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APPLICATION OF FECES BRIQUETTE FOR ALTERNATIVE ENERGY IN INDONESIA'S VILLAGES

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Abstract

The number of people in the world increase rapidly every day. This condition also make the needs of consumption increase. One of the best way to solve the problem is by increase the number of livestock. According to data from Central Statistics Agency, the number of livestock in Indonesia by 2017 are 2.313.941 heads. Livestock's waste and its by-products supply greenhouse gas emissions at least 32.564 million tons of CO_{2e} per year, or about 51 percent of annual greenhouse gas emissions worldwide. In other place, according from source data in 2016, there are 12.659 villages from total 74.759 villages in Indonesia are still living with no electricity. This study aimed to generalize the electrical activities in Indonesia also to minimize gas emission and environmental pollution produced by livestock's waste (feces). Methods used in this study divided into two steps, feces briquette making and briquette converting into electrical source then measured by calorimeter bomb. The result of this study showed that calories produced from 4 kgs feces briquettes are equally the same with 10,64 kgs coals. As conclusion, instead of using non renewable energy from coal, feces briquette which can be produce everyday is much more efficient for electrical source.

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1. Introduction

The number of people in the world increase rapidly every day. This condition also make the needs of consumption increase. One of the best way to solve the problem is by increase the number of livestock. Unfortunately the management of livestock waste still become a complex environmental issue. Livestock waste can have both positive and negative impact on environment. Most of Indonesian livestock farms still not manage the waste well and left it decomposed itself so the environmental had been polluted too. According to FAO (Food and Agriculture Organization) in 2006, an estimated 7.516 million metric tons per year of CO_2e (carbon dioxide equivalent), or 18 percent of annual greenhouse gas emissions caused by cattle, buffalo, sheep, goats, camels, horses, pigs, and poultry. According to the analysis of Goodland and Anhang (2009), livestock and its by-products supply greenhouse gas emissions at least 32.564 million tons of CO_2e per year, or about 51 percent of annual greenhouse gas emissions worldwide.

According to data from the Central Statistics Agency, the number of livestock in Indonesia by 2017 are 2.313.941 heads. By that amount, the waste product is certainly not small number. This number surely produce waste that can have the negative impact for environmental if can't be managed well. One of the most popular waste that can be harm human's health is feces, moreover from cattles with polygastric digestion system. This polygastric digestion system convert food into ammonia which can be one of the global warming cause. The price of feces itself is free or sometimes cost as IDR 40,00 or equal as MYR 0,011 per kgs which really cheap. That's why feces can be called as black gold because it is a priceless thing which can be converted into useful product if managed effectively.

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Based on these reasons then the government drafted the Law of the Republic of Indonesia Number 32 of 2009 on the Protection and Environmental Management. Chapter 1 Article 1, Verse 3 stating that: "the protection and management of the environment means a systematic and integrated approach to preserve the environment and prevent pollution and/or damage to the environment that includes planning, utilization, control, maintenance, supervision, and law enforcement."

In other place, according to data from government official source in 2012, Indonesia have 17.504 islands in total. This islands divided into 13.449 islands which already verified, and 4.055 islands which still not officially verified yet. Moreover, according from source data in 2016, there are 12.659 villages from total 74.759 villages in Indonesia which are still living with no electricity. This number of villages without electrical activities are very apprehensive compared to those villages which live near the capital city, mostly in Java island. Most of this villages which already become industrial area are fully supported by electrical activity in all aspects. This unbalance comparation can be manage by the good managing in waste product to produce electrical energy. One of effort is by convert waste (feces) from livestock product into briquette. This briquette are aimed to gain the electricity activities of some small islands in Indonesia. Those islands have to develop too considered by other island (example is Java) which already developed with technology. Another goals are also for minimize the gas emission and environmental pollution produced by livestock's waste (feces). This paper can give advantage for writers, researchers, governments, and farmers as well in managing waste. Also, for better and more equity Indonesia.

2. Literature review

Feces from the explanation of Daely (2000) is the solid or semisolid metabolic waste from animal's digestive tract, discharged through the anus or cloaca during a process called defecation. Urine and feces together are called excreta in poultry. Rumen's content can also be managed as briquette because it content fibers, high protein microorganism, and methan.

