International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 03 Issue: 06 | June -2019 ISSN: 2590-1892

Mechanical and Thermal Characterization of Coir Reinforced PBS Composite

Prasanna M Bhagwat[1], Dr. Rahul Lodha[2].

[1]Mechanical Engineering , Sharad Institute of Technology College of Engineering, Yadrav, Ichalkaranji
[2]Mechanical Engineering Department, Mewar University, Gangrar, Chittorgarh

---***---

Abstract - Composites have various properties like it is lightweight, high caliber and immovability. Nowadays, composites are overriding standard materials like metals and wood furniture. These materials have various applications in vehicle and marine endeavors, normal, military and plane materials. Usage of composites is perfect in view of high bore and straightforwardness. The PBS composite had the attractive mechanical inflexible nature and warm soundness to be reused and reused. The purpose of this study paper is to focus on the effect of Resins, textures and included substances PBS biodegradable composite in light of mechanical tests, DSC test and to recognize the best fitting property. Coir is a characteristic fiber removed from the husk of coconut .In this examination, poly butylene succinate composites were set up with the coir strands. The phase morphology, melting and crystallization conduct, mechanical properties and thermal stability of PBS and Coir Fiber composites were investigated in detail. The results demonstrated that, although raw Coir Fibers were utilized with no adjustment, they played a significant job in improving the properties of PBS.

***Key Words*:** composites, PBS, resin, coir fiber, DSC, TGA

1.INTRODUCTION

The Composite material is created by the engineered mix of various natural or inorganic materials to acquire explicit properties [1]. These blends improve the quality, solidness to weight proportion, thermal conduct, weariness life and erosion and wear obstruction. The applications wherein high quality and modulus is required, the properties of polymers are changed by mixing the strands [2]. The utilization of fiber fortified polymer framework composites that gives elite is all around reported in past research. The mechanical properties of fiber-fortified composites changes as indicated by the sort, amount, fiber dissemination and direction of the constituent materials [6]. PBS is biodegradable aliphatic polyester with high adaptability, incredible effect quality, and no major unfriendly impacts on the earth [8]. PBS is thermoplastic polyester orchestrated through the poly buildup response of 1, 4-butanediol with succinic corrosive [8,9]. This polymer has high adaptability, superb effect quality, warm and synthetic opposition. The most extreme explicit surface territory was acquired from Nano filaments. The investigations results demonstrates that the Vapor developed carbon Nano filaments can be utilized to control soften consistency the glass change temperature is expanded by 10 degree during procedures [5]. In the expansion of essential crosslink structure of polymers and Nano tubes the auxiliary system structure was framed. The subsequent composites displayed great scattering within the sight of Vapor developed carbon Nano strands (VGCNF). The mechanical, thermal, and electrical properties have been tried on Nano fiber scattering for various sort of thermoplastic polymers like PMMA, nylon , poly carbonate and so forth the outcome incorporate the expansion in the rigidity [6]. In these articles, the mechanical, thermal, properties of the Coir Fiber and PBS were perused and considered, trailed by examining these properties of the composites made [7]. The investigation of the mechanical properties included yield quality, elasticity, stress created, the connection between the connected burden and strain, load and stress, anxiety of the filaments and the biodegradable composites; while, the thermal properties included readings of softening purpose of the composites, warm debasement, warm conduct of the composites and so forth [8].

2. PREPARATION OF COMPOSITES

PBS was consolidated with different Coir Fiber (5, 10, 15, 20 gms) to frame the composites. A shape was utilized to set up the composites. The mould was kept in the machine with a set temperature of 153°C. The PBS was then filled the form and permitted to dissolve. Pursued by this, the coir fiber was included as an added substance in the liquefied PBS and blended uniformly for 5 mins. After this progression, a uniform pressure wasapplied on it with the goal that the top plate could without much of a stretch slid into the shape cavity. The shape with the blend was kept for 15 mins so within material could soften and get blended totally with the filaments. The temperature was then set to glass transition temperature and the mould was permitted to cool up to 110°C. To expel the air inside the form, pressure of 50, 100 and 150 bar was applied on the mould. The mould was at that point permitted to cool after which it was opened.


Fig 1 Sample of 80:20


Fig 2 Sample of 85:15


Fig 3 Sample of 90:10


Fig 4 Sample of 95:05

3. MECHANICAL CHARACTERISATION

3.1. Tensile testing

The elastic properties of Coir Fiber strengthened PBS composites were found by differing the fiber loading as appeared table 1. The tensile strength of PBS with Coir fiber in the proportion of 85:15 was tested to be greatest at 66 MPa though the yield quality of PBS with coir fiber in the proportion of 90:10 was tested to be greatest at 44MPa. These considered composites demonstrated a inclination that yield strength increased with increasing fiber loading up to an ideal point, after that the yield strength would in general diminishing.

