammer, falling at a predetermined velocity through a fixed distance. The test measures the energy absorbed by the fractured specimen. Impact tests are used in studying the toughness of material. A material's toughness is a factor of its ability to absorb energy during plastic deformation. Brittle materials have low toughness as a result of the small amount of plastic deformation they can endure. The impact value of a material can also change with temperature. Generally, at lower temperatures, the impact energy of a material is decreased. The size of the specimen may also affect the value of the Izod impact test because it may allow a different number of imperfections in the material, which can act as stress risers and lower the impact energy.

Impact testing machine

Impact test equipment name is izod charpy impact tester with notch cutter code of machine is PTC/090/ME and type of machine is TINIUS OLSON,U.S.A .Impact testing machine working range is 0-25 joule and accuracy of the machine is 0.015 joule purpose of impact testing machine is to find out mechanical property of the work piece.

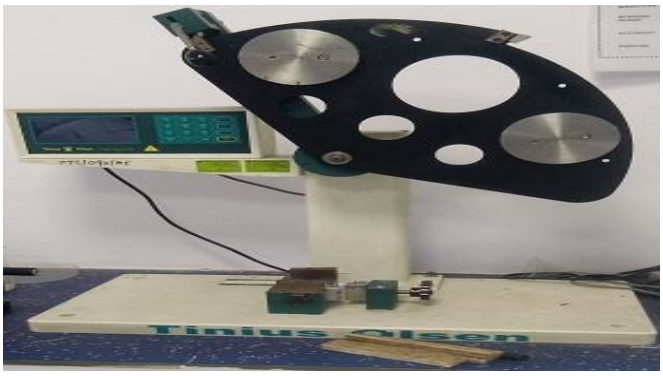

Figure 9- impact testing machine

Figure 10(a)-specimen before fracture

Figure 10(b)-specimen after fracture

Table No.1.1 Result of izod test

S.No.	Test	Standard	Test value(J/m)
1.	IZOD	ASTM-D256	47.18 J/m
2.	IZOD	ASTM-D256	53.34 J/m
3.	IZOD	ASTM-D256	52.42J/m

Mean value of composite strength= 50.98J/m

Conclusion from izod test

From the above table no.1.7 is clearly shown that the impact test of the particulate form of banana, hemp and sisal hybrid composite **50.98 J/m** is more than impact value of bamboo-linen, resin epoxy composites material.

Hardness test

The Rockwell scale is a hardness scale based on indentation hardness of a material.The Rockwell test determines the hardness by measuring the depth of penetration of an indenter under a large load compared to the penetration made by a preload.

Results

Table No. 1.2 - Result of hardness test

S.No.	Test value
Sample 1	42.54
Sample 2	42.68
Sample 3	43.02

Hardness of composite = 42.74 HRM

Conclusion from hardness test From the above table no 1.8 it is clearly shown that the hardness of the particulate form of banana, hemp and sisal hybrid composite **42.74** is more than hardness value of bamboo-lilen, resin epoxy composite.

Water absorption test

Water absorption test conducted in chemistry lab of maharishi institute of information technology at 54% humidity In which specimen is immerged for 48 hours at room temperature under normal condition and each 4hours their weight would be measured .since the epoxy do not make hydrogen bond so that there is less possibility to increase their weight but natural fibre absorbed some amount of water initially but after some hours it is in variant in weight. A square test piece of dimension (35mm×35mm×10mm) was dipped in a glass beaker (500ml) containing water 250ml for 48 hrs. Initial weight of the specimen was 16 g measured by the weighing balance (manufactured by Ohaus) whose least count is 0.01g. The weight of the specimen was measured at a time interval of 4 hrs till 48 hrs. the specimen absorbed water only upto 24 hrs. The water used for testing is bought by the Raj Galaxy Enterprises Pure 360 jankipuram India,lucknow.The specimen weight increased upto 0.80g in 24 hrs only and after that the specimen. Weight shows that there is no increase in weight .The weights of the samples were taken and then dipped them to sea water and bore well water. After 24 h, the samples were taken out from the moist environment and all surface moisture was removed with the help of a clean dry cloth or tissue paper.

