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TENSILE PROPERTIES OF ALKALINE TREATED COCONUT MEAT HUSK REINFORCED POLYESTER COMPOSITES

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Abstract

Synthetic fibers such as glass fiber and carbon fiber are traditionally used as reinforcement in engineering composites. The increasing of environmental concerns has led to the use of natural fibers as renewable alternatives reinforcement. Among them, coconut meat husk fiber which abundant availability can be used as reinforcement fiber. However, the coconut meat husk fiber, same as other natural fibers, has the issues of fiber/matrix bonding and moisture absorption. Chemical treatments are needed to modify the surface of fiber, aiming at improving the adhesion with polymer matrix and reducing the hydrophilicity of the fiber. Alkalization was used in this study to treat the coconut meat husk fiber. The effects of chemical treatments for 1hr and 24 hr treatment time on the coconut meat husk fibers reinforced composites were investigated. A result showed that the 24 hr alkali treatment gave the highest tensile stenght compared to the 1hr treatment and RO water.

Keywords: Tensile properties, Coconut meat husk fiber, Alkaline, Natural fiber composites

Introduction

Natural fiber reinforced polyester composites have raised great interests among material scientists and engineers in recent years due to the considerations of developing an environmental friendly material, and partly reducing the dependency on synthetic fibers such as glass fiber and carbon fiber that were traditionally used as reinforcement in engineering composites. Natural fiber composite is a combination between plant-derived fibers with a plastic binder (Ishak et al., 2010). Natural fibers such as coconut meat husk is low in density, low cost to manufactured, non-abrasive nature, high filling levels possible, low energy consumption, high specific property, bio-degradable, and wide availability of fibers throughout the world and it may generate more income in terms of rural or agricultural based economy. Malaysia particularly has many natural fibers resources and one of it can be obtain from coconut such as coir and also the meat husk.

It is well known that the performance of the composites depends on the properties of the individual components and the interfacial compatibility (Aji et al., 2009). One of the significant drawback in natural fiber reinforced composites is the moisture absorption, and poor compatibility of the fiber with the matrix due to the hydrophilic characteristic of the cellulose and hydrophobic nature of matrix material and this will leads to poor interfacial adhesion between the fiber and the matrix as well as poor fiber dispersion. To improve interfacial bonding and to reduce moisture uptake, natural fibers may go surface modification such as physical or chemical methods. One types of chemical treatment were by alkalization.

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Coconut meat husk were abundantly available in Malaysia. It can be obtained easily from the coconut meat that were grated using machine to get the coconut meat husk. Therefore in this paper, the main objective is to investigate the effect of chemical treatment on the coconut meat husk fiber reinforced polyester composites by conducting mechanical testing to analyse the tensile properties

Materials and Methods

Materials

Coconut meat husk were obtained from the wet market at section 1, Bandar Baru Bangi and the polyester resin will be Asapes 9506 and hardener, Butanox M60.

Composites fabrication

In order to investigate the effect of chemical treatment on the mechanical properties of coconut meat husk fiber reinforced polyester composites, three samples of untreated fiber, three samples of treated fiber with alkaline treatment for 1 hours, and three samples of treated fiber with alkaline treatment for 24 hours were prepared. Coconut meat husk fiber were dried first after taken from the wet market, then for the treated fiber alkaline peroxide will be used as the chemical treatment for 1 hour and 24 hour duration of treatment. Then the treated fiber will be drain from any excess chemical then were dried in oven at 50˚C for total of 24 hours. The composites were fabricated by using vacuum bagging method at 15 psi. Fiber volume fraction for all specimen were at 15% for 200 mm (L) x 150 mm (W) x 3 mm (T) flat mould, that is 14.45 gram weight of fiber, 65.79 gram of polyester and 1.64 gram of hardener. The flat mould were prepared by using aluminium sheet and double sided tapes as the side wall in size of 200 mm (L) x 150 mm (W) x 3 mm (T).

Fig.1 Coconut Meat Husk Fibers

Coconut meat husk fiber was placed into the moulds by hand layup according to the fiber volume fraction and then the polyester and hardener will be mixed together based on the weight to form a matrix then it will be poured over the fiber. Then process of vacuum bagging will be started for 10 minutes. After that, the panel will be removed from the mould then the panels will be left for one week under room temperature (27˚C) for cooling and conditioning process. After conditioning process, the panels will be cut into desired standard size of test specimen, ASTM D638 Type 1 for tensile test and ASTM D790 for flexural test by using vertical band saw.

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Results and Discussions

Tensile Strength and Tensile Modulus

All testing were performed in Fiber and Biocomposite Centre (FIDEC) at Olak Lempit, Banting, Selangor. The testing has been carried out at air condition room temperature (21˚C) with a constant cross head rate of 5mm/min using Gotech Universal Testing Machine as per ASTM D638 standard. Load cell that will be used is 500 kg. Tensometer equipment also were used to measure the elongation of the test sample during testing period.

