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DIFFUSION IN SOUTH AFRICA

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ABSTRACT

The cane sugar diffusion process in South Africa is reviewed. Topics discussed include research, diffuser operation, maintenance and running costs, and the effect of diffusion on boiling house performance.

INTRODUCTION

At the end of 1973 there were 6 diffusers in industrial operation in South Africa and a seventh very large unit on order for commissioning in 1974. Thirty per cent of South African mills are therefore dependent on diffusion for sugar extraction, handling approximately 25% of the crop harvested. The fact that, since 1966 when the first 2 diffusers were installed, only 2 new milling units have been installed, both to work in conjunction with diffusers, illustrates the trend away from conventional milling.

This preference for diffusion is due mainly to the higher capital and maintenance cost of mills required to acheive the same extraction. Various factors have limited up to now the choice of diffuser to the bagasse type but a large cane diffuser is on order and this will probably be the future trend.

Research on the diffusion process was started in South Africa well before the introduction of industrial diffusers. It was then aimed at understanding the mechanism of diffusion and more work has been done in this field in recent years. Industrial experience with diffusers has also stimulated research into the effect of this process on juice quality and boiling house work.

The purpose of this paper is to review this work and to summarise the experience gained with the operation of diffusers in South Africa.

TYPES OF DIFFUSERS AND THE MECHANISM OF DIFFUSION

The 7 diffusers operating or on order in South Africa are of the following makes:

BMA at Union Co-op (1966) and Empangeni (1967)
De Smet at Entumeni (1966) and Malelane (1967)
Saturne at Umfolozi (1971)
FS (van Hengel System) at Pongola (1973)
Huletts at Amatikulu (1974)

A schematic representation of the position of these units in their respective extraction plants is given in Fig. 1 and this diagram also gives an idea of the preparation and dewatering equipment used in each case.

Descriptions of most of these diffusers are available in the literature or in trade publications and this aspect will not be covered in this paper, nor will engineering details which may influence the performance of the machines but do not affect basic design or principles of operation.