Figure 12(a)-work piece for bore well water

Figure 12(b)-work piece for sea water

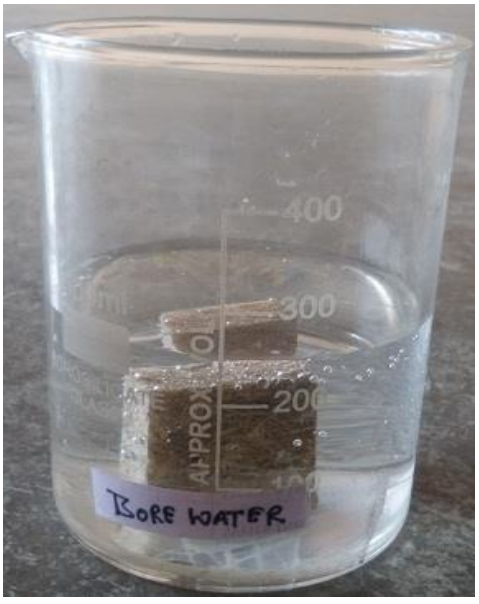

Figure 12-Borewell water

Figure 13-Sea water

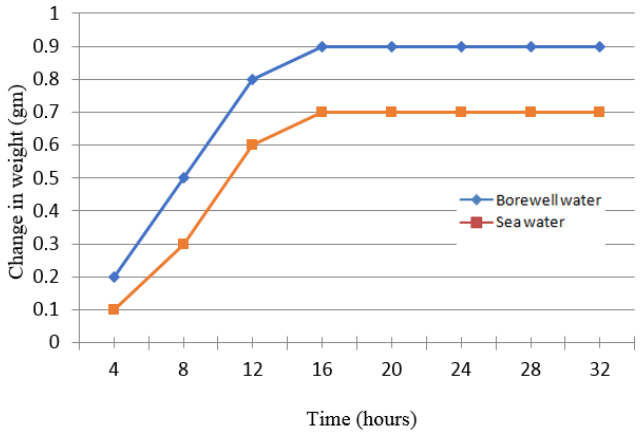

Figure 14-water absorption test

Table No.1.3 Results of water absorption test

Time(hours)	0-4	4-8	8-12	12-16	16-20	20-24	24-28	28-32
Bore well water **Weight in (gm)**	0.2	0.5	0.8	0.9	0.9	0.9	0.9	0.9
Sea water **Weight in (gm)**	0.1	0.3	0.6	0.7	0.7	0.7	0.7	0.7

Change in weight in bore well water=0.9gm
Change in weight in sea water=0.7gm

Result

Above figure show the water absorption test of specimen. The initial weight of specimen was 16 gm after 4 hours the weight of the work piece measured. The figure 14 show the water absorption curve in the change in weight and time.

V. CONCLUSION

This works shows that successful fabrication of homogeneous composite laminates is by hand lay-up methods test and Hardness test of banana, hemp and sisal give the most significant results. According to the Impact results, banana ,hemp and sisal composite showed the highest value of 50.98 J/m and while bamboo-lilen epoxy resin composite showed the lowest value 3 Joules for IZOD test. According to the hardness results, banana ,hemp and sisal reinforce epoxy composite had the highest Rockwell hardness test value of 42.74 RHN while bamboo-lilen epoxy resin composite had the lowest Rockwell hardness test value of 40 RHN.

VI. REFERENCES

[1]. U.S.Bongarde1, V.D.Shinde2 etal (2014)"Review on natural fibre reinforcement polymer composites" ISSN: 2319-5967.

[2]. Puneet Sharma etal(2013) "Research Work On Fibber Glass Wool Reinforced And Epoxy Matrix Composite Material"Issn 2278 – 0149 Www.Ijmerr.Com Vol. 2, No. 2, April 2013

[3]. Ramachandran M, etal (2016) Perspectives in Science (2016) 8, 313—316

[4]. Deenadayalan, etal (2018)" Fabrication and characterisation of B-H-G fibre with teak wood particles reinforced hybrid composite" International Journal of Engineering & Technology, 7 (2.31) (2018) 208-211.

[5]. K. V. Sreenivas Rao, etal (2016)" Mechanical Properties Of Natural Fibres Reinforced Hybrid Composites" Vol. 11, No. 1, January 2016 Issn 1819-6608.

[6]. Md. Shariful Islam etal (2019)" Comparative Study on Mechanical Properties of Banana and Rattan Fiber Reinforced Epoxy Composites" E-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-8, Issue-2, pp-01-06

[7]. A. John Martin et al (2018)"Investigation And Analysis Of Hybrid Composites Natural Fibre From Papaya Stem And Sisal Plant" e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-7, Issue-5, pp-200-207.

[8]. M. R. Sanjay et al (2016)" Applications of Natural Fibers and Its Composites: An Overview" Natural Resources, 2016, 7, 108-114

[9]. U.S.Bongarde1, V.D.Shinde2 etal (2014)"Review on natural fiber reinforcement polymer composites" ISSN: 2319-5967.

[10]. Ramachandran M. etal (2016)"Experimental study of bamboo using banana and linen fibre reinforced polymeric composites" Perspectives in Science (2016) 8, 313—316.

[11]. Ajith Gopinath etal (2014)" Experimental Investigations on Mechanical Properties Of Jute Fibre Reinforced Composites with Polyester and Epoxy Resin Matrices" Procedia Engineering 97 (2014) 2052 – 2063.

[12]. V.Mastan etal (2014)"A Review Paper on Tensile Properties of Natural Fibre Polymer Matrix Composites" Vol.04, Issue 12 (December 2014), PP: 60-63 ISSN (e): 2278-4721, Issn (p):2319-6483,

[13]. S.V. Joshia,*, L.T. Drzalb et al,(2003)" Are natural fibre composites environmentally superior to glass fibre reinforced composites" Composites: Part A 35 (2004) 371–376

Cite this article as :

Deepak Sonkar, Pragya Singh, "Impact, Hardness and Water Absorption Properties of Natural Fibres (Banana, Hemp and Sisal) Hybrid Composite Material", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 6 Issue 4, pp. 63-71, July-August 2019. Journal URL : http://ijsrset.com/IJSRSET19644