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PRELIMINARY STUDY OF WATER BOILING TEST PROCEDURES USED FOR PERFORMANCE EVALUATION OF FUELWOOD COOKSTOVES

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Abstract—A critique of the water boiling test procedures developed over the last decade for fuelwood cookstoves is presented. Results of some preliminary tests conducted on single- and double-wall fuelwood cookstoves are presented, and their implications for the test procedures are discussed.

Fuelwood cookstoves   Water boiling test   Thermal performance evaluation   Portable metallic cookstoves

NOMENCLATURE

C_c = Calorific value of charcoal (kJ/kg)
C_w = Calorific value of fuelwood (kJ/kg)
I = Time taken for boiling (min)
M_c = Mass of charcoal (kg)
M_w = Mass of fuelwood (kg)
T_f = Final temperature of water (°C)
T_i = Initial temperature of water (°C)
W_f = Final mass of water (kg)
W_i = Initial mass of water
W_i' = Mass of water left after high power phase (kg)
W_i'' = Mass of water left after entire test duration (kg)

INTRODUCTION

Tests designed to examine a fuelwood cookstove generally provide quantitative and qualitative information about its performance. To determine the effect of various design modifications on the performance of a fuelwood cookstove, and to optimize its design, rigorous testing is required. The water boiling test, controlled cooking test, and kitchen performance test are usually employed for testing fuelwood cookstoves [1].

The water boiling test is a short and simplified simulation of certain standard cooking practices. The test measures the fuel consumed to boil water under a given set of conditions and also the time required for simulated cooking. The test is done both at high power and at a lower simmering level to replicate the most common cooking tasks. It is used for a quick comparison of the performance of a given stove under different operating conditions. Several procedures for conducting and analysing water boiling tests for performance evaluation of fuelwood cookstoves have been recommended over the last decade [1–4]. While the basic purpose is the same in all these procedures, there are certain procedural, computational and measurement related differences among them. A brief critique on such differences is presented in this work. Some preliminary experiments were conducted on a single wall, as well as on a double wall, fuelwood cookstove with the objective of studying the above existing water boiling test procedures. The results of these experiments are presented and discussed.

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WATER BOILING TEST PROCEDURES

The research and development work on dissemination of improved fuelwood cookstoves is presently being undertaken on a global level. Consequently, there are various test procedures used by R&D workers which have appeared in the literature. However, the present work is confined to four important water boiling test procedures only. A brief description of these methods is given below.

Test Procedure Developed by VITA

In December 1982, a provisional standard was drafted by a group of scientists and stove practitioners and published in 1983 by Volunteers in Technical Assistance (VITA). This was later revised and finally published as "Testing the efficiency of wood burning cookstoves VITA 1985". The VITA test procedure includes a high power phase test and a low power phase test. The high power phase test involves heating a fixed quantity of water from ambient temperature to boiling as rapidly as possible, without being wasteful of fuel. In the low power phase test, water is kept simmering for 30 min. The following figures of merit are calculated for both the high power and low power phases of testing.

(i) Fire power (P). It is the rate of energy liberated by burning fuelwood.

$$P = \frac{M_w C_w - M_c C_c}{60I} \quad \text{(kW)}.$$

(ii) Percentage heat utilized (PHU). The index gives the percentage of heat released from the fire that is absorbed by the water in the pot. This is the thermal efficiency of the "stove and pot combination" and is quoted in relation to a specific power output.

$$\text{PHU} = \frac{4.186 W_i (T_f - T_i) + 2260(W_i - W_f)}{M_w C_w - M_c C_c}.$$

The factor 4.186 is the specific heat of water in kJ/kg °C, and the factor 2260 is the latent heat of vaporization of water in kJ/kg.

(iii) Standard specific consumption. For the high power as well as low power phases, the index is defined as

$$\text{SSC} = \frac{\text{equivalent dry wood consumed}}{\text{amount of water evaporated}}.$$

Baldwin [5] has slightly modified the computational procedure suggested by Ref. [1]. He defines the fire power and PHU the same way as defined in the VITA procedure. However, an index named average specific fuel consumption (ASFC) is defined in place of two separate indices for fuel consumption in the high and low power phases.

$$\text{ASFC} = \frac{M_w - 1.5 M_c}{W_f}$$

where W_f is the mass of water remaining at the end of the test, M_w is the mass of wood consumed during the low power phase, and M_c is the mass of charcoal formed during the phase.

