THE STORAGE AND PACKING OF TEA

J. LAMB

That the moisture content of made tea, quality, and keeping properties are very closely related is well known to the practical man.

Time and energy, as well as money, spent on improvements in the manufacture of tea are wasted if due care is not taken over the storage of the resultant product, both in the factory and in transit. This particular aspect of the tea industry has been generally neglected in the past and Ceylon cannot claim to be innocent in this respect.

In Java different markets often receive individual attention in matters such as final firing and moisture content at despatch. There are very sound reasons for such a procedure, as in different parts of the world tea is subjected to very different conditions of humidity and temperature. Tea with a high moisture content will deteriorate much more rapidly in a warm than in a cold climate, but the rate and degree of gain of moisture by made tea is directly dependent upon the humidity of the atmosphere with which it is in contact. It is this fundamental relation between moisture content of tea and atmospheric humidity that I wish to deal with in this article.

Tea conforms to well-known physical laws and it is hoped that the following data will be of assistance to those carrying out trials with various types of packing materials. A study of this article will reveal that a trial shipment of tea in a packing material under test may be invalidated by conditions which are quite independent of the material being tested.

Made tea falls among the class of materials known as hygroscopic substances. Hygroscopic materials have a marked tendency to absorb water, and the amount of water so taken up tends to establish an equilibrium with the water vapour of the atmosphere.

The following table shows the behaviour of tea exposed to three different conditions of relative humidity.

Interval	Relative humidity		
	94%	80%	62%
	Moisture content of Tea (Per cent)		
0 days ...	3·0	3·0	3·0
4 ,, ...	5·6	4·7	3·2
9 ,, ...	11·8	6·5	3·4
12 ,, ...	15·0	6·9	4·1
18 ,, ...	16·3*	8·1	4·4
24 ,, ...	16·7*	8·5	4·4
27 ,, ...	17·9*	8·7	4·6
32 ,, ...	20·0*	8·8	4·6
35 ,, ...	20·8*	8·8	4·6
41 ,, ...	21·5*	8·7	4·5

The asterisk denotes that the tea had become mouldy.

It is evident from this table that in a very humid atmosphere tea gains moisture rapidly, while in an atmosphere of 62 per cent humidity the rise in moisture content is slow and terminates at about 4·6 per cent moisture content. In a damp atmosphere the moisture content showed signs of becoming established at 20-21 per cent of moisture, but at this stage the tea was so mouldy that further determinations were valueless.

The teas from different estates do not show any marked differences in their affinity for moisture.

Estate	Exposure to atmosphere of 94% Relative humidity for 7 days.	
	Before	After
	Moisture content of tea.	
	%	%
1. Pekoe ...	5·3	11·6
do. ...	5·0	10·9
B.O.P. ...	5·3	10·9
do. ...	4·9	11·9
2. B.O.P. ...	4·9	11·6
3. B.O.P. ...	4·4	10·6
4. B.O.P. ...	4·6	10·8

Drying out does not affect the subsequent hygroscopic nature of tea to any marked extent.

The following are results obtained with teas from the same estate which were all exposed on the same occasion for the same period. One set of teas with a normal moisture content of 4·5 per cent was exposed for several days whilst the other set was dried out in a steam oven before exposure.

	4-5% Initial Moisture	0% initial Moisture (Oven dried)
	Final moisture content %	
Invoice 8 B.O.P. ...	15·0	14·3
9 do. ...	14·9	14·2
10 do. ...	15·1	15·6
13 do. ...	15·6	15·0

Different dhools from one manufacture do not exhibit any difference of practical importance in hygroscopic properties.

Dhool	Fermentation	Hygroscopic values *Set I*	*Set II*
1.	4-55 hours	7·2	8·0
2.	4-35 do.	7·0	7·9
3.	4-05 do.	7·0	7·9
4.	3-55 do.	7·1	7·6
5.	5-20 do.	7·1	—
B.B.	5-45 do.	8·1	8·0

The grading of tea does not separate out any material of characteristic behaviour.

The conclusions to be drawn from the figures is that the tea, *whatever its origin or grade*, tends to establish an equilibrium with the humidity of the atmosphere to which it is exposed.

The next question which arises is, does tea, having reached equilibrium with a damp atmosphere, lose moisture when exposed to a dry atmosphere ? In order to answer this question the following experiment was carried out.

