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Bundled Corn Stalk Stoves for Malawi

Stove Camp 2010

Dean Still

One fine rainy morning two fine fellows from StrawJet, an Oregon company that makes equipment to bundle agricultural waste in Malawi, wandered into the lab and asked if it's possible to make a stove that uses bundled corn stalks to cook food. I said that I thought it was possible and after some conversation and testing of prototypes StrawJet put up a $250 prize to encourage Stove Camp participants to make it so. www.strawjet.com

Burning corn stalks leaves quite a bit of ash that does not fall apart but keeps its shape. For this reason stoves must be adapted to deal with a lot of solid ash. Two types of stoves were tested: 1.) A Jon Anderson Rocket Stove with lots of draft and a grate and 2.) Two large TLUDs built by Paul Anderson and Art Donnelley that were vertically loaded.

Introduction to micro-gasification

From: Boiling Point Issue 53 (2007) Paul Anderson, Thomas Reed, Paul Weaver

When burning any biomass, various gases and vapors called "smoke" must be driven from the solid fuel and then the smoke is burned. For over a hundred years scientists and engineers have known that combustion of biomass is cleaner when the air is well mixed with only combustible gases, instead of having the combustion occur in zones where solid fuel is still present. The creation of combustible gases that are separate from the combustion of those gases is a clearly distinguishing characteristic of a true "gasifier". Practical gasification in small devices (i.e., micro-gasification) was not achieved until 1985 when Dr. Thomas B. Reed conceptualized and accomplished what is now called "Top-Lit Updraft" (TLUD) gasification with batches of biomass fuel. In 2004 Dr. Paul S. Anderson created a variation of traditional updraft micro-gasification with continuous-operation, being called AVUD for "Another Variation Updraft" to distinguish it from conventional updraft gasifiers. To achieve these advances, Drs. Reed and Anderson mainly do practical experimentation based on combustion theory and principles*.

The natural draft TLUD gasifiers utilize the principles of Anderson's "Champion" stove that won the "Kirk Smith Cat Pee Award" for clean combustion at ETHOS Stove Camp 2005. A 15 inch (38 cm) riser or "pre-pot internal chimney" is needed to achieve the natural draft, but additional chimney height is needed at elevations above 3000 feet (1000 meters). This design is maintained in Andreatta's TLUD testing unit, seen in Figure 3.

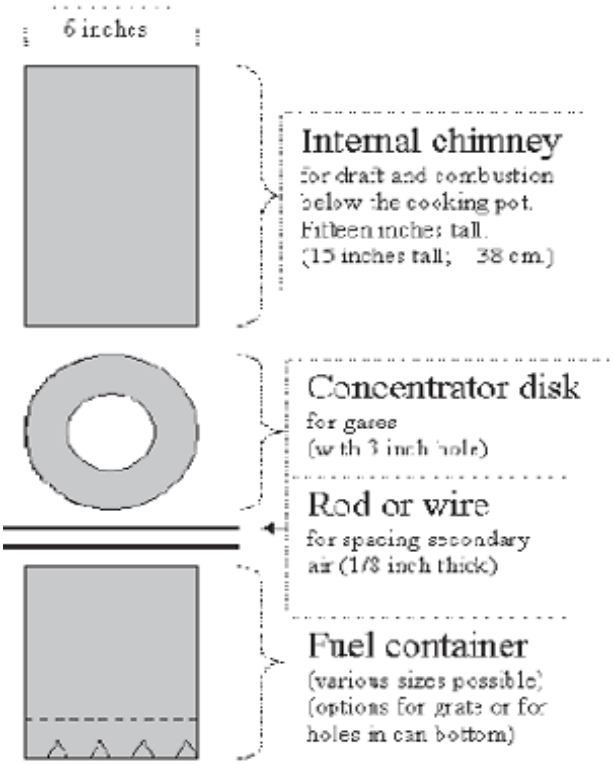
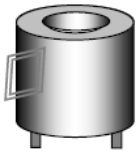


Figure 3: 2005 Champion stove diagram (Paul Anderson)

The Multi-fuel Combustion System Peko Pe

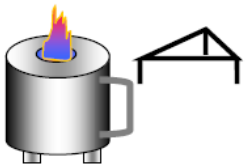
Designed for fuel and energy conservation

Energy for everyone

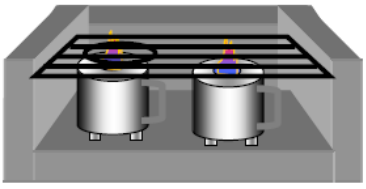


The energy unit
is the hart of the system .The unit is burning with a clear, smoke and sootless flame of about 600-700 °C with most types of combustible dry biomass.

