THE EFFECT OF ALKALIZATION BY K2CO3 ON COMPOSITE REINFORCED BANANA FIBER AND RESIN POLYESTER MATRIX

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Abstrak

Penelitian yang akan dilakukan adalah bagaimana pengaruh perlakuan kimia terhadap serat batang pisang jika direndam dalam larutan K2CO3 dengan varian waktu perendaman 1, 3, 5, 7, 9 jam sebelum menganalisis bahan komposit serat batang pisang, dan pengujiannya. metode yang digunakan adalah metode tarik. Tujuan yang ingin dicapai melalui penelitian ini adalah menganalisis kekuatan tarik material komposit bertulang serat pinang setelah dilakukan pencampuran dengan larutan kimia K2CO3 dan menentukan waktu perlakuan kimia yang tepat untuk karakterisasi komposit bertulang serat batang pisang dan membuat batang pisang. material atau material komposit yang diperkuat serat sesuai standar ASTM D638 Tipe 1. Hasil uji tarik komposit serat pisang menunjukkan bahwa kekuatan tarik akhir komposit yang diberi perlakuan basa K2CO3 (2%) meningkat dibandingkan komposit yang tidak diberi perlakuan. Komposit dengan perlakuan konsentrasi K2CO3 2% dengan lama perendaman 9 jam mempunyai kuat tarik tertinggi sebesar 37,92 MPa dan modulus elastisitas tertinggi sebesar 15,29 Gpa. Hasil foto makro menunjukkan bahwa komposit yang tidak diberi perlakuan mempunyai banyak serat yang tertarik keluar dibandingkan dengan komposit yang diberi perlakuan konsentrasi basa.
Konsentrasi basa K2CO3 memperkuat ikatan antarmuka antara matriks dan serat.

Kata Kunci : serat batang pisang, larutan K2CO3, kekuatan tarik, foto makro

Abstract

The research to be carried out is how the effect of chemical treatment on banana stem fibers, if soaked in K2CO3 solution, with variants of soaking time 1, 3, 5, 7, 9 hours before analyzing banana stem fiber composite materials, and the test method used is the tensile method. The objectives to be achieved through this study are to analyze the tensile strength of areca nut fiber-reinforced composite materials after mixing with K2CO3 chemical solutions and to determine the right chemical treatment time for the characterization of banana stem fiber-reinforced composites and make banana stem fiber-reinforced composite materials or materials according to ASTM D638 Type 1 standards. The results of the tensile test of banana fiber composites showed that the final tensile strength of composites treated with alkaline K2CO3 (2%) increased compared to untreated composites. Composites with K2CO3 concentration treatment 2% with an immersion period of 9 hours have the highest tensile strength at 37.92 MPa and also the highest modulus of elasticity at 15.29 Gpa. Macro photo results showed that untreated composites had many pull-out fibers compared to composites treated with base concentrations.
The alkaline concentration of K2CO3 strengthens the interface bond between the matrix and the fibers.

Keywords : banana stem fiber, K2CO3 solution, tensile strength, macro photo

1. INTRODUCTION

In this modern era and technology is developing very fast, manufacturers are making a dialogue to create environmentally friendly, economical, suntainable and convenient products. Products with materials that are easy to find and of high quality and affordable are always researched and then developed, but the use of materials is still a lot of care because more and more products are affordable but the production process has a negative impact on society, especially the environment. The large use of materials that are difficult to recycle, the impact of waste from the production process is also the largest evaluation of the world industry, increasingly limited resources and lack of conservation efforts.

Many manufacturers also use composite materials or materials as the main material in the manufacture of their products, such as the shipyard, aircraft and automotive industries. Composites have the properties of low density, light weight, corrosion resistance, strength, resistance to wear and fatigue and economical. In addition, composites are easily formed into components.

Composites are materials formed from a combination of two or more materials that have stronger mechanical properties than their constituent materials. Composites consist of two parts, namely matrix as a binder or protective composite and filler as a composite filler. Alternative natural fibers are composite fillers for various polymer composites due to their advantages over synthetic fibers. Natural fiber is easily obtained at low prices, easy to process, low density, environmentally friendly, and biodegradable (Kusumastuti, 2009: 27).

