TEST OF A MARSHALL'S NEW "EMPIRE" TEA DRYER.

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The cost of firing is by no means an insignificant item in the total cost of manufacture, and in the course of a year the sum lost through the use of an inefficient firing machine may amount to an appreciable sum.

Data of the performance of different types of dryers under specified conditions will, therefore, be of interest, and details of a test carried out on a Marshall's New "Empire" Dryer are given below.

In this test the machine was worked continuously over a period of time sufficient to give the characteristic of the dryer. The characteristic is expressed in terms of British Thermal Units required to evaporate a pound of water from the leaf at specified inlet and exhaust temperatures, the latter being maintained at a steady figure throughout the test.

It is realised that it is sometimes difficult to keep a firing machine full during the whole period of ordinary routine firing. Failure to do so will of course add to the cost of firing, but the cost still depends mainly on the efficiency of the machine in use. The same applies when the machine is used to generate hot air for withering. The purpose of the test was to find the efficiency of the machine as a water evaporator under specified conditions, which efficiency can be compared with that of other machines under similar conditions.

Date of test—11th July, 1934.
Size of machine—6 feet.
Fuel used—Firewood.
Time of lighting up—9-30 a.m.
Time when first leaf was fed into machine—11 a.m.
Weight of firewood used in heating up—200 lbs.

The calorific value of the firewood used was 6,602 British Thermal Units per pound, so that the heat required to warm up the dryer was 1,320,400 British Thermal Units.

The weight of dhools fed, together with their moisture contents, before and after firing, are given in the following table. The calculated weight of made tea serves as a check of the accuracy of the moisture assay. There is very close agreement, viz. 1,230 pounds against 1,206 pounds actually weighed.

TABLE 1.

Bulk	Weight	% Moisture	Weight of water	Calculated weight of made tea
	lb.		lb.	lb.
Special dhool	86·5	51·3 (Initial) 2·7 (Final)	43·2	43·3
Dhool 1	69·5	57·1 3·3	38·7	30·8
Dhool 2	109·5	54·3 2·5	58·2	51·3
Dhool 3	131·0	53·5 2·7	68·4	62·6
Dhool 4	128·5	53·8 2·8	67·4	61·1
Dhool 5	230·5	64·0 2·3	122·0	108·5
Dhool 6	714·5	54·3 2·3	380·3	334·2
Big Bulk	1,180·5	55·9 3·3	642·1	538·4
Total	2,650·5		1,420·3	1,230·2

The curves in Figure I are plotted to show the rates of feeding of dhool and firewood together with the rate of out-turn of made tea. The relationship between the three quantities of material may then be obtained by interpolation between two vertical lines from the time axis.

The "straight line" nature of these graphs indicates regular performance.

PLATE VIII.

