

# TEMPERATURE CORRECTIONS IN JUICE POLARIZATION

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The method of calculating the uncorrected Brix of the composite of the four aliquot portions of mixed juice used for the determination of sucrose by the Jackson and Gillis method is given in the "Recommended Methods of Chemical Control" of the South African Sugar Technologists' Association (p. 27) as follows:—

"*Calculation.*—The four Brix determinations (uncorrected) of the composited aliquots are then averaged in proportion to the amount of juice taken. This figure is used as density of the average sample."

At some factories a variation of this is employed in which the temperature of the composite at the beginning of the analysis is taken, and this temperature is applied in a reverse direction to the weighted average of the corrected Brix.

The four aliquots are taken at different temperatures. Merging of the different temperatures and their adjustment to room temperature both occur. The final temperature is approximately room temperature but not necessarily the average of the original temperatures of the aliquots. The true uncorrected Brix is that which would be revealed by a Brix hydrometer placed in the composite, and not necessarily the average of the original uncorrected Brix readings. The difference may be quite marked at a time when atmospheric temperatures are altering appreciably, e.g. during the morning or evening shifts. The weighted average of the corrected Brix readings should give the true corrected Brix of the composite. The theoretically true uncorrected Brix of the composite would be found by taking its temperature and applying a reverse correction to the corrected Brix.

What is the correct figure to use for the Jackson and Gillis procedure? In order to answer this it is necessary to consider all the various temperatures which occur during the analysis.

**A.**—50 ml. of filtrate at  $t^{\circ}\text{C}$ . is pipetted into a 100 ml. flask, and made up to the mark at  $20^{\circ}\text{C}$ . (temperature of mixture). Polarization takes place at  $20^{\circ}\text{C}$ .

In this case the only error introduced is the effect of temperature on the weight of the 50 ml. of filtrate from the pipette. This can be corrected by applying to the corrected Brix the correction for the temperature of the composite at the time of polarization.

**B.**—50 ml. of filtrate at  $20^{\circ}\text{C}$ . is pipetted into a 100 ml. flask and made up to the mark at  $t^{\circ}\text{C}$ . Polarization takes place at  $20^{\circ}\text{C}$ .

In this case the mixture contains the correct weight of sucrose but not quite the correct weight of water; the temperature correction in this case should be in the reverse direction.

**C.**—50 ml. of juice at  $t^{\circ}\text{C}$ . is pipetted into a 100 ml. flask and made up to the mark at  $t^{\circ}\text{C}$ . Polarization takes place at  $20^{\circ}\text{C}$ .

In this case the normality of the mixture is correct. No temperature correction should be applied. Corrected Brix may be used. In point of fact, this is the same as uncorrected Brix, if the correction is made at the temperature of polarization.

**D.**—50 ml. of juice at  $t^{\circ}\text{C}$ . is pipetted into a 100 ml. flask and made up to the mark at  $t^{\circ}\text{C}$ . Polarization takes place at  $T^{\circ}\text{C}$ .

In this case the normality is correct, but the concentration in the saccharimeter tube is incorrect. This can be corrected by

using the temperature at the time of polarizing, when finding the uncorrected Brix.

A combination of all the above conditions can be considered:—

**E.**—50 ml. of juice at  $t^{\circ}\text{C}$ . is pipetted into a 100 ml. flask and made up to the mark at  $t^{\circ}\text{C}$ . Polarization takes place at  $T^{\circ}\text{C}$ .

In such a case the conversion of the Ventzke reading to percentage of sucrose would be

$$\text{Per cent. sucrose} = \frac{0.26V \times \text{s.g. } t}{\text{s.g. } t \times \text{s.g. } T}$$

This could be attained by adding together the temperature corrections corresponding with  $t^{\circ}$  and  $T^{\circ}$  and subtracting the correction corresponding with  $t^{\circ}$  and applying the difference to the corrected Brix (of course with sign opposite to that used for adjusting from uncorrected to corrected).

In actual practice  $t$  and  $T$  would usually be somewhere near room temperature, so that the conditions would be those of **D** and the temperature correction to be applied to the corrected Brix should be that of the solution at the time of polarization, not that at the commencement of the analysis, nor yet that resulting from an average of the original temperature. The weighted average uncorrected Brix is likewise not the correct figure to use.

So much for the Jackson and Gillis method. What of other methods of analysis?

In the case of direct analysis with Horne's dry lead  $t$  makes no difference;  $T$  does not arise. The reading is only affected by  $T$ . In our present practice we wrongly assume that  $T = t$ .

In the case of 100/110 dilution method  $t$  and  $T$  must be very nearly equal (since so little dilution occurs) and these cancel out. As before, the only relevant temperature is  $T$ .

In the normal weight method the temperature of the original juice does not affect the weight taken, and so the only temperature which has any effect is  $T$ .

It would thus appear that every reference to "uncorrected Brix" in the descriptions of methods of polarization should be substituted by "corrected Brix adjusted to the temperature of the solution, at time of polarization," for which I suggest the simple term "polarization Brix."

Mr. W. Buchanan has kindly provided me with the following comparison between the total crop sucrose in mixed juice at Empangeni as calculated when the temperature before inversion is used to find uncorrected Brix, and as calculated when the temperature at time of polarization is used, as suggested above.

Using temperature before inversion	...	51682.360 tons sucrose.
Using temperature at time of polarization	...	51660.860 tons sucrose.
Difference	...	<u>21.500</u>

The value of the above sucrose in terms of price of cane is about £130.

Unfortunately, I have no figures available to show the difference arising from the use of the procedure in the "Recommended Methods of Chemical Control."