Waste to Energy – Making charcoal fines useable

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Abstract

Agricultural wastes and charcoal fines can be transformed into charcoal briquettes, this result in a decreased exploitation of rain forests. The paper reports a about charcoal briquette production and a study on 25 charcoal consumer's perception about using these briquettes.

Keywords: Charcoal fines; Briquettes.

Background

Uganda's energy balance is comprised of hydro, solar, petroleum and biomass. Among these, biomass contributes to over 91% of the total energy consumed in the country to meet basic energy needs for cooking and water heating. The traditional ways of using biomass are 80% wood, 6% charcoal and 5% agricultural waste (MEMD[1], 2008).

Uganda's failure to transform her natural agricultural wastes into charcoal briquettes has resulted in an increased exploitation of Uganda's primary forests. In addition, the country's failure to plan ways of sustainability for its logging industry has resulted in forests that are currently being depleted with no plans for replacement. Moreover, the ravaging of our forests is causing an even greater shortage of the woody biomass necessary for making firewood and charcoal. This has contributed to increment in prices for cooking needs among the rural people. More still, these people tend to spend more time and effort in collecting firewood.

Charcoal is a popular household fuel in many parts of Uganda with a consumption of about 600,000 tons as of 2008 (MEMD, 2008 Annual report). To produce 1 ton of charcoal, on average 7 tons of wood is burned in inefficient kilns causing rapid dwindling of forests resource. The charred material burns longer, has a steady flame; is easier to transport / handle and dries faster after it becomes wet compared to wood.

The proportion of charcoal fines in bags increases significantly up to 15% during distribution. The more the charcoal is handled and the more the transport stages, the more the charcoal fines are produced. The disadvantages of charcoal fines include its inability burn in the usual charcoal stove as well as its lower purity than charcoal. Partly because of these charcoal fines are hardly used and often get dumped.

Approach

Objective

The main purpose of this study was to establish a sustainable business model for effective use of charcoal briquette made from charcoal fines and agricultural by-products.

Data from the survey in Kampala allowed the following: (i) gaining more understanding of charcoal users' perceptions and attitudes towards charcoal and Eco-Manda; (ii) assessing households' ability and willingness to switch from charcoal to Eco-Manda; and finally (iii) identifying barriers that may inhibit charcoal users from switching to Eco-Manda.

Waste to energy

The process of compaction of residues into a product of higher density than the original raw material is known as briquetting. Briquettes are made by pressing a mixture of binding material with charcoal fines and carbonized agricultural waste into a mould. The briquettes are then sun dried, packaged and distributed to the final consumer. Briquettes can be used in the available stoves as a cooking fuel.

Compared to fire wood or loose biomass, briquettes give much higher boiler efficiency of 1000 to 1500 kg/m^3 and bulk density of 800 kg/m^3 because of low moisture compared to 60 to 180 kg/m^3 of loose biomass (Ahmed[2], 2010). Due to their density and low moisture content the briquettes give a longer burning time. In this way they make use of waste and relieve forestry resources of depletion. Furthermore, end-users save money because the product is a result of cheaper raw materials.

Pilot project

Production

The process briquette production took place at CREEC[3] bio-energy research centre. One hundred twenty five kilograms of charcoal briquettes were produced using two

[1] MEMD – Ministry of Energy and Mineral development

[2] Dr. Ahmed Hassan Hood's Biomass briquetting in Sudan

[3] CREEC: Centre for Research in Energy and Energy Conservation

main components; charcoal fines and a binder. This time cassava flour was used for binding the fines.

To remove larger particles charcoal fines were crushed and sieved. Proportions of crushed material and gelatinized starch (cassava) were poured into a mixing container in a 50:1 ratio, (charcoal fines to starch). The crushed fines then thoroughly mixed by use of hands to coat with a film of a binder, in order to enhance adhesion. The mixture was converted into finished products using a manual press e.g. modified mincing machine. The wet produced briquettes were placed on paper boards and later dried under the sun for three days. The dried briquettes were packed in 5 kg bags.

User survey and results

The packs were distributed to 25 charcoal users by Green Heat (U) Ltd[4]. The company chose Eco-Manda as the brand name for the self-made briquettes; Manda is a Ugandan word for charcoal. Both the product and name were tried with 25 charcoal users in September 2010 in Kampala.

The trial group represented different types of charcoal user, ranging from households, barbecue stalls and small restaurant owners. Each user was supplied with a 5 kg pack of Eco-Manda and a customer satisfaction questionnaire.

All subjects surveyed showed high preference for the brand name and the feedback on the initial product was very positive. Twenty three questionnaires were returned and out of these, 13 respondents were willing to buy a 5 kg pack of Eco-Manda at $ 1.25, while the rest were willing to spend $ 1.50. Results from the survey indicated that households and small restaurants spend at least $ 5 to $ 65 respectively on charcoal per week.

The survey observed/showed what would motivate current charcoal users to switch from charcoal to Eco-Manda. The responses are shown in the table below:

Table 1: Motivating factors

Factor	Respondent	
	Number	Percentage
Lower cost (LC)	1	4
Efficiency (Eff.)	6	26
Environment (Env't)	6	26
All the above	3	13
LC and Eff.	1	4
LC and Env't	2	9
Eff. and Env't	2	9
None of the above	2	9
Total	**23**	**100**

From the table above, 26 percent of the respondents would purchase Eco-Manda because of; environmental and efficiency reasons. Thirteen percent would be motivated to buy Eco-Manda because of the low cost, efficiency and environmental reasons.

In addition, 20 respondents found Eco-Manda better than conventional charcoal, since Eco-Manda provided stable heat for a longer period of time. Nineteen respondents reported Eco-Manda to be of superior quality than conventional charcoal.

A criticism of Eco-Manda from some of the respondents was that it was easy to break and could not be transferred to another stove once lit, as it would disintegrate. Fifteen subjects stated that Eco-Manda was also harder to ignite than conventional charcoal.

Lessons learned

Transformation of charcoal fines and agricultural waste into charcoal briquettes, contributes to fuel (charcoal) efficiency thus, reducing carbon dioxide emissions and saving wood.

Briquettes from charcoal fines provide additional income to charcoal vendors, serving both social and economic functions. Finally, Eco-Manda would enable households and restaurants save $ 2 and $ 15 weekly, respectively.

Research demands

Green Heat (U) Ltd will purchase on an electric powered briquette press which will mould Eco-Manda into pillow-like shapes. This press has rollers which exert a pressure of 900 kg/m^2 making each pillow tougher and more compressed. The thin edges of the pillow are presumed to allow easy ignition.

Research is needed on alternative binders; cassava-starch is commonly used as the binder yet is a staple for many communities in Uganda.

Since cost of fuel is an important factor to majority of Ugandans, any company wishing to venture into this as a business should aim at producing a fuel that is sustainable and affordable. This requires both consumer behavior and market research.

[4] Green Heat (U) Ltd starts commercial briquette production in January 2011.