Table 1 Tensile & Yield Strength results

Sr.No	Sample Code	Tensile Strength(KN/mm^2)	Yield Strength(KN/mm^2)	Elongation (%)
1	80PBS/20CF	0.055	0.038	6.250
2	85PBS/15CF	0.066	0.039	6
3	90PBS/10CF	0.058	0.044	5.5
4	95PBS/05CF	0.057	0.037	5.25

3.2. Hardness Test

The Hardness is assessed by the amount of permenant deformation or plastic flow of material.. The table2 demonstrates hardness of the composites. It was observed that these values decreased with the decrease in Coir Fiber content. There was no distinction in the estimations of hardness acquired for composites of composition 80:20 and 90:10 which demonstrate the most extreme hardness which is 99.91 BHN.

Table 2 Hardness Test Results

Samples	Observation 1	Observation 2	Observation 3	Avg.Observation	BHN
80:20	1.5	1.4	1.5	1.47	99.91
85:15	1.6	1.4	1.6	1.53	91.31
90:10	1.4	1.5	1.5	1.47	99.91
95:05	1.6	1.6	1.5	1.57	86.11

3.3. Izod Impact Test

The reason for testing is to gauge an object's ability to resist high rate loading. The energy absorbed at fracture is generally related to the area under the stress-strain curve which is termed as toughness in some references. Izod Impact is a solitary point test that estimates a material's resistance to impact from a swinging pendulum. Izod impact testing is an ASTM standard of determining the impact resistance of materials. The consequences of the Izod impact test are shown in table3. The fuse of coir fiber clearly builds the effect quality of flawless PBS. The most noteworthy effect quality of the composites is 9.7 J.

Table 3 Izod Test Results

Coir Fibre: PBS Composition	Izod Impact Strength (J)
80:20	4
85:15	6
90:10	7.5
95:05	9.7

4. Thermal Analysis

4.1. Differential Scanning Calorimetry (DSC) Test

Differential Scanning Calorimetry (DSC) is a thermal analysis technique that looks at how amaterial's heat capacity (Cp) is changed by temperature. This allows the detection of transitionssuch as melts, glass transitions, phase changes, and curing. The below graphs of PBS + Coirfiber shows the different melting points of composites. On Y-Axis is the supply of current whichincreases the temperature of composite as well as the reference material which is taken as
nitrogen and on X-Axis the temperature. The influence of varying ratios of PBS & coir fibre onthe melting points of the composites was investigated by DSC. The results of these experimentsare summarized in table .2 the incorporation of PBS with lesser coir fiber (90:10) compositelead to an increase in the melting temperature (117.58°C).

