# DEVELOPMENTS IN ROTORVANE MANUFACTURE

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In this paper I propose to give you a summary of our experiments and observations on Rotorvane manufacture.

The McTear Rotorvane Continuous Tea Roller comes in two standard sizes, namely the 15" machine and the 8" machine. As we consider the capacity of the 15" machine too high in relation to the average crops being harvested in Ceylon tea estates, we have confined our experiments to the 8" machine, one of which has been installed in St Coombs factory. Drier capacity is of course a deciding factor as to which size machine can be installed in a factory. It may be of interest to note that the estimated through-put of rolled leaf in a 15" Rotorvane at a speed of 30 r.p.m. is in the region of 4500 lb per hour.

The 8" commercial Rotorvane has a gunmetal cylinder about 3 feet in length and 8 inches in diameter, with a hopper at one end and a discharge at the other. At the discharge end is a device for adjusting the pressure on the leaf being processed. Within the cylinder is a rotor assembly, which consists of a worm for propelling the leaf forward and a series of rotating vanes. The vanes rotate between resistors fixed to the inner surface of the cylinder, and subject the leaf to a shearing action. The vanes are pitched relative to the rotor axis and this imparts a rotary and linear motion to the leaf, which ruptures the leaf cells and initiates fermentation.

Once leaf has passed through the Rotorvane, we observe that the dhool outturn is somewhat decreased because the leaf particles tend to "ball" very tight, and, if the wither is particularly soft, the leaf becomes so very sticky that it clogs the rollbreaker mesh and makes dhool extraction difficult. The conventional ball-breaker arrangement on our rollbreakers does not have the desired effect of breaking up these "balls" very satisfactorily.

It is here that the Rotorvane Ball-breaker and Aerator proves its usefulness. This machine appears to be a simplified Rotorvane with a relatively high speed of about 650 r.p.m. It works supplementary to the Rotorvane, disintegrating the balled leaf discharged from the Rotorvane. It also induces evaporative cooling of the leaf by a high degree of aeration.

We find that the Rotorvane functions best if feeding is continuous, to ensure uniformity in leaf processing. Accordingly, it is desirable that an automatic feed system using a plastic conveyor belt be installed with provision for varying the degree of feed.

A very important precaution is that leaf fed to the Rotorvane must first be passed on a withered leaf sifter to remove sand, dirt and metal particles. If this is not done, the sand and dirt would by their abrasive action cause abnormal wear on the vanes, while metal particles would naturally damage them.

A feature of the Rotorvane is that very little heat is generated inside the cylinder. With soft withers no more than 5°F rise in temperature has been recorded, whilst with harder withers, the increase in temperature rarely exceeds 15°F. As the period of passage of leaf is only about 3 minutes through the cylinder, these temperature increases have not been found to have an adverse effect on liquors or infusions, judging from tea-tasters' reports.

We also recommend an automatic feed system between the Rotorvane and the Ball-breaker and Aerator. Here again, even feeding of the machine results in more uniform disintegration of the leaf discharged from the Rotorvane.

In the machine we have experimented with so far (which incidentally is the 1962 model) all rotors are forward propelling. Teas produced by this machine were rather brownish and not as well twisted as leaf from an orthodox roller, and tip was destroyed. It has now been brought to our notice that the introduction of a few reversed pitch vanes has the effect of distributing pressure inside the cylinder much more evenly, with beneficial results to both leaf appearance and liquors. Together with the introduction of reversed pitch vanes, a new type of adjustable discharge device known as the "Iris" end-plate has been fitted to the rotor shaft of new machines. We were hoping to give you more information regarding the modified 1963 model but it is rather unfortunate that new components we ordered quite some time back have not yet arrived at St Coombs. When our tests on the modified machine are completed, the results will be published in a future issue of the Tea Quarterly.

Since speed appears to be critical, which may depend on the wither and type of leaf, a factory installing a Rotorvane may have to conduct some initial trials to determine the most suitable speed. At St Coombs 25 r.p.m. has given satisfactory results and there are indications that 35 r.p.m. is just as good or even better, but we consider that more experimental work is required before any definite statement could be made. Variable results can be obtained by the manner in which the leaf is fed into the machine, but generally speaking, the slower the speed the worse the appearance.

