# BIOMASS BRIQUETING FOR CHANGING COMMUNITIES

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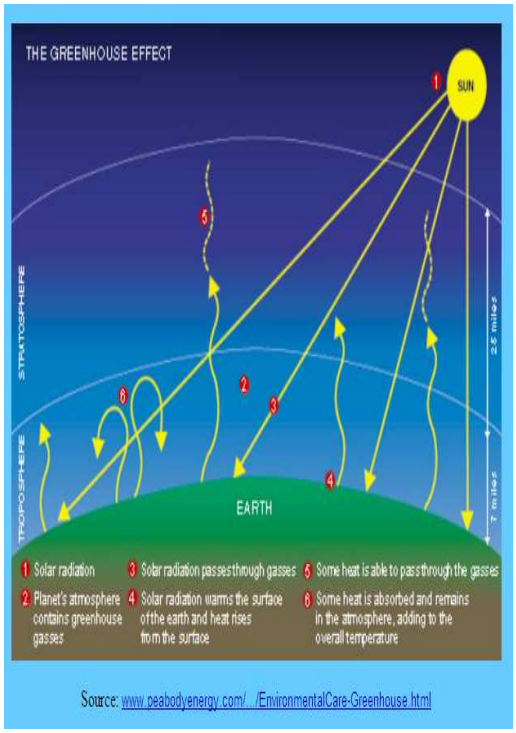
**Abstract**

*Greenhouse effects which bring about Global warming caused by $CO_2$ and other substances have become an international concern. To protect forestry resources which act as major absorbers of $CO_2$, controlling the ever increasing deforestation, along with the increase in the consumption of wood fuels, such as fire wood and charcoal, needs urgent attention. Given this, it becomes pertinent to develop a substitute fuel for charcoal. Bio-coal Briquette production technology, a clean type of coal technology can help prevent flooding and serve as a global warming counter measure by conserving forestry resources through the provision of a stable supply of briquettes as a substitute for charcoal and firewood. This paper x-rayed the importance and use of biomass briquetting as an alternative source of energy for changing our communities.*

**Key words:** Biomass, Briquetting, greenhouse effects & Global warming,

About 80% of Nigerians live in the rural or semi-urban areas and they depend solely on fuel wood for their energy needs (Ogbu, 2010).Fuel wood accounts for about 37% of the total energy demand of the country. According to Energy Commission of Nigeria,(2010),out of the total wood demand from the forest, 90% goes to fuel wood. Direct combustion of this fuel wood generates greenhouse gases like $CO_2$. . These pollutants remain and cause global warming. The consequences of this have made the country to face forest degradation problems, desertification, flooding etc.




It is very obvious that reduction in the use of fuel wood will drastically reduce the pressure mounted on the forest in search of wood. Meanwhile, the total forest cover of Nigeria is still less than 10% of the land area, which is far below the 25% recommended by the United Nation Development Programme (UNDP) (Philip, 2007). Efforts should therefore be geared towards addressing this situation. The energy requirement is increasing

day by day as the population as well as the number of industries is increasing proportionately without corresponding increase in power supply.

Aside the environmental effects of fuel wood, its use for cooking has other health implications. Generally, the smoke from fuel wood and other biomass contains a large number of pollutants. Some of these pollutants include particulate matters, carbon monoxide, formaldehyde and carcinogens such as benzo[α]pyrene, 1, 2–butadiene and benzene (Schirding and Bruce, 2002). It has also been revealed that exposure to biomass smoke increases the risk of a range of common diseases in children and adults. For instance, acute lower respiratory infection (ALRI), particularly, pneumonia in children (Smith and Sammet, 2000), chronic bronchitis and chronic obstructive pulmonary diseases (COPD). Eye irritation (sore, red eyes, tears etc (Bruce and Perez-padilla, 2001). Studies has also proved that a person exposed to biomass smoke has high risk of cataracts disease which is capable of damaging the eye lens (Ezatti and Satch, 2010)

Many of the developing countries produce huge quantities of agro residues but they are used inefficiently causing extensive pollution to the environment. The major residues are rice husk, coffee husk, coir pith, jute sticks, bagasse, groundnut shells, mustard stalks and cotton stalks. Sawdust, a milling residue is also available in huge quantity. Apart from the problems of transportation, storage, and handling, the direct burning of loose biomass in conventional grates is associated with very low thermal efficiency and widespread air pollution. The conversion efficiencies are as low as 40% with particulate emissions in the flue gases in excess of 3000 mg/Nm³ (Grover and Mishra, 1996). In addition, a large percentage of unburnt carbonaceous ash has to be disposed of. Rice husk, amounts to more than 40% of the feed burnt. As a typical example, about 800 tonnes of rice husk ash are generated every day in Ludhiana (Punjab) as a result of burning 2000 tonnes of husk. Briquetting of the husk could mitigate these pollution problems while at the same time making use of this important industrial/domestic energy resource.

