# A Preliminary Study of Analysis and Characterization of Briquettes Quality on Asphalt Bitument from Buton Island as Alternative Fuel

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**Abstract**

In this study, the material used is asphal bitument then made briquettes weighing 10 gram in each sample. In making the briquettes used a cylindrical mod with a diameter of 2.5 cm and a height of 7 cm. After compactioned the briquettes produced dried first. Drying of briquetttes made using free air during 4 days to reduce the water content contained in the briquettes. Furthermore, the heat test and proximat analysis (i.e : analysis of water content, ash content, volatile matter, fixed carbon, and density). Calorific test and proximate analysis aims to determine the quality of asphal bitument briquettes that will be used as a fuel alternative.

This results of this study indicate that the asphalt briquettes have analyzed proximet variation i.e.: water content between 1.23% -7.26% ; volatile matter : 16,797%-32,02% ; ash content : 48.96%-61.35% ; fixed carbon : 11.76%-33.36 ; and density : 1,22 g/cm$^3$-1.92 g/cm$^3$. Asphalt briquettes obtained has a calorific value variation between 1902.39 kcal/kg-3407.82 kcal/kg, with the largest being the calorific value of cashew charcoal with variation of 30 %.

This provides an initial indication for the use of asphalt bitument briquettes as alternative fuel and also provide information that adhesive such as cashew charcoal can be used as aggregate to strengthen the adhesion of asphalt on the pavement layers.

*Keywords : Asphalt Bitument, Proximate Analysis, Calorific, Fuel, Briquettes.*

## 1. Introduction

Petroleum is a unrenewable energy, but in the daily life of fuel is still the main choice that will resulte in the depletion of oil reserves in the earth. While natural gas and other alternative energy has not been maximized.

For using and developing of alternatif energy source as substituter of oil burning material, so there are several ways that can be used included the use of alternative fuels, such as in the form of briquettes. Many researchers have reported utilization of briquettes as fuel, such as : Studies on development of fuel briquettes using biodegradable waste materials (Raju,at.all,2014),Optimum parameters for the formulation of charcoal briquettes using bagasse and clay as binder (Onchieku,at.all,2012), Processing water hyacinth into biomass briquettes for cooking purposes(Ighodalo,at.all,2011), Mechanical characteristics of standard fuel briquettes on biomass basis (Plíštil,at.all,2005), Converting Biomass and Waste Plastic to Solid Fuel Briquettes (Zannikos,2012)

Moreover, there are some studies related physical and chemical properties of briquettes, i.e : Comparison of the Physical and Chemical Properties of Briquette and Wood Charcoal in Khammouane Province, Lao PDR (Sayakoummane,2009), Physico-chemical characteristics and market potential of sawdust charcoal briquette

(Joseph,at.all,2012), Physical and Combustion Characteristics of Briquettes Made from Water Hyacinth and Phytoplankton Scum as Binder (Davies,at.all,2013), Physical and combustion properties of briquettes produced from sawdust of three hardwood species and different organic binders (Emerhi,2011).Te studies have been cnducted related to synthesis of activated carbon from petroleum residues, such as : Synthesis and characterization of activated carbon from asphalt (Kandah,at.all,2006), Characterization of Viscoelastic Properties of Bitumen-Filler Mastics (Liao,2013), Study on Physical and Chemical Properties of crop Residues briquettes for gasification (Khardiwar,2013).

One of mine material to be used in the manufactures briquettes is asphalt bitument derived from the Buton Island, South East Sulawesi, Indonesia, which has the largest reserves of nature asphalt in the world, with a deposit of approximately 677 million Tons and able to provide for infrastructure in this country for up to 200 years to come (Statistical Centre Agency,2010).

Asphalt bitument is nature asphalt with rock asphalt type, i.e. rock which impregnated asphalt into parent rocks of limestone (Hadiwisastra,S.,2009). Asphal bitument particles composed of mineral, bitument and water, brownish black, porous and relatively mild. When asphalt is extracted, it can be separated into mineral with its bitument (Devianto,I.,M,2013). Asphalt bitument of varies from 10 % to 40 %. Aspalt bitument Known as Asbuton (Asphalt Buton) is the result of oil sludge which experienced a long destilation process and continuous that its asphaltene levels much higher than its maltene levels, lower than the artificial asphalt. Therefore the Asbuton has better adhesion and sensitivity to temperature chances are smaller.

