

Applications of Various Bio-Energy Packages

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Biomass Devices for Various applications

1. Stoves for Domestic application
2. Stoves for community application
3. Combustor for Dryers
4. Combustor with recuperation for Puffed rice production
5. Gasifier for Thermal Application
6. Gasifier for power Generation

Stoves for Domestic application

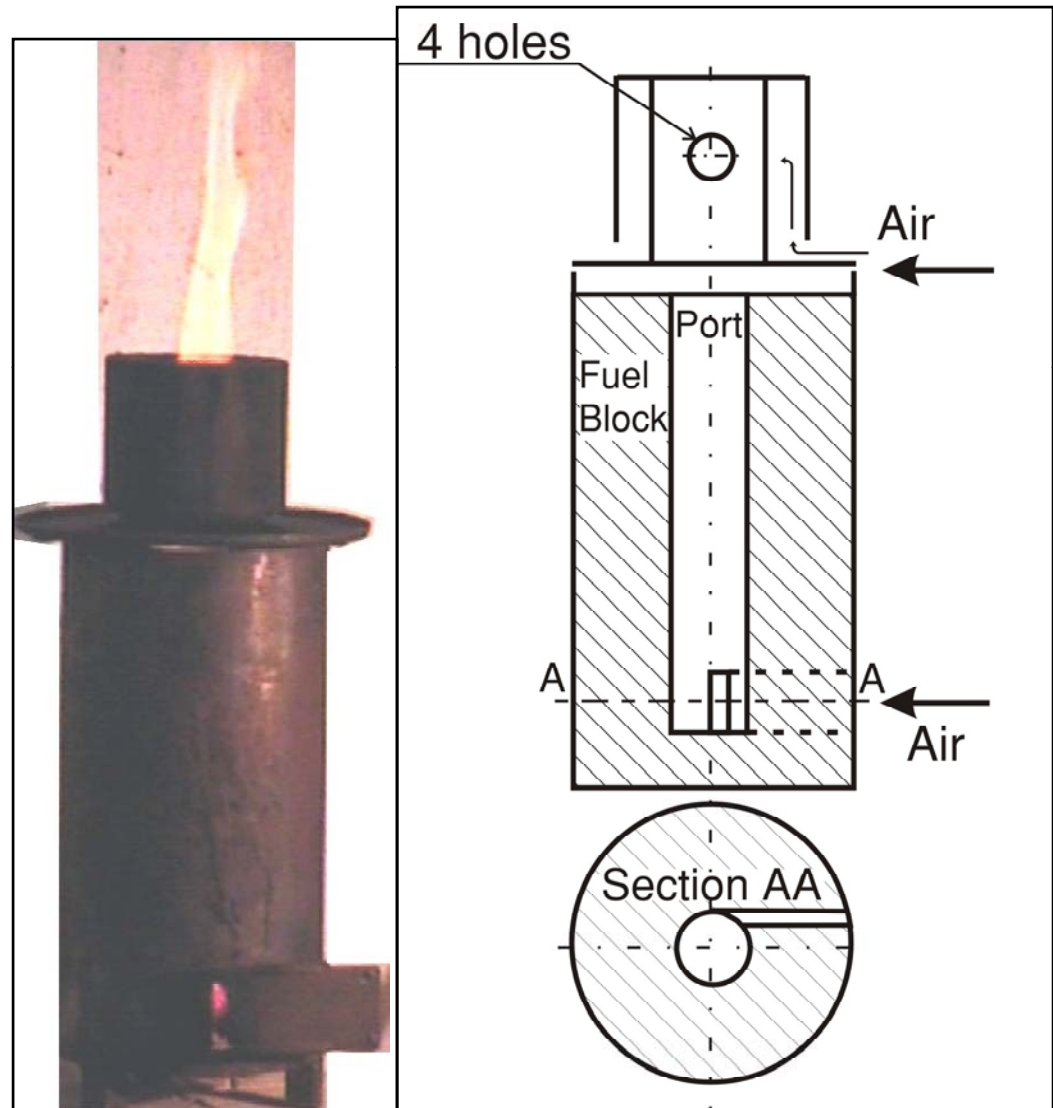
- Domestic application addresses thermal energy needs of house hold like cooking and bath water heating.
- Stoves developed to use Powdery Biomass and Solid biomass.
- Powdery biomass can be saw dust, coir pith, dry leaves etc. having particle size less than 5mm.
- Solid biomass can be woody or pellets of powdery biomass.