The index, thus, gives the amount of wood consumed per unit mass of water cooked.

The procedure, as adopted for the present work, is summarized as follows:

(i) The test conditions are recorded, including air temperature, wind speed, etc.

(ii) A quantity of wood, not more than twice the required amount, is weighed and set aside. The moisture content and the calorific value of the wood are estimated.

(iii) The pots are cleaned, dried and weighed empty. A fixed amount of water (usually about two-thirds of the pot capacity) is added, and the weight is again recorded. The initial water temperature is recorded.

High power phase

(iv) The fire is lit in a reproducible manner (i.e. by using 10 ml of kerosene). The pot is kept on the cookstove, and the water in the pot is made to boil as rapidly as possible without being wasteful of heat. The water temperature is recorded every 5 min.

(v) When the water comes to a full boil, the temperature and time are recorded, and the following tasks are carried out rapidly: the wood is removed from the stove, the charcoal formed is knocked off, and this wood is weighed together with the previously weighed supply. The weight of the pot with water and of the charcoal formed are also determined.

Low power phase

(vi) The charcoal and wood are returned to the stove, and the fire is relit. The pot is again kept on the cookstove. The fire is then maintained at the lowest possible power that is sufficient to keep the water temperature within 2°C of boiling.

(vii) At the end of the simmering period, the wood, charcoal and pot with water are again weighed.

No lid is used throughout the experiment.

Test Procedure Recommended by Bois de Feu (France)

This procedure also recommends the water boiling test in two phases: a high and a low power phase. In fact, the experimental procedure is almost identical to that in Ref. [1] except that the charcoal is not put back into the stove after the high power phase. The following figures of merit are calculated:

(i)
$$\text{PHU for high power phase} = \frac{4.186W_i'(T_f - T_i) + 2260(W_i - W_i')}{M_w C_w - M_c C_c}$$

(ii)
$$\text{Overall PHU} = \frac{4.186W_i'(100 - T_i) + 2260(W_i - W_i'')}{M_{tw} C_w - M_{tc} C_c}$$

where W_i' is the mass of water left after the high power phase test and $(W_i - W_i'')$ is the amount of water evaporated for the entire duration of the test. M_{tw} is the total mass of wood consumed for the test, and M_{tc} is the total mass of charcoal formed.

(iii) Specific consumption:

For high power phase

$$SC_1 = \frac{\text{equivalent dry wood consumed in kg}}{\text{mass of water at the end of high power in kg}}.$$

For low power phase

$$SC_2 = \frac{\text{equivalent dry wood consumed in kg}}{\text{amount of water evaporated in kg}}.$$

Test Procedure Recommended by Wood Burning Stoves Group, Eindhoven, The Netherlands

The total fuel quantity to be used in the experiment is divided into equal parts, and the stove is charged at time intervals determined by the desired fire power. The test lasts for 1 h. The procedure recommends only one figure of merit, the efficiency of the pan–stove combination.

$$\text{Efficiency} = \frac{4.186W_i(T_f - T_i) + 2260(W_i - W_f)}{M_w C_w}.$$

This procedure, as practiced for the present work, is as follows:

(i) 1 kg of wood is taken and divided into four batches of 250 g each. Each batch is fed to the stove at regular intervals of 15 min. This ensures that the test lasts for 1 h. Since the calorific value of the wood used is about 19,000 kJ/kg, a power input of 5.4 kW is achieved.

(ii) The pot is weighed empty.
(iii) It is filled with water to two-thirds capacity and again weighed.
(iv) The stove is charged with the first batch of 250 g of wood, and the water is made to boil. The remaining batches are also fed at regular intervals.
(v) When all the wood is burnt (which is indicated by a decrease in temperature of the water), the pot with water is taken out and weighed. The charcoal formed is also weighed. No lid was used throughout the experiment.