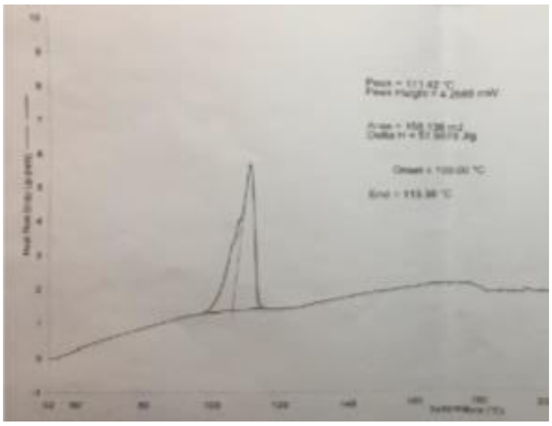

Figure 5 DSC Results of 80:20

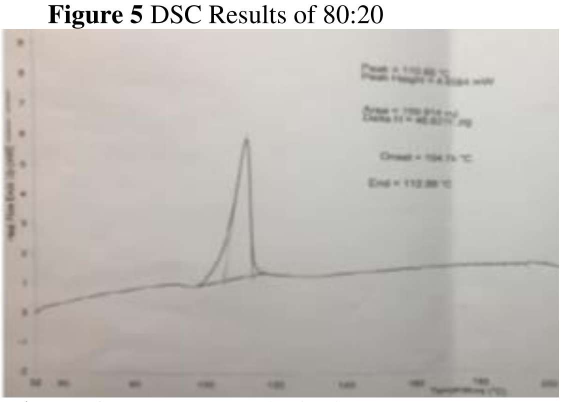

Figure 6 DSC Results of 85:05

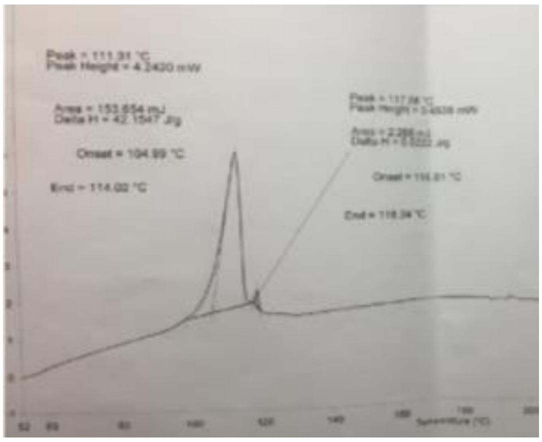

Figure 7 DSC Results of 90:10

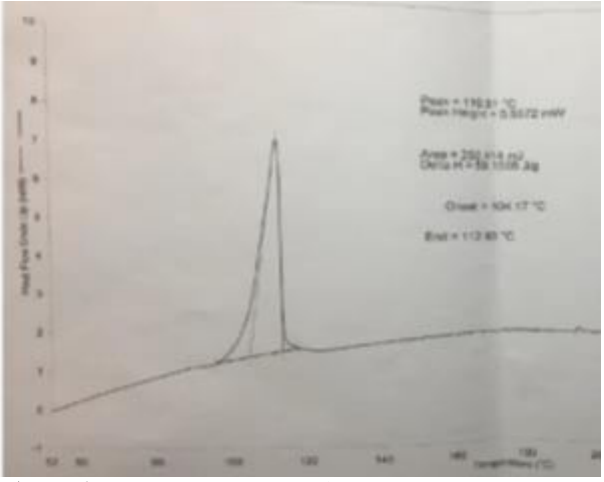

Figure 8 DSC Results of 95:05.

Table 4 DSC Test Results

Sr.No	Composition	Onset Temp ^{0}C	Peak Temp ^{0}C	End Temp ^{0}C
1	80:20	106.00	**111.42**	113.36
2	85:15	104.74	**110.66**	112.88
3	90:10	116.81	**117.58**	118.24
4	95:05	104.17	**110.91**	112.93

Fig -1: Figure

4.2. Thermo gravimetric Analysis (TGA)

Thermo gravimetric examination of the composites brought about the quantitative investigation of the debasement of composites. The composite 90:10 achieves the most elevated liquefying point to finish the corruption of the material. While, 80:20 sees the most minimal softening point. As the rate of polymer expands the softening purpose of the composites increments up to a specific dimension, and with the expanding liquefying point it requires greater investment to totally corrupt the composite.