Powdery biomass stove

- *Naturally Aspirated
- *Accepts any loose agro-residues
- *Power level ~ 2 – 4 kWth
- *Efficiency ~ 37%

-The agro-residue should be Packed in the stove and Ignited in the central hole.

-Char on top and in inner side of tubular of wall helps in Gasification.

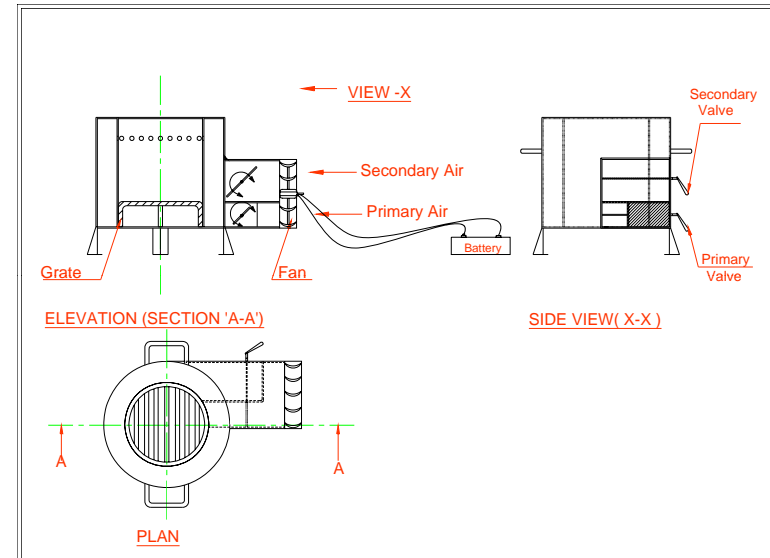


Solid Biomass Stove

- Forced Draft Gasification Stove
- Accepts Solid bio-residues
- Power level ~ 2 – 4 kWth
- Efficiency ~ above 50%
- Max Efficiency = 62% in water boiling test.

Air is provided by a small fan, distributed below grate and at the top.

The bottom air is primary air for combustion and the top air is secondary air is for complete combustion of gaseous products.



Novelty in Solid Biomass Stove

- Proper air distribution for gasification and complete combustion of Producer gas.
- 1.5 W fan for 3 kWth stove – uses rechargeable battery
- Gaseous flame contacts the vessel bottom – No soot.
- Reduced NO_x and HC emissions due to better combustion.
- 40 mins burn time – ensures complete cooking.

Applications of Solid Biomass Stove

Combi Stove:

Biomass stove and LPG burner integrated in a common Platform.

LPG burner acts as a backup for Biomass Stove.



Bath Water device:

Biomass Stove integrated with fire tube boiler for bathwater heating application.

The hot gas transfers heat to the vessel bottom and also to water in the passage inside.

Efficiency ~ 75 – 80%

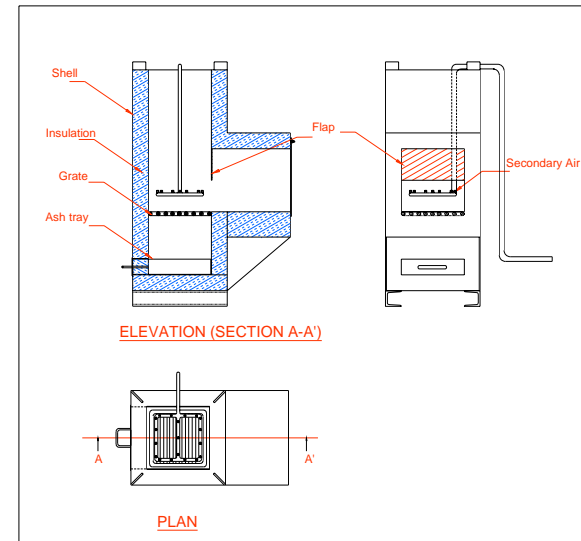


Stoves for Community application

- **Ejector based Gasification Stove**
- **Secondary air provided by blower**
- **This provides suction for primary air.**
- **Accepts any Solid bio-residue**
- **Power Level ~ 5 – 50 kWth**

