ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

STUDIES ON POLYPROPYLENE BIO COMPOSITE WITH SEA WEEDS

N Jaya Chitra and R Vasantha Kumari

B S Abdur Rahman University, Vandalur , Chennai 600 048

ABSTRACT

The interest in the utilization of bio-fillers in thermoplastics has increased recently, mainly due to the need in overcoming the environmental problems caused by the agricultural by products. Polypropylene is an outstanding commercially available important thermoplastic material with wide range of applications in various fields because of its balanced chemical and mechanical properties. The incorporation of the bio fillers (sea weeds) at compositions ranging from 10-30% was carried out by melt compounding in segmented single screw extruder and then injection molded into standard test samples. Mechanical, thermal and morphological characteristics of the blend systems were studied to evaluate the effect of filler content on polypropylene. It has been found that while there is a slight decrease in tensile strength and elongation, the tensile modulus was found to be increased with the filler content. There is a good dispersion of both the filler materials in PP matrix. The thermal stability of the PP matrix is found to be increased significantly by the presence of filler.

Keywords: sea weeds, biocomposite, polypropylene

**Corresponding author*

ISSN: 0975-8585

INTRODUCTION

In recent years, polymeric composite materials are being used in variety of applications such as automotive, sporting goods, marine, electrical, industrial, construction, household applications etc. Polymeric composites have high strength and stiffness, light weight and high corrosion resistance. Most of the composites available on the market today are produced with a high durability to ensure product longevity. Unfortunately, in order to make these products, companies have traditionally used non-biodegradable fibers, made from non-renewable resources [1-4]. The most important disadvantage of such composite materials is the problem of disposal after end use. This raised the attention of people for the use of natural, sustainable, biodegradable and renewable resources. In modern production environment, there is a great demand for every material to be recyclable or degradable.

Polypropylene is an outstanding commercially available important thermoplastic material with wide range of applications in various fields because of its balanced chemical and mechanical properties [5, 8]. Natural fiber composites (NFCs), are composite materials i.e., formed by a matrix (resin) and a reinforcement (fiber), in which the fibers are natural i.e., mainly formed by cellulose and therefore originating from plants. Some of these fibers can be hemp, jute, flax, sisal, banana, kapok, corn husk etc. [5-8, 17].

Considerable work has been carried out on various aspects of Indian seaweeds. Owing to the utilization of seaweeds in India for commercial production of agar and alginates, the research on seaweed has attained new impetus. Survey of seaweed resources on various coast of India had been completed and their respective estimates were made (9). An interest in studying the amino acid composition to establish nitro-protein in green, brown and red algae was attempted [10]. Interest in research and utilization of seaweeds has increased a lot during these days [11-16].

Scope of the Work

The present work is aimed at the following objectives.

- To use non edible sea weeds as bio fillers at different composition in polypropylene to get bio composite.
- To determine its effect on mechanical, thermal and morphological properties of polypropylene bio-composites. Therefore the experiments are classified into two parts.

Polypropylene and Sea Weed Composites

Seaweeds are also called macro-algae .This distinguishes them from micro-algae which are microscopic in size, often unicellular, and are best known by the blue-green algae that sometimes bloom and contaminate rivers and streams.

ISSN: 0975-8585

MATERIALS AND METHODS

EXPERIMENTAL

Materials

Polypropylene co-polymer grade (Repol B650) was supplied by Reliance Company which has melt flow index 65g/10min (230^{o}C/2.16 Kg) and density of 0.9g/cm$^{3.}$ The reinforcing filler used is brown sea weed (BS) (Sargassum tenerrium) and red sea weed (RS) (Kappaphycus alverizzi) collected from the eastern coastal region near Kilakkarai which was washed with water and dried. Reagent grade Toluene used for wet ability was obtained from RR Scientific chemicals, Chennai.

Preparation of composites

The BS and RS were washed thoroughly with water to remove the adhered contaminants, and dried in an air oven at 100^{o}C for 24 hours. The dried seaweeds were ground and then sieved to obtain sea weed flour with size of ≤75µm, Polypropylene is mixed with various weight ratios of red and brown seaweed (10%, 20%, 30%) and toluene, introduced into a laboratory single screw extruder maintained at maximum temperature of 210^{o}C at a screw speed of 200 rpm. The extrudate was cooled and pelletized into granules and dried.

