International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Correlation Between Tensile Test Specimen Surface Fault of Teki Grass (Cyperus Rotundus) Composite with Tensile Strength

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Abstract

This study aims to determine the correlation between composite tensile strength with surface photo of 3 tensile specimens fault. In this research teki grass (cyperus rotundus) used as fiber, this type of fiber is selected because teki is agricultural weeds that have not been utilized to the maximum, difficult to eradicate and often found in the open fields. The length of fiber used are 1 cm, 2 cm, and 3 cm with each tensile strength of 23,99 MPa, 30,10 MPa and 18,91 MPa. SEM photo result of composite fault surface with a fiber length of 2 cm and tensile strength of 30.10 MPa indicates that the fiber is broken and there is no cavity between the matrix and the fiber. It can be concluded that the bond between the matrix and fiber is so good that make the tensile strength becomes the highest compared to the other 2 specimens. Photo of a composite fault surface with a fiber length of 1 cm and a tensile strength of 23.99 MPa shows that the fiber is broken, but there is little cavity between the matrix and the fibers. It can be concluded that the bond between the matrix and the fiber is not that good so that the composite tensile strength is lower than the 2 cm fiber. Composite fault surface photo with a fiber length of 3 cm has tensile strength of 18.91 MPa and shows that there is an open cavity along the fibers, this cavity informs that bond between matrix and the fibers doesn't occur properly. Although from the photo shows that the fiber is broken, but the cavity still reduces the composite tensile strength to the lowest of 18.91 MPa.

Keywords: Photo SEM; Fault Surface; Composite; Tensile Strength.

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1. Introduction

Composites are structures on a macro or micro scale made of different materials, the characteristics still carried after the components are fully formed. Therefore always an interface between two materials, and the properties of these interfaces have a clear effect on the composite properties [1]. The use of composite materials is currently growing. Its use from simple thing such as home appliances to industrial sectors, both small and large scale industries [2]. In the USA the composite industry has grown 25 times since 1960, while the steel industry has grown only 1.5 times and the aluminum industry 4.5 times. By 2016 composite sales in the United States reach 8 billion dollars and by 2022 is expected to 10.6 billion dollars [3]. Synthetic fibers as the composite reinforcement are still the most widely used materials today. Globally the worldwide use of fiber by 2016 is 99 million tons, and synthetic fibers is on the firt rank with a percentage of 62.7% or nearly 63 million tonnes [4]. Among the various types of synthetic fibers, glass fiber is the most widely used as a composite reinforcement because it provides good strength and stiffness, impact resistance, chemical resistance, and thermal stability [5]. But the glass fiber itself has some disadvantages such as the price is quite expensive, can not decompose naturally, limited, and harmful to health. Therefore researchers have tried to find synthetic fiber replacers from natural fibers that have several advantages, which are easy to obtain, biodegradable, harmless to health, available in large quantities, and at low cost [6]. In this study the natural fiber is used from teki grass (cyperus rotundus), this type of fiber is selected because the teki is agricultural weeds that have not been utilized to the maximum, difficult to destroy and many found in open land. The grass will be used as a reinforcement on a composite tensile test specimen, then a tensile specimen will be photographed with SEM and analyzed.

2. Materials and Methods

The material used are fault of 3 composite specimens ASTM D638 - 02a tensile test results with fiber length 1 cm, 2 cm, and 3 cm. This fault will be photographed by SEM to observe correlation of the fault surface with composite tensile strength.

The method in this research is:

1. The specimen surface is cut and cleaned.
2. The specimen placed on the sample holder.
3. In order to specimen surface clearly for observed, the surface must be coated with a thin film made of gold, so that it can reflect electron beam.
4. After the coating is completed then it will be photographed by Scanning Electron Microscope (SEM) to observe the correlation between fault surface and composite tensile strength.

3. Result and Discussion

The teki grass (cyperus rotundus) is pulled from the ground, cleaned with water, soaked for one hour in the 5%

solution of NaOH to remove the sap (lignin) and the impurities that can reduce the bond quality between matrix and fibre, and dry in the shiny sun for 5 days to remove its liquid. After that the teki grass used in tensile test specimens manufacture with polyester resin BQTN 157 EX as the matrix. The test results showed the largest tensile strength is at the fiber length of 2 cm is 30.10 MPa, while the 1cm fiber length has tensile strength of 23.99 MPa and the smallest is 18.91 MPa on the fiber length of 3 cm.