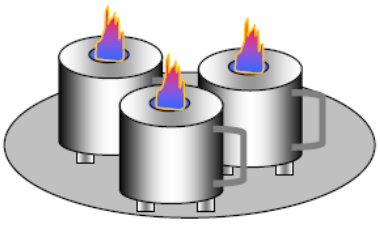
Fuel
1 kg chopped wood or briquettes will burn about 1 hour with flame, and be glowing about 2 hours. That means you will have about 3hours time of cokking



With a simple iron device on top of the unit you will be able to make a meal or heating water



Two units arranged in a system of blocks or bricks and a grid will make it more convenient to prepare meals



If you need more energy for big pots, wok or grill, you just put more units together then you will cover all needs of energy. To keep food warm you need only one unit
3 units with 6kg of chopped wood will bring 60 litre of water to boil within 50 minutes and continue to boil another 2 hours.

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Overview of Rocket Stove (from Wikipedia)

A rocket stove achieves efficient combustion of the fuel at a high temperature by ensuring that there is a good air draft into the fire, controlled use of fuel, complete combustion of volatiles, and efficient use of the resultant heat. It has been used for cooking purposes in many third-world locales (notably Rwandan refugee camps) as well as for space and water heating.

A rocket stove's main components are:

- Fuel magazine: Into which the unburned fuel is placed and from where it feeds into the combustion chamber
- Combustion chamber: At the end of the fuel magazine where the wood is burned
- Chimney: A vertical chimney above the combustion chamber to provide the updraft needed to maintain the fire
- Heat exchanger: To transfer the heat to where it is needed, ie the cooking pot.

The fuel magazine can be horizontal where additional fuel will be added manually or vertically for automatic feeding of fuel. As the fuel burns within the combustion chamber convection draws new air into the combustion chamber from below ensuring that any smoke from smoldering wood near to the fire is also drawn into the fire and up the chimney. The chimney should be insulated to maximize the temperature and improve combustion. From the chimney the heat passed into a suitable heat exchanger to ensure the efficient use of the generated heat.

For cooking purposes the design keeps the cooking vessel in contact with the fire over the largest possible surface area by use of a pot skirt to create a narrow channel which forces hot air and gas to flow along the bottom and sides of the cooking vessel. Optionally baffles guide hot air and flame up the sides of the pot. For space heating purposes the heat is transferred to a heat store which can in some cases be a part of the structure of the house itself. The exhaust gasses then pass out of the building via the chimney.

The design of stove means that it can operate on about half as much fuel as a traditional open fire and can use smaller diameter wood. They are insulated and raised from the floor which reduces the danger of children burning themselves. Some more recent designs in use are self feeding using gravity to add fuel to the fire as required.

History

Dr. Larry Winiarski, now Technical Director of Aprovecho, began developing the Rocket Stove in 1980[1] and invented the principles of the Rocket stove in 1982.[2] TWP and AHDESA were winners at the Ashden Awards for Sustainable Energy in 2005 in the 'Health and Welfare' category for their work in Honduras with the 'Justa Stove' which is based on principles of the rocket stove.[3] Aprovecho were winners of the Special Africa Award at the Ashden Awards in 2006 for their work with rocket stoves for institutional cooking in Lesotho, Malawi, Uganda, Mozambique, Tanzania and Zambia.[4]

Aprovecho and Shengzhou Stove Manufacturer won the 2009 Ashden Award for creating a factory with the production capacity of 1,000,000 stoves per year. StoveTec (a not just for profit spin off) has created a worldwide distribution network of these high quality, low cost Rocket stoves also designed initially by Dr. Larry Winiarski.

Stove Camp Winner

Participants voted for the best stove that, in their opinion, was most effective. Jon Anderson won the 2010 Cat Piss Award for a tall Rocket stove made entirely from found materials that successfully burned the bundled corn stalks. The hope is that a pilot test could be conducted in Malawi. If so, we'll pass along the results.

Jon and his wife Flip have been in Haiti recently for three months helping folks to build these kinds of Rocket stoves. They are beautiful, dedicated people, who like many folk at Stove Camp, deserve real praise and adoration. I'm happy to send them some of both and congratulations for making a wonderful stove!