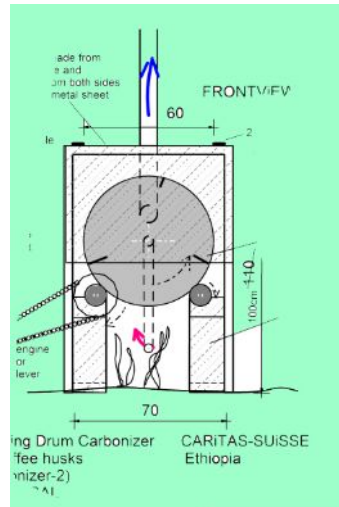


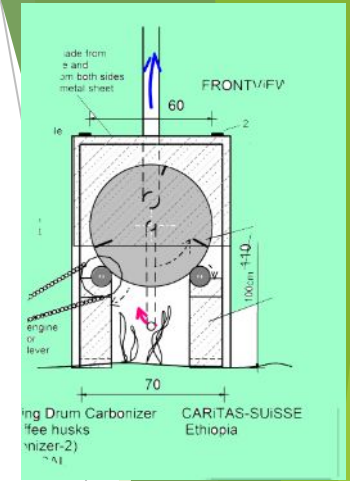
A small, black, rectangular biomass boiler with a green metal frame, emitting thick white smoke from two tall chimneys. It is situated outdoors in a rural setting with trees and a pile of sticks in the background.





- ▶ This is an overview about a **medium-scale, semi-industrial, low-cost charcoal production**. All systems enable a more environmentally friendly charcoal production- compared to traditional methods.
All of these 5 systems do heavily reduce methane emissions!
- ▶ 5 different systems were developed.
- ▶ 2 of this system are designed to work with **wood** or with kind of biomass where hot air can pass between the material (like corn cobs).
- ▶ 3 of these systems are designed to work with **coffee husks** or similar biomass (saw dust, nut shells, etc.).

Many projects take care for small cooking stoves which partly also **produce charcoal** as a side-effect, however **little attention** is given to single units for pure charcoal production (kilns & retorts).



1)
adam-retort kiln

2)
Box-Kiln

3)
Drum-Pit
Carbonizer

4)
Drum-Retort
Carbonizer

5)
Rotating-Drum
Carbonizer

Retort System

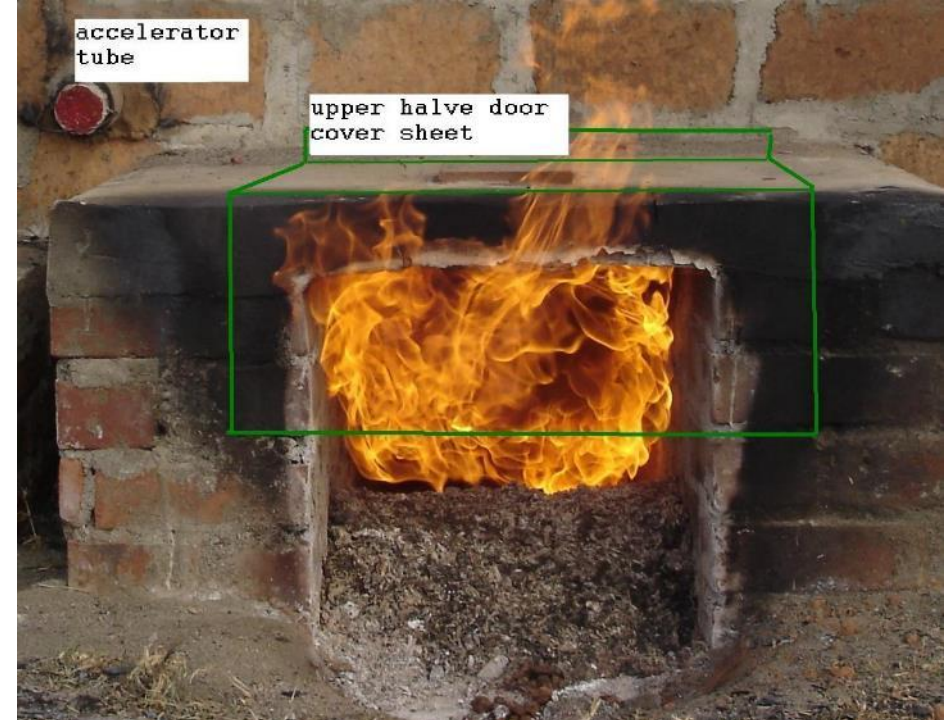
traditional system

Open Pit System

Retort System

Retort System

1) adam-retort kiln



PHASE-2: Burning of wood gas

The retort-kiln works in 2 stages:

PHASE-1 can be compared to a baking oven, water is evaporated from the wood by burning „waste wood“ in an external fire-box.