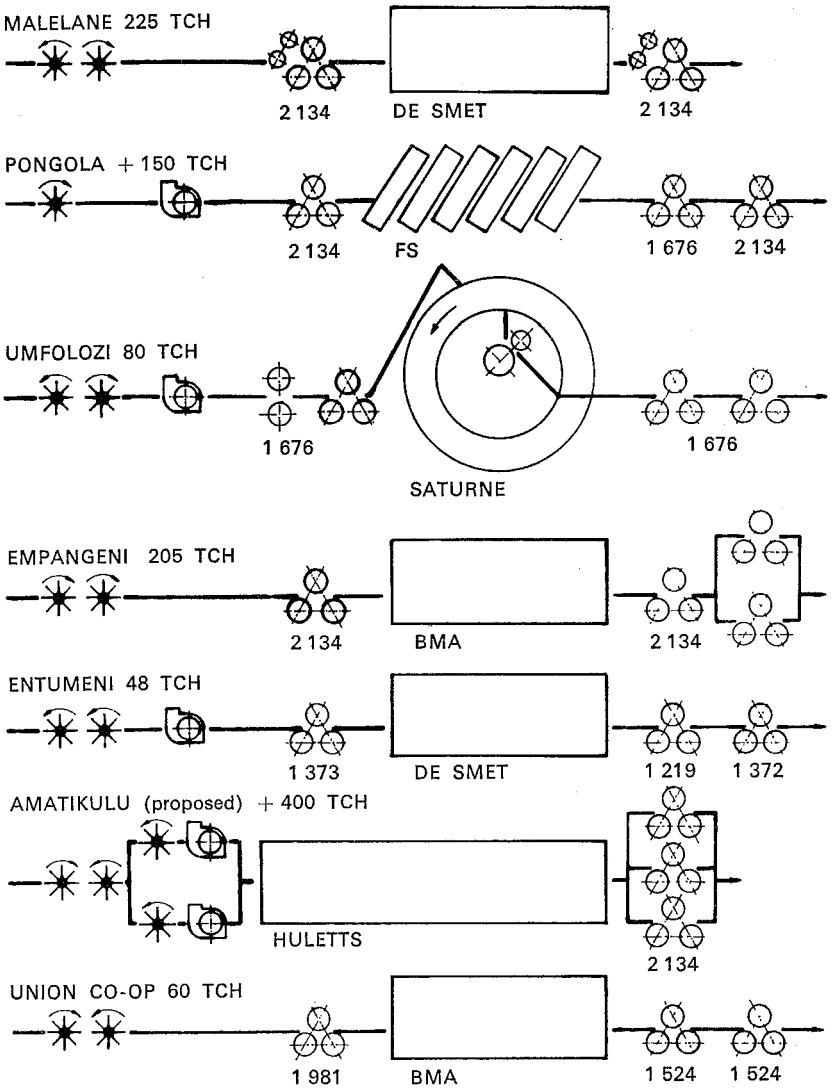

FIGURE 1. Schematic representation of the South African diffuser installations.

The various diffusers installed can be divided into 2 basic types: the bed type and the submerged type, depending on the way the bagasse is conveyed through the diffuser. The only submerged type diffuser in South Africa is the Saturne at Umfolozi. The BMA, De Smet and Huletts diffusers are of the bed type while the FS is a bed diffuser with systematic breaking down and reforming of the bed at regular intervals.

Research on the mechanism of diffusion has covered principles common to all diffusers as well as particularities of each type.

Van der Pol and Young[15] considered cane diffusion to be a combination of leaching (lixiviation) and dialysis (diffusion through a permeable membrane). They postulated that the rate of extraction by diffusion would approach that of leaching after plasmolysis and attempted to evaluate a mass transfer coefficient based on a Fick's law analogy. They found, however, that this coefficient was not constant but varied with the contact time.

Graham *et al*[8] considered the diffusion process to be a first order process by analogy with other physical absorption phenomena. Using actual diffuser performance data, the predicted exponential relationship between the bulk liquid phase concentration and the residence time in the diffuser was obtained. By applying the same model to different molecular species, e.g. reducing sugars and inorganic ions, similar relationships were obtained. It was concluded that, as the mass transfer coefficients obtained were different for each species, the controlling mechanism must be one of diffusion rather than direct washing as this would lead to a coefficient independent of molecular size.

Buchanan[3] attempted to confirm the controlling influence of molecular diffusion by applying a McCabe-Thiele graphical method to determine the number of ideal stages required. He pointed out that the extraction by diffusion involved not only transfer through the permeable cane cell walls but also molecular diffusion through the broken cells and capillary passages.

Buchanan and Jullienne[4] using laboratory batch type percolation and submerged diffusers investigated the rate of change of concentration in the liquid phase, with the liquid phase concentration. As the extraction progressed, a distinct change in the relationship occurred for both types of diffusers. This was postulated as marking the transition between washing and the slower diffusion controlled extraction. Investigations at various degrees of preparation led to the conclusion that unless the preparation is so fine that the complete extraction is rapidly achieved by displacement washing, the ultimate extraction is determined by a diffusion mechanism.

It was left to Rein[11,12] to develop a usable mathematical model to define the extraction of brix by a cane sugar diffuser. The model proposes that the cane diffusion process occurs via 2 first order relationships operating in parallel representing broadly the washing and diffusion mechanisms. The validity of the model was confirmed by pilot plant diffuser tests and Rein showed how it could be applied to full scale diffusers of the moving-bed type.

As a result of this work, it has been generally accepted in South Africa that in a cane sugar diffuser, brix is extracted from prepared cane or first mill bagasse by a combination of 2 processes:

(i) A physico-chemical transfer of brix from within the solid phase to the surrounding extract — commonly referred to as "diffusion", and

(ii) the mechanical removal of this adhering enriched extract — washing or lixiviation.