The selection and use of composite materials in material engineering is due to problems that have an impact on the environment and sustainability of fiber sources. The presence of natural fibers (eg flax, hemp, sisal, abaca) can be used as a substitute for synthetic fibers, one solution to reduce the level of carbon dioxide
(CO2) in the air, fibers have the ability to be broken down by bacteria (biodegradability) and mechanical properties that can replace glass fibers. Various treatments of natural fibers can be used to strengthen various types of polymers, into a type of composite material. Natural fiber composites are a type of composite whose constituents use natural fibers or matrices, derived from natural materials. Matrix is a composite material that functions as a filler (Xanthos, 2005).

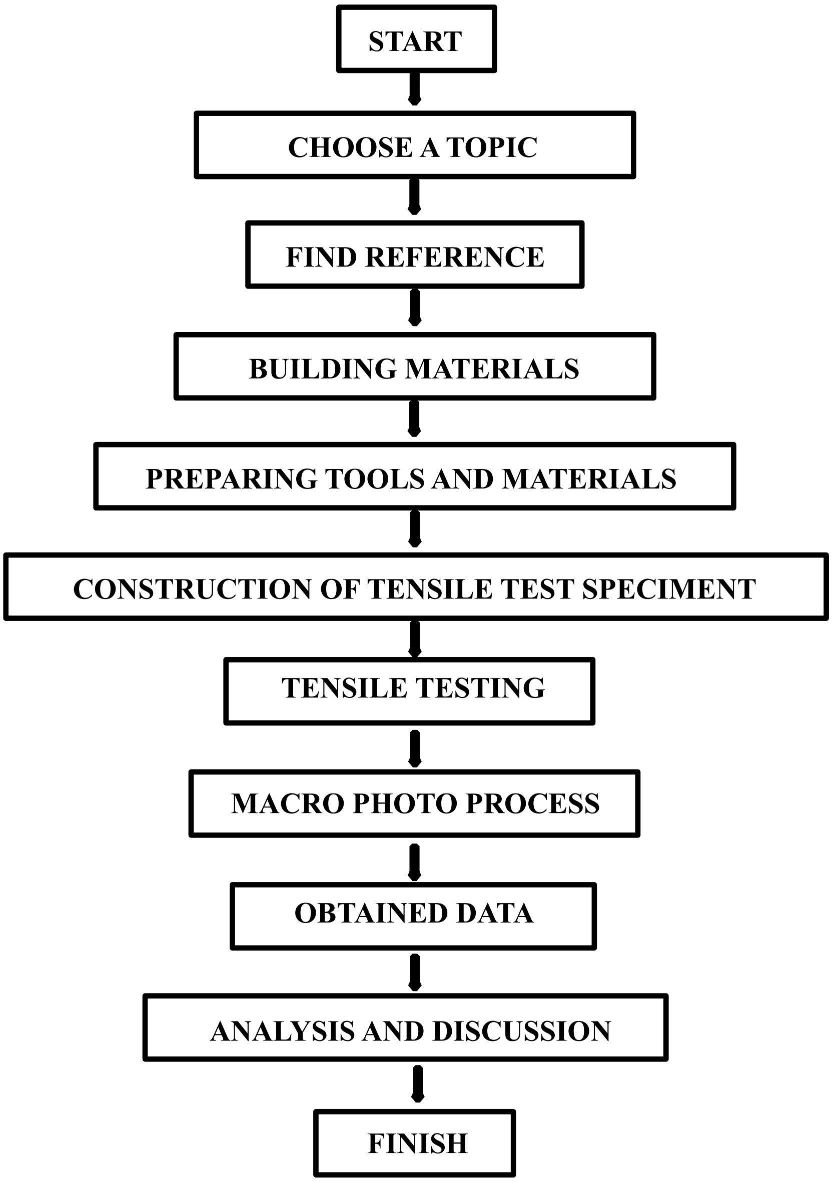
Natural fiber is fiber derived from nature such as fiber fiber, pineapple fiber, coconut fiber, and others. According to Chandrabakty (2011) there are several reasons for using natural fiber as composite reinforcement such as More environmentally friendly and easily biodegradable compared to synthetic fiber, The specific gravity of natural fiber is smaller, Has a better weight-modulus ratio than E-glass fiber, Natural fiber composites have higher acoustic damping power than E-glass fiber and carbon fiber composites, Natural fiber is more economical than glass fiber and carbon fiber.