Gerber *et al.* (2013) state that livestock sector contribute 14,5 % emission gas in global warming worldwide and 41% of it comes from ruminant's manure. Hambali (2007) said that 10-30 kgs feces can be produce from a cow per day. Lingga (1991) state that ruminant's feces content N 0,3%, P 0,2%, K 0,15%, water 80% for cow and N 0,7%, P 0,4%, K 0,25%, and water 64% for goat. Normally, poultry can produce excreta 6,6% from it's total weight. Poultry's excreta contents N 1%, P 0,80%, K 0,40% and 55% water.

According to Susana (2007) briquette is an organic material derived from living bodies, both plants and animals, one of the example is manure (feces). The feces can be processed by mix it with starch flour so it can be coagulated and solid. This dough then can be molded. The final product of this molded dough then could be checked by burn it on fire. Time measured of this fire being burn t used as parameters to know if the product can be use effectively as alternative energy.

Briquette commonly used as substitution for Liquified Petroleum Gas (LPG). Most of Indonesian use LPG for cooking. Unfortunately, LPG is derivied from fossils which include as non renewable energy. That's why LPG is pricy, so briquette could be one of alternative. Daely (2000) mentioned that 4 kgs feces briquettes are equal with 6 kgs LPG also equal with 144 hours fire on non-stop.

Take a look of this opportunity, instead of using briquette as LPG substitution, this paper trying to convert briquette from feces as electrical source in Indonesia's no electricity area. The main concept is by using the heat of briquette combustion result as generator mover to produce electricity. Both coal and briquette is utilizing steam from combustion result. But coal which made of fossils can't be renewable. So, as comparation, BTBRD-BPPT (2017) state that coal compounds calories of 6.322 kcal per kgs. Meanwhile, LPG compounds calories of 11.220 kcal/per kgs. It means that 10,64 kgs coal equal with 6 kgs LPG.

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There are 3 methods for converting briquettes into electrical source include gasification, densification, and combustion. The main concept of gasification is utilizing carbon dioxide (CO_2) from burning result as main compounds in moving the generator. Densification is a process which utilizing briquette's pressure as generator mover. Combution is a process which using calor as main compound to produce electrical source.

3. Materials and methods

3.1. Materials

3.1.1. Equipments. Equipments used for briquette's making are press-machine biobriquette, crusher, stove, weight scale, stop watch, hoe, vessel, mixer, carbonizator, molder and oven. Equipments for electrical source converting are boiler tank, stove, turbine, generator, magnetic field, and condenser.

3.1.2. Ingredients. Ingredients used for briquette's making are livestock's feces, rice husk, coconut shell, and starch flour with comparation of 5:3:2:1 also 5:2:3:2. Ingredients for electrical source converting are end product of feces briquette, fire, and water condenser.

3.2. Methods

3.2.1 Briquette making. Livestock's feces, rice husk, coconut shell, and starch flour measured with comparation of 5:3:2:1 also 5:2:3:2 for total briquettes (600 g) for square mold and 100 g for cylindrical mold. Then, add starch flour which already mixed by water and heat on the vessel. All of those ingredients mixed homogenely. This dough then put in the press-machine biobriquette. The pressure controlled and variated on 200 kgs/cm2 and 225 kgs/cm^2 . Pressing process in 5 and 7,5 minutes to make it more solid. After molded, then briquette is being dried with oven with some temperature variated in 50 and 60 °C. The drying process being done in 2 and 3 days.

3.2.2. Electrical source making. Electrical source making divided into four processes. First one is process on producing steam. Boler tank filled with water and heat by primer energy from briquette. Heating process produce steam. Second, convertion calor into mechanical energy process. Steam from the heating product, with pressure and temperature measured stream to the turbine. The streams can be used as turbine mover. The turbine's moving convert steam into mechanical energy. Third, mechanical energy convertion into electrical energy. Turbine is connected directly into generator. Inside of the generator, there are magnetic coils which produce electrical source which then stream into output generator terminal. Last one, condensation process. By product of steam for moving the turbin go to condenser. Condenser using cold water with big amount to make condensation process more effective. The condenser water then can be used for filling boiler again.

