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Tensile and Micro Structural Properties Analysis of Biodegradable Polymer Blends

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***Abstract:** poly lactic acid (PLA), Acrylonitrile butadiene styrene (ABS) and tapioca cassava starch powder (TCSP) were melt blended using twin screw extruder. Mechanical properties, which are tensile strength, young's modulus, % elongation and flexural strength Vs. flexural modulus determined by the help of Universal testing machine (INSTRON UTM-3969) .Morphological of PLA/ABS /TCSP blends was investigated by the help of scanning electron microscopy (SEM), the SEM images of (b-d) shows spherical morphology on the tensile fractured*

***Key Words:** Tensile properties and microstructure of polymer blends.*

I. INTRODUCTION

Manufactured Synthetic polymers are of significance in current science and innovation as they are basic to our day by day existence with a wide scope of uses in different fields, for example, bundling, farming, food, consumer items and medical appliances. In the previous couple of decades, significant consideration has been centered on the biodegradable polymers because of their one of a kind biodegradability, upgraded biocompatibility just as adaptable physical and mechanical properties PLA and its copolymer it's have been utilized broadly in various fields, for example, tissue designing, polymer building, tranquilize conveyance framework and a fewmedical inserts of vital. As utilization rate in the year 2010, PLA was seen as the world second most imperative bio plastic [1].. There are report discovered that PLA and PCL structure an incomplete miscible mix where it demonstrated an expansion of extreme malleable strain of PLA when PCL was added to this blend system [2]. PLA characteristic crude materials of polymers. [3-7].Mechanical properties of the following blends approach view [8]. Thermo Plastic [9]. The crystalline morphology of the PLA/PBS blends wasmeasured by scanning electronMicroscopy (SEM). Mechanical properties were examined by tensile testing [10].

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In thisresearch paper, explore the effect ofPLA/ABS/TCSPpolymer blends, on mechanical and morphological properties , which are prepare on the weight basis like as pure PLA and ABSPLA70/ABS30, PLA50/ABS50, PLA30/ABS70, PLA47.5/ABS47.5/TCSP5, PLA45/ABS45/TCSP10 PLA60/ABS25/TCSP 15 and PLA25/ABS65/TCSP15, were produced bymeltblending.

II. METHODS AND MATERIALS

A. Materials

The PLA used in this work was a commercial grade type Ingeo^{TM} Biopolymer 3052D (MFI = 14-30 g/10 min at 210 ^{0}C) provided by Nature Works (Minnetonka, MN, USA).Its physical and thermal Properties of Density and glass progress temperature in the 1.24 g cm^{-3}and 55– 60 °C range individually, and a dissolve temperature extend involved between 155– 170 °C. With respect to, a commercial grade 3903HSN/SAC (MFI = 18 - 23 g/10 min at 160 °C) was provided by LG Chem ROK Ltd. (SOUTH KOREA) in granules structure with a thickness of 1.05 g cm^{-3}, MFI= 21.3g/10 min (220°C/10 kg, MFR= 50 g/10min (200°C/21.6 kg)]. 1.146 g cm^{-3}. ABS fundamental thermal most extreme arrangement temperature, T_{Max} of 88 to 89 °C in air, Cassava starch Commercial grade 11081400 HS (Density and consistency of 0.6-0.7 g cm^{-3}and 200 - 500 Cs) (i.e.Centi stokes(Cs)) provided by ANGEL STARCH&FOOD Pvt.Ltd (Chennai INDIA).It has a molecule size of 0.075mm.

B. Manufacturing of binary and ternary of PLA/ABS/TCSP Blends

Manufacturing of binary and ternary blends were completed in two separate stages. Before further preparing, all materials were dried to maintain a considered reserve from wetness, which could influence hydrolysis during collecting. PLA, ABS and TCSP were dried at 60 ^{0}C for 24 h. The amount of PLA in all ternary blends was, maintained at 70, 50, 30 wt%. In binary blends 60, 47.5, 45and 20 wt%.in ternary mixes as showed inTable 1, and the Results had been in comparison with pure PLA, as the primary objective is to get toughened PLA formulations. The suitable amount of each component have been measured and exactly pre-blended in a zip pack. Until homogenization. At the primary manufacturing stage was conducted via extrusion in a twin-screw extruder (ZV20-High Torque, L/D= 40, NEOPLAST) at 196^{0}c (extrusion die) and 45 rpm, from Central Institute of Plastics Engineering and Technology, CIPET (Kochi, India). A pivoting pace of 40 rpm was utilized with a temperature profile of 190^{0}C (expulsion bite the dust), 195^{0}C, 200^0 C, and 205^0 C (feeding, hopper). These conditions promise great processing in terms of viscosity and avoid thermal degradation, as past analyses in the gathering have revealed.

