Enhancing the Heating Properties of Coal Briquette Blending Rice Husk

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Abstract— In this work, smokeless briquettes of coal and rice husk were produced and starch was used as the binder. Calcium-hydroxide(Ca(OH)2) was the desulphurizing agent and the different type of briquette samples were produced prepared by different composition of coal and rice husk in subsequent ratio 100:00, 80:20, 60:40, 20:80, and 00:100. The briquettes were produced mechanically using a manual briquetting machine through pressure maintained at 5MPa. Results of the proximate analysis showed that of the dissimilar compositions that 50% coal, 50% rice husk briquettes with following values for ash content 27.45 %, fixed carbon 38.83%, moisture content 3.85%, density 0.475g/cm3, volatile matter 22.18%, porosity index 59.96%, calorific value 132.93KJ/g, water boiling test 3.15mins, ignition time 35.06secs, burning time 22.43mins and sulphur content 7.05% exhibited optimum combustible quality when compared through other compositions of briquettes produced. In this we calculate the maximum temperature and cost of fuel and transportation cost, smoke, flame, and decrease of ignition temperature. The briquette present improved properties with regard to combustible property when judge against to the other briquettes were produced with same binder but various composition.

Key words: Rice Husk, Coal, Starch, Bio-Briquettes

I. INTRODUCTION

Several of the developing countries generate enormous quantities of agro –residues and they are used improperly causing broad pollution to the environment. Rice husks are residues of rice harvesting and handing out operations for which fairly smallest amount consumption outlets have been found in India although its huge potentials. Rice husk is the furthest layer of the paddy grain and it is also called rice hull. It is separated from the brown rice in rice milling. Burning rice husk produce rice husk ash and if the burning process is uncompleted carbonized rice husk is created and around 30% of the paddy weight is husk. In 2014 the world paddy fabrication was 885 million tons and accordingly 331 million tons of rice husk were also formed. Even though there are various uses of rice husk and it is still commonly measured a waste product in the rice mill, therefore regularly also burned on waste lands. Husk has an elevated calorific value and consequently can be used as a renewable fuel, rice husk is produced in the opening in the milling progression when the husk is separated from the grain in the husking stage of the rice mill (Beloiol, 2005).

A briquette is a building block of compressed coal, biomass that is used as fuel (Graingeret al., 1981). In the production of briquettes, the materials can be compacted without addition of adhesive while in others adhesive materials called binders are added to assist in asset the particles of the material together depending on the type of raw material used for the fabrication (Mohammed, 2005).

In an effort to make a better and more efficient briquette to reduce gases that contributes to green house effect, briquetting procedure has paying attention more on the making of smokeless solid fuels from coal and agricultural waste and the use of organic briquettes (biomass briquettes) ongoing more only just compared to coal briquettes which are dated back to eighteenth century (Choudburi, 1983). The subsequent are frequent types of briquettes in use, coal, peat, charcoal, and biomass briquettes. Newly, researches showed that combination of coal and biomass will give increase to a briquette through better combustion properties and environmentally friendly and bio-coal briquettes are arranged by blending coal, biomass, binders and sulphur fixation agent (Lu et al., 2000).

In this process, calcium hydroxide Ca(OH)2 acts as sulphur fixation agent. The desulphurizing agent in the briquette reacts with the sulphur present in the coal, converts about 70-80% of it into the ash, even as lime (CaO) as a desulphurizing agent captures able to 90-95% of the total sulphur in the coal. The process is uncompleted carbonized rice husk is created and thus enhance the energy density, when combustion takes place and there are two class aspects that require to be measured, firstly, the briquette has to remain in solid shape awaiting it has served its function (handling characteristics), secondly, the briquette has to achieve well as a fuel (fuel characteristics). The energy characteristics are other essential issues when telling and comparing briquettes through other fuels, the energy characteristics illustrate how the briquette take action and what it produces while burned.