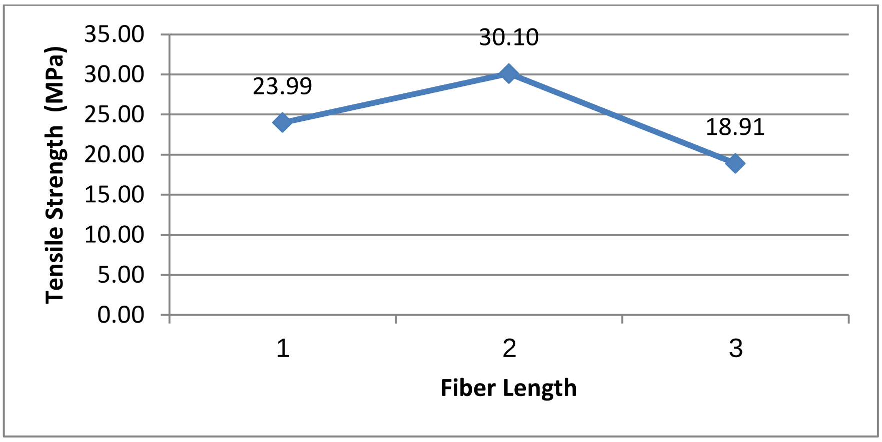

Figure 3.1: Tensile Strength Graphic

Most forces that work on composite are held up by the fibers, while the matrix serves as a protective and fiber fastener to work well. Therefore, the tensile strength is strongly influenced by the bond between the matrix and the fibers. If the matrix does not bind fibers properly then the fibers will be revoked, so that the tensile strength will decrease. When the matrix binds the fibers perfectly, then the fibers will break and the tensile strength is higher. Results of SEM images for 3 cm fiber length can be seen in Figure 3.2. From the photo it appears that there is a fairly open cavity along the fiber, this cavity shows that there isn't a perfect bond between the matrix and the fiber. So although from the photo the fiber is broken, but the cavity still reduces the composite tensile strength to be the lowest of 18.91 MPa.

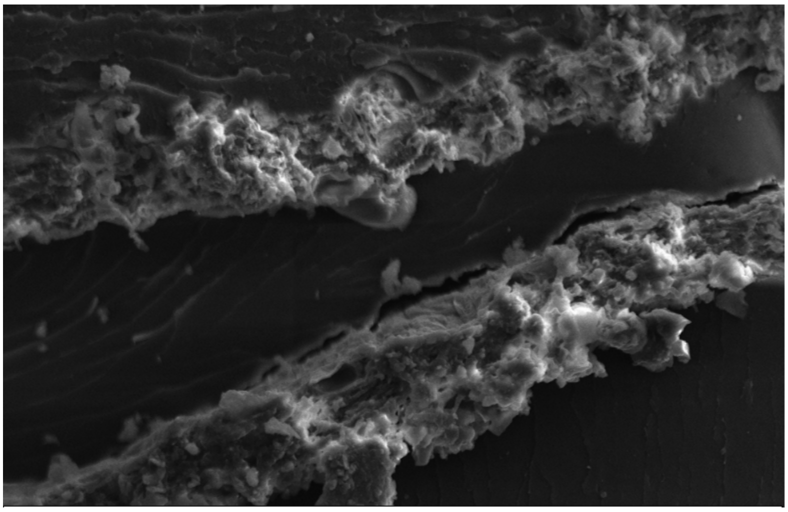

Figure 3.2: Surface of the composite fault of 3 cm fiber

This can be caused by dirt or sap from the teki grass (cyperus rotundus) that is still attached, so that the bonds between the fibers and the matrix does not occur properly. This dirt and sap may occur because the immersion time by NaOH is not maximum or the percentage of NaOH should be increased.

