

## Design and techno economic evaluation of biomass gasifier for community cooking

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■ **ABSTRACT** : This paper deals with design of community gasifier cookstove. The stove works on natural cross draft mode with two pots for community cooking. Gasifier stove fabricated at Department of Renewable Energy Sources, CTAE, Udaipur has a capacity of 18.78 kWh. The biomass-fired gasifier stove consisted of four main parts *i.e.* fuel chamber, reaction chamber, primary air inlet and combustion chamber. The diameter of gasifier reactor was 30 cm and 56 cm in height. Area for primary and secondary air requirement was 109.67 cm<sup>2</sup> and 69.33 cm<sup>2</sup>, respectively. The stove was insulated by refractory castable cement with thickness 18cm to minimize heat losses. The cost benefit ratio was found to be 1.27 with a payback period of 6.7 months. The design criteria and techno economic evaluation of biomass gasifier for community cooking presented in this paper.

■ **KEY WORDS** : Biomass gasifier, Gasifier, Cooking stove

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Community cooking normally refers to cooking of food for a group of about 25 or more persons in hostels, schools, community centers, hotels, rural/semi urban restaurants and road side dhabas, places of worship, residential monasteries, ashrams, caterers, suppliers of mid-day meals for schools etc. Community cooking is done using a coal-based traditional oven/furnace (bhatti) and direct burning of wood in ovens. Recently the use of LPG-based burners has also become a common practice in India. It is obvious that the use of a biomass gasifier based system for community cooking may provide an overall efficiency of about 40 per cent as compared to 8 to 20 per cent from traditional oven/furnace, etc. Biomass gasifier-based community cooking systems are available in the thermal rating of 17.5 to 291kW.

In this case a biomass fuel is first converted to producer gas using a suitable gasifier; the producer gas is next burned to produce energy for cooking. The main advantage of a producer gas fired stove is that it produces no smoke during cooking. These stoves differ from domestic units in being used in community and commercial environments, where multiple meals for a much larger number of people are prepared with a greater frequency daily.

The use of the community stove will be for much longer time at a stretch as compared to the domestic stoves which have much shorter cooking cycles. Fuel uses for community

cook stove are big logs, small twigs and processed fuel (briquettes or chopped wood). Stove may be forced draught or natural draught based; they may be fixed or portable etc.

### METHODOLOGY

The present study on cross draft gasifier operated cook stove was carried out to design the community sized biomass based gasifier cook stove. The initial design conditions and assumptions made for the design of cross draft gasifier system are listed in Table A.

#### Design of cross draft gasifier:

The following design parameters were considered for the design of the cross draft gasifier with two pots for community cooking.

#### Heat required for community cooking, $Q_n$ :

Cooking of food for 100 people

Total requirement of rice = 150 g/ person  $\times$  100 = 15 kg

Total requirement of vegetable = 80 g/person  $\times$  100 = 8 kg

#### Energy needed

The amount of energy needed to cook food can be calculated using the formula: