Experimental analysis of Briquetted cashew shell and tamarind seed as source of bio energy generation

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Abstract. Sustainable development implies development brought to the present society without giving up on the scope of needs that future generation requires. For achieving sustainable development various goals were been fixed and indicators are been used to measure up the progress. Energy utilization is one of the important aspects for development of a country, technology etc. The energy utilized has mostly been fossil based such as coal, oil etc. These sources have been used in electric generation in most countries and crude oil refined petrol and diesel have been used for transporting purpose. The usage of the fossil-based fuels which has more carbon content in them possess the threat of polluting the environment by causing emission into the atmosphere, Moreover the availability of reserves of these sources are also become thin as these are non-renewable source of energy. For overcoming these obstacles, the developed countries are being focussing on renewable sources of energy for managing the energy demand and to have eco-friendly environment. The advancements in the field of bioenergy have contributed energy generation from different sources through various techniques. One of the important aspects about the bioenergy generation is utilizing the waste, end products of the biomass to energy. Various wastages from agro to food industries are not managed as it degrades on its own. However, these organic wastages can be viewed as a source for energy generation. The objective the experiment is analyse tamarind seed, cashew seeds and blend of both in powder form and briquetted for energy generation. The experimental result indicates that the briquetted form of is more suitable in terms of properties with higher fixed carbon contents.

1 Introduction

The rising population and environmental sustainability objectives, there is a growing need for alternate and ecologically acceptable energy sources. Both industrialised and developing nations are concentrating on building infrastructure based on renewable energy sources to

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achieve the goals of sustainable development. [1] One of the alternative energy sources that has gained popularity in remote areas for energy delivery is energy from organic biomass. The energy obtained from biomass feedstocks is used to produce power, recuperate heat, retrieve liquid fuels, and other things. It is a perfect solution for various industries. [2] In recent years the concept of waste to energy is gaining more prominence as the energy generation from source are been more renewable in nature. The waste generated in day-to-day activities in households, kitchens are been simply categorized as garbage and disposed in different ways such as degrading on its own, mass burning after garbage collection etc. Similarly, the food processing industries the by-products of different food products are also been left and potential for energy generation from the sources is immense. An untapped by product of the tamarind pulp business is tamarind seed. The textile, paper, and jute industries only employ a small percentage of the seed, in the form of tamarind kernel powder (TKP), as a sizing ingredient. Although this seed has a wide range of potential uses, such as as an addition in food compositions, very little else has been done with it. [3] High combustion characteristics make tamarind seed oil biodiesel suitable for use in engines. In addition, when utilised as motor fuel, tamarind seed oil biodiesel is harmless to the environment and can help minimise carbon emissions. Tamarind seed oil biodiesel has demonstrated that the overall greenhouse gas emissions may be significantly decreased. [4] Pyrolysis of tamarind seeds into bio-oils were investigated. The physical and chemical features of the pyrolysis liquid produced under these ideal processing conditions were examined in order to be employed as an alternative fuel. The findings indicate that tamarin seeds have the potential to be a significant source of chemicals and alternative fuels. [5] Investigation of Cashew nut shell liquid biodiesel production in diesel engines indicates promising results as brake thermal efficiency is around 12.3 to 25.7 based on the experimental conditions and lower emission also been observed. However, the problems associated is higher density and viscosity of the cashew nut shell liquid biodiesel. [6] Blending the tamarind seeds and cashews seeds in powdered form and briquette of the same can be optimized to generate energy efficiently. The manufacture of briquettes depends heavily on the briquette binder. The quality of the briquette binder has an impact on both the quality and performance of briquettes. Different briquette kinds require various briquette binders.[7] Raw material particle size is one of the crucial factors affecting briquetting efficiency. The materials are often cut since doing so immediately raises the calibre of the final output. According to the study, heterogeneous materials have greater qualities than those of a uniform size. The combined materials produce a superior product density while using less energy. [8] The amount of moisture present is a key factor in determining how effectively a process works. Ideal briquettes should have a moisture level of between 10 and 18%. The briquette that results from cutting non-optimized values has weak bonding and crumbles easily. [9]

2 Materials and Methods

Tamarind seed and cashew seeds are been selected for experimental investigation based on the literature studies. The samples of tamarind seed and cashew seeds are finely powdered using sharper grinders. Totally six combinations of material samples were taken shown in the table no 1.
Table 1. Materials

