

NOTES ON DRUM WITHERING

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Introduction

Conventional withers are carried out in elaborate multi-storey factories on banks of tats. Leaf is spread at about 1 lb. per 10 square feet and various fans and heaters and other methods of controlling air movement and temperature are employed with varied success; in other cases, nature is relied upon to do the work unaided by mechanical means. The former method is known as "artificial withering" and gives a great deal of control, especially when there are adverse ambient conditions. This method has reached its perfection in Ceylon and South India, while the natural method is the one commonly employed in N.E. India and much of Africa. Withering periods vary from 12 to 36 hours. Much labour is used to spread the leaf and recurring expenditure is involved on maintenance and replacement of tats.

The Sirocco withering drum gives a fully controlled wither more quickly, with very little labour, with a smaller outlay on building and equipment than any other means, with virtually no recurring expenditure on maintenance, and with a very low consumption of fuel.

Withering Drums

Attempts at withering leaf in drums, hot-air boxes, tunnels, etc. have been made many times during the past 60-70 years. Most have failed. The Sirocco withering drum, however, has achieved considerable success since its advent in 1952; many experiments have been done by the makers' overseas engineers; and experience has been gained on estates which have installed these drums—mainly in Africa, where over a hundred of them are now in use.

The Mark II withering drum is divided into two sections with four compartments in each and is designed to work at a speed of $1\frac{1}{2}$ R.P.M. Hot air is supplied from a Sirocco No. 8 air heater, which can provide enough for four drums. Temperatures are controlled by two potentiometers mounted on the control panel and actuating a control unit which opens and closes dampers on the hot-air and cold-air inlets, keeping the temperature within $2\frac{1}{2}^{\circ}\text{F}$ of whatever temperature it is set for. The original idea was to wither the leaf at an inlet temperature of 130° - 140°F for $\frac{1}{2}$ -1 hour (to dry off surface moisture), using the high range potentiometer, and then to switch to the low range instrument for a further 2-2 $\frac{1}{2}$ hours at an inlet temperature of 100° - 120°F . Provision was also made for running on cold air only. Air was provided by a fan adjacent to the mixing chamber and this escaped after passing through the leaf by means of the perforated sides and doors of the drum compartments. A charge of 1,600 lb. of leaf per drum or 200 lb. per compartment was aimed at, with a recommended wither equivalent to a 38% out-turn of made tea to withered leaf.

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Early operating conditions, difficulties and modifications

An early difficulty was the odd leaf left over above a full drum charge. A simple solution was a butterfly valve fitted half way up the central trunnion and operated by a lever at the end of the drum. This shut off the end half of the drum to make it possible to use half charges. Another early difficulty was uneven withers, the leaf in the section nearest the fan withering more quickly than the end section. This was overcome by enclosing the sides of the drum, leaving only the perforated door for the air to escape through. The next difficulty was the question of whether or not to store leaf before "drumming." Experiments proved conclusively that leaf stored on racks or moveable trays for up to twelve hours before drumming was superior to leaf stored by other methods. A slight loss of moisture of 4 to 6% takes place on the racks.

The next difficulty was to match drums to drier capacity when the withering period had to be extended in wet weather. Running the drier empty for certain periods, or the addition of a drum, would have solved the problem, but some other more satisfactory means had to be evolved to close the gap. It was found that by increasing the fan speed and introducing a greater volume of air, withers could be speeded up, but this, in itself, was not enough and some other means had to be found without prolonged high temperatures.

Exhaust Control

Exhaust control was based on the finding that even at the high inlet temperature of 180°F in the early stages of withering, the air after passing through the leaf left the drum at a temperature of about 85°F. Therefore it was assumed that so long as the exhausted air was controlled to 85°F, the inlet temperatures would not matter, as they would automatically be reduced as withering progressed, till finally the inlet temperature would be only about 15° more than the exhaust temperature. The potentiometer element was therefore moved so that the exhaust air played on to it and the exhaust temperature was thus controlled to within $\pm 3^\circ$ of 85°F. The results, as recorded on a thermograph, were surprising. As soon as the drum was charged and started up, the inlet temperature moved up to anything between 170°-220°F for a few minutes, according to the state of the leaf, then settled down to about 160°F and then, over a period of three hours, slowly dropped to 95°-105°F, when the leaf was discharged.

This method, known as "Exhaust Control," considerably improved the teas but made no appreciable difference to the withering times; but it was found that the high initial temperature had a detrimental effect on quality.

Lower exhaust temperatures of 80°F and less were tried, but they were not successful, for the instrument was working at the limit of its scale, where it was not sufficiently sensitive; moreover, since the daytime ambient conditions were often above 80°F, the control was influenced by atmospheric temperature and could be used only at night. At night, with an inlet maximum of only 140°-150° and with the same reduction of temperature over three hours, the quality of the tea was much improved.

