

# **Design of a Cashewnut Moisture Meter<sup>1</sup>**

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## **Abstract**

High moisture content in raw cashew nut causes deterioration of the kernel due to mould, bacteria, and enzyme action. Cashew nuts are to be dried to 6-8 % (d.b.) for storage. This paper explains the details of the Cashew nut Moisture meter designed for accurate determination of moisture content in raw cashew nuts. The Instrument works on the principle of electrolytic capacitance. Cashew acts as the dielectric of the parallel plate capacitor which is the sensor of the instrument. The moisture meter is calibrated against standard air oven method. It can read the moisture content upto 20% (d.b).

## **Introduction**

The moisture content of raw cashew is as high as 25% with an average of 15% (Pattinson,1968). High moisture content causes deterioration of the kernel due to mould, bacteria or enzyme action. Affected nuts may lose their nutty taste and aroma which would result in loss of quality (Ohler 1979). Drying the nuts immediately after harvesting is essential to preserve their quality by bringing down the moisture content to 6-8% (d.b.) (Bavappa,1994). At present there is no instrument available in the market to estimate the moisture content of raw cashew nut. Cashew farmers and the processing units should be able to note the m.c. available in their cashew stock to ensure quality. Price of cashew can be fixed by reducing a percentage of total cost for the extra % of moisture available in their product. More over India imports large quantity of raw cashew nuts to meet the domestic demand of processing units. Imports of raw cashewnut into India during Jan. to June 97 amounted to 98881 M.T. valued at Rs.30740.71 lakhs (The Cashew,1997 ). So if there is excess moisture available

in the lot , the loss of foreign exchange will be large. So a moisture meter which can read the moisture content in raw cashew nut was designed by Central Plantation Crops Research Institute, Kasaragod.

### **Materials and Methods :**

The instrument was designed according to the theory of electrolytic capacitance. Electrolytic capacitance  $C = \frac{K A}{d}$  , where K is the dielectric value; A, the area of cross section of the parallel plates of the capacitor and 'd', the distance between the plates. When A & d are fixed, C varies according to K. The dielectric properties of agricultural products depend on the moisture content. The capacity of a condenser is affected by dielectric constant of the material placed between the condenser plates. Wet materials have high dielectric constant.

Applying this principle, the cashew moisture meter was designed. The instrument was designed in the 'Schering Bridge' form (Sawhney, 1978). This is an AC Bridge particularly suitable for small capacitance. The instrument consists of a high frequency oscillator, a pre amplifier, a capacitance bride, a main amplifier and an A to D converter with digital display (Fig.1). Here, the raw cashewnut acts as the dielectric of the unknown capacitor  $C_x$  fixed on one arm of the Schering Bridge.  $C_x$  consists of two parallel brass plates of 22 gauge, which is fixed 1.5 cm apart. This gap is selected to accommodate the cashew samples, breadth wise. Samples can be loaded from top and unloaded from bottom by sliding the base plate of the sensor.

Initially, the Schering Bridge is balanced with known value of capacitance. When the sensor compartment is filled with cashew, depending on the m.c. in it, the bridge unbalances and output current flows. This can be read in the output meter and this value is proportional to the m.c. of raw cashewnut.

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## Results and Discussions :

### Calibration

The instrument is calibrated against standard air oven method. When no sample is kept in the sample compartment (sensor), the instrument reads zero or a constant value which can be adjusted with the potentiometer provided in series with the output meter. First, raw cashewnut is filled up in the sensor compartment. As the size of the cashew is not uniform, it is difficult to pack the samples tightly in the compartment, but try to pack it as far as possible. The instrument reads in microamperes. The same sample is weighed and kept in the oven at a temperature of 55 to 60°C for drying, till the entire moisture is removed. The difference in weight of the sample before and after the drying gives the moisture content of the sample. The % m.c. on dry basis =  $\frac{W_1 - W_2}{W_2}$

where  $W_1$  = Weight of sample before drying

$W_2$  = Weight of sample after drying

The experiment was repeated with samples of different moisture content. The reading was statistically analysed and suitable equation formulated for calibration of the meter.

A graph was plotted taking output current in microamperes in the Y-axis and % m.c. of raw cashewnut in X-axis (Fig.3).

The equation for calibration is  $y = -24.59 + 10.28x - 0.29x^2$

$$r^2 = 0.97$$

The instrument can read % m.c. up to 20% (d.b.). The size of the cashewnut samples is not generally uniform and the shape of the nut is also not of any

standard shape / specification and so there will be always air gap in the sensor compartment and this air gap also varies with the size of the nuts loaded in the sensor. The net result is that the dielectric of the capacitor is a combination of cashew and air and so the reading on the moisture meter for the same sample loaded at different times will be different. This error was calculated to be 1% to 1.5% m.c.(aprox.). So the moisture content of the same sample is to be measured two or three times and the average is to be taken.