Without question, the standard of plucking has a direct bearing on teas passed through the Rotorvane. Good results cannot be expected from coarse leaf. It was also observed that teas produced from leaf from very old fields were inferior in appearance to those from young fields. No definite conclusion was reached on the effect of the degree of wither on this characteristic.

Average figures for intake of withered leaf in the first pass through the Rotorvane were approximately as follows:—

Rotor speed 15 r.p.m. — 600 lb. per hour
Rotor speed 25 r.p.m. — 1000 lb per hour
Rotor speed 35 r.p.m. — 1300 lb per hour

These figures can of course be varied considerably, depending on the manner in which the machine is fed. With an automatic feed system, the intake could almost be doubled. At constant speed, the intake of the Rotorvane increases with each subsequent pass. In one experiment, for instance, in which the leaf was conditioned with a 10-minutes roll in an orthodox roller and then passed through the Rotorvane, the following figures were recorded:—

Rotor speed 35 r.p.m. — 1st Pass — 1600 lb leaf per hour
2nd Pass — 2400 lb leaf per hour
3rd Pass — 2600 lb leaf per hour

This feature of the Rotorvane has been observed in all our experiments at all rotor speeds, irrespective of whether the leaf used has had only a 10-minutes roll or more rolling.

In considering Rotorvane manufacture in preference to orthodox, one important advantage in its favour is the saving in power. The 8" machine requires 7.5 h.p. and the Ball-Breaker Aerator requires 2 h.p. whereas an orthodox roller with a

similar capacity would require as much as 15 h.p. for efficient performance. The saving in power is quite considerable and of importance specially in those factories which are under-powered or have reached saturation point.

As regards the actual tea itself, we have so far not been able to produce a tea superior in liquoring properties to orthodox, or with a higher outturn of B.O.P. and B.O.P. Fannings grades. One reason for this is that we make as much as 80% of these two grades at St Coombs by hard rolling and use of small roll-breaker mesh. It does not follow however that the same results would be obtained on another estate. A factory equipped with rollers of poor performance may very well benefit from the introduction of a Rotorvane, but must be prepared to accept a tea not as well twisted as an orthodox rolled tea. So it is quite evident that if the Rotorvane is to prove a success the liquors should be good enough to outweigh the poorer appearance. On the London market, this may not be so important.

It is worthy of note that in certain factories which use this machine at present, besides an improvement in main-grade percentages, there was an increase in the B.O.P. Fannings percentage and a slight drop in the B.O.P. percentage. Rotorvaned teas were brighter in the cup and had improved colour in liquors and infusions. There was no reduction in strength, which was equal to that of orthodox rolled teas.

A point to be remembered is that though a single Rotorvane replaces a number of small rollers, one machine by itself is not a very satisfactory arrangement. We are aware that leaf, even if pre-conditioned, requires two or three passes through the Rotorvane. We also know the effect, specially on quality, of allowing leaf to be piled up in trolleys till machinery is free. It is thus obvious that if the best results are to be obtained from Rotorvane manufacture, two 8" machines would be the best proposition.

The use of the Rotorvane also suggests a new approach to fermentation, not very feasible in an orthodox roller. Tocklai has been investigating the introduction of oxygen into the cylinder with a view to accelerating fermentation. It has been found to be practical and economical and is considered a worth while measure.

# *ANSWERS TO QUESTIONS RAISED ON MR WERAGODA'S PAPER*

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**Question:**—Is it possible to induce flavour in teas by addition of herbs or chemicals?

**Answer:**—We are not aware of any herb or chemical which could induce flavour in teas. Some time ago we investigated an essence which was claimed to produce such an effect, but we found that the flavour it introduced was so foreign to tea, that some tasters called it a taint.

**Question:**—To what extent should grades like Pekoe, OP and BP be done away with and amalgamated in the BOP grade in Mid-grown and High-grown grading?

**Answer:**—The pekoe and OP grades could be almost completely eliminated by hard rolling, use of small rollbreaker mesh and small cutter cells. The BP grade would be minimised by the same process.

**Question:**—The agents of the Rotorvane strongly advocate conditional rolling with orthodox rollers before passing through the Rotorvane and taking a 50% dhool. Is this recommended by the T.R.I. ?