The Existence and nature of the asbuton interesting to study and be investigated in other forms that have been used only as pavement construction. This research will focus on testing the quality in the form of asphalt briquetttes as an alternative fuel. This study is a new relatively done and try to use the adhesive mixture material comprising : wheat flour, cashew charcoals, and dried mud (waste material that is not utilized and very much reserves).

## 2. Materials and methods

### 2.1 Materials

Material used in this study is asphalt bitument, then made of briquettess weighing 10 grams in each sample. In making the briquettes used cylindrical mold with a diameter of 2.5 cm and a height of 7 cm. Once compactioned the briquettess produced dried first. Drying of briquettes made using free air for 4 days to reduce the water content contained in the briquettes.

### 2.2 Methods

#### 2.2.1 Experimental procedure

**A. The process of making briquettes**

**A1. The process of making adhesive**

For gluten wheat flour weighted 10 grams, and then inserted into a 250 ml beaker and add 90 ml water, then heated above the water heater to form a gel. As for mixture of cashew charcoal and dry mud is finely ground and weighed each 1 gram.

**A.2. The process of mixing the adhesive of asphalt bitument powder**

Asphalt bitument weighed 9 gram each and then added 1 gram of a mixture of adhesive so that the adhesive number on briquettes is 10 %, then mix until evenly

distributed. Repeated for the number of adhesive 20 % and 30 %.

**A.3. Compacting Asphalt bitument**

Asphal bitument mixed with an adhesive and then weighed and put into a cylindrical briquettes mold with a diamater of 2.5 cm and height of 7 cm. Briquettes mold is placed below the compacting tool, then sample the mold compacted (pressed) to 100 Kg/cm$^2$ pressure.

Figure. Produce of asphalt bitument briquttes

**A.4. Drying of briquettes**

Asphalt briquettes which have been compacted then dried in the free air for 4 days with ± 40° C temperature. After the drying process is carried out proximate analysis on briquettes.

**B. Testing the quality of briquettes with proximate analysis**

**B.1. Determination of water content**

Analysis of water content aims to determine the water content in the briquettes. Effect of water content of the briquettes is increasing the heat loss, due to evaporation and superheating of steam, helping the binding of fine particles, as well as help the radiation heat transfer (UNEP, 2006).

In addition to the high water content makes it difficult ignition and reduce the combustion temperature. Water content contained in the sample using the following equation:

$$\text{water content } (\%) = \frac{[\text{BS} - (\text{BC} + \text{SP}(105^{o}\text{C})) - \text{BCK}]\text{x}100\%}{\text{sample mass}}$$

Where :

BCK : the mass of the empty cup (gram)

BS : the mass of sample (gram)

BC +SP (1050C) : the mass of cup + sample after heating at a temperature of 1050C (gram)

**B.2. Determination of Volatile matter**

Volatile matter is a substance that is easly evaporates.Volatile matter determined by heating the asphalt briquettes produced at a temperature of 750 $^{o}$C, a substance that evaporates at a temperature of volatile substances (Jahiding,M,2012). Calculate the levels of volatile matter contained in the sample :

Volatile matter (%) = concentration of substances lost (KHZ on 750$^{o}$C – water content

$$\text{KZH } (\%) = \frac{[\text{BS} - (\text{BC} + \text{SP}(750^{o}\text{C})) - \text{BCK}]\text{x}100\%}{\text{sample mass}}$$

Where :

BCK : the mass of the empty cup (gram)

BS : the mass of sample (gram)

BC+SP (750$^{o}$C ) : the mass of cup + sample after heating at a temperature 750$^{o}$C (gram)

**B.3. Determination of ash content**

Ash content analysis aims to determine the ash content in the briquettes that have been generated. Effect of ash content on the quality of the briquettes which can lower the calorific value of briquettes. According to Obernberger and thek (2006) states that the higher ash content in the briquettes , then the lower calorific value. Good quality briquettes can be seen from a low ash content after combustion and high carbon content. The high carbon content in the briquettes will produce heat stable and evenly.

