SIXTY-FOURTH ANNUAL REVIEW OF THE MILLING SEASON IN SOUTHERN AFRICA (1988-1989)

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Abstract

Performance data for South African, Swaziland, Malawi and Zimbabwe mills are listed and discussed. The growing period for the 1988 crop was characterised by overcast weather and cane yields were lower than the first estimates.

Sucrose % cane (12,61) was lower than the long term average in South Africa but a very good extraction (97,60) and a relatively good boiling house recovery (88,33) contributed to an average cane to sugar ratio (9,16).

The proportion of the variety N14 has increased in all irrigated areas and N12 has progressed mainly in the Natal Midlands. These two new varieties now account for 19,4% of all cane crushed in South Africa.

The proportion of sugar refined by the back-end refineries increased to 31,6%. Development of back-end refining, export of power and industries based on by-products have caused the total fuel requirement of the industry to exceed the available bagasse supply.

Introduction

Weights of cane crushed and sugar produced by South African mills have been deleted from the tables in this report at the request of the industry.

All data listed in the tables are as reported by the mills except for the cane transport and cane varieties figures, which were supplied by the Sugar Industry Central Board. The recovery and performance parameters have been calculated using "made and estimated" sugar weights reported by the mills to take into account massecuite kept in stock between seasons.

The performance data of South African mills (Table B1) are calculated from sucrose based analyses of mixed juice and final molasses, while those of mills in Swaziland, Malawi and Zimbabwe (Table B2) are pol based. These differences will affect comparisons between the two sets of data.

A refinery undetermined loss of 0,6% has been assumed in calculating the corrected boiling house recovery (CRB) of mills with back-end refineries, but all other data have been treated in exactly the same way as raw house data. Boiling house figures of TR in Zimbabwe and DW in Malawi, which convert some of their factory products into ethanol, have not been reported.

The Cane Crop

*Weather and crop conditions**

The winter of 1987 was mild and there was above average rainfall in spring and early summer (the September floods will be well remembered). December 1987 and January 1988 were a little drier than the previous months and were hot and humid, but this spell was followed by more wet, overcast and cool weather in late summer and autumn. Winter of 1988 was also mild with reasonable rainfall. In general the growing period for the 1988 crop was characterised by overcast weather and lower than average incoming radiation; these are the likely reasons for cane yields being lower than those first estimated.

The April 1988 eldana infestations in older cane, which was harvested at the beginning of the 1988 season, were high, particularly in coastal cane on the North Coast.

*Cane Varieties***

The popularity of N14 in the northern irrigated areas has continued to grow, and it accounted for 80% of the crush at ML last season. Presumably there can be little further expansion of this variety in the ML mill area, but further expansion is likely at PG where 69,1% of the total crush was N14. In Swaziland there has been a decrease in the tonnage of this variety delivered to the mills, and there appears to be a slight resurgence in the popularity of NCo376. N14 is not suited to areas where the cane is subject to stress, and NCo376 grows better under these conditions. N17, which was released for the more highly stressed situations, appears to be gaining some acceptance in the MH area, but does not appear to be a very popular variety in the other irrigated areas. N19, which was released in 1986, is now appearing in some of the mill returns. The area planted with this variety is likely to increase over the next few years as it can be cut early in the season when NCo376 and N14 may have a very low sucrose content.

Two years ago an increase in the popularity of N12 for the southern rain fed areas was predicted, and the figures for last season show that this increase is now occurring. It is greatest in the Midlands area, where there has been a 10% increase in throughput of the variety at both NB and UC. N12 accounts for more cane than NCo376 at both these mills and, at NB, it is almost equal to the amount of NCo293 crushed. It appears that the amount of N12 grown will continue to increase as, in addition to producing high yields of cane, it has a higher sugar content than either NCo293 or NCo376.