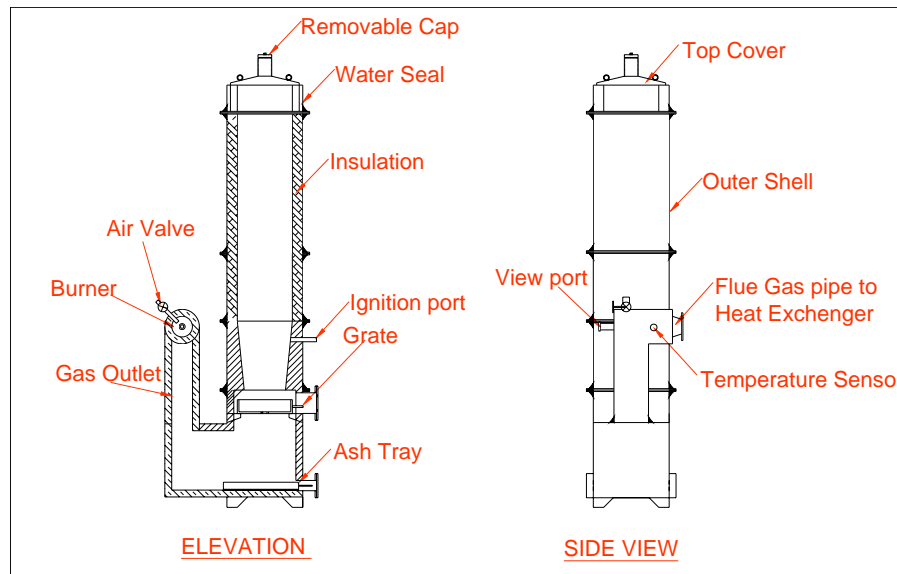
Useful for community cooking in Hotels, Hostel etc.

Controlled power level possible



Combustor for Dryers

- Induced draft Combustor for dryer application
Works on gasification principle



Case study – Cardamom drying

- Cardamom is a spice used in flavoring food.
- Cardamom drying is a twenty hour cycle.
- Controlled heating rate is essential.
- Diesel fired indirect heated drying chambers are used.
- The diesel burner replaced with biomass combustor.
- The hot gas is sucked through the system by a blower.
- The combustor has a grate to hold the charge with air distribution and gas generation akin to down draft gasifier.
- The hot gas is mixed with combustion air and burnt completely before entering the drier.
- The change in power level for controlled operation is through speed change in suction blower.
- 2 l/hr diesel replaced by 8 – 10 kg/hr biomass.

Combustor with recuperation for Puffed rice production

Puffed Rice is a processed food – popular snack.

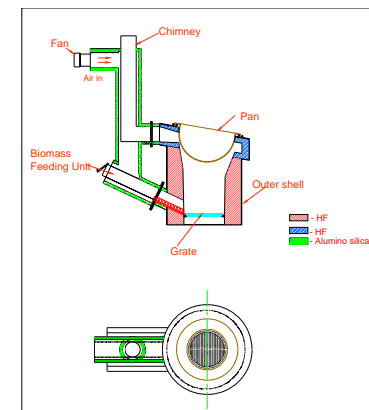
Prepared by roasting conditioned rice grains in hot sand bed.

Traditional devices highly inefficient and also used tire to achieve higher temperatures.

High pollution lead to closure order from Court.

Technology intervention was sought from IISc.

