

Research Paper :

## A hot water dual purpose improved cook stove- a device to drudgery reduction of rural woman

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### ABSTRACT

In the rural kitchen cooking and heating of water for bathe are two major operations performed on the chulha. The time for these operations always overlap in the morning hours. This can delay the cooking operation and require more time to spent in the kitchen for rural women otherwise this can be spent in productive work in agriculture. In Jalgaon district two pot mud cookstove is most common. For the study a two pot modified laxmi chulha was selected. The Laxmi Chulha is a two pot mud cook stove with chimney and can be constructed with clay and some readymade parts such as pottery liner combustion chamber, connecting tunnels, chimney pipe, cowl and metal grate. Special "L" shape device of mild steel is inserted in Laxmi Chulha in order to increase its thermal efficiency by absorbing heat lost. Thermal efficiency of a chulha is the ratio of heat actually utilized to the heat theoretically produced by complete combustion of a given quantity of fuel. Special device absorbs the heat lost to the surrounding area, in this way heating the water in special device can increase the heat utilized. It increases the heat utilization and the extra time and fuel wood is saved for heating of water. The efficiency of Laxmi Chulha can be increased by 10 to 12 %. The life of special device is about 8 to 10 years so its operating cost and maintenance cost is very low. The use of fuel wood is very common and widely adopted in rural areas of India. The main purpose of study was to minimize deforestation by saving the fuel wood. Also the time and money of the rural women can be considerably saved.

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**Key words :** Duel purpose cookstove, Efficiency

**E**nergy is a vital input for economic and social development. In most of the developing countries, wood and other biomass fuels are still the primary source of energy for the majority of people, particularly the poor. Most countries in Asia are giving an increasingly higher priority to energy conservation, both in the industrial/commercial and domestic sectors. As cooking in developing countries constitutes a large part of the total energy consumption in the domestic sector, conservation approaches have concentrated on the development and introduction of improved cooking stoves (ICS). In principle an improved chulha can save 30-40% of fuel wood or other bio fuels. Therefore, it is expected that fuel saving per chulha would be about 700 kg/year. In India, the Ministry of Non-Conventional Energy Sources (MNES) recently informed in their stove programs that priority should now given to women's health aspects rather than to efficiency.

For present study a special device of hot water is

designed to get hot water while cooking is in progress. There will be no disturbance to the cooking activity. One can get hot water and cooking simultaneously. It will reduce the drudgery of women handling cooking and providing hot water for different activities. The designed model of improved chulha also can provide hot water even after 10 to 12 hours of cooking and for getting hot water no extra fuel is required to burn. A special device is absorbing the heat loss in the earth material near the chulha and this heat can be utilized to increase the temperature of water present in special device (L Shape Box). Ajmera, (2007), in his article in Dhanyalaxmi magazine, explained the working of a hot water Chulha. This Chulha had various advantages but not tested scientifically.

The objective are to design the improved Chulha, to evaluate performance of Improved Chulha and to compare the improved chulha with existing Laxmi chulha.

## METHODOLOGY

### Construction of special device (L shape box):

The special device (L shaped box) can be installed in following way

- Make L shape pot of 16 gauge GI sheet which is coated with red oxide to prevent it from corrosion. Its dimensions are

Cross sectional area = 125 mm x 125 mm

Length = 300mm and width= 250mm

Capacity = 5.50 lit

- Connect two GI pipes, one for filling cold water and other for discharging hot water from it. As shown in Fig. 1

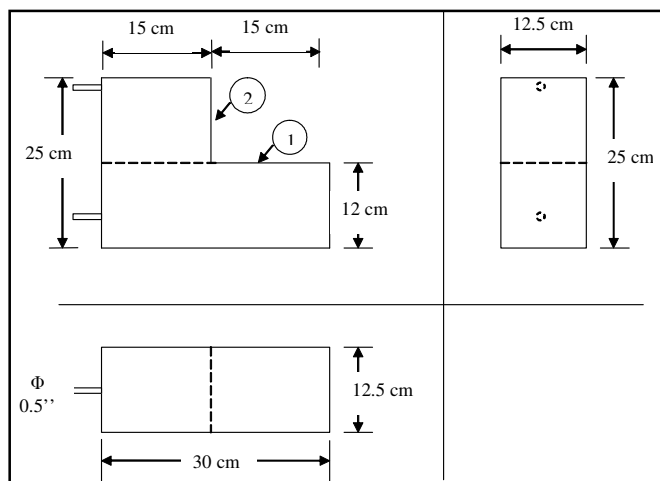


Fig. 1 : Orthographic view of special device

- Make a pit of 0.35 m deep and 0.40 m long. Fill the pit with coarse sand up to 0.1m from its bottom. The layer of sand is placed in order to prevent corrosion of pot due to soil and the sand gets heated earlier but cooled slowly so one can get hot water for longer time. Place the hot pot (special device) on sand layer.

- Place the hot pot( special device) on sand layer.

