FACTORY BALANCE SYMPOSIUM

DRY SOLIDS, SPINDLE AND REFRACTIVE BRIX DATA

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It was found that the difference between spindle and refractometer brix of final molasses was not constant during the crushing season but no explanation for this has been given. The difference between refractometer brix and dry solids was usually about three units, but the difference between spindle brix and dry solids which was much larger also varied considerably.

Experimental

Analyses of spindle and refractometer brix as well as of dry solids were carried out on weekly composite samples of final molasses over the 1969/70 season. Spindle brix and dry solids were determined by the methods given in the Laboratory Manual for South African Sugar Factories. Refractometer brix was measured on samples which had been diluted one to one by weight with distilled water and filtered through S & S type 613 filter paper using filter aid prior to taking the readings. All readings were made at 20° C.

Results and Discussion

The results of the spindle and refractometer brix measurements are shown in Figure 1. The spindle brix follows a general rise until week number 18 is reached after which it follows a general downward trend which levels off before the end of the season. The refractometer brix was more nearly constant but showed a rise towards the end of the season when attempts were being made in the factory to produce a higher brix final molasses. The difference between these two parameters is shown in Figure 2. This difference increased from the initial values of about 2.5 units to a maximum of more than seven units and finally decreased to three units at the end of the season. Consequently it is apparent that refractometer brix measurements may not be used