Mechanical properties

The tensile test specimens were prepared by hand injection molding machine as per ASTM D 638-04 and tested in Universal Testing Machine at 50mm / min crosshead speed.

Thermal Properties

Simultaneous TGA-DTA scans are obtained using the SEIKO instrument to study the thermal stability of the composites

Scanning Electron Microscopy

Scanning electron microscopy Varian model (SEM) has been employed to study the morphology of the composite.

RESULTS AND DISCUSSION

The tensile properties of various percentages of sea weeds (red &brown) in polypropylene composites are given in the Table 1.

ISSN: 0975-8585

Table 1: Mechanical properties of PP/ Brown Seaweed blends

Sample	Tensile strength (Mpa)	Tensile Modulus	Elongation at Break (%)
PP	35.56	1968.37	4.17
PPBS (10 %)	33.75	2116.90	3.63
PPBS (20%)	31.25	2306.88	2.31
PPBS (30 %)	22.48	1866.32	1.73

Table 2: Mechanical Properties of PP/Red seaweed blends

Sample	Tensile strength (Mpa)	Tensile Modulus	Elongation at Break (%)
PP	35.56	1968.37	4.17
PPRS (10%)	23.84	2064.99	1.95
PPRS (20 %)	19.99	1853.79	1.28
PPRS (30 %)	17.85	1344.14	1.71

PP : Polypropylene, RS : Red sea weed, BS : Brown sea weed.

Tensile strength of PP decreases marginally with the increase in BS content up to 20%. The decrease is significantly high at 30% loading, In case of PP/RS blends the values of tensile strength decreases gradually with increasing filler content, possibly due to poor compatibilisation of filler in the PP matrix. Similarly elongation was also found to decrease with the increase in filler content but there is a significant increase in modulus at low filler content.

Thermal properties

Thermo gravimetric analysis has been carried out to study the thermal stability of the blend system containing 20% of filler content. Fig 1&2 shows the TGA results of PP (100%), PP/BS (80:20) and PP/RS (80:20). All the TG curves exhibit a single degradation step. The decomposition temperatures at 50% and 100% for all the three samples are given in the following Table 3.

Table 3: Thermal stability of PP Sea weeds composite

Materials	Decomposition temperature(ºC)	
	at 50%	**at 100 %**
PP	435	465
PP/RS (20%)	450.4	485
PP/BS (20%)	457.7	520

PP melts around 165 deg C and this melting temperature is not very much affected by the presence of either brown or red sea weed. The endothermic peak decomposition temperature of PP is 455 deg C and is shifted to higher values by the addition of 20% filler showing higher thermal stability.

ISSN: 0975-8585

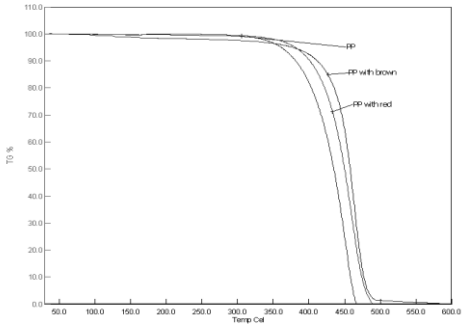

Fig1: Comparison of TGA of Seaweed-PP Composite

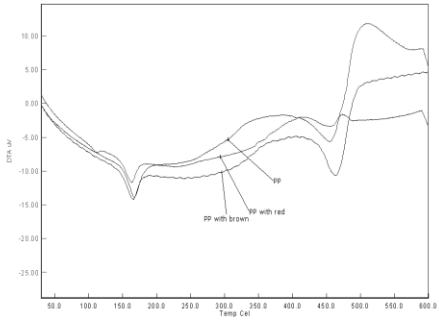

Fig2: Comparison of DTA of Seaweed-PP Composite

Morphological characteristics

Scanning electron microscopic observation is considered as an effective method for accessing visibility between the components in a polymer blend. SEM observations were made for various blends of PP/BS and PP/RS and are presented in the following Fig(3a &3b) for 30% filler content)

