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Thermal and Morphological Characterization of Coir Reinforced Poly Butylene Succinate

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ABSTRACT

Composites have different properties like it is lightweight, high quality and firmness. These days, composites are supplanting customary materials like metals and wood furniture. These materials have numerous applications in car and marine ventures, common, military and airplane materials. Utilization of composites is ideal because of high calibre and ease. The PBS composite had the satisfactory mechanical unbending nature and warm soundness to be reused and reused. The point of this survey paper is to concentrate on the impact of Resins, fabrics and added substances on PBS biodegradable composite in light of mechanical tests, DSC test and to distinguish thebest appropriate property. Coir is a natural fibre extracted from the husk of coconut In this study, poly butylene succinate composites were prepared with the coir fibres. The phase morphology, melting and crystallisation behaviour, mechanical properties and thermal stability of PBS and Coir Fibre composites were investigated in detail. The results showed that, although raw Coir Fibres were used without any modification, they played an important role in improving the properties of PBS.

Keywords : , poly butylene succinate composites, Coir Fibre, Resins, DSC test

INTRODUCTION

Plastic sheets are becoming very popular and have wide applications in domestic and industrial sector. Not surprisingly, the related environmental concerns have also increased in recent decades; this has led to strengthening efforts in order to reduce the ecological effect of polymeric materials. Moreover, the prospective depletion of petrochemical feedstock is an important concern. Due to these two significant considerations, the plastic industry has started looking for alternative sources of raw materials in the last few decades, and considerable interest is being shown in natural, renewable solutions [1]. One of the fast developing alternatives is Bio based polymer. The usage of biopolymers has increased rapidly at higher rate due to the economic effects. Because of very good degradation property, the biopolymers can be used anywhere and many researchers have been going on to improve the mechanical properties of the biopolymers to make it usable in various applications [2]. There are numerous natural fibres available like bamboo fibres, jute fibres, sisal fiber that show very good mechanical properties over the synthetic fibres. Modification is a key tool for improving the property of the biopolymer-natural fiber reinforced plastics material. In this proposed research work, the task is to figure out the effect of the various blend ratios of the biopolymers, fibres and filler material on mechanical properties [3]. PBS based bio-polymer will be used (which has good mechanical properties) and jute fibers as fiber reinforcement and carbon nano powder will be used as a filler material for the natural fiber reinforced plastic. Several characterization and mechanical tests such as TGA, tensile test, flexural test, and SEM test and water absorption property are proposed to be carried out to figure out the correct blend ratio of biopolymers and fibres for the natural fiber reinforced plastic [4].

The objective of the idea is to develop biodegradable roofing sheet with entirely agricultural based product and check the commercial viability. Other aspects like maximum durability, transparency and cooling effect of roofing sheet etc [5, 6]. May also be computed. PBS is thermoplastic biodegradable aliphatic polyester with high flexibility, excellent impact strength, and no major adverse effects on the environment[7, 8]. This polymer has high flexibility, excellent impact strength, thermal and chemical resistance. The maximum specific surface area was obtained from Nano fibers. The experiments results shows that the Vapour grown carbon Nano fibers (VGCNF) can be used to control melt viscosity the glass transition temperature is increased by 10 degree during processes [9, 10]. In the addition of primary crosslink structure of polymers and Nano tubes the secondary network structure was formed. The resulting composites exhibited really good dispersion in the presence of Vapour grown carbon Nano fibers (VGCNF). the mechanical, thermal, and electrical properties have been tested on Nano fiber dispersion for different kind of thermoplastic polymers like PMMA, nylon , poly carbonate etc. the result include the increase in the tensile strength [11]. The tensile strength of the heated jute textile composite is 189.479 MPa, the flexural strength is 208.705 MPa & the fibre is main and cross direction woven.The jute textile FRP exhibited a tensile strength of 189.479 N/mm2, which is 21% of the tensile strength of carbon FRP (923.056 N/mm2) and 28% of the tensile strength of glass (E-glass) FRP (678.571N/mm2) [12,13]. The jute textile FRP exhibited flexural strength of 208.705 N/mm2, which is 13% of the flexural strength of carbon FRP (1587.134 N/mm2) and 32% of the flexural strength of glass (E-glass) FRP (666.871 N/mm2). JFRP strengthening displayed highest deformability index and proved that jute textile FRP material has huge potential as a structural strengthening material [14].

