EVALUATION OF THE PRESS METHOD FOR CANE ANALYSIS UNDER SOUTH AFRICAN CONDITIONS

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Abstract

Cane analysis by an inferential method using the press is described. Experiments conducted to assess the method have revealed certain limitations, more particularly the results obtained when there is a significant level of soil present in the cane samples. Variety, and whether the cane is trashed or burnt, also have influence on results.

Introduction

Small hydraulic presses have been in use in many laboratories to extract juice samples from cane. The first systematic attempt to use a hydraulic press for routine cane analysis appears to have been made by Tanimoto[8] in Hawaii when he compared the press and pol ratio methods.

Jamois[5] in Guadeloupe carried out considerable experimentation on the use of the hydraulic press in conjunction with a core sampler for cane analysis to be used for cane payment purposes. Work along the same lines was carried out in Reunion by Cazal[2] and Boyer de la Giroday[1] and finally by Hoarau[3, 4] who showed that the ratio of sucrose % absolute juice to sucrose % extracted juice was equal to the ratio of juice extraction to sucrose extraction.

Hoarau's work and his definition of the relationship between juice extraction and sucrose extraction improved the accuracy of cane analysis by the press method and led to its acceptance as the official method of cane analysis for payment purposes in Reunion and other countries. This led to an inferential method of analysis which only involved massing the press cake and analysis of the expressed juice.

The work carried out in Reunion has shown that fibre % cane, degree of cane preparation, pressure and time of application had a definite effect on the results obtained by the press method. The effect of other variables such as cane variety, trash and soil was not reported and it was considered necessary to have some information on their effect on cane analysis using the press. The Sugar Milling Research Institute acquired a Pinette Emidecau hydraulic press operating at 25 MPa to test the method under South African conditions where there is probably a larger variation in cane quality than in Reunion.

After initial tests at the Sugar Milling Research Institute, the press was transferred to the Tongaat sugar mill where the Sugar Industry Central Board (SICB) carried out analyses which encompassed the following aspects:

(*a*) Determination of pol, brix and fibre % cane by the analysis of both the extracted (press) juice and the bagasse (press cake) for pol and brix as well as the analysis of the press cake for moisture content.

(*b*) Investigation, using the above data, into the relationships necessary for obtaining pol, brix and fibre % cane solely from the press juice pol and brix data and the mass of the press cake, for all samples analysed as well as for the cane varieties encountered.

(*c*) Comparison of the cane analysis data obtained via the procedure described in (*a*) with that obtained via the direct analysis of cane procedure as described in the *Manual of Cane Sampling and Analysis for South African Sugar Factories.*[6]

(*d*) Investigation into the effect of soil and trash in cane.

(*e*) Investigation into the extent to which variations in degree of cane preparation affect results obtained by the press method of cane analysis.

Description of the inferential method of press analysis

A known mass of shredded cane is subjected to pressing in the hydraulic press — the time of pressing and pressure applied being specified. The press juice is collected and analysed for pol and brix per cent. The bagasse residue (press cake) is removed from the press and massed. From this data fibre, pol and brix per cent cane are calculated as follows:

Fibre % cane

Numerous analyses are carried out to establish a relationship between mass of press cake and fibre per cent cane. In each analysis the cane mass as well as the press cake mass are noted and the press cake analysed for moisture and brix from which fibre per cent is inferred. Fibre per cent cane is then calculated as follows:

$$\text{Fibre \% cane} = \frac{\text{Fibre \% press cake} \times \text{press cake \% cane}}{100}$$

Thereafter the cake mass and fibre % cane are related via linear regression analysis resulting in a general equation of the type

$$\text{Fc} = \text{a} + \text{b M} \qquad (1)$$

where a and b are constants and M = cake mass.

Pol % cane

With the fibre % cane available via equation (1) it is but a short step to calculate the absolute juice per cent cane. The next step necessary is to determine a relationship between pol per cent absolute juice and pol per cent press juice. With this relationship established it is then possible to calculate the pol per cent cane.

Use is again made of the analytical data obtained in the previous section to calculate the ratio of pol % absolute juice to pol % press juice (C factor) for each test. These calculations will show that the ratio is not a constant but, as shown by Hoarau, varies inversely with fibre % cane — it will also vary with cane preparation and pressure but these two variables are standardised. Thus the relationship between C and fibre % cane must first be established so as to allow the ready determination of the C factor for any fibre level encountered. Linear regression analysis is used to relate C factor to fibre % cane via an equation of the type

$$C = a - b\,Fc \qquad (2)$$

where a and b are constants and Fc = Fibre % cane.