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sample Material</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Tamarind Seed Powder</td>
<td>Powder</td>
</tr>
<tr>
<td>B</td>
<td>Cashew Seed Powder</td>
<td>Powder</td>
</tr>
<tr>
<td>C</td>
<td>Blend of Tamarind and Cashew Seed Powder</td>
<td>Powder</td>
</tr>
<tr>
<td>D</td>
<td>Briquetted Tamarind Seed Powder</td>
<td>Solid</td>
</tr>
<tr>
<td>E</td>
<td>Briquetted Cashew Seed Powder</td>
<td>Solid</td>
</tr>
<tr>
<td>F</td>
<td>Briquetted Blend of Tamarind and Cashew Seed Powder</td>
<td>Solid</td>
</tr>
</tbody>
</table>

The sample of tamarind seed, cashew seed and mixture of tamarind seed and cashew seed in ratio of 50:50 are briquetted and characterized. By drying them in the open air, the moisture content is reduced throughout the briquetting process. The dried material is then added to the briquetting machine's hopper. Through the screw, the feed material is introduced into the cold chamber. Continuous feed material input causes the die section to build up pressure, which causes loose feedstock to take the shape of the die. To keep the briquette's form, it is heated between 3500 and 400 °C. The briquetting machine has a 50 hp induction motor with a 1400 rpm maximum speed. Screw dimensions are 395 mm in length and 52 mm in outer diameter. The material is E.N.32. Die measures 78 mm in length, 85 mm in external diameter, and 62 mm in internal diameter as shown in figure 1. The power transmission method uses V and pulley belts, and the hourly electricity usage is 0.15 kW.

Fig. 1. Briquetting Machine

Fig. 2. Briquette sample of Cashew Seeds and Blend of Tamarind Seed and Cashew Seeds
3 Result and Analysis

3.1 Proximate Analysis

For the proximate analysis, the modified ASTM standards D3172-75 techniques advised for solid and powdered samples are applied. For performing the proximate analysis, a muffle furnace was used.

**Moisture content**

As samples were taken in crucibles and weighed after being exposed to a temperature of 110 + 5°C for an hour, the moisture content of the sample was measured. For better efficiency the sample should contain minimum amount of moisture and the sample E is with 0.15 % of moisture content, whereas sample A contains maximum moisture content of about 0.67 %.

![Fig. 3. Moisture content](image)

**Volatile Content**

The dried samples in a closed crucible were heated to 950 oC for 7 minutes to determine the volatile content, and then they were allowed to cool. The weight of the heated sample is compared to the dried sample's weight. Biomass for energy generation should have higher volatile content which makes the material easy to burn, the sample A has higher volatile content of 8.46 % and sample E has 2.8 % of volatile content.
Ash Content

Ash content is estimated using the weight of the original sample divided by the weight of the ash. The dried samples obtained from the moisture content analysis were heated to 750\(^\circ\text{C}\) in a furnace for a duration of one twenty minutes in order to assess the amount of ash present. A sample exposed to high temperatures for an extended period of time produced ash as carbon and volatile substances oxidised. Using solid biomass for fuel desired to have lower ash content level for minimal maintenance. The sample E has the lowest ash content % of 0.34 % and sample A has the maximum ash content residue around 8.2%.

Fixed carbon

Fixed carbon is the solid residue that is left over after heating causes the volatile stuff to be released. For getting higher efficiency the solid biomass should have high carbon concentrations. The sample E has the high amount of fixed carbon content with 96.7 % and sample A with lower fixed carbon around 82.67 %.
The sample weight of 1 grams is taken and measured for calorific value using digital bomb calorimeter. The result indicates that the powdered of samples and briquetted sample’s calorific values are sample with sample B and E having the higher calorific value of 1854.985 cal/g and sample A and D having lower caloric value of 1494.314 cal/g. The blend of Sample C and briquetted blend sample F having intermediate calorific values of 1660.369 cal/g.

### 4 Conclusion

Based on the characterization of the six samples the cashew shell samples are having better properties and briquetted samples also exhibits better results comparing the powdered sample. Normal combustion of these sample causes pollution to the environment and utilizing the samples for gasification process can be viewed as viable as both briquettes and blended combinations shown excellent properties characterized on proximate analysis. The moisture
content levels of the briquetted samples are low comparing the powdered samples which are important aspects for gasification process. However, the volatiles content is higher in the powdered sample comparing to the briquetted sample and for gasification process materials with which are volatile in nature are been preferred. The sample F briquette blend of tamarind seed and cashew seed having relatively higher volatile content in briquettes and can be suitable for gasification. Likewise, the fixed carbon values are improved in briquetted samples which can result in generating higher energy generation on heating. Regardless of the briquetting or powdered form the sample the calorific values don’t change and cashew seeds samples and briquetted cashew seed sample shows higher calorific value comparing the other samples and blend of tamarind seed and cashew seed shows better calorific value comparing tamarind seed samples.

References