AMRITA SeRVe
AMRITA SELF RELIANT VILLAGES
TRANSFORMING RURAL INDIA

THE AMRITA STOVE:
A Front-Loaded Natural-Draft Top-Lit Updraft Gasifier

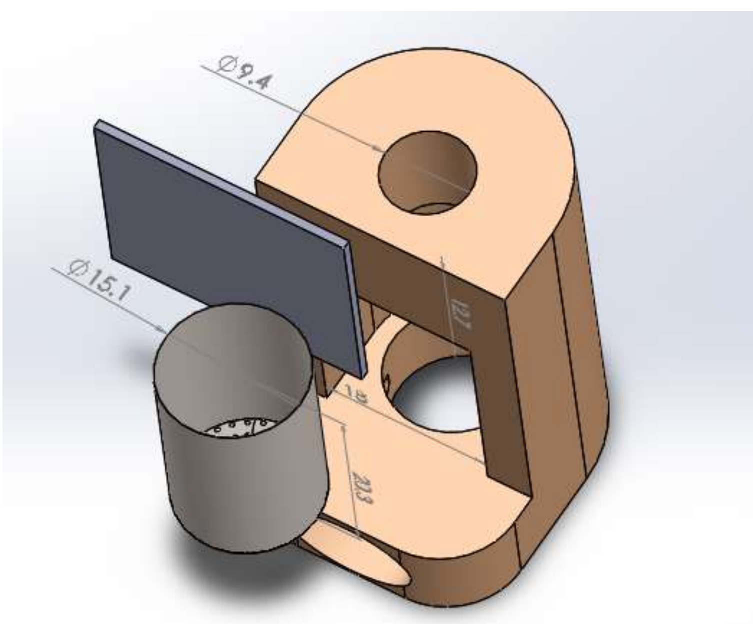
Objective

The guiding principle behind the Amrita TLUD is to design an improved cookstove that can be fabricated by the user at no cost. The design is similar both in materials and construction to the traditional “chulha” widely used in India, which augments its social viability. Additionally, the stove is designed to produce biochar, a valuable co-product of pyrolytic combustion.

Materials and Construction

The stove body is fabricated by hand from a mixture of clay, ash, and fiber. The clay provides cohesive strength, the ash serves as insulation, and the fiber provides tensile strength. The combination of these three with water produces a workable mix which becomes very durable and moderately insulative when dry. A hollow chamber around the combustion chamber/riser is packed with ash for insulation.

The primary air enters through 25 holes about 0.6 cm in diameter, evenly spaced across the bottom of the fuel canister. Secondary air enters near the bottom of the fuel canister under the door (area is about 50 cm^2) and through a hole in the back (about 30 cm^2). This air rises through a 1 - 2 cm wide space between the can and the stove body and then is forced through a 1 cm wide gap at the top of the canister where it mixes with the wood gases. The ratio of primary to secondary air supply is approximately 1 to 6 by surface area.



The fuel canister is a large food can (20.3 cm by 15.1 cm), and the combustion chamber/riser is a smaller food can (12.7 cm by 9.4 cm). Primary air enters through a similar food can in the front, modified into an oblong oval shape.

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Operation

The fuel canister is first packed with small pieces of fuel (about 2 to 4 cm), and a layer of flammable material can be placed on top to catch the fuel. Otherwise, a few pieces of fuel soaked in kerosene can be placed on top of the fuel bed. The stove is started by top-lighting the packed fuel canister and placing the canister inside the stove body. Whether or not the door is immediately put in place doesn't seem to make a difference. Once the stove starts to burn strongly, the temperature can be slightly moderated by blocking the primary air inlet.

Performance

Starting: Depending on the flammability of the fuel, starting can be difficult. With coconut shells as fuel, it typically takes 2 to 4 minutes of weak, smoky combustion before the flame reaches a point where it is sufficient to burn the smoke.

Mid burn: The stove produces a very strong flame after the fuel has equally lit and the can is starting to heat up (about 4 or 5 minutes). With high-calorie fuel (i.e. coconut shell), the flame can reach up to 8 inches above the combustion chamber/riser in a vertical column. With low calorie fuel (i.e. grass and cow dung), the flame is much smaller but still vigorous. Without a pot, the flame produces no visible smoke and does not cause stinging to the eyes or produce smell. When a pot is placed on top of the flame spire, however, puffs of smoke and a very thin stream of smoke are produced periodically.

Transition: If excess primary air is supplied near the end of the burn, the transition is almost entirely smokeless. The charcoal will continue to burn slowly and cleanly if left in the stove (though this is presumably damaging to the fuel canister).

Efficiency: The stove will bring 2 L of water to a rolling boil in 12 minutes when placed on the burner after the fire has caught evenly. The turndown ratio, however, is very poor. At present, the stove essentially has two heat settings: high and very high. Even with tiny amounts of primary air, the flame is still very strong. Total burn time with coconut shell is about 30 minutes and 45 minutes with top-loading (at high heat). The stove yields about 20 to 25% biochar by weight if the char is removed. At any point during the combustion cycle, the stove body surrounding the combustion chamber/riser is cool to the touch.

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