Resource Session About Micro-, Small- and Farm-Scale Production Methods and Quantities of Char Suitable to Become Biochar

A presentation to the USBI 2018 Conference,

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Abstract (as accepted, with adjustments)

- An **introductory overview** and a typological **classification** of micro- to farm-scale methods of char production are presented. The emphasis is on **practical technologies** that realistically can attain **significant quantities** of char suitable to become biochar.
- **Scales and examples:**
- **A. Micro-scale:** TLUD gasifier stoves producing ~0.8 kg/day X over 30,000 stoves in West Bengal, India.
- **B. Small-scale:** As in 200 L barrel-size TLUD units, or in retort units, or "flame cap (C4 kiln)
- **C. "Midi-scale":** As in 500 L to 5000 L “flame-cap” trough kilns/ovens/pyramid kilns (Kon Tiki), and to include the Adam Retort units.
- **D. Farm-scale:** “Dumpster-size” (such as Air Curtain) and larger units that are not industrial scale. (On-going developments will be announced at the conference.)
- NOTE: Following the opening comments, **practical Q&A will be held among the attendees**, inviting comments from others with experience with small-scale char production but who are not making presentations.

One objective is to match interested persons with experts about the various sizes and methods for making char.

- All discussions are in reference to char that is acceptable to be biochar into soils.

Partial list of attendees / resource persons

- 1. Paul Anderson - experienced.
- 2. Paul Taylor experienced. (includes work with Norm Baker).
- 3. Hugh McLaughlin experienced. "Experience is a wonderful thing - it let's you recognize a mistake the second time you make it...."
- 4. Gordon West experienced. Has his own presentation.
- 5. Doug Clayton experienced. Retort over TLUD.
- 6. Gary Gilmore experienced.
- 7. Others:

Poll of INTERESTS: Who here wants to learn about which of the sizes and technologies?

A. Micro-gasifiers (that make char): 1 to 10 L (Quart to 3 gal.)

B. Small: 20 to 200 L (5 to 55 gal. buckets and barrels mainly)

C. Midi-: ~500 L to ~5000 L (100 to 1200 gallon)

D. Farm-scale: "Dumpster" size,

E. Industrial / high tech:

Stationary installation.

G. Residual char as by-product of industrial process.

1. **TLUD:** Natural Draft (ND), Forced Air (FA – Fan Assisted)
2. **Retort:** Ovens, barrels, Adam Retort
3. **Flame cap: "Kilns"** Cone, Pyramid, Kon Tiki, C4 (Controlled, Continuous, Covered Cavity), Air Curtain.
4. **Experimental:** AVUD, Open burn, PBR (Pyrolytic Biomass Reduction), other.
5. **High Tech** (large / expensive): Fast Pyrolysis, Hydrothermal, Heated Screw, other.

Poll of EXPERIENCE: Who present has much experience with these sizes & technologies?

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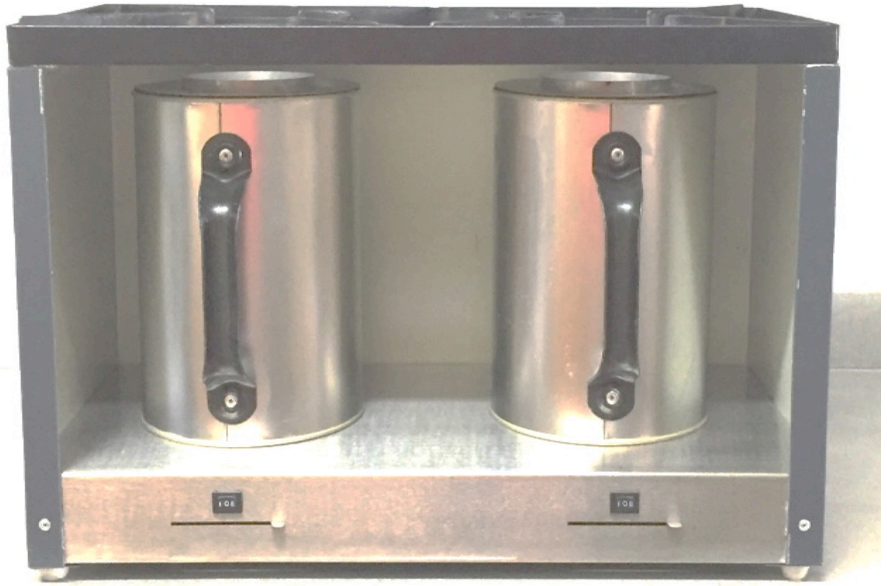
Next Steps:

- Char from TLUD cookstoves
- Char from TLUD barrels
- Char from C4 kilns (**C**ontrolled **C**ontinuous **C**overed **C**avity kilns)
- PBR (Pyrolytic Biomass Reducer)
- Special extra topic: Char to Power
- Open discussion about all non-industry-based methods.

Examples of TLUD Stoves

Akha TLUD-ND
in Bangladesh

Champion TLUD-ND
in West Bengal, India



FabStove TLUD-FA
in South Africa.

Designed for pellet fuel.
Uses a fan powered by
battery, solar or grid.