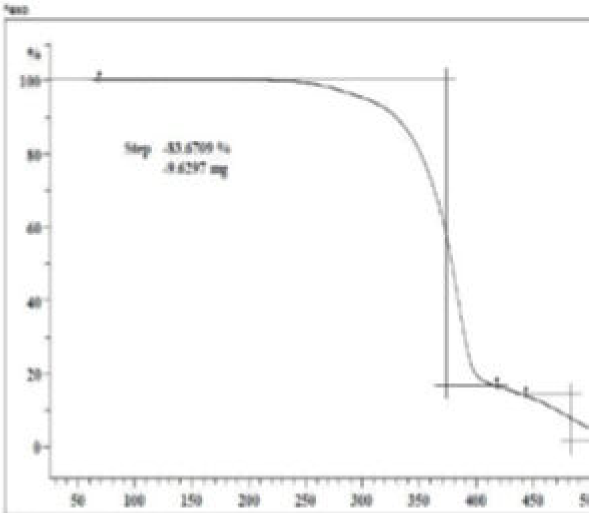

Figure 9 TGA Analysis of 80:20

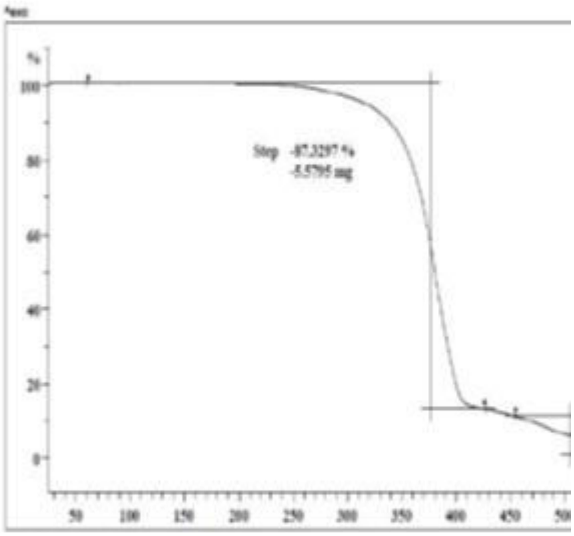

Figure 10 TGA Analysis of 85:05

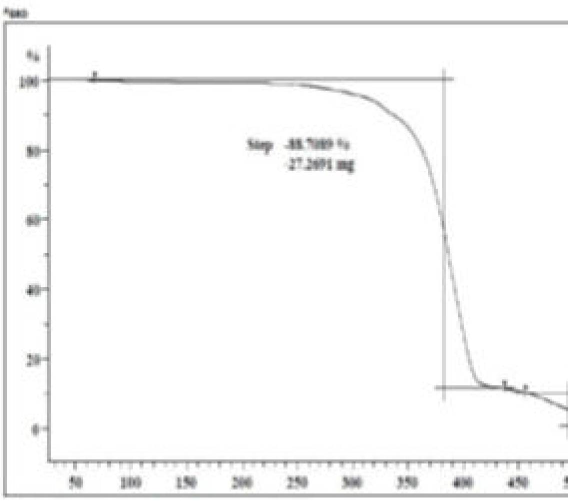

Figure 11 TGA Analysis of 90:10

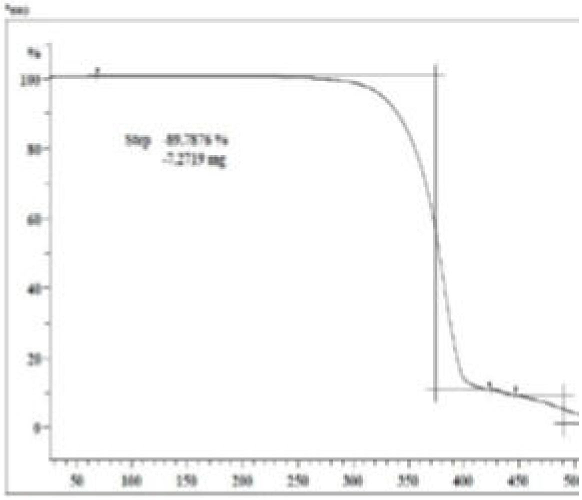

Figure 12 TGA Analysis of 95:05

5. CONCLUSIONS

The inclusion of Coir fibre is enhancing all the mechanical properties of Poly butylene succinate composite like (Tensile strength, hardness, and impact strength and heat resistance). The thermal degradation of the composites is decreasing with respect to addition of coir fibre. Short coir fibres are not allowing crack propagation while destructive testing. PBS/CF composites can be used to many fields as a low-cost biodegradable material having high performance. The mechanical and thermal properties suggest that the composites made of PBS & Coir fibres have better mechanical strength and can resist a bigger force. The tensile properties of Coir Fibre reinforced PBS composites were investigated by varying the fibre loading as shown in table 4. The tensile strength of PBS with Coir fibre in the ratio of 85:15 was tested to be maximum at 66 MPA whereas the yield strength of PBS with coir fibre in the ratio of 90:10 was tested to be maximum at 44 MPA. These studied composites showed a tendency that yield strength increased with increasing fibre loading up to an optimal point, after that the yield strength tended to decrease. The results of the Izod notched impact test are shown in table.3 the incorporation of coir fibre obviously increases the impact strength of neat PBS. The highest impact strength of the composites is 9.7 J. The table 1 shows hardness of the composites. It was found that these values decreased with the reduction in Coir Fibre content. There was no difference in the values of hardness obtained for composites of composition 80:20 & 90:10 which show the maximum hardness which is 99.91 BHN. The influence of varying ratios of PBS & coir fibre on the melting points of the composites was investigated by DSC. The results of these experiments are summarized in table .2 the incorporation of PBS with lesser coir fibre (90:10) composite lead to an increase in the melting temperature (117.58°C). FTIR enables a qualitative determination on the extent of degradation with the representation of the range of wave numbers. The range starting from 4000 cm-1 ending to 500 cm-1 has various types of regions like from 4000 to 2500 it shows single bond stretch, from 2500 to 2000 triple bonds, from 2000 to 1500 double bonds, and from 1500 to 500 it shows bending and stretching pattern occurring in the composites. Thermo gravimetric analysis of the composites resulted in the quantitative study of the degradation of composites. The composite 90:10 reaches the highest melting point to complete the degradation of the material. Whereas, 80:20 sees the lowest melting point. As the percentage of polymer increases the melting point of the composites increases up to a certain level, and with the increasing melting point it takes more time to completely degrade the composite.

