TEA MANUFACTURE

PART II. COMMON PROBLEMS IN TEA MANUFACTURE

By

E. L. Keegel

Withering.

In the course of my advisory work I have frequently come across instances where despite the best withering facilities and plenty of tat space, under-withered leaf was being fed into the rollers. Attempts to reduce costs are often responsible for soft withers, but when it is realized that this surplus moisture has ultimately to be driven off in the driers, thus lengthening the working day, there is really not much to be said in favour of very soft withers. Even with extra care in rolling it is doubtful whether a satisfactory product will ever be obtained.

The shutting up of all loft windows at night, especially when the fans are stopped, is still practised without a knowledge of the harmful consequences. Withering leaf breathes and if the carbon dioxide gas is not allowed to escape it has an injurious effect on the leaf almost akin to keeping it in a closed basket. I am almost certain from all evidence available that this is one of the main contributory causes of dull infusions and "sweaty" liquors.

The temperature at which leaf should be withered is still a much discussed question. Admittedly on the data at one's disposal, both practical and theoretical, there is a considerable risk in employing a high temperature for withering, particularly if it is maintained too long. It may interest you to learn that no detrimental effects will result if leaf is subject to a temperature even as high as 220°F. for a few seconds only. However, if exposed for a minute at this high temperature the leaf is completely killed and will not ferment. At lower temperatures, but considerably higher than those adopted in practice, it was observed that at 160°F. exposure of leaf for even 5 minutes was sufficient to stop fermentation. For shorter periods than 5 minutes fermentation was adversely affected. Other experiments carried out on high temperatures revealed that no damage resulted from the employment of temperatures of 100 — 110°F. for

periods as long as 2 hours. Fermentation was quite normal, which explains why Mr. Webber has obtained such satisfactory results with his machine. In the light of the results of all these experiments it appears that the length of time during which a high temperature is maintained is what matters most. Long hours of withering at over 90°F. are known to redden the leaf. I have not found much evidence of very high temperatures being used for withering but the reddening of leaf I have seen on a few occasions was more due to heaping of the leaf for unduly long periods. This invariably occurred in factories where organisation was faulty and labour costs were cut. Though great care was exercised in the withering process the overlooking of a trifling matter like this nullified many of the advantages that would have accrued from the observance of low temperatures and even spreading.

Rolling.

Now that I have referred to leaf temperatures, it may be as well to see its relation to rolling. The idea that "Heat is the enemy of quality" seems to have been engraved in the minds of most planters. Time and again have I seen leaf being under-rolled just because it was too warm to the hand. To my mind some heat in the roller is a healthy sign. It shows that work is being done on the leaf. So long as the leaf is freely circulating there is nothing to fear from apparent over-heating and fortunately the roller itself comes to your aid in this matter. If too much pressure is applied the upper layers become caked which will be a signal that you have exceeded the limit. The real danger of heat actually arises under this condition which more often than not is a result of over-charging the roller. The danger of keeping rolled leaf lying about for any length of time must also not be overlooked. If this is a regular feature in your factory then obviously your organisation is a fault. It is far better to keep that leaf jogging along in your roller than discharging it just because it has had, say, a 30 minute roll.

This brings me to the length of time for which pressure should be applied. The variety of pressure periods I meet with from factory to factory is simply bewildering — 5 minutes on 5 off, 7 on 3 off, 4 on 3 off, 8 on 2 off and even 2½ on 2½ off. On investigation I generally find that there is no special reason for adhering to any particular combination. It merely happens to be a tea-maker's fancy. Obviously the idea behind all this is to cool the leaf but you will probably agree with me that this must be intelligently applied. Provided that the leaf is circulating properly there does not appear to be any justification for raising the pressure cap at all. The actual cooling effect observed in the commercial rollers at St. Coombs by raising the cap every 5 minutes in a 30 minute roll was only 2° so long as the leaf was circulating under pressure. From the point of view of breaking up the balls the raising of the pressure cap is certainly of great help, but why overdo it? Release of pressure about the middle of a roll for a few minutes and again at the end is quite sufficient. It is prolonged rolling at high temperatures that has a detrimental effect. A general rule that may be wisely adopted is, therefore, short rolls if heavy rolling is the objective and long rolls in association with light rolling. If fermentation periods are accordingly adjusted the ultimate result is more or less the same.

