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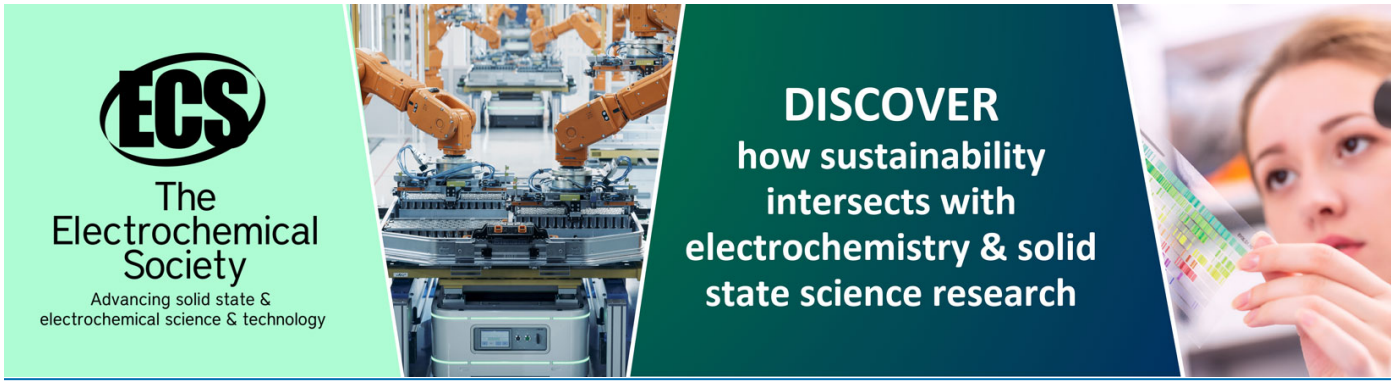

Utilization of natural crust as a raw material of plastic biodegradable in sustainable development equipment goals

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Abstract. East Java Province is the largest sugarcane producer in Indonesia, in year 2015 total sugar cane production in East Java Province reached 1,076,240 tons, in that year Malang Regency is area with the biggest production level that is 273,540 tons. Sugar cane production from Malang is sent to several sugar companies (PG) spread in East Java, such as: PG. Temple and PG. Krembung. Mill sugar mill capacity at PT. Perkebunan Nusantara X PG. Krembung, Sidoarjo which reached 2750 TCD (Ton Canes per Day) produces sludge waste that ranges from 250 kg/day and the waste is not yet utilized, but it is immediately discarded. Sap crust waste is one of the remaining sugar cane processing products derived from the process of thickening sap for sugar crystals. Based on the analysis test, the crust has 30.3% cellulose, 4.52% hemicellulose, and 11.25% lignin. Cellulose is contained in the waste of sap crust, has the potential to be utilized as raw material for making biodegradable plastic. Biodegradable plastic is made by inverse phase method. Making biodegradable plastic using a variation of waste of 2, 4 gr, 6 gr, 8 gr, and 10 gr. The addition of glycerol and sorbitol plasticizers with a ratio of 100: 0, 50:50, and 0: 100 will be formed on a 4 ml basis. The characterization of biodegradable plastic was carried out by using tensile strength and elongation tests. The results showed that on the composition of the 10 gram sap crust with the addition of plasticizer glycerol and sorbitol of 100: 0 has the highest tensile strength value of 8.08 Mpa and the highest elongation on the composition of the crust 2 gram with the addition of plasticizer glycerol and sorbitol of 0: 100 ie by 20.16%.

1. Preliminary

The use of many plastic can trigger environmental problems in the world, especially in Indonesia associated with plastic waste.

Plastic waste can pollute the environment because it takes hundreds of years to decompose or decompose perfectly and can produce dioxin when burned [1].

According to Jambeck [2], Indonesia ranks second in the world of plastic waste to the sea which reached 187.2 million tons after China reached 262.9 million tons. One way to reduce this plastic waste by recycling the plastic.

This recycled plastic also rises health issues that can be harmful regarding the level of security and health for the wearer [3].

Based on these problems, an eco-friendly plastic alternative that is derived from biodegradable materials in the environment, available in the wild in large quantities, can produce similar products with synthetic plastics [4].

The alternative offered on the manufacture of biodegradable plastics comes from the waste from the sugar industry. Sap crust waste is derived from the process of thickening sap for sugar crystals. In the

process sugar hardens and sticks in the channel or pipe. Based on the analysis test, the sap crust has 30.3% cellulose, 4.52% hemicellulose, and 11.25% lignin. Cellulose is contained in the sap crust, has the potential to be utilized as a material for making biodegradable plastic.