Thus given the mass of the press cake and pol % press juice, the fibre % cane is first determined via equation (1); the corresponding C factor determined by equation (2) and pol % cane then calculated as follows:

$$\text{Pol \% cane} = \frac{C \times \text{Pol p j} \times (100 - Fc)}{100} \qquad (3)$$

$$\text{where } C = \frac{\text{Pol \% absolute juice}}{\text{Pol \% press juice}}$$

Pol p j = Pol % press juice

Fc = Fibre % cane.

Brix % cane

The same procedure as used for the pol % cane determination is used for the brix determination, so that instead of a C factor a C^1 factor — being the ratio of brix % absolute juice to brix % press juice — is established. Thereupon brix % cane is calculated as follows:

$$\text{Brix \% cane} = \frac{C^1 \times \text{Brix p j} \times (100 - Fc)}{100} \qquad (4)$$

$$\text{where } C^1 = \frac{\text{Brix \% absolute juice}}{\text{Brix \% press juice}}$$

Brix p j = Brix % press juice

Fc = Fibre % cane.

Apparatus

The hydraulic press used was a 45-ton Pinette Emidecau model O B 102. The maximum specific load on the material is 268 kg/cm² for a gauge pressure of 25 MPa. All other apparatuses used were standard items as described in the *Manual of Cane Sampling and Analysis for South African Sugar Factories.*

Experimental

General equations for relating press cake mass to fibre % cane, and fibre % cane to the C and C^1 factors

A sample of mill-prepared cane (i.e. sample taken from the mill carrier after passing the cane knives and mill shredder) was subjected to further preparation in the SICB shredder. From this sample of shredded cane, 1 000 g were massed and transferred to the perforated cylinder of the hydraulic press. A load of 268 kg/cm² was applied for 4 minutes. The press juice was collected and analysed for pol and brix — pol was determined via the Horne's dry lead method and brix determined refractometrically. For the latter determination samples were first filtered through a Whatman 6 paper in order to remove suspended matter.

The press cake was removed from the press and massed. Of this cake, 200 g were used with 2 000 g of water for cold digestion and the moisture content determined on the remainder of the cake. The extract from the cold digestion was analysed for pol and brix as described above. From the same sample of shredded cane as used for the press a further 1000 g and 300 g were used respectively for cold digestion and moisture determination as per the standard SICB method of analyses.

In all 104 samples were analysed in this way.

Investigation into the effect of soil and trash

A set of seven samples was analysed to determine more fully the effect of soil and trash. Sufficient whole stick cane from which all trash and tops had been removed was cut into 5 cm billets and then shredded to provide three sub-samples. To one sub-sample soil was added to constitute 5% by mass whilst to another dry trash was added to constitute 10% by mass. All three samples were given a further shredding before being subjected to the press procedure as described above; press juice and cake also being analysed as described before.

Investigation to determine the effect of variations in cane preparation

A set of ten samples was analysed to determine the effect of preparation of the cane. In this case, from a sample of mill-prepared cane, one sub-sample was pressed "as is", one sub-sample was shredded for one second before being pressed and a further sub-sample was shredded for five seconds before pressing. Analysis of press juice and cake was as described above. A further portion of the five-second shredded cane was analysed by direct analysis of cane procedures as described in the *Manual of Cane Sampling and Analysis for South African Sugar Factories.* In conjunction with the above analyses, the preparation index was determined on the three different preparation levels.

Results and Discussion

As mentioned earlier 104 samples were analysed in order to determine the relationships necessary for obtaining pol, brix and fibre % cane from the press cake mass and press juice analysis. In each case the press juice was analysed for pol and brix, the mass of the cake determined as well as pol, brix and moisture % cake using direct analysis of cane procedures. From these analyses the pol, brix and fibre % cane were computed as well as the equations necessary for obtaining this information solely from the press cake. In parallel with each of the above cane samples a second sample was analysed for pol, brix and fibre % cane via the SICB direct analyses of cane procedure. Average results of the press juice and cake analyses as well as the comparison of the two sets of pol, brix and fibre % cane data are shown in Appendix A.

Press cake mass versus fibre % cane

Regression equations relating press cake mass to fibre % cane (via fibre % press cake) were computed in respect of the total number of tests as well as for the two major cane varieties encountered, i.e. NCo 376 and N55/805 — the former being separated into trashed and burnt cane categories. Results are shown in Table 1 and plotted in Figure 1.