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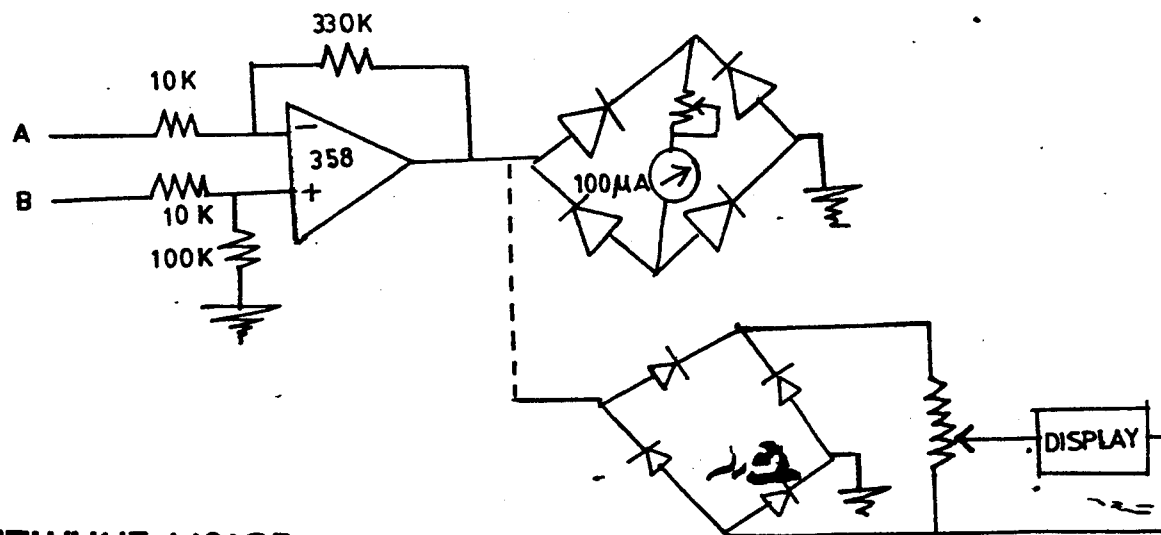
