# A BIOMASS-FIRED GASIFIER STOVE (IGS-2) FOR INSTITUTIONAL COOKING

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Gasifier stoves appear to be promising for community type cooking as these can be operated continuously if necessary, and they produce very little or no smoke. An improved briquette-fired gasifier stove suitable for institutional kitchens and traditional cottage industries has been designed and developed at AIT; this stove can be fired by sized biomass briquettes or wood. This paper presents the design and operating parameters of the stove in detail.

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To promote a few selected mature and nearly mature renewable energy technologies, a five-year regional research and dissemination programme, *'Renewable Energy Technologies (RETs) in Asia'* involving six Asian countries was sponsored by the Swedish International Development Co-operation Agency (Sida), and coordinated by the Asian Institute of Technology (AIT). Biomass briquetting is one of the three technologies, under which improved biomass briquetting systems and briquette-burning stoves were designed, developed and disseminated. The gasifier stove was developed within this framework.

## DESIGN DETAILS

The stove, named IGS-2, was made of 2mm thick mild steel sheets, and consisted of four main parts i.e. fuel chamber, reaction chamber, primary air inlet and combustion chamber. Different parts of the stove could be attached together by bolts and nuts.

Fuel chamber: The fuel chamber is conically shaped, and located above the reaction chamber. It has a height of 70 cm. The lower part of the truncated cone has a diameter of 20 cm while the upper part, 15.5 cm. The top end of the chamber has a water seal and a cup-type lid for easy loading of fuel. Water rail fixed on the upper edges of the hopper is filled with water, which prevents gas leakage from the joint during operation.

Reaction chamber: The outside wall of the reaction chamber was made of mild steel sheet, with an outside dimension of 36 cm (side) x 36 cm (side) x 44 cm (height). The inside wall was made of bricks cemented together and plastered with refractory cement (Castable 13). The inner cross section of the reaction chamber, which can hold the fuel, is 20cm x 20cm square. The upper part, which is connected to the fuel chamber, was 20cm in diameter. Fuel from the fuel chamber flowed down by its gravity to the reaction chamber. The grate,

fixed at a height of 22cm from the top of the reaction chamber, was made of 5mm diameter round parallel steel bars with 2cm spacing in between. Ash from the reaction chamber could fall down freely through the grate. An ash scraper was fixed below the grate to remove excess ash from the reaction chamber. A mild steel door (21cm x 18cm) was provided below the grate at one side of the reaction chamber for removing the accumulated ash.

Primary air inlet: The inverted 'L' shaped primary air inlet was attached to one side of the reactor. A butterfly valve was provided in it to control the amount of primary air supply to the reaction chamber. The cross sectional area of the primary air inlet at its entrance and exit were 8cm x 8cm and 18cm x 12cm respectively. Perforated mild steel sheets of 2mm thickness were used at the primary air inlet and exit areas to hold the fuel inside the reaction chamber.

Combustion chamber: It is of rectangular box-type construction, with an outer dimension of 20cm (side) x 20cm (side) x 25cm (height). The inner surface of the chamber is insulated with a layer of refractory cement, of 2.5cm thickness. The combustion chamber is connected to the producer gas outlet of the reaction chamber at one side (with a cross sectional area of 10cm x 15cm), while a cylindrical burner is attached to it at the top. The burner, made of 3mm thick mild steel sheet, has forty four holes of 10mm diameter each through which secondary air needed for combustion is supplied.

The cross section of the assembled stove is shown in Figure 1.