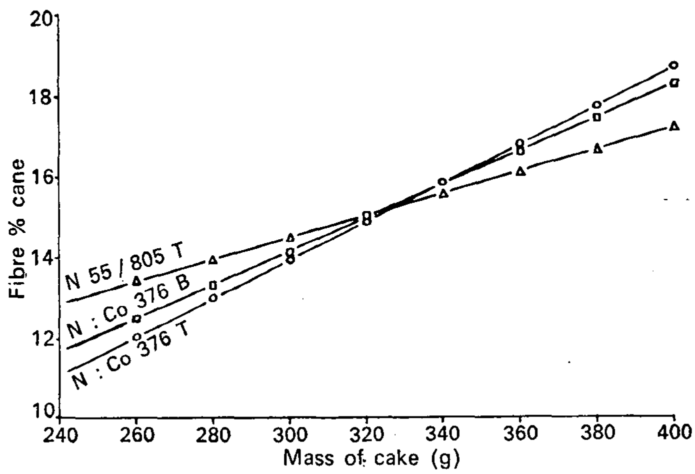

FIGURE 1 Mass of cake vs fibre % cane.

It is seen from Fig. 1 that there is similarity between the curves found for the trashed and burnt categories for NCo 376 but that the curve for N55/805 is dissimilar from those found for NCo 376. It has been found from a study of the press cake mass and fibre % press cake data that for NCo 376 the ratio of fibre % cake to press cake mass is constant while there is a distinct negative correlation in the case of the N55/805 variety, i.e. the fibre % press cake decreases with increase in press cake mass. In other words there is an increase in the juice to fibre ratio with increase in cake mass. A satisfactory explanation for this has still to be found.

Because of the variations in slope for the various cane categories there do appear to be limitations in the practical application of the press method.

Pol % press juice and pol % absolute juice

Regression equations relating the ratio of pol % absolute juice to pol % press juice (C factor) with fibre % cane were computed in respect of the various cane categories, and are indicated in Table 2 and plotted in Figure 2.

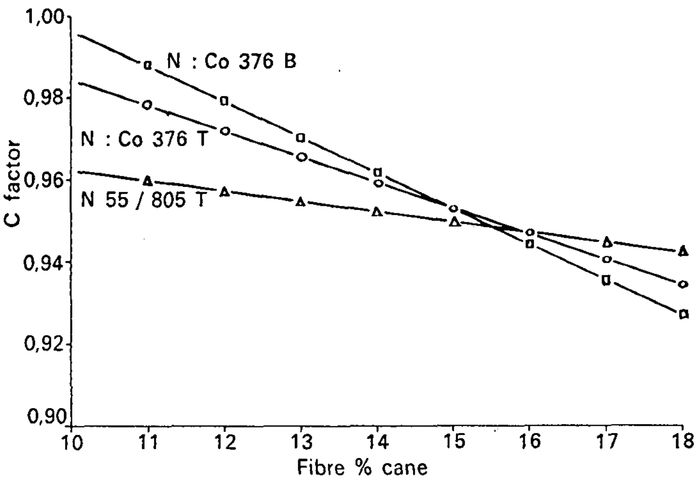

FIGURE 2 Fibre % cane vs. C factor.

The relationship between C and fibre % cane is inverse and this can be ascribed to two factors, i.e. the relationship pol % absolute juice to pol % undiluted juice and the relationship pol % undiluted juice to pol % press juice. Thus C can be expressed as follows:

$$C = \frac{\text{Pol \% absolute juice}}{\text{Pol \% undiluted juice}} \times \frac{\text{Pol \% undiluted juice}}{\text{Pol \% press juice}}$$

The finer the cane preparation and the higher the pressure applied the more nearly will the second factor approach unity and C therefore tend toward the relationship pol % absolute juice to pol % undiluted juice.

In the absence of fibre it is clear that C should be equal to unity, yet in Table 2 the intercept for all equations (except variety N55/805) is greater than unity. An explanation for the intercept found being greater than unity is that the relationship between C and fibre % cane is non-linear, and that in fitting a linear relationship in the fibre range encountered in the experiments there is an over-determination of the slope towards zero fibre. The relationship between the ratio of pol % absolute juice to pol % undiluted juice and fibre % cane is clearly non-linear and it is unlikely that the ratio of pol % undiluted juice to pol % press juice increases with fibre % cane. Hence the deduction of a non-linear relationship.

For the twenty N55/805 results there is effectively no correlation between C factor and fibre % cane and this matter requires further investigation. A very real problem in the case of N55/805 and to a lesser extent for NCo 376 has been the limited fibre range encountered in the tests and it is felt that this has contributed to the low correlations.

As in the case of the relationship between press cake and fibre % cane there are variations in the slope for various cane categories and again this does appear to impose a limitation on the practical implementation of the press method.