Procedure Recommended by Department of Non-Conventional Energy Sources, Government of India

The test is planned for 2 h. Fuelwood is stacked in small equal lots in sufficient quantity so as to last for the entire test duration. The figures of merit proposed are

$$\text{Thermal efficiency} = \frac{\text{total useful heat}}{\text{heat liberated from the fuel}}$$

$$= \frac{4.186 W_i (T_f - T_i) + 2260(W_i - W_f)}{M_w C_w}.$$

Power rating (PR)—the power rating of a cookstove is a measure of the total energy produced during 1 h by the fuelwood.

$$\text{PR} = \frac{M_w C_w \times n}{860}$$

where M_w is the fuel burning rate in kg/h, C_w is the calorific value of the wood in kcal/kg and n is the thermal efficiency of the cookstove.

This procedure, as followed during the present work for a few tests conducted, is given below:
(i) 2 kg of wood approx. 10–15 cm long and 3–4 cm dia is taken and divided into eight batches of 250 g each. The stove is charged at a rate of 250 g in 15 min so that the test lasts for 2 h.
(ii) The pot is weighed empty, filled with water to two-thirds capacity and again weighed.
(iii) The fire is lit, and the water is made to boil. As soon as the water boils, the lid is taken off and the testing is continued for 2 h.
(iv) The pot with water is weighed.
(v) Any charcoal left is also weighed.

CRITIQUE OF WATER BOILING TEST PROCEDURES

The water boiling test procedures described above have a number of computational, procedural and measurement related differences among them. Some of these differences are described below.

Computational Differences

Three of the procedures described above [1, 2, 5] recommend the calculation of percentage heat utilized (PHU), while the other two methods [3, 4] suggest the calculation of a single efficiency for the stove.

Percentage heat utilized

The procedures recommended in Refs [1, 5] suggest similar expressions for calculating PHU. The useful heat consists of the heat used in sensible heating of the water and that used as latent heat of vaporization. While the methods suggested in Refs [1, 5] consider the initial amount of water in the pot to calculate the energy used for sensible heating, the procedure recommended in Ref. [2] considers the amount of water left after the high power phase to calculate the sensible heat. Moreover, in Ref. [2], an overall PHU is defined rather than two separate indices for the high and low power phases. The procedures suggested in Refs [3, 4] define the term "efficiency" for the entire duration of the test. The definition of efficiency in these two procedures is similar to the definition of PHU in the procedures in Refs [1, 2, 5].

Specific consumption

Different formulae are suggested for calculating specific consumption. The procedure recommended in Ref. [1] defines an index named standard specific consumption (SSC) separately for both the high and low power phases. An average value of specific consumption for the entire test duration is defined in the procedure recommended in Ref. [5]. The index gives the amount of wood consumed for the low power phase per unit of water cooked, i.e. the water remaining at the end of the test. The procedure recommended in Ref. [2] defines the specific consumption for the high power phase as the amount of wood consumed per unit of water cooked, whereas for the low power phase, it is defined as the amount of wood consumed per unit of water evaporated.

The procedure recommended in Ref. [3] does not recommend the calculation of the specific consumption from the water boiling tests. Instead, a method for converting the water boiling test results in terms of specific fuel consumption is suggested by them. The procedure recommended in Ref. [4] does not recommend the calculation of the specific consumption.

Procedural Differences

Various procedural differences exist among the test methods proposed. Different opinions exist regarding the use of the lid during the test. The procedure in Ref. [1] suggests that, if the testing site is properly protected from draughts, lids can be avoided, otherwise they may result in an increased rate of evaporation, thus making the relevance of the figures of merit obtained quite debatable. The procedure suggested in Ref. [5] also suggests that the lid should not be used while testing and recommends that the test should be done in enclosed areas only. The procedure points out that the use of lids not only proved to be cumbersome in practice but additionally increased the scatter in the data obtained. The procedure recommended in Refs [2, 3] also does not suggest the use of a lid. The procedure recommended in Ref. [4] suggests the use of a lid in the beginning of the test but recommends that the lid be taken off at the instant when the water starts boiling. It is expected that, in this manner, the problems arising out of the possible subjectivity in controlling the fire power during the test can be reduced.