Hidayat et al. (2015) have conducted research on the effect of adding taro starch on the mechanical properties and degradability of polypropylene and corn sugar mixed plastics. In this study, the addition of taro starch 3 was varied by 0 g, 9 g, 12 g, 15 g, and 18 g. The highest bending and tensile strength values were obtained from samples with the addition of 9 g taro starch, namely 37.44 N/mm2 and 5.19 N/mm2. The fastest degraded samples were samples with the addition of taro starch as much as 18 g, with an average degradation rate of 0.68% per day. The best material composition has not been obtained because the test strength values obtained are in different compositions.

In this study, banana stem fibers will be used as fillers that have gone through a soaking process using potassium carbonate (K2CO3), while the matrix used is polyester resin. This research uses one dimensional reinforcement method on the layout and direction of fibers. The test parameters used are mechanical properties, namely tensile strength.

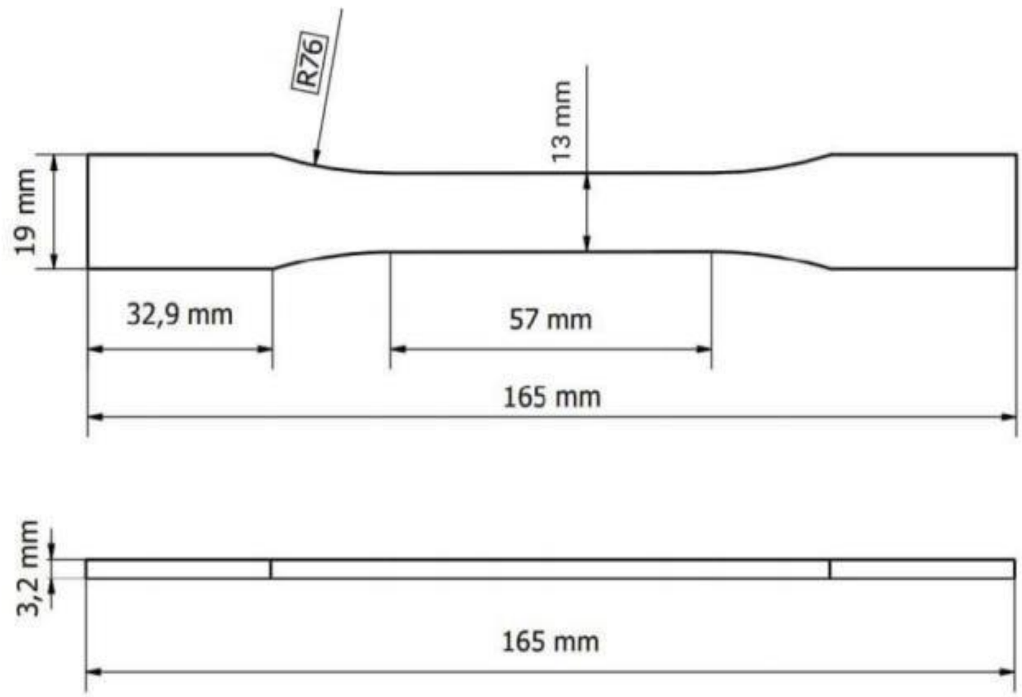
Banana stem fiber is a fiber that has better properties, cellulose content 63%64%, hemicellulose content 20%, lignin content 5%, average tensile strength 600 Mpa, average tensile modulus 17.85 GPa and increased fiber length around 30.9240.93 cm (Lokantara, 2007). The fundamental advantage possessed by natural fibers is that they are renewable and do not pollute the environment (Renreng, 2015).

