RoCC Barrel-size Char-Maker:
Kenya Experience - Nov. 2019

Revised by

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This document supersedes the earlier report entitled:

4C Kiln Char Production Experience in Kenya 2019-11

Both the original and updated documents are available online at:

woodgas.com/resources

The RoCC pyrolysis technology is protected by patent pending status.

Paul Anderson developed several designs of side-feeding 4C barrel-size kilns during 2014 to 2019, precursors to the RoCC kilns.

These predecessors were referred to as "4C" kilns because they were:

- **Clean** — Cleaner
- **Controlled** — More controllable
- **Covered** — Mostly covered
- **Cavity** — In a cavity or cone or pyramid or trench

- The "4C" name distinguishes this design from the other char-makers that use "flame-cap" technology to provide pyrolytic heat over cavities, such as Japanese cone kiln, Oregon pyramid kiln, Kon-Tiki char-maker, WarmHeart trench char-maker, troughs, and other flame-cap cavity-type char-makers that utilize low-or-no oxygen zones where the produced char is protected from char gasification/oxidation.

During July to October 2019 Paul Anderson and Gary Gilmore experimented with the ways and impacts of occasionally rotating cylindrical 4C barrels, (becoming RoCC kilns) including the separation of the chimneys from the cylinders.

In November 2019, Anderson went to Kenya where he directed the fabrication of a rotatable covered cavity kiln (RoCC).

Roller Base for RoCC kiln.

Four casters were brought from USA.
Everything else was obtained in Kenya.

RoCC Barrel-size Kiln

**55 gallon / 200-liter drum.
**Door for fuel loading and char discharge (not used).
**Pipe for controlled secondary air (not used but served as handle for rotation.

Shown on the roller base, but is fabricated separately

Frame to Support Hood and Chimneys

Hood on its Support Frame for RoCC Char-making Kiln

The entire RoCC unit was fabricated in 24 hours by two workers on the porch of a welding shop in a rural Kenyan community.

Biochar production test

- Reasonably dry, split firewood (approximately 2 inches thick and 30 inches long, or 5 x 75 cm) was available for purchase from a supplier for Ksh 10 (10 US cents) per piece, weighing on average 800 grams (~2 pounds) each. 50 pieces (see photo) were purchased for US$5.00, with total weight of 40 kg (88 pounds) as measured by a quality digital scale.
- An additional approximate 10 kg of this fuel was also pyrolyzed. This came from abundant wood-shavings from a carpenter shop and some miscellaneous blackened but not pyrolyzed remnants from the initial experiment the previous day with damp fuel.

- The test with all 60 kg lasted 2.5 hours, with the wood being placed into the RoCC kiln at 15- to 20-minute intervals during the first 2 hours. One kg of non-pyrolyzed wood was separated at the end of the trial.
- The energy released is estimated to be between 8 and 10 MJ per kg (allowing for moisture content and the energy remaining in the collected charcoal). That becomes 480 to 600 MJ released during 2.5 hours, which is 192 to 240 MJ/hr, or 53 to 67 kilowatt-hr per hour, or 182,000 to 227,000 BTU/hr. That indicates substantial flames and heat during the time of operation.

Both images are or the rear side (portal position A).

- The resultant charcoal was a mixture of sizes (see photos), weighed 9.4 kg (dry, before quenching) and formed a pile measuring approximately 60 x 60 cm and 15 cm deep, being about 5.4 liters. The 9.4/49 = 19% yield by weight would be higher if the source fuel had been drier.
- Two Kenyans independently estimated the retail value ofthe produced char to be about Ksh 700 (US$ 7.00), which approximately matched the price of similar amounts of lump charcoal sold by the bucket in the community.
- Emissions: The RoCC kiln is still being refined in both physical structure and methods of operation. Except for brief smoky periods during fueling and “assisting the pyrolysis”, for the most part there are only the emissions of strong flames (good combustion) in the chimneys, not the smokiness of pyrolysis of traditional charcoal making.

Economics of the RoCC experience in Kenya

- A. The biomass purchased for $5.00 became charcoal valued at $7.00. Even with conservative calculations, it appears that people who earn their living by making charcoal via traditional (and generally inefficient and actually illegal) methods could possibly break even or earn more income if using the RoCC kiln technology. But there are at least two further factors to be examined: the cost of the RoCC equipment and the differences in the necessary labor and time (through-put) between traditional and RoCC methods. [One study that could include the examination these factors is already known to be funded in Kenya.]
- B. Of major importance are the prospects of utilizing the thermal energy that is currently released (wasted) through the chimneys. The experiences cited in this report have led to a recommendation that the RoCC kiln be considered for supplying heat for institutional cookstoves (such as at schools and orphanages), for ovens (such as at bakeries) and for hot water heating (such as at hotels).
- C. Although the testing was done with wood biomass fuel (which is a topic of concern where forests are threatened), the RoCC kiln is quite suited to using other dry biomass such as maize stalks (corn stover), other agricultural residues, and invasive species that are not otherwise appropriate for making charcoal or providing useful heat.
- D. The various advantages experienced by using RoCC kilns suggest that in some societies (including Kenya) there could be carbon emission reduction offsets (carbon credits) created by regular and documented use of RoCC kilns.

Additional information and assistance

- There is substantial further work on the development of the RoCC kilns of various sizes, including the barrel size.
- Some information is posted at woodgas.com/resources .

- The RoCC pyrolysis technology is protected by patent pending status. You are invited to participate in its development.
- Persons interested in studying or making RoCC kilns are strongly encouraged to contact the inventor for the latest information:

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