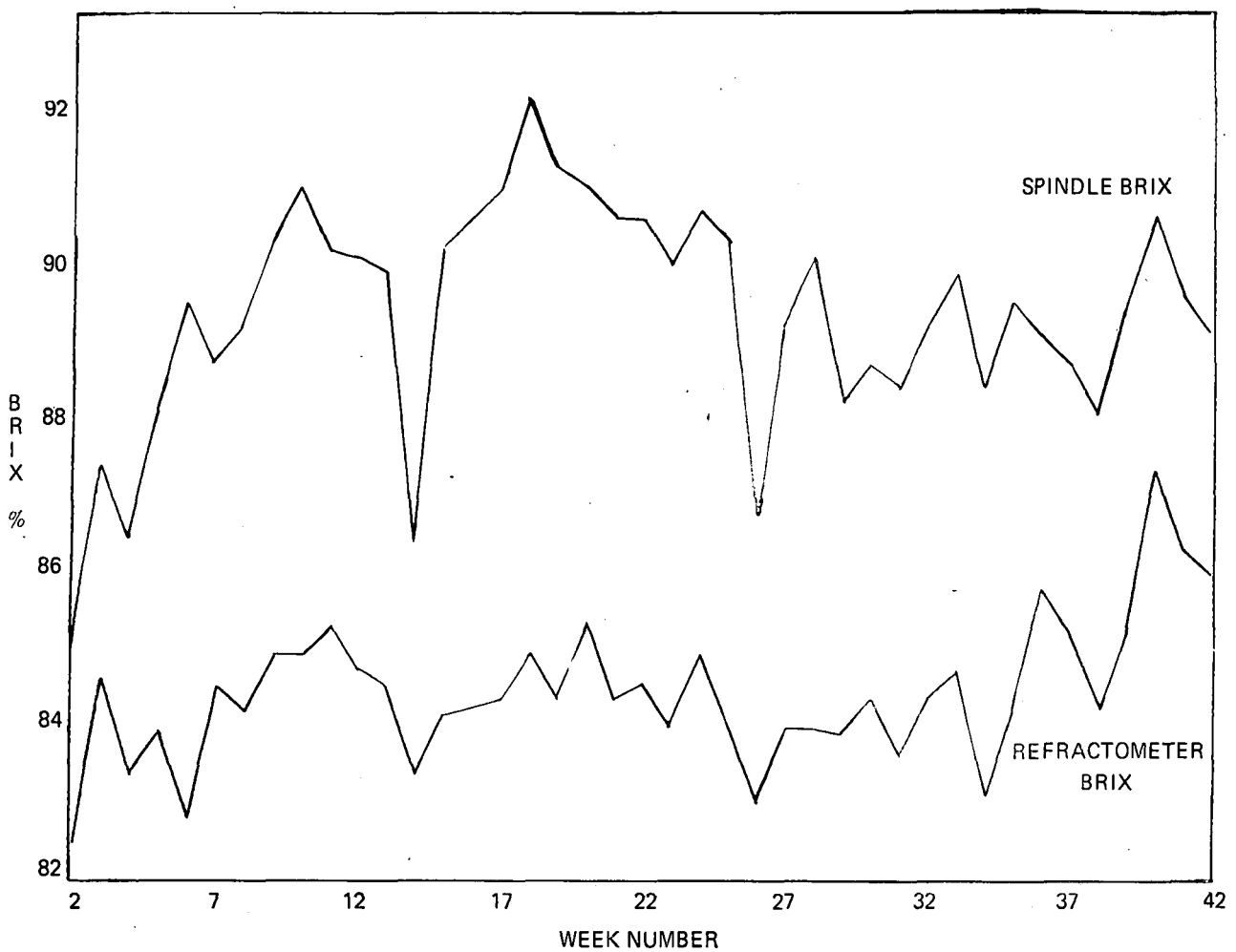

FIGURE 1: Spindle and refractometer brix measurements of final molasses for 42 weeks.