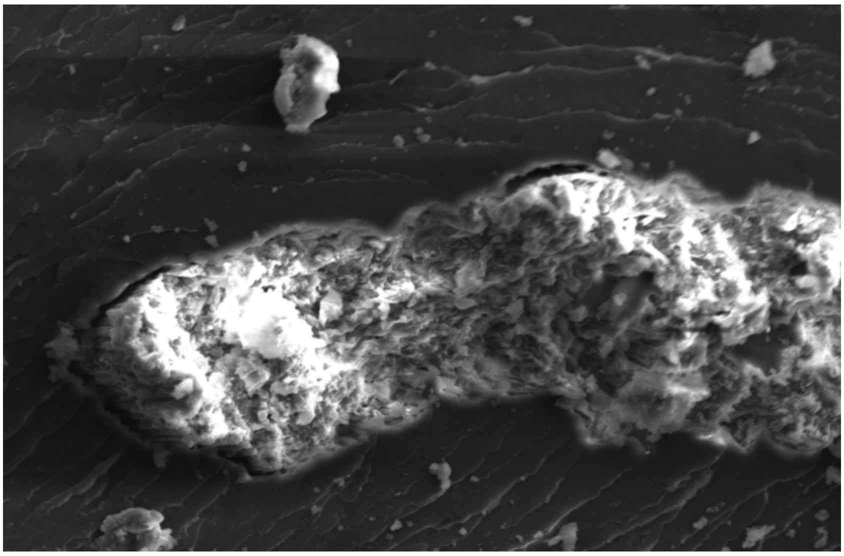

Figure 3.3: Composite fault surface of 1 cm fiber

Figure 3.3 is a composite fault surface photo of 1 cm fiber length with a tensile strength of 23.99 MPa. From the photo SEM can be seen that the fiber is broken, but there is still a cavity between the matrix and fiber although not as long as in Figure 3.2. So it can be concluded that composite tensile strength is higher than figure 3.2 but not maximum because the cavity is still formed. Figure 3.4 is photo of a composite fault surface of 2 cm fiber length and tensile strength of 30.10 MPa. From the SEM photo it can be seen that the fiber is broken and there is no cavity between the matrix and fiber as in Figures 3.2 and 3.3. So it can be concluded that the bond between the matrix and fiber occurs well so that the composite tensile strength becomes the highest compared with 2 other specimens.

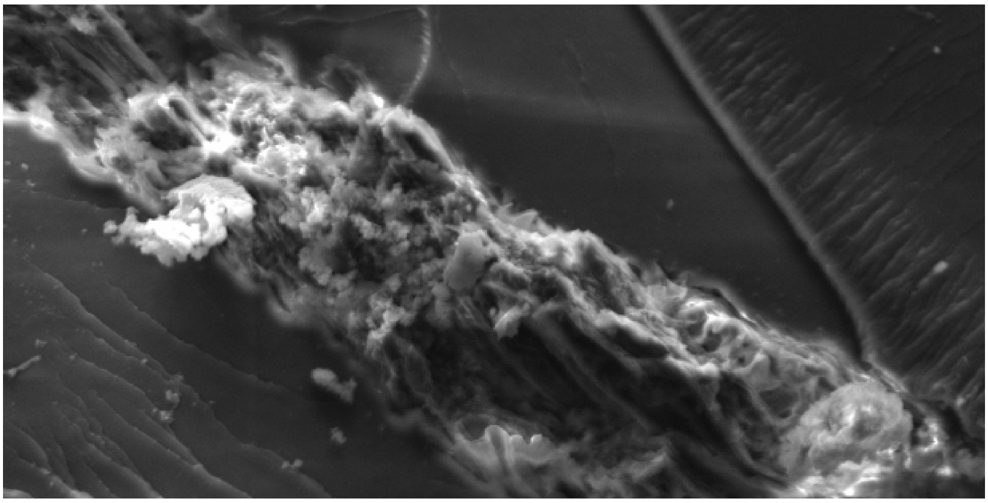

Figure 3.4: The surface of the composite fault of 2 cm fiber

4. Conclusion

1. The tensile strength is strongly influenced by the bond between the matrix and the fibers. If the matrix does not bind fibers properly then the fibers will be revoked, which means the fibers can not held the tensile forces that work on the composite, so the tensile strength will decrease. When the matrix binds the fibers perfectly, the fibers will break and make the tensile strength higher.

2. Cavities occur means the bond between the matrix and the fibers does not occur properly, although the fiber is broken but the tensile strength remains reduced.

3. The bonds between fibers and matrices does not occur properly because there is still dirt or sap from the fibers. This dirt and gum may still attached because the NaOH immersion time is not maximum or the percentage of NaOH should be increased.

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