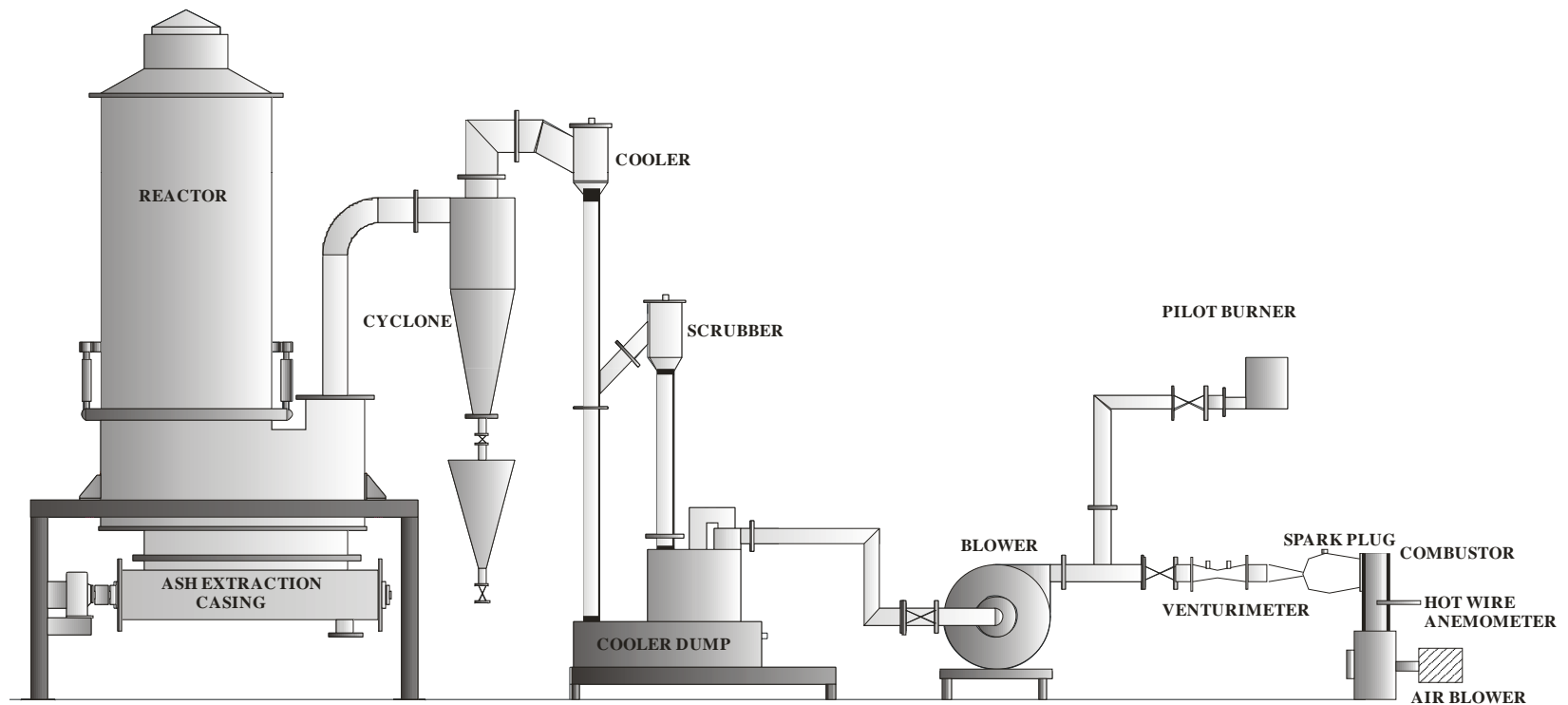
Careful study of process led to recuperated stove which meets the requisite criteria.