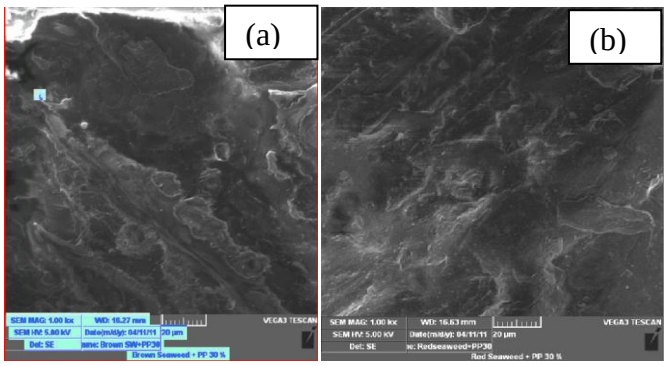

Fig 3: SEM micrographs of (a) PPBS (30 %), (b) PPRS (30 %)

This distribution of sea weed in thermoplastic domain is found to be good in this PP seaweed composite.

CONCLUSION

The results of the present study showed that useful PPBS, PPRS biocomposites with good compatibility were successfully developed. However tensile strength and elongation of PP decreases with increase in filler content and it decreases more at higher filler content while tensile modulus is found to increase at low % of filler content. DTA/TGA studies showed significant increase in thermal stability for PP composites. Melting temperature of PP is not very much affected by the presence of filler. The morphology of the composites using Scanning Electron Microscope (SEM) showed a fairly good compatibility between polypropylene and the filler. Further studies are in progress to get compatilised PP blend at higher content of sea weeds

Hence PP composites with either sea weeds or cornhusk waste can be used for low end applications where strength is not considered to that extent such as in boards, baskets, household utensils, etc.

ACKNOWLEDGEMENT

The author likes to thank NilafarNisha & Archana, B.Tech project students, B.S.Abdur Rahman University, for their support to carry out this research work.

REFERENCES

[1] Principia Partners. Current Emerging Applications for Natural & Wood fiber composites,"7th International Conference of woodfiber-Plastic composites 2003.
[2] Y Wang, F Yeh, S Lai, H Chan and H Shen. Polymer Engineering and Science 2003.
[3] M.Woolcot et al, the 7th International Conference of Woodfiber-Plastic Composites. 2003.
[4] Jacquelot E et al. J Polymer Sci PartB: Polymer Physics 2006; 44: 431-440.
[5] Nasrul Hatta, Nairul Akmar. Mechanical Properties of Polystyrene/Polypropylene Reinforced Coconut and Jute Fibers. CUTSE International Conference 24-27 November 2008, Malaysia.
[6] Bwire SN dazi et al. Bio Resorces 2007; 3(4): 1267-1277.
[7] Murtuza Ali Syed et al. Development of Green Composites from Agro waste Material for Reducing Carbon Foot prints of Plastics. International Conference on Advances in Polymer Technology, Feb 26-27, 2010, India, pp.60.
[8] Mohd Shahril Ezuan Mustapa et al, "Priliminary Study on the Mechanical Properties of Polypropylene Rice Husk Composites"Simposium polimer Kebangsaan Ke-V. Ogos 2005; 23-24.
[9] V Mohan. CMFRI Bulletin 2010; 41: 80-81.
[10] Sergio O Lourence. Phycolo Res 2002; 50 (3): 253-241.
[11] Abbott IA and Williamson EH. Limu: An ethnobotanical study of some edible Hawaiian seaweeds. 2nd ed. Pacific Tropical Garden, Lawai, Hawaii, 1974, pp.21.
[12] Blunden G. Agricultural uses of seaweeds and seaweed extracts. In: Seaweed resources in Europe: uses and potentials (Guiry, M. D. and Blunden, G., editors), John Wiley & Son, New York, pp.65-81.
[13] Weinberger F and Friedlander M. J Phycol 2000; 36: 1079-1086
[14] Waaland JR, et al. J Phycol 2004; 40: 26-33.
[15] Peters AF, et al. J Phycol 2004; 40: 1079-1088.
[16] Chan CX et al. J Appl Phycol 2004; 16: 297-301.
[17] Jayachitra and Vasanthakumari. International journal of scientific engineering and research(1015934) 2012; 3 (7):