Before I turn to the question of duration of rolls, number of rolls and dhool outturns — matters that puzzle many planters — I wish to touch briefly on an equally perplexing problem, namely, roller charges. Makers' ratings have been followed sometimes with disastrous results. The size of a roller is not the main governing factor, the most important being the design of the table and most particularly the design of the central portion. With most tables a simple *true cone* fixed on the door will ensure adequate circulation even under moderate pressure. Details of the fittings have been given in our publications and I will not enlarge on this subject beyond warning you not to confuse these *true cones* with fittings which are used in Epicyclic Pressure or E. P. rolling. The degree of wither has to be taken into consideration as well; let me give

you an example. Supposing the optimum charge for a roller is 400 lbs. for a soft wither (40% outturn made tea to withered leaf), a simple calculation will show you that it contains about 240 lbs. of water and 160 lbs. of dry matter. The water in the leaf occupies no extra space of course. Now, if you have hard-withered leaf corresponding to an outturn of made tea of 50% and do not wish to overload that roller the charge must not exceed 320 lbs. Note carefully the difference in the optimum charges. It is as much as 80 lbs. although in both cases the volume taken up by the leaf is the same. Having seen hundreds of rollers of all sizes and all makes in action I am convinced that half the trouble experienced in rolling is caused by over-charging. True, it may appear uneconomic to under-charge rollers but you may rest assured that in the long run it will pay not to over-charge. The optimum charges of withered leaf I would recommend for the more familiar rollers are as follows :—

44 ins.	...	...	400 lbs. withered leaf.
40 ins.	...	...	350 „ „ „
36 ins. (Deep jacket)		...	300 „ „ „
36 ins. (Standard jacket)		...	250 „ „ „
34 ins.	...	...	225 „ „ „
32 ins. (Square jacket)		...	250 „ „ „
35 ins. (Economic)		...	300 „ „ „
32 ins. „	...	...	250 „ „ „
28 ins. „	...	...	125 „ „ „

increase by 10% for *rolled* leaf.

These figures are based on normal withers. If you go in for abnormal withers, very soft or very hard, add or deduct 10%. When rolled leaf is to be charged the amounts may be increased by 10%.

Turning to the question of duration of rolls I have this to say: Do not be tied down to the orthodox 30 minutes. Your machinery must decide this for you and this is where organization comes in, a subject which is far too wide to talk to you about now. In some factories, smooth working is sacrificed for the sake of following orthodox methods not realizing that a slight shortening or lengthening of a roll makes no material difference to the result. Dhool outturns must similarly depend on your machinery and this applies to the number of rolls as well. The logical amount of dhool to be taken out in a four roll programme appears to be 10, 20, 25 and 30% but what of it if you instead take 40% in the third roll and only 15% in the last? There will be practically no difference provided the big bulk outturn is the same. This may sound illogical, but if you doubt me try an experiment out with the same leaf and on the same roller and see what you get.

As I said earlier, the sizes of your rollers are the chief influencing factor in deciding on how much dhool should be removed from a roller. If we take an extreme case where, say, 400 lbs. is charged into a 40 ins. roller, the leaf from which has to go into a 32 ins. for the next roll, surely it will be the height of folly to take only 20% dhool just because orthodoxy demands it. At least 30% of that leaf will have to be extracted as dhool to give satisfactory results in the following roller. I hope you see the point I am driving at, which in a nutshell is this; do not bother yourself with how much dhool is taken; concern yourself more with how much leaf should go into a roller. In other words, first fix the charges in relation to the sizes of your rollers and the order in which they are to be used, then dhool outturns should adjust themselves. And speaking of dhool outturns do not blame your roller if you sometimes get inadequate dhool. A loose belt in the dry weather can quite easily be the cause.

The speed at which a roller should run is another of those things which confuse most people. There is more than sufficient evidence to show that speed has very little effect on the teas produced. In general it may be said that a

slow speed improves appearance slightly, but if it is below 30 r.p.m. poor circulation of the leaf will result. Experience shows that speeds of over 50 r.p.m. are wasteful of power and that the factor of importance is the crank-throw. As a guiding principle you may take it that if the crank on a roller is small the speed should be high and vice-versa. In practice it will be found that speeds of 35-40 r.p.m. need not be exceeded but if a roller is over-charged or has no contrivance, such as a cone, on the door it will be found necessary to increase its speed to 50 r.p.m. to get the leaf to circulate properly. Most modern rollers are provided with relatively big cranks which assist the circulation of leaf and, therefore, need not be run at more than 40 r.p.m. The whole question really boils down to this; adopt a speed that will circulate the leaf briskly; that is all. It does not matter whether the roller runs at 30 or 40 or 50 r.p.m. but do not forget that faster rolling consumes more power.

Another question frequently asked is how long must leaf be fermented and in what order should dhools be fired. The most favourable point to be reached in fermentation is to my mind the most difficult task in the process of manufacture. Should one be guided by colour or by nose? There is at present little precise information on this point, but some preliminary work has brought me to a stage where I can lay down certain broad generalizations. To judge the progress of fermentation by colour is very misleading indeed because if the wither is hard the leaf will look green no matter how long it is left on the fermenting racks and if the wither is soft it quickly acquires a coppery hue. Aroma on the other hand is a safer guide but experience is needed to distinguish what some old planters will describe as first nose, second nose and third nose. If you can do this you will have no doubts about your fermentation.

