

ENERGY UTILIZATION TECHNOLOGY OF AGRICULTURE AND FORESTRY WASTE

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Abstract-*The increasing of fossil energy consumption and will be limited of fossil energy source, cause important to develop alternative energy. One of alternative energy is energy from biomass waste, like agriculture and forestry waste. Those biomass wastes contain cellulose, hemicellulose and lignin. The utilization technology of biomass waste could be done by thermochemical and biochemical process. Direct combustion, gasification, conversion to solid fuel and esterification are the thermochemical process, that produce heat supply generator, flammable gas, solid fuel and diesel fuel. Anaerobic digestion and ethanol fermentation are the biochemical conversion, that produce methane gas and ethanol. The energy bioconversion technology to convert ethanol from biomass waste are pretreatment, hydrolysis, fermentation, distillation and dehydration.*

Key word-*Agriculture and forestry waste, direct combustion, gasification, conversion to solid, anaerobic digestion, ethanol fermentation*

INTRODUCTION

In the recent years, the energy consumption in Indonesia was increased significantly. This condition has to seriously attract attention, consider with the energy fossil source will be limited. With that prediction, it is a fortune to develop another energy alternative to change of the energy fossil. One of the alternative energy that has to develop is energy from biomass waste, like agriculture and forestry wastes.

The concept lies within the cascading utilization of biomass in order that biomass resources are utilized to their full potential. The aim is to first utilize biomass as raw material and product, use it as fuel after it deteriorates, and repeat recycling it gradually from higher to lower quality, thereby saving biomass resources. There are two main methods to utilize biomass, i.e. the material utilization method and the energy utilization method. For the energy utilization of biomass, it is necessary to convert the biomass resources into easily accessible energy such as electricity, heat and transport fuel. The biomass energy utilization can be broadly divided into thermo-chemical utilization and biochemical utilization.

The former deals with causing chemical reaction via heat, and the latter obtains useful substances as energy via biological actions.

AGRICULTURE AND FOREST WASTE

The agriculture and forestry waste are content of major lignocellulosic material. Garotte et.al. were reported compilation of lignocellulosic waste material of different hardwoods, softwood and agriculture residue. The hardwoods contain 39-54% cellulose, 14-37% hemicelluloses and 17-30% lignin. The softwoods contain 41-50% cellulose, 11-27% hemicelluloses and 20-30% lignin. The composition of agriculture residues are diverse widely.

ENERGY UTILIZATION TECHNOLOGY OF BIOMASS WASTE

The agriculture and forestry biomass waste energy utilization can be broadly divided into thermo chemical conversion, extraction conversion and biological conversion. The thermo chemical conversion deal with causing chemical reaction via heat. Extraction

conversion is a physically process and biological conversion useful substance as energy via reaction. The typical of technologies available with agriculture and forestry biomass waste energy utilization is shown in figure 1