After this blending stage, the got materials were pelletized and further prepared by semi-automatic compression forming in a Neo PlastEngineering (NP30)
(Cochin, India). The temperature with water-cooling (25°C) and pressure was 9 MPa. The molded shaped with square sheet with dimensions of 200 mm X 200 mm X 4mm, width, breadth and thickness respectively.

C. Sample preparation

Table 1 formulation of binary and ternary Blends

Samples	PLA (wt. %) (g)	ABS (wt. %) (g)	TCSP (wt. %) (g)
PLA	100	-	-
ABS	-	100	-
PLA70/ABS30	70	30	-
PLA50/ABS 50	50	50	-
PLA30/ABS70	30	70	-
PLA47.5/ABS47.5/TCSP5	47.5	47.5	5
PLA45/ABS45 /TCSP10	45	45	10
PLA25/ABS60/TCSP15	25	60	15
PLA60/ABS25/TCSP15	60	25	15

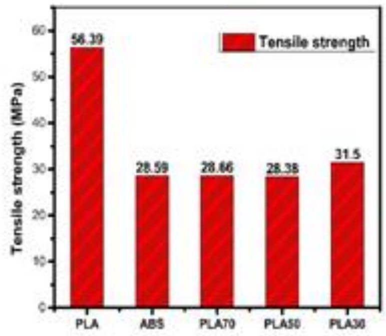
III. MECHANICAL AND MORPHOLOGICAL PROPERTIES

Mechanical charecterisation tests to observe stress at break (N/mm^2), endure break (%) compressive, flexural Stress and Modulus were performed utilizing INSTRON 3969 - 50KN (The INSTRON Company Ltd., USA) [8].At room temperature, all Samples had been strained at 5mm/min. Tests were molded normal temperature for a time of forty eight hr. earlier than testing. Results from 4 - 6 samples were located the averaged value of calculated and morphological properties were analysis for tensile fractured of polymer blends

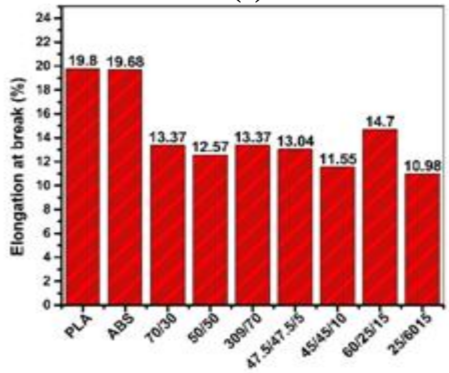
IV. RESULTS AND DISCUSSIONS

A. Mechanicalproperties

The observed tensile strength tensile modulus and % elongation at break are shown in Fig .1.Mechanical properties of PLA .ABS and TCSP were shows distinct material and properties. Tensile strength and % elongation of PLA were much higher than ABS but young's modulus was lower than the ABSPLA its alone hard and brittle material and ABS has softer and ductile nature, and also conclude tensile strength of ternary blends shows higher than the binary blends . These distinct mechanical characteristics were carried out into the PLA /ABS /TCSP blends shown in Fig.1.



(a)



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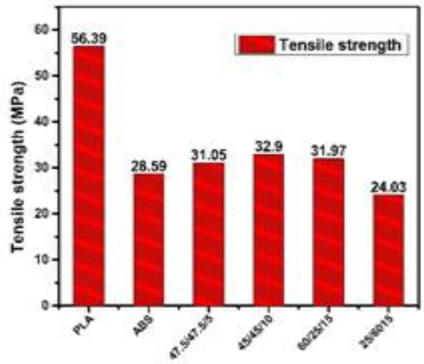
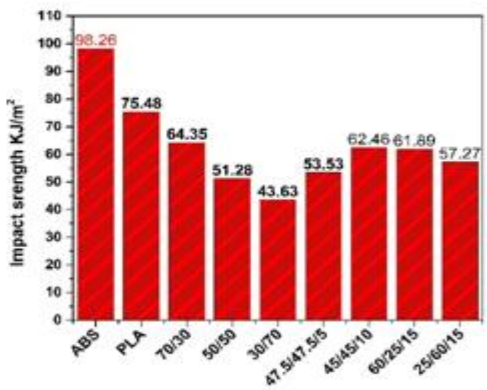