Ash content is determined by the following equation :

$$\text{Ash content (\%)} = \frac{\left[\left(\text{BC} + \text{SP}(400^{o}\text{C})\right) - \text{BCK}\right]\text{x}100\%}{\text{mass of sample}}$$

Where :

BCK : the mass of the empty cup (gram)

BS : the mass of the sample (gram)

BC+SP ($400^{o}$C ) : the mass of cup + sample after heating at a temperature $400^{o}$C (gram)

**B.4 Determination of fixed carbon**

Fixed carbon is the fraction of carbon contained in charcoal be side ash content. determination of Fixed carbon includes several stages. first determined the amount of water content, ash content, volatile matter in the briquettes, then is reduced with 100 % which then becomes the value of percent fixed carbon (Jahiding,M,2012).

ash content is determined by the following equation :

*fixed carbon (%)= 100%-(water content +ash content+volatile matter conten)*

**B.5 Determination of density**

In This study, the analysis of the density of the asphalt briquettes to determine the affect calorific value that produced on the grain density of asphalt bitument.

According to Wilaipon,P., (2010) states that the density affects the heating value. The higher density of the grains in the briquettes produced greater heat.

Density is determined by the following equation :

$$\rho = \frac{\text{m}}{\text{V}}$$

Where :

ρ : density of briquettes (gram/cm3)

m : the mass of briquettes (gram)

V : changes in the volume of water in a measuring glass (cm3)

**C. Determination of calorific value**

Calorific value is determined by the following equation :

$$Calorific = \frac{T_{final} - T_{initial}}{sample\ mass} x\ 2458\ k\,kal/kg$$

Where :

Tfinal = temperature after the combustion

Tinitial = initial temperature

**3. Results**

Asphalt briquettes that have been made in the subsequent heat test and proximat analysis (analysis of water content, ash content, volatile matter, fixed carbon, and density). The Results of the analysis of asphalt briquettes are shown in table 1 and table 2. Proximate analysis aims to determine the quality of asphalt briquettes to be used as an alternative fuel.

**Table 1**. Calorific value testing results

| Mixed Type | Variation (%) | Sample Weight (gram) | Initial Temperature (°C) | Final Temperature (°C) | Energy (kcal / Kg) |
|---|---|---|---|---|---|
| Wheat flour | 10 | 1.58 | 25.62 | 27.25 | 2532.26 |
| | 20 | 1.75 | 24.80 | 26.80 | 2806.26 |
| | 30 | 1.36 | 24.93 | 26.61 | 3035.68 |
| Cashew charcoal | 10 | 1.84 | 25.05 | 27.31 | 3021.53 |
| | 20 | 1.60 | 24.78 | 26.89 | 3243.72 |
| | 30 | 1.63 | 25.38 | 27.64 | 3407.82 |
| Dried mud | 10 | 1.40 | 25.43 | 27.06 | 2866.11 |
| | 20 | 1.66 | 24.87 | 26.70 | 2714.14 |
| | 30 | 1.69 | 25.73 | 27.04 | 1902.39 |

**Tabel 2** Proximat testing results of the asphalt bitument briquettes

| Mixed Type | Variation (%) | Water Content (%) | Volatile Matter (%) | Ash Content (%) | Fixed Carbon (%) | Density (gram/cm$^3$) |
|---|---|---|---|---|---|---|
| Wheat Flour | 10 | 2.26 | 32.02 | 51.22 | 17.74 | 1.37 |
| | 20 | 3.55 | 31.64 | 61.35 | 11.76 | 1.62 |
| | 30 | 7.26 | 25.80 | 48.96 | 28.43 | 1.92 |
| Cashew Charcoal | 10 | 1.23 | 25.64 | 56.82 | 13.90 | 1.12 |
| | 20 | 1.63 | 24.43 | 61.12 | 12.82 | 1.33 |
| | 30 | 3.64 | 19.95 | 45.45 | 33.36 | 1.64 |
| Dried Mud | 10 | 1.43 | 29.26 | 53.95 | 15.37 | 1.38 |
| | 20 | 2.26 | 27.50 | 56.29 | 13.95 | 1.59 |
| | 30 | 2.64 | 22.11 | 54.98 | 20.27 | 1.56 |

## Discussion

### 1. Proximate analysis

Proximat analysis consist of analysis of water content, ash content, volatile matter, fixed carbon, and density. This results can be showed in the graph as follows :

