

BATCH STOVE TEST METHOD

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A Batch Stove is one to which fuel cannot readily be added during a test, and which typically is difficult to empty when hot.

TASK 1	Determine the Thermal Efficiency by burning a known fuel and calculating the heat gained by a pot of water
TASK 2	Determine the Thermal Efficiency when the stove is already hot by burning a known fuel and calculating the heat gained by a pot of water
TASK 3	Determine the specific fuel consumption when boiling water
TASK 4	Determining the specific fuel consumption when simmering
Issue 1	The stove cannot easily be extinguished to see how much wood has been burned in order to separate and weight the unburned charcoal.
Issue 2	The stove cannot easily be restarted 'hot' with the same fuel.
Issue 3	The stove cannot operate for a long enough time to complete a standard WBT
Issue 4	The quantity of ash, charcoal, torrefied wood, dry wood and moist wood is very difficult to determine, even if the stove were to be extinguished each time. Thus it is very difficult to know with any precision what the heat content of the fuel remaining is, to determine the heat used during the test.
Solution 1	Do not stop the stove, let it run to a complete burnout of the fuel on every test. All tests will always use all the fuel. Determine the thermal efficiency of a boiling, standard pot by running the stove at a 'standard power level' from beginning to end and observing Delta T and Water Loss It is proposed that the voltage of the fan be monitored and a standard power level be set when 'rating' the standard pot of boiling water's thermal efficiency. Weigh a quantity of fuel and measure its moisture content. Calculate the total amount of heat it can produce, net, accounting for sulphur, ash and moisture. Operate the stove for a portion of the WBT, completing it before the fuel is burned out, then put on the standard pot and set the power level to 'standard'.

Calculate the amount of heat collected in the standard pot during the burn-out phase of the test by dividing the heat gained by its known thermal efficiency.

Subtract this amount from the total heat that was available from the fuel to begin with.

The remainder is the heat that was used during the first portion of the test. Calculate the quantity of wood that would be needed to provide this amount of heat.

Solution 2

Put on the standard pot and then start the stove, operating it at standard power.

After the stove is hot, take off the standard pot and put on the test pot, noting at that time the total heat accumulated by the standard pot.

Use all the fuel during the test portion of the run.

When the test is complete, calculate the total heat in the fuel batch, subtract the heat gained by the standard pot at the beginning of the test.

The remainder is the heat that was used during the test.

In the same manner, a standard pot can be used to get the stove hot, a short test can be run, and the standard pot can be used to finish off the fuel.

Adding the two figures for heat gained by the standard pots at the beginning and end, subtracted from the total available, yields the heat used during the test.

Solution 3

An equivalent stove performance figure can be determined by adding up the specific fuel consumption numbers for various portions of the tests, factoring for time and water quantity.

Solution 4

At no time during the test is any attempt made to determine how much or what type of fuel is remaining in the stove. It does not matter.

The heat applied and the heat gained for any task are the only important numbers and they are obtainable without examining the fuel's condition or makeup.

SIMPLE SAMPLE TEST

Only 3 numbers are required

Heat in wood	16.4	MJ/kg, net factored for moisture content. This can be determined accurately with a bomb calorimeter.
Mass used	275	g of fuel put into the stove - 'the batch'
Boiled away	188	g of water boiled out of the standard pot during the fuel burn out. The standard pot was already boiling.
Heat available	4,510,000	Joules can be generated by burning all the fuel completely.
Efficiency	25.33%	Standard pot on the stove run at standard power level (monitor the fan speed), determined as above.
Heat gained	424,316	J was gained by the standard pot, calculated from the missing water
Heat offered	1,675,152	J generated during the fuel burn out phase and offered to the pot
Test heat	2,834,848	J generated during the test portion of the burn, being the balance available from the total in the fuel
Fuel used, 1	173	g equivalent used during the test, without worrying if it was volatiles or wood or charcoal.
Fuel used, 2	102	g equivalent used during the burn out portion of the burn. The composition is immaterial.
Water boiled	2,487	cc was in the test pot to start with
Temp rise	80	Deg C to the local boiling point
Evaporated	17	cc evaporated from the pot while bringing it to a boil
Captured heat	871,216	J captured by the test pot during the test portion of the run
Thermal eff	30.73%	Test result for the new pot or circumstance, in this case, boiling a pot of water
Sp Fuel Cons	69.5	g of fuel per litre boiled. Use the initial, not final ,water mass because missing water was in fact boiled.

Determining the CO level during the test will give a correction factor for the combustion efficiency which can de-rate the fuel.

To do this, the mass of CO can be calculated for each portion based on the CO level and the excess air (dilution) measured appropriately.