A Study of Banana Fiber: A Review

R. Vinoth[1] K. S. Gokulnath[2] K. J. Barathkumar[3] K. Ahildarshan[4] E. Gokulprakash[5]
[1]Assistant Professor [2,3,4,5]B.E Student
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Nandha Engineering College, Erode, India

Abstract— This paper is about the fabrication and testing of banana fiber eco-friendly carry bag. Now a day the government banned the plastics bags by 2019. In our project we are try to change the material of the carry bag by banana fiber. This will help to keep the environment healthy and pollution free. By implementing our project we can reduce the usage of the plastics and keep the world away from the plastics. Natural fibers are best in both cost savings and low in density when compared to glass fibers. They are grown steadily in many applications. A natural fiber is a resource to synthetic fibers, as reinforcement for polymeric materials for the manufacture is very cheap, renewable and environment friendly.

Key words: Banana Fiber, WRM, DMA

I. INTRODUCTION

Banana fiber is obtained from the pseudo-stem of banana plant. It is the best fiber with perfect mechanical properties. It has the lower density than glass fiber. It has the high strength, light weight, fire resistance and biodegradable. It is used for making handmade bags and covers. It is used to make products like filter paper, paper bags, greeting cards, lamp stands, pen stands, decorative papers, rope, mats and composite material etc. Waste of the banana fiber is not utilized properly and all of the banana fiber is at the waste. Germany currency are used in banana fiber and now in India it's also be used. There are many demands in banana fiber. In future, it is cheaper, lighter and environmental compared to other fibers. It is one of the rhizomatous plant and its growth in 129 countries in the world. The fiber is extracted from pseudo-steam and is used for making many products. It is also used for building and construction materials and also in textile materials. Banana fiber is an environmentally friendly like a fiber and is demand in many countries like Japan, Germany, Australia and many. Banana is a fourth most important global food crop.

II. LITERATURE REVIEW

1) The potentiality of jute & banana fiber composites shows both mechanical and physical properties and their chemical composition. The application of the cheaper goods in very high performance appliance is possible with the help of the composite technology.
2) The findings from this presented 25-30% yield from the mechanical process. For a comparison of fiber extraction, the Mechanical extraction should be employed. The improvement of the fabric hand feel and yarn quality must be developed.
3) In addition, bio-fibers can also be used to produce fuel, chemicals, enzymes and food. Byproducts produced from the cultivation of corn, wheat, rice, sorghum, barley, sugarcane, pineapple, banana and coconut are the major sources of agro-based bio-fibers. Likewise banana fiber based production processes, structure, properties and suitability of these bio fibers are to be identified for various industrial.
4) Banana fibers have high variability along the length and fibers, which is a characteristic of natural fibers. The standard deviation has been found to that decrease with increasing diameter of the fibers. The tensity of banana fibers was a function of a testing speed. At low strain rate, an increase in strain facilitates the amorphous to crystalline sharing of the loads.
5) Banana fibers have been successfully extracted from banana waste using various applications of sodium hydroxide as rent media. A fiber yield of 0.25% to 0.55% was acquired.
6) On average, specimens reinforced with 50mm fibers were performed better, in both flexural and the compressive strength, compared to the unreinforced specimens and specimens reinforced with the different variations of 25mm fibers. The highest flexural and the compressive strength values were recorded at the reinforcement with 50mm fibers and the 0.35% fiber content by weight.
7) There is an improvement in the tensile properties of the randomly oriented banana fiber – epoxy resin composites. At 35% of the fiber volume fraction, the tensile strength is increased. Banana fiber having high specific strength and the flexural strength makes a lightweight composite material and can be used to make light weight automobile interior parts.
8) The present review explores the potentiality of banana fiber composites, emphasizes both mechanical and physical properties and their chemical composition. Properties of banana fibers are superior as compare to other natural fibers.
9) The new banana fiber extraction machine can be designed with higher efficiency. This machine will reduce manual work and is suitable for mass production. The factors affecting quality of fiber are roller speed; feed angle and clearance also affect the production quantity of fiber. By choosing these factors, correctly quality and production of fiber can be increased.
10) The natural fiber reinforced hybrid composites are successfully fabricated using handmade technique. The banana hybrid composite with weight fraction of 25/15 shows maximum flexural strength and maximum flexural modulus. The banana hybrid composite with weight fraction of 25/15 shows maximum inter laminar shear strength.
11) The effect of varying cross-sectional area on the failure strength of banana fibers at the gauge lengths of 10mm, 20mm, 25mm, and 40mm. It is that the fiber strength decreases as the gauge length increases; this is about due to the number of flaws increasing along with the varying cross-sectional area. The predicted strength by within

fiber conical frustum volume variation shows the best result in the fiber strength prediction.