Cane Quality

The average sucrose % cane for the 1988/89 season (12,61) was higher than for the preceding year but still considerably lower than the long term average (Table J). The highest sucrose values were reported by the Midlands mills (UC: 13,77 and NB: 13,26) and good quality cane was also suplied to IL (13,31) and ML (13,02). The poorest cane was grown on the North Coast with an average of 11,94 at GH and 11,90 at MS.

Industrial average fibre % cane (15,44%) was about equal to the long term average, and again UC stands out for having the lowest fibre cane (13,56), while NB reported a relatively high value of 14,52 and IL was higher than the industrial average. The difference between the three mills is attributed to the very clean cane supplied to UC.

Mixed juice purity averaged 85,70, the highest value recorded since 1972, with UC reporting the highest value (88,05) and with purities of over 87 at NB, IL and UK. All the factors influencing cane quality were at their best at UC and it is therefore not surprising that this factory had the highest ERC% cane (12,21) and the lowest cane to sugar ratio (8,10). As a result of the effect of cane quality on factory performance, UC also led the industry in overall recovery (89,19).

DW in Malawi and HV in Zimbabwe processed even better quality cane than UC. ERC % cane was 12,81 at HV and 12,56 at DW, but it was considerably lower in Swaziland (MH: 11,12, UR: 11,37 and SM: 11,12).

The 1988/89 season was characterised by heavy cane flowering and it has been postulated that this may have been the reason for the relatively low drop in sucrose % cane and in mixed juice purity during the second half of the season (Figure 1).

Extraneous matter in cane and delay between burning and crushing have long been recognised as two of the main sources of poor mill performance and of high maintenance costs. They have given rise to lengthy discussions, debates and reports, but little positive action except at UC with the very good results reported above. Experiments carried out at MS on the effect of tops and trash in cane on factory operation have shown that trash had the most unfavourable effect on both mill capacity and mixed juice quality. It has been estimated from the results of these experiments that the cost of maintaining the same sugar production (14,8 tons per hour) on the MS milling tandem when crushing very dirty cane (unburnt, untopped, untrashed) or perfectly clean cane (hand cleaned) would be about R10 million in capital cost and additional running costs of about R53 per hour. There are indications of a fresh willingness to tackle this problem at factory level, and IL became the first mill to monitor delay between burning and crushing of cane by ethanol analysis of cane juice on a routine basis last season. This measurement confirmed the very high average delay (117 hours) and the factory has taken steps to reduce the delay for its own cane as from next season.

FX, which has suffered costly damage to its preparation equipment because of rocks, has applied penalties to cane consignments containing rocks, and has noted an immediate improvement. A number of mills have also improved cane quality by setting an example and supplying cleaner cane from their own fields.

There are, however, some factors over which the miller has little or no control. The main one is eldana borer, which caused damage to the cane and also necessitated the cutting of younger cane. The effect of new cane varieties can also be appreciable. It has been noted at NB that N12 had better juice purity and lower fibre than the average of all cane supplied to the mill, while ML and SM blame N14 for the higher colour juices which they have to process.

Cane Transport***

Very little change occurred in transport systems compared with 1987/88. Articulated trucks delivered 68%, rigid trucks 9% and various tractor-driven vehicles 18% of the crop to