Size of the pot used for testing

Regarding the size of the pot used for testing a fuelwood cookstove, the procedures recommended in Refs [1, 2, 5] do not provide any information. Reference [3], however, points out that the VEG Gas Institute in The Netherlands uses a simple formula to select pots for testing of gas stoves. Their recommended power density for gas stoves is 7 W/cm^2. Higher power densities reduce the life expectancy of commercially available aluminium pots in Europe. In the procedure recommended in Ref. [4] for portable stoves, it is suggested that the diameter of the pot should be 1.5 times the diameter of the exposure slit or 50 mm more than the diameter of the stove, whichever is less.

Amount of water for testing

In all the procedures, it is recommended that, in the beginning of the test, about two-thirds of the capacity of the pot should be filled with water. This is a reasonable recommendation as long as no specific data are available on the influence of the amount of water in the pot on the magnitude of the various indices determined on the basis of the test.

Duration of the test

The earlier versions of procedure [1] have recommended 15 min of extension of the high power phase after the water boils. Also, the simmering phase was for 60 min. Later on, extension of the high power phase was eliminated, and the 60 min simmering was reduced to 30 min. The latter revision concerning the duration is also suggested in the procedures given in Refs [2, 5]. However, the procedure recommended in Ref. [3] fixes the duration of the test to be 1 h, whereas the suggested procedure in Ref. [4] has a fixed duration of 2 h.

Fuelwood size

About the size of the fuelwood to be used for testing, all procedures recommend a uniform size while expressing difficulty to ignite and maintain a fire without smaller or tapered pieces. The procedure recommended in Ref. [4] specifies a wood size of 30–40 cm in length and of 4–5 cm in diameter. The procedure in Ref. [1] also recommends a diameter of 3–4 cm for the wood pieces used for testing.

Measurement Related Differences

Measurement of moisture content of wood

About the measurement of moisture content, different procedures recommend different methods. The effective calorific value of wood is obtained by multiplying the correction for moisture content by the mass of wood consumed. The procedure recommended in Ref. [1] suggests the measurement of moisture content on a dry basis, and the corresponding correction for moisture content is

$$1/(1 + \text{mositure content on dry basis}).$$

The procedure suggested in Ref. [5] considers the moisture content on a wet basis. This procedure uses a correction factor of (1–1.12 × moisture content on a wet basis). The energy of the wood which has been utilized in vaporizing the humidity of the wood is taken into consideration in this case. The procedure recommended in Ref. [2] uses the moisture content on a wet basis and suggests determining it as 20% of the relative humidity of the air. The correction for moisture content used in this procedure is (1 − moisture content on a wet basis).

EXPERIMENTAL PROCEDURE

The test procedure recommended in Ref. [1] was tried on a single wall as well as on a double wall fuelwood cookstove. Tests using procedures in Refs [3, 4] were also conducted on the cookstoves. The single wall cast iron cookstove (Vishal Chulah) used in this work is presently being disseminated by the Delhi Energy Development Agency, a nodal agency of the Department of Non-Conventional Energy Sources, Government of India (Fig. 1). One typical double wall portable metallic cookstove is the Mamou, several versions of which have been developed at the Brace Research Institute [6]. Another version of the Mamou fuelwood cookstove was fabricated

