

Promotion of Cleaner Cooking Company

Kuphika Kwaphweka

July 2023, Giel de Pooter

Consultant (semi) industrial charcoal production

(Semi) industrial charcoal production

Efficient environmental friendly conversion of all types of biomass into first class charcoal

1. Introduction

The major cause of deforestation in almost all Sub-Saharan Africa countries is the increasing use of wood for household cooking both by using wood-cookstoves and charcoal-cookstoves. Especially the use of charcoal is seen as the major culprit of the disappearance of huge areas of woodlands. However, it has been demonstrated in various studies that after modernisation and professionalization across the entire value chain the charcoal will become a sustainable product.

Recent studies have shown that for a number of reasons charcoal will be a better fuel than wood and thus we recommend high efficient charcoal stoves for household cooking. The advantages are a lower daily expenditures; a cleaner kitchen and cases of PM child related pneumonia are practically zero.

The combination of an efficient charcoal production using all types of biomass and an efficient charcoal stove will result into a huge decrease in the rate of deforestation.

It's up to private sector to start the production of industrial charcoal which has the potential to become a very profitable business.

2. The Charcoal Challenge

- a. Replacing the Njiko charcoal stove by a much more efficient charcoal stove.
 - Data obtained by a certified testing laboratory in the US:
 - Fuel Reduction up to: 70%
 - Toxic Emission Reduction up to: 70%
 - Confirmed by the users in Malawi: "Instead of three bags only one bag".
- b. Industrial charcoal production units i.s.o. of the earth mount kiln
 - Efficiency improvement from 10-15 % to 30-35 %.
 - All types of biomass like sawdust can be converted into charcoal

The combined effects of these two interventions are:

- A biomass saving of about 80 %
- Much healthier environment for both charcoal producers and cooks
- A substantial decrease in the emission of greenhouse gasses

Promotion of Cleaner Cooking Company

Kuphika Kwaphweka

July 2023, Giel de Pooter

Consultant (semi) industrial charcoal production

3. Advantages of charcoal

After extensive literature studies combined with own observations we strongly advise the use of charcoal for household cooking.

The importance of charcoal for Sub-Sahara Africa has been documented in a number of articles. Only one is mentioned here

<http://www.fao.org/3/a-i6935e.pdf>

- Transport costs per unit of energy for wood is much higher than for charcoal.
- Consequently the daily fuel costs for a family will be considerably lower when using charcoal.
- Replacing the traditional charcoal stove by a more advanced charcoal stove saves 60-70 % of the monthly expenditures. ROI for an extended family less than 4 months.
- When using efficient charcoal stoves the cases of PM-related child pneumonia will decreased by about at least a factor of 3.
- Storage of charcoal is less problematic than the storage of wood
- It has been shown that, after improving the charcoal production methods, from an overall energy point a view it will be much better to use charcoal.

Sustainable charcoal, using all types of biomass, can be produced at competitive prices.

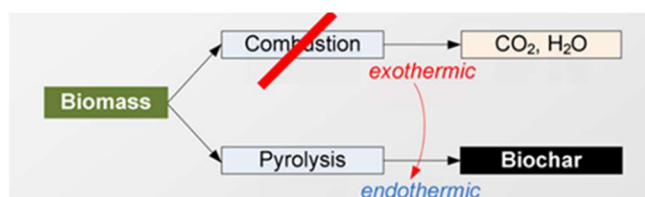
4. Charcoal Production (traditional versus industrial)

Practically all charcoal in Malawi is being produced by small- and medium-scale incidental producers which produce together nearly 70 % of the total charcoal production.

In general the raw material has been obtained “for free” and thus most producers do not pay attention to the efficiency of the conversion. By-far the only technique that has been applied is the traditional earth mound kiln causing a high emission of toxic gasses and greenhouse gasses. The reported efficiency (gravimetric yield) of these kilns varies between 5-15 %. Even percentages down to 2 % have been observed. (It should be noted however that the actual efficiency of the energy conversion is twice the gravimetric yield).