**Answer:**—We recommend conditional rolling in orthodox rollers, but we do not recommend extraction of 50% dhool. Extraction of a high percentage of dhool in the conditional roll would result in liquors being thin. We recommend the extraction of about 10%-15% dhool to improve the appearance of the graded teas.

**Question:**—Do you consider it necessary to rollbreak the leaf after the first roll, prior to passing it through the Rotorvane?

**Answer:**—The extraction of dhool from the first roll would improve the appearance of teas, when the orthodox rolled first dhool is bulked with the Rotorvane dhool. (see answer to question 3).

**Question:**—Is it not advisable for the Institute to carry out manufacture on a commercial scale with the Rotorvane on a big estate rather than on St Coombs? The following problems arise with Rotorvane manufacture:—

(*a*) Firing
(*b*) Keeping quality
(*c*) Appearance

These need careful investigation and advice. Will it be necessary to do double firing?

**Answer:**—We consider it possible to obtain necessary information on Rotorvane manufacture, on a commercial scale in St Coombs factory. A few experiments will of course be necessary in each factory where this machine is to be installed. As regards firing and keeping quality we observe no problems different to orthodox manufacture, provided correct techniques are employed. In the case of appearance, the model we use, has resulted in adverse reports on appearance, which could be compensated by improved liquors. (see answer to question 3). We do not consider it necessary to re-fire Rotorvaned teas, if firing has been carried out satisfactorily.

**Question:**—Is it essential that an estate using the Rotorvane must have a Ball-breaker and Aerator together with a green leaf sifter, as in most cases there is insufficient accommodation for such additional items; particularly with green leaf sifters in the loft?

**Answer:**—On the experimental evidence available so far we recommend use of the Ball-breaker and Aerator to break up the tight 'balls' of leaf and minimise clogging of the rollbreaker mesh. We recommend a leaf sifter to separate foreign particles from the withered leaf. This would minimise wear on the rotor assembly. If no accommodation is available for a sifter there is very little that can be done about it.

**Question:**—Has the TRI at St Coombs carried out manufacture using a combination of the Rotorvane and orthodox rollers and were there any marked differences in quality and time of manufacture?

**Answer:**—We did not observe any marked differences in quality. Some estates using this machine report that they observed marked differences.

**Question:**—In spite of the installation of humidifying appliances, it is difficult to maintain low temperatures in the rollers. What should be done?

**Answer:**—If the humidifying system is functioning satisfactorily, small roller charges and good circulation of leaf will minimise the heating effect. In addition, early morning manufacture may have to be carried out.

**Question:**—What sizes of mesh do you use on your rollbreaker meshes at St Coombs?

**Answer:**—Galvanised iron thick wire Nos. 5 and 6 mesh.

**Question:**—Adequate withering capacity required by increasing crops is cause for concern on many estates. Has not the Institute anything to tell us on such aspects as Drum and Trough Withering, Nylon tats, *etc*?

**Answer:**—No information is available at present as we have not yet tested the drum withering unit at St Coombs. Withering troughs are still being investigated and show signs of promise but more experimental work is necessary before specific recommendations can be made. We recommend the use of suitable synthetic mesh as a replacement for hessian tats. Further information on Nylon tats is available in the Technologist's Annual Report for 1961.

**Question:**—What are your views on the CTC process in Comparison to Rotorvane teas?

**Answer:**—As the teas produced by the two processes are so different, no true comparison is possible. Both are capable of producing teas with liquors superior to that of orthodox rolled teas. Detailed information on the two processes are in the Technologists' Annual Report for 1963.

**Question:**—Where appearance and black tea are the predominant characteristics presently required of low and Mid Country teas, how will the resultant brownish appearance of the CTC and Rotorvane teas affect prices?

**Answer:**—It is very probable that with the demand for better liquoring teas, some producers will benefit from introduction of these techniques, even though appearance is adversely affected. As there is insufficient experimental evidence on the CTC process in Ceylon we do not wish to make any recommendation just yet.

We consider that with the right techniques, the introduction of the Rotorvane may be worth-while in the high grown districts and for the higher mediums. Under special circumstances, this machine may be considered at lower elevations.