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TENSILE STRENGTH OF ABACA STRANDS FROM SANGIHE TALAUD ISLANDS

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ABSTRACT

The study of abaca strands from Sangihe Talaud Islands North Sulawesi Indonesia has been developing for biocomposite materials. The aim of this research is to recognize abaca fiber's tensile strength, so that it could be prepared for biocomposite application. Average diameter of abaca fiber is 0.151 mm. The result of this research had given its maximum tensile strength of 189.24 MPa. It shows that abaca fiber is potential to be developed as alternative material in biocomposite.

Keywords: abaca fiber, tensile strength, sangihe Talaud Islands.

INTRODUCTION

Abaca (*Musa textilis Nee*) is a kind of Musaceae family, it is known well as manila hemp, pohon kofo or hote (Sangihe Talaud). Abaca as a producer of fiber actually been long-established in Indonesia, which before World War II by the Dutch colonialists until Indonesia's independence in the form of community plantation or plantation companies.

Regional development of abaca in Minahasa in 1853, then in Java, South Sumatra and Lampung in 1905, in the area of Besuki East Java in 1915, but all the results are less encouraging so that gradually plantation of abaca was replaced by other plantation crops (Nur, 1957).

After that, in 1925 in North Sumatra, also attempted the development of abaca, the results are better than before, but it did not last long, until 1961 acreage stay 404 ha with an average fiber productivity 695 kg/ha. Ultimately, abaca areas will gradually depleted replaced by other commodities (Dempsey, 1963).

Lately abaca began to demand back by farmers and private entrepreneurs and state enterprises because it promises a high income. Agribusiness abaca since their Poverty Program (Taskin) at the end of 1998. It is related to the opening of the market at home and abroad, especially Japan, America, Britain, and other European countries are in need of abaca fiber as raw material for paper money and other high-quality specialty papers such as paper and paper checks are included in other papers albeit inadequately, memiograph, tea bags, tissue, and others as well to textiles, geotextiles, and carpet (FAO 1996a, 1996b).

Indonesia is known in three clones popular abaca, namely Tangongon, Bangulanon, and Maguindanau, but all three are currently not easily recognizable as an accurate description is not there and does not get noticed by the competent authorities. In Sangihe-Talaud, North Sulawesi province, especially on the islands of Sangir Besar and Karakelang island, there are many types of abaca which allegedly came from the Philippines since many centuries ago. Retrieved 15 abaca accession of the two islands. A striking difference from each accession lies in the character of the color bar, color and shape of the heart, height and trunk diameter and strength "fiber" (Lucky-Setyo Budi, *et al*., 2004).

Natural fibers have many advantages when compared with other fibers. The advantages of natural fiber are: it can be degraded naturally (biodegradability), it has the characteristics of renewable, environmentally friendly, it has low density, and it has a specific strength and stiffness than the matrix. Thereby, natural fiber can improve its mechanical properties for composites application (Sergio N. Monteiro, 2005).

In Industrial application, fiber strength is one of the most important characteristics. Natural fibers include sisal (Li *et al*., 2008), flax (Zhang *et al*., 2013), ramie (Yu *et al*., 2014), bamboo (Takagi and Ichihara, 2004), and abaca (Liu *et al*., 2013) exhibit good strength and are thus suitable for fabrication of fiber–reinforced composites.

Abaca fiber reinforced composites have been used for under-floor protection of passengers Daimler AG vehicles (Knothe *et a*l., 2000). Importantly, abaca fibers satisfy the stringent quality requirements of road transportation, especially resistance to influences such as dampness, exposure to the elements, and stone strike (Bledzki *et al*., 2007). Understanding the unique physical and chemical properties of abaca fibers, and the structure-function relationship of the fibers, is critical to their effective utilization in industrial applications.