TABLE 1

Variety	n	Fibre % cane (± SD)	Regression equation	Corr. Coefficient	Standard error of regression esimate
All samples . . .	104	15,45 (± 1,64)	Fc = 1,48 + 0,0420M	0,92	± 0,63
NCo 376 T . . .	51	15,82 (± 1,86)	Fc = – 0,37 + 0,0477M	0,94	± 0,61
NCo 376 B . . .	14	14,26 (± 1,72)	Fc = 1,70 + 0,0415M	0,94	± 0,57
N55/805 T . . .	22	15,67 (± 0,89)	Fc = 6,42 + 0,0270M	0,81	± 0,52

T = Trashed cane SD = Standard Deviation M = Mass press cake
B = Burnt cane Fc = Fibre % cane n = number of tests

TABLE 2

Variety	n	Fibre % cane (± SD)	Regression equation	Corr. Coefficient	Standard error of regression estimate
All samples . . .	104	15,45 (± 1,64)	C = 1,0508 – 0,006543 Fc	– 0,69	± 0,011
NCo 376 T . . .	51	15,82 (± 1,86)	C = 1,0456 – 0,006181 Fc	– 0,75	± 0,010
NCo 376 B . . .	14	14,26 (± 1,72)	C = 1,0822 – 0,008601 Fc	– 0,82	± 0,010
N55/805 T . . .	22	15,67 (± 0,89)	C = 0,9865 – 0,002499 Fc	– 0,18	± 0,012

T = Trashed cane SD = Standard Deviation $C = \frac{\text{Pol \% absolute juice}}{\text{Pol \% press juice}}$
B = Burnt cane Fc = Fibre % cane n = number of tests

TABLE 3

Variety	n	Fibre % cane (± SD)	Regression equation	Corr. Coefficient	Standard error of regression estimate
All samples . . .	104	15,45 (± 1,64)	$C^1 = 1,050 - 0,00412$ Fc	– 0,35	± 0,018
NCo 376 T . . .	51	15,82 (± 1,86)	$C^1 = 1,070 - 0,00509$ Fc	– 0,44	± 0,020
NCo 376 B . . .	14	14,26 (± 1,72)	$C^1 = 1,048 - 0,00433$ Fc	– 0,40	± 0,017
N55/805 T . . .	22	15,67 (± 0,89)	$C^1 = 0,995 - 0,00101$ Fc	– 0,07	± 0,013

T = Trashed cane
B = Burnt cane
SD = Standard Deviation
Fc = Fibre % cane
$C^1 = \frac{\text{Bx \% absolute juice}}{\text{Bx \% press juice}}$
n = number of tests

TABLE 4

	Press juice			Press cake					
	Pol	Brix	Purity	Mass	Pol	Brix	Moist.	Fibre	Purity
Clean	19,00	21,13	89,9	250 g	7,31	9,16	46,22	44,60	79,8
Soil (5%)	18,97	21,11	89,9	277 g	6,08	7,75	37,20	55,07	78,5
Trash (10%)	19,07	21,61	88,2	395 g	7,38	10,07	44,15	45,73	73,3

	Cane (press juice + cake)					Cane (theoretical)				
	Pol	Brix	Moist.	Fibre	Purity	Pol	Brix	Moist.	Fibre	Purity
Clean	16,07	18,13	70,59	11,28	88,6	16,07	18,13	70,59	11,28	88,6
Soil (5%) . . .	15,40	17,41	67,35	15,24	88,5	15,27	17,23	67,05	15,72	88,6
Trash (10%) . .	14,45	17,05	64,93	18,02	84,8	14,46	16,32	64,73	18,95	88,6

	Fibre % cane	C factor	C^1 factor
Clean	11,28	0,953	0,967
Soil (5%) . . .	15,24	0,958	0,973
Trash (10%) . .	18,02	0,924	0,962

Brix % press juice and brix % absolute juice

Low correlations were found between the ratio of brix % absolute juice to brix % press juice (C^1 factor) and fibre % cane. These are listed in Table 3 above.

This relationship is discussed further in the next section.

Influence of extraneous material

Average results of a limited number of tests (7) to determine the influence of soil and trash are presented above in Table 4. Individual results are shown in Appendix B.

Sufficient soil and trash (dry leaves) were added to sub-samples of shredded clean (trash-free) cane to constitute 5% of soil and 10% of trash in the respective sample. (All cane samples, i.e. clean, with soil and with trash, were subsequently re-shredded before analysis.)

The soil added to the cane was analysed for moisture and water solubility with the following results:

Soil type	% Moisture	% Water solubility
Fernwood	0,3	1,0

The dry leaves used for the trash addition were analysed for moisture content only with the following result:

Trash type	% Moisture
Dry leaves	12,0

With the above analytical data as well as that for the clean cane samples it was possible to calculate theoretical results for those samples to which soil and trash had been added and compare them with actual.