2. PREPARATION OF COMPOSITES

PBS was incorporated with various Coir Fibre (5, 10, 15, 20 gms) to form the composites. A mould was used to prepare the composites. The mould was kept in the machine with a set temperature of 153°C. The PBS was then poured into the mould and allowed to melt. Followed by this, the coir fibre was added as an additive in the melted PBS and mixed evenly for 5 mins. After this step, a uniform pressure was applied on it so that the top plate could easily slid into the mould cavity. The mould with the mixture was kept for 15 mins so that the inside material could melt & get mixed completely with the fibres. The temperature was then set to glass transition temperature and the mould was allowed to cool up to 110°C. To remove the air inside the mould, pressure of 50, 100 & 150 bar was applied on the mould. The mould was then allowed to cool after which it was opened.

Figure 1 Sample of Composite 80:20

Figure 2 Sample of Composite 85:15

Figure 3 Sample of Composite 90:10

Figure 4 Sample of Composite 95:05

3. THERMAL ANALYSIS

3.1. Differential Scanning Calorimetry (DSC) Test

Differential Scanning Calorimetry (DSC) is a thermal analysis technique that looks at how a material's heat capacity (Cp) is changed by temperature. This allows the detection of transitions such as melts, glass transitions, phase changes, and curing. The below graphs of PBS + Coir Fiber show the different melting points of composites. On Y-Axis is the supply of current which increases 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 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).

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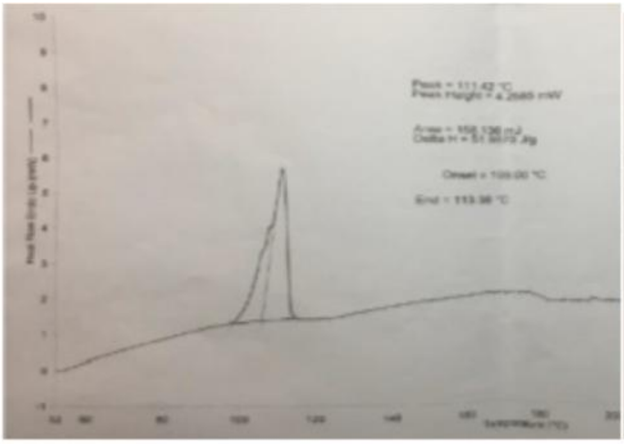