PHASE-2 once the temperature is raising above 320°C, the wood gas (and methane) is developing and cleanly burned in the external fire-box (□ photo). Excess heat from the burned wood gas is used to push carbonisation.

Volume: ~2,5m³
Wood loaded: ~750kg dry mass, ~1000kg wet mass
Charcoal received: ~225kg or more
Efficiency: ~30%
Operating time: 12hrs for burn
Cooling time: 24hrs
Costs: ~1200€
Construction time: 1-2 weeks & 3 weeks curing of the cement
Reduction of emissions ~75%

2)



Round steel kiln, FAO, World Bank

The **Box-Kiln** is an improvement to the existing round steel kilns (Mark-II). (photo: Ghana for giz)

Advantages:

- * Operation possible by only one person due to the counterweights when lifting the lid.
- * Ease of harvesting of the charcoal because of easy access. (It's fun to produce charcoal in this way!)
- * Insulation possible because of a straight surface.

Volume: $\sim 2,3\text{m}^3$
Wood loaded: $\sim 600\text{kg}$ dry mass,
 $\sim 800\text{kg}$ wet mass
Charcoal received: $\sim 150\text{kg}$
Efficiency: $\sim 25\%$
Operating time: 12hrs burn
Cooling time: 24hrs
Costs: $\sim 800\text{€}$
Construction time: 4 days,

3) Drum-pit carbonizer for coffee husks

Photo & design for
CARITAS-ETHiOPiA



The **drum-pit carbonizer** works semi-continuously as the vessel will be exchanged once its content is carbonized. The **clean flue gas** leaves the chimney without smoke.

Also other biomass as **saw dust** can be carbonized. The vessel needs continuous attention by adding material and stirring it.

Volume: $\frac{1}{2}$ oil drum ~100 litre
Husks loaded: continuous operation
Charcoal received: ? Efficiency: ?
Operating time: continuous operation
Cooling time: 2hrs
Costs: ~300 €, Construction time: 2 days



This is a **drum-retort carbonizer** for coffee husks, nut shells, etc. It works well for dry coffee husks due to a double chimney and ceramic wool insulation at the outer shell.

Methan and wood gas are cleanly burnt

Volume: oil drum ~190 litre

Husks loaded: 20kg

Charcoal received: 7kg Efficiency: 35%

Operating time: 2hrs

Cooling time: 12hrs

Costs: ~300 €, Construction time: 3 days

4) Drum-retort carbonizer

Photo: Ethiopia



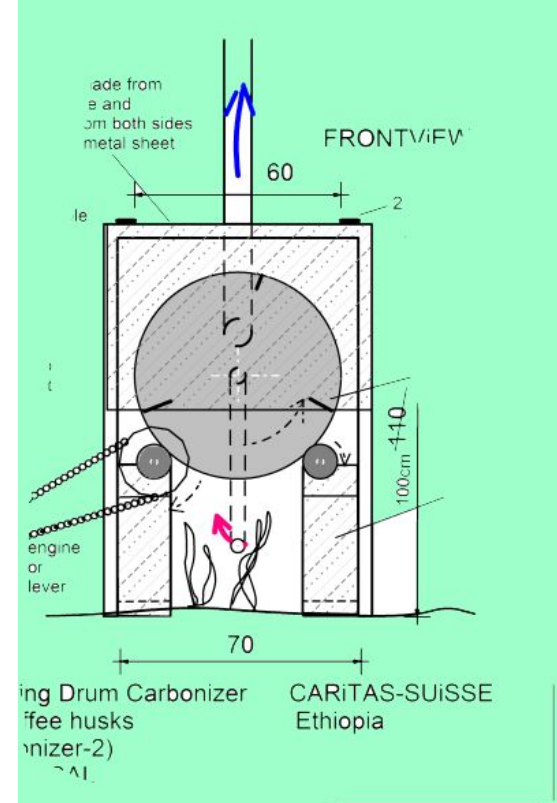
5) Rotating drum kiln

The rotating drum kiln works as a retort and a batch system.

The drum can be removed and replaced by a 2nd barrel during operation.

The drum is turned manually or by a motor. This drum kiln was **not** yet built, however drawings are available. Coffee husks, saw dust, nuts etc, can be carbonized.

Thanks
for
listening



Volume: 215 litre about ½ of it used

Husks loaded: about 100 litre

Charcoal received: ?

Efficiency: to be expected high

Operating time: 1hr ?

Cooling time: 3hrs ?

Costs: ~900€ ?

Construction time: ~1 week