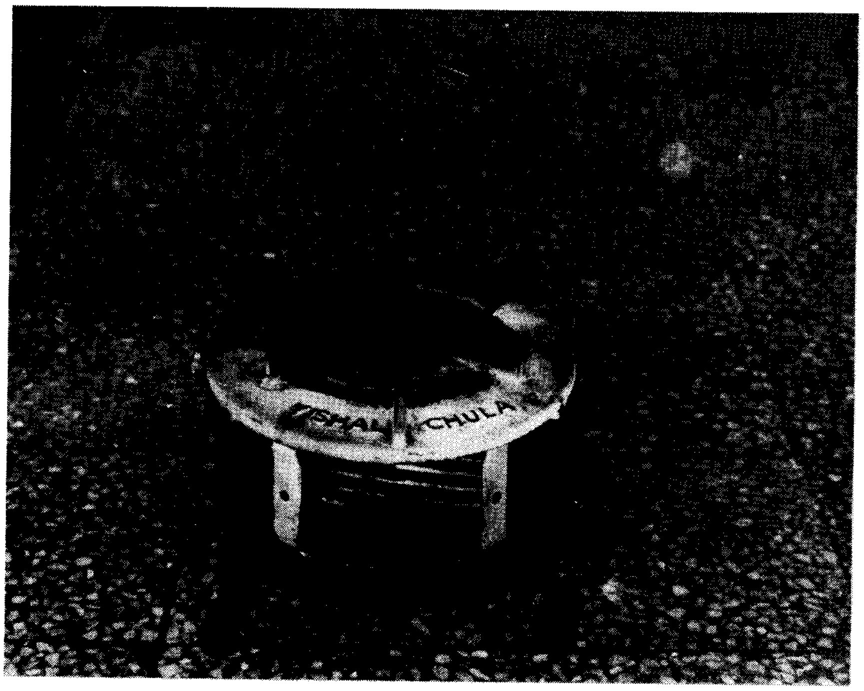

Fig. 1. Single wall cast iron fuelwood cookstove.

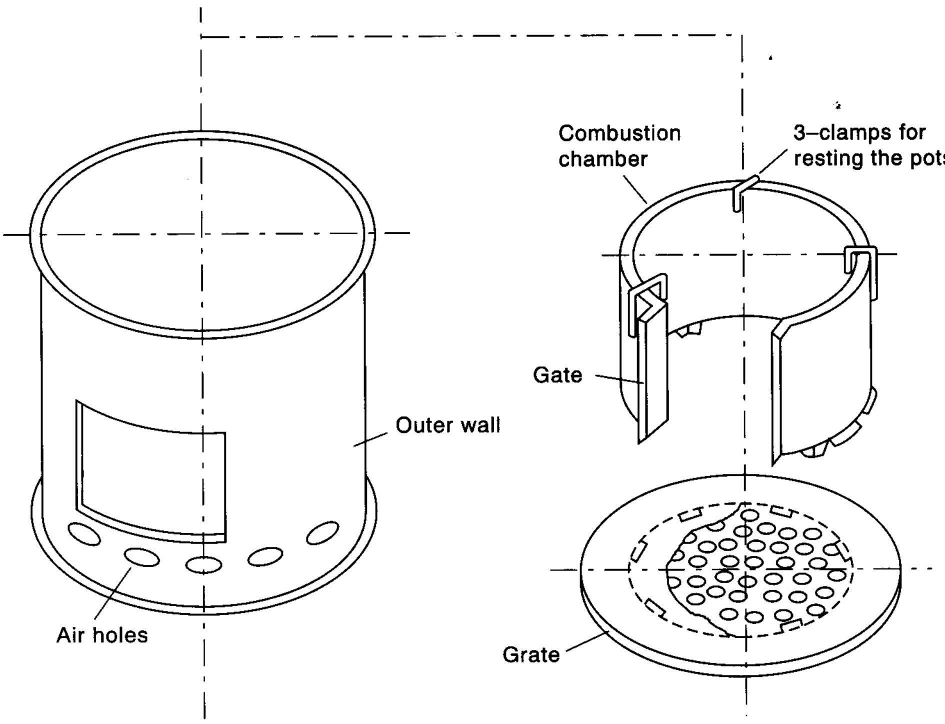

Fig. 2. Exploded view of Mamou.

in the workshop of the Centre for Energy Studies, I.I.T. Delhi. An exploded view of the cookstove is given in Fig. 2. Figure 3 gives the overall view of the double wall cookstove. Three flat-bottomed stainless steel pots were used for testing the cookstoves. Tests were conducted on the single wall cookstove using all three pots, whereas only the biggest pot was used for testing the double wall cookstove. The dimensions of the pots and cookstoves are given in Tables 1 and 2, respectively.