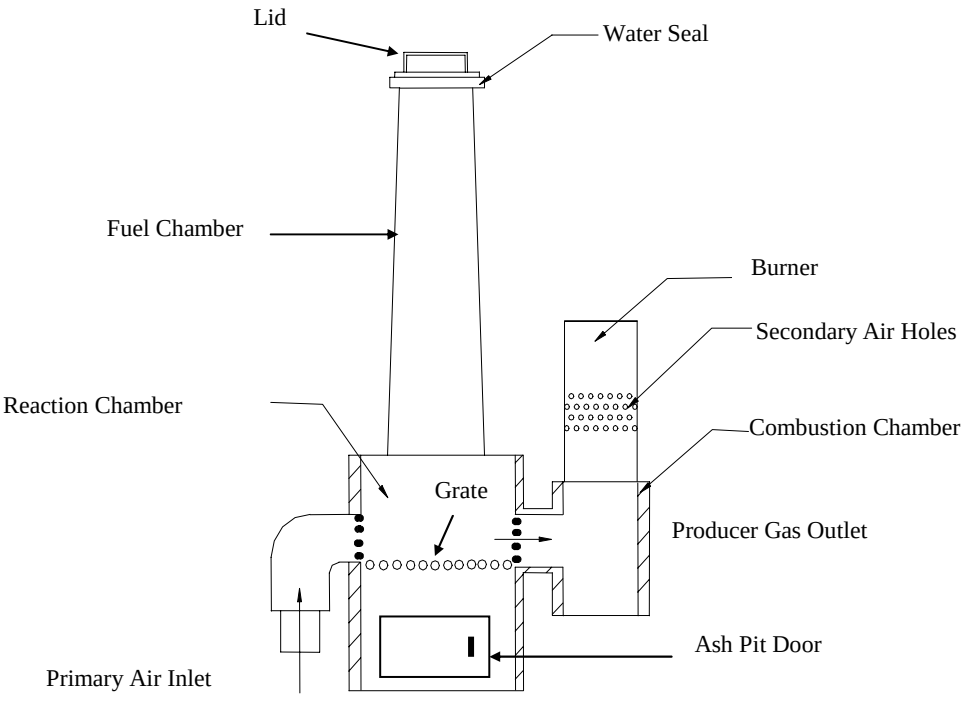


Figure 1: Institutional Gasifier Stove IGS-2

## FUEL FOR THE STOVE

Wood chips (1-inch cube), twigs and rice husk briquettes could be used as fuel in the stove. The fuels may be sized by cutting them into small pieces, of about 1 cubic inch volume (Figure 2).

Figure 2: Fuel for Gasifier Stove

## OPERATION

The stove may be started after loading the fuel chamber with fuel. The water seal should be filled with water to arrest any gas leakage through the lid. A flame torch is used to ignite the fuel from below the grate through the ash pit door. It usually takes about 6-8 minutes for the start up. The butterfly valve at the primary air inlet should be kept fully open during start-up. After 6-8 minutes, combustible gases in the form of thick white smoke will evolve through the burner, which could be ignited using the flame torch.

The stove gives smokeless combustion, high efficiency, and can be operated for about 2 hours with one batch load of sized fuelwood or biomass briquette pieces. The flame is sufficiently strong, and almost steady (Figure 3). Water boiling tests with two pots indicate typical efficiency figures of 22.2%, 27.8% and 17.1% with wood twigs, wood chips and ricehusk briquettes respectively, as fuel. Figure 4 presents the two-pot configuration used for the efficiency testing.

The stove can be loaded while operating, and can be run continuously for 24 hours a day if needed. The intensity of the flame could be controlled to an extent by adjusting the butterfly valve at the primary air inlet.

Figure 3: IGS-2 in operation

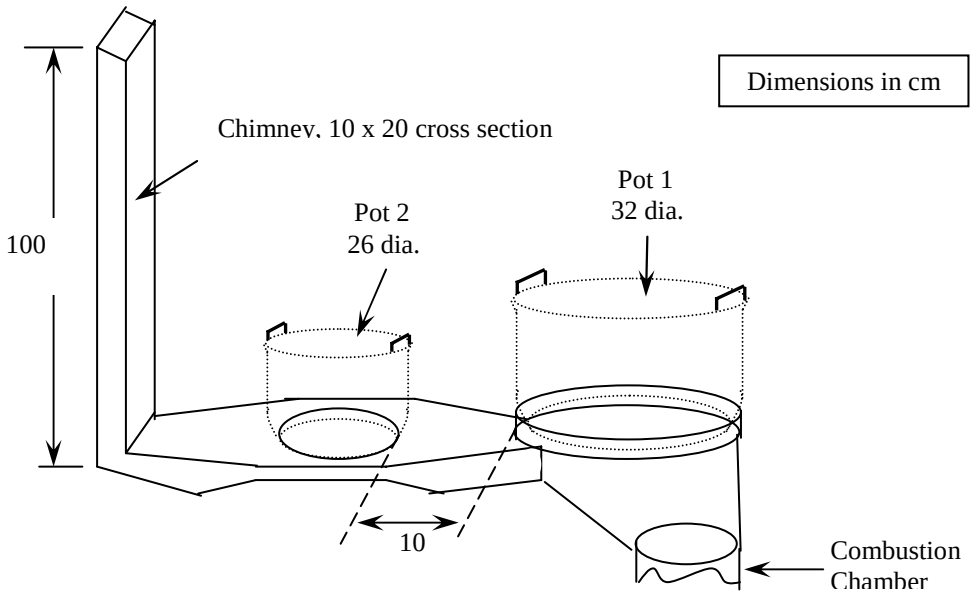


Figure 4: Pot setting configuration

## CONCLUSION

The gasifier stove IGS-2 is versatile, allowing different fuels such as wood chips, wood twigs and ricehusk briquettes to be used in it as fuel. Smoking is almost completely eliminated with all the above fuels. Experimental results indicate an average efficiency of 17% with ricehusk briquettes (two-pot configuration), 27% with wood chips and 22% with wood twigs. The stove seems to be an attractive alternative to conventional wood stoves used in institutional kitchens and traditional cottage industries. It is presently being disseminated in the six Asian countries involved in the *RETs in Asia* regional programme. Additional information on the stove and the programme is available at the website http://www.retsasia.ait.ac.th.