**History of Biomass Briquetting Technology**

Biomass densification, which is also known as briquetting of sawdust and other agro residues, has been practiced for many years in several countries. Screw extrusion briquetting technology was invented and developed in Japan in 1945. As of April 1969, there were 638 plants in Japan engaged in manufacturing sawdust briquettes, known as 'Ogalite'. The fact that the production of briquettes quadrupled from 1964 to 1969 in Japan speaks for the success of this technology. This technology should be differentiated from such processes as the 'Prest-o-log' technology of the United States, the 'Glomera' method in Switzerland and the 'Compress' method in West Germany.

Historically, biomass briquetting technology has been developed in two distinct directions. Europe and the United States has pursued and perfected the reciprocating ram/piston press while Japan has independently invented and developed the screw press technology. Although both technologies have their merits and demerits, it is universally accepted that the screw pressed briquettes are far superior to the ram pressed solid briquettes in terms of their storability and combustibility. Japanese machines are now being manufactured in Europe under licensing agreement but no information has been reported about the manufacturing of European machines in Japan. Worldwide, both technologies are being used for briquetting of sawdust and locally available agro-residues. Although the importance of biomass briquettes as substitute fuel for wood, coal and lignite is well recognized, the numerous failures of

briquetting machines in almost all developing countries have inhibited their extensive exploitation.

Briquetting technology is yet to get a strong foothold in many developing countries because of the technical constraints involved and the lack of knowledge to adapt the technology to suit local conditions. Overcoming the many operational problems associated with this technology and ensuring the quality of the raw material used are crucial factors in determining its commercial success. In addition to this commercial aspect, the importance of this technology lies in conserving wood, a commodity extensively used in developing countries that leads to the widespread destruction of forests.

At present two main high pressure technologies: ram or piston press and screw extrusion machines, are used for briquetting. While the briquettes produced by a piston press are completely solid, screw press briquettes on the other hand have a concentric hole which gives better combustion characteristics due to a larger specific area. The screw press briquettes are also homogeneous and do not disintegrate easily. Having a high combustion rate, these can substitute for coal in most applications and in boilers. Briquettes are a household and institutional fuel, made by compacting biomass waste

**Briquettes and its Applications**

A briquette (or briquet) is a compressed block of coal dust or other combustible biomass material such as charcoal, sawdust, wood chips peat, or paper used for fuel and kindling to start a fire. The term comes from the French language and is related to *brick*. Briquettes are made from raw materials that are compacted into a mould. Briquette could be made of different shapes and sizes depending on the mould. The appearance and burning characteristics of briquettes depends on the type of feedstock and the level of compactness and the mould used.

Briquettes of different shapes and sizes.

Briquettes have a wide variety of use from household to industrial. The fuel has not been fully exploited probably because of lack of awareness. However, with the current fuel shortage and ever rising prices, consumers are looking for affordable alternative fuels and briquettes to fill this gap for:

• Cooking and water heating in households;

• Heating productive processes such as tobacco curing, fruits, tea drying, poultry rearing etc;
• Firing ceramics and clay wares such as improved cook stoves, pottery, bricks etc;
• Fuel for gasifiers to generate electricity;
• Powering boilers to generate steam.

**Benefits of Briquetting**

Briquettes can potentially offer the following benefits over traditional biomass fuels (firewood or charcoal):
• Uniformity and standardisation;
• Could be tailored to the particular usage i.e. Long burning time, stove (institutional or households), smoke and ash levels among others;
• Lower overall fuel costs for users as they are made from biomass waste.
• It can use either no machinery at all, or low cost machinery (as little as US$70), so you can start small;
• Raw materials are often readily available – can either be grown or obtained from factories as waste;
• It requires low technical skills for you as an entrepreneur.
• The household market comprises individual onsumers who need fuel for cooking and heating. Briquettes can be a great substitute for charcoal. The key benefits include reducing household fuel bills and longer-lasting burning.
• The institutional market (e.g. schools, hospitals, hotels) could be made up of organizations that utilise charcoal and firewood for their production or cooking processes. The use of briquettes could prove to be a more economical, healthy and environmentally friendly way to provide energy.

**Briquettes Production**

The size and shape should be designed to match the market (Stove to be used). For household use, a high surface area (compared to its weight) is needed to enhance burning. This helps to make combustion uniform and complete, reducing harmful gases and smoke. This can be achieved by: a) having a hole(s) in briquettes, or b) making small briquettes commonly referred to as pellets, say half the size of a mug.

**Feedstock**

The choice and availability of feedstock can make or mar your business. A common feedstock to use is charcoal dust (particles of charcoal too fine to be sold). But other combustible material can potentially be used too, including: saw dust, bagasse, coffee husks, maize cobs, wheat/beans/barley straws and charcoal dust etc. For example, the Figures below shows (a) a mountain of saw dust and (b) dried grass in readiness for briquettes production.

a. Saw dust

b. Dried grass

For one to produce quality briquettes, a number of factors need to be taken into considerations such as: moisture content, calorific value of the feedstock, smoke levels and ash content. In

most cases (unless a powerful machine is used) a binding agent is added. Clay is common. There is an added benefit to using clay: it can lower the rate of burning, so less heat is produced but for a longer period.