The aim of this study is to recognize the tensile properties of abaca fibers. SEM and tensile testing machine were used to measure diameter and to undertake fiber strength, respectively. The obtained structural which is combined with mechanical tests on the untreated abaca fibers, serve to guide the development of the surface modification processes of natural fibers for biocomposite applications.

EXPERIMENTAL METHOD

Abaca fibers were taken from Sangihe Talaud islands of North Sulawesi, Indonesia. The fibers were taken from the middle of aabaca tree as shown in Figure-1, then decomposed into fibers mechanically using fiber

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rendering engine. After that, the fibers were soaked in water for one week. Further it was dried naturally as shown in Figure-2.

Ten specimen of fibers sample was taken. Then the fiber's diameter was measured using SEM as in Figure-4. Then conducted using a tensile testing machine as shown in Figure-5. The data of test results were averaged.

Figure-1. Middle part of Abaca stem.

Figure-2. Drying Abaca fiber naturally.

Figure-3. Abaca fiber.

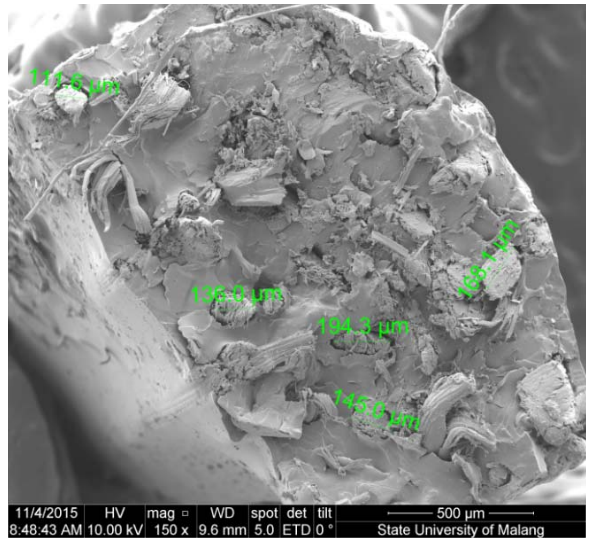

Figure-4. Measurement of Abaca fiber's diameter with SEM.

Figure-5. Tensile test of Abaca fiber.

RESULTS AND DISCUSSIONS

From the abaca fiber tensile test results obtained by the graph that represents some of the samples A, B and C is shown in Figure-6 to Figure-9. The results of measurements of the average diameter of abaca fiber is equal to 0.151 mm. Figure-6 shows the relationship strain versus fiber tensile force on the sample A. It can be seen that the fiber tensile force of 7.1 N to 7.8 N and the fluctuation of the strain of 2.6 to 2.9. While the relationship strain versus fiber tensile force on the sample B shown in Figure-7, also here seen that the maximum fiber tensile force of 9.2 N happens strain of 3.3. But in the B sample is not fluctuate strain.

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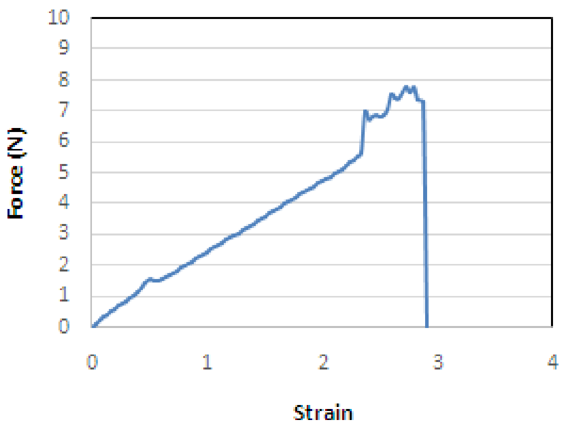

Figure-6. Force versus strain for sample A.