12) The tensile strength on the pseudo-stem banana woven fabric composite is increased by 90% compared to the virgin epoxy. The flexural strength increased when banana woven fabric was used in epoxy material. The results of the impact strength tested shows that the pseudo-stem banana fiber is improved that impact strength properties of the virgin epoxy material by approximately 40%. Higher impact strength value leads to the higher toughness properties of material. The banana fiber composite a ductile appearance with minimum number of plastic deformation.
13) Immersion treatment effect of alcohol on the surface of the banana fiber on physical properties and the mechanical properties of banana fiber is not suitable, because it is the power of banana fiber itself becomes fragile. The influence of the tensile load of fiber when mixed with the epoxy resin with a volume fraction of 50: 50 in the form of the pull sufficient effect on the tensile strength of the composite, as it makes the tensile strength composite itself to be increased or stronger.
14) The future of the natural fiber composites appears to be bright because they are cheap, light and environmentally superior to glass fiber composites. Future research should hence focus on achieving the equivalent or superior technical performance and the component life.
15) Mechanical tests of the natural fibers were not trivial. Each fiber has a characteristic morphology. Therefore, the irregular cross-section of the fibers could be considered in the analysis of tensile tests. Sisal, coir and piassava presented a non-linear region starting at the stress levels of 100MPa or below which can be related to the degradation mechanism due to the collapse of the weak primary cell walls.
16) At high temperatures, DMA results show a slight increase in the rubbery plate for composites with both PALF and coir fibers aligned in the relation to a neat epoxy resin. These composites display a reinforcing effect that improved in the thermal mechanical stability above 100°C.
17) It has been verified that the variable strength data available from the literature may not represent in the real strength of the single hemp fibers. This data is not being suitable for predicting the performance of the hemp fiber composite materials.
18) The comparison of the tensile strength reveals that 20% of the banana fiber and 80% of the epoxy on 90^0 orientation fiber composite has a 56.5MPa exhibit higher tensile strength than 15% of the banana unidirectional fiber 47.4MPa.
19) Using natural fibers as reinforcement for polymeric composites introduce a positive effect on the mechanical behavior of the polymers. Natural fiber reinforced polymer composites have a beneficial properties such as lower density, less expensive, and reduced solidity when compared to the synthetic composite products.
20) Banana fibers have shown high variability along the length and the fibers, which is a characteristic of the natural fibers. The standard deviation has been found to be decrease with increase in the diameter of fibers. The diameter variability had a normal distribution. The tenacity of the banana fibers was a function of testing speed.
21) The use of the natural fibers in polyester composite has a point of the interest since 1980s. Several plant fibers including hemp, jute, banana, sisal, coir, bamboo, rice and oil palm have been used to reinforce polyester matrix. These fibers are highly susceptible to the water absorption in humid environment.
22) The mechanical properties will be change in the composition of fibers. On combination of sisal and banana where banana is in excess amount than sisal tensile strength value is very high but bending values are very low.
23) The maximum tensile strength is 73.23MPa and 30.86MPa which is done by the 15 wt% banana fiber and 3 wt% coconut fiber reinforced epoxy resin composites respectively.
24) The water absorption tested and it is founded that L2 absorbs more amount of water and L1 absorbs minimum amount of water. It is found that as the glass layer in laminate increases its mechanical properties. These composites shall be used for medium load applications.
25) The mechanical properties of the composites are influenced mainly by the adhesion between matrix and the fibers and which increases with hard adhesion between them.
26) The banana sisal glass hybrid composites have more tensile strength than other composites materials that can withstand the tensile strength of 21.06MPa followed by the sisal banana glass reinforced composites which have the value of 10.42MPa.
27) The banana and carbon fibers reinforced hybrid composites were fabricated by the handmade process and the mechanical properties such as tensile strength, flexural strength, and impact strength and water intake behavior of these composites are evaluated.
28) The right treatments to improve fiber and the cement matrix compatibility are still to be found. The same could be said about the variation on fiber properties thus controlling quality methods are needed in order to know minimal variations on the properties of the natural fibers.
29) The maximum impact strength which has the 60% glass fiber and 40% epoxy resin composites is 11.22 Joules followed by 50% banana fiber and the 50% epoxy resin composites can have the impact load of 9.48Joules.
30) Tensile properties of bamboo fiber, grass fiber and coconut fiber reinforced PLA composites were prepared by the extrusion and injection molding process. Tensile strength of untreated grass fiber and coconut fiber composites were low than neat PLA and decrease with increase of fiber content.
31) The nonwoven capacity decreases with the addition of the Alfa fibers. The mechanical properties degrade with the increase of Alfa fibers ratio. Nonwoven Alfa blended with the wool fibers have the highest values of the air permeability, specific strength in the machine direction (MD) and elongation at break for all the Alfa fibers blends.
32) The fabrication of the banana fiber based epoxy composites with different loading of the fiber and

different lengths of the fiber are possible by handmade process. Fiber loading and length has major effect on the mechanical properties of composites like as hardness, tensile strength, and impact strength. It has been observed that the better mechanical properties found to be with 10 mm fiber length with 15% fiber loading.

