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Analysis of Bio Pellet Process based on Mass Balance

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Abstract

As a bio-fuel, the bio pellet is popular as an alternative for replacing firewood for cooking. The potential of bio pellet as a bio-fuel produced from cassava skin becomes the focus of this study. The purpose is to determine the process and composition of bio pellet based on mass balance. The material was collected from several fermented cassava industries located in Jember Regency and Yogyakarta Special Region. The flow of this study includes material collection, preparation, drying, and calorie measurement, and proximate analysis. The cassava skin used in this study was stemmmed from "tape" industries. The results showed that the composition of bio pellet materials from cassava skin and tubers was 60.9% to 39.3%. It was found that the process resulted in 17.72% bio pellet.

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Keywords: cassava skin; bio pellet; mass balance

1. Introduction

Bio pellet is an alternative bio-fuel that is made from by product biomass, especially from fermented cassava, called "tape". The advantages of this material are abundant, inexpensive and classified as renewable energy source. Nevertheless, it has problem such as low energy density (Saptohadi, 2006). The direct use of biomass without processing can cause problem of respiration from carbon monoxide, sulphur dioxide and particulates properties

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(Yamada, *et al.*, 2005)

Bio pellet have solid form, it is shaped in a small size. It is processed through a combination of high compression and temperature. Biomass is converted into bio pellet as an activity of waste treatment at cassava agroindustry. There are other bio pellets as processed from Jatropha oilcake, (Wahyuni, et al., 2006). Previous studies showed that bio pellet manufacture using cassava agro-industry waste was being investigated as a potential alternative renewable fuel.

"Tape" industries yield waste that containing high carbon content such as cassava skin, stem and leaf. The leaf and stem of cassava are a yield of cassava plant, while the cassava skin is a waste of "industry of "tape", modified cassava flour (MOCAF) and others. Waste of cassava skin is potential to be transformed into bio pellet as a bio-fuel. Therefore this study is directed to model process of cassava waste into bio pellet. The goal is to analyze the bio pellet processing with is efficient using mass balance technique.

The object of this study is cassava skin as tested using chemical reagents for proximate analysis. The analysis method is proximate analysis and calorie measurement. The equipment used including hammer mill, printing machine and mass balance. Location of the study was in Jember Regency. The process included cassava skin washing, drying, flouring, printing, and drying.

2. Material and Method

Cassava tube is a potential source of carbohydrate. Figure 1 shows there are two parts of cassava that able to be used as biopellet which are tuber and skin. Utilization of cassava tubers is varied ranging from the feed, textiles, pharmaceuticals and chemical industry. Utilization of cassava skin component is merely used as animal feed or disposal.

Cassava skin is a waste that stems from the fermented cassava industry. Utilization of cassava skin as raw material for making bio pellet is an alternative to increase the added value of cassava skin. Bio pellet made from cassava skin can be used to substitute the use of briquettes and fire wood that are used to be utilized for cooking.

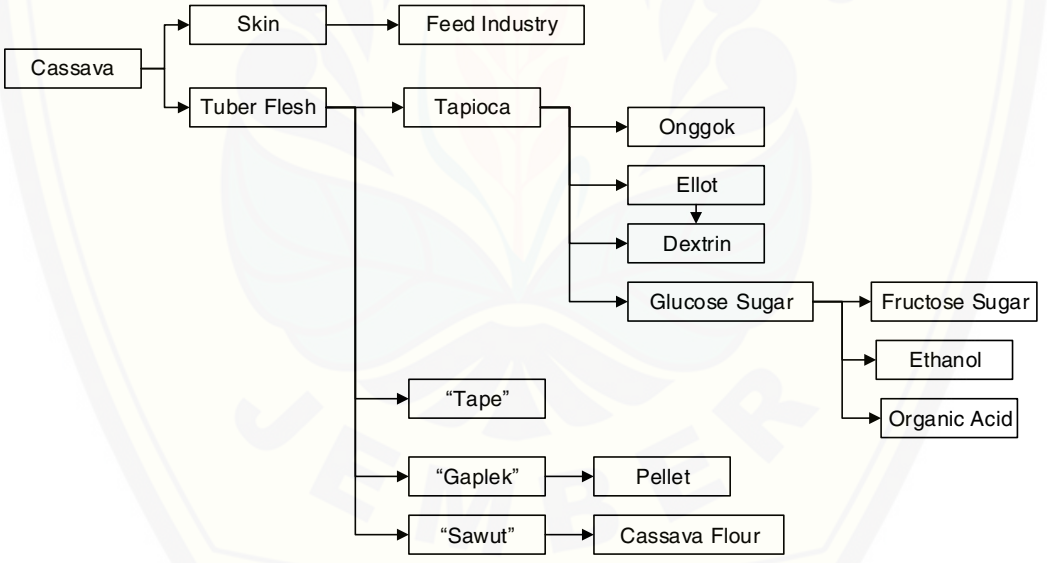

Fig. 1. Cassava Industry Tree (source: BPPT, 2008)

