The International Journal Of Engineering And Science (IJES)
||Volume||2 ||Issue|| 3 ||Pages|| 31-33 ||2013||
ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

"THE EFFECTS OF CHEESE WOOD STEM BARK *(Alstonia Boonei)* ON THE MECHANICAL PROPERTIES OF LOW DENSITY POLYETHYLENE"

[1,]Francis Ngozichi Onuoha, [2,]Michael Ifeanyichukwu Ugbaja,
[3,]Callistus Izunna Iheme. [4,]Iheaturu nnamdi Chibuike

[1,4,]Department of Polymer and Textile Engineering School of Engineering and Engineering Technology Federal University of Technology Owerri, Nigeria. P.M.B. 1526, Owerri, Imo State, Nigeria

[2,]Department Of Polymer Technology, Nigerian Institute of Leather and Science Technology,(NILEST), P.M.B 1054, Zaria, Kaduna State, Nigeria.

[3,] Department of Biochemistry, School of Sciences, Federal University of Technology Owerri, Nigeria. P.M.B. 1526, Owerri, Imo State, Nigeria.

Abstract

In this study, Cheese Wood Stem Bark (Alstonia Boonei) was reinforced with Low Density Polyethylene (LDPE) using the process of injection moulding and then compressed into a dumb-bell shape. It was surprisingly found that the filler reduced the mechanical properties of the composites. However, the density of the reinforced LDPE composites was enhanced. The fillers used in blend proportion were in the order: 100/0%, 99/1%, 98/2%, 97/3% and 96/4% LDPE-filler ratios.

Keywords: *Fillers, reinforcement, low density polyethylene and mechanical properties.*

Date Of Submission: 5 .March, 2013 Date Of Publication: 25 March 2013

1. INTRODUTION

In this modern age, polymers are no longer considered as cheap or novelty substitutes for traditional materials such as glass, metals, ceramic and wood. They are indispensable genre of materials in their own right. Polymer applications abound in industries, offices, homes and schools. The quantity of plastics consumed per household assesses the living standard of a country. In order to enhance the performance of plastic materials, fillers are added to the polymer matrix [1]. Researchers are exploring plastic materials, improving performance and durability [2]. Thermoplastic resins softened when heated and solidified when cooled. Other materials can be mixed with the plastic resins because of the aforementioned properties. The mechanical properties of polymers determine its response to an applied stress or strain [3]. These properties are manifested in the ability of the material to resist deformational characteristics. The mechanical properties are the strength, hardness, ductility, just to mention a few. Reports had been made on the effect of Meranti Hardwood sawdust on the mechanical properties of Polypropylene composites [4]. Moreso, there has been a special interest in the interaction of inorganic fillers with Polyolefins such as polyethylene and its variants [5]. The cheese particles were difficult to bond perfectly with the non-polar low density Polyethylene due to the lack of chemical interactiveness of the fillers. It has been established that the interfacial adhesion between fibres and matrix can be improved by the application of appropriate coupling agents such as Maleic-anhydride -grafted-Polyethylene. [6, 7, 8, 9].

The components of the Cheese wood stem bark are given in the Table 1 below:

Element	% Composition
Phosphorus	1.18
Potassium	1.13
Calcium	0.10
Sodium	0.08
Magnesium	0.03
Nitrogen	1.32

TABLE 1: CHEMICAL COMPOSITON OF CHEESE WOOD ALSTONIA BOONEI)

II. EXPERIMENTAL

2.1 MATERIALS USED

- Low density polyethylene (LDPE) was obtained from Ceeplast Industry limited, Adaelu Street, Osissioma, Industrial Layout, Aba, Abia State, Nigeria. The LDPE has density of 0.922 g/cm^3 and a melt flow index (MFI) of 4.0 g/10 minutes at 190 ºC.
- Alstonia Boonei Stem Bark (ABSB) powder was obtained from Cheese wood in Okrika Nweke, Ahiazu Mbaise, Imo State, Nigeria.
- Reagent grade chemical glycerol (plasticizer) was used and received from Fisher Scientific, Pittsburgh, PA.
-

2.2 SAMPLE PREPARATION

- The Cheese wood stem bark (Alstonia Boonei) was pulverized using a cassava grater, reground with electric grinder and then sieved with a mesh size of 0.3 mm. The filler loadings of 0-4% were used to compound the low density polyethylene using with a kitchen blender. Each formulation is fed into the hopper of the Injection moulding machine and processed at the same temperature of 300 ºC after failed attempts to produce at lower temperatures. The samples were produced into dumb-bell shapes to examine the mechanical properties. The formulation of the sample is shown in Table 2.

SAMPLES	CHEESE WOOD STEM BARK (%)	LDPE (%)
Unfilled	0	100
B1	1	99
B2	2	98
B3	3	97
B4	4	96

Table 2: Formulation of Samples

2.3 MECHANICAL TESTS

The mechanical tests were done at Socotherm Nigeria Limited, Oneh in Rivers State, Nigeria. The tensile tests were carried out using the Matest machine in accordance with ASTM D638-95 specification. The test provides the tensile strength, elongation at yield, modulus of elasticity and percentage elongation. Specific gravity was calculated from the data obtained.