Roll-Breaking.

Roll breaking is one branch of manufacture where no serious attempt has yet been made at standardization. The reason is not far to seek because there is such a variety of machines on the market working on different principles. In consequence it is not surprising to see various devices being resorted to in an attempt to obtain an even dhool. Double roll-breaking is certainly a good way of getting an uniform dhool but it involves more time, more machines and more labour. Why go to all this trouble when by a suitable combination of mesh, speed and slope you can get the same results in a single operation? How then is one to set about it? In the first place ensure that the roll-breaker is fed at an even rate. This is of paramount importance as by over or under-feeding a roll breaker a wide variation of dhool size will be obtained. Next, aim at getting the size of dhool which when fired corresponds to that of B.O.P. If your dhool is larger despite the use of No. 5 mesh, the generally accepted standard which produces a dhool of the recognized size, you can correct it by either or all of the following ways:—

(a) A smaller mesh at the end of the roll-breaker.

(b) A faster speed.

(c) A steeper slope.

If it is too small decrease the speed or slope, perhaps both. As you see, the adjustment is quite easy and only requires a little ingenuity and common sense. If your factory is one of those which specializes in large leafy grades a No. 4 mesh may give the desired results and if you wish to make a high percentage of B.O.P. and Fannings No. 6 mesh will probably give the best results.

Firing.

When I turn to the consideration of firing I must remark upon a recent tendency to over-fire. Faulty inlet thermometers, absence of exhaust thermometers and long drying periods are very common not so much on the modern endless chain pressure driers, but on the older semi-automatic tilting tray types. The fully automatic drier rarely gives trouble and there is no reason why even the other types should not give equally satisfactory results if only they are properly used.

Over-loading of trays, hurried spreading of the leaf and irregular charging of the trays in the case of tilting tray machines are common faults. The factories where these faults occur invariably have trouble with dull infusions. It is unnecessary for me to stress the fact that firing is a mechanical process and even in semi-automatic driers the human element only enters in the feeding and collecting of the leaf and maintenance of temperatures, but it is still a common practice to see firing being judged by the feel of the tea. There is no need for uncertainty about firing when, by having a constant load, a constant exhaust temperature and changing trays by the clock, you can do away with such malpractices as slipping from one pulley to another, opening port holes, running a few trays empty and closing down on the fan valve. At this stage you may ask what should be the correct load for these tilting tray machines. A safe rule of thumb to follow is to work as near as possible to ½ lb. leaf per square foot of tray area. My final word of advice on firing is to take every precaution to ensure that teas are thoroughly cooled before they leave the firing room.

Grading.

Finally, I come to grading. The procedure varies to such an extent from estate to estate that unlike the other branches of manufacture no rules can be laid down. I must, however, refer to the dangers inherent in attempting to keep the percentage of off grades at too low a figure. It is very easy to spoil the appearance of the main grades by so doing. There is no hard and fast rule for the percentage of Broken Mixed, but if it is too high first look into the standard of plucking before blaming the teamaker. If you are convinced that it is not due to coarse leaf you can then be sure that the fault is due either to rolling of under-withered leaf, or too severe fittings on the roller tables. Light rolling also sometimes tends to produce more Broken Mixed and the only remedy is to put more pressure on the leaf. Finally, to avoid greying use your cutter judiciously and see that its cutting edges are always sharp. Excessive handling of freshly fired tea must also be avoided to keep teas really black in appearance.

DISCUSSION.

I. QUICK WITHERING—C. R. WEBBER.

Major O. L. M. Lebbe said that quick withering machines had been in use for over 50 years ; he himself had originally used a desiccator and now he had a Paragon drier. He asked whether the latter machine would not be more suitable and also more profitable.

Mr. Webber said he thought this was highly improbable especially from the point of view of the prices realized.

Mr. Morford asked if the output varied appreciably for wet leaf and dry leaf.

Mr. Webber said he always weighed 750 lbs of leaf wet or dry, so the output was always the same.

Mr. Dyer remarked that he had observed that the teas from this machine were rather flaky.

Mr. Webber agreed that the teas were inclined to be choppy, but no adverse comments had been received from the brokers. In fact reports indicated no difference in appearance between normal and quick withered teas, nor was there any appreciable difference in price.

In reply to various other questions, Mr. Webber said that there was no evidence either that the percentage outturn of made tea to green leaf was reduced by the use of this machine, or that there was a danger of case hardening of the leaf. He further stated that no extra labourers were required to operate the machine.