The development of Rein's model led to the concept of "easy" and "difficult" or "tightly held" juice fractions to represent the influence of both mechanisms and their use in attempting to evaluate the performance of a diffuser independently of the cane preparation and de-watering equipment.[6,7] The dependence of this parameter on the degree of preparation and the difficulty

of obtaining representative samples has however been a major stumbling block in the application of this approach.

Attempts have been made by the SMRI to compare the performances of the diffusers at Union Co-op, Empangeni, Umfolozi and Malelane.[7] It has been found that, in practice, it is impossible to evaluate the diffuser in isolation from other equipment in the extraction plant and that performance depends, to a very large extent, on the physical state of the feed to the diffuser. This study did not reveal any clear cut advantage of a particular make as far as extraction is concerned. It did show, however, that the diffuser performs a dual role in the extraction plant. In addition to extracting sugar, the diffuser makes more sugar extractable by the de-watering mills and increases the total amount of sugar extracted by these mills when compared with the last 2 mills of a milling tandem. The overall extraction which could be credited to a bagasse diffuser was found to be equivalent to that of 3 mills in a typical South African 6-unit milling tandem.

It would appear therefore that the choice of a particular type of diffuser for a new extraction plant will be influenced mainly by capital and maintenance costs. In the case of an existing factory, space limitation may be an overriding consideration and the Saturne with its relatively small floor area is then at an advantage. The modular concept of the FS is particularly attractive if gradual replacement of mills by a diffuser is programmed.

An important consideration in the choice of a diffuser is the possibility of increasing its throughput over maximum rated capacity to cope with future expansions. This is an advantage of rectangular bed diffusers and the modular FS which can be lengthened to deal with moderate increases in capacity.

COST AND CAPACITY OF DIFFUSERS

The main reason for the preference for diffusers over mills in South Africa during the past years has been their lower initial and maintenance costs.

Typical installed costs (1973)[1] of diffusers and mills for 250 tons of cane per hour are:

Bagasse diffuser	R500 000
Cane diffuser	R570 000
One 2 145 mm mill with drive	R400 000

Assuming a bagasse diffuser does the work of 3 mills, the difference in cost in favour of diffusion is of the order of R700 000. The advantage is even more apparent in the case of a cane diffuser where the cost of one mill has to be balanced against an increase of only R70 000 in the price of the diffuser.

In spite of this, all diffusers operating in South Africa in 1973 were bagasse diffusers. Until recently, the cane payment system was based on first expressed juice sampling, thus excluding cane diffusion. The case in favour of having a first mill was further strengthened by the belief that diffusion had a harmful effect on boiling house recovery. It was felt that this effect could be minimised by extracting more than 50% of the sugar by a first mill.

An attempt was made to confirm this last theory by by-passing the first mill for 2 weeks at Empangeni. There was, however, no apparent effect on the boiling house although extraction did suffer as was to be expected, as no additional stages were included in the diffuser.

Experience with diffusers has led to a more favourable view of cane diffusion

and the first cane diffuser in South Africa will be commissioned at Amatikulu in 1974. In this case the over-riding consideration in the choice of a cane diffuser was the very large throughput (over 400 tons of cane per hour) which it would be impractical to handle in a single mill. At least 2 other factories have plans to convert their bagasse diffusers to cane diffusers in the light of possible future expansion.

The maintenance cost of diffusers is accepted as being lower than that of the mills required to reach the same level of extraction. Comparable figures are not always available as a new diffuser is, in most cases, used in conjunction with old mills in the same plant or because development work carried out on diffusers when first commissioned cannot be separated from routine maintenance costs.

Detailed maintenance costs have been obtained from Malelane for the 1972 - 73 season. They are listed in Table 1.

TABLE 1. Maintenance costs (Rand).

Malelane	Diffuser	Mill no. 1	Mill no. 2
Material	14 000	21 000	28 000
Labour*	15 000	9 000	9 000
Total	29 000	30 000	37 000

* Average cost about R5/man hour.