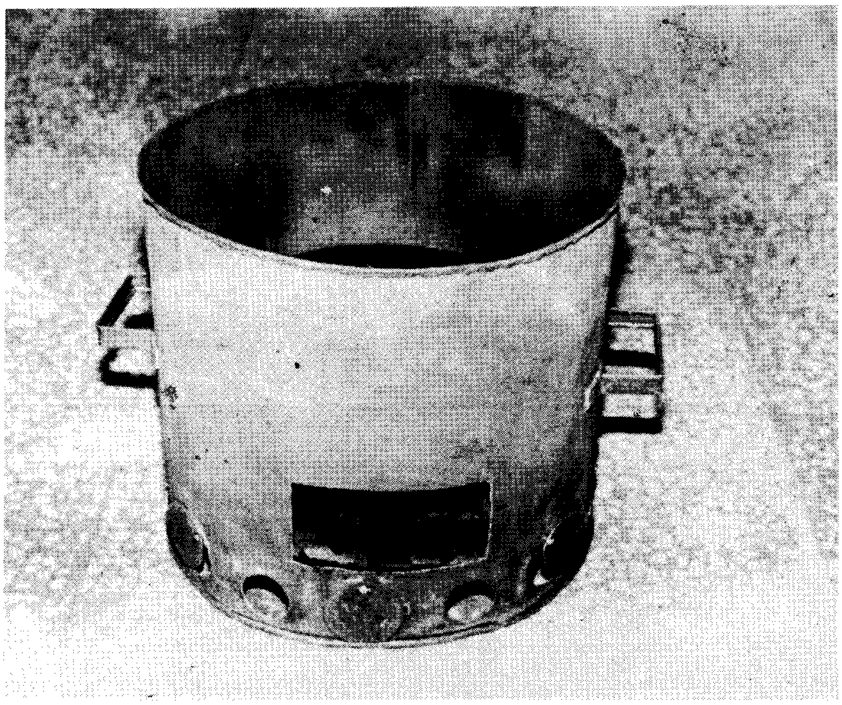

Fig. 3. Double wall metallic fuelwood cookstove.

Table 1. Pot specifications

Pot No.	Diameter (m)	Height (m)	Mass (kg)	Full capacity (l.)
1	0.14	0.089	0.343	1.4
2	0.22	0.13	0.785	5.0
3	0.26	0.16	1.07	8.4

Table 2. Specifications of fuelwood cookstoves

		Combustion chamber		Outer chamber	
Stove type	Mass (kg)	Height (m)	Diameter (m)	Height (m)	Diameter (m)
Single wall	5.2	0.12	0.25	0.12	0.25
Double wall	2.7	0.14	0.23	0.27	0.29

Some tests were also conducted to study the effect of the initial amount of water in the pot and the use of a lid on the test results. The results of these tests are also presented and discussed.

RESULTS AND DISCUSSION

The results obtained from the water boiling tests, as per the procedure in Ref. [1], conducted on the two fuelwood cookstoves, are presented in Tables 3–6. It may be noted from Tables 3–5 that, as the size of the pot is increased, the performance of the single wall cookstove improves.

Table 3. Test results of single wall fuelwood cookstove. VITA test procedure—pot 1

	High power phase		Low power phase		
Sl. No.	Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)	ASFC
1	2.5	13.50	2.50	12.8	0.31
2	6.0	10.10	2.60	13.10	0.33
3	2.9	11.45	2.84	11.80	0.34
4	4.0	12.00	2.76	13.3	0.36
5	3.7	13.30	2.90	12.1	0.38
6	5.0	11.20	2.49	14.9	0.32

Table 4. Test results of single wall fuelwood cookstove. VITA test procedure—pot 2

	High power phase		Low power phase		
Sl. No.	Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)	ASFC
1	5.3	21.0	3.8	20.8	0.13
2	5.6	17.7	3.9	20.9	0.13
3	5.8	16.0	3.5	21.9	0.11
4	2.7	20.0	3.9	20.1	0.12
5	4.1	20.7	4.0	20.9	0.13
6	4.1	20.3	3.8	20.1	0.12
7	5.4	22.4	3.9	18.0	0.13
8	6.8	12.5	3.6	24.0	0.10
9	5.8	16.8	3.2	22.2	0.08
10	4.8	20.0	3.0	21.3	0.14