- Pour the sand on three sides of pot leaving sides (1) and (2) shown in Fig. 1

- The lower pipe (inlet) is connected with 0.7 m long pipe fitted bucket for easy filling of water. Cover the bucket by cloth which prevents the entry of foreign material, insects, etc.

- The upper pipe (outlet) is connected 0.3m long pipe which further connected to plastic pipe to collect hot water.

- If cold water is supplied continuously from tank, it is necessary to install control valve on inlet line.

Make the Chulha in such a way that the surfaces 1 and 2 shown in Fig.1 should be the sides of combustion chamber.

Table 1 : Material required for the construction of a special device in improved cookstove

Sr. No.	Material required	Quantity
1.	G I sheet (16 gauge)	1 sqm
2.	Elbow (0.5 inch)	3
3.	GI pipe (0.5 inch)	1 m
4.	Plastic bucket	1
5.	Coupler	2

### Working of the improved cook stove :

- When fuel burning starts inside the combustion chamber of the Chulha , some heat is lost in earth material near the Chulha. Due to this heat loss, the sand around the Chulha and special device get heated and the temperature of cold water inside the special device starts to increase. As soon as the temperature of water starts increasing and this hot water can be taken by simple siphoning method for the use.

- The temperature attained by discharge water is nearly about 75°C -80°C.

- One can get 25-30 lit hot water after 10-12 hours of cooking without burning of fuel.

### Laxmi Chulha

The model was developed in 1986 at the Technical Back-up Unit, Centre for Application of Science and Technology for Rural Development (CASTFORD), Indian Institute of Education, Pune.

The Laxmi, a two-pot mud stove with chimney, was specifically designed for Western India, particularly for the States of Maharashtra, Goa and Gujarat, where baking of bhakari (traditional pancake) is common, besides boiling and steaming. The stove can be used with fuel wood, twigs, agri-residues and dung cakes. The design can accommodate pots 18-26 cm. in diameter. The stove can be constructed with clay and some ready-made parts such as a pottery liner combustion chamber, connecting tunnels, chimney pipe, cowl and metal grate. The constructional details of Chulha are shown in Fig. 2.

So far, nearly one million stoves have been disseminated in Maharashtra, Goa, Karnataka and Gujarat. The production cost estimate is Rs. 70-87 per model.

### Components of Laxmi Chulha:

#### Body:

It is that part on which the combustion chamber, fuel feed opening and pot openings are made in specific dimensions.

#### Combustion chamber:

It is place on body of Chulha where fuel is burnt. Its

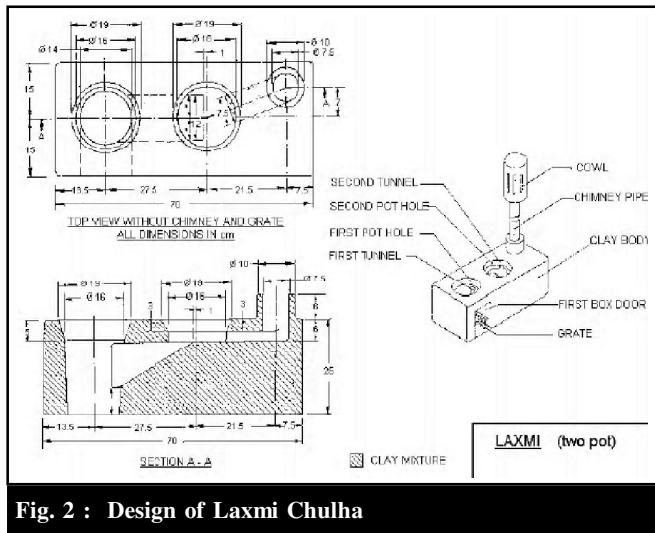


Fig. 2 : Design of Laxmi Chulha

height is about 18 cm. It is circular in cross section. Its diameter is 16 cm. Grate is provided below the combustion chamber.

**Fuel feed opening:**

It is provided for feeding the fuel. Its height is 14 cm and width is 16 cm.

**Pot openings:**

There are two pot openings. First pot opening and another called “Wail”. They are circular and are of different diameter. Wail has 16 cm diameter and 1<sup>st</sup> pot opening has diameter of 22 cm.

**Grate:**

Square and round cast iron grates with specific dimensions and strength have been designed by the TBU. Through the grate, the combustion chamber gets good aeration to burn the fuel wood. The ash formed after burning of fuel can be removed easily. It is noted that the efficiency is reduced by 3 % if the bottom square grate is not used. Square grate has size of 15 x 15 cm. while round grate has diameter of 16 cm.

**Chimney:**

It is asbestos pipe of 2m length and is of 10 cm diameter. It carries the smoke from Chulha to outside of Chulha and draft the air. Due to chimney, there is no need to blow the fuel. Due to easy aeration, continuous burning of fuel takes place.

**Cowl:**

A pottery cowl that ensures that cinders do not damage the roofs of rural houses and prevents rainwater from entering the house.