TLUD Stoves Producing Char – India 2013 - 18

- Each Champion TLUD stove in one household (HH) **produces about 0.8 kg/day, or 25 kg/month,** or 300 kg/yr/HH.
- Buy-back price ~US$ 0.12/kg (~$3/mo) to the HH. But the char is resold for the **commercial price of ~$0.17/kg** (to make incense sticks). This is ~$51/stove/yr. (Plus this earns 2 Carbon Credits).
- Per 1000 TLUD stoves in daily use, this 800 kg/day or 24 tonne (MT)/month.
- There are about **40,000 stoves in use, which is 32 MT/day** or 960 MT/mo or 11,500 MT of char per year within quite confined areas.

- A TLUD stove project with biochar usage of the char is started in Bangladesh, now with fewer than 400 stoves.

Char production in TLUD barrels

- Also known as Jolly Roger Ovens (or J-ROs) (left)
- (Right) Doug Clayton has barrel-TLUD-FA at the bottom with a 30-gallon retort barrel inside the 55-gallon stack, which than has a chimney.

Char Production in TLUD barrels

- We thank Hugh McLaughlin and Gary Gilmore for some data:
  - Weight-to-volume estimate: About 1.5 to 2 pounds of per gallon of dry wood. (HM) (Variation partly depends upon sizes of the pieces.)
  - Per 55 gal barrel: ~ 140 lbs 20%MC Aspen > 16% yield of about 20 – 25 lbs Dry-wt char. (GG) (MC = Moisture Content)
- These two are about the same: 2 lbs x 55 gal = 110 lbs DRY wood, then add 20% MC becomes 132 lbs/barrel. **120 to 150 lbs of wood/barrel.**
- Metric equivalent: **200 L barrel holds ~64 kg of 20%MC wood, to yield 10 to 13 kg of charcoal.**
- Approx. 2 – 3 hours per TLUD batch. Times 3 to 4 batches/day could yield ~ 30 to 52 kg/8-hour-workday. Times **4-barrel system could yield ~ 120 to 200 kg/person-day-of-work.** @$10/hr = $80 labor.
- (The result equals ~100 to 160 Indian women cooking two meals in a day on TLUD stoves.)

Notes:

- The charcoal production with TLUD stoves is economical and sustainable because the **thermal energy from the stoves is used for cooking.**
- Examples of other commercially viable char production with small-scale devices include:
- A. (open for discussion). (Supported by **research funds**?)
  - Adam retort work; Kon Tiki flame cap char;
- B. ????

- PBR = **Pyrolytic Biomass Reduction**. Excessive agro-residues must be removed. Prime examples in California where burning is prohibited.

Char Production in Retorts

- Data should exist, but not on hand now.
- Small retorts
- Adam retort

Char Production in Flame Cap Devices

- Data should exist, but not on hand now.
- Cone kilns
- Kon Tiki
- C4
- Air Curtain

C4 Kilns: Controlled Continuous Covered Cavity kilns

A demonstration of a C4 kiln (photos at left) during the USBI Conference is being arranged. See Paul Anderson or Gary Gilmore for information.

PBR at Scale of Commercial Farming

- PBR is **Pyrolitic Biomass Reduction**
- The **objective** is to remove unwanted biomass. Creation of char is a possible secondary benefit. PBR justifies the expenses.
- MAJOR issue in California and other areas with stringent environmental regulations, especially about burning of biomass.
- Literally millions of tons of agro-refuse available annually.
- The discussion here is about POSSIBLE ALTERNATIVES. Much is still in the realm of experimentation, even for prototypes at reduced size.
- PBR is focused on commercially viable solutions at substantial sizes, and therefore are too costly to expect the "backyard charmakers" to do this alone.

PBR at Scale of Commercial Farming (slide 2)

- PBR is **Pyrolitic Biomass Reduction**
- Paul Anderson has four (4) design variations to target different types and shapes of biomass.
- He has insufficient resources to do the developmental work that requires fabrication and testing.
- Needed: Funding (including possible grants), engineering, fabrication, testing/documentation, scale-up, management, business development (anywhere in the world).
- If you can meet any of these needs, contact Paul Anderson. Otherwise, await possible updates at future conferences.

Char Production in (to be named) Devices

- Data should exist, but not on hand now.
- One more topic before we return to this for open discussion.

Extra Topic: Char Gasification for Power

- You already know and appreciate wonderous charcoal and know how to make it sustainably.
- Charcoal can give you **CLEAN gas for direct use in internal combustion engines** for shaft power for pumps, pelletizers, and electricity generation. (This is also possible for vehicles, but is not recommended.)
- Gary Gilmore is a recognized world expert on char gasification. He and Paul Anderson have created Char to Power (C2P) for commercial efforts.
- A C2P unit utilizing a 55-gal (200 L) barrel can generate gas to operate a genset to **create up to 10 to 15 kW continuously with charcoal fuel.**
- For further information (or to see the demonstration on Thursday), see Gilmore or Anderson. Phone/text: 309-531-4434

C2P Data

- Roughly one (1) kg of charcoal can yield one (1) kWh or ¾ HP.
- Two sizes (stated as G-L capacity):
  - 16-66 (upper photo) for 7 kW genset, etc.
  - 55-200 for 10 to 15 kW or vehicle engine.
- Fully functional units of the two sizes are at the USBI Conference.
- Arrangements are being made for demonstrations. Contact Gary Gilmore or Paul Anderson for more information.
- C2P anticipates regional licenses to associated manufacturers, such as in Mexico, South Africa and Thailand.

Questions about the presentation?

Then open discussion about Char Production in (to be named) Devices

- Data should exist, but not on hand now.

For further contact:

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Thank you for attending.