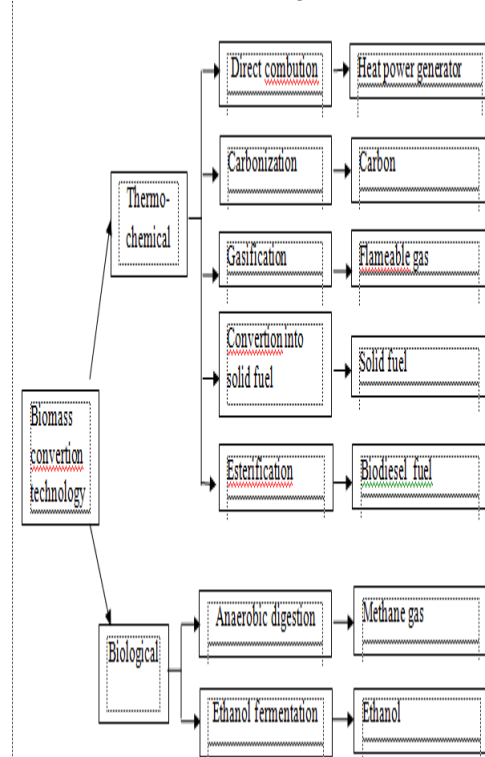


Figure 1. Energy utilization technology of biomass

Direct combustion

Direct combustion is the most common and basic technology involving the extraction of thermo energy from direct combustion of ligneous or herbaceous biomass. This is a major way of energy utilization especially in developing countries. In addition, the heat generated during the process can also be used to create steam for power generation. Although direct combustion is already a technology widely used, the issue concerning technical development for better and efficient usage needs to be addressed.

Carbonization

The carbonization technology has long been used as a method of turning

ligneous waste, unused materials, etc into high calorie substances. By heating and decomposing pyrolytically under oxidant-free condition, an efficient solid substnsces containing high level of carbon can be obtained. In developing countries this is widely use along with direct combustion and anaerobic digestion

Gasification

The gasification is used to decompose the biomass waste, first by heating then reduce the molecule level before using the final product as flammable gas or as raw material that synthesize with liquid fuels. When biomass waste is heated in oxygen deficient, environmental thermal decomposition usually take place and flammable gas, tar and coal are produced. The variable process control such as adding steam, the level of oxygen added and quick-heating is called gasification control. The composition of the product depends on the condition given, though the main constituents are hydrogen, methane, carbon monoxide and carbon dioxide.

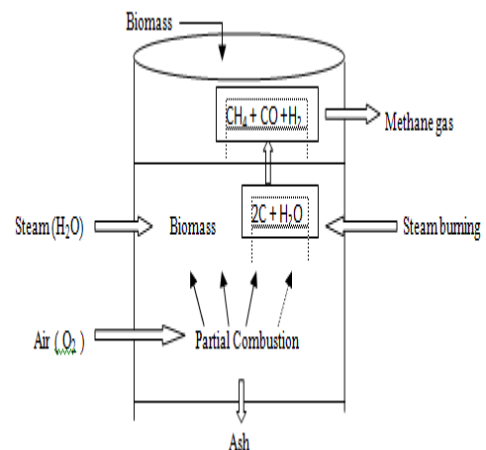


Figure 2 Example of the Structure of Gasification tank

Conversion into solid fuel

Through this technology fuel is created by first compressing biomass waste meal or mixture of biomass meal and coal after heating at 100-150 °C, followed by solidifying the substance by utilizing the adhesive nature of lignin. The pellet produced are convenient for

fluidity and portability, and serves as excellent fuel due to their dry nature which allows easy ignition and combustion.

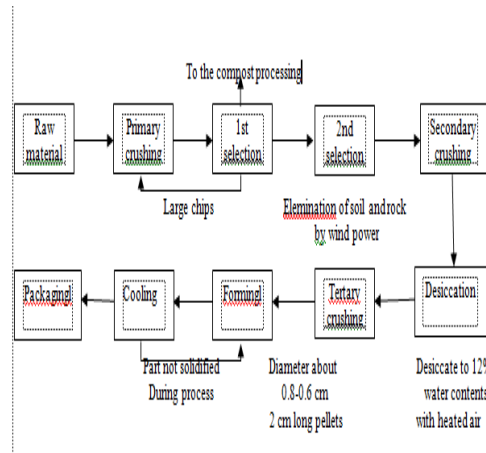


Figure 3. Example of Solid Fuel Utilization

Esterification

Esterification is a technology where fuel diesel automobiles (Bio Diesel Fuel) is obtained by chemical reaction between methanol and oil (rape oil, sunflower oil, soybean oil , etc). Oil is a glycerine and ester molecular structure formed by fatty acid, when it is mixed with methanol with catalyzer as alkali added and then heated for about an hour at 70 °C. Fatty acid creates methanol and ester to produce methyl ester, and glycerine is released. The methyl ester from fatty acid can be used as diesel fuel

