Study the effect of particle size on the water absorption behavior and density of Polyester/ Bertam fiber composites

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ABSTRACT

Background: The paper analyses the effect of size of fiber on the absorption behavior and density in case of Bertam fiber composite reinforced with unsaturated polyester. The weight ratio of polyester and fibers were the same for each composite analyzed but were using 15µm, 120µm and 284µm fiber sizes. The specimens for density and water absorption tests were cut from the composite plates. The results of absorption behavior and density tests in case of the composite materials tested were analysed. Finally, the paper graphically shows the effects of fiber size on density and water absorption tests.

Objective: write the main objective for your paper. Results: write the main and most important results for your paper. Conclusion: write the main conclusion for your paper.

INTRODUCTION

The composite materials are using in daily application such as landscape and decoration. Exploration of natural composites are one of new field in Malaysia because the natural fiber are green technology and lower cost. With regard to the environment aspects, it would be very interesting if natural fibres could be used and replace of using glass fibers as reinforcement in some structural applications. One of objectives in using fiber composite is to utilize the fibers as reinforcements in matrix resin. Fibers by themselves cannot be used to sustain actual loads. Moreover, the choice of the fiber and matrix pair and the type of process must be considered.

Bertam with the scientific name Eugeissona tritis, are widely wild plant in Malaysia, Borneo and Thailand. Eugeissona is a clustering genus of flowering plants in palm family native, have many benefits in medical and housings sector (Rozman et al.,2003), (Asyraf and Rahmad, 2012), (Chee, 2005). Others example plants are in same group, which are oil, coconut and date palm. Commonly, Bertam plant can grow until 6-10m tall with green leaflet amd spiny leafstalks. Bertam fiber is a natural fiber that is no research done to study the effect of the fiber sizes. However, the Bertam fronds are widely used in horticulture. Moreover, fruit eaten fresh can relieve from fever, the sap from the stem is used for insect sting. The leaves are used as fish traps and fishing poles (Rozman et al.,2003). The fruits are sometimes carved to serve as a decorative item.

The research deals with the preparation and characterization of bertam leaves fibre reinforced polyester (PE) matrix based polymer composites. Among the equipments has been used are rotor mill, sieving machine and weighing scales. The research was conducted by reinforcing the matrix (polyester) resins with natural material (Bertam leaves). Regarding to different fiber sizes (15, 120, and 284µm), the different composite compositions were prepared. After preparations of composite material, water absorptions and density test were conducted. This fundamental research was generate information about absorption behavior and density of Bertam leaves fiber reinforced polyester composites.

Materials and methodology:

Unsaturated polyester (Renacarb K2 brand) was supplied from Ain Medicare Sdn.Bhd, Kota Bharu and Methyl Ethyl Ketone Peroxide (MEKP), (Andonox KP-9 brand) was supplied from Sweden. A company at Kedah, Malaysia was provided Bertam leaves. The Bertam fibers were extracted by mechanical decortication which is using a Fritsch Pulverisette mill. Figure 1(a) shows the mill. Pulverized fiber was sieved using Vibratory Sieve Shaker into three different sizes (<63, 63-250, and 250-500µm). The shaker sieve is shown in
Figure 1(b). Particle size analyzer was used to identify exactly size of fibers. Table 1 shows the comparisons fiber sizes between sieve shaker machine and particle size analyzer. The mould was prepared with dimension 30 cm x 22 cm x 0.5cm. The mould was built by wood with thickness 5mm. Before the mold would be opened, composites were left to cure for about 24 hours. After that, the composites were cut to standard sizes for the tests.

<table>
<thead>
<tr>
<th>Sieve shaker machine</th>
<th>Particle size analyzer</th>
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<tr>
<td>&lt;63 µm</td>
<td>15 µm</td>
</tr>
<tr>
<td>63-250 µm</td>
<td>120 µm</td>
</tr>
<tr>
<td>250-500 µm</td>
<td>284 µm</td>
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Water absorption test were performed as long-term immersion proceeding in seven days, in agreement with ASTM D570. Every cases was filled with two liter water and the specimens were weighted every day to show the increment weights. After 24 hours, one of the sample was removed and wiped off with a dry cloth and weighted immediately and the process was repeated for every sample for every 24 hours until 7 days. The percentage incerement was calculated by using equation (1) as follows:

\[
\text{Percentage of increment weight (\%)} = \frac{\text{wet weight (g)} - \text{conditioned weight (g)}}{\text{Conditioned weight (g)}} \times 100\%
\] (1)

Density was measured by using densitimeter (electronic densimeter MD 300S). Standard ASTM D 792 was used. The specimens with diamension 20 mm (length) x 10 mm (weight) were weight first.

RESULTS AND DISCUSSIONS

A water resistance of the composites is an important parameter mainly when a plant fiber is applied. Fig. 3 presents the water absorption profile of Bertam composites. The effects of size fiber are observed in this research. Fiber with 12µm size composites presents a mass gain of around 1.4% the lowest value than 120µm with 1.9% and biggest fiber size (280µm) has 5.1%. It is also observed that an increase fiber size, the corresponding water absorption percentage increases. This agrees with the observations Farias et al(2009) who reported that more bigger size of fibers, more easier water diffusion.

![Graph showing the percentage of water absorption vs particle size](image)

Fig. 2: Percentgae of water absorption versus fiber size.
The density values as shown in Figure 3 generally increasing as the particle fiber size increased. Composite with fiber size 15 µm has the lowest density than other size Bertam fiber composites. This is agreed with Dagwa et al. (2012), Husseiniyah et al. (2011) and Shehu (2014) which are the density increased when the content increased. However, the densities of fiber composites are lower than density of polyester. It was suggested that the situation occurred because of the pressure was given manually while did the composite and also voids are possible to be produced and more porosity.

**Fig. 3:** Variations of density with variations of fiber sizes.

**Conclusions:**

The less water absorption is obtained for composite prepared with 0 fiber and 15 µm fiber sizes. An increase of particle fiber sizes, the water absorption goes on increasing. As same with water absorption, the density of composite having 15 µm is less compared to others fiber sizes. The density curve shows that increase of particle fiber sizes, the increasing of density values. As conclusions, the fiber size 15 µm is the best size regarding water absorption and density tests.

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