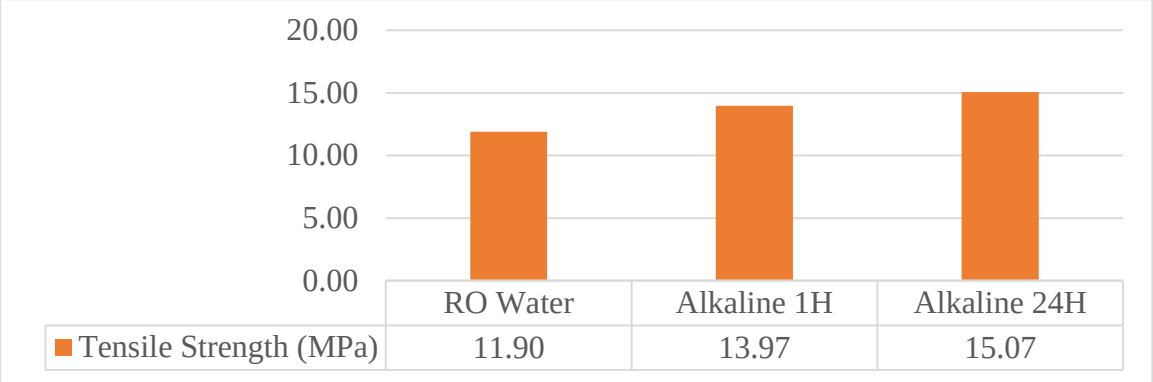

Fig. 2 Tensile Strength

Fig. 2 and Fig. 3 showed the tensile test data regarding the tensile and young modulus strength. The result showed that the treated fiber with alkaline peroxide chemical will give higher strength in terms of tensile properties and young modulus but only for treated fiber with alkaline peroxide for 1 Hour, it showed degraded young modulus. Other than that, all testing showed an increase of strength. The increases on tensile strength between untreated with treated for 24 Hour fiber showed an increase of more than 26 % (from 11.90 MPa to 15.07 MPa) and for young modulus strength, the increases were more than 15 % (From 693.67 MPa to 803.67 MPa). The drop of young modulus strength on 24 Hour treated fiber may cause by fluctuation on thickness of the test sample for that particular test specimen. Increase of strength for tensile and young modulus were causes by the alkaline treatment that improve the natural fibers or plastic bonds.

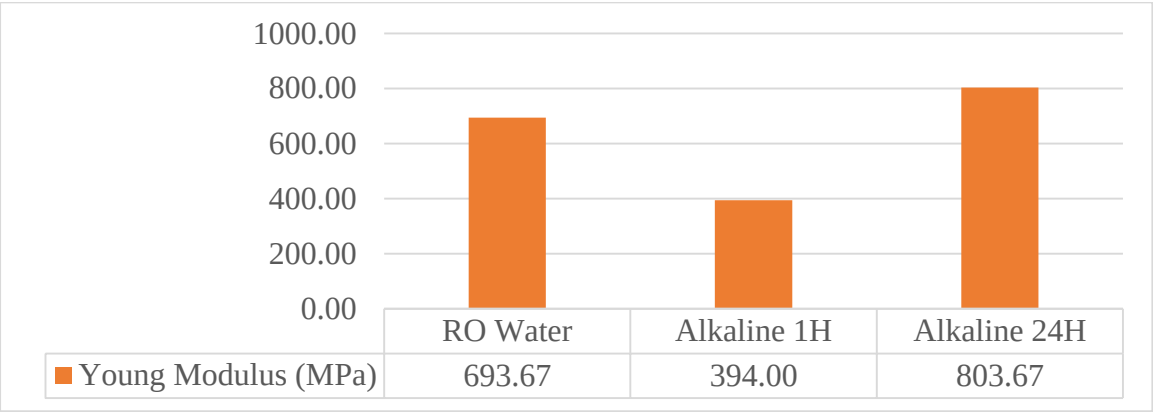

Fig. 3 Young Modulus

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The result of tensile testing were clearly confirm the study by Li *et al*., (2007) for the review of "Chemical Treatments of Natural Fiber for Use in Natural Fiber-Reinforced Composites" that conclude that fiber treated with chemical treatments will achieved various levels of success in improving fiber strength, fiber fitness and fiber-matrix adhesion for natural fiber reinforced composites. Rokbi *et al*., (2011) conclude that as the time treatment increase for alkaline treatment, the higher will be the alkali concentration those excess delignification of natural fiber occurs and resulting in a weaker or damaged fiber, but as the result showed, the as the duration of chemical treatment increase, the tensile strength will also increase.

Conclusion

This research was carried out to study and investigate tensile properties of alkaline treated coconut meat husk reinforced polyester composites that were fabricated by using vacuum bagging method. Other variable were also used during this research that is time taken for the fiber treatment (1 Hour and 24 Hour) with constant fiber volume fraction at 15 %. Based on the data, the highest value for tensile strength were 15.07 MPa for 24 Hour treated fiber and for young modulus strength, the highest were also 24 Hour treated fiber at 803.67 MPa. The trend from the data showed that fiber that were treated with alkaline will achieve higher tensile properties and the longer the duration of chemical treatment, the higher the tensile properties will be outputted.

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