**Process options**

**Carbonised process**: In this process the feedstock is first partially burned in an environment where fresh air is controlled. The process is known as charring or carbonisation. Once carbonised, the materials are then compacted using a briquette press. The advantage with carbonised briquettes is that they are **virtually smokeless** – a key consideration for household users. Carbonising kilns range from the very simple (a hole in the ground, covered by turf) to more complex and more efficient designs. For example, a carbonising kiln from Appropriate Rural Technology Institute (ARTI), India. It is a portable cylindrical structure about 150cm wide with 100 cm tall made out of sheet iron or a used drum: A very common practice is to make briquettes from charcoal dust that has already undergone carbonisation.

**Non-carbonised process:** This is the process of making briquettes without first carbonising them. The biomass materials are simply prepared and compacted to produce briquettes. This is simpler (and cheaper) process for a micro and small scale enterprises than carbonising – but only suited to applications where smoke is not an issue. However, for industrial applications, it requires sophisticated machines to attain the level of compactness required.

**Pressing Machines**

Briquettes can be made by hand. Feedstock is mixed with water and a binder, moulded into balls and left to dry. This is an easy way to get your business off the ground and there is no excuse for not giving it a go. However, machines can potentially: 1) add value to the product 2) increase the amount of briquettes a single person can produce in a day.

**Range of Machines.**

Machines range from simple manual press to a fully motorised and complex type. The main thing to consider is how many briquettes you want to produce and this will narrow down the type of briquette machine required. For start-ups, a manual briquette machine might be appropriate, as it may not require too much investment. For example, the machine with a capacity of up to 100kg/hr, may be effective for small-scale production. The first section gave an overview of briquetting as a technology; now read about the business angle to briquettes.

**Micro Briquette Producer**

A popular business model is to be a producer of briquettes; that is, collecting and processing raw materials and selling direct to consumers or wholesalers. Some investment would be needed to get such a business off the ground, but the amount could be a quite small, less than US$200. Comparing this to monthly sales revenues (up to US$300 monthly) it is clear such a briquetting business could be profitable.

Another model (if producers already exist in the area) is briquettes trading; buying in bulk from a producer and selling at a convenient location to customers at a markup. This could be a good diversification opportunity for already existing charcoal deal

**Step-by-step production**

**I. Sorting/sieving:** all unwanted materials or large biomass waste are removed to ensure that all the feedstock is of the required size. For example, the raw sawdust you collect could contain unwanted larger pieces of wood. These can be sieved out with a wire mesh.

**ii. Shred biomass materials into small pieces:** The biomass materials are chopped into small pieces so as to enhance their workability and compactness. The process is dependent on the type of biomass feedstock. For example, coffee husks and saw dust would not require shredding but materials such as groundnut waste, bagasse, wheat straws, barley and maize straws and cobs would need to be chopped into small sizes. In the case of carbonised biomass, the materials would need to be grounded into small pieces after they have been carbonised.

**iii. Mixing:** This process is done in situations where you want to use a range of different feedstock to optimize the burning characteristics of the final fuel. For example, biomass materials with high ash content could be mixed with biomass material of low ash content. Biomass with low energy content such as papers can be appropriately mixed with those of high energy content. This helps to attain the right quality (long burning period, non-smoking and odour free) that will make briquettes competitive in the market.

**iv. Binder:** In addition to biomass mixing, an appropriate binder is added and mixed with the biomass thoroughly. This enhances the compactness of the biomass materials and prevents them from falling apart. An example of such binders includes starch or clay rich in biomass.

**v. Adding water:** Water is usually added to the feedstock to make them loose and easy to work on. Some biomass materials require to be soaked in water for a number of days to ensure that they are soft enough to work on.

**vi. Compaction & Drying:** Finally the feedstock is ready for compaction, either by machine or by hand. The briquettes will need to be left to dry for up to a week.

## Conclusion

Worldwide, biomass is the fourth largest energy resources after coal, oil and natural gas, estimated to be about 14% of the global primary energy. Biomass is a potential source of renewable energy as the conversion of plant material into a suitable form of energy can be achieved using different routes. Coal energized the 19"' century while oil worked for the 20"' century. The question that remains pending is the future energy source. With the expanding population and growing demands from industrialization, total reliance on fossil fuel is not sustainable. The urgent need for a green and sustainable fuel prompted research into energy crops as an alternative to fossil fuels. There is a need to identify a suitable biomass species, which can provide high-energy outputs in order to replace conventional Fossil fuel. The type of biomass used would then depend on the energy conversion process and the form in which the energy is required. Even though, theoretical and experimental studies are also required to investigate the relevant parameters for future process optimization, biomass briquetting has been tested and trusted.

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