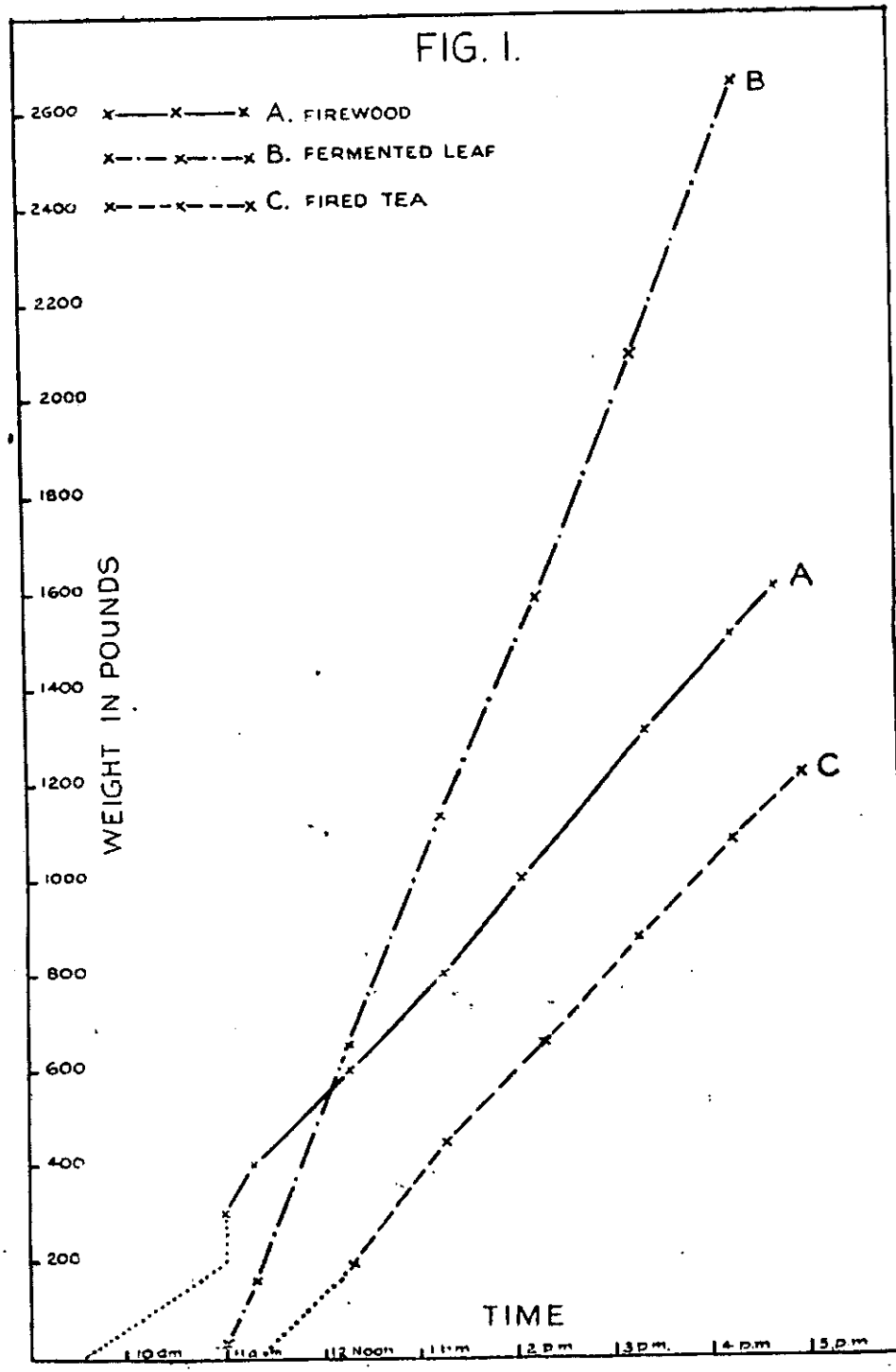
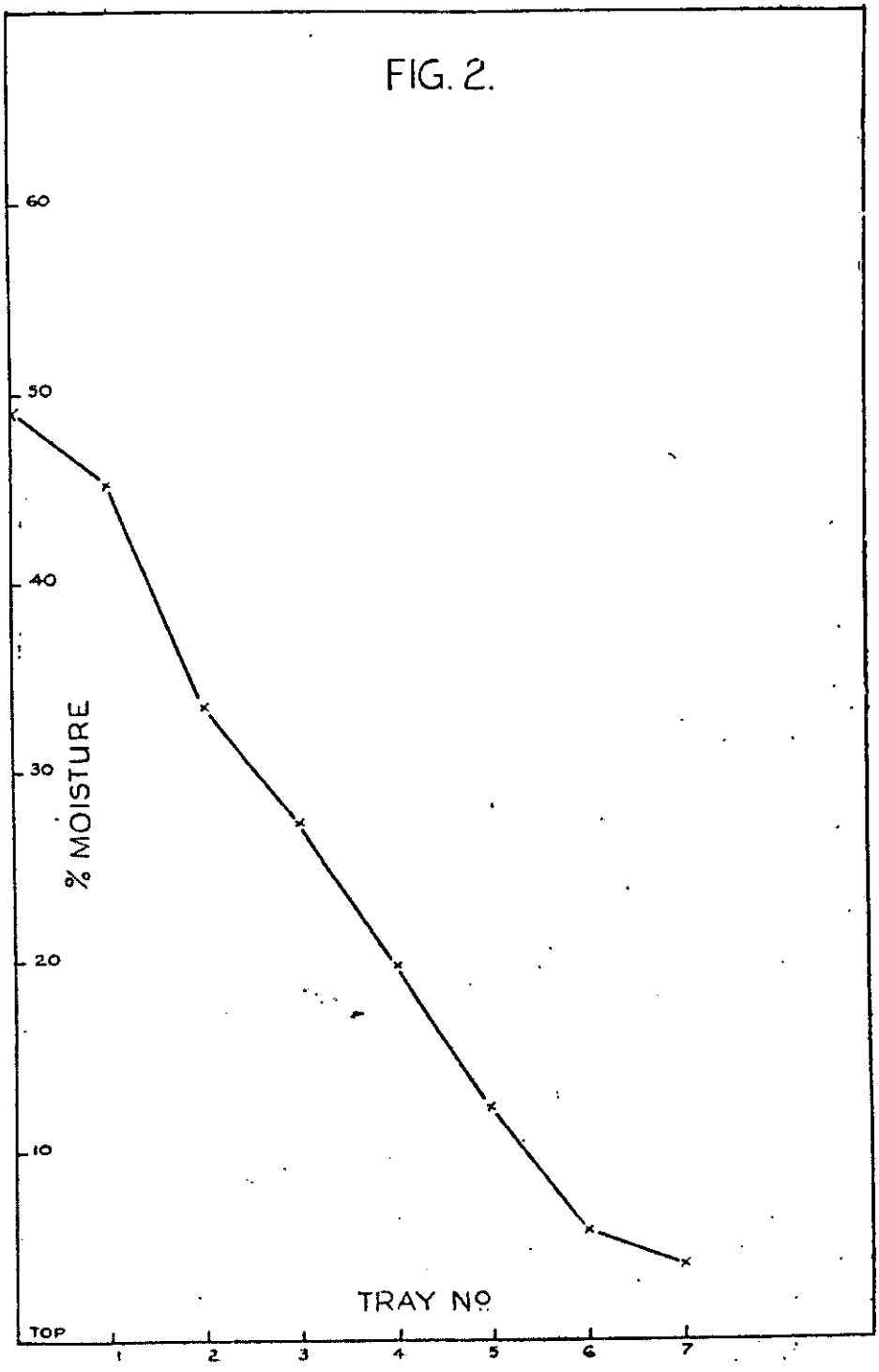


