THE EFFECT OF THE ENVIRONMENT ON BIODEGRADATION TIME OF BIODEGRADABLE PLASTIC FROM RUBBER CASSAVA STARCH WITH USING SORBITOL AND GLYCEROL PLASTICIZER

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Abstract. Rubber cassava is a plant that underutilized due to toxic HCN that contained in it, it has very high carbohydrate content that is 98.47% sorubber cassava can be as basic material of manufacturing of biodegradable plastic. This research was did to determine the effect of composition of sorbitol and glycerol plasticizer and obtained an optimum composition with using addition materials such as chitosan, acetic acid, and aquadest. Utillization of Sorbitoland glycerol plasticizer varied with comparation of 40% fromweight starch with 5% of each sample interval. The results obtained in the form of an edible film of biodegradable plastic that tested mechanical properties and biodegradation test for 60 days. Based on analysis of the tensile strength test, biodegradable plastics obtained from rubbercassavastarch that optimum namely with composition of 25% sorbitol and 15% glycerol by0.00613 Mpa. Based on analysis of elongation test, biodegradable plastics obtainedfrom rubbercassavastarch that optimum namely with composition of 15% sorbitol and 25% glycerol by 5%.Based on analysis of biodegradation test showed that biodegradable plastic with optimum condition that tested with the land medium has been degraded perfectly for 60 days while with the river, sea, wells, rain,brackish, and sterilled water media can be degraded just needed longer time for plastic can degraded perfectly

Keywords: Glycerol,Biodegradable Plastic, Rubber Cassava, Sorbitol, Biodegradation

I. INTRODUCTION

Plastic is a material that is often used in everyday life. The plastic that using now is a synthetic plastic. This synthetic plastic made from petroleum, natural gas and coal. Synthetic plastic need decades or even hundreds of years times for bacterial decomposition to decompose plastic waste so it causes the buildup of plastic waste that can aggravate conditions such as flooding, especially in urban areas. Biodegradable plastic is plastic that can be decomposed by microorganisms naturally back into compounds that environmentally friendly [4].

Synthetic plastics made from petroleum, natural gas, or coal while biodegradable plastics made from renewable materials. they are compounds found in plants such as cellulose, collagen, casein, proteins or lipids that contained in the animal [7].

Indonesia as a rich country of natural resources (agricultural products) potentially to produce a variety of biopolymer materials, so that the biodegradable plastic packaging technologies have good prospects [1].

Starch is a polymer type that naturally produced by types plants of tubers, corn, and rice [4]. One of starch that can be the material of the manufacture of biodegradable plastic is a rubber cassava (Manihot glazovii). Rubber cassava is a plant that underutilized due to toxic HCN that contained in it and existance of this plant is overflow.

Rubber cassava is very potentially to be used as the basic material for the manufacture of biodegradable plastic because rubber cassava has a very high carbohydrate content namely 98.47% as compared with other types of tubers [6].

One of the factor that take effect in the manufacture of biodegradable plastics is plasticizer. This plasticizer is a nonvolatile substance that is added into the plastic formula will affect on the mechanical and physical properties of plastic that formed because it will reduce the intermolecular properties and lowing internal hydrogen bonds. Plasticizer

has a high boiling point and the addition of plasticizer needed to resolve fragile properties of plastic that caused by extensive of intermolecular force. [3] stated that the plasticizer frequently used namely glycerol and sorbitol.

As for the problem of this research is the addition of sorbitol and glycerol plasticizer that used. In this the manufacture of biodegradable plastics is not yet known how the effect of the addition of the sorbitol and glycerol plasticizer and the amount of sorbitol and glycerol plasticizer which is optimum to be added in the manufacture of biodegradable plastics from rubber cassava starch and environmental influences on the decomposition of biodegradable plastics on biodegradation time.

II. RESEARCH METHOD

This research was done using two stages, namely the manufacture of plastics and result of biodegradable plastics analysis.

A. Materials and Tools

Tools and materials that used in this research are the rubber cassava starch, sorbitol, glycerol, acetic acid, chitosan, distilled water, measuring cups, hotplate, beaker, stirrer, thermometer, plate glass, analytical balance, tensile test equipment, and mortar.