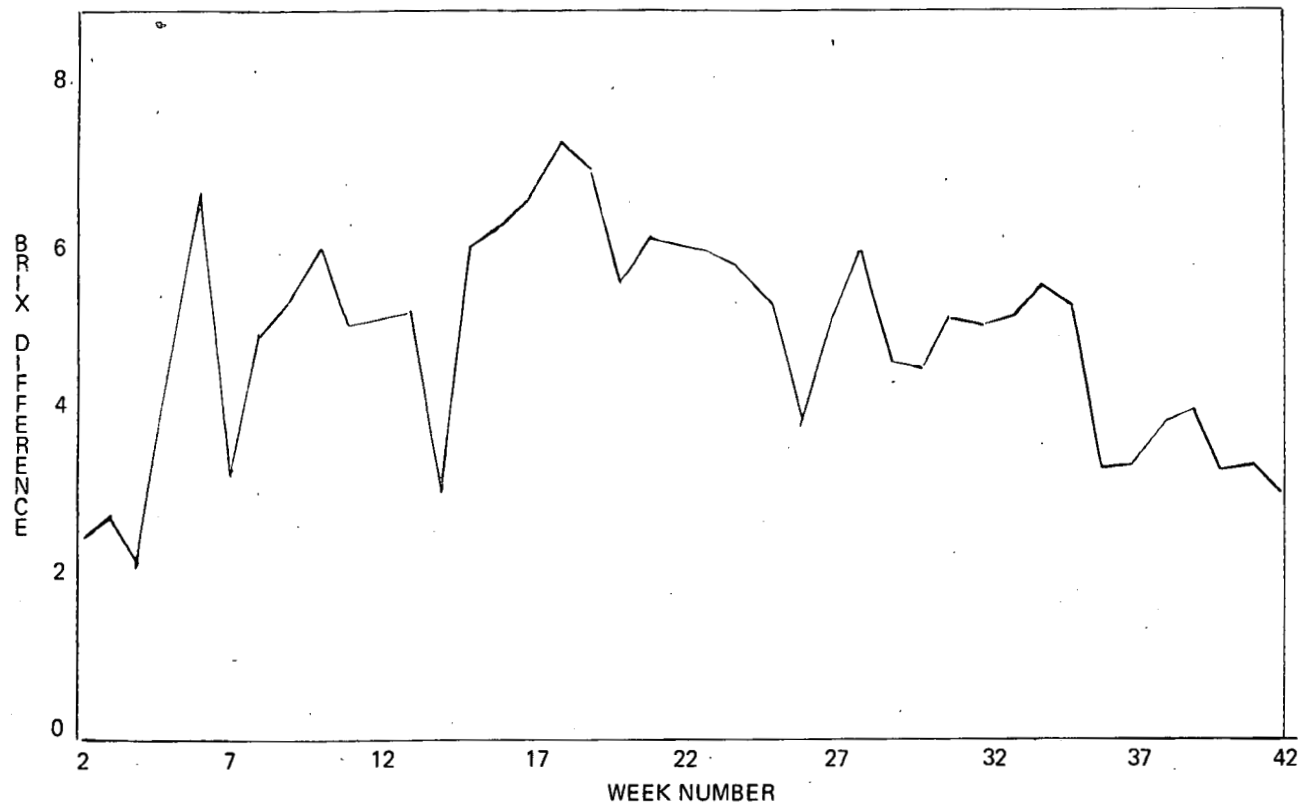

FIGURE 2: Difference between spindle and refractometer brix measurements for 42 weeks.

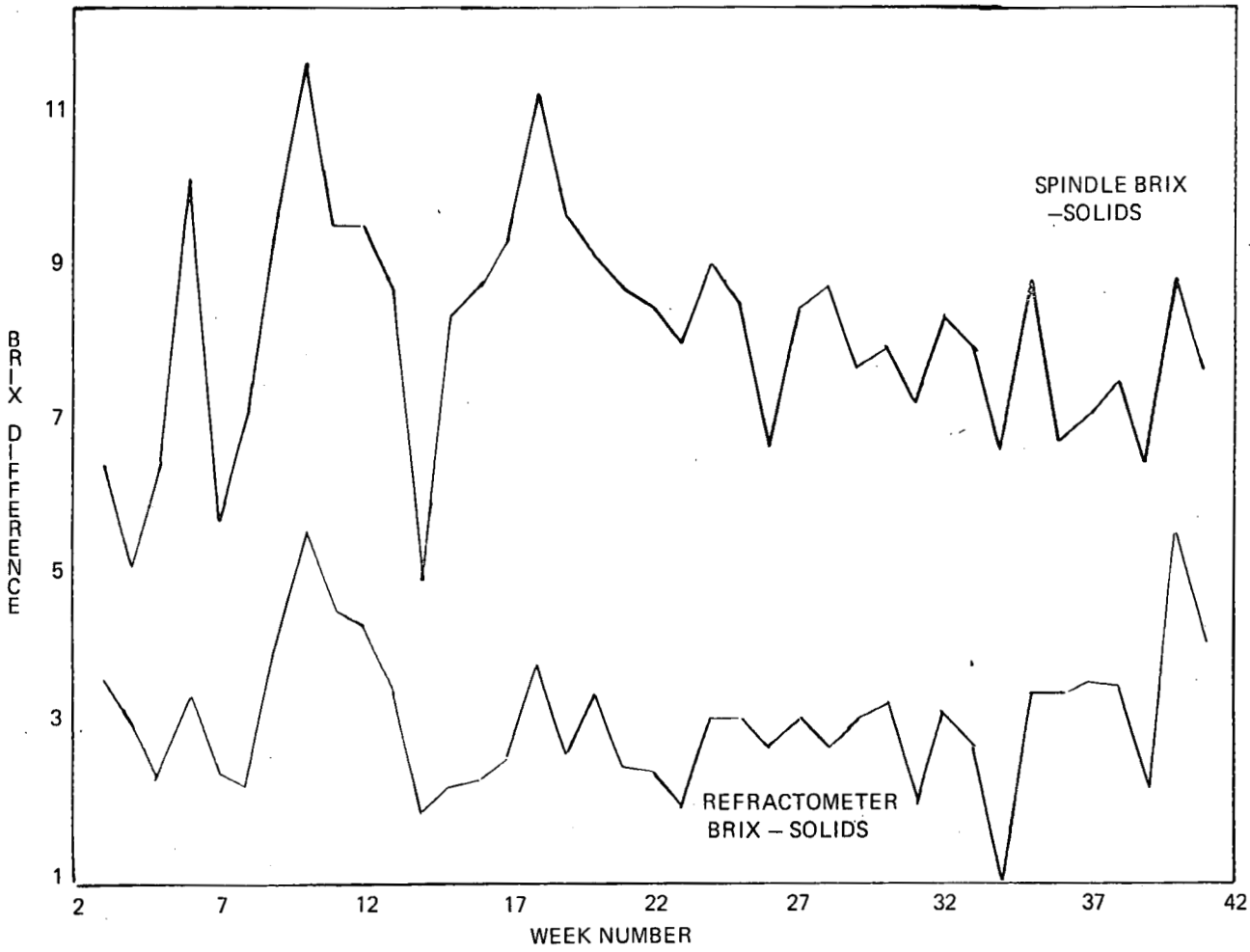

FIGURE 3: Spindle and refractometer brix compared with dry solids measurements for 42 weeks.

to control the brix of final molasses within specifications which are defined in terms of spindle brix.

