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Development of composites using low density polyethylene (LDPE) and coconut fibers (CF)

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Abstract - The use of natural fibers as reinforcement for LDPE in extrusion of thin plates, can generate good studies of applications. In this work we evaluate the thermal, mechanical and morphological properties of LDPE with 10% w/w of CF and addition of the maleic anhydride functionalized PE (PE-g-MAH). PE-g-MAH was used as compatibiliser agent to provide better adhesion between the LDPE and the CF. Thermal analysis behaviour was using to helping to establish the processing temperatures, the morphological studies were conducted to evaluate the interfacial adhesion. The CF maintained and enhanced the level of mechanical properties and improved the surface appearance.

The production of composite plastic-wood or WPC (wood plastic composites) has been known for many years. Historically, most of these composites using wood powder as filler for plastics. The wood dust decreases the cost, but not necessarily improves the performance of these materials. More recently, the use of natural fibers to promote a character of reinforcement for thermoplastic materials has been of substantial interest [1, 2].

In this study we used a low density polyethylene (LDPE) which was kindly donated by the company Laminor SA, melt flow rate of 1.0 g/10min (190 °C / 2.16 Kg). Coconut fibers were treated on the Laboratory of Embrapa Agroindústria Tropical and maleic anhydride functionalized Polyethylene (PE-g-MAH), Polybond 3009, as used how compatibilizer, was supplied by Chemtura Corporation.

The curves of thermogravimetry (TG) were obtained in an equipment brand TA Instruments model TGA Q500, the heating rate of 10 °C min^{-1}, sample mass around 10mg, sample port of platinum, from room temperature to 600 ºC, flow synthetic air oven at 60 ml min^{-1} and flow of nitrogen in the balance 40 ml min^{-1}.

The curves of differential scanning calorimetry (DSC) were obtained in an equipment brand TA Instruments DSC Q100, the heating rate of 10 ° C min^{-1}, sample mass around 3 to 4 mg, the specimen holder with aluminum cover, in the temperature range -20 to 300 °C and nitrogen flow 50 ml min-1.

The formulations of the composites that were mixed in single screw extruder (d = 16 mm and L / D = 26) of AX Plastics, using a temperature profile of 180/185/190 °C. Specimens for mechanical testing were cut from the ribbons flat using laser cutting and characterized by mechanical tests in the universal test machine Shimadzu model with load cell 100KN, with initial velocity of 1mm/min until reaching a deformation of 0.5% and final velocity of 5mm/min until failure, used specimen type I tie ASTM D-638 and morphological studies were performed using a scanning electron microscope of Shimadzu. The formulations of the composites processed are presented in Table 1 below.

The addition of coconut fibers in the amount of 10% in polyolefins led to obtain composites with maintaining the level of mechanical properties with an indication of better performance of the composite compósitodo compatible. The use of new materials in the form of composites from polyolefins and coconut fibers, which are currently of great production in the region along the northeast coast of Brazil, is possible, profitable and promising, with positive impact on the environment.

Table 1 – Formulations of the composites

#	Materials	% weight
1	LDPE	100
2	LDPE / $CF_{untreated}$	90/10
3	LDPE / $CF_{treated}$	90/10
4	LDPE / $CF_{untreated}$ / PE-g-MAH	85/10/5
5	LDPE / $CF_{treated}$ / PE-g-MAH	85/10/5

References

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