II. COMMON PROBLEMS IN TEA MANUFACTURE—E. L. KEEGEL.

Mr. Lockhead and Mr. Childerstone asked if it would be possible to arrange a conference of Teamakers, presided over by Mr. Keegel.

The Director said he would require time to consider this suggestion.

Mr. Morford and Mr. Childerstone suggested in this connection that a precis of Mr. Keegel's paper should be circulated to all teamakers. The Director agreed to this, and asked those interested to send in their names and addresses. (THIS HAS BEEN DONE—Ed.).

Mr. Morrison asked whether the recommendations regarding constant pressure were applicable at all elevations.

Mr. Keegel replied that although his recommendations were based principally on results obtained in upcountry factories, there was no reason why continuous pressure (with shorter rolls) should not give equally good results in the low-country. It was, however, advisable to raise the pressure cap for a few minutes in the middle and at the end of each roll.

The Director added that thorough circulation of the leaf the whole time was of prime importance in maintaining an even temperature in the roller.

In reply to a question by Mr. Childerstone. Mr. Keegel said that the speed recommended for E. P. rolling was the same as for batten pressure/cap rolling.

In reply to a question by Mr. Clowes, on the types of mesh in roll breakers, Mr. Keegel said that it was advisable to have a smaller mesh at the lower end, since during the passage of the dhools through the machine, the larger particles tended to accumulate there.

Mr. Birkett asked whether the use of a high pressure in the first roll would not spoil the appearance.

Mr. Keegel replied that if tip was the main consideration, it was certainly preferable to keep the first dhool out-turn as low as possible. The figures he had given referred to 3rd and 4th rolls, and might be applied to the 2nd as well.

Mr. Birkett then asked whether the percentage of big bulk was not the most important factor, since it governed the amount of cutting taking place in the sifting room, and what limited the percentage outturn of dhools.

Mr. Keegel replied that the higher the big bulk outturn the more the cutting. However, if the big bulk outturn was the same it made very little difference what percentage outturns of dhools were taken in the later rolls.

Mr. Jayawardene asked whether continuous rolling was recommended if big bulk outturn was to be reduced.

Mr. Keegel replied that in his opinion continuous rolling could not be recommended for this purpose alone, as it was apt to produce more "reds" than the orthodox system.

Mr. Clowes asked how the statement by Mr. Keegel that temperatures above 100°-110°F. would ruin the teas could be reconciled with statements by Mr. Webber.

The Director explained that fermenting enzymes were destroyed at about 120°F. but a lower temperature maintained for about 3 hours would not affect the activity of the enzymes.

Mr. Jayawardene asked what standard withering percentage was recommended.

Mr. Keegel replied that he considered that for a good average wither the leaf should contain about 55% moisture (i.e., the outturn of made tea to withered leaf would be 45%).

Mr. Childerstone asked whether it would be economic to hold crops over for certain periods and how long factory windows could be closed during withering without any detrimental effect.

The Director replied that it was not possible to state after what length of time injury to the withering leaf could be anticipated. At St. Coombs it had not been found economic to hold over crop and daily manufacture was practised.

In reply to a question by Mr. Stewart, Mr. Keegel said that in recommending a firing load for trays of ½ lb. per sq. ft. he was referring to fermented leaf.

In reply to questions on the types of battens recommended for well twisted tea—one of the most important considerations in low country manufacture—Mr. Keegel said that no special type of batten was recommended—of greater importance was the type of the fitting on the door.

The Director added that the Colombo Commercial Company M & S, and Walkers Crescent battens would probably be found suitable. These firms had co-operated with the T. R. I. and had devised a type of cone known as a "Fadeaway" cone. Of course, these true cones must not be confused with fittings used in E. P. rolling which was sometimes incorrectly referred to as cone rolling.

Arrival of His Excellency the Governor-General.

At the hour of 11-00 a.m. His Excellency the Governor-General arrived with his A. D. C. The Chairman thus addressed the Conference :—

Your Excellency, and Gentlemen :

It is an honour indeed, Sir, that you have made the long journey from Kandy this morning to be present with us at the hour appointed, and purpose your return to Colombo this evening—a considerable call on your busy occasions. We are delighted to see you present.

The Tea Research Institute of Ceylon is very conscious of its peculiar responsibility towards an Industry which has provided, and we hope will continue to provide, the main revenue of the Island. From conversation I had with you, Sir, and by your recent visit to St. Coombs, you have shown great interest and concern for the work of the Institute.

We were disappointed indeed that the Minister of Agriculture was not present with us yesterday to open this conference, and it is gratifying that you have made this visit to us today. I now invite you, Sir, to address us.

Note. The reply by His Excellency the Governor-General is given in full in volume XXI, Part IV, "Conference Number" *The Tea Quarterly*—December, 1950.