The manufacture of biodegradable plastics has various methods depending on the physical and chemical properties of the raw materials used. In this study, the method used is a phase inverse technique, is by evaporating the solvent that has been printed on the plate glass. Based on other research, to improve the mechanical properties of biodegradable plastic added plasticizer. Research on biodegradable film with the addition of glycerol as a plasticizer in pineapple pulp shows that glycerol is able to change the biodegradable properties of film into more plastic [5]. The addition of plasticizers to biodegradable films serves to reduce the film's fragility, increase moisture permeability and improve plastic properties [6].

Sintaria [7] conducted a research based on *Eucheuma cottonii* seaweed waste showed that tapioca can be used as a filler in paper making so that the paper surface is smoother. Tapioca can be used as a filler in the cavities of biodegradable films, thereby reducing the pores and homogenizing the biodegradable film [8]. The addition of tapioca is expected to improve the biodegradable properties of films from cellulosic materials.

This research was conducted to know the utilization of sludge waste from sugar industry as plastic biodegradable. The results of this study are expected to overcome the degradable plastic waste and produce a new biodegradable plastic that has superior properties.

2. Research methods

In this research the raw materials used are sap crust waste obtained from sugar industry PT. PG Krembung National Estate, Sidoarjo. Conducted pre-treatment of the sap with the distilled water as much as 100 ml put into beaker glass. Heating and stirring at 60°C for 30 minutes. Next, mashed and sieved with a size of 100 mesh and then in the oven to dry.

Prepared an isolated sap crust, then heating the mixture of raw materials, tapioca flour, and distilled water at 60-70°C using a magnetic stirrer for 60 minutes. Add glycerol and sorbitol as per treatment and stirring for 30 minutes. It was then removed and printed on a glass plate and dried at 50°C for 5 hours. Bioplastics are ready to be analyzed and tested for their mechanical and biodegradability characteristics.

3. Result and discussion

3.1. Tensile strength of plastic biodegradable

Biodegradable plastic samples were made from the utilization of waste of sap palm with variation of composition 2 gr, 4 gr, 6 gr, 8 gr, and 10 gr.

The addition of glycerol and sorbitol as plasticizers to improve the elasticity of biodegradable plastic samples in the ratio of 100: 0, 50:50, and 0: 100 based 4 ml.

The following is a visual appearance of biodegradable plastic in this study which can be seen in Figures 1, 2, 3, 4, and 5.

(a) (b) (c)

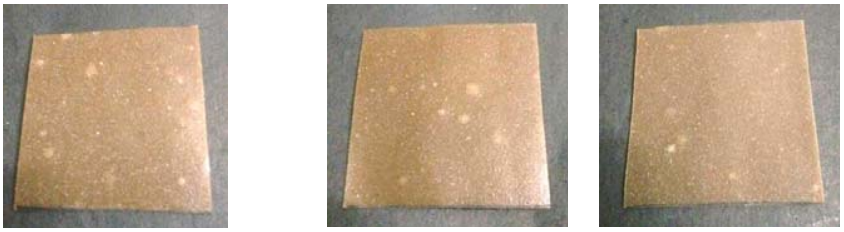
Figure 1. Samples with Addition of 2 grams of Nira Crust and Comparison of Plasticizer Glycerol and Sorbitol (a) 100:0 (b) 50:50 (c) 0:100

(a) (b) (c)

Figure 2. Samples with Addition of 4 grams of Nira Crust and Comparison of Plasticizer Glycerol and Sorbitol (a) 100:0 (b) 50:50 (c) 0:100

(a) (b) (c)

Figure 3. Samples with Addition of 6 grams Nira Crust and Comparison of Plasticizer Glycerol and Sorbitol (a) 100:0 (b) 50:50 (c) 0:100



(a) (b) (c)

Figure 4. Samples with Addition of 8 grams Nira Crust and Comparison of Plasticizer Glycerol and Sorbitol (a) 100:0 (b) 50:50 (c) 0:100

(a) (b) (c)

Figure 5. Samples with Addition of 10 grams Nira Crust and Comparison Plasticizer Glycerol and Sorbitol (a) 100:0 (b) 50:50 (c) 0:100

Visual appearance of biodegradable plastic that is formed increasingly brownish. This is influenced because the addition of pineapple crust of 2 grams still looks whitish change colour along with the increasing composition of the powder crust and peak at 10 gram brownish sample.

In addition, in some samples there are white spots or bubbles formed. This may affect the results of tensile strength and elongation tests because the samples formed are not homogeneous. In this study, 4 grams of tapioca was used as a filler in the biodegradable cavity of the film, thus reducing the pores and

homogenizing the biodegradable film. However, it is suspected that the cellulose in the powdered crust of nira and tapioca is not able to bind properly so that the resulting film visually from some samples appears not homogeneous.