The Malelane costs provide interesting comparisons as both diffuser and mills are of the same age and no modifications or development work were carried out during this season. The costs include some operational costs, e.g. welding rods for arcing the mill rollers as well as some items which do not recur every year, e.g. diffuser chain pins and bushings, a new diffuser pump, mill rollers, etc. They do not cover the cost of mill roller shafts and diffuser screens or chains which only occur at intervals of several years but which are probably more expensive for mills than for diffusers. Fifty per cent of the diffuser costs are for maintenance of pumps which would also be partially incurred in a milling tandem.

For a small factory (Union Co-op), maintenance costs (materials only) of the diffuser were about R2 000 per year as against R6 500 annually for the first mill (drive excluded). In this case the diffuser costs include depreciation of a new chain over 10 years. Maintenance cost of another small diffuser (Entumeni) is reported to be about the same as that of Union Co-op and only 27% of that of the 3 mills in the same extraction plant. Umfolosi reports that maintenance costs of the Saturne were one-third those of a mill in the same tandem.

It can safely be assumed that the maintenance cost of a diffuser is thus lower than that of one mill of corresponding size especially if the cost of maintenance of intermediate carriers is included with that of the mills. A further saving is in the amount of spares which have to be carried in stock.

Corrosion-erosion problems have been experienced in the older diffusers and have necessitated the replacement by stainless steel of part of the steel plates in contact with bagasse. Wear on pumps and drives is equivalent to that experienced on similar equipment in a milling train. Maintenance of chains has proved to be surprisingly low.

The capacity rating of diffusers is still uncertain. Attempts have been made to relate screen area of bed type diffusers to fibre loadings by selecting good average monthly performance at high tonnages at Malelane, Empangeni and Union Co-op. Results are listed in Table 2.

TABLE 2. Fibre loading per unit screen area.

Factory	Diffuser	Tons cane/hr	Tons fibre/hr	Tons fibre/m²/hr
Malelane	De Smet	229	28,7	0,18
Empangeni	BMA	215	35,1	0,18
Union Co-op	BMA	63	8,6	0,18

These results indicate that a good extraction (over 96) can be obtained at a fibre loading of 0,18 tons/m²/hr. It is probable that this loading could be increased without fall in extraction by redistribution of the screen area between different hoppers to increase stage efficiency.

More experience at near maximum capacities will be required before it is possible to estimate capacity rating of other types of diffusers (Saturne, FS).

DIFFUSER OPERATING CONDITIONS

Diffuser operators in South Africa have experimented with variations in temperature and pH in the diffusers and, so far, have not reached agreement on the optimum level of these 2 parameters.

Temperatures in the diffusers range from 70 to 95° C, the lower values being due to fears of harmful effects on juice quality while the higher temperatures are reported to give better extraction. Union Co-op and Entumeni for example, report better extraction at 82 to 88° C than at 75° C but this may be due to the relatively coarse preparation at these factories.

Lime is added to the juice hoppers along the length of the diffuser at all factories except Malelane where the only pH control is by return of clarified press water at a pH of about 7,5, the pH along the length of the diffusers being usually maintained at between 6,0 and 6,5. At Umfolozi pH control is achieved by liming the scalding juice and press water.

The biggest difference in operating procedures of various installations is to be found in the treatment of press water. The first installations commissioned in South Africa were supplied with press water clarifiers in which press water, limed to a pH of 9 or above, was settled for one to two hours and the clear overflow returned to the diffuser. This practice has been retained at Malelane and Entumeni although press water is now limed at a lower pH (8,0 to 8,5) to reduce possible destruction of reducing sugars. Under these conditions, the clarifier overflow is dark but causes no percolation problems in the diffuser. Union Co-op has worked alternatively with or without press water clarification with no apparent effect on juice quality. At Empangeni, press water is returned untreated but the bagasse bed in the diffuser is churned up by vertical screws to improve percolation.[16] The other factories return unclarified press water to the diffusers and the trend away from press water clarification is illustrated by the fact that the last 3 diffusers commissioned or on order are designed to accept press water without any form of clarification.