33) The chemical modification of the banana fibers resulted for further improvement in the properties of the composite. The angle of the fiber orientation to the loading direction was found to be the effect on the tensile strength, failure strength at break of the composites.
34) Bonding between cotton or natural fibers and the binder polymer are very good when composites were made from mixed fiber or carded webs. Intimate blending of the binder fiber with cellulosic fibers is the key to manufacture the composite with best properties.
35) It is observed that the short beam strength is improved by 131 % when glass fibers (WRM) are replaced with woven banana fiber. The strain energy release rate of composite seems to increase with the strong adhesion between fiber and the polymer matrix which also gives less possibility of the voids in composite.
36) The flexural strength of the banana fiber composites is 40.16MPa, which is 14.78% higher than the strength of banana fiber. Thus, the higher compressive strength of 122.11MPa of the banana fiber composite is attained after fiber pretreatment and is 38.35% higher than observed strength without the treatment.
37) The samples were rough and composed of the hollow Webs whose walls were formed of micro brills of the cellulose. These studies will allow us to choose the temperature of the pyrolysis of webs before the incorporation cement matrix, to predict the behaviors of the elaborated composites.
38) Composites from double-carded mats showed higher water resistance, and better bending properties than that of made from the single carding mats. In tensile properties high value in perpendicular and low in parallel was found, which is indicated as the less anisotropic nature of the system.
39) The most effective enzyme for banana fiber treatment is the poligalacturonase, showing a higher specific activity and being specific for substrates is not damaged the cellulosic structure of fibers. Banana fiber can be spun to the produce yarns, mixed or not mixed with the other fibers, while the most suitable for industrial scale-up without major equipment changes the blend of banana fiber and wool.
40) The tensile strength on polymer fiber with the epoxy 15.529 N/mm2 which is lesser than the kenaf fiber reinforced with the polypropylene 25.17 N/mm2. The strength is 844 N/mm2 but as an anisotropic material, jute fiber had a large scatter in the tensile properties depends on the testing of specimen span length.
41) The maximum tensile strength and flexural strength of 130MPa & 145MPa is observed from the banana hybrid combination with the three layers of glass fiber. The inter-laminar shear strength and the inter-laminar fracture toughness of the banana fiber reinforced hybrid composites were higher than those of the GFRP.
42) Banana fibers had been characterized for their physical, chemical, and the tensile properties. Banana fibers have good length, strength, fineness and excellent moisture absorption. The mechanical properties of Banana bark fibers are: tensile strength 381MPa, strain at the break 2.1%.

III. Conclusion

From the literature survey, it is observed that problem arising by plastic is too high in the world, so we decide to make usage of plastic less and increase the biodegradable usage high. This help to implement the government policy easily and help to keep the world pollution free. It is kindly made for pollution free that are coming from the plastics bag. When compared to other fiber banana fibers are most useful for textiles, building construction etc. Banana fiber have best strength, moisture absorption, hardness and fineness.