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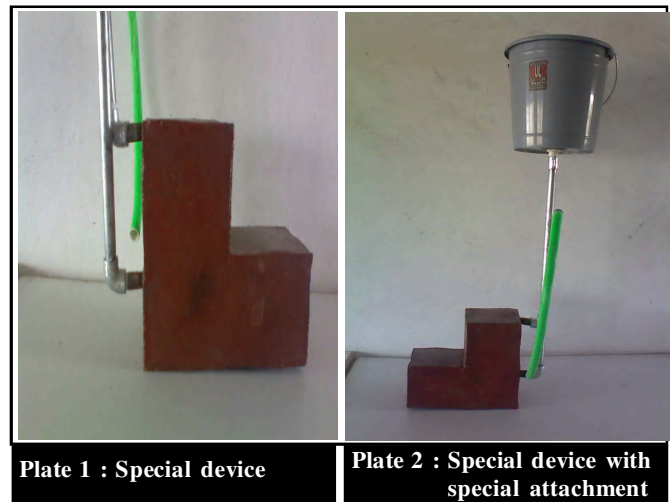


Plate 1 : Special device

Plate 2 : Special device with special attachment



Plate 3 : Special device

Plate 4 : Special device with special attachment

**Test for thermal efficiency:**

The thermal efficiency was calculated using standard water boiling test.

## RESULTS AND DISCUSSION

The performance evaluations of laxmi chulha with special device were carried out with different amount of fuel wood. Water was heated to calculate thermal efficiency.

**Thermal efficiency:**

The thermal efficiency of Laxmi Chulha without special device was 24 %. Special device is inserted in to Laxmi Chulha to increase its efficiency by absorbing heat loosed to surrounding material of Chulha.

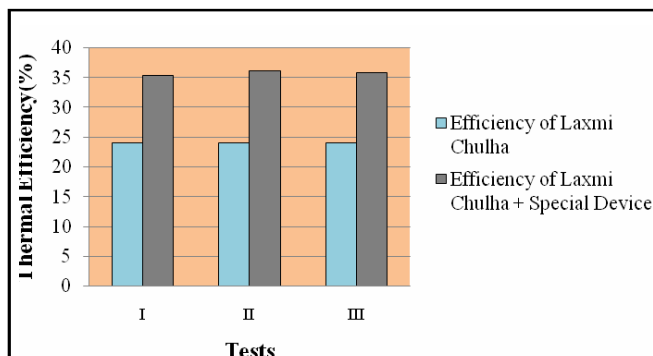
**Effect of installation of special device on thermal efficiency:**

The study of special device with Laxmi Chulha was conducted to compare the thermal efficiencies. Three trials for calculation of thermal efficiencies were

conducted at Dr. Ulhas Patil college of Agricultural Engineering and Technology, Jalgaon and results are presented in Table 2.

**Table 2 : Efficiency of Laxmi Chulha and Laxmi Chulha + special device**

Sr. No.	Tests	Efficiency of Laxmi Chulha (%)	Efficiency of Laxmi Chulha + special device (%)
1.	I	24	35.40
2.	II	24	36.10
3.	III	24	35.75



**Fig. 3 : Comparison of efficiencies of Laxmi Chulha and efficiencies of Laxmi Chulha + special device**

**Table 3 : Cost economics**

Sr. No.	Cost of Laxmi Chulha (Rs.)		Cost of Laxmi Chulha + Special device (Rs.)		Total saving	
	Capital cost	Operating cost / annum	Capital cost	Operating cost / annum	Fuel (kg)	Cost (Rs.)
1.	75	5110*	400**	3226.6***	940	1883
2.	Total = 5185		Total = 3626.6			

\* is the operating cost of Laxmi Chulha. On an average a family of 5 persons required fuel wood 7 kg per day. The annual fuel wood required for family is 2555 kg. It costs about Rs. 5110 per year.

\*\* is the capital cost of Laxmi Chulha + special device.

\*\*\* is operating cost of Laxmi Chulha + special device. The equivalent fuel required for Laxmi Chulha + special device with average efficiency of 36 % will be  $7 \times 24/36 = 4.66$  kg. An annual fuel required is 1703.3 kg. Its cost is Rs. 3406.6 per year.

It was found that there was about 11.4 %, 12.1 % and 11.75 % increase in thermal efficiency by inserting the special device for getting hot water.

### Cost economics:

Cost economics is compared by considering capital cost and operating cost as follows.

### Conclusions:

- The efficiency of Laxmi Chulha was increased due to the addition of special “L” shape device.
- One can get 25-30 l hot water after 10-12 hours of cooking without burning of fuel.
- The temperature attained by discharge water at outlet of special device was nearly about 50°C to 60 °C so it can be used for many daily works like cooking, washing cloths, bath etc.
- The capital cost of improved Chulha is more but it is recovered with saving of wood more than the capital cost during very short duration of one year.

- The time and work of rural women can be minimized for searching fuel wood.
- The health of rural women can be maintained good during cooking with improved Chulha as it is smoke less.

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