The average C factors and C^1 factors were calculated from the analytical data and are also shown. Individual sample factors are reflected in Appendix B.

Some of the points to note from a study of the data in Table 4 are the following:

(*a*) The press cake moisture for the sample with soil is substantially lower than the moisture recorded by either of the other two samples (clean cane and cane with trash).

(*b*) The moisture % press cake for the sample with trash is also lower than the clean cane sample, but to a much smaller degree than the sample with soil.

(*c*) The extent to which soil is washed out of the press cake into the press juice must be quantified.

(*d*) The fibre % cane figure recorded for the sample with trash is persistently lower than the theoretical fibre % cane.

(*e*) The C and C^1 factors for the cane sample containing soil are higher than those for the clean cane sample despite the former sample being associated with a fibre % cane considerably in excess of the latter sample.

(*f*) The cane sample with trash has a C^1 factor only marginally lower than the clean cane samples despite a fibre difference of nearly 7 units.

These points are discussed below.

Variations in moisture % press cake levels and the relevance this has to fibre % cane determination

Further tests were conducted to confirm the trends indicated in Table 4. In these additional analyses the same quantities of soil and trash were added as before but only the mass and moisture content of the press cake were determined. The average moisture figures for all samples including those used for the Table 4 data are given below in Table 5.

TABLE 5
Moisture % press cake

Moisture %					
Clean cane	Cane + extraneous matter	Diff.	SD	SE	n
42,72	36,94 (soil)	5,78	± 2,85	± 0,59	23
44,48	44,30 (trash)	0,18	± 3,14	± 0,91	12

It is seen that for soil there is confirmation of the trend indicated in Table 4 but in the case of trash there is seemingly little or no effect on the press cake moisture. However the results for the samples with trash must be treated with caution since in the second run of 5 comparisons all the trash sample moistures were higher than those of the clean cane samples, which is a reversal of the trend found in the first run of 7 comparisons. Thus although the overall result indicates that the addition of trash has virtually no effect on the press cake moisture this aspect requires further work before a definite conclusion can be drawn in this regard.

Returning to the sample containing soil, a twofold reason is put forward for the low moisture of the press cake:

(*a*) The soil added to the cane sample contained virtually no moisture, i.e. either as surface, absorbed or bonded as brix-free water.

(*b*) The juice to insoluble matter ratio is lower in the press cake with soil than in the clean cane press cake. Less juice is retained in the cake per unit of soil than is retained per unit of vegetable fibre.

It is clear that under these conditions, i.e. in the presence of soil, the ratio of press cake mass to fibre % cane varies significantly from that for clean cane or cane with trash and hence any simple formula which merely relates press cake mass to fibre % cane as a fixed ratio or near to a fixed ratio does not hold for all conditions.

Returning to the data in Table 4 it is seen that a formula Fibre % Cane = 0,0455 × Mass cake satisfies the average situation for both the clean cane and cane with trash samples but under-determines the fibre % cane for the sample with soil by 2,64 units (refer to Table 6).

TABLE 6

Sample	Mass cake (g)	Fibre % cane		
		Derived (Fc = 0,0455M)	Analysed	Diff
Clean . .	250	11,38	11,28	+ 0,10
Soil . .	277	12,60	15,24	− 2,64
Trash . .	395	17,97	18,02	− 0,05

Since there is no simple and rapid method for determining the amount of soil in order to correct for its presence, it appears that the method for determining fibre % cane by the application of a ratio to the cake mass is limited to situations where all cane delivered to the mill has little or no soil present. Where this latter condition does not obtain it is necessary to go a step further than the mere determination of cake mass and also to determine the moisture % press cake for all samples. With this additional information it is possible to determine a fibre % cane using the method according to Tanimoto. Essentially this procedure assumes that the total moisture in the press cake belongs to the residual juice and that the residual juice has a brix concentration equal to that of the extracted or press juice — this implies no brix-free water. Any difference between press and residual juice brix will also introduce an error although this is likely to be small with finely-prepared cane.

Using the data in Table 4 the fibre % cane as determined by the SICB indirect method is compared in Table 7 with the Tanimoto fibre. The fibre derived by the application of a constant factor to the press cake mass is also included for comparison.

TABLE 7

Sample	Mass cake (g)	Fibre % cane		
		(Fc = 0,0455M)	Tanimoto method	SICB method
Clean . .	250	11,38	10,45	11,28
Soil . .	277	12,60	14,64	15,24
Trash . .	395	17,97	17,25	18,02

M = Mass cake

Because of the assumption of no brix-free water the Tanimoto fibre % cane is under-determined and it will be necessary to correct this by means of a factor relating all the individual fibre determinations to a master fibre % cane as obtained via the summation of the fibre present in final bagasse and mixed juice. However there is still the problem that the percentage error via the Tanimoto method is not uniform, indications being that it is the greatest for clean cane.

