Fuel Briquettes: An affordable and cleaner cooking and heating fuel

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The development of innovations that meet people's cooking and heating energy needs and preferences helps to reduce the burden of work for women and girls, while conserving the environment, improving health, and eradicating poverty in sub-Saharan Africa (SSA). Recycling organic waste for fuel briquettes is a promising alternative source of cheaper and cleaner cooking and heating energy while contributing to cleaning urban neighbourhoods, generating income and creating job opportunities, especially for women and youth. This article presents a few examples of fuel briquette production techniques, applied by local community groups in sub-Saharan Africa (SSA), and which can easily be applied in similar situations.

Fuel briquettes in SSA?

Fuel briquettes are a form of energy similar to firewood or charcoal (both referred to as wood-fuel). Fuel briquettes are made by compressing biomass material into a solid unit while using manual or automated presses/machines or other techniques either with or without a binder. Fuel briquettes can be made from non-carbonised (fresh) raw materials such as uncooked food wastes e.g. banana peelings and leaves, maize cobs, rice husks. The biomass materials can also be carbonised (burned under controlled oxygen to remove volatile gases and liquid) before being compacted into briquettes. A binding agent is required while producing briquettes from raw materials that have low agglomerating capacity.

Briquettes are used just like wood-fuel and in similar charcoal and firewood cook stoves, making them a practical alternative or complementary source of energy. Charcoal and firewood are relied on by more than 90% of the population in SSA as a primary source of domestic energy (IEA, 2006). While firewood is mainly used in rural areas, charcoal, on the other hand, is used in urban areas. The demand for charcoal is predicted to increase due to urbanisation and population increase. A 1% increase in population results in a 14% rise in charcoal consumption, despite the fact that there is already a high deficit (World Bank, 2009). Unless the supply of charcoal increases tremendously or the prices fall radically, both unlikely trends, there is need for alternative cheaper sources of biomass cooking and heating energy.

Community-based technologies

One common type of community-based technology is charcoal briquettes. Production of charcoal briquettes is a widespread technique practised by women and youth groups, mainly in urban informal settlements, and involves the recycling of charcoal dust. Charcoal dust comprises small, fine particles and is considered a waste product (heaps of it are visible in charcoal retailing places). About 10-15% of charcoal along the supply chain ends up as charcoal dust (Mugo et al., 2007). Charcoal dust was acquired free till demand for briquettes increased and a customer base was created. The charcoal dust is sieved to get fine particles and remove impurities such as pieces of bone, wood, and stones. The charcoal dust is placed on the ground or in a plastic basin and a binding agent, such as soil, starch or biodegradable paper soaked in water for about 2-3 hours, is added. The amount of binding agent is dependent upon its binding capacity. Some examples of mixing ratios are given below. Water is then added as needed and, using bare hands, the mixture is combined until a homogenous slurry is achieved. Another type of briquette is that made from well-dried raw (non-carbonised) sawdust, which is mixed with gum arabic



(a)Charcoal briquettes moulding in recycled plastic containers and (b) compacted in wooden manual press and (c) sawdust briquettes compacted using metal manual press. All photos by Mary Njenga



(a) Producing charcoal using drum kiln, (b) grinding charcoal and (c) producing briquettes using automated machines by Great Heat in Kampala

resin as a binder. The gum arabic is soaked in water overnight and used the following day. Once the slurry of the raw material and the binder is thoroughly and homogenously mixed it is then compacted using manual metal or wooden presses or moulded using bare hands in the case of charcoal briquettes.

There is a gender issue on choice and preference of compaction technologies, with women preferring simple techniques that require less use of force, such as moulding in recycled containers. Women also prefer presses with handles that allow use of weight as a source of force as opposed to using arms.

Youth are more interested in getting employed in briquette-producing enterprises that use complex machines such as automated grinders, mixers and presses.