4. Results and discussion

This program will gain the farmer knowledge. Additionally, the raised of public interest and farmers to manage the feeding and livestock waste into products such as biogas, compost, liquid fertilizer and briquettes. Daely (2000) state that test materials for briquette bioarang done thermolysis process (pyrolysis) on biomass briquettes by using retort (heating oven) with heating temperature and a constant holding time, 300^{o}C for 2 hours, and treated with inert gas and non-inert gas treatment. After the process is complete, the retrieval is done, data burning calorific value, and carried on. End of sample testing process using adiabatic bomb calorimeter, where taking data is done 3 times for each test material, and the average value is taken. From the test result is calculated dry calorific value (GEk) and wet calorific value (GEb) biomass briquettes and bioarang briquettes.

Electrical energy source making divided into four processes. First one is process on producing steam by heating. Second, convertion calor into mechanical energy process. Third, mechanical energy convertion into electrical energy. Fourth, condensation process (GeothermalIndo, 2017). By using this method, electrical energy can be produced from feces briquettes.

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According to some literation above, instead of using non renewable energy from coal, feces briquette is much more efficient for electrical source. By using LPG as parameter, 4 kgs feces briquettes are equally the same with 10,64 kgs coals. Most of coals are made of plant's fossils. The process of fossils making it self take million years. Meanwhile, livestock's feces which become the main product of briquette can be produce everyday. These are provements that feces briquette is a good idea for electrical energy source in Indonesia.

Substantially can be achieved by application of briquette's making as electrical source. First, provide training also empower communities and traditional farmers to manage their animal waste, so it can provide more value to the farm business. Second, community and traditional farmers can run production process on the farm effectively and efficien so that the waste from the rest of the uneaten-feed can be reduced. In addition, the farm management has also become the focus of the program that is traditional farms can increase the productivity for major livestock products. Third, this can direct community's minds and farmers to develop their entrepreneurship spirit. The way is by marketing the processed products of animal wastes into products that are environmentally friendly and can be a source of alternative energy for other areas of Indonesia. Fourth, for government to use feces briquette as the renewable electrical energy source and support to develop it nationally so it can be used as for no electrical activities villages in Indonesia. It can increasing equity in all aspects.

There are several elements that involved in the implementation of using feces briquettes as electrical source, such as government, stakeholder, village communities and farmers, also academics. Government's role are providing support and facilities to run the program. In addition, they also can allocated fund and play a role in expanding this program to be run in various region in Indonesia, mostly for no electrical activities villages. Stakeholder, entrepreneurs and companies can have a strategic role to run this program. The company can provide support facilities and infrastructure to facilitate the implementation of programs, especially when processing animal waste in workshop.

Communities and farmers are the object of the program should have an active role. Not all of the people directly involved. People who run the program is not restricted but should have sufficient physical condition and willing to change. People who are not involved can be a contributor to the raw materials for waste treatment voluntarily, such as feces, urine, and the uneaten feed. Also, overseeing the course of the program passively. The intellectuals or academics (involving faculty and students) should be involved in taking this role. Lecturers and students are able to provide socialization, recommendations, training and guidance for communities and farmers or other elements, so the program can be achieved on target.

5. Conclusion and recommendation

5.1. Conclusion

Feces briquette is an idea that arise because of the increasing issue which blame livestock sectors as the main reason of greenhouse effect emisions in the world because of its waste. This inovation is expected as solution to animal waste management which previously thought as priceless products become the efficient renewable energy source. Also, this inovation is a useful activity and give addictive impact to the applicator because involves all the village member (leaders, communities, and farmers) to run the program. This inovationis aim to increase electrical activities in Indonesia equally. This innovation also make be the opportunities to increase the quality of human resources to become the high quality human and capable to compete in recent time even for the future, moreover for better Indonesia. There will be no more left behind area in Indonesia, and equity can be achieved in all aspects.

5.2. Recommendation

a. Feces briquette needs cooperative work from all elements to become sustain and give benefits.
b. Feces briquette needs intensive assistance from the academics to run continously.

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