B. Procedures of Experiment

1. Manufacturing of Rubber Cassava Starch

Setting up rubber cassava as much as 4 kg and cleaned. Rubber cassava that have been cleaned, shredded it and separated liquid cassava from pulp. Liquid that separated from the pulp then deposited it during one day and one night. The sediment of starch that obtained, dried it by the sun. Furthermore, starch that obtained sieved it to obtain a homogeneous size namely 60 mesh.Pembuatan Plastik Biodegradable

Providing a solution of starch, chitosan, acetic acid, sorbitol and glycerol. Manufacturing of starch solution made by mixing 5 grams of rubber cassava starch and 50 ml of distilled water. Each composition that used dissolved into 50 ml of distilled water. Then stir until starch suspension to 50 ml. Mixing the ingredients to a formula consisting of 50 ml suspension of starch, chitosan 1 gram, 1 ml of acetic acid and the composition ratio of sorbitol and glycerol (0-40% at intervals of 5%). Furthermore, the material is mixed and then heated at a temperature of 70-80C and stirred with a speed of 300 rpm. Stirring is carried out to produce a viscous solution such as glue and homogeneous.

2. Molding of Biodegradable Plastic

Starch solution that has thickened (has gelatinization) are molded with using glass plates. glass plate made of glass rectangular that in its edges have given a tape or glue to hold out a solution and to make it easier to release from the plastic mold. Furthermore, the solution poured on a glass plate and leveled by using plastic plat in accordance with the desired thickness. Plastic that has been molded then allowed to stand at a temperature chamber for 1-2 days to dry.

C. Analysis ofBiodegradable Plastic

1. Tensile Strength Test

The tensile strength shows the size of the resilience of biodegradable plastic, which is the maximum acceptable strain samples, while the percent elongation is the maximum length change experienced plastic during plastic when did the tensile strength test, which means until samples to tear [8].

2. Biodegradation Test

Biodegradation test was conducted to determine the time that needed the sample to be degraded plastic film. The selected test bidegradadation is controlling soil microorganisms as maid degradation process or called that soil-burial technique test [7].

Biodegradation test is done by placing a plastic with measuring 2 cm x 1 cm into a container of containing soil, river water, sterile water, brackish water, well water, rain water and sea water. Biodegradation of plastics are tested using soil media done 2 times the test is tested by putting plastic on the soil and planted in the ground. Biodegradable plastics are tested using water media did two tests, namely at an open container (aerobic) and in a sealed container (anaerobic). Then did it observations on plastic until plastic degraded.

III. RESULT and DISCUSSION

Based on the analysis of tensile strength test showed that the optimum composition is obtained namely with composition of 25% sorbitol dan15% glycerol amounted to 0.00613 MPa whereas the elongation test analysis (percent elongation) it can be seen that the optimum composition that obtained namely with composition of 15 % sorbitol and 25% glycerol by 5%. Both plastic did analysis biodegradation test in soil media (above and in the soil) and the water (river water, wells, rain, sea, brackish, and sterile in aerobic and anaerobic conditions) for 60 days.

A. Analysis of Biodegradation Test

Biodegradable plastics with optimum composition on tensile strength test namelywith composition of 25% sorbitol and 15% glycerol and the optimum composition in the elongation test is namelywith composition of 15% sorbitol and 25% glycerol have been biodegradation tested with using soils and water media.

Sample	Before	After	
		Above soil	In the soil
25 % Sorbitol + 15% glycerol			

15 % Sorbitol + 25% glycerol	

Fig 1. Results of biodegradation test of biodegradable plastic with soil media

Biodegradation test with using soil did 2 tested namely sample take above soil and in the soil for 60 days. Plastic sample in the soil has degraded perfectly while plastic sample that take above soil just few that degraded for 60 days and tend to suffer due to the mushrooming because microbes in the soil contained more than on the soil.Biodegradable plastic tested with using water media namely river, wells, rain, sea, brackish and sterilled water for 60 days in aerobic and anaerobic conditions.

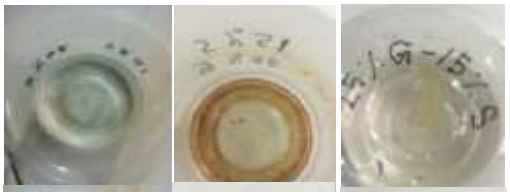
Sample	Before	After	
		Aerob	Anaerob
25 % Sorbitol + 15% glycerol			
15 % Sorbitol + 25% glycerol			

Fig 2. Results of biodegradation test of biodegradable plastic with river water media

Sample	Before	After	
		Aerob	Anaerob
25 % Sorbitol + 15% glycerol)			
15 % Sorbitol + 25% glycerol)			

Fig 3. Results of biodegradation test of biodegradable plastic with wells water media

Plastic sample that tested using river and wells water have biodegraded perfectly for 60 days. These can be happen because in river and wells water there are a lot of microbes compared with other water media and there is no nitrogen compound in river and wells water so decompotition plastic process can be faster [4].