Figure 5 DSC Results of 80:20

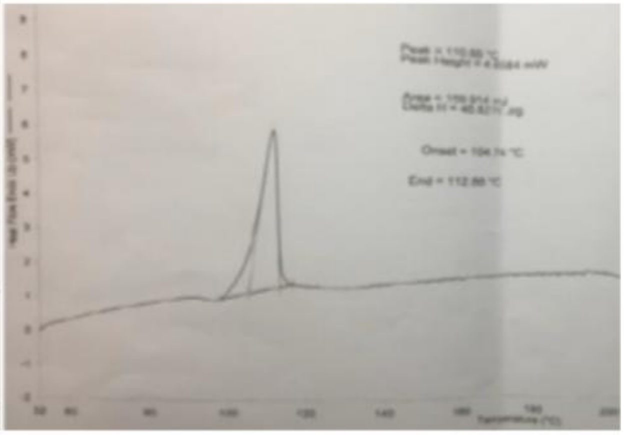

Figure 6 DSC Results of 85:05

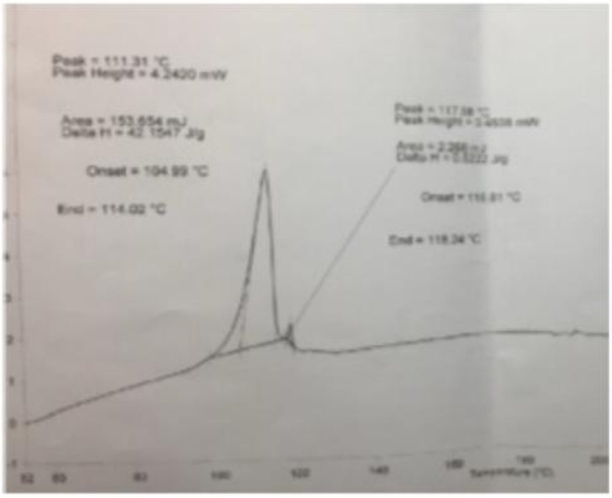

Figure 7 DSC Results of 90:10

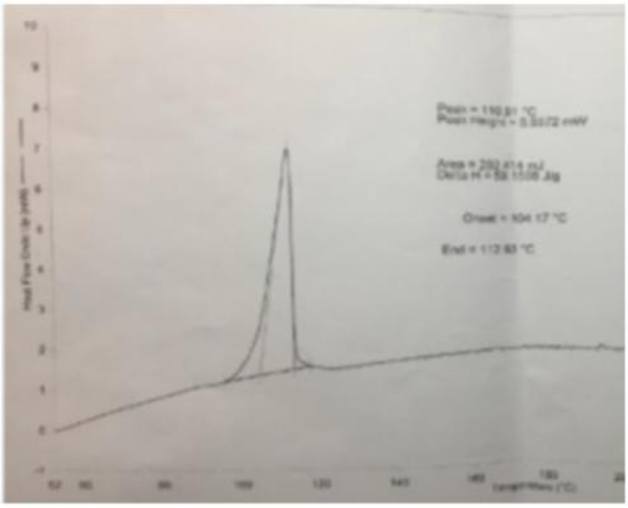

Figure 8 DSC Results of 95:05

Table 4 DSC Test Results

Sr.No	**Composition**	**Onset Temp ℃**	**Peak Temp ℃**	**End Temp ℃**
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

3.2. Thermo gravimetric Analysis

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.