Hot Air versus Cold Air

Experiments were carried out, when ambient conditions were favourable, on withering leaf in the drum with cold air only, at night, over a period of twelve hours. The results were most encouraging: It was most noticeable that quality, which had been lost with the heat in the controlled drum, was now present even with hard withers. The old bugbear of leaf blackening in the drums was still

present, though to a lesser degree. Dull teas were generally the order of the day during the rainy season and this was attributed to the longer period in the drum and the heat causing pre-fermentation.

Percentage Wither and Out-turns

It had meanwhile been established that an out-turn of 42-44% M.T./W.L. was far superior to the 38% figure quoted originally and that a much blacker well-twisted tea resulted.

Reduction of Leaf Movement

As previously mentioned, the blackening of the leaf, which had been thought to be due to heat, but which was present (though much less noticeably) even when only cold air was used, was still a matter of some concern, particularly with harder withers. It was realized that the blackening was caused by bruising, through the movement of the leaf in the drums. So it was supposed that if the drum were slowed up by half, bruising might be reduced by half as well, so long as only cold air was being used or very low temperatures; with higher temperatures, scorching could occur in certain places in the drum. It was then found that using cold air at night, the appearance of the leaf was much better and really hard withers could be obtained without loss of quality.

Pre-Withering in Drums and Doubling of Charges

It was found that after three hours of withering on cold air when ambient conditions were favourable, a wither of 75-80% had already taken place, with a bulk reduction of 50%. It was therefore decided to try doubling up the drum charges with partly withered leaf in order to reduce leaf movement.

In the case of a factory with three drums, two were charged together and run for three hours on cold air. One drum was then discharged, door by door, and added to the first drum, so that the original two charges of 1,600 lb. each had been converted to a single charge of 2,400-2,500 lb. of partly withered leaf; this filled the drum compartments nicely, without packing down, and left much less room for movement. The wither was continued for a further nine hours. On discharge it was found that the leaf appearance was excellent, and the wither very even. One minor problem in the past had been to wither the stalks to the same extent as the leaf, but this was now solved.

The new programme, which matched the drier fairly well, is shown in the following table:—

New programme with three MK. II Drums Charge: 1,600 lb. per drum initially.

Times:	Drum No. 1	Drum No. 2	Drum No. 3
6 p.m.	(A) IN	(B) IN	
9 p.m.		(B) OUT (to No. 1)	(C) IN
10 p.m.	DOUBLED UP (A+B) IN	RECHARGED (D) IN	
12 p.m.		(D) OUT (to No. 3)	
1 a.m.		RECHARGED (E) IN	DOUBLED UP (C+D) IN
7 a.m.	(A) OUT		
8 a.m.	(B) OUT		
9 a.m.			(C) OUT
10 a.m.			(D) OUT
11 a.m.		(E) OUT	

With three drums, up to five charges, or 8,000 lb. of leaf, can be dealt with in this way and with four drums, up to 11,200 lb. of green leaf can be dealt with similarly, and so on, discharging every hour.

This worked well in dry weather when ambient conditions were right, but, when the rains came, some alteration was necessary. As it was known that high temperatures caused loss of quality, it was decided to try a low inlet-temperature, with the idea of just drying the air. For convenience, 85°F inlet was tried—it being a simple matter to remove the potentiometer element from the exhaust control position to the original inlet control position and *vice versa*. This system has worked very well under the worst possible climatic conditions and also applied itself very well to the new programme of "Double Drumming," with the added advantage that the initial pre-wither can be done in 2-3 hours and the remaining period in about 10 hours on cold air or about seven hours on hot air at 85°F.

Conclusions

Samples of all these experimental wither teas have been favourably reported on by London brokers, stage by stage, and it now appears that the ideal way to use drums is:—

- (1) 1,600 lb. initial charges for drums;
- (2) pre-wither at 85°F inlet temp. or cold air for 2-3 hours;
- (3) double-up drums after pre-wither to reduce leaf movement;
- (4) run drums at speed of $\frac{3}{4}$ R.P.M. (or less);
- (5) when ambient conditions are favourable, use cold air (after pre-wither) for remaining period in drums (7-10 hours);
- (6) when ambient conditions are not favourable, continue to use hot air at 85° inlet for remaining period of 6-9 hours;
- (7) an out-turn of 44-46% M.T./W.L.=about 55% withers in the dry months is aimed for;
- (8) an out-turn of 40-42% M.T./W.L.=about 50% withers in the wet months is aimed for.

There is a considerable saving in firewood by using low temperatures; $\frac{1}{4}$ -1 cu. yd. per 4,800-8,000 lb. of green leaf is sufficient and of course the capacity of the drums is doubled but the power used remains unaltered.

It is estimated that six drums worked off one suitable air heater at 85° inlet temperatures, with two 6" driers and nine rollers, would deal with about 17,600 lb. of green leaf per day.

Many of the modifications mentioned have now been incorporated into the design of the latest drums, which are believed to be greatly improved; but the writer believes that the withering drum, though here to stay, still offers a great challenge for continued improvement not only to withering; but to the whole process of tea manufacture and factory design. It is worth mentioning that many of the top-priced African teas today are made using withering drums.

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