Table 5. Test results of single wall fuelwood cookstove. VITA test procedure—pot 3

	High power phase		Low power phase		
Sl. No.	Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)	ASFC
1	5.4	22.0	4.5	23.0	0.098
2	4.5	22.8	4.4	20.0	0.086
3	5.1	20.0	4.4	21.8	0.085
4	5.4	19.7	4.9	21.2	0.10
5	5.2	22.7	4.8	19.6	0.09
6	5.1	21.8	4.3	21.5	0.086

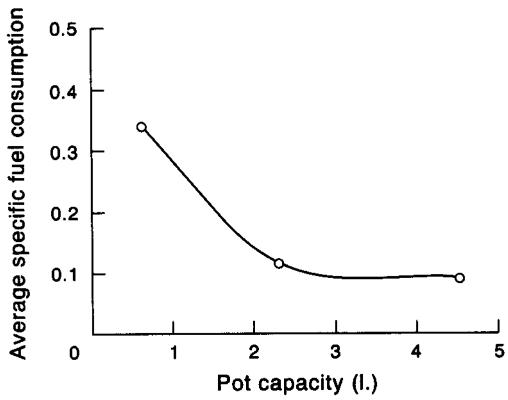

Fig. 4. Variation of ASFC with pot capacity.

However, the relative advantage of using pot 3 over pot 2 is only marginal, as the diameters of both pots are close to the diameter of the cookstove combustion chamber. Accordingly, the average specific fuel consumption (ASFC) of the cast iron stove is considerably higher with pot 1 (Table 3) as compared to that with pots 2 and 3 (Tables 4 and 5). Table 6 presents the results of various tests conducted on the double wall cookstove with pot 3.

From Tables 5 and 6, it is evident that the performance of the double wall stove is better than the performance of the single wall cookstove. The improvement can be attributed to the provision of a double wall. The double wall reduces the heat loss from the walls of the combustion chamber by providing a dead air space between the two walls. The temperature of the outer wall is also reduced, thus making the stove safer to handle. Table 7 presents the values of the r.m.s. error involved in the calculation of PHU of both the single wall and double wall cookstoves. It may be noted that, for both the cookstoves, the r.m.s. error is very small as compared to the actual difference between their PHU values. This indicates that the procedure is accurate enough to distinguish between the performance of a single wall and a double wall cookstove. Figure 4 shows the plot of average specific fuel consumption (ASFC) against pot capacity. It can be seen that ASFC decreases as the pot size increases. The curve has an approximate flat region which indicates that, as the pot size further increases, ASFC can also increase.

As indicated earlier, the results presented in Tables 3–6 were based on the procedure in Ref. [1]. The results of the water boiling tests conducted, as per the procedure in Ref. [3], are given in Tables 8 and 9. The results show that the efficiency for the entire test duration is almost the same as the low power phase PHU of the procedure in Ref. [1] at the same fire power. It may also be

Table 6. Test results of double wall fuelwood cookstove. VITA test procedure—pot 3

Sl. No.	High power phase: Fire power (kW)	High power phase: PHU (%)	Low power phase: Fire power (kW)	Low power phase: PHU (%)	ASFC
1	4.6	22.7	4.3	26.4	0.089
2	5.4	24.0	4.4	24.1	0.09
3	6.9	20.2	3.4	29.9	0.06
4	5.2	24.0	3.5	27.1	0.06
5	4.6	25.2	4.0	25.0	0.07
6	4.4	24.1	3.9	28.0	0.075
7	5.4	25.6	4.0	27.7	0.062
8	4.7	25.4	3.7	27.0	0.09

Table 7. r.m.s. error. VITA procedure—pot 3

	Single wall		Double wall	
	HP	LP	HP	LP
Average PHU	21.5	21.2	24.4	26.9
r.m.s. error	1.2	1.5	1.0	1.7