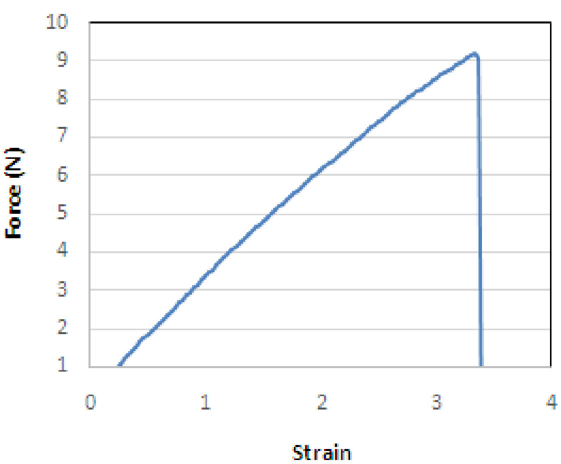

Figure-7. Force versus strain for sample B.

The relationship between tensile strength fiber to the strain in the sample C is shown in Figure-8. It can be seen that the maximum fiber tensile strength of 12.1 N occur strain of 3.5. The relationship between the strain of the tensile strength in all three samples A, B and C is shown in Figure-9. Here it appears that the maximum tensile strength of the fiber occur at 677 MPa and a strain of 3.5 occurred in the sample C. The tensile strength of the fiber in the sample B is equal to 513 3.3 MPa and strain. A sample produces fiber tensile strength of 434 MPa and a strain of 2.8. Overall samples were obtained an average tensile strength abaca fiber trunk without treatment (natural) amounted to 541 MPa.

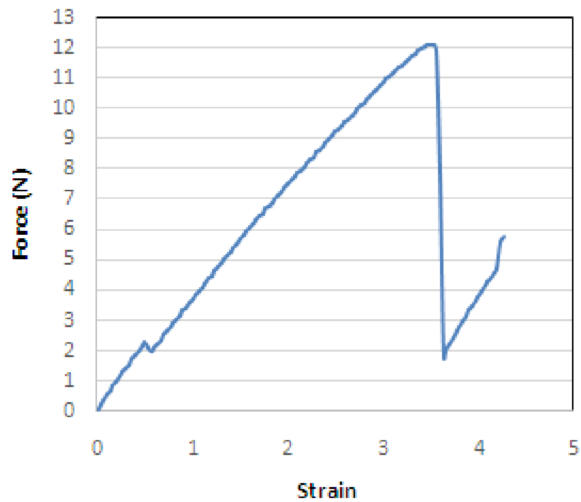

Figure-8. Force versus strain forsample C.

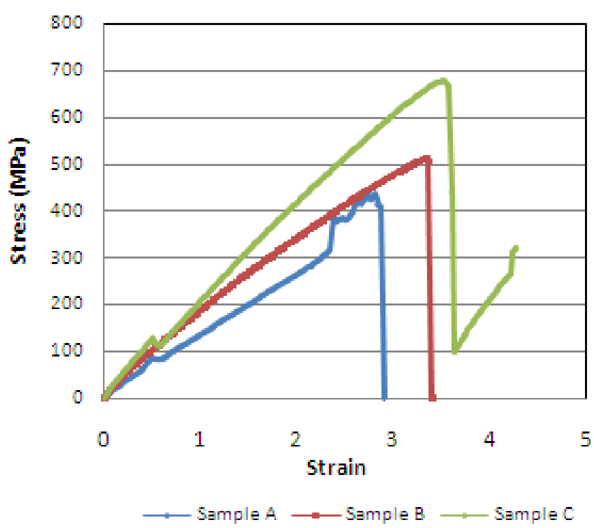

Figure-9. Tensile strength versus strain of sample A,B,C.

CONCLUSIONS

Based on the test results of the tensile strength of the untreated abaca fiber from Sangihe Talaud islands of North Sulawesi Indonesia can be concluded:

a) Tension force abaca fiber the stem average was 9.7 N and the strain average of 3.2.
b) The maximum tensile strength is of 677 MPa and tensile strength on average amounted to 541 MPa.

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