The results of biodegradable plastics will be made biodegradable plastic feasibility test so that biodegradable plastic is expected to be applied directly as a fruit wrapper (edible coating). The feasibility test will be performed such as tensile strength test, elongation (elasticity), and biodegradation test to determine the level of plastic degradation so that can be described by microorganisms in nature.

Measurement of tensile strength using Universal Testing Machine (UTM). The tensile strength of biodegradable plastic obtained from the measurement results is between 0.58 MPa to 8.08 MPa. Figure 6 shows the results of a biodegradable plastic tensile strength test.

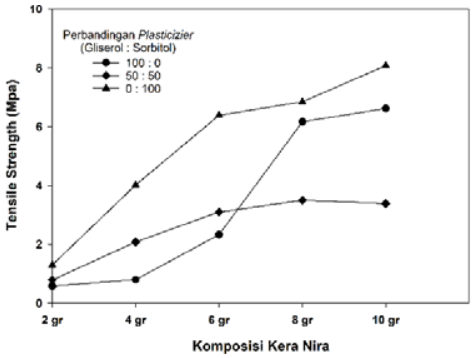


Figure 6. Strong tensile strength test result biodegradable

Based on figure 6, it can be seen the addition of pineapple crust that contains 30.3% cellulose play an active role to increase the value of tensile strength of biodegradable plastic. Judging from the composition added, in the comparison of plasticizers 100: 0, 50:50, and 0: 100 there is an increase in tensile strength of the powder composition of 2 gram to 10 grams.

Cellulose characteristics are strong and hard because cellulose structures can be arranged regularly and form crystalline regions [9, 10]. The crystalline region is an area formed with a very orderly chain arrangement.

Compared with SNI plastic standards, the magnitude of tensile strength reaches 24.7-302 MPa and biodegradable plastic type plastic lactic acid poly (PLA) [11] which reaches 2050 Mpa. The magnitude of tensile strength of biodegradable plastic produced in this study is 8.08 Mpa is in accordance with the standard used by SNI plastics, but not in accordance with the standards used in biodegradable plastic type lactic acid poly (PLA).

3.2. Elongation of plastic biodegradable

The percentage of elongation (elongation) was obtained by comparing the length of elongation with the initial length of the sample after the tensile test. Elongation of biodegradable plastic obtained from intermediate measurements 7.84% to 20.16%. Figure 7 shows the result of an elongation plastic biodegradable.

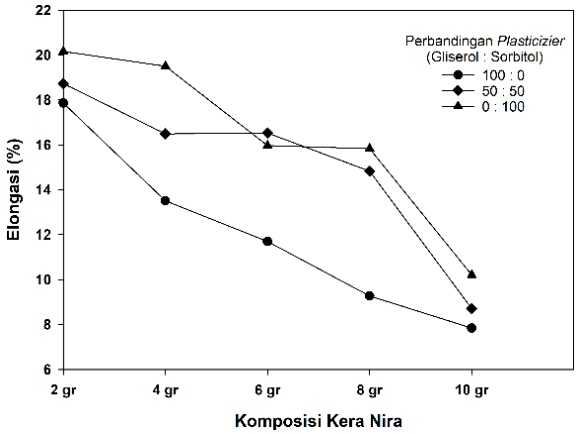


Figure 7. Plastic elongation test results biodegradable

Percent length (elongation) is very important to know, because it can help to know the plastic level. Biodegradable films, the higher the percent value of elongation, the more plastic, the lower will be fragile [12]. Based on figure 7, it can be seen on the plasticizer ratio of 100: 0, 50:50, and 0: 100 there is a decrease in elasticity due to the increased composition of pineapple filament crust. Addition of the composition of the powder of the sap crust increased, causing the plasticizer glycerol and sorbitol on a 4 ml basis cannot reduce the molecular bonds in cellulose and cannot break the long chain so that the resulting biodegradable film becomes less plastic (elastic).

When compared to the standard plastic SNI percent extension reaches 21% -202% and plastic plastics biodegradable type lactic acid poly (PLA) [11] which reaches 9%. The percentage of plastic biodegradable extension generated in this study is 20.16% not in accordance with the standards used by SNI plastics, but in accordance with standard plastic biodegradable plastic type lactic acid poly (PLA).

4. Conclusions

The results showed that the addition of the composition of the sap crust was directly proportional to the increase in tensile strength value, but the elongation value decreased. In this study, biodegradable plastic samples with the highest tensile strength value of 8.08 Mpa with a composition of 10 grams of sap crust with a ratio of glycerol and sorbitol 100: 0 and the highest elongation of 20.16% with a composition of 2 grams of crust with the ratio of glycerol and sorbitol 0: 100.

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