2. METHOD



Picture 1. Research Flow

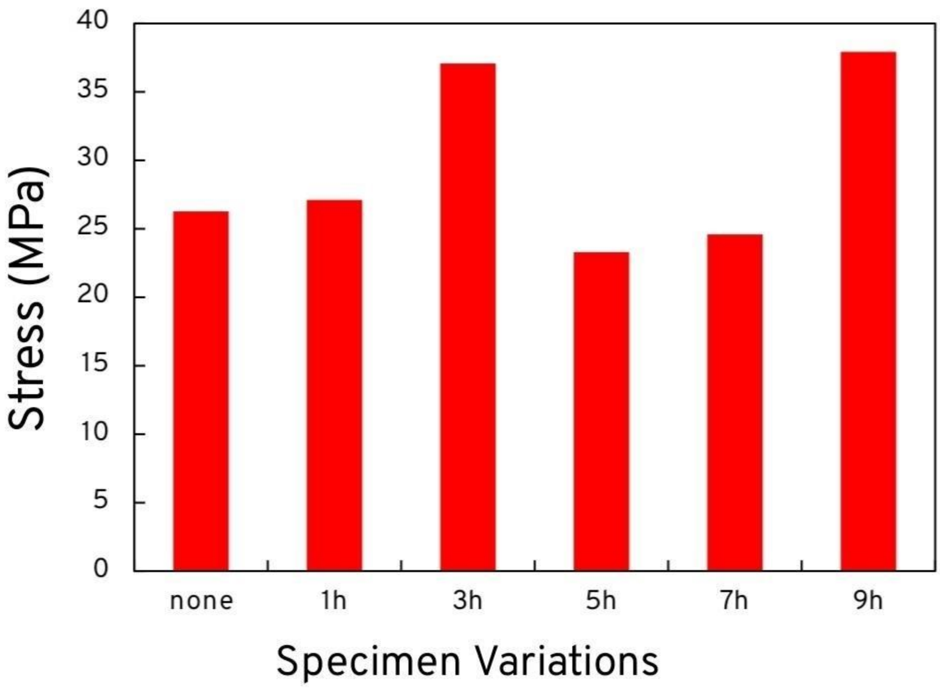
The design for the specimen mold is as shown in figure 2. The prints are designed using a computer and then made on the printed material according to the size in figure 3.2. The mold size is intentionally larger intended to be easily formed ASTM (American Society for testing and Materials Standart) D638 Type 1 standard tensile test specimens.



Picture 2. Tensile Test Speciment Dimensions Based on ASTM D638 TYPE 1 (Zameroski et al., 2020)

The place for testing on this tensile test is at the Mechanical Engineering Materials Laboratory, Vocational School, Gadjah Mada University, Jalan Grafika 2A, Yogyakarta, on April 8, 2023.