Removal of soil in the press cake by the press juice

The press juices obtained from clean cane and for the same cane but to which soil had been added to constitute 5% of the total mass were each analysed *in toto* for insoluble solid content according to the method published by Prince.[7] Twenty such comparisons were carried out, and in all the same soil, i.e. Fernwood sand, was used. The increase in insoluble solids content found in the press juice obtained from the cane sample with soil was attributed to loss of soil from the press cake. Results are given in Table 8.

TABLE 8
Insoluble solids % press juice

Insoluble solids % press juice					
Cane + soil	Clean cane	Diff	SD	SE	n
0,48	0,25	0,23	± 0,10	± 0,02	20

Based on a cane sample mass of 1 000 g and an average press cake mass of 315 g the mass of press juice by difference is given as 685 g. On this mass, an increase in insoluble solids content of 0,23 units % will account for a reduction in fibre % cane by 0,158 units. This loss is not excessive or of particular significance but more work is required for different soil types.

Influence of soil and trash on the C and C^1 factors

In Table 4 average C and C^1 factors are shown for the three categories of cane quality, i.e. clean cane, cane with 5% soil and cane with 10% of dry leaves. It is seen that relative to the factors recorded for the clean cane sample, the sample with soil has C and C^1 factors that are too high for the fibre % cane figures concerned. Furthermore the C^1 factor for the cane sample with trash also appears to be too high.

In the case of the cane samples with soil the elevation in factor level can be explained by the fact that the soil contained no brix-free water. As a consequence the pol % absolute juice (and pol % cane) will be higher for the sample with soil than for a sample of the same fibre % cane content but in which all of the fibre is vegetable fibre capable of containing brix-free water. This is illustrated in the example below which assumes that vegetable fibre in the cane contains 25% brix-free water.

	Sample without soil	Sample with soil
Pol % undiluted juice	18,71	18,71
Vegetable fibre % cane	15,24	10,78
Soil % cane	—	4,46
∴ Fibre % cane	15,24	15,24

Sample without soil

$$\text{Pol \% absolute juice} = \frac{18{,}71 \times (100 - 1{,}25 \times 15{,}24)}{(100 - 15{,}24)} = 17{,}87$$

$$\text{Pol \% press juice} = 19{,}00$$

$$\therefore \text{C factor} = \frac{17{,}87}{18{,}71} \times \frac{18{,}71}{19{,}00} = 0{,}941$$

Sample with soil

$$\text{Pol \% absolute juice} = \frac{18{,}71 \times (100 - 1{,}25 \times 10{,}78 + 4{,}46)}{(100 - 15{,}24)} = 18{,}12$$

$$\text{Pol \% press juice} = 19{,}00$$

$$\therefore \text{C factor} = \frac{18{,}12}{18{,}71} \times \frac{18{,}71}{19{,}00} = 0{,}954$$

The above has therefore shown that the presence of soil can result in significant variation in C factor level from that recorded for cane of the same fibre % level but in which soil is absent. Similar reasoning to the foregoing can be used to explain the elevated C^1 factor for the cane sample with soil.

In so far as the cane sample with trash is concerned it is seen (Table 4) that despite the large fibre % cane difference from the clean cane sample, there is very little difference in C^1 factor levels. A possible explanation is that the brix present in the trash is extracted with greater difficulty than the brix present in the rest of the cane. Consequently for the sample with trash the press juice brix will be lower than the undiluted juice brix to a greater extent than would obtain (if at all) for clean cane. Therefore the ratio of brix % undiluted juice to brix % press juice (and in turn the C^1 factor) will be higher for the sample with trash than for the corresponding clean cane sample with the same fibre % cane level.

However there is another possible explanation and this may be linked to the influence of suspended matter on the refractometric brix determination. Particularly in the case of the samples with trash, the filtrates appeared cloudy and the presence of suspended matter may have introduced a high percentage error at the low levels of brix — approximately 1 unit — encountered in the analysis of the press cake.

Thus further work is necessary to determine whether the elevation of the C^1 factor in the presence of trash is due to poorer extraction of trash brix or due to limitations of present analytical methods. Indication that it may be due to the latter is given by a study of the data in Appendix A in which pol, brix and fibre % cane were determined in 104 samples via two avenues, i.e.:

(*a*) analysis of press juice and press cake for pol and brix (press cake analysis via cold digestion) with the press cake being further analysed for fibre (indirect method);

(*b*) analysis of a duplicate cane sample by the standard SICB procedure.