External heating under controlled conditions is the only procedure to approach the maximum theoretical efficiency which is about 35 – 40 %. Thus a so-called retort system should have to be applied. Because the industrial retort systems are equipped with condensers the emission of harmful volatiles into the atmosphere is negligible. Standard is also the collection of valuable by-products of the carbonisation process. Wood vinegar has useful applications in the traditional agriculture and bio-oil will have some value as a heating source.

External heating instead of internal heating (prevent partial combustion of the biomass)



Promotion of Cleaner Cooking Company

Kuphika Kwaphweka

July 2023, Giel de Pooter

Consultant (semi) industrial charcoal production

5. Charcoal production using (semi)industrial installations

A world-wide survey showed a variety of charcoal production installations. Some of them are relatively new, others are already being used for decades.

Only companies in Ukraine and in China offer relatively high yields combined with attractive investment costs:

- a. Trolley system Ukraine: 15 kg/USD ex-works
- b. Rotary furnace ex China: 115kg/USD ex works
- c. Retort system ex China: 60 kg/USD ex-works

Because of some negative “rumours” regarding the trolley systems we have focussed upon the Chinese producers exclusively.

a. Rotary furnace

The rotary furnace is designed for the direct conversion of sawdust and other grinded biomass into charcoal powder.



The capacity ranges from 300 to 1,000 kg charcoal per hour.

The endproduct (charcoal dust) is converted into high quality briquettes.



Industrial installations have been implemented in e.g. Tanzania, Kenya and South Africa.

An artist impression of the whole production line (including dryers; excluding the briquetting facilities)



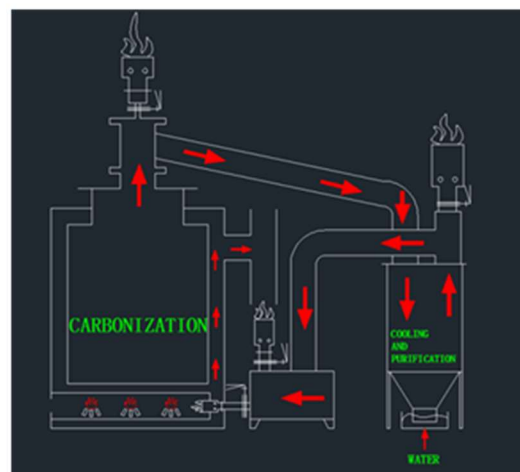
Promotion of Cleaner Cooking Company

Kuphika Kwaphweka

July 2023, Giel de Pooter

Consultant (semi) industrial charcoal production

b. Retort system (China)



During the run internal vessel no 2 has already been loaded with biomass. After the carbonization of run 1 the internal vessel is set apart for cooling and vessel no 2 is put into the reactor and the carbonization is again started. In this way it's possible to perform 3 carbonization runs each 24 hours.

Batch-wise operation; run time: 6 to 8 hours. Usually the inner furnace is about 2.5 m³. Charcoal yield about 400 kg charcoal per run per furnace. Normally two furnaces are coupled which results into about 700 Mt annually. Coupled systems will be energy neutral; the flue gas generated in reactor no 1 will be used to start reactor no 2. Recovery of useful by-products like wood vinegar and bio-oil is one of the extra options. Alternatively all these by-products are converted into energy.

A single retort system is operational in Chikwawa (own design; constructed in Malawi)

6. Preliminary economic evaluation of the industrial charcoal production

- Charcoal yield from about 600 Mt to 8,000 Mt annually
- Investment, including the total installation costs from \$150,000 to \$700,000
- Annual operation costs (capital payback period of 3.3 years) varies from \$90,000 to \$900,000
- Net profit \$20,000 to \$150,000
- Consumer price per kg including the whole supply chain: 0.20 USD to 0.30 USD
PM: Current prices for the “illegal” charcoal varies in Malawi from 0.30 to 0.42 USD/kg (depends upon the local availability)