CONE SHAPED STOVE

This improved cookstove has been developed in the CRF (Centre de Recherche Forestière, Morocco) to respond to a need of fuelwood saving cookstoves in rural areas. The idea behind its conception is to approach the combustion principle in a gas stove. This has been made possible by a cone-shaped combustion chamber. Cookstoves with such conception has not been tested before.

The core of the stove consists of a cone-shaped body with the following dimensions (Fig. 1):

Fig. 1 The cone-shaped cookstove in metal

Diameter at the Bottom	24 cm
Diameter at the top	12 cm
Height	18 cm

The wall of the stove has two rows of small holes: seven holes at bottom and six ones at the half height of the stove; the diameter of these holes is about 1.5-2 cm. This design is easy to make either in metal or in clay (Fig. 2),, which make it very cheap and affordable by a poor community. With a mold, it can be easily made by rural women with local materials.

Fig. 2 The cone-shaped cookstove in clay

When used alone, the core needs only a simple support for the pan (Fig. 3 and 4), and the performance is very interesting. But, to increase the thermal efficiency, a second cylindrical envelope with a cover at the top, which serves as a support, are added to minimize heat transfer through the wall (Fig.5 and 6). The primary and secondary air recover some of the heat lost through the wall of the cone before entering to the combustion chamber.

Fig. 3 The cone-shaped cookstove with a simple support


Fig. 4 The cone-shaped cookstove during operation


Fig. 5 The cone-shaped cookstove (combustion chamber) with an outer envelope

Fig. 6 The final design of the cone-shaped cookstove

During the combustion of wood in the chamber, the volatiles produced by the decomposition of wood are mixed with the primary and especially secondary air entering from the holes and the door when it is kept open: in our case, the door was kept slightly open so as not to have an excess of air draft. The door may be closed if the wood used has small length (< 20cm). In this case, some holes must be added in the outer cylindrical envelop (this scheme will be tested in the future.) A fraction of the volatiles and air mixture is burned in the chamber, while the remaining fraction is removed out of the chamber. This removal occurs because the combustion chamber is not voluminous enough to permit the burning of all the volatiles, the residence time of which is smaller than that in the case of the cylindrical combustion chamber.

The combustion of the volatiles at the exiting section at the top of the stove results in a big flame (Fig. 7). When the pan is put on the stove, the flame licks directly the bottom of the pan, enhancing a good heat transfer (Fig. 8). In the other hand, since the combustion gases get in contact with the pan at the center, they are forced to lick totally the surface of the pan and spend longer time to transfer heat to it. This heat transfer is reinforced by the fact that the velocity of the gas is quite high since the exiting section is small (∅12 cm) compared to that existing in a stove with a cylindrical shape (∅24 cm). With the flame and the gas directly in contact with the pan at its center, this stove works approximately as gas stove.

Fig. 7 The final cone-shaped cookstove flame during wood burning

Fig. 8 The final cone-shaped cookstove during operation

In addition, because of the reduced volume of the combustion chamber and the high induced velocity of the gases, there is quite high draft, making good turbulence of the volatiles and the secondary air mixture. The appeal of secondary air through the holes of the stove is proportional to the intensity of combustion: the more the volatiles are, the stronger is the flame and higher the air draft is. Furthermore, the reduced volume of the combustion chamber helps also to keep the combustion zone very hot. The combustion of wood is thus clean, except in the beginning of the combustion.

The results of eight water boiling tests (without the pot's lid and without a skirt) are summarized in table 1. For each variable, the mean ± standard deviation is reported. During these tests, the high power phase (cold start) is followed by the low power phase (simmering).

The results are quite interesting and other improvement of this cookstove will be tried in the future.

Table 1	Total	High power Phase	Low Power Phase
Equivalent dry wood consumed (g)	950 ± 69	495 ± 98	458 ± 36
Thermal efficiency (%)	24.40 ± 1.69	25.60 ± 3.68	23.54 ± 3.39
Time to boil (min)	-	27.83 ± 5.31	-
Firepower (kw)	4.07 ± 0. 54	5.02 ± 1.00	3.45 ± 0.69
Specific fuel consumption (g/l)	183 ± 24	101 ± 24	114 ± 15
Burning rate (g/min)	13 ± 1.75	16 ± 3.2	11 ± 2.2

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Legend of the images

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