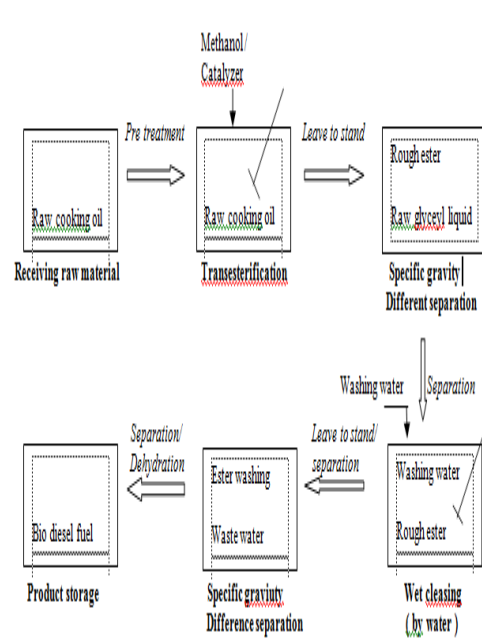


Figure 4 . Manufacturing of Bio Diesel Fuel

Anaerobic digestion

When biomass is exposed to an environmental devoid of air, anaerobic microorganisms work to decompose into methane and carbon dioxide and from this main substances flammable gas is produced. Depending on the substance the composition can be different, but generally the gas mainly is composed by methane and carbon dioxide, and the concentration of methane is about 50-70%

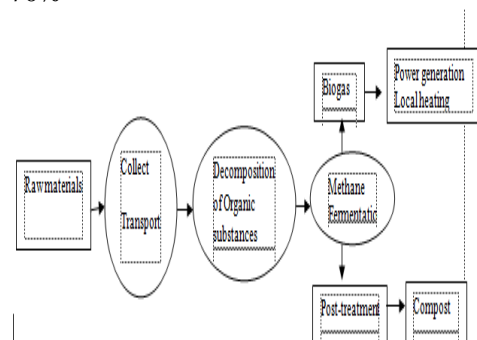


Figure 5 . Process flow of anaerobic digestion

Ethanol Fermentation

Ethanol and carbon dioxide are produced by yeast decomposition of sugars, such as glucose, fructose and sucrose. This type of microorganism

mechanism has been employed in alcoholic beverage production since ancient times, and is known as ethanol fermentation. With this method, which uses yeast to obtain ethanol, high purity fuel can be collected by distilling the ethanol. When using lignocelluloses raw materials, sugar is first obtain from hydrolysis of cellulose and hemicelluloses, followed by the ethanol fermentation of the acquired sugar. There is prospect for a large market for biomass ethanol as automobile fuel or oxygenated octane boosting gasoline additive. Ethanol fermentation is a technology expected in the future to have the price competitive power against gasoline that comes from fossil fuel.

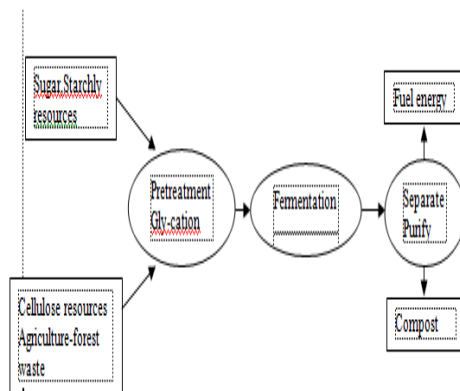


Figure 6 . Process flowchart of Ethanol Fermentation

CONCLUSION

3. The agriculture and forest wastes have potentially as energy raw material
4. The energy utilization of the agriculture and forest waste can be carry out by thermochemical utilization and biochemical utilization.
5. The heat energy were produced from direct combustion, conversion into solid fuel, gasification and anaerobic digestion process, and the fuel energy were produced from esterification and ethanol fermentation process

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