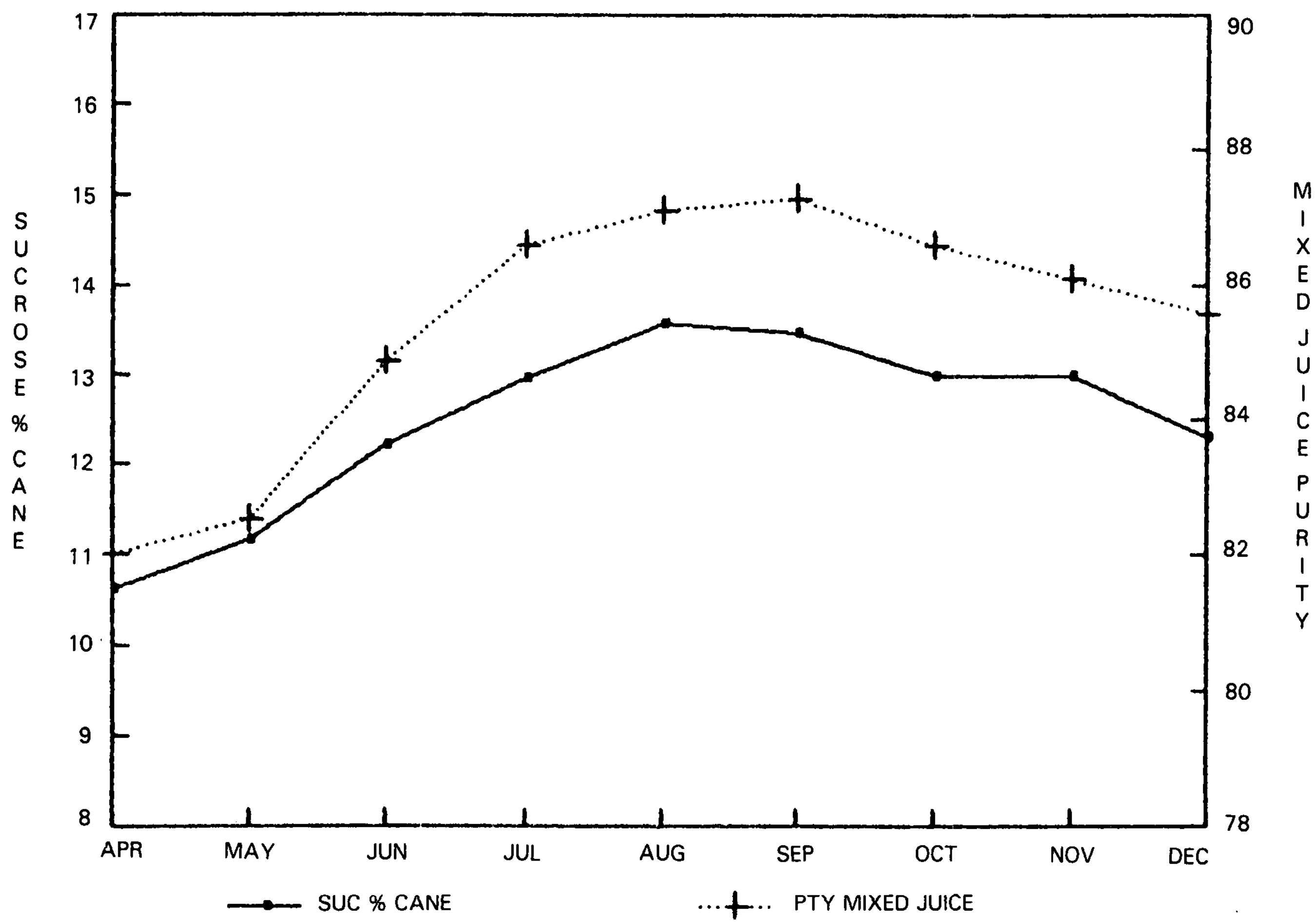

FIGURE 1 Crushing season 1988/89. Industrial average

the factories. Deliveries by S.A. Transport Services have been phased out at all mills except UF. At ML 92% of the cane is delivered by truck and the rest by tractor/trailer units. Deliveries by truck interlink increased from 43 to 59% at FX while deliveries by truck decreased. The increased popularity of truck interlinks was further evidenced at DL and NB where cane handled by these units increased from 29 to 36% and from 28 to 34%, respectively. The exception to the rule was at GD where interlink deliveries dropped from 19 to 1% with a corresponding increase in standard hilo deliveries. Tractor deliveries fell from 33 to 24% at DL. Deliveries by S.A. Transport Services ceased at ME with interlink deliveries increasing from 41 to 55% due to the installation of spiller unloading facilities. At other factories the mode of cane deliveries was virtually unchanged from 1987/88.