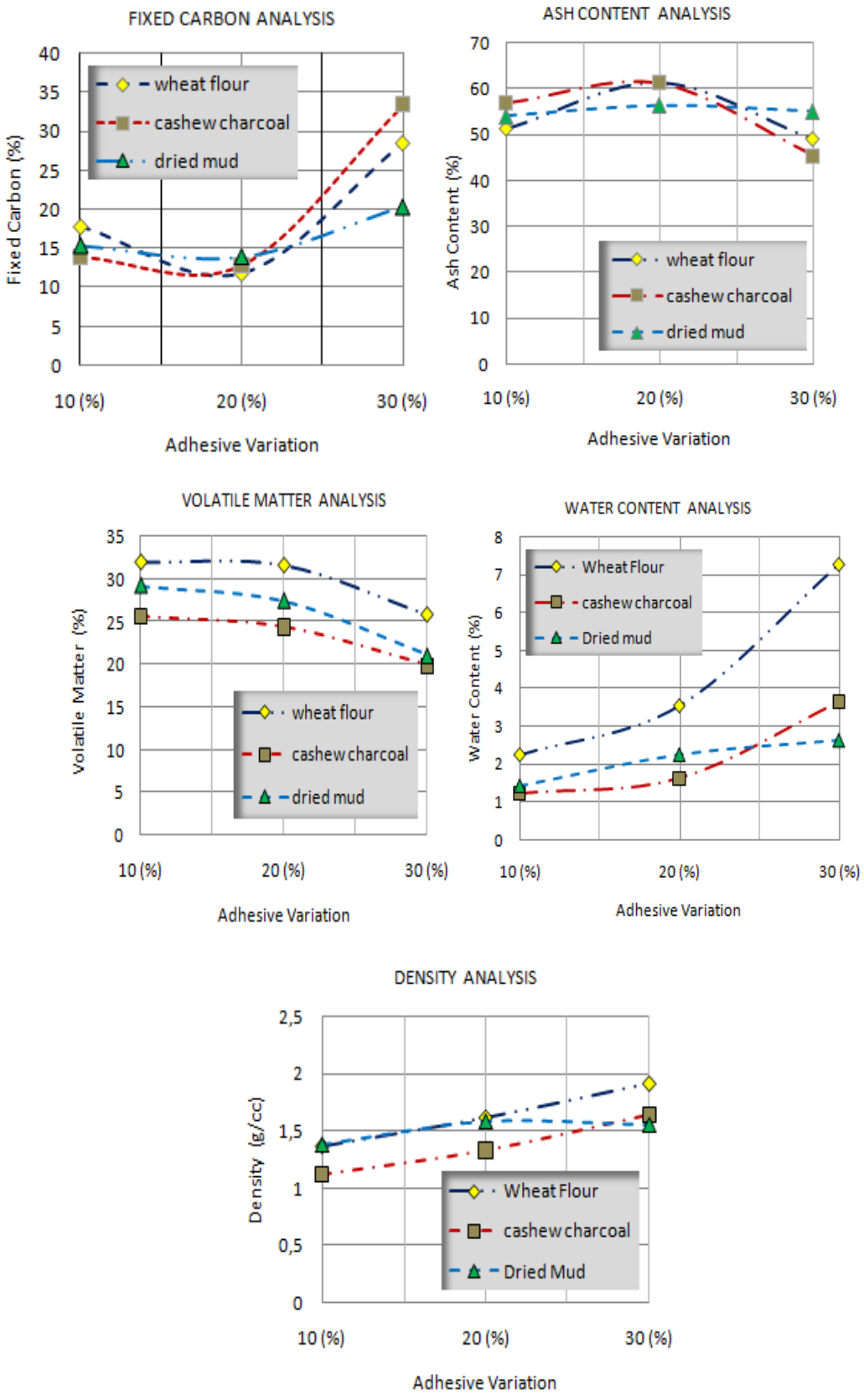


Figure. Relationship the Proximate analysis of asbuton bitument (asphalt Buton) with adhesive variation (10%,20%, and 30 %)

**1.1 Analysis of water content**

The results obtained showed that the briquettes using gluten of wheat flour produces trend of higher water content than other mixtures (cashew charcoal and dried mud). This is due to differences in innate water content of the two types of adhesives. At first wheat flour mixed with water and heated to produce an adhesive of gel form so mixture the asphalt briquettes with wheat flour tend to have a higher water content than other blends. This is different with the mixture of cashew charcoal and dried mud no addition of water on each of the various mixture .

**1.2 . Analysis of Ash content**

The results obtained indicate that the asphalt briquettes have a fairly high ash, there is a tendency difference the ash content between mixture of wheat flour, cashew charcoal, and dry mud. The mixture of dry mud and ash content tends to be lower than in the two other mixtures only ranged from 53 % - 56%, while for the other two mixtures that is 45% - 61%.