There are simple techniques of making charcoal from organic waste. For example, Green Heat, a social enterprise run by youth in Kampala Uganda, works with local communities from whom they buy charcoal produced from banana leaves and peelings using drum kilns. The group use an automated machine to grind the charcoal into a fine dust which is later mixed with molasses as a binder in another automated machine. The mixture is finally transferred to a third automated machine that compacts it into charcoal briquettes.

Utilisation

As a cooking and heating fuel, briquettes are used in similar stoves as firewood and charcoal. There are other uses of briquettes such as keeping chickens warm in chicken hatchery farms and drying tea by small-scale farmers in tea factories.

Benefits

The following benefits can be identified.

- ***Cheaper energy for cooking and heating***. Briquettes are a cheaper form of energy, hence their popularity among low-income populations, particularly in informal urban settlements. For example, cooking a traditional meal of



(a) Drying briquettes on beds in Kampala (b) and on rooftops in Nairobi


(a) Cooking with briquettes, (b) heating space to keep chicks warm. Photos by Trevor Rees



Pots after cooking for 3 hours with (a) briquettes, (b) charcoal and (c) kerosene.

500 grams of green maize mixed with 500 grams of dry beans (enough for a Kenyan standard household of 5 people) costs 3 ksh (US$0.04) when using 850 grams of charcoal-soil briquettes, 26 ksh (US$0.35) using 890 grams of conventional charcoal and 45 ksh (US$0.6) using 0.36 litres of kerosene. Cooking the meal with charcoal briquettes is thus 9 and 15 time cheaper than cooking the meal with charcoal and kerosene respectively.

- ***Income and reduced expenditure on energy for cooking***. Households that produce briquettes for own use and those that purchase them save about 70% and 30% respectively of income spent on cooking energy. Briquette producers generate income, which is hard to do in the informal settlements.
- ***Reduced health risks associated with indoor air pollution.*** Charcoal briquettes made of 80% charcoal dust and 20% soil reduce concentrations of carbon monoxide (CO) and fine particulate matter ($PM_{2.5}$) in the kitchen by 66% and 90% respectively compared to cooking with charcoal. This quality characteristic is influenced by raw material, binder and the production process.
- ***Improved water use and hygiene in the kitchen***. Cooking pots used when cooking with briquettes accumulate no soot and hence require less cleaning, improving hygiene and water use at the household level.
- ***Reduced cost of production***. Using briquettes saves money that would otherwise be spent on electricity bills in order to keep chicks warm or drying tea for example. This increases income of farmers by reducing expenditure.
- ***Resource recovery and reuse.*** The technology is largely based on use of organic by-products in the form of crop or tree residues that otherwise pollute urban areas, especially informal settlements that lack waste management services. Recycling waste reduces expenses incurred by municipalities in transportation and management of landfills.
- ***Environmental management.*** Using briquettes reduces the pressure on trees otherwise cut down for charcoal or firewood. Recycling charcoal dust reduces the global warming potential from the charcoal life-cycle, which includes carbonising trees into charcoal, transportation and cooking.

Recommendations

Despite these benefits, there are a number of challenges that needs to be tackled for community-based briquette production and use. One is lack of land for drying the briquettes, or poor access to water. To solve the water problem, the groups could be trained on simple household wastewater purification for use in briquette production. This is practical as briquette production generally takes place near their homes. Another issue is the access to capital for equipment like high-capacity presses or large drying beds/shelves under shade of translucent roof sheets for enhanced drying. Organised financial support by savings groups or support by local financial institutions is needed. Equal opportunities in accessing land, water and other resources should be given to women and men including the youth, and it is important to respond to specific gendered needs and preferences when improving efficiency in briquette production. For instance, building structures for better drying of briquettes will be more practical than piling up moulded briquettes by hand on the ground. Promotion campaigns such as through television and radio programmes, mobile phones and online edutainment video clips are required to tackle low awareness on the quality and benefits of briquettes in the community and hence low sales. And finally, there is need to integrate briquette making into a proper waste management system aimed at recycling, including development of public and private partnerships in waste collection and use.

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