Mill Performance

Length of Season, Time Efficiency and Cane Supply

The season started at UC on 5 April 1988 and ended when GD stopped crushing on 30 January 1989. Its overall length was 300 days, but the average number of crushing days was 250. The shortest season was at GH which only ran for 199 days and the longest at EN where the mill was open for 289 days. At most mills crushing stopped before Christmas and the absence of stops for the festive season had a favourable influence on time efficiency which averaged 79,1 for the industry, an improvement on the five-year average of 78,4. The highest time efficiency in South Africa (90,9) was reported by GH and the lowest (61,5) by EN. As usual, the time efficiency of mills in neighbouring countries was higher than in South Africa. The average for Swaziland was 81,4, for Malawi 83,8 and for Zimbabwe 91,4.

Comparisons of time efficiency can be misleading because of a lack of standardisation in the calculation of this parameter. The data listed in tables B_1 and B_2 have been calculated from hours available time and hours of stops reported by the mills, and arithmetic averages have been used in the case of two tandem mills, Some mills, notably UF, GD, ML and MH, correct the time lost for stops when operating at reduced throughput. They therefore report lower values than other mills. A throughput efficiency factor to be read with the time efficiency would give a more balanced picture of the efficiency of equipment utilisation in factories. The main problem would be to establish the rated capacity of each factory.

Lost time % available crushing time, which is a measure of the mechanical and operational efficiency of factories, averaged 7,41 for South African mills with very low values reported by GH (1,1) and AK (1,3). No cane stops have an influence on scheduled stops as is evident in the case of GD which suffered from erratic cane deliveries (no cane stops: 18,8%) and was therefore able to reduce its scheduled stops to 2,2%. There is, however, a definite trend in the industry for a reduction in scheduled stops which has been achieved through better maintenance planning and especially through better evaporator cleaning. Most mills now operate their evaporators for two successive weeks without cleaning the tubes and IL crushed twice for periods of five weeks without cleaning the evaporator. UR in Swaziland reported the very low value of 2,7% for scheduled stops in spite of low no cane stops (3,5%).

Several mills, especially on the North Coast, reported erratic cane supply due to difficulties in co-ordinating deliveries by growers, and UF suffered from a shortage of trucks which interfered with cane deliveries on Sundays. GD lost 614 hours crushing due to poor deliveries by their small growers. ML commissioned a computerised cane delivery system similar to that in operation to MS which governs supply of cane to the factory from the miller's fields and from various groups of growers in a set proportion. It proved to be very successful.

An interesting comment connected with cane supply comes from UR where each of three Cameco cane loaders loaded its millionth ton of cane during the past season.

Extraction

The average extraction for South African mills was 97,60 compared with 97,63 for the previous season and with the record extraction of 97,66 set in 1986/87. It is too early to say if the marginal fall in extraction represents the beginning of a trend, but it certainly reflects a drop in imbibition rate from 368% fibre in 1986 to 357% in 1987 and 355% in 1988. This same three-year period saw a reduction in moisture % bagasse from 51,27 in 1986 to 50,92 in 1988.

An analysis of the extraction of individual mills is listed below:

Higher than 98	: FX (98,07), AK (98,06), GH (98,07), UC (98,07).
Between 97,5 and: 98	ML, PG, EN, DL, ME, IL, MH, DW, HV, TR.
Between 97 and: 97,5	MS, GD, NB, SZ, UR, SM, NH.
Below 97	: UF (96,89), UK (96,59).

This is an impressive performance with four mills reporting extractions of over 98, ten mills between 97,5 and 98, seven mills between 97,0 and 97,5 and only two below 97. The lowest extraction (96,59), reported by UK, would be a record in most other sugar producing areas of the world.

The lowest pol % bagasse (0,67) was reported by FX and the lowest moisture % bagasse (46,77) by PG. Four other mills in South Africa (EN, GH, UC, IL) and four affiliated mills (SM, DW, HV, TR) reported values below 50. It is interesting to note that the majority of these mills have diffusers. Their performance disproves the common belief that diffusion is normally associated with a high moisture content of bagasse.