3. RESULT AND DISCUSSION

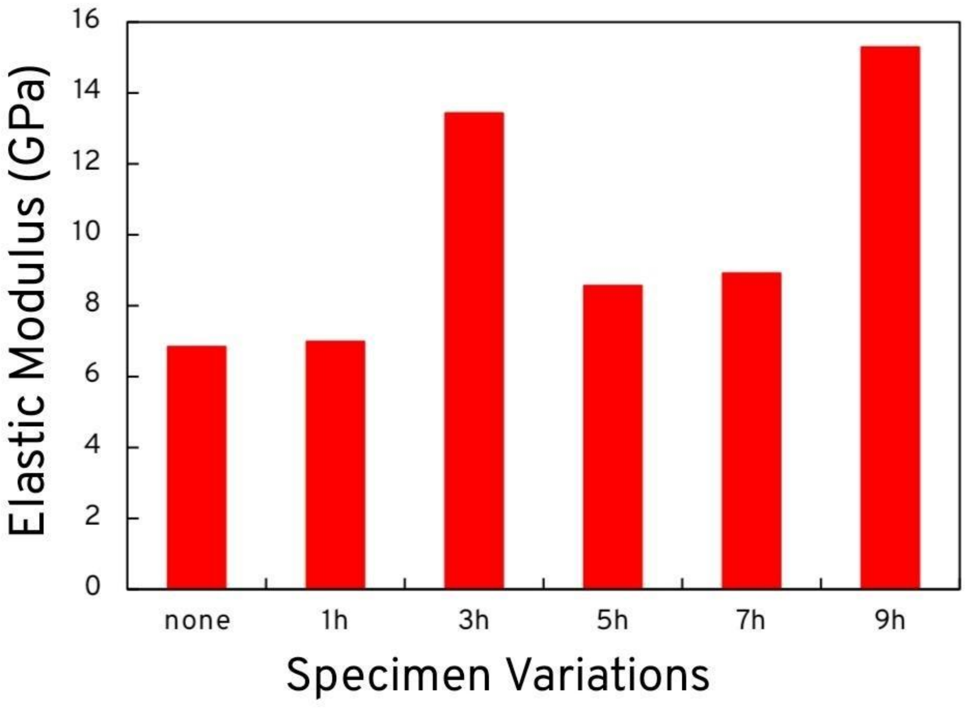


Picture 3. Tensile Stress

When tensile testing experiences problems, namely the slippery specimen surface, causing the release of specimens from the testing equipment. But it has got a solution by propping it up using cloth.

The tensile stress graph above shows an increase in stress value from the first specimen to the third specimen, a significant increase in stress value from the second specimen to the third specimen. Then experienced a decrease in stress value in the fourth specimen and increased again in the fifth specimen and sixth specimen. The lowest stress value is in the fourth specimen.

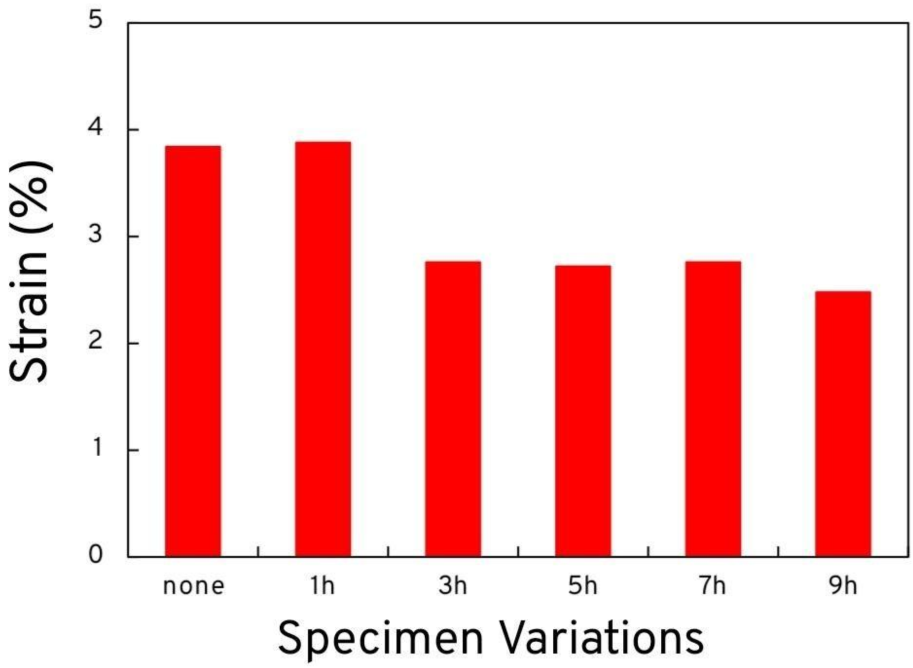
From Picture 3 above shows that composites reinforced by fibers with alkaline treatment have higher tensile strength compared to composites reinforced by fibers that are not alkaline-treated. This is because the alkaline-treated fibers are surface modified and interfacial adhesions are formed between fibers with a stronger matrix. In Graph 4.1 shown with alkaline treatment time 9h higher tensile strength compared to no treatment tensile stress value of 37.92 MPa. This is because with a long time alkaline treatment will form interfacial adhesion between fibers with a more perfect matrix.



Picture 4. Elastic Modulu

The elastic modulus graph above shows an increase in elastic modulus value from the first specimen to the third specimen, a significant increase in elastic modulus value from the second specimen to the third specimen. Then it decreases the elastic modulus value in the fourth specimen and increases again in the fifth specimen and sixth specimen. The lowest elastic modulus value is in the first specimen.