**1.3 . Analysis of Volatile matter**

From the graph show a comparison of each mix in wheat flour mixture in which the amount of fly matter contained higher on mix of 30 %, while the other have a mix of lower value. This can happen where the briquettes of asphalt bitument will be made without thorugh the stages of carbonation causes its soft point of a vey low that is $30^{o}C$ so it will be very difficult to convert it into a form of charcoal briquettes.

**1.4 Analysis of Fixed Carbon**

In addition cashew charcoal, fixed carbon in the briquettes of the asphalt bitument produced increases with the amount of charcoal is mixed. In the mixture of flour wheat, fixed carbon is tend increasing in the variation of a mixture of 10 % and 20 %, but declining 30 %, while the variation in the mix of dried mud decreased 20 % and increased 30 %. It is caused by changes in water content, ash content, and volatile matter at asphalt briquettes due to changes in grain size.

**1.5 . Analysis of Density**

In the wheat flour mixture, the value of the density increasing significantly . This is indicated briquettes with an adhesive mixture has higher density level than the other mixtures. On The other hand, the addition of adhesive will minimize the volume of biquettes due to cavity of inter-granular more tightly, so that when drying the volume of the briquettes restained and not expand anymore. Large Density showed high densities. This will affect the water content especially the internal water content due to the high density indicates a low water absorption.

**2. Analysis of Calorific value**

From the figure above it can be seen that there is a diffrence between the amount of calorific each mixture. In a mixture of wheat flour and cashew charcoal increased amount of calorific in each of the various adhesive mixture, i.e. : the wheat flour ranged between 2532.26 kcal /kg to 3035.68 kcal/kg while the cashew charcoal ranged between 3021.53 kcal/kg to 3407.82 kcal/kg. Otherwise in the mixture of dried mud has lower calorific value ranged between 1902.39 kcal/kg to 2866.11 kcal/kg in the variation. So it could be argued that the cashew charcoal is a mixture of the best of the other two mixtures, because it has higher of calorific value than wheat flour and dried mud.

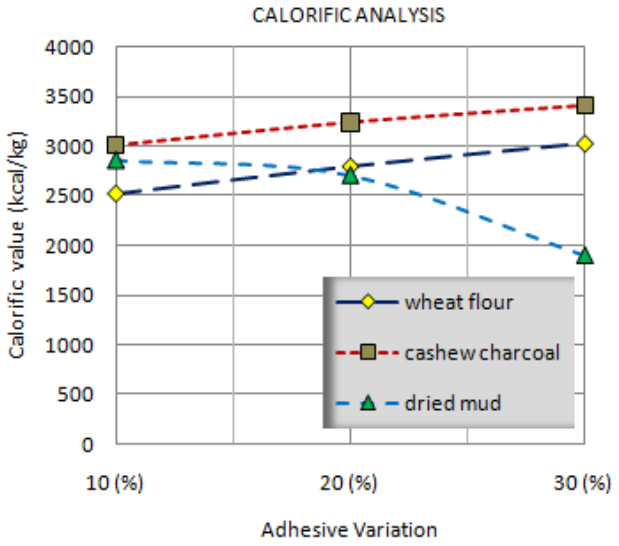


Figure . : Relationship the adhesive variation with Calorofic value

## Conclusion

1. Testing the proximate analysis produces variation of water content between 1,23%-7,26%, volatile matter of 16,797%-32,02%, ash content of 48,96%-61,35%, fixed carbon of 11,76%-33,36, and density of 1,22 g/cm$^3$-1,92 g/cm$^3$. In this study , the carbonation process aimed reducing the levels volatile matter content and ash content is very hight.
2. Asphalt briquettes obtained has a calorific value variation between 1902.39 kcal/kg- 3407.82 kcal/kg, with the largest of calorific value be in the cashew charcoal mixture with calorific value is 3407.82 kcal/kg in the variation of 30 %. From three variation of calorific obtained a briquettes which mixtured with cashew charcoal has a better quality than the other mixtures.
3. This results of this provides an initial indication for the use of asphalt bitument briquettes as fuel alternative and also provide information that adhesive such as cashew charcoal can be used as aggeragate to strengthen the adhesion of asphalt on the pavement layers

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