There was no major installation of extraction plant in 1988, but the drive towards improved performance has not died down and two major plant modifications involving new diffusers were planned for commissioning at PG and UF in 1989. The past season was mainly a period of consolidation which nevertheless saw the commissioning of a new Tongaat shredder on the milling tandem at MH and a new spiller table and cane knives set at ME.

Extraction plants are still characterised by very wide variations in equipment capacity and power rating, with some factories like FX operating well under rated capacity, while others like UK and NB are above normal ratings. Comparisons are difficult because of different norms for diffusers and mills, but reference to Table K will show that total installed power of the preparation equipment averaged 87 kW/tfh with a maximum value of 195 reported by the GH (A) tandem and a low value of 48 by GD. Similarly the screen area of cane diffusers ranged from 3,08 m^2/tch at FX to 1,42 m^2/tch at UR (A), and total roller volume of milling tandems from 1,44 m^3/tfh for the UR (B) tandem to 0,88 m^3/tfh at UK.

Overcapacity is not necessarily an advantage, and experiments carried out at FX during the season have shown that long retention time in the diffusers was one of the causes of formation of acetic acid which has led to severe corrosion problems. In the course of a survey of diffusers in five factories it was noted that relatively low temperatures (below 70°C) in sections of the diffusers and in the press water circuit could also lead to formation of acetic and lactic acid by thermophilic bacteria. This survey also showed that about eighty percent of the juice in cane was washed out in the feed section of the diffuser within 14 to 20 minutes of feeding, and that the relative draw-off points of scalding juice and draft juice from the diffuser influenced the efficiency of extraction by washing. Severe corrosion was noted in diffusers in which juice liming was not properly controlled.

The following new developments have been reported by the mills:

- UK has succeeded in finishing the season without any mill roller shaft breakage by reducing hydraulic pressure by an average of 2 MPa per mill. The mill has also reduced chokes at the knives by reducing the pitch circle of the knives. These measures enabled the mills to maintain an average throughput of 242 tons of cane per hour at the cost of a reduction of 0,32 points in extraction.

  UK has also built a gabion wall to protect the factory from floods. The design was based on a study carried out by the University of Stellenbosch on a scale model of the Umzimkulu river.
- SZ has installed a DC drive electric motor to replace the turbine on one of the dewatering mills. The mill has also manufactured a diffuser lifting screw from 3CR12 steel and has been very satisfied with the results.
- IL has commissioned instrumentation for remote control of the extraction plant from a central control room. The installation has proved very successful and the total time lost due to instrument problems for the season was only 25 hours.
- Both IL and SZ have attempted to improve shredder performance by attention to the anvil bars. SZ has set the anvil bars with a wider setting at the discharge and (20 mm) then at the feed end (tip to tip) and IL has increased the number of anvil bars and the "wrap around" effect. Both mills have been satisfied with their modifications.
- MS has successfully used a Delkor linear belt cush cush fitted with a polypropylene cloth to screen their mill juice. The same mill has also fitted a one-meter wide perforated plate with 12 mm holes across the width of one Hilo spiller feed table. A cross conveyor under the perforated plate removed 2,5 cubic meters of sand every twelve hours.
- A new mill lift indicator has been developed by the SMRI and been submitted to preliminary tests in some factories.

Clarification and Filtration

Although no clarification problems were experienced during the season, control of clarification work in the mills is still unsatisfactory. Evidence of this is provided by clear juice purities lower than the corresponding mixed juice purities reported by no less than nine mills and reflected by an industrial average value of - 0,17 for the purity difference (clear juice - mixed juice). This purity drop is probably due to sampling and analytical errors. If, however, it did take place, it could account for a substantial part of the undetermined losses reported at some mills. For example, the purity drop of 0,82 reported by PG could be equivalent to about 0,5% undetermined losses.