It is seen from the comparison that there is a definite bias in the brix determination with that determined via procedure (*a*) above being the higher — lending support to the contention that there could well be over-determination of the press cake brix.

Whatever the reason for the trash elevating the C^1 level it is clear that this has contributed to the poor correlations found between C^1 and fibre % cane. Any soil present in cane samples will also upset the correlations both for C and C^1.

The effect of cane preparation

Average results of 10 tests, each consisting of a comparison of the press results on mill-prepared cane, mill-prepared cane plus an additional one-second shredding and finally mill-prepared cane plus five seconds shredding, are given below.

As anticipated the press cake mass for the sample with mill preparation alone is higher than that of the cane subjected to a further five seconds shredding. The rise of press juice pol and brix with increased cane preparation must be viewed in the light of parallel increase in the cane pol and brix data — the cane data being obtained via complete analysis of the press cake and the press juice. There clearly has been moisture loss

TABLE 9

	Mass cake (g)	Fibre % cane (Fc = 1,48 + 0,042M)	Press juice		Cane		
			Pol %	Brix %	Pol %	Brix %	Fibre %
(i) Mill preparation	336	15,59	15,14	17,44	12,20	14,68	14,75
(ii) Mill + 1 sec. shredding	335	15,55	15,23	17,58	12,28	14,78	14,98
(iii) Mill + 5 secs. shredding	326	15,17	15,30	17,82	12,31	14,87	15,09
Mean Diff.							
(i)–(iii)	10	0,42	− 0,16	− 0,38	− 0,11	− 0,19	− 0,34
Standard Deviation	± 12,6	± 0,56	± 0,21	± 0,19	± 0,22	± 0,28	± 0,52
Standard Error	± 4,0	± 0,18	± 0,07	± 0,06	± 0,07	± 0,09	± 0,16

due to evaporation during the shredding operation and this will account for the trend of the press juice pol and brix to rise with increased preparation.

Tests conducted at two factories have shown the increase in preparation index after 5 seconds of laboratory shredding to be approximately 9 units, whereas the average variation between samples at a particular mill is just over 1 unit. Average results of the preparation index analyses at the two mills concerned are given below in Table 10.

TABLE 10

Mill	n	Preparation index				P.I. Diff. (Shredder-Mill)
		Mill	SD	Shredder	SD	
A	7	88,3	± 2,9	96,7	± 1,3	8,4
B	5	86,2	± 0,7	95,6	± 1,0	9,4

On the basis of the results shown in Tables 9 and 10 it is concluded that the extent of the variations in preparation encountered after sample shredding at a particular mill and the effect this will have on the press results is not of a magnitude sufficient to give rise to concern. However on an inter-mill basis variations in preparation index can be large and hence press fibres will not be comparable unless the fibres at each mill are first related to a master mill balance fibre determined at each mill. Alternately use of a device such as a Jeffco cutter-grinder in place of the laboratory shredder would largely eliminate variations in preparation index, both intra and inter mill.

Conclusion

Whilst there is attraction in the simplicity and ease of operation of the inferential press method of analysis, this investigation has revealed certain limitations, namely,

(*a*) the errors which are introduced when there is soil present in the cane sample;

(*b*) the variation, between different categories of cane, in the relationships necessary to calculate pol and fibre % cane from press juice and cake mass data;

(*c*) the poor correlation between C^1 and fibre % cane although this aspect needs further investigation in view of the possibility of the poor correlation being due to limitations in the refractometric brix determination rather than the press method in itself.

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APPENDIX A

Press juice and press cake analysis

n		Press juice			Press cake				
		Pol %	Brix %	Purity	Mass	Pol %	Brix %	Purity %	Fibre %
104		15,09	17,56	85,93	333 g	6,14	8,77	70,01	46,40
	SD	± 1,63	± 1,63	± 2,90	± 36 g	± 0,62	± 0,92	± 5,72	± 1,95

SD = Standard Deviation n = number of tests

Cane analysis

	n	Pol %	Brix %	Purity	Fibre %
Press juice + cake		12,11	14,63	82,78	15,45
DAC		12,09	14,44	83,73	15,64
Diff.	104	+ 0,02	+ 0,19	− 1,05	− 0,19
SD		± 0,22	± 0,44	± 2,08	± 1,26
SE		± 0,02	± 0,04	± 0,20	± 0,12

DAC = Direct analysis of cane by SICB method n = number comparisons SD = Standard Deviation SE = Standard Error

APPENDIX B

Analysis of cane samples with and without extraneous matter. For the soil and trash (dry leaf) samples sufficient of each were added to sub-samples of shredded clean (trash-free) cane to constitute 5 and 10 per cent respectively of the sub-sample mass.

