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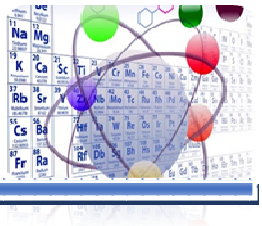

Biodegradation Study of Polymer Composites Reinforced by Areca catechu fibers (*Areca catechu L.)* and Snake plant fibers (*Sansevieria Trifasciata*)

Tasya Natalia Lumban Gaol* and Nurfajriani

Chemistry department, Fakultas Matematika dan Ilmu Pengetahuan Alam, State University of Medan

**Email :* tasyalbngaolmandala10@gmail.com

ABSTRACT

Natural fiber components are used for composite materials because they provide strength to the fibers. Composite materials commonly used are thermoset polymers, one of which is epoxy resin. Biodegradation aims to determine the rate of change in the mass of the specimen after 40 days of burial. The purpose of this study was to determine the effect of the volume fraction of the combination of areca catechu fibers and snake plant fibers on biodegradation properties. The method used in this research is the soil burial test, which is to determine the rate of polymer biodegradation in the soil. The best results in the biodegradation property test obtained the highest mass value of 30% variation obtained after burial for 40 days amounting to 13,417 grams, with the biodegradation test obtained a comparison before and after burial the mass value obtained did not experience a significant increase, this is because the composite material have no pores. or holes for the entry of microorganisms into the soil.

Keywords: composite, biodegradation, thermoset polymers,natural fiber

1. INTRODUCTION

Cocomintan with the development of technological and scientific transformations in the last period, forcing new ideas that are more varied in various fields, not only in the industrial and engineering fields. Composite materials are widely used in industries such as the automotive, marine and infrastructure industries. Composite materials are widely used in applications in the military field and are widely used in various industrial sectors, both large and small scale industries. Composites are composed of 2 types, namely synthetic composites and natural composites or natural fibers.[1,2] Natural fiber composites have the

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advantages of being strong, lightweight, economical, heat resistant, environmentally friendly and so on. The component of the fiber used for composite materials is cellulose, where cellulose provides strength to the fiber. Cellulose with the chemical formula $(C_6H_{10}O_5)n$ is an organic compound that does not dissolve in water and is a component of vegetable fiber. Composites are composed of a matrix which functions as an adhesive or binder as well as a filler protector (filler) from external damage and a filler which functions as a reinforcement.[4]

For the manufacture of composites, the materials used are polymeric materials, thermosetting polymers due to their advantages in temperature and chemicals and solvents due to their liquid state and low viscosity so they can wet the surface of the fiber. Epoxy resin is a chemical resin from the polymerization of epoxyda. These resins are known as thermoset resins which form strong molecular bonds in a structure between polymers.[5] Research is transformed by the use of natural fiber materials in various synthetic and natural matrices. This is intensified in the renewed fiber-reinforced composites because it relates to the widespread use of composites in various lives and the necessity of using materials that are inexpensive, lightweight, mechanically robust and non-corrosive, and solutions other than metals.[6]

So far, the use of areca nut shell fiber has been limited to leaves, stems and seeds. In the areca nut coir is wasted without being used or used so that it becomes waste. Waste is waste that manifests from a production stage something the environment does not want because it has no economic value.[7] Remember that the direct use of areca fiber is still minimal, so innovation is needed to use areca fiber, for example the creation of natural composites. Snack plant fiber (*Sansevieria trifasciata*) the natural fiber contained has the characteristics of being shiny, not brittle and long. In these leaves there are quite high chemical components of cellulose and lignin.[8] The component of the fiber used for composite materials is cellulose, where cellulose provides strength to the fiber. Biodegradation is defined as a stage of oxidation of organic compounds from microorganisms, waters, soil, or in wastewater treatment plants. Polymer degradation is a stage labeled the breakdown of the backbone of the main chain or the side bonds, namely the destruction of the properties of commercially useful polymers, for example reducing or increasing the relative molecular mass.[9-11]

Based on the description of the background above, this research was developed by varying the Areca Catechu fibers with Snake palnts fiber. In this research, fiber reinforcement from Areca Catechu fibers and Snake plants fiber will be used along with chemical treatment using NaOH in polymer composites with discontinued fiber orientation and biodegradation tests will be carried out by burying the composite in the soil for 40 days.

2. EXPERIMENTAL

2.1. Soil Sampling

In this research, the material used is a composite material with various combinations of fiber and Epoxy Bisphenol A resin with variations of 0%, 5%, 10%, 20%, 30% with a composite specimen size of 11x3 cm. The soil medium used was waste soil found at TPA Mandala, 1.5 kg of soil samples were used, each of which was put into a polybag using a small shovel. The composite specimen sample is then put into a polybag which has previously been filled with soil and backfilled with soil in a zig-zag pattern. The equipment used is digital scales, beaker glass, ruler, spatula, alcohol, aquadest, plastic.