Different clarifying agents have been tried at pilot plant scale for press water clarification at Union Co-op.[14] Some of these chemicals such as phosphoric acid or sulphur dioxide, followed by liming, yielded a very clear overflow at low retention times but the cost of the chemicals makes them uneconomical for use under normal circumstances. An interesting observation made during this work was that, regardless of the reagent used, a stable precipitation of press water occurred only at pH's lower than about 4,5 or higher than 9,5.

The problem of press water treatment is compounded by the disposal of the underflow from the clarifier. Because of the importance of the mill mass balance in the South African cane payment system, this "mud" must either be weighed, returned to mixed juice or returned to bagasse after the diffuser. The only mill equipped for weighing press water underflow is Malelane. At Entumeni press water mud is returned to mixed juice.

Procedure adopted during normal scheduled stops is not standard for all diffuser mills. Some empty their diffusers (Empangeni, Umfolozi, Entumeni) while others do not (Union Co-op, Malelane). Sucrose losses have been found to be negligible for stops of up to 15 hours and the decision to empty the diffuser is prompted by fears of adverse effect on boiling house work on start-up.

CANE PREPARATION AND BAGASSE DE-WATERING

The first 4 diffusers installed in South Africa were rectangular diffusers in which juice percolates by gravity through a bagasse bed of about 2 m in depth. Percolation rates are critical in this type of diffuser which is characterised by flooding and even overflowing whenever juice flow through the bed is restricted. This occurred frequently when processing dirty and specially muddy cane.

To improve percolation, fineness of cane preparation was reduced, the best example of this being provided by Empangeni where the shredder was removed and only 2 cane knives retained.[16] With more experience in diffuser operation and modifications to press water return systems and the ratio of screen area to volume of recirculated juice in the last stages of the diffusers, the trend towards coarse preparation has been reversed. Malelane and Empangeni have installed very heavy swing knife sets fitted with overhead anvil plates which can be considered as intermediate between knives and shredders. Entumeni and Umfolozi have improved the performance of their shredders while Union Co-op has achieved better preparation by reversing the rotation of the first set of cane knives.

Since the beginning of the 1973 season, cane preparation has been measured by a standardised method and reported in terms of Preparation Index (Procedure described in Appendix 1). Values of Preparation Index (PI) reported at the end of September 1973 by the diffusion factories and by some milling factories known for their good preparation are listed in Table 3.[13]

Except at Union Co-op and Entumeni, preparation at all diffusion factories is now fine to very fine and, in spite of this, flooding is no longer an operational problem. This has influenced the design of preparation equipment for the last 2 diffusers to be installed (Pongola and Amatikulu) and in both cases, very heavy knives and shredders have been specified, a PI of over 90 being the objective.

With the exception of the Saturne, all diffusers in South Africa are followed

TABLE 3. Preparation Index

Factory	Type	PI
Malelane	Diffuser	85
Umfolozi	Diffuser	79 (Occasional tests)
Empangeni	Diffuser	85
Entumeni	Diffuser	64 (Occasional tests)
Union Co-op	Diffuser	75
Gledhow	Mills	89
Jaagbaan	Mills	87
Sezela	Mills	89

by conventional mills and no special technology has been developed for bagasse de-watering. The Saturne diffuser is followed by light de-watering rollers which can lower the moisture content of bagasse to 70% therefore reducing the work load on the de-watering mills.

Hot, wet (80%) moisture bagasse is difficult to feed to mills and tall chutes and underfeed feeder rollers are standard equipment on de-watering mills. The moisture content of final bagasse from diffusion plants is slightly higher than the industrial average but still within the range of moistures of bagasse from milling tandems. Final bagasse at Union Co-op has the lowest moisture content in South Africa and shows that high moisture is not inevitable but is a function of the roller volume available for de-watering. It is generally accepted that more roller volume per unit of fibre is required for de-watering than for conventional milling but no scientific work has been done on this subject and values quoted must be accepted with caution.