	Press juice			Press cake						Press cane				
	Pol	Brix	Purity	Mass	Pol	Brix	Moist.	Fibre	Purity	Pol	Brix	Moist.	Fibre	Purity
(1) Clean	19,35	21,01	91,8	253	8,04	9,08	46,18	44,70	88,5	16,49	18,04	70,65	11,31	91,4
(1) Soil	19,28	20,94	92,1	278	7,02	8,26	38,48	53,25	85,0	15,87	17,41	67,76	14,83	91,2
(1) Trash	19,40	21,37	90,8	391	6,99	9,49	44,68	45,77	73,7	14,55	16,72	65,38	17,90	87,0
(2) Clean	19,39	21,31	91,0	246	7,52	9,51	46,80	43,63	79,1	16,47	18,41	70,12	11,47	89,5
(2) Soil	19,44	21,34	91,1	281	6,53	8,60	39,80	51,59	75,9	15,81	17,76	67,74	14,50	89,0
(2) Trash	19,63	21,88	89,7	396	8,05	10,76	45,18	43,93	74,8	15,05	17,48	65,12	17,40	86,1
(3) Clean	19,90	21,61	92,1	244	7,52	9,09	46,94	43,97	82,7	16,87	18,55	70,70	10,75	90,9
(3) Soil	19,81	21,55	91,9	266	6,18	7,42	36,91	55,73	83,3	16,19	17,80	67,44	14,80	91,0
(3) Trash	19,80	22,03	89,9	389	8,13	10,32	43,68	45,89	78,8	15,26	17,47	64,68	17,85	87,3
(4) Clean	18,42	20,46	90,0	240	7,13	9,54	48,77	41,64	74,7	15,70	17,83	72,16	10,01	88,1
(4) Soil	18,32	20,40	89,8	260	5,56	7,00	36,53	56,56	79,4	15,00	16,91	68,36	14,73	88,7
(4) Trash	18,30	20,80	88,0	345	6,43	9,03	40,92	50,01	71,2	14,21	16,74	66,01	17,25	84,9
(5) Clean	19,17	21,61	88,7	263	7,32	9,09	47,12	43,79	80,5	16,05	18,32	70,16	11,52	87,6
(5) Soil	19,14	21,61	88,6	288	6,30	8,57	37,05	54,38	73,5	15,44	17,85	66,49	15,66	86,5
(5) Trash	19,39	22,12	87,7	412	7,73	10,76	44,79	44,45	71,8	14,59	17,44	64,25	18,31	83,7
(6) Clean	19,76	22,15	89,2	246	7,30	9,49	45,16	45,35	76,9	16,68	19,03	69,82	11,15	87,7
(6) Soil	19,73	22,09	89,3	270	5,76	7,82	35,05	57,13	73,7	15,95	18,23	66,35	15,42	87,5
(6) Trash	19,71	22,65	87,0	412	7,84	11,08	45,58	43,45	70,8	14,81	17,87	64,23	17,90	82,9
(7) Clean	17,01	19,73	86,2	260	6,34	8,31	42,55	49,14	76,3	14,23	16,76	70,46	12,78	84,9
(7) Soil	17,05	19,82	86,0	295	5,25	6,59	36,56	56,85	79,7	13,57	15,92	67,31	16,77	85,2
(7) Trash	17,23	20,40	84,5	419	6,46	9,06	44,31	46,59	71,2	12,72	15,65	64,83	19,52	81,3
Average														
Clean	19,00	21,13	89,9	250,3	7,31	9,16	46,22	44,60	79,8	16,07	18,13	70,59	11,28	88,6
Soil	18,97	21,11	89,9	276,9	6,08	7,75	37,20	55,07	78,5	15,40	17,41	67,35	15,24	88,5
Trash	19,07	21,61	88,2	394,9	7,38	10,07	44,15	45,73	73,3	14,45	17,05	64,93	18,02	84,8

	C factors			C[1] factors		
	Clean	Soil	Trash	Clean	Soil	Trash
(1)	0,961	0,966	0,914	0,965	0,976	0,953
(2)	0,959	0,951	0,928	0,976	0,973	0,967
(3)	0,950	0,959	0,938	0,962	0,969	0,965
(4)	0,947	0,960	0,938	0,968	0,972	0,973
(5)	0,946	0,956	0,921	0,958	0,979	0,965
(6)	0,950	0,956	0,915	0,967	0,976	0,961
(7)	0,959	0,956	0,917	0,974	0,965	0,953
Mean	0,953	0,958	0,924	0,967	0,973	0,962