III. RESULTS AND DISCUSSION

The mechanical properties of LDPE-cheese filler had been studied using injection mouding process and compression process. As shown in Figure 1, the specific gravity increases with increasing filler loading. Figure 2 is a plot of Tensile Strength against the % filler. As the filler loading increases, there was a significant decrease in the tensile strength. This could be as a result of lack of adhesion between the cheese particles and the LDPE matrix due to the absence of a compatibilizer. The particulate nature of the fillers could cause phase discontinuity and heterogeneity in the LDPE composites which is also attributable to the drop in tensile strength.

Sample ID	Wt % Filler	Ultimate Tensile Strength (MPa)	Elongation at Break (%)	Specific Gravity (g/cm^3)	Hardness
CT	0	11.433	592.60	0.93	50.30
B_1	1	10.571	61.90	1.11	44.70
B_2	2	8.648	52.10	1.15	43.70
B_3	3	8.497	42.70	1.21	43.00
B_4	4	8.038	33.00	1.27	40.70

Table 3: Specific Gravity Test Results

CT = control sample, B1- B4 = Samples with varying filler weights of 1-4%

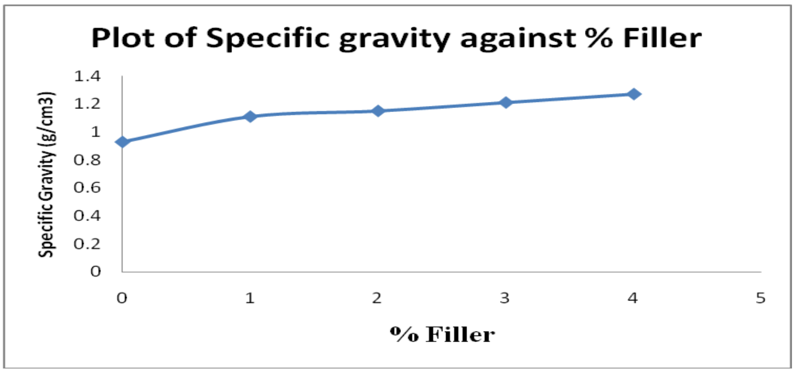

Fig.1: Plot of Specific gravity against % Filler Weight

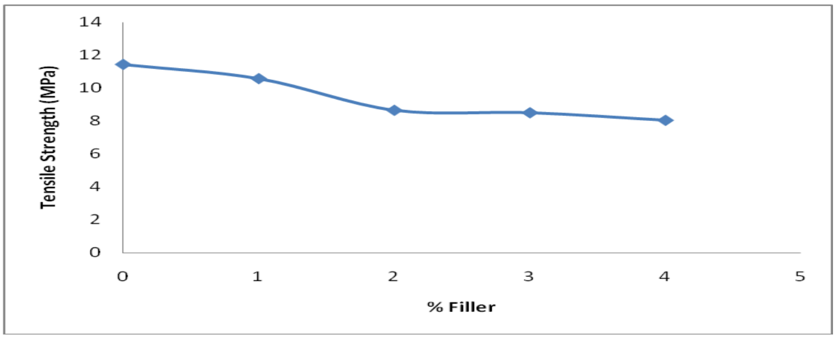

Fig.2: Plot of Tensile Strength against % Filler Weight

IV. CONCLUSION

Cheese-reinforced LDPE composites were prepared by injection moulding and compressed into dumb-bell shapes. Mechanical properties of the composites were studied. Considering the overall mechanical properties, the specific gravity increases with increasing filler loading while the there was a significant decrease in the tensile strength, elongation at break and hardness with increasing filler content. The elongation at break was enhanced while hardness was found to be reduced.

REFERENCES

[1] Mittal, V. (2007) "Polypropylene-layered silicate Nanocomposites; filler matrix interactions and mechanical properties" Journal of Thermoplastic composites. 20:575

[2] Pinchot, G. (2004) "Wood-Plastic Composites, WL Forest Product Laboratory.

[3] Katchy, E.M. (2000) Introduction to Polymer Technology" El Demark Publishers 5, 184- 190.

[4] Jutara, P. (2003) The mechanical Properties of Polypropylene Composites reinforced by Meranti Hardwood Sawdust.

[5] Lyu, S.G. et al (1997) "A study on the Physical Properties of precipitated CaCO3/LDPE composites" Korea Polymer Journal 5(3) 176-177.

[6] Bkiaris, D. Et al. (2001) "Use of Silanes and copolymers as adhesion promoters in glassfibre/Polyethylene composites. Journal of Applied Polymer Science 80, 2877-2888.

[7] Georpolous, S. et al. (2005) "Thermoplastic polymers reinforced with fibrous agricultural wastes" Polymer Degradation Stabilization 90, 303-312.

[8] Gupta, A.P. Saroop, U.K. Verma, M. (2004) "Studies of the Mechanical and Thermal Properties of Polyethylene/LLDPE- copolymer blends and its glass fibre composites". Polymer Plastic Tech. Eng. 43, 937-959.

[9] Matthew A.P.et al. (1995) Journal of Polymer Science 25, 4295.