Utilization of Gendruwo waste (*Sterculia foetida* Linn.) as briquettes

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**Abstract.** Gendruwo plant (*Sterculia foetida* Linn.) or more commonly known as Kepuh is a plant species in Indonesia that origination from East Africa, Asia, and Australia. This plant can be used as biofuel raw material in the form of biodiesel and bio-oil. Gendruwo plant seeds contain vegetable oil which consists of fatty acids namely stercylat acid (C₁₉H₃₄O₂). The seeds that have been extracted into biodiesels leave the residue or waste in the form of gendruwo seed pulp. From the analysis, the remaining extract or debris can still be used as fuel because it contains the remaining fatty acid compounds. These gendruwo dregs can be used as coal substitute briquettes. Gendruwo seed waste briquettes have quality advantages than coal briquettes or coconut shell briquettes because they have longer coal resistance, which are environmentally friendly and also produce a better heat.

1. Introduction

Indonesia is one of the countries with a high population, consequently, the energy needs are also quite high. Energy requirements increase over years, while energy supply decreases. Such conditions require new energy sources [1]. Indonesia, which is rich in natural resources and plants, is potential in finding alternative energy to meet needs.

The alternative renewable energy can be derived from plants that have a relatively high oil content, such as is *Sterculia foetida* Linn or commonly known as gendruwo plant. These plant seeds contain approximately 40% oil content, or 75% after purification [2, 3, 4]. Its seed oil can be used as biofuel or biodiesel [5], while seed waste can be used as briquettes.

The development of science and technology provides an alternative use of plants as raw materials for biofuel [4, 6]. Various methods and development of plants through existing components are used as "biofuel", for example as bioethanol (substitute for premium), biodiesel (substitute for diesel fuel), bio-oil (substitute for lubricating oil) [5, 6, 7].
2. Methods

2.1. Location and time of research
The study was held at Laboratory of Plant Physiology and Biotechnology, Laboratory of Biology Soil, Faculty of Agriculture and Laboratory of Machine Faculty of Technique Sebelas Maret University Surakarta. The seed’s gendruwo plants were obtained from East Java and Central Java Indonesia [8].

2.2. Tools and materials
The material for this research were hoe, clay, pressing machine, basin, bucket, pellet, tarpaulin, blender, sieve, collision, strainer, scales, bowl, measuring cup, stove, charcoal, seeds, skin, kerosene, stone, and firewood.

2.3. Research design and data analysis
The data were analyzed using descriptive methods that describe the results of observational studies.

2.4. Step-step for making briquettes

2.4.1. Experiment one for making briquettes from gendruwo plant seeds waste. The materials were ground with particle sizes of 30-60 mesh. Tapioca flour was diluted in water to form glue. The raw materials consisted of clay, lime, tapioca flour with a ratio of 85: 10: 3: 2 were mixed until smooth (if it was not broken), the briquette mixture was added to the mold and pressed it in a hydraulic manner, oven at a temperature of 80 – 100 ºC for one hour to reduce moisture content. The materials were simple carbonized by soaking it in gasoline or kerosene, then burned by means of closed carbonization.

2.4.2. Experiment two for making briquettes from gendruwo plant seeds waste. The materials that were used as briquettes were prepared, including gendruwo waste or pulp and seed shells, gendruwo seeds which have been extracted for biodiesel in the form of crushed pulp and shells. Gendruwo seeds waste and shells were completely dried, then imperfectly burned in large drums to form charcoal (not ash). To carbonize, gendruwo seed waste and shell then were mashed by milling or pulping method, then filtered with a certain mesh size and sieved to have the same size to obtain the same porosity to the produced briquettes. Dry clay was crushed with collisions, then smoothed with a blender and filtered with a filter cloth, mix 1256.8 g of filtered main ingredient with 337.7 g of filtered clay (mixed material), mix 1313.6 g of ingredients mixed with 500 ml of starch glue, stirred like batter. The soft-shell waste was mixed with adhesive mixture (clay or tapioca flour) which will be compared to efficiency and fuel. The waste was pressed and formed into solid like coal briquette or briquette from coconut shell. Then, the briquette was dried in the sun. Briquettes were tested by looking at the flame and the heat resulted. Briquettes were tested in the design and the design of the existing stove briquettes such as stoves for coal briquettes or coconut shell briquettes, then the effectiveness and efficiency regarding the duration of flame and the flame color produced.

3. Results and discussion

3.1. Color of gendruwo plant seeds briquettes
Experiment 1 produced briquettes with less flame duration compared to Experiment 2. The manufacturing of briquettes in experiment 1 by carbonization after pressing resulted in a pale or yellowish white briquette color. After the flame test was conducted, it did not produce a long flame time and a lower temperature. To increase the flame time, a carbonization process needs to be done. In experiment 1, carbonization was done after pressing the briquettes.
In experiment 2 carbonization was done before pressing the gendruwo shells and waste.
1. Burning waste and shells or gendruwo pulp by using kerosene placed in a closed barrel.
2. Every ± 15 minutes the waste and shell of the seeds were stirred by using a wooden stirrer, so that the heat obtained was evenly distributed
3. Waiting until the shell or waste of the gendruwo seeds color became black, and the oil content in the seed was disappear.

3.2. Shapes of gendruwo plant seeds briquettes
The briquettes obtained through the carbonation process showed a good quality. Figure (a) is a briquette product produced from experiment one, the appearance of the product was not similar with Figure (b), which was gendruwo plant seeds briquettes. However, the effectiveness and efficiency of briquettes from gendruwo plant seeds can be increased continuously, and minimize the air pollution and do not emit diverted gas. This can be seen from the good color of briquettes, the large carbon content, and the small ash content, which produced flammability, high heat energy and durable.
4. Conclusions
It can be concluded that gendruwo (*Sterculia foetida* Linn.) seed waste briquettes produce a high heat energy and durable. Therefore, gendruwo seed shell waste briquettes have potential as a renewable energy source.

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