The setting of mills used for de-watering differs from that of conventional mills and more juice drainage space has to be provided. Feed to discharge work opening ratios of 3:1 and even 4:1 are reported instead of the 2:1 commonly used in milling.

Equipment used for de-watering in South African diffuser factories is shown schematically in Fig. 1.

DIFFUSION JUICE QUALITY AND EFFECT ON BOILING HOUSE WORK

This has been the most controversial aspect of diffusion since its introduction to the cane sugar industry and a considerable difference of opinion still exists as to whether a diffuser installation has an adverse effect on boiling house performance. Perk[10] showed that the boiling house recovery for South African diffusion factories lay significantly below the industrial average but Lamusse[9] was able to show that a substantial amount of the evidence may be due to extended teething problems with the new process.

Graham *et al*[8] found that pH and temperature in a diffuser had very little effect on the extraction of the commonly determined impurities except for starch. If the operating temperature exceeded that of the starch gelatinisation temperature, however, starch was extracted to an appreciable extent. Operating above this temperature, the ratio of impurities in diffuser juice to first mill juice was found to be of the same order of magnitude for both milling and mill-cum-diffusion. The extraction of wax, however, was significantly lower in diffusion than in milling. The authors further demonstrated the effectiveness of pH as a control for enzymatic destruction of sucrose.

Buchanan and Jullienne[4] confirmed the temperature dependence of polysaccharide extraction by diffusion noted above and investigated further their dependence on the degree of preparation.

Rein[12] during his modelling work provided further confirmation of the past work on the extraction of organic impurities and extended this into the field of inorganic impurities. He found the inorganic species measured occurred in the following order of decreasing concentration: K, Cl, Ca, Mg, Na. Further, he noted that the degree of preparation influenced the availability of inorganic cell wall constituents for extraction. Douwes Dekker[5] reported measurements of Ca and Mg in mixed juice which show order of magnitudes in agreement with this work.

Based on the premise that organic acids formed by the decomposition of sucrose and reducing sugars would be concentrated in final molasses mainly in the form of calcium salts, Bruijn and Vanis[2] analysed by chromatographic means final molasses samples from both milling and diffusion factories. No major differences in composition or quantity or organic acids were found.

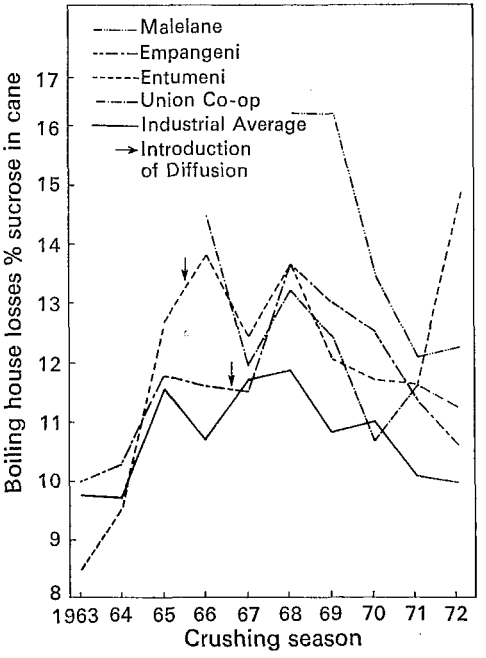

FIGURE 2. Sucrose lost in boiling house % sucrose in cane for diffuser factories.

An inspection of Fig. 2 in which sucrose lost in boiling house % sucrose in cane are plotted for diffuser factories together with the industrial average will reveal arguments for use against diffusion. In all cases diffusion factories reported higher losses than the industrial average. If, however, the losses are corrected for difference in mixed juice purity as is done in Fig. 3 in which reduced boiling house recovery is plotted for the same mills, one finds that all diffusion factories save one now have higher reduced boiling house recoveries than the industrial average.