Table 8. Test results of single wall cookstove. Wood Burning Stoves Group procedure—pot 3. Fire power = 5.4 kW

Sl. No.	Time for boiling (min)	Thermal efficiency (%)
1	37	22.3
2	32	21.7

Table 9. Test results of double wall fuelwood cookstove. Wood Burning Stoves Group test procedure—pot 3. Fire power = 5.4 kW

Sl. No.	Time for boiling (min)	Thermal efficiency (%)
1	40	25.0
2	30	30.0
3	30	28.0

noted that the procedure in Ref. [3] can also clearly distinguish between the performance of a single wall and a double wall cookstove. The results of the 2 h duration tests conducted on the double wall cookstove, as per the procedure in Ref. [4], are presentd in Table 10. It is noted that the results obtained are the same as those by the procedure in Ref. [3].

Several tests were performed on the double wall cookstove by varying the amount of water filled in the pot. The results are summarized in Table 11. Water filled to 3/4, 2/3 and 1/2 of the pot capacity gave almost identical values of PHU in both the high and low power phases of testing. However, the test with initial water filled to 1/4 capacity yielded poor results in both phases. It may, therefore, be concluded that the amount of water filled in the pot does not produce any significant change in the test results, unless it is less than one-half of the pot capacity.

The effect of using a lid during testing on the values of the various indices obtained by following the procedure in Ref. [1] is shown in Table 12. It may be noted that the use of a lid does not significantly affect the values of the high power phase PHU, whereas there is a considerable difference in the low power PHU. During the low power phase, the water is maintained within 2°C of its boiling point, and evaporation occurs at a much faster rate. The use of a lid does not permit the water vapour to escape, and therefore, it is possible to operate the stove at much lower values of fire power, still maintaining the water temperature in the desired range, as seen from Table 12. The use of a lid further increases the scatter in the data obtained. Thus, the lid only helps to find the minimum possible fire power at which the stove can be operated.

Table 10. Test results of double wall fuelwood cookstove. DNES test procedure—pot 3. Fire power = 5.4 kW

Sl. No.	Time for boiling (min)	Thermal efficiency (%)
1	30	28.0
2	31	27.7

Table 11. Effect of initial amount of water in the pot on the performance of double wall fuelwood cookstove. VITA procedure—pot 3 (capacity = 8.4 l.)

Sl. No.	Amount of water	High power phase		Low power phase	
		Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)
1	Three-quarters of pot capacity	5.4	25.6	4.0	27.7
2	Two-thirds of pot capacity	4.4	24.7	3.9	28.0
3	One-half of pot capacity	4.7	25.4	3.7	27.0
4	One-quarter of pot capacity	4.2	21.6	3.9	25.6

Table 12. Effect of using lid on the pots while testing the double wall fuelwood cookstove. VITA procedure—pot 3

High power phase				Low power phase			
Without lid		With lid		Without lid		With lid	
Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)	Fire power (kW)	PHU (%)
4.4	24.1	4.3	25.7	3.9	28	1.2	14.0
4.7	25.4	4.6	25.7	3.7	27	1.6	21.3

Some conclusions which can be drawn from the experiments conducted are summarized as follows:

(i) The water boiling test procedures discussed in the present work are accurate enough to distinguish between the performance of a single wall and a double wall fuelwood cookstove.

(ii) The tests conducted with a lid in the low power phase can only be used to find the minimum possible fire power at which the stove can operate. The PHU value at this fire power has no importance. Moreover, since the results with the lid in the low power phase has no repeatability, the use of a lid on the pots while testing in the low power phase is not recommended.

(iii) The amount of water in the pot does not influence the test results very much, except for a pot filled with less than one-half of the capacity. Therefore, the recommendation of all the test procedures for taking water up to two-thirds pot capacity may be followed.

(iv) For testing a fuelwood cookstove, selection of an optimum pot size is very important. As seen from the results of the tests conducted, the diameter of the pot should preferably be greater than the diameter of the combustion chamber of the cookstove. However, the results of additional tests with smaller pots can be useful, since the users of the cookstove may sometimes employ smaller pots as well.

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