REFERENCES

[1] P. Pradeep, J. Edwin Raja Dhas, M. Ramachandran, Mechanical Characterization of jute
fiber over glass and carbon fiber reinforced polymer composites, International Journal of
Applied Engineering Research. ISSN 0973-4562 Volume 10, Number 11 (2015) pp. 10392-
10396.

[2] R. Petrucci , C. Santulli , D. Puglia , E. Nisini , F. Sarasini , J. Tirillò , L. Torre , G. Minak
, J.M. Kenny, Impact and post-impact damage characterization of hybrid composite
laminates based on basalt fibres in combination with flax, hemp and glass fibres
manufactured by vacuum infusion, Composites: Part B 69 (2015) 507–515.

[3] Rakshit Agarwal, M. Ramachandran, Stanly Jones Retnam, Tensile Properties of
Reinforced Plastic Material Composites with Natural Fiber and Filler Material, ARPN
Journal of Engineering and Applied Sciences, Vol. 10, No. 5, 2015, pp. 2217-2220.

[4] Priyanka, Sanjay Palsule , Banana fiber/chemically functionalized polypropylene
composites within situ fiber/ matrix interfacial adhesion by Palsule process, Composite
Interfaces, 2013, Vol.20, No.5, 309–329.
[5] C. Elanchezhian, B.VijayaRamnath, KaosikR., NellaiappanT.K, SanthoshKumar.K,
Kavirajan .P, Sughan M.U, Evaluation of mechanical properties of kenaf based hybrid
composite for automotive components replacement,Vol.10, No.13, 2015.
[6] G. Caprino, L. Carrino, M. Durante, A. Langella, V. Lopresto , Low impact behavior of
hemp fibre reinforced epoxy composites; Composite Structures 133 (2015) 892–901.
P. M. Bhagwat, M. Ramachandran and Pramod Raichurkar
http://www.iaeme.com/IJMET/index.asp 413 editor@iaeme.com
[7] D. Bino prince raja, B. Stanly Jones Retnam, M. Ramachandran, Analysis of mechanical
properties of glass and carbon fiber reinforced polymer material, International Journal of
Applied Engineering Research. Vol 10, No 11 (2015) pp. 10387-10391.
[8] Sudha J, Harish Kumar, Padma kumar, Ranjani R, Sheela Ramani G, Naviyarasan M,
Comparative Study of Impact Properties of Coir & Aloe Vera Based Composites With
GFRP, Vol 10, No 8 (2015) pp.20517-20528.
[9] NabiSaheb.D and J. P. Jog, Natural Fiber Polymer Composites: A Review, Advances in
Polymer Technology, Vol. 18, pp. 351–363, 1999
[10] Chana Prapruddivongs and NarongritSombatsompop, Biodegradation and Anti-bacterial
Properties of PLA and Wood/PLA Composites Incorporated with Zeomic Anti-bacterial
Agent. Advanced Materials Research Vol. 747 (2013) pp. 111-114
[11] Han, Seong Ok, Mehdi Karevan, Md A. Bhuiyan, Jung Ho Park, and KyriakiKalaitzidou.
"Effect of exfoliated graphite nanoplatelets on the mechanical and viscoelastic properties of
poly (lactic acid) biocomposites reinforced with kenaf fibers." Journal of Materials Science
47, no. 8 (2012): 3535-3543.
[12] Li, Shasha, Xiaoli Shi, Changqing Fang, and Nailiang Liu. "Effect of graphite and Ag-plated
graphite nanoplatelets on the thermal properties of polypropylene nanocomposites:
Experimental studies and modeling."ThermochimicaActa 630 (2016): 11-20.
[13] Arjmandi, Reza, Azman Hassan, M. K. M. Haafiz, Zainoha Zakaria, and MdSaiful Islam.
"Effect of hydrolysed cellulose nanowhiskers on properties of montmorillonite/ poly lactic
acid nano composites." International journal of biological macromolecules 82 (2016): 998-
1010.
[14] Purushotham G. Sarvade, Deepak Nayak, Aayush Sharma, RaginiGogoi and
SagarMadhukar Strength Characteristics of Randomly Distributed Coconut Coir
Reinforced Lithomargic Clay. International Journal of Civil Engineering and Technology
8(5), 2017, pp. 1122–1134.
[15] Kumar, MS Senthil, N. MohanaSundaraRaju, P. S. Sampath, and L. S. Jayakumari. "Effects
of Nanomaterials on Polymer Composites-An Expatiate View." *Reviews on Advanced
Materials Science* 38, no. 1 (2014): 40-54.