Two grades of known moisture content were first exposed in an atmosphere of 94 per cent relative humidity for 10 days. They were then exposed to an atmosphere of 80 per cent relative humidity for a further 5 days, followed by exposure to 65 per cent relative humidity for 15 days. The following table shows that these teas first gained and then lost moisture and *still* obeyed the law of equilibrium between moisture content and relative humidity of the surrounding atmosphere.

	B.P.	B.P.
Initial moisture content ...	3·2%	4·2%
Moisture content after exposure in atmosphere of 94% relative humidity for 10 days ...	11·5%	12·0%
Moisture content after being moved to an atmosphere of 80% relative humidity and exposed for 5 days	10·6%	10·8%
Moisture after moving once more, this time to 65% relative humidity and exposing 15 days ...	6·9%	7·1%

These periods and humidity conditions approximate to those which would be encountered by fully exposed tea shipped from a Ceylon estate to London. Thus 10 days in an atmosphere of 94 per cent relative humidity would correspond to Colombo, Indian Ocean and Red Sea conditions, while 5 days at 80 per cent relative humidity would correspond to conditions in the Mediterranean. After this the relative humidity of the atmosphere would be much lower, and 65 per cent would be representative of conditions in London.

Samples of such a shipment of tea would show normal moisture content in London, since 6-7 per cent is not unusual in samples of tea taken at the time of auction. Nevertheless a moisture content of 11-12 per cent in a warm climate would be sufficient to produce rapid deterioration, which means that the tea would have suffered

in quality between the estate and London. It is not my intention to suggest that these conditions and results are hard and fast, but it is my contention that moisture content tests taken on the estate and in London give no indication of the condition in which the tea may have been during some portion of its transit.

The logical conclusion to which we are therefore forced is that where tea is subjected to a humid climate for any considerable period, an airtight and moisture proof package is essential. Soldered or effectively sealed metal foil is not permeable to moisture, and is therefore suitable, provided that it is not punctured by the sharp ends of leaves or torn during packing or transit.

During the past year several other materials have been suggested as being suitable for packing tea. Amongst these were various grades of cellophane and a rubber coated paper. Certain grades of cellophane are highly permeable to water. Ordinary rubber prepared directly from latex is also permeable to moisture, a property due to the non-rubber constituents of the latex.

In the following test packets of tea $3\frac{1}{3}$'' x $1\frac{1}{2}$'' x $1\frac{1}{2}$'' were exposed to an atmosphere of 90 per cent relative humidity.

Test 1 *Cellophane.*

Packets sealed with gum	
Initial moisture content of tea ...	3·5%
After 3 days	8·7%
After 7 days	15·5%

Test 2 *Cellophane, Grade No.* 200

Packets sealed with gum.	
Initial moisture content of tea ...	3·5%
After 3 days	4·0%
After 7 days	5·8%

Test 3. *Rubber coated paper.*

Packets sealed with rubber solution.	
Initial moisture content of tea ...	4·2%
After 19 days	9·5%
After 29 days	12·8%

Test 4. Patent paper lining.

Sealed with gum.

Initial moisture content of tea ...	2·4%
After 9 days	12·9%

Test 5. Patent paper lining, thicker quality.

Sealed with gum.

Initial moisture content	3·0%
After 9 days	12·0%

Test 9. "Pliofilm" a patent transparent rubber product closely resembling Cellophane.

Sealed with rubber solution.

Initial moisture content	4·5%
After 11 days	4·5%

Further tests with an improved quality double paper lining were carried out in half chests. The linings were sealed with gum, and the chest nailed down in the usual way.

The tea, a broken pekoe, was packed at 4·0 per cent moisture. Details of samples drawn follow.

Chest I.

Stored in a Colombo warehouse for one month. September-October.

Edges of chest ...	6·6% moisture.
Middle of chest ...	5·9% ,,

Chest II.

Stored in a Colombo warehouse for two months. September-November.

Edges of chest ...	8·4%
Middle of chest ...	7·4%

Chest III.

Stored in grading room of St. Coombs factory for three months — September-December.

Bulked sample ...	7·6%

SUMMARY

Cogent reasons are given why tea should be packed in a lining which is impermeable to water vapour, when the chests are liable to be stored in a humid atmosphere. Soldered or sealed metal foils which are mechanically strong enough to resist puncturing and tearing fulfil requirements, but results of preliminary tests with various other substitutes are given.

The most satisfactory of these materials is a patent rubber product resembling Cellophane.