

THE 'KAYBEE' INFRA-RED MOISTURE TESTER TYPE X-14

E. L. Keegel

This is an instrument which depends for its operation on the heat from infra-red light. As the accompanying photograph shows, it is very simple in construction, consisting of an infra-red lamp and a pendulum balance, one end of which holds a pan. The material to be tested is placed in the pan and, on exposure to the radiations from the lamp, rapidly loses its moisture. A pointer on the balance, which moves over a scale graduated 0-30 per cent., indicates the percentage moisture content of the sample.

It will be seen, therefore, that no weights have to be used. Those provided are meant only for checking the instrument from time to time. The procedure for a moisture determination is to load the pan with the sample until the pointer is at zero, switch on the 150 watt infra-red lamp and note the reading on the scale after a specified time for a certain setting of the lamp. Slots enable the height of the lamp above the sample to be varied.

Numerous tests were carried out with tea varying in moisture content from 1 to 10 per cent., particular attention being paid to the performance of the instrument when dealing with samples at moisture levels between 2 and 6 per cent.

Drying period.—The design and principle of the infra-red tester is such that the time necessary for a sample to reach its true moisture content figure varies with its original moisture content, and the height of the lamp above the sample.

If, therefore, the instrument is to function for a fixed drying period it has to be calibrated for a certain height of the lamp. The most suitable drying time will have to be one which will not cause burning of a sample having a very low moisture content. From numerous determinations it was found that with the lamp set at the highest and lowest positions the maximum period permissible was 10 minutes and 7 minutes respectively.

Calibration.—The instrument was accordingly calibrated for these respective periods by comparing the reading on the scale corresponding to each sample against the moisture content obtained by the standard steam oven method.

There was very little to choose between the two positions of the lamp. However, considering that there is some risk of a sample charring, say in a dry atmosphere, by the use of the lamp at its lowest position, it was decided to make the final calibration with the lamp set in slot 5 (highest position) and a drying period of 10 minutes.

The curve of closest fit was drawn by plotting all the figures obtained on a graph. From this calibration curve the following Table (1) has been drawn up and will be found to be more convenient for actual use:—

Table 1

<i>Reading on scale</i>	<i>Nearest true moisture content</i>
1.0	0.4
1.5	1.0
2.0	1.6
2.5	2.2
3.0	2.8
3.5	3.4
4.0	4.0
4.5	4.6
5.0	5.2
5.5	5.8
6.0	6.4
6.5	7.0
7.0	7.6
7.5	8.2
8.0	8.8
8.5	9.4
9.0	10.0

Accuracy.—Although the normal range of moisture in made tea is small an absolutely accurate value is not essential. For all practical purposes a difference of half per cent. moisture is of no significance. At high moisture content levels of over 7 per cent. a difference of even 1 per cent. is immaterial.

A close examination of the foregoing table reveals that, for the range of 3 to 5 per cent., the most important in tea manufacture, the instrument is accurate to within ± 0.2 per cent. Below 3 per cent. the meter gives readings approximately 0.5 per cent. more than the true moisture content. And in the range 5 to 10 per cent the deviation is greater. Yet the differences do not exceed the tolerances mentioned. A direct reading off the scale may, therefore, be taken as the moisture content of a sample. However, where a higher degree of accuracy is desired, it is recommended that the calibration figures given be adopted. Briefly, the correction to be made is as follows:—

<i>Reading on scale</i>	<i>Correction</i>
Between 1 and 2	Subtract $\frac{1}{2}$ per cent.
„ 2 and 5	No correction
„ 5 and 7	Add $\frac{1}{2}$ per cent.
„ 7 and 10	Add 1 per cent.

For still more accurate work the exact position of the pointer between the divisions can be easily gauged by means of an ordinary magnifying lens. In this way it is possible to take readings to 0.2 per cent.

Reliability.—This was tested by a complete series of new readings taken on different samples. The corrected figures were obtained from the calibration curve plotted and checked against the true moisture contents. Nearly 50 samples of all descriptions of tea were dealt with. The difference between the interpreted values of moisture contents and the true moisture contents was never greater than half per cent. The error is of such a small order that the reliability of this instrument compares favourably with that of a steam oven.

Possible sources of error :

- (1) Variation in the humidity of the atmosphere.
- (2) Variation in the size of the sample.
- (3) Variation in the composition of the sample, depending on the proportion of leaf to stalk.
- (4) Uneven spreading of the sample in the pan.

None of the above mentioned factors is likely to introduce a perceptible error, but their influence could be reduced by the following measures:—

- (a) Operation of the instrument with the lamp set at the highest position.
- (b) Levelling of the sample in the pan without compacting it under pressure.

Precautions.—To ensure good results and reduce all errors to negligible proportions it is important that:—

- (1) The instrument be checked from time to time with the weights provided.
- (2) It be placed in a draught-free and dust-free room.
- (3) The part of the instrument which houses the knife edge and pendulum be enclosed in a case when not in use.
- (4) The pointer be at rest and at the zero reading on the scale before the lamp is put on.
- (5) The pan be cooled before each determination.

Conclusions.—The standard of performance of this instrument renders it most suitable for use in tea factories. It is easy to handle, simple in operation and offers a quick method for the determination of moisture in made tea with an accuracy approaching that of a steam oven.

The value of the instrument would, however, be enhanced if the scale was marked in terms of actual moisture content as determined by oven drying (vide Table 1) and in divisions of half per cent. moisture.

The instrument is available locally. The electric supply, whether alternating or direct current, and voltage, should be specified when ordering. The life of the infra-red bulb is stated to be a minimum of 800 hours, equivalent to about 5,000 moisture determinations. According to the suppliers its life may even be twice as long.