References

[1] Satish Pujaria, A. Ramakrishna and M. Suresh Kumar, Comparison of Jute and Banana Fiber Composites, Inpressco, (2014).
[2] Uraiwan Pitimaneeyakul, Banana Fiber: Environmental Friendly Fabric, King Mongkut's Institute of Technology (2010).
[3] C.Vigneswaran, V.Pavithra, V.Gayathri, K.Mythili, Banana Fiber: Scope and value added product development, Journal of Textile and Apparel, Technology and Management (2015).
[4] Samrat Mukhopadhyay,Ph.D., Raul Fangueiro, Ph.D., Yusuf Arpac, Ulku Senturk , Banana Fibers – Variability and Fracture Behaviour , Journal of Engineered Fibers and Fabrics (2008).
[5] Ebisike K., AttahDaniel B. E., Babatope B., Olusunle S.O.O, Studies on The Extraction of Naturally-Occurring Banana Fibers, The International Journal Of Engineering And Science (IJES), (2013).
[6] Marwan Mostafa and Nasim Uddin, Effect of Banana Fibers on the Compressive and Flexural Strength of Compressed Earth Blocks, Open Access Building (2015).
[7] Subba Reddy D, Thyagaraj N, Manjunatha.K.N, Evaluation of Mechanical Properties in Banana Fiber Reinforced Polymer Composites, Iconic Research And Engineering Journal (2017).
[8] Ravi Bhatnagar, Gourav Gupta, Sachin Yadav , A Review on Composition and Properties of Banana Fibers , International Journal of Scientific & Engineering Research (2015).
[9] Suhaib A Sheikh, N.P.Awate , A Review Paper On Design And Development OF Banana Fiber Extraction Machine , International Journal Of Engineering Sciences & Research Technology(2016).
[10] Madhukiran.J, Dr.S.SrinivasaRao, Madhusudan.S , Fabrication and Testing of Natural Fiber Reinforced Hybrid Composites Banana , International Journal of Modern Engineering Research (IJMER) (2013) .
[11] Samrat Mukhopadhyay, Ph.D., Raul Fangueiro, Ph.D., Yusuf Arpac, Ulku Senturk2 , Modified Weibull analysis