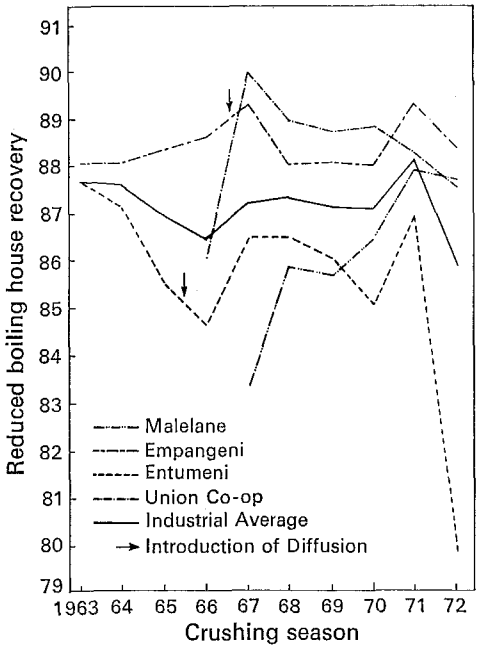

FIGURE 3. Reduced boiling house recovery of diffuser factories.

Reduced boiling house recovery is based on mixed juice purity and therefore does not compensate for any juice deterioration in the diffusers. An attempt has been made to evaluate deterioration across the diffuser by calculating the percentage increase in non pol from cane to mixed juice using data provided by the Sugar Industry Central Board for the direct analysis of cane. Results are listed in Table 4.

TABLE 4. *Percentage increase in non pol across extraction plant. (based on to-date figures 1.9.73).

Factory	% Increase in Non Pol
Malelane	6
Empangeni	6
Entumeni	12
Union Co-op	16
Average diffusion factories	10
Industrial average	10

$$* \text{ \% increase in non pol} = \frac{\text{Non pol in cane by Mass Balance} - \text{Non pol in cane by Direct Cane Analysis}}{\text{Non pol in cane by Direct Cane Analysis}}$$

Once again diffusion results straddle the industrial average and do not indicate systematic deterioration. Even the high percentage increase calculated for Union Co-op is within the range reported by some milling tandems.

Purity of final molasses does not appear to be affected by the diffusion process with some diffuser factories reporting lower purities and others higher than the industrial average. There is, however, a definite indication that more molasses is produced by diffusion than by milling factories and that consequently molasses losses are higher. This is shown in Table 5.

TABLE 5. Sucrose in final molasses % non pol in cane (mass balance).

Factory	To date 1.9.73	1972/73* Season	1971/72* Season
Malelane	45,2	49,2	50,7
Empangeni	49,8	49,2	44,2
Entumeni	76,0	70,2	57,0
Union Co-op	62,4	48,6	51,3
Industrial Average	44,1	46,2	45,2

* Based on *Non-Sucrose* in cane.

CONCLUSION

After 7 years of industrial experience, diffusers are accepted in the South African sugar industry as the most economical way of achieving high extraction. Capital and maintenance costs of diffusers are far lower than those for mills required to achieve the same extraction.

There is still a divergence of opinion as to the best type of diffuser and at least 3 distinct types are in operation or on order. Experience with bagasse diffusers has stimulated interest in cane diffusion which is more attractive from a capital investment point of view.

Experience has shown that diffusers are capable of processing finely prepared cane and that this is a requirement for good extraction. Attempts to compare the performance of different types of diffusers have not been successful because of the effect on performance of cane preparation and the position of the diffuser in the extraction plant. This work has revealed that in addition to the extraction achieved in diffusers, the unit made more sucrose available for extraction by the de-watering mills and that the unit extraction of these mills was about twice that of the last 2 mills of a milling tandem.