The calorific value of briquettes is an essential measure of the sum of energy released from each briquette when burned, briquettes are usually priced by weight, but still, the calorific value is the mainly important aspect in determining the competitiveness of the fuel. The calorific value varies by means of ash content and moisture content. Dissimilar ash and moisture contents in briquettes outcome in special calorific values. Normally; the ash content of wood briquettes is regarding 0.7%. The resulting calorific value is 17-18KJ/kg as the normal moisture content in Swedish creation is about 10% (Eriksson et al., 1990).

II. OBJECTIVE OF THE STUDY

To manufacture smokeless briquettes that can provide as an substitute to fuel wood and determine the combustible properties of the dissimilar briquette samples produced.

A. Characteristics of the Briquettes

The major function of briquetting material is to decrease the volume and thus enhance the energy density, when densification takes place and there are two class aspects that require to be measured, firstly, the briquette has to remain in solid shape awaiting it has served its function (handling characteristics), secondly, the briquette has to achieve well as a fuel (fuel characteristics). The energy characteristics are other essential issues when telling and comparing briquettes through other fuels, the energy characteristics illustrate how the briquette take action and what it produces while burned.

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III. MATERIALS AND METHODS

A. Materials

Pulverized coal, rice husk, starch, calcium hydroxide, electronic weighing machine, manual briquetting machine, electric milling machine, stop watch, muffle furnace, and oxygen bomb calorimeter machine model-OSK 100A.
B. Methodology:

1) Preparation of the Coal Sample
The coal sample (sub-bituminous coal) was sun-dried for five days to reduce the moisture content of the material and then, it was pulverized into particle sizes that could go into the hopper of the grinding machine using hammer.

2) Preparation of the biomass
The biomass (rice husk) were collected were air-dried for ten days to reduce the moisture content of the materials.

3) Preparation of starch
Potato is used as starch and the starch was air dried for five days to reduce the moisture content.

4) Preparation of the Briquette Samples
The briquettes were produced using a manual briquetting machine. Briquettes of coal and rice husk of various compositions were shaped with a precise amount of Ca(OH)2 added based on the mass of coal was used as the desulphurizing agent and a certain amount of starch based on the whole mass of the blend was used as the briquette binder. Throughout the production, specific quantity of water was added to the blend to attain homogeneity and the pressure was maintained at 5MPa throughout the production time, after the production of these briquettes it was sun dried for 10 days before study.

5) Proximate Analysis of the Briquettes

<table>
<thead>
<tr>
<th>Serial no.</th>
<th>Briquette sample</th>
<th>Water boiling test (min.)</th>
<th>Burning time (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100% CD</td>
<td>2.42</td>
<td>36.22</td>
</tr>
<tr>
<td>2</td>
<td>80% CD &amp; 20% RH</td>
<td>2.80</td>
<td>27.83</td>
</tr>
<tr>
<td>3</td>
<td>60% CD &amp; 40% RH</td>
<td>3.15</td>
<td>22.43</td>
</tr>
<tr>
<td>4</td>
<td>20% CD &amp; 80% RH</td>
<td>4.24</td>
<td>17.44</td>
</tr>
<tr>
<td>5</td>
<td>100% RH</td>
<td>6.50</td>
<td>18.40</td>
</tr>
</tbody>
</table>

Key-CD = Coal dust, RH = Rice husk

<table>
<thead>
<tr>
<th>Serial no.</th>
<th>Briquette sample</th>
<th>Ignition temperature (oC)</th>
<th>Decrease temperature (oC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100% CD</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>80% CD &amp; 20% RH</td>
<td>303</td>
<td>27 oC decrease</td>
</tr>
<tr>
<td>3</td>
<td>50% CD &amp; 50% RH</td>
<td>291</td>
<td>39 oC decrease</td>
</tr>
<tr>
<td>4</td>
<td>20% CD &amp; 80% RH</td>
<td>272</td>
<td>58 oC decrease</td>
</tr>
<tr>
<td>5</td>
<td>100% RH</td>
<td>253</td>
<td></td>
</tr>
</tbody>
</table>