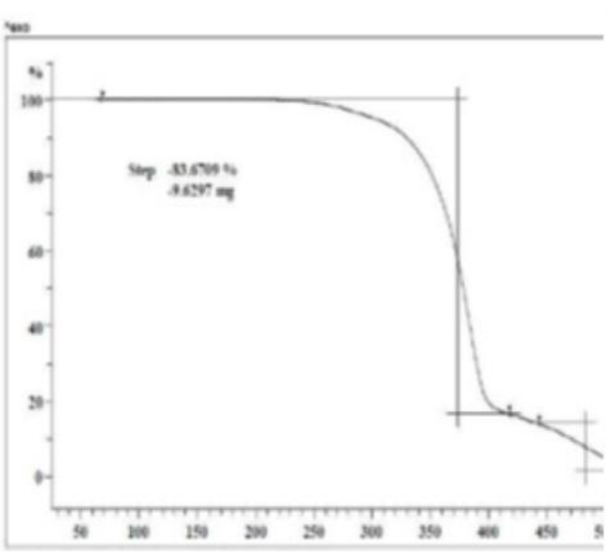

Figure 9 TGA Analysis of 80:20

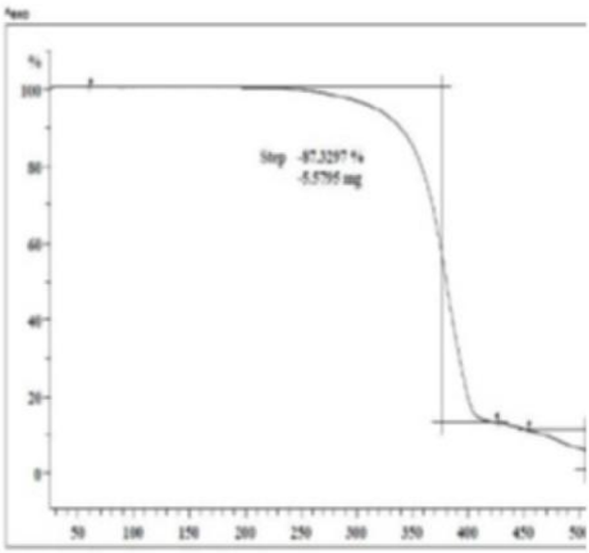

Figure 10 TGA Analysis of 85:05

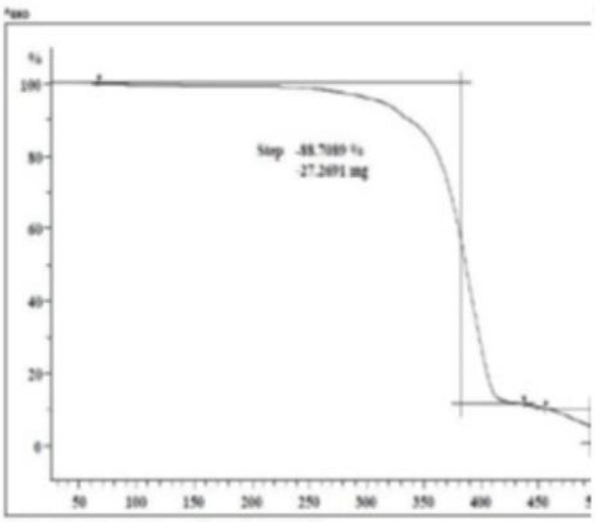

Figure 11 TGA Analysis of 90:10

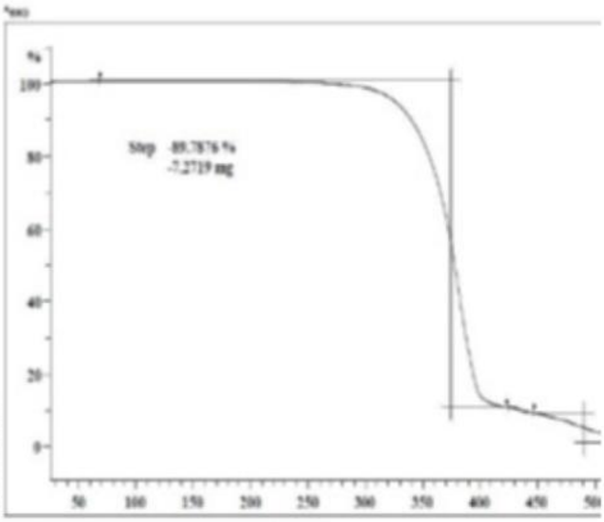

Figure 12 TGA Analysis of 95:05

4. MORPHOLOGICAL ANALYSIS

4.1. SEM (Scanning Electron Microscope) Test

The microstructure of the bio composites can be viewed by using scanning electron microscope. The microstructure of the bio composites is used to examine the scattering of fibre inside the resin and their nature of bonding between the resin and the fibre. Interfacing of resin with filler in the biodegradable composites

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cannot be revealed by lower magnifications images. The arrangement of fibres was observed using a scanning electron microscope of 20 kV. Before scanning, the specimen was coated with thin gold layer to escalate the conductivity of specimen to prevent electrostatic charging during specimen investigation.