FIG. I.
A. FIREWOOD
B. FERMENTED LEAF
C. FIRED TEA
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
WEIGHT IN POUNDS
B
A
C
TIME
10 a.m.
11 a.m.
12 Noon
1 p.m.
2 p.m.
3 p.m.
4 p.m.
5 p.m.

PLATE IX.



The amount of water evaporated from the leaf was 1,420·3 pounds, and this required the use of 1,300 lbs. of firewood. The calorific value of this firewood was again 6,602 British Thermal Units per pound. 1,420·3 pounds of water were, therefore, evaporated with 1,300 × 6,602 British Thermal Units. The time taken was 325 minutes. Hence:—

One pound of water was evaporated with 6,040 British Thermal Units, and 262 pounds of water were evaporated per hour.

In cruder practical units 1,206 pounds of tea were dried with 1,300 pounds of firewood, excluding wood used in heating up. The out-turn of made tea on fermented leaf was 45·5%, the moisture content of the latter being 55·6%. 223 pounds of made tea were turned out per hour.

The time taken to pass through the dryer averaged 20 minutes with an inlet temperature varying between 200 and 210°F. and an exhaust averaging 129° over the top tray. The fan revolution varied between 450 and 470.

It is possible that more efficient working would have resulted from a slightly larger load but this would have meant a lower exhaust temperature.

The flow of air is unfortunately very difficult to determine accurately but can be approximately calculated from the hygrometric readings taken:—

Average Temperatures	Exhaust, 129° Dry. 95° Wet.	equivalent to 1·710 lb. water per 1,000 cu. ft.
	Outside, 80° Dry. 70° Wet.	equivalent to 0·938 lb. water per 1,000 cu. ft.

Now at 129°F., 1,000 cubic feet of outside air will contain 0·925 pounds of water. Therefore, water carried off by 1,000 cubic feet = 1,710 − 0·925 = 0·785 pounds. Since 1,420·3 pounds of water were evaporated, air flow $= \frac{1,420·3}{0·785} = 1,810,000$ cubic feet, and as the test ran for approximately 325 minutes the air flow per minute = 5,500 cubic feet. Anemometer readings indicated a higher rate of flow of air but varied unduly according to the method they were taken by.

Moisture determinations done on tray samples taken at the end of each tray, just before the tea was due to fall on to the next tray revealed an even rate of drying. (Table II).

TABLE II.

	Mean	Right	Left
Top	49·1	49·3	48·9
Tray No. 1	45·3	45·6	44·9
,, 2	33·6	36·7	30·5
,, 3	27·2	28·5	25·9
,, 4	19·7	22·6	16·8
,, 5	12·3	15·8	8·7
,, 6	5·8	6·6	5·0
,, 7	4·0	4·7	3·3
Bottom	—	4·8	—

A tube connected to a sensitive manometer was inserted between the stove and the dryer. The doors of the insulating casing immediately in front of the tubes were then suddenly opened. No difference of pressure was revealed, showing that the insulation does not impede the intake of air.

SUMMARY.

Time taken to heat up	90 minutes.
Firewood used to heat up	200 pounds. =1,320,400 B.Th.U's
Heat taken to evaporate 1 lb. water ...	6,040 B.Th.U's. =0·9 pound wood.
Water evaporated per hour ...	262 pounds.
Made tea per hour	223 pounds.
Firewood used per pound made tea exclusive of fuel used in initial heating up	1·08 pounds.
Calorific value of firewood	6,602 B. Th. U's per pound.
Moisture content of fermented leaf ...	55·6% average.
Out-turn made tea on fermented leaf ...	45·5%.

Out-turn calculated from samples taken for moisture content	... ..	45·4%.
Moisture content of made tea	...	3% average.
Time taken through dryer	... ...	20 minutes, average.
Inlet temperature	... ...	200-210°F.
Exhaust temperature	... ...	129° average dry bulb. 95° wet.

The firewood used in this test was rather damp, containing 26·6% moisture. The weights of firewood used were, therefore, higher than one might have obtained with drier material.

NOTICES.

The Institute's Laboratories are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station c/o Messrs. Hemachandra & Co., Forwarding Agents.

Visitors' Day.—The *last* Wednesday in each month has been set aside as Visitors' Day at St. Coombs Estate, when it is hoped anyone interested will visit the Station.

Visitors at other times are welcomed, but it is requested that an appointment be made if possible.

Publications.—Applications for the Institute's Publications should be directed to the Secretary, at Victoria Commemoration Buildings, Kandy, and *not to the Director's Office.*

ROLAND V. NORRIS,
Director.