RICE HUSK GAS STOVE FOR ENHANCED CHAR PRODUCTION

by Alexis Belonio and Ted Redelmeier

Rice husk gas stove can now be used not only to save fuel but also to enhance char production. Instead of using the stove merely for cooking, the new design of the stove can be used to produce high amount of char while preparing meals for the family. This development was undertaken by Carbon Neutral Commons (CNC) to enhance carbon sequestration at household level. A pilot project aimed at poverty alleviation, soil restoration and carbon sequestration is being carried out by CNC for which it has distributed units of the rice husk gas stove in the Philippines, particularly in the Central Luzon Area being the rice granary of the country.

Pictorial of CNC BTRHGS Model 20-D1

Model	CNC BTRHGS 20-D1
Reactor Diameter	19 cm
Reactor Height	55
Fan Size and Specs	40 mm D, 12 V x 0.78 Amp

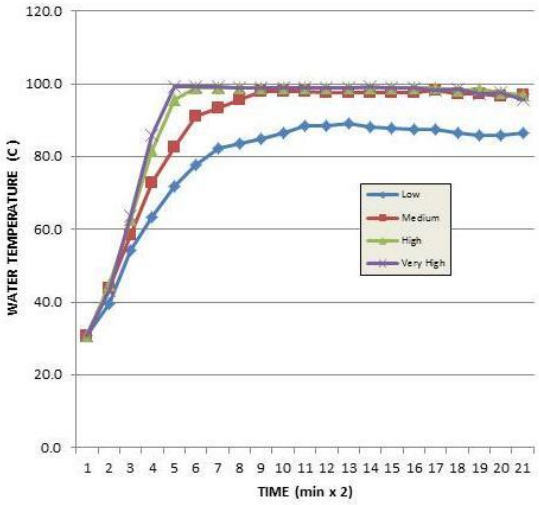
The stove, shown at the right, is an enlarged version of the basic design of the batch-type rice husk gas stove. Instead of the conventional14cm-diameter by 55cm-high reactor, the stove adopts a 20cm-diameter by 55cm-high reactor for the same size of fan. The burner gas outlet is reduced and gas holes are made compact to direct the burning gas to the bottom of the cooking pot. The burner has an enclosure to shield the flame from wind and, at the same time, to collect spilling water. A removable fan enclosure is provided for the stove to quickly detach the fan from the reactor when unloading the char.

The stove is supported by three-support legs directly welded to the reactor. An aluminum screen is used as a shield to protect stove user from accidentally touching the reactor, especially when it is hot. This model of the stove uses series-200 stainless-steel fabrication materials, such

Weight of Fuel	2.3 to 2.5 kg
Start-Up Time	1 to 1.8 min
Gas Generation Time	1.0 to 2.5 min
Boiling Time	7 to 21 min for 2 liters of water
Total Operating Time	38 to 66 min
Char Produced	0.63 to 0.78 kg
Specific Gasification Rate	72.7 to 140.8 kg/hr-m^2
Overall Thermal Efficiency	6.7 to 11.4%
Turn-Down Ratio	3.22

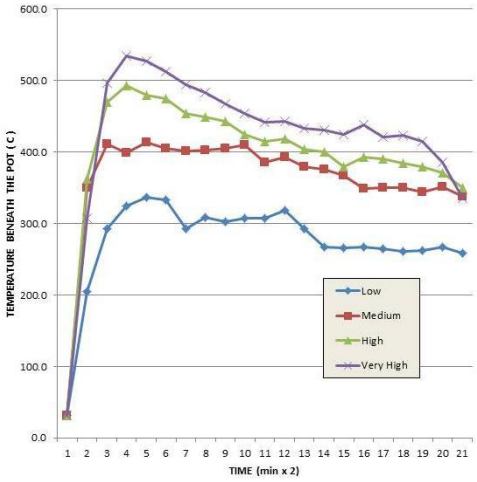
as sheet, tube and bars. A wooden material is used only for the handle and a rubber as shoe for the stove legs.

The stove was tested following a water boiling test using 2 liters of water at 12- volt fan input with different fan opening, i.e., low, medium, high, and very high settings. The time required to attain 80% combustion upon ignition of fuel and the time required for combustible gas to appear were recorded during the tests. The weight of rice husks used per load, including the weight of char produced after burning all the fuel, were measured. The temperature of water during boiling and the temperature beneath the pot were also monitored during the tests using type-K thermocouple sensor attached to a digital thermometer.



Temperature Profile of Boiling Water

Results showed that that the stove has 2.3 to 2.5 kg rice-husk fuel loading capacity. Spontaneous combustion of rice husk fuel takes place within 1.0 to 1.8 min and combustible gas appeared within 1.0 to 2.5 minutes thereafter. The stove runs for 38 to 66 min, depending on the setting of the fan. The stove operates at 72.7 to 140.8 kg/hr-m^2 specific gasification rate while the overall thermal efficiency ranges from 6.7 to 11.4%, which indicates high amount of char produced. The computed turn-down ratio for the stove is 3.22.



Temperature Profile Beneath the Pot

The temperature profile of boiling water and that beneath the pot are shown at the right side. At low setting, 2 liters of water is hardly boiled and, if ever boiled, takes longer time to boil it in the stove. Also, the temperature monitored at the bottom of the pot at this setting is lower than at high fan setting. At this setting, moreover, the temperature ranges from 204° to 337°C. At very high fan setting, on the other hand, the temperature ranges from 308° to 535°C. A dramatic increase in the temperature beneath

Sample of Char Obtained from the Stove

Stoves Being Tested in the Philippines

the pot was observed during the first 10 minutes of the operation and gradually decreases for the remaining period.

Twelve stoves are currently under monitoring study for carbon sequestration activity in the Philippines. Emission testing will be done in due time to see the effect not only on carbon sequestration but also on minimizing smoke indoor pollution at the household level.

The stove can be fabricated using local skills and materials at P5,000.00, including the fan and the AC-DC Adoptor. The computed operating cost is P5.70 per hour with P647.20 monthly saving against conventional stove, and the payback period is 0.6 year. It can be further simplified to reduce materials and labor costs as well as to facilitate the fabrication by using thinner stainless steel sheet and TIG weld to properly weld parts. The benefits that can be derived from using and/or producing this stove are: (1) energy cost savings to households; (2) added income to local shops; (3) improves quality of soil in the farm since char has high water-holding capacity; and (4) helps in sequestering carbon from the atmosphere back to the soil.

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