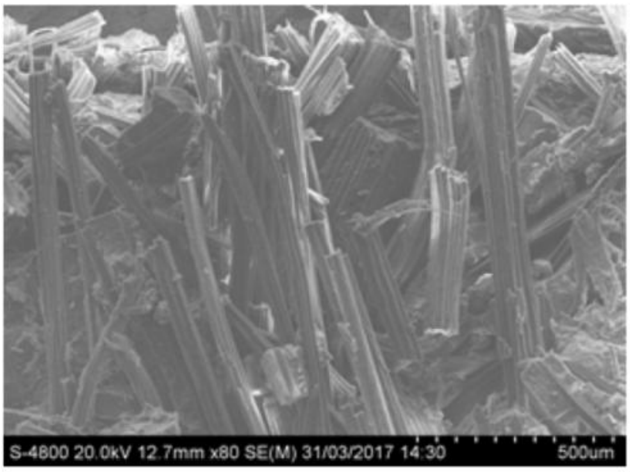

Figure 13 SEM Images of 90:10

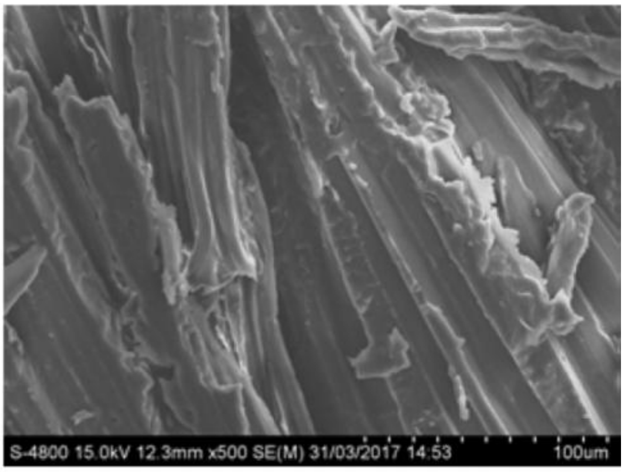

Figure 14 SEM Image of 95:05

The Fig. 13. Shows that the Fibers were reinforced in the matrix uniformly signifying the strength of the composite.The Fig. 14 Clearly shows that the Fibers were not pulled out from the matrix even after the effect of the tensile strength. The sample is the cross-section view of the broken part of the tensile test.

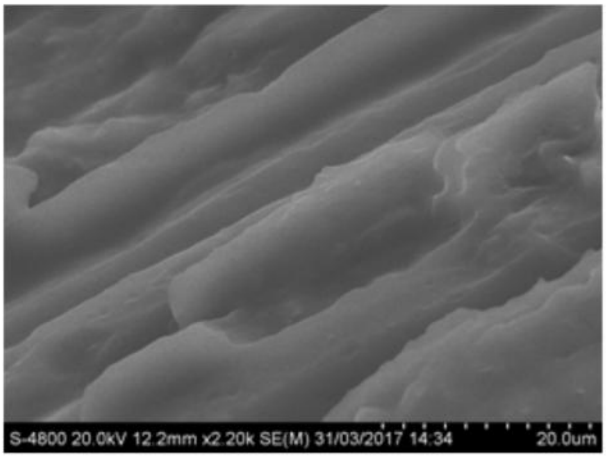

Figure 15 SEM Image of 90:10

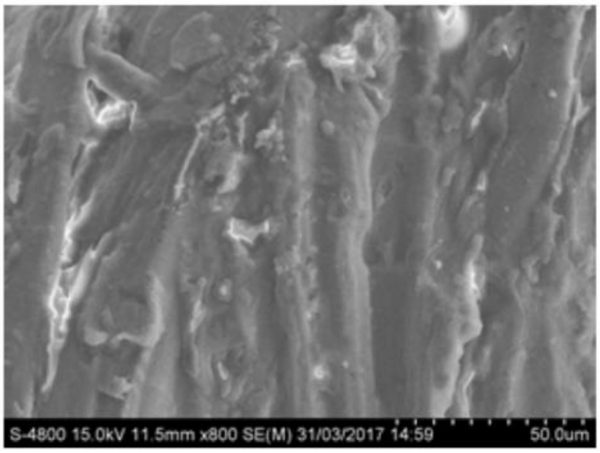

Figure 16 SEM Image of 95:05

The Fig. 15. It also shows that there was no accumulation of the fibre in the matrix. The Fig. 16. Shows that the Fibers were uniformly mixed in the matrix leaving no vacant space after the applied force during the preparation of the composite. The Fig. 16. Shows that the one fibre was attached to another Fiber with thin layer of PBS matrix. It also shows the binding nature of the matrix with fibre.

CONCLUSION

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). There is an excellent compatibility between the Poly butylene succinate and coir fibre which is evident from morphological analysis carried out by scanning Electron Microscope. As per FTIR result, there is no chemical reaction between the matrix and fibre. Increase in tensile strength proves that coir fibre is having best physical bonding with the PBS resin. 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.

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