(c)



(d)

Figure 1. Mechanical properties of PLA.ABS, and PLA/ABS/TCSP (a) and (b) tensile strength of binary and ternary blends (c) Young's modulus (d) % elongation

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B.Flexural properties

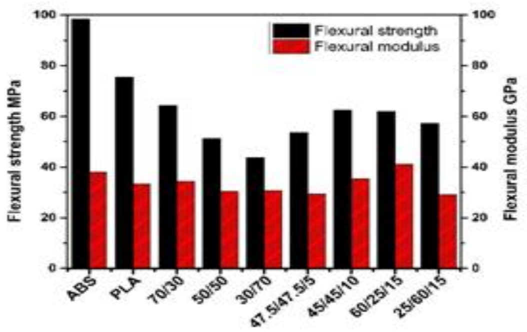

Figure 2. Variation of Flexural strength and modulus of polymer blends

Figure 2.indicated variation of flexural strength and flexural modulus, here we getting ABS Having higher flexural strength and flexural modulus than the PLA and their blends. From results shows flexural modulus increasing over the all range of blends and higher flexural strengthshows for ternary blends than the binary blends due to ternary blends have higher young's modulus it is reason to shows higher flexural strength for ternary blends.

D. Impact properties

The Figure 3.Shows that Izod impact properties of polymer blends. In this impact test ABS shows the highest impact strength compare to the pure PLA and their blends The mechanical properties of polymer blends test specimens were set up as an un-necked Izod samples .The specimens must be loaded in the testing machine and permits the pendulum until it cracks or breaks. Utilizing the effect test, the energyneeded to break the material can be estimated effectively and can be utilized to measure the effect resistance of the material and the absorbed energy. The Fig.3 shows the most maximum Izod impactstrengthof binary blend is 64.35KJ/mm^2 at PLA70/ABS30

Figure 3. Impact strength of polymer blends

D.Scanning Electron Microscopy (SEM)

The authors seen by SEM .The incorporation of PLA-ABS-TCPS improves the interfacial similarity that is obviously clarified in SEM observation. The figure 5 (a) – (d) demonstrates scanning electron microscopy (SEM), the ABS spherical morphology was observed by scanning electron microscopy (SEM) to tensile fractured samples. The figure (b) and (c) shows similar spherical morphology was observed i.e. .Fig (b) PLA70/ABS30 (c) PLA47.5/ABS47.5/NBTCSP5.

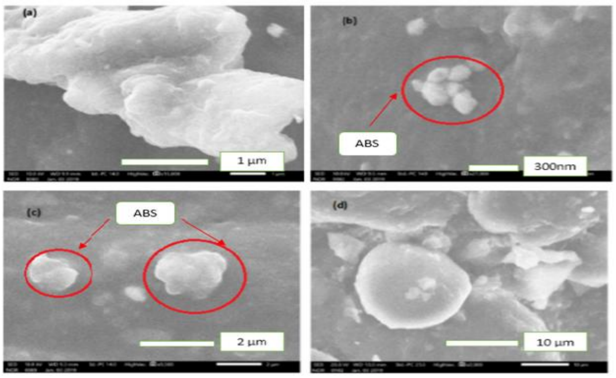

Figure 5. SEM photomicrographs of the fractured surfaces of: (a) PLA50/ABS50at 1500x magnification,; (b) PLA70/ABS30 27000x magnification,; c) PLA47.5/ABS47.5/NBTCSP5 1500xmagnification,; and(d) PLA60/ABS25/TCSP15 at2,000x magnification

V. CONCLUSIONS

The mechanical and morphological properties of PLA/ABS/TCSP blend are investigated on this work. Due to lower young's modulus of PLA , all binary and ternary was observed to be lower than that of ABS (Fig.1) however , incorporation of PLA in ABS does not show a considerable effect on mechanical blends was observed increase of the effect tensile strength, young's modulus,Flexural strength, Flexural modulus and impact strength with increasing of ABS content the mechanical properties shows not considerable effect but Incorporation of Abs in PLA shows a Considerable increase on all mechanical properties.

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