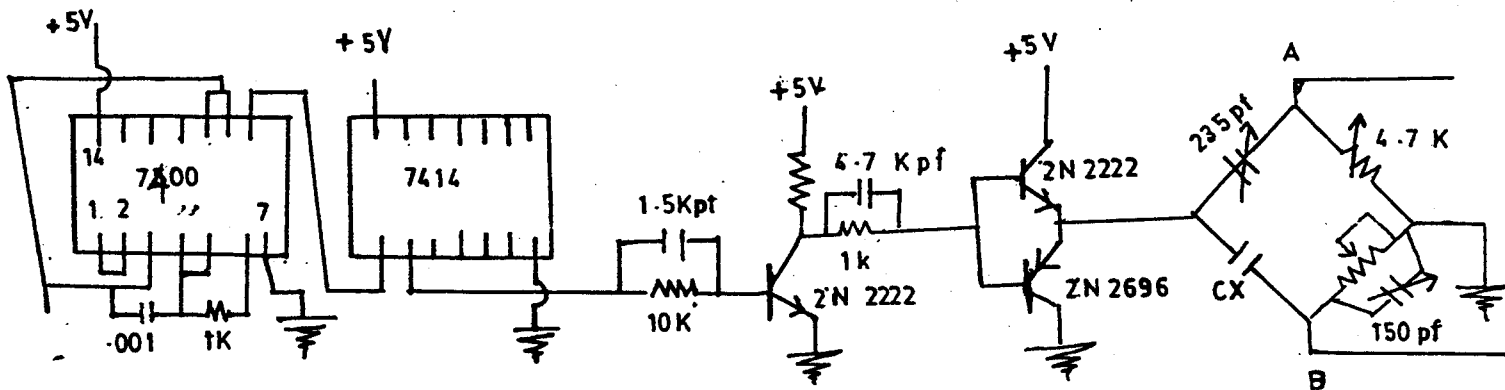
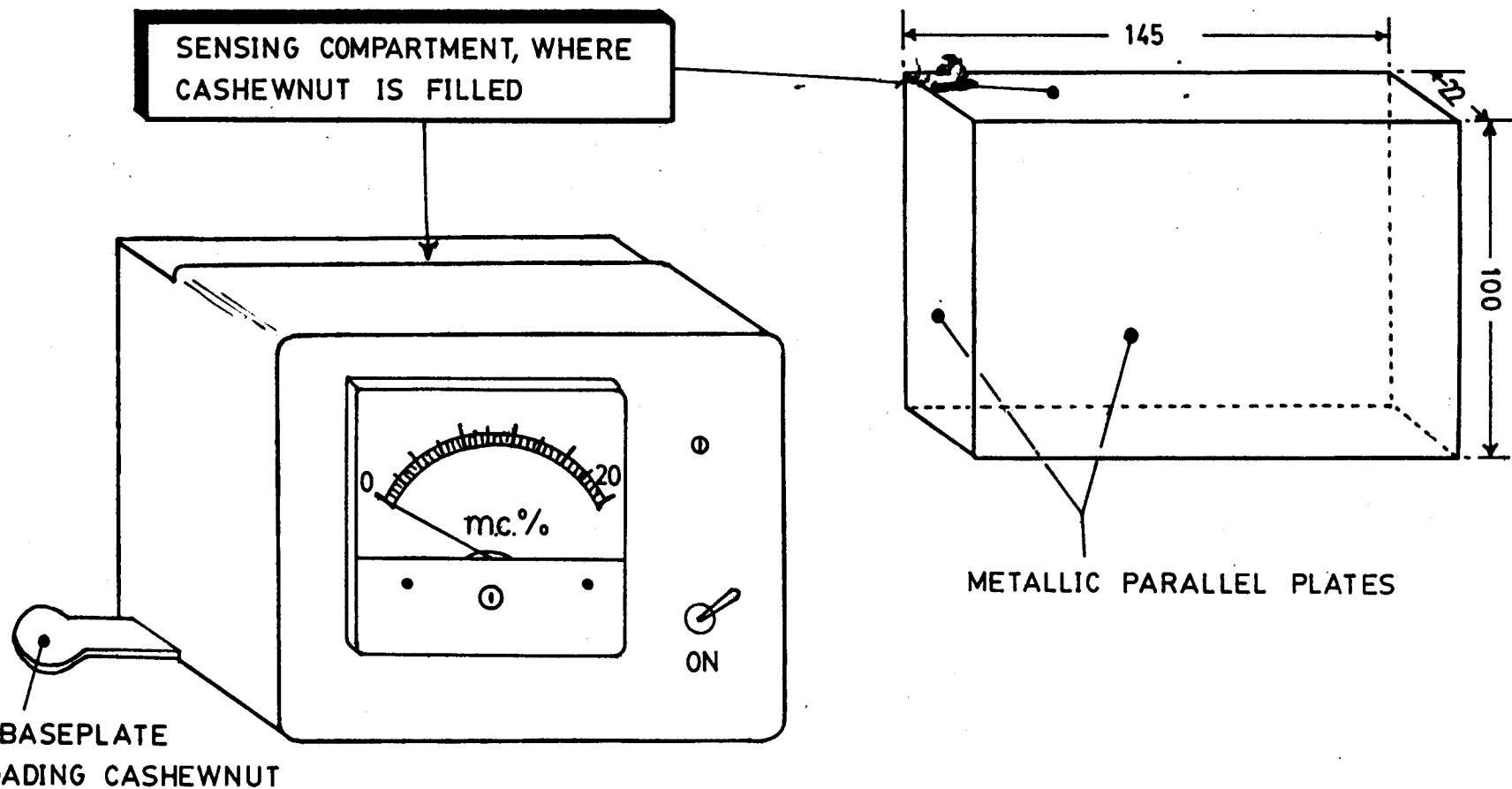
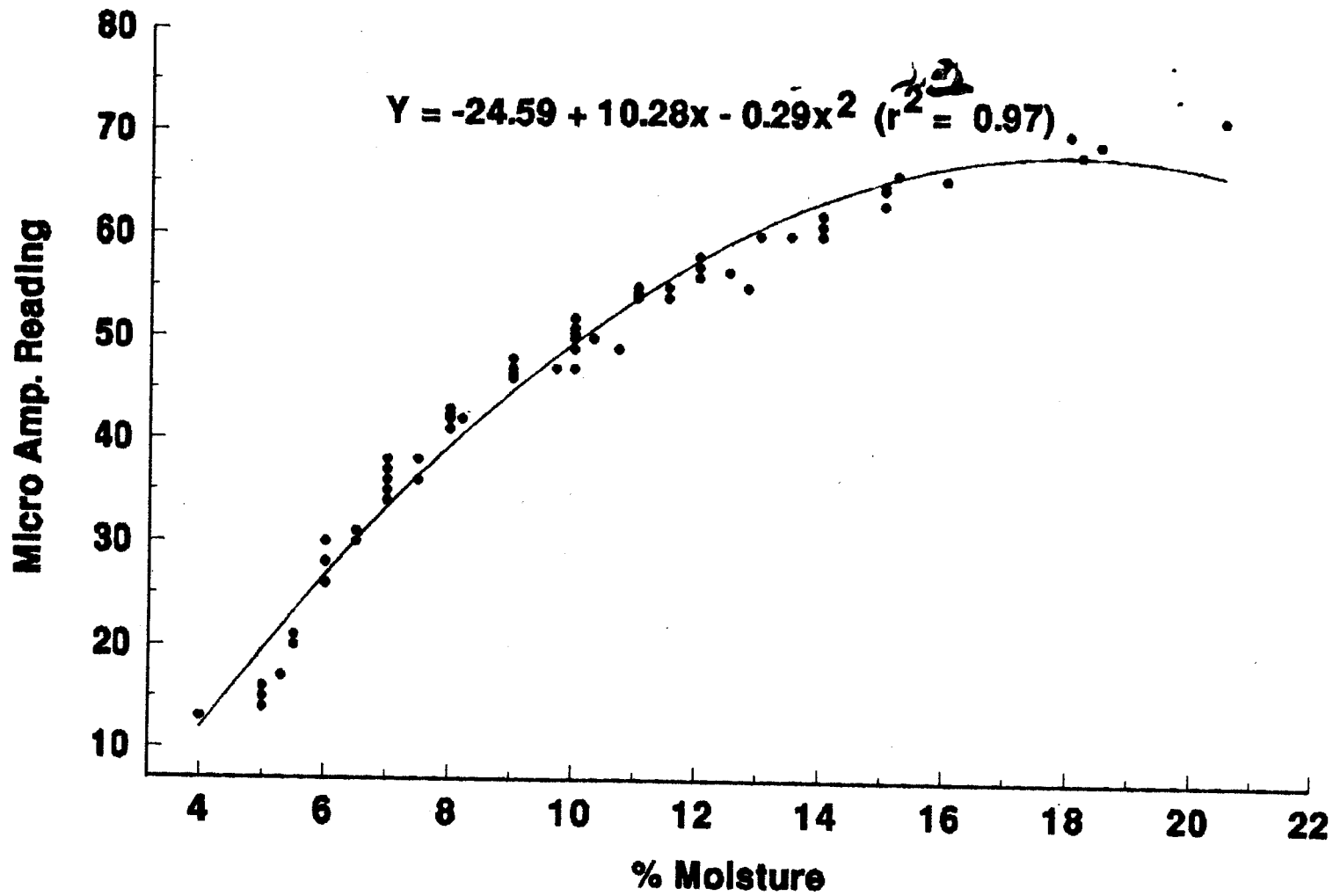