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2.2. Research Procedure

This degradation stage uses the soil burial test method to determine the biodegradation rate of the composite in the soil. The biodegradation test is carried out using soil microorganisms to assist the degradation stage. The first stage is the polymer composite sample preparation. The composite sample is measured and weighed before burial with soil media. with the first stage is preparing the soil media, with the type of waste soil and dividing the soil into several polybags that have been prepared as much as 1.5 kg each, then inserting each sample into a polybag that has been filled with soil, burial is carried out until it sets and each - each poly bag is named with a variation of the composite sample. The samples were put in the soil and left in the open air and watered for 2 days so that the moisture content was sufficient. The samples were left for 40 days of burial in the soil, after 40 days the composite samples were removed from the treatment site and cleaned with distilled water and soaked in alcohol for 15 minutes so that the composite samples were free from the soil media. Then the sample is dried and the weight of the composite is weighed and a comparison of the sample weight is tested.

3. RESULTS AND DISCUSSION

3.1. Biodegradation Results

The purpose of the Biodegradation Test is to find the rate of change in the mass of the specimen after burial. Biodegradation is known as an alternative treatment for the oxidation of organic compounds from microorganisms, in soil, water, or wastewater treatment plants. Many native microorganisms in water and soil are capable of reducing hydrocarbon contamination. We can find out the stages of degradation by looking at the mass transformation of the specimen before and after being placed in the soil at a certain time. Table 2 can be seen the weight of the composite before burial and after burial with the volume fraction of fiber and mixing with epoxy resin after burial for 40 days.

Tabel 1. Composite Molecular Weight Test Data before burial and after burial

Variation	Before Burial (gram)	After Burial(gram)
0%	9,441	9,925
5%	10,221	10,575
10%	10,535	11,479
20%	11,259	12,359
30%	12,235	13,417

The highest mass value of the composite for the Biodegradation test before planting in the soil for 40 days was at a 30% variation of 12.235 grams found in the combination of fiber and resin, and after burial the composite specimen at a variation of 30% the mass of the composite did not increase significantly with magnitude 13.417 grams. With the addition of 30% areca nut fiber and mother-in-law's tongue resulted in an increase in mass manifested while the lowest weight value was found in a 100% pure solution of epoxy resin

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which was worth 9.925 grams. The fiber mass in the biodegradation test did not have much impact because the content of each test specimen resulted in a not significant increase in mass transformation before and after burial. Another reason for the impact on biodegradation tests is humidity and the amount of microbial decomposers in the soil. There is space between the samples during burial causing humidity and total microbes in different soils and in the composite samples there is no destruction (decomposition) caused by microorganisms in the soil, which is due to the dense composite samples and the absence of pores in the samples which can cause Microorganisms in the soil can enter into the composite material.

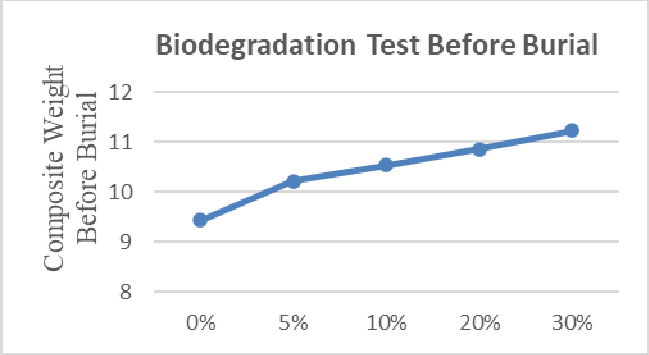

Figure 1. *Biodegradation Test Before Burial*

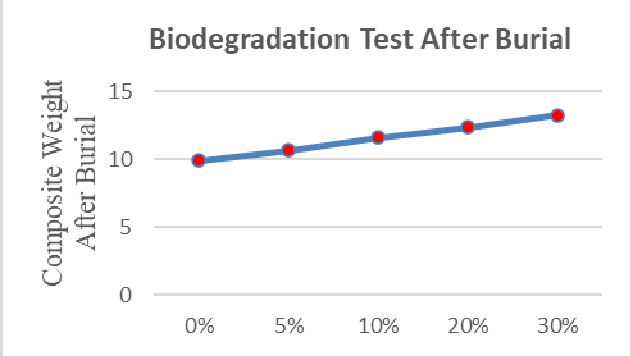

Figure 2. *Biodegradation Test After Burial*

Of the graph, it can be seen that the mass percentage of material increases with the burial time. The greatest mass percentage of degraded material occurred after being stockpiled for a period of 40 days. Proves that the higher the fiber used for mixing the volume of the resin, the greater the weight percentage of the biodegradation test on the composite material. In this research, composite materials are formed from natural constituents, namely areca nut skin fiber and mother-in-law's tongue fiber which are natural fibers and epoxy resin which is a filler in the manufacture of composites that can be used as additional components for ballistic helmet manufacturing. Where after the Biodegradation test was carried out with burial for 40 days there was no splitting or decomposition of the composite sample caused by the action of microorganisms in the soil. Microorganisms play a role in the biodegradation stage bacteria, fungi, and actinomycetes. There was no significant increase in the weight of the composite samples before burial and after burial.

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4. CONCLUSION

Of the results of the biodegradation test on the composite, the highest mass value was in the combination of fiber and resin with a variation of 30% after burial for 40 days, namely 13.417 grams, with a value that did not significantly increase with the mass before burial, due to the absence of a brittle composite (decomposes) caused by the action of microorganisms in the soil, because the composite material is very dense and there are no pores on the composite surface. So that the composite performance that manifests has good heat and corrosion resistance, is not easily decomposed by microorganisms, strong, and light compared to metal materials.

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