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INJECTION MOULDING OF PLA (POLYLACTIC ACID) REINFORCED BACTERIAL CELLULOSE FIBER FROM NATA DE COCO BIOCOMPOSITES

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Abstract

For many applications, natural fibers provide reinforcement properties at lower cost, lower density, and higher strength and stiffness. The potential advantages of natural fiber have been well documented and are generally based on environmental friendliness as well as health and safety factors. Most researches concentrate on natural fibre/nondegradable polymer composites but research reports on natural/biodegradable polymer composites are rather limited. The performance of natural fiber including recycled newspaper fiber, bamboo and hemp fiber, nata de cassava etc, reinforced PLA composites has been investigated. Determined the mechanical properties of the PLA/jute fiber composites and showed that the tensile strength of composites was significantly higher than that of PLA. But the elongation at break of the composites is still very low as about 2%. Cellulose is a biopolymer whose availability on earth is abundant, known as a major component in plants. But cellulose is also an extracellular microbial polymer. Cellulose bacteria is a specific product of primary metabolism. Cellulose is synthesized by bacteria derived from Acetobacter, Rhizobium, Agrobacterium, and Acetobacter generation Sarcina. Effectively effective gram is acetobacter xylinum acetic acid bacteria. Cellulose bacteria has been applied as nata de coco, wound care products, and tissue engineering. In addition, bacterial cellulose also has the potential to strengthen the polymer to form a nanocomposite

Keywords: Bacterial, Nata De Coco

1. Introduction

At this time the use of environmentally friendly natural materials with the criteria can be easily deciphered, can be recycled, renewable and does not damage the ozone layer is particularly preferred. So research on these materials is very active. One of them is the material biocomposites.

PLA is a linear aliphatic thermoplastic polyester, produced from renewable resources. PLA has properties that are comparable to many polymers (polypropilen, polyvinilchloride, polyethilene, etc) such as high stiffness, clarity, gloss, and UV stability. PLA is commonly produced by two methods. It can be commonly synthesized by ring-opening polymerization of lactide. PLA may also be produced by direct polycondensation of lactic acid. Lactic acid, the starting material for PLA synthesis, can be produced by fermentation from a number of different renewable resources. PLA has been used as package materials and other products Because PLA has high strength, thermal plasticity, and biocompatibility. However, the physical properties of PLA such as brittleness limit the PLA polymer application [1]. PLA is a type of commercial biopolymer made from L- and D-lactic acids, which can be derived from the fermentation of corn starch. The use of such bio-based materials can help maintain the balance of carbon in nature. In comparison with traditional plastics, PLA has good mechanical properties. However, it still has deficiencies such as brittleness, low impact strength, and low ability in resisting thermal deformation, which limit the extensive application of pure PLA [2].

For many applications, natural fibers provide reinforcement properties at lower cost, lower density, and higher strength and stiffness. The potential advantages of natural fiber have been well documented and are generally based on environmental friendliness as well as health and safety factors. Most researches concentrate on natural fibre/nondegradable polymer composites but research reports on natural/biodegradable polymer composites are rather limited. The performance of natural fiber including recycled newspaper fiber, bamboo and hemp fiber, nata de cassava [3] etc, reinforced PLA composites has been investigated. Tao et al. (2009) determined the mechanical properties of the PLA/jute fiber composites and showed that the tensile strength of composites was significantly higher than that of PLA. But the elongation at break of the composites is still very low as about 2%.

Cellulose is a biopolymer whose availability on earth is abundant, known as a major component in plants. But cellulose is also an extracellular microbial polymer. Cellulose bacteria is a specific product of primary metabolism. Cellulose is synthesized by bacteria derived from Acetobacter, Rhizobium, Agrobacterium, and Sarcina generations. Effectively effective gram is acetobacter xylinum acetic acid bacteria. Cellulose bacteria has been applied as nata de coco, wound care products, and tissue engineering. In addition, bacterial cellulose also has the potential to strengthen the polymer to form a nanocomposite [4].

Compared with cellulose fibers derived from plants, bacterial cellulose is characterized by high purity (for example no lignin, hemicellulose or pectin as found in plant fibers), high mechanical strength and nanometer-sized three-dimensional fiber mesh structure. Based on its characteristics, bacterial cellulose becomes a potential candidate for the development of high-power nanocomposites [5].

Injection molding is the most widely used process for thermoplastic articles, especially for those that are complex in shape and require high dimensional precision. All injection molding machines have an extruder for plasticizing the polymer melt. Most injection molding machines for PLA are based on the reciprocating screw extruder, although two-stage systems, which integrate a shooting pot and extruder in a single machine, have also been deployed for injection molding of preforms for PLA bottles. The two-stage system consists an in-line extruder integrated to a shooting pot. The extruder plasticizes and feeds the melt into the shooting pot under relatively low injection pressure, from which the melt is injected into the hot runner under high pressure by a plunger in the shooting pot. The machine must stop the screw during the injection and packing phases. The two-stage system presents some advantages over its reciprocating counterpart, including shorter cycle time, small screw motor drive, and more melt quality [6].

For this study we investigated the mechanical properties and morfology of PLA-BC by injection moulding. It has been shown in previous work that BC is potensially as reinforcement of composites materials[7].

2. Methods

2.1 Material

The materials used are PLA imported from China. While bacterial cellulose fiber made from dried nata de coco then powdered and filtered on the size of 100 mesh. As an additional material is a coupling agent in the form of Vinyl silane which is useful to wet the fiber so it can blend with the PLA matrix.

2.2 Tool

The tool used is a heater with thermocouple to measure the temperature of the liquid PLA. Aluminum plate to hold liquid PLA, spoon for stirring, injection to make pellet and extruder to make filament.

2.3 Testing

In this research the test is a tensile test and observations made are observations with SEM. Test fangs using universal tarit testing tool, while SEM is done in Undip.

3. Conclusions

This research is new to the stage of data retrieval. However, based on literature studies, PLA-cellulose bacteria composite is highly potential for use as bone and dental implants.

4. References

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