on banana fiber strength prediction , Journal of Mechanical Engineering and Sciences (2018).
[12] M.A.Maleque , F.Y.Belal , Mechanical properties study of pseudo-stem banana fiber reinforced epoxy composite , The Arabian Journal for Science and Engineering(2006).
[13] G.N Anastasya Sahari , Atus Buku , Tensile strength of fiber for some type bananas , International Journal of Research in Engineering and Technology (2015).
[14] S.V.Joshi, L.T.Drzal, A.K.Mohanty, S.Arora, Are natural fiber composites environmentally superior to glass fiber reinforced composites? , S.V. Joshi et al. / Composites(2004).
[15] Maria Ernestina Alves Fidelis, Thatiana Vitorino Castro Pereira, Otávio da Fonseca Martins Gomes, Flavio de Andrade Silva, Romildo Dias Toledo Filho, The effect of fiber morphology on the tensile strength of natural fibers, J Mater Res Technol.(2013).
[16] Fernanda Santos da Luz , Sergio Neves Monteiro , Flávio James Tommasini, Evaluation of Dynamic Mechanical Properties of PALF and Coir Fiber Reinforcing Epoxy Composites, Materials Research(2018).
[17] Mizi Fan, Characterization and performance of elementary hemp fibres, Bio Resources 5(4), 2307-2322.
[18] Idiris Mehamud, Jegan Raj, Cheru Zeleke and Thomas Gebre, Fabrication and Mechanical Property Evaluation of Ethiopia Banana Fiber Reinforced Polymer Composites, Advances in Research 7(5): 1-10, 2016, Article no.AIR.26991.
[19] Layth Mohammed, M. N. M. Ansari, Grace Pua, Mohammad Jawaid and M. Saiful Islam, A Review on Natural Fiber Reinforced Polymer Composite and Its Applications, International Journal of Polymer Science(2015).
[20] Samrat Mukhopadhyay, Ph.D., Raul Fangueiro, Ph.D., Yusuf Arpac, Ulku senturk, Banana Fibers – Variability and Fracture Behaviour, Journal of Engineered Fibers and FabricsVolume 3, Issue 2— 2008.
[21] Shayesteh Haghdan and Gregory D Smith, Natural fiber reinforced polyester composites, Journal of Reinforced Plastics and Composites2015, Vol. 34(14) 1179–1190.
[22] Hemant Patel, Prof. Ashish Parkhe, Dr P.K. Shrama, Mechanical behaviors of banana and sisal hybrid composites reinforced with epoxy resin, Patel et. al., Vol.4 (Iss.1): January, 2016.
[23] Pongsathorn Kongkaew, Mechanical properties of banana and coconut fibers reinforced epoxy polymer matrix composites, International Conference, Tokyo, Japan, 15th January 2016, ISBN: 978-93-82702-12-2.
[24] M. R. Sanjay, G. R. Arpitha, L. Laxmana Naik, K. Gopalakrishna, B. Yogesha, Studies on Mechanical Properties of Banana/E-Glass Fabrics Reinforced Polyester Hybrid Composites, J. Mater. Environ. Sci. 7 (9) (2016) 3179-3192.
[25] Raghad Hussein Mohammed, Mustafa Amer Hassan and Noor Sabah Sadeq, The edition effect of natural fibers on polymeric materials and study some of thermal and mechanical properties, Journal of Al-Nahrain University Vol.13 (1), March, 2010, pp.84-90.
[26] Krishna Kumar, K.J. Gokuleshwar, S.Ranganathan and C.Thiagarajan, Fabrication and mechanical property study on glass/sisal/banana natural fibres, International Journal of Pure and Applied Mathematics Volume 119 No. 12 2018, 15637-15645.
[27] Manickam Ramesh, Ravi Logesh, Manivannan Manikandan, Nithyanandam Sathesh Kumar, Damodaran Vishnu Pratap, Mechanical and Water Intake Properties of Banana-Carbon Hybrid Fiber Reinforced Polymer Composites, Materials Research.
[28] Fernando Pacheco-Torgal, Said Jalali, Cementitious building materials reinforced with vegetable fibres: A review, F. Pacheco-Torgal, S. Jalali / Construction and Building Materials (2010).
[29] M.Ramesh, T.Sri Ananda Atreya,U.S.Aswin, H.Eashwar,C.Deepa, Processing and Mechanical Property Evaluation of Banana Fiber Reinforced Polymer Composites, 12th Global Congress On Manufacturing And Management, GCMM 2014.
[30] Wassamon Sujaritjun, Putinun Uawongsuwan, Weraporn Pivsa-Art, Hiroyuki Hamada, Mechanical property of surface modified natural fiber reinforced PLA biocomposites, Energy Procedia 34 (2013) 664–672.
[31] Lassaad Ghali, Mohamed Taher Halimi, Mohamed Ben Hassen, Faouzi Sakli, Effect of Blending Ratio of Fibers on the Properties of Nonwoven Fabrics Based of Alfa Fibers, Advances in Materials Physics and Chemistry, 2014, 4, 116-125.
[32] Sujeet kumar, Study on mechanical behaviour of banana fiber reinforced epoxy composites, B. Tech. Thesis 2014.
[33] Dr. Rajashekar Patil, Ganesh Kalagi, The mechanical properties of natural fiber reinforced polymer composites: A Review, IJERT ISSN: 2278-0181(2015).
[34] Ikechukwu Christian Ezema, A. R. Ravindranatha Menon, Camelus Sunday Obayi, Augustin Dinobi Omah, Effect of Surface Treatment and Fiber Orientation on the Tensile and Morphological Properties of Banana Stem Fiber Reinforced Natural Rubber Composite, Journal of Minerals and Materials Characterization and Engineering, 2014, 2, 216-222.
[35] M. G. Kamath, G. S. Bhat, D. V. Parikh, and D. Mueller, Cotton Fiber Nonwovens For Automotive Composites, Department of Materials Science and Engineering, The University of Tennessee, Knoxville TN 37996.
[36] Jiyas N, DrBinduKumar K, Mathew John, Synthesis and Mechanical Characterization of Woven Banana and Glass Fiber Reinforced Epoxy Composites, International Journal of Scientific & Engineering Research, Volume 7, Issue 3, March-2016 ISSN 2229-5518.
[37] Lina Herrera-Estrada, Selvum Pillay and Uday Vaidya, Banana fiber composites for automotive and transportation applications, Department of Materials Science & Engineering, University of Alabama at Birmingham, Birmingham, AL 35294.
[38] Ketty Bilba, Marie-Ange Arsene, Alex Ouensanga, Study of banana and coconut Wbers Botanical composition, thermal degradation and textural observations, Bioresource Technology 98 (2007) 58– 68.
[39] Hajnalka Hargitai, Ilona Racz and Rajesh Anandjiwala, Development of hemp fibre reinforced polypropylene composite, H-1116. Budapest, Fehervari u. 130. Hungary.

[40] Zaida Ortega, Moises Moron, Mario D.Monzon, Pere Badallo and Ruben Paz, Production of Banana Fiber Yarns for Technical Textile Reinforced Composites, Materials 2016, 9, 370.
[41] Guduru KK, Pandu R, Banothu S and Vinaya K, Synthesis and Analysis of Natural Fibers Reinforcement of Synthetic Resins, Guduru et al., J Material Sci Eng 2016, 5:5.
[42] Jiyas N, DrBinduKumar K, Mathew John, Synthesis and Mechanical Characterization of Woven Banana and Glass Fiber Reinforced Epoxy Composites, International Journal of Scientific & Engineering Research, Volume 7, Issue 3, March-2016, ISSN 2229-5518.
[43] S.Ganapathy, S.Karthick, A.Sreenivasan, J.Jinish John, N.Thirumoorthi, Analysis of Mechanical Behaviour of Banana Fiber Reinforced Composite Materials, International Journal of Emerging Technologies in Engineering Research (IJETER) Volume 4, Issue 4, April (2016).