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IV. DISCUSSIONS
The proximate analysis illustrate that moisture content values improved through the sum of rice husk added with 100% rice husk briquettes having the utmost value since rice husk is more coarse than coal and the density decreased by adding up of rice husk to the coal and 100% coal briquettes have the maximum value because coal particles are a lot held jointly. The outcome of the sulphur content showed that 100% coal briquettes have the maximum sulphur
content other than with the briquetting of coal and rice husk, increasing the total of the sulphur fixing agent Ca(OH)₂ the sulphur content decreases and the results also show that the extra the free particles of flammable material are, the added expected the volatile matter produced, because particles of rice husk are a smaller amount bonded to each than coal particles, 100% rice husk briquettes will produce more volatile matter ahead heating than 100% coal briquettes and to decrease the volatile matter and create the briquettes more appropriate for ignition the composition of coal and rice husk were different to yield briquettes with reduced volatile matter. The ash contents of briquettes is high in 100% coal briquettes than 100% rice husk briquettes since coal contains more non-combustible compounds than rice husk and the combination of the coal and rice husk will generate briquettes with reduced ash content, fixed carbon gives an suggestion of the percentage of char that remained after the devolitization phase and the production of briquettes from coal and rice husk with varying their compositions outcome in briquettes with reduced carbon content. The porosity index shows that briquettes of biomass in which the particles are more adhered to each other will have a lesser porosity index values than those with loose particles and rice husk has more coarse loose particles not like coal dust particles, for itself the briquettes from blend of coal and rice husk will have pores that will assist in the passageway of oxygen that is required for combustion to take place. The moisture content is a calculate of the quantity of water in the fuel, in solid fuels, moisture can exist in two forms- as free water within the pores and interstices of the fuel, and as leap water which is element of the chemical structure of the material (Borman et al., 1998). Moisture content is a especially important property and be able to greatly influence the burning characteristics of the briquettes (Yang et al. 2005). The results shows that briquettes of 100% rice husk have the utmost values of moisture content while compared to other compositions of briquettes, the result as well shows that the briquetting of coal and rice husk reduces the moisture content and because coal is denser than rice husks, the briquettes formed with higher composition of coal will have a high density rate than those briquettes with high rice husk values, the lesser the porosity index of the briquettes the superior the density of the briquettes formed, the values shows that 100% coal briquette has a higher density than 100% rice husk, the calorific value (or heating value) is the standard determine of the energy content of a fuel. It is defined as the quantity of heat evolved when a unit weight of fuel is totally burnt and the combustion goods are cooled to 298k, the ignition time of the briquettes shows that 100% rice husk briquettes are simply ignited unlike 100% coal briquettes, the blending of coal and rice husk produces briquette that ignites very speedy, thereby solving the unhurried ignitability difficulty of coal briquettes. The water boiling test passed out on the briquettes shows that the briquettes prepared from blends of coal and rice husk briquettes burn quicker than 100% coal briquettes and 100% rice husk briquettes and the differences in burning time for briquettes of 100% coal and those of coal and rice husk are a small amount, then blending will not single build the briquettes ignite very fast other than will permit for longer cooking time. The cost of briquettes is four times lesser than coal.

V. CONCLUSION

In conclusion, bio-mass briquettes contain drawn worldwide attention as an energy resource because it does not harmfully influence the environment and these bio-coal briquettes are very capable since the quality of solid fuel depends on the subsequent factors, as long as satisfactory heat as at time needed, igniting simply lacking danger, generating less smoke and gases that are injurious to environment, generating less ash, because these make up irritation for the period of cooking. The briquette sample 50% coal:50% rice husk yielded best possible combustible values when compared through the additional blends of briquettes.

REFERENCES