Waste generated from the tape process that is not used on the stripping raw material. Skin, the base of the bulb and the bulb was broken (rot, black spot and hard) is the part that is not utilized in the industrial tape. Tape waste industry fractionated to see the percentage of existing components and can be used. The waste product fractionation results found that there are two major components of the waste were observed. The composition of industrial wastes such as skin tape cassava and tubers with the percentage of each component among others, 60.9% and 39.3%. Tape industrial waste used as raw material for the manufacture of biopellet is cassava, while cassava tubers can not be

utilized due to the lower calorific value than calorific value cassava skin. Components of industrial waste tape consist of cassava tubers and skin can be seen in Fig. 2.

Fig. 2. Component of waste of "tape" (fermented cassava) industry, left to right: white skin, brown skin, hump

Waste of cassava skin is generally a mixture between the skin and pieces culled tubers. Sortation is necessary to separate the cassava tubers and skin. This is continued by the washing process to remove impurities such as soil. Drying of cassava skin is sunray drying for 3 days consecutively. Dried material then is crushed using a hammer mill. The yield is a flour that is stored in plastic bag to cover from humidity and keep from the damage. Bio pellet the is made by mixing flour with hot water at a ratio 1: 1.77. This mixture is then molded using a molder with diameter of 1.3 cm. Wet pellet are dried using the sunray to get a maximum moisture content of 10%. The complete bio pellet process is depicted in Fig. 3.

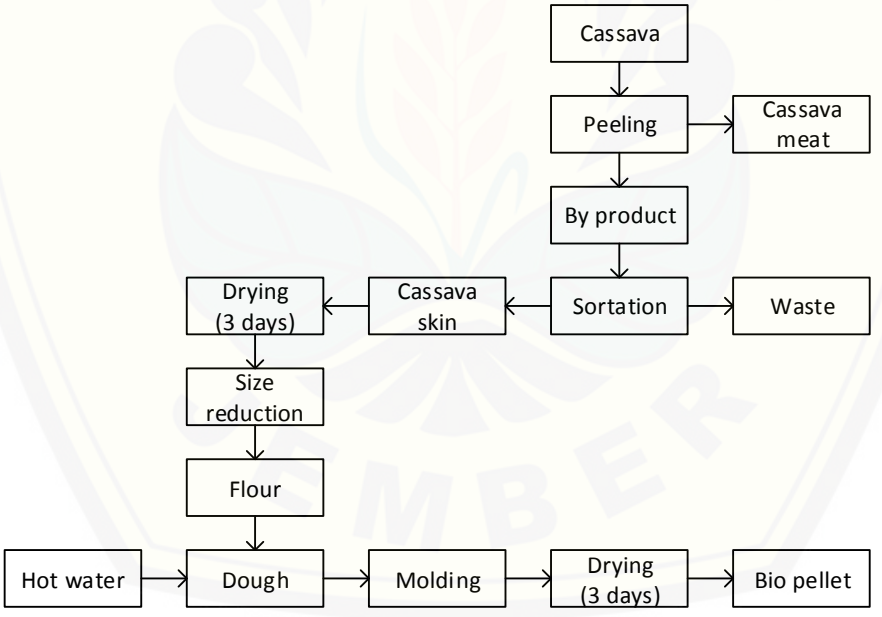

Fig. 3. Process Flow Chart Bio pellet

Mass balance calculations are aimed to measure how much bio pellet obtained from cassava skin used. Bio pellet yield calculations will be used as the basis for the economic feasibility test if bio pellets industry. Mass balance calculations are presented in Table 1.

Table 1. Mass balance of bio pellet process

Process	Material in	material out
Stripping	1000 g cassava	a. tuber 855,3 g b. by product 140,5 g
Sorting	By product 140,5 g	a. Tuber pole 55,24 g b. skin 83.82 g
Drying	Skin 83,82 g	*1. Dried skin 17,72 g* *2. Water (gas) 66,10 g*
Milling	Dried Skin 17,72 g	Flour 17,72 g
Mixing	Flour 17,72 g Water 31,36 g	Dough 49,08 g
Forming	Dough 49,08 g	Wet pellet 49,08 g
Drying	Wet Pellet 49,089 g	1. Dried Pellet 17,08 g 2. Water (gas) 32,90 g

Based on the above table, it was found that the waste generated from 'tape" industries will get dried cassava skin as amount of 17.72% waste. This means that within 100 kilograms cassava skin will be gained 17.7 kg of dry cassava skin that can be used as raw material for making bio pellet.

Conclusions

The "tape' industry yields 3 components, namely white, brown skin and tubers of cassava. The waste of this industry has a potential to be used as raw material for making bio pellet that sufficiently contain high calories value of 15715.19 J / g as can be yielded from cassava skin to bio pellet at a rate of 17.7% per kilogram used.

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