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- Puffing time 10 – 15 Secs
- Volume appreciation – 4 times
- Sand temperature to be maintained at 573 K – critical for the process.
- The recuperated stove uses flue gas to heat incoming air.
- 100 W fan used for air supply
- Combustion complete with clean exhaust.
- Field operation has shown 38% saving in energy (from 120 kWth to 74 kWth)

Gasifier for Thermal Application



Gasifier for Thermal Application - 1

- Typical applications large scale industrial drying – Crumb rubber, Marigold flower for chemical extraction etc.
- Low grade application – high quality gas not required.
- System Elements: Reactor, Cyclone, Cooler and Scrubber, end use burner.
- 3.5 kg of biomass to substitute 1 L of fossil fuel.

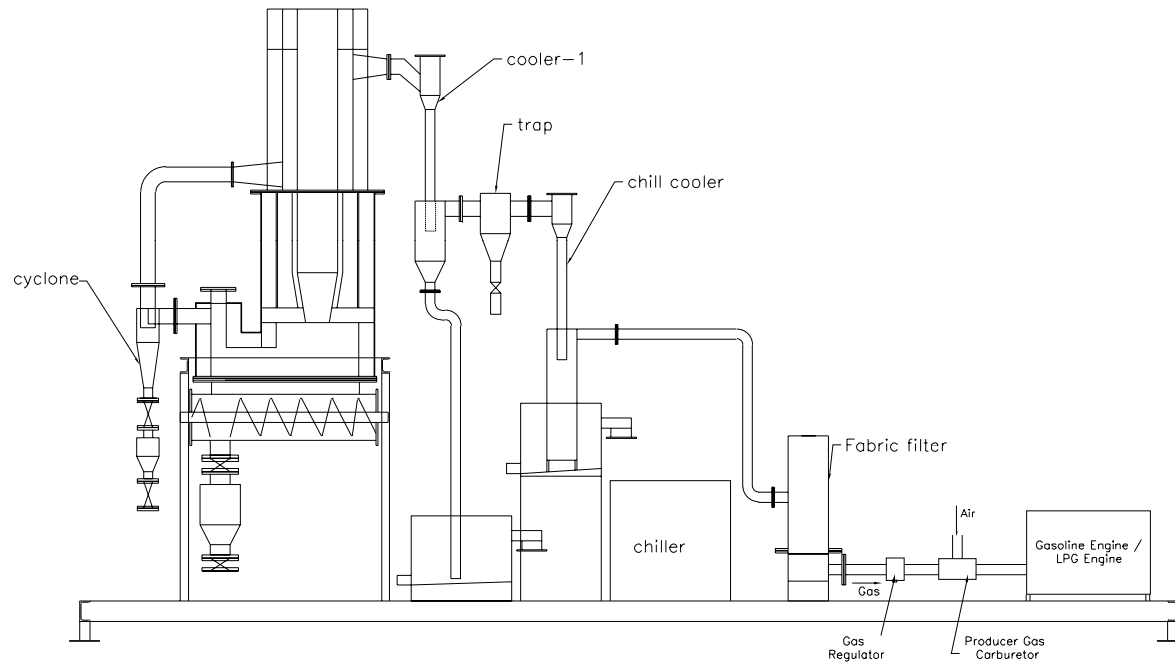
Gasifier for Thermal Application - 2

- Heat treatment and high temperature applications (process industry).
- Air to fuel ratio controls adopted for higher flame temperatures.
- High gas quality required for proper functioning of controllers.
- System Elements: Reactor, Cyclone, cooling & scrubbing system, Chill water scrubbing system, burner with controls.
- 3.7 kg biomass to substitute 1 L of fossil fuel.

Gasifier for Thermal Application



Gasifier for Power Generation



Gasifier for Power Generation

- Power generation through Reciprocating engines and Gas turbine.
- Dual fuel mode of operation - conventional diesel engine.
- 0.8 to 1.0 kg of biomass with 65 to 80 mL diesel per kWh.
- Gas alone mode operation – natural gas engine with producer gas carburetor (30% de-rating).
- 1.1 – 1.4 kg/kWh of biomass depending on power level.
- High gas quality required especially turbocharged applications.
- System Elements: Reactor, Cyclone, cooling & scrubbing system, Chill water scrubber, fabric filter.

Gasifier for Power Generation



Thank you