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Preparation of Wood Plastic Composite from Polyethylene and Bagasse

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Abstract: The target of this research is development a new composite from bagasse and wood sawdust and recycled polymers such as polyethylene. This composite can be used instead of wood parts in moist place. *The* mechanical properties of low density polyethylene (LDPE grade 0075) produced by Bandare Imam-Iran, mixed with the wood and bagasse as fillers with 10-50 % w/w have been studied. The result show desirable properties for the prepared composite.

Key words: Wood · Bagasse · Composites · polyethylene

INTRODUCTION

Wood plastic composites (WPC) have some advantages over the conventional mineral material. They are lighter in compared to the fiber glass (2.5 kg/m^3), talc (2.8 kg/m^3). Moreover, these materials are less abrasive and not wear the equipment [1-3]. Usage of composite is very significant in the world; in USA about 1,170,000 ton of wood-profile extruded plastic was produced. In Europe, consumption was approximately 1,200,000 ton each in 2007. The consumer sectors are furniture, packaging (pallets) and construction (manufacture of terraces, balconies, ceilings, etc.). In the other countries, consumption still comes up [4-5].

Thermoplastics modified by vegetable fibers are recent and its melting point should be below the point of degradation of the fibers, usually between 200 to 220°C [6-8]. The low-density polyethylene is highly translucent. It is resistant to most chemicals product, except for strong acids and some ketones. Almost half polyethylene produced in recent years has been to the film or plastic film because of its low density, flexibility, high resilience, resistance to wear, resistant to moisture and chemicals [9-11].

MATERIALS AND METHODS

Materials:

- Low density polyethylene (LDPE) grade 0075 was supplied by Bandare Imam-Iran Company.
- Cellulosic fillers; wood sawdust and bagasse from the waste of sugar factory in Ahvaz. The cellulosic fibers were gride by grinder (powder with mesh size of 45 μm).

Table 1: Polyethylene and sawdust ratios.

Ratio	60:40	70:30	80:20
LDPE	1.2	1.4	1.6
Bagasse	0.8	0.6	0.4
Total	2.0	2.0	2.0

Table 2: Parameters of the extruder

Flow (kg/h)	Rotation (RPM)	Zone 1 (°C)	Zone 2 (°C)	Zone 3 (°C)	Zone 4 (°C)
15	180	175	180	180	185

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Table 3: Parameter of the injectors

Speed injection (mm/s)	Time injection (s)	Pressure pump (bar)	Temperature injection (°C)	Zone 2 (°C)	Zone 3 (°C)
40	3	50	182	179	178

Preparation of Composites: The residue of sawdust and LDPE were initially dried in an oven for 85°C for 20 h. The components of the mixture under appropriate proportions as showed in Table 1, were homogenized manually in a plastic container.

The components were fed directly into the funnel of feeding the extruder, being merged, homogenized in the cannon and pushed through the twin screw co-rotational forming continuous yarns that are cooled in a tank with water in recirculation. The pellets are formed in the chopper that pulls the wires into the tank and short form of granules. Extruder parameters are showed in Table 2.

The pellets were placed in an oven for 20 hours at 80°C for drying before the injection to produces the specimens. Data from the injector process are showed in Table 3.

RESULTS AND DISCUSSION

Particle Size Distribution: According to the standard NBR 7211/83, the residue of bagasse powder can be classified as a fine aggregate (Table 4).

Impact Test Results: The impact test was carried out according to the ASTM 256-97 [12]. It was tested 10 specimens for each ratio. The impact results showed in the Figure 1. Three sample were tested. T1 (60% polymer/40% sawdust), T2 (70% polymer/30% sawdust) and T3 trace (80% polymer / 20% of sawdust. Ratio T3 showed better performance.

Flexure Test Results: The flexure test results showed in the Figure 2. According to the comparison of polymers types, there is a significantly difference. For this property of T1, T2 and T3 are not significantly different.

Table 4: Bagasse size distribution

Mesh (mm)	Mass Retained (g)	% Retained	Acumulated.
3.6	1.22	0,57	0,57
1.98	0.50	0,27	0,84
1.12	7.00	4,01	4,84
0.44	70.10	40,38	45,22
0.32	56.15	31,72	76,94
0.13	29.87	17,00	93,94
residue	11.12	6,06	100,00
Total	175.96	100,00	

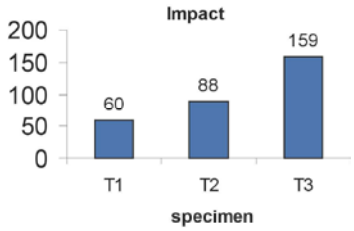

Fig. 1: Impact Test Result

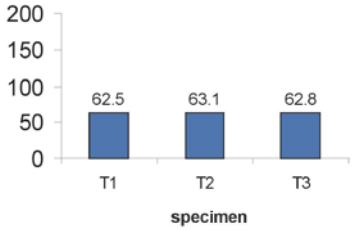

Fig. 2: Flexion Test

CONCLUSIONS

With respect to the tests it can be concluded that the ratio 80% of polymer and 20% of bagasse sawdust by weight showed a better performance for manufacturing wood plastic components. To manufacturing pallet boards, which is a piece that needs to bear loads and presents some flexibility, can be concluded that the ratios studied in this research did not interfere in the bending property. The low density polyethylene was more suitable than recycled for this application.

Biodegradability test, mainly fungi resistance, is also an important point to consider.

The development and use of other types of recycled plastic is also an important point for reducing the cost of products.

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