Attempts have been made to relate the magnitude of the difference between spindle and refractometer brix with properties of the molasses such as purity, reducing sugars content, non-sugars content, etc., but no clear pattern has emerged.

Finally the brix data are compared with dry solids in Figure 3. Over a large part of the season the difference between refractometer brix and dry solids remained close to three units but the difference between spindle brix and dry solids was very much greater and also showed bigger variations in this difference.

Discussion

In the non-sucrose balance the non-sugar removal during clarification is normally not taken into account. However, it is considered that defecation is mainly a removal of suspended solids and that any removal of soluble non-sugars is negligible. For this reason a gap in the non-sucrose balance is most likely due to analytical errors, which are at present still unknown.

The reliability of our present data could be checked by applying the Monte Carlo technique, in which the actual data are compared with a randomly generated uniform distribution. If the practical results are of the same order as those obtained from the randomly generated distribution the results can be regarded as valueless.

Consideration should be given to whether the sucrose balance or the brix balance shows the greater inaccuracy. At present the latter is the most suspect, but research will be carried out into the isotope dilution method and the pol determinations will be compared with the sucrose value obtained by this new technique.

Recently the factory balances for brix and sucrose have been compared with the chloride balance. The chloride determination itself was considered sufficiently accurate by most investigators, but the largest errors are likely to be in the weighing and sampling of molasses. This has to be very reliable as 95% of the chloride ion leaves the factory in the molasses.

If the brix determinations are carried out by spindle measurement, the non-sucrose ratio is approximately 80%. Using the refractometer, which is considered to be more accurate, the value obtained drops to 70% and even lower when using dry solids determinations. This is a clear indication that the analytical methods are not fully reliable.

At the moment non-sucrose balances are related to mixed juice, but the values obtained will vary with the suspended matter. For this reason it might be decided in future to use only filtered mixed juice for analyses.

In reporting data, too many dedcimal places should not be given, particularly if the accuracy of the analysis is considered doubtful.

In connection with the syrup weighing at Empangeni there appear to be deviations of more than 1% between juice and syrup. These differences obviously cannot be explained by wrong stock taking and sampling errors are most likely.

If the non-sucrose ratio is expressed in terms of monetary value it can be stated that 1% absolute is equal to R0.08 per ton of sugar, which is high compared to bonuses or penalties for sugar quality, which are of the order of R0.02 per ton of sugar. For this reason more knowledge on the determination or meaning of the non-sucrose ratio is important. In Hulett's factories the figure varies between 67-89%.

According to Tate and Lyle, sucrose in molasses is on the average 3% absolute too high if compared with the C14 technique.

If this is correct the non-sucrose balance will improve, but the undetermined losses will increase.

Kestoses are dextra rotrary and show identical behaviours in acid and enzymic hydrolysis.

Inversion cannot be proved from reducing sugar ratio as this normally decreases during the process in the factory but other sucrose degradation might take place. It is, however, possible to determine the effect of retention time of juice on sucrose concentration or pol in laboratory experiments. This can be done under variable conditions of time, temperature and pH.

At Empangeni it was indicated that losses occurred after the syrup stage. For this reason more investigations have to be carried out into sucrose losses during boiling and crystallizing. In the refinery of Hulsar, A-massecuites showed a significant relation between the temperature at which the strike was dropped and the drop in purity of massecuite during crystallization. The same result was found at Jaagbaan for C-massecuite.

It is the opinion of Tate and Lyle Technical Services that a large part of the sucrose losses in South African factories takes place during the long retention of crystallized products.