

Utkarsh

Details efficient Chulha for Rural India

Introduction The primary motivation for a cleaner cooking stoves initiative is reduction in health impacts from indoor air pollution. A national stove contest in China recently highlighted a number of such stoves being sold around the country . Other important co-benefits include improved efficiency of resource use, reduction in time and effort to collect biomass with concomitant social benefits, and climate mitigation from reductions in emissions of Green House Gases (GHGs) and black carbon, a climate warming agent. Therefore we need to develop the cleanest possible cooking stoves. In fact, our broad aspiration should be to deliver a clean cooking experience with biomass as good as with other common options such as LPG.

Technology status: Promising *advanced biomass stoves* (ABS) for household cooking include:

- a. *gasifier stoves*
- b. *direct combustion or "rocket" stoves.*

Gasifier stoves using wood-chips as fuel and an electric blower were developed for cooking during 1990s. This has been followed up by development of several designs of gasifier stoves based on forced draught as well as natural. A national stove contest in China recently highlighted a number of such stoves being sold around the country. Direct combustion stoves with design innovations like a post-combustion "*rocket*" section, or others, have been developed and used for example in rural settings and in some international programs for displaced people.

Performance criteria: Basic performance criteria of stoves include thermal and emissions performance are typically measured using a water boiling test (details of which will be provided). Thermal performance is typically expressed as a thermal efficiency (ratio of the amount of useful heat derived to the heat released by burning the fuel), needs additional data for its calculation including calorific value of the fuel, the thermal capacity of the water-pot assembly and the calorific content of the remaining char. Emissions performance includes the emissions of pollutants per kg of fuel burned, typically for CO and particulate matter. A measure of combustion efficiency is the CO/CO₂ ratio. It must be noted that particle matter (PM) and CO emissions do not bear a simple relationship and need to be individually addressed. In addition emissions of black carbon (BC), a climate warming pollutant, must also be curtailed. Other criteria include, easy turn-down of power (i.e. high power and simmer), safety criteria (external surfaces should remain cool), durability (material lifetime which withstands 1000-2000 thermal cycles or 5-10 y) and cost (recommended cost Rs. 1000-2000). In the table below, we suggest two sets of standards labelled Generation I and Generation II. Stove power should be 2-3 kW. It may be noted that the market demand in India alone is about 150 million units, each 5-10 y, depending on technology life.

Table 2: Proposed performance bands of thermal efficiency and pollutant emissions factors in g of pollutant emitted per kg fuel used for next generation advanced biomass stoves.

S No	Fuel		Thermal efficiency (%)	CO (gkg ⁻¹)	PM (gkg ⁻¹)	CO/CO2 ratio	BC (gkg ⁻¹)
1	Wood, crop residues*, light chopping / splitting (sticks of 25-30 cm length and 1-4 cm diameter).	Gen I	40	30	1.5	0.07	0.3
		Gen II	45	25	1	0.05	0.2
2	Wood, crop residues. Processed biomass chips, briquettes, pellets (flat chips, cubes, cylinders of 3-4 cm length).	Gen I	50	7	0.7	0.003	0.1
		Gen II	55	5	0.5	0.002	0.05

Aim: Develop a Cooking Stove taking into consideration available local fuel, cooking practice and above performance levels.