Sample	Before	After	
		Aerob	Anaerob
25 % Sorbitol + 15% glycerol			
15 % Sorbitol + 25% glycerol			

Fig 4. Results of biodegradation test of biodegradable plastic with sea water media

Sample	Before	After	
		Aerob	Anaerob
25 % Sorbitol + 15% glycerol			
15 % Sorbitol + 25% glycerol			

Fig 5. Results of biodegradation test of biodegradable plastic with rain water media

Sample	Before	After	
		Aerob	Anaerob
25 % Sorbitol + 15% glycerol			
15 % Sorbitol + 25% glycerol			

Fig 6. Results of biodegradation test of biodegradable plastic with brackish water media

In the sea, rain and brackish water media, plastic samples tested just decomposed partially, because the microbes contained in those water is less than the river and well water. In addition, the sea and brackish water, their salinity levels higher than other water. Salinity affects the growth of microbes. Salinity of brackish water namely 1-30% and salinity of sea waternamely 30-35%[9]. Sea and brackish water temperature is usually around 25-30 C. Bacteria normally grow at these temperatures one of which is Bacillus sp [2]. The bacteria can not survive in saline conditions above 10% so that the sea and brackish water media , microbes contained in those water and at a certain temperature can not survive so that decomposition plastic process will be longer.

In the rain water media, the process of decomposition of biodegradable plastics for longer than the river and well water because there are dangerous chemical ingredients contained in rain water due to pollution from industries such as sulfuric acid, nitric acid and other acid compounds. In addition, there is also carbon in the form of light ash (fly ash) from the volcano [5]. Those condition can cause bacterial growth to be slow so that decomposition of biodegradable plastics for longer because of the number of microorganisms contained in the water decreases.

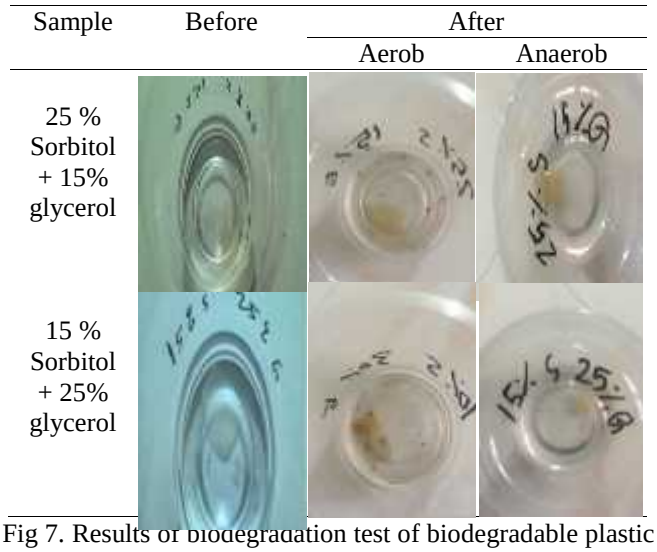


Fig 7. Results of biodegradation test of biodegradable plastic with sterilled water media

In the sterilled water, biodegradable plastic not yet degraded and needed longer times to biodegradable plastic can degraded perfectly because in the sterilled water very little microbe contained in it.

Aerob and anaerob conditions also affect the decomposition of biodegradable plastics. In aerob conditions, biodegradation processes run faster marked with biodegradable plastic that tested decomposed faster than in anaerob conditions. This can happen because in aerob conditions, microbes contained in the open air is higher than anaerob conditions (less air).

IV. CONCLUSION

From the research that has been done can be concluded that the variations in the concentration of sorbitol and glycerol plasticizer affects the mechanical properties of biodegradable plastic namely the tensile strength, percent elongation and chemical properties such as biodegrability. The optimum conditions for tensile strength values of biodegradable plastic from rubber cassava startch namely 0.00613 MPa (25% sorbitol and 15% glycerol), while the optimum conditions for percent elongation value namely 5% (15% sorbitol and 25% glycerol).

Environment (water and soil) affect the time of decomposition of biodegradable plastic. Decomposition of biodegradable plastics with the soil media degraded faster than the water media. River and well water media decomposes more quickly than with other water media and decomposition of biodegradable plastics in aerobic conditions decomposes faster than in anaerobic conditions.

ACKNOWLEGMENT

The authors give thank you to all parties who helped in this research. Utterance thanks also to technician laboratory has helped contributing in this research. Hopefully this research usefull for the other researchers.

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