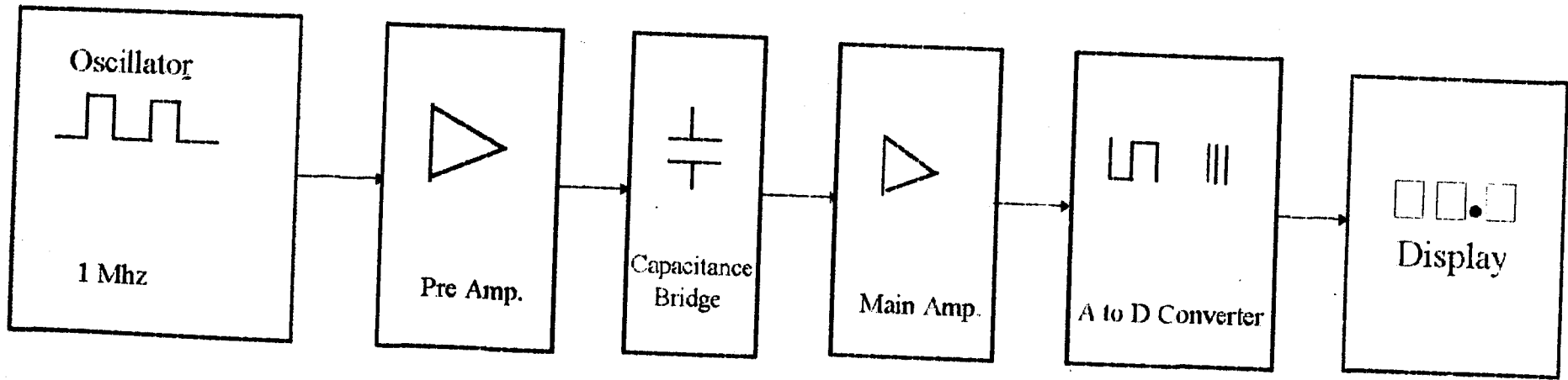
Fig.1 CASHEWNUT MOISTURE METER



CASHEWNUT MOISTURE METER [All dimensions in mm, Scale 1:2]

**Fig. 3. DEVELOPMENT OF MOISTURE METER**





**Block schematic of Cashew moisture meter**