From Picture 4 it appears to show that the result of the modulus of elasticity is highest in the variation of alkaline treatment 9h compared to without alkaline treatment with a value of 15.29 Gpa. This is because it is directly proportional to the tensile stress, where the greater the tensile stress the greater the modulus of elasticity. With a long alkaline treatment, it can form so much adhesion of fibers with a matrix.



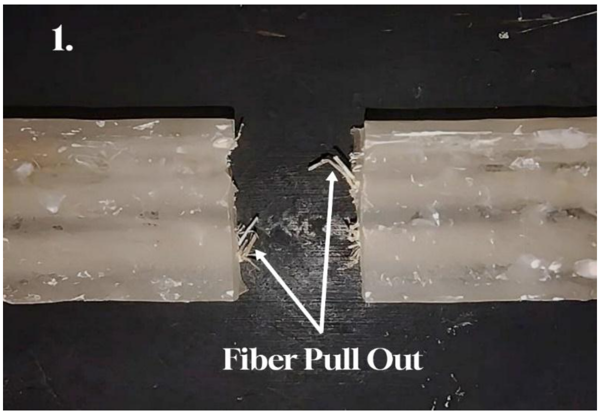
Picture 5. Strain

The strain graph above shows an increase in strain values in the second specimen and a significant decrease in strain values in the third to fourth specimens. Then experienced a slight increase in strain value in the fifth specimen and again decreased strain value in the sixth specimen. The value of the tlow strain is in the sixth specimen.

From Graph shows that the strain with those without alkaline treatment is higher than that with alkaline treatment soaking times of 1, 3, 5, 7, and 9h. This is because fibers that do not have a mixture of K2CO3 have higher mechanical strength so that the fibers are able to withstand loads up to a certain length compared to samples with alkaline treatment. In addition, the increase in alkaline treatment forms the fibers tend to be more rigid (brittle), thus making the fibers tend to break with low length.

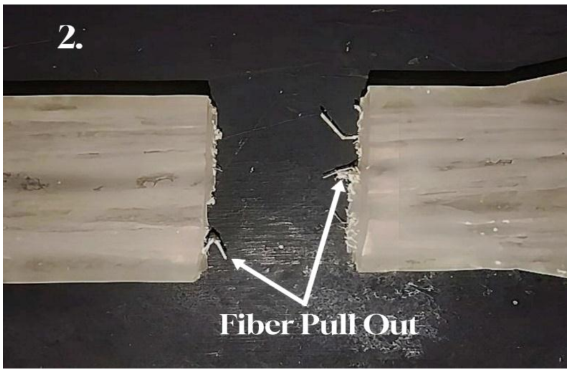
Observations from macro structure on tensile composite specimens concluded that the kind of the fracture is fiber pull out. Fiber pull out occurs due to the weakness of the interfacial bond strength between matrix and fiber. Macro picture of tensile test:

No Chemical Treatment



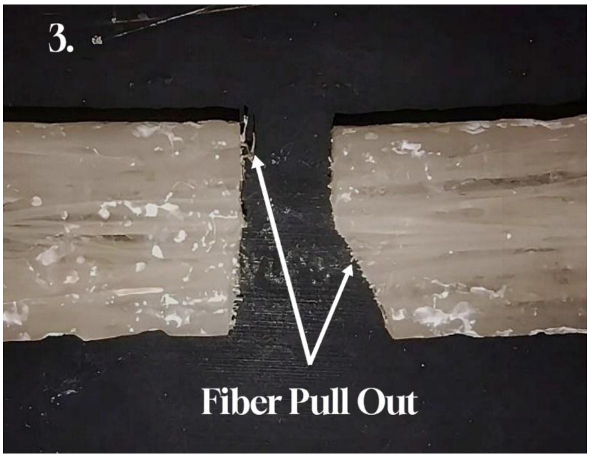
Picture 6. Macro picture of (1) 0% alkaline (K2C03) concentration.