The following trends can be noted in diffuser operation:

a) The return of unclarified press water;
b) Liming juice in the diffuser to a pH of about 6;
c) Operation at higher temperatures;
d) Processing of more finely prepared cane;
e) A reduction in the number of washing stages and a corresponding increase in stage efficiency.

The reduced boiling house recovery of all but one of the diffuser factories is now higher than the industrial average but losses in molasses per unit of non-sucrose in cane are still higher with diffusion than with mills although the process has no apparent effect on molasses purity. Research carried out has failed so far to identify any differences between the molasses from either processes.

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APPENDIX I

PROCEDURE FOR THE DETERMINATION OF PREPARATION INDEX

Sampling

It is not easy to sample shredded cane in a representative way, and great care should be taken to avoid biased sampling. When catching a sample by hand, or when sub-sampling, do not shake the handful of cane, as this will lead to a bias in favour of larger pieces of cane. When a sample is brought to the laboratory do not sub-sample directly from the bucket. Tip the sample out onto a flat surface, mix it thoroughly and spread it out into a layer 5-7 cm thick before sub-sampling.

1) Grab samples of shredded cane should be taken from the air-operated hatch in the screw conveyor feeding the Central Board prebreaker, over a period of 3 to 5 minutes. Until this hatch is available samples should be taken by hand from the cane falling from the screw conveyor into the hatch feeding the prebreaker. Do *not* sample by hand directly from the screw conveyor itself because of safety hazards. The samples should be placed in plastic or stainless steel buckets, fitted with lids, and taken directly to the laboratory.
2) Samples of prepared cane are taken simultaneously from the prebreaker discharge and placed in a separate bucket fitted with a lid.
3) The 2 samples are taken to the laboratory and each sample is thoroughly mixed before sub-sampling.
4) The sample taken from the *screw* is used for leaching and the sample taken after the *prebreaker* is used for disintegration.

Analytical procedure

Two procedures can be used depending on equipment available for leaching. The preferred procedure is based on the use of plastic bottles which are rotated on a special frame (Markham, R. J. SASTA Proc 43, 1969, p 230).

An alternative procedure using tumbling drums as described in SMRI Quarterly Bulletins nos. 19 and 20 is also given for those mills which have this equipment.

The 2 methods have been found to give closely comparable results but the first method (rotating bottles) is preferred because of the larger sample and shorter tumbling time.

1) *Rotating Bottles Method*
   1) Leaching
      500 g of prepared cane from the *screw* sample and 3 000 g of water are weighed into a plastic bottle. The bottle is rotated on a specially designed frame for 30 *minutes*. The brix reading of the filtered extract (B_1) is measured by means of a precision refractometer.
   2) Disintegration
      333 g of prepared cane from the *prebreaker* sample and 2 000 g of water are weighed into an Elgin type cold disintegrator and disintegrated for 20 *minutes*. The brix reading of the filtered extract is measured (B_2).
2) *Tumbling Drums Method*
   1) Leaching
      200 g of prepared cane from the *screw* sample and 2 000 g of water are weighed into a 4,5 litre drum fitted with internal baffles. The drum is rotated for 60 *minutes* at 45 rpm. The brix reading of the filtered extract (B_1) is measured by means of a precision refractometer.
   2) Disintegration
      200 g of prepared cane from the *disintegrator* sample and 2 000 g of water are placed in a cold disintegrator which is run for 20 *minutes*. The brix of the filtered extract is measured (B_2).

Calculations

$$\text{Preparation Index} = \frac{B_1}{B_2} \times 100$$

Note: The use of pol instead of brix will affect the results because of differential extraction of pol and brix during leaching.

DIFUSION EN AFRICA DEL SUR

J. R. FitzGerald y J. P. Lamusse

RESUMEN

Se hace una revisión del proceso de difusión aplicado a la caña de azúcar en Africa del Sur. Los temas tratados incluyen investigación, operación del difusor, costos de operación y mantenimiento y el efecto de la difusión en la eficiencia de la elaboración.