With Chemical Treatment for 1 Hour



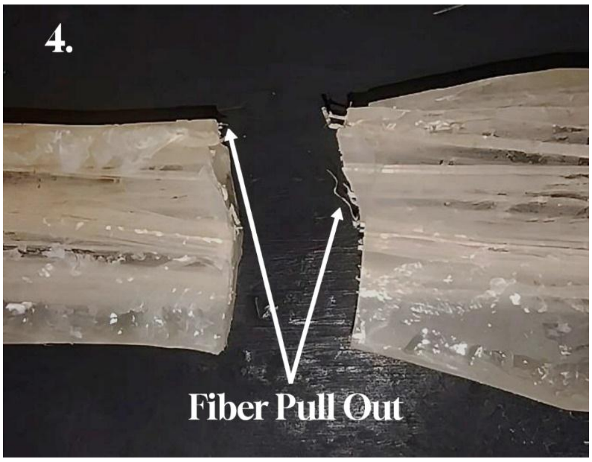
Picture 7. Macro picture of (2) 2% alkaline (K2C03) concentration.

With Chemical Treatment for 3 Hour



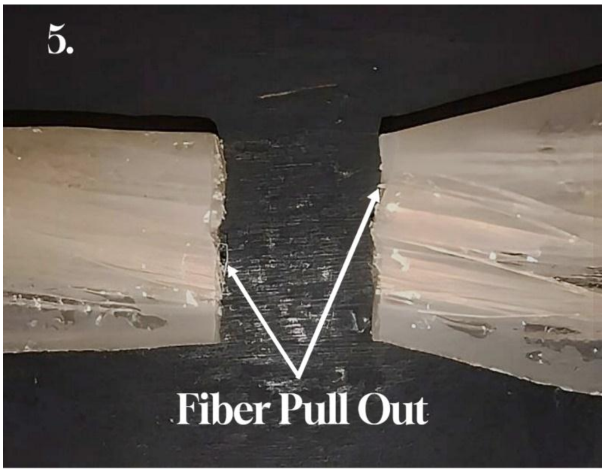
Picture 8. Macro picture of (3) 2% alkaline (K2C03) concentration.

With Chemical Treatment for 5 Hour



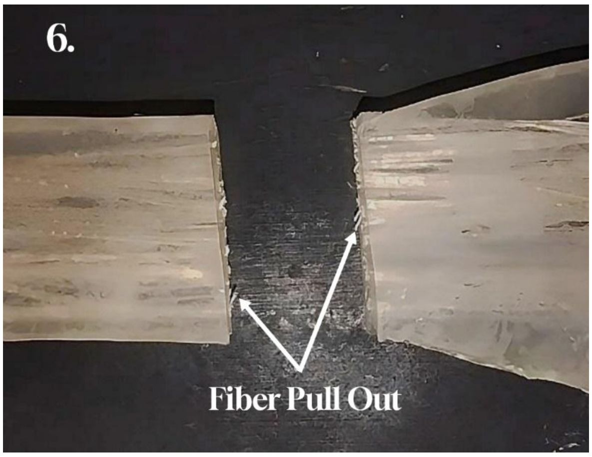
Picture 9. Macro picture of (4) 2% alkaline (K2C03) concentration.

With Chemical Treatment for 7 Hour



Picture 10. Macro picture of (5) 2% alkaline (K2C03) concentration.

With Chemical Treatment for 9 Hour



Picture 11. Macro picture of (6) 2% alkaline (K2C03) concentration.

From Picture 6 to 11 it can be concluded that the treated composite (K_2CO_3 concentration 2%) has few fibers drawn out due to the high bond strength of the interface between the matrix and the fibers. The results from the macro photo echo results from previous studies in which alkaline treatment can improve the strength of the interface bond between the matrix and fibers.

4. CLOSING

4.1 Conclusion

The results of the tensile test of banana fiber composites showed that the final tensile strength of composites treated with alkaline K_2CO_3 (2%) increased compared to untreated composites. Composites with K_2CO_3 concentration treatment 2% with an immersion period of 9 hours have the highest tensile strength at 37.92 MPa and also the highest modulus of elasticity at 15.29 Gpa. Macro photo results showed that untreated composites had many pull-out fibers compared to composites treated with base concentrations. The alkaline concentration of K_2CO_3 strengthens the interface bond between the matrix and the fibers.

4.2 Suggestion

Based on the results of the research that has been done, there needs to be further research on the length of soaking and become comparative data, the type of chemicals used so as to get more effective results in Tensile testing.

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