Pol % filter cake averaged 1,05 and purity drop from clear juice to filtrate averaged 1,23 with the highest value being reported by GD (2,55) and the lowest by SZ (0,50). The negative values reported by some mills for purity of clear juice minus purity to filtrate can only be due to sampling

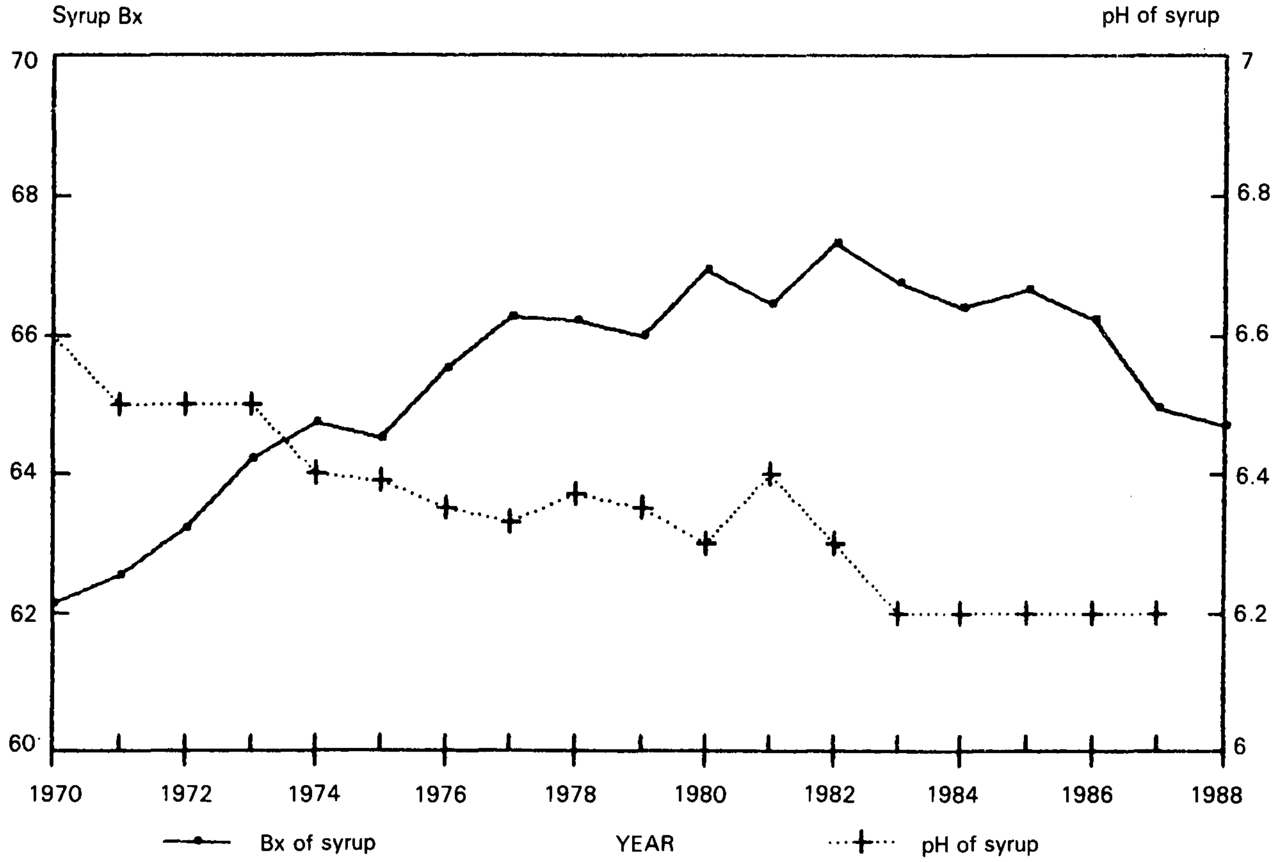

FIGURE 2 Syrup Brix and pH

or analytical errors as filtrate cannot have a higher purity than the clear juice from which the mud has settled out, unless refinery muds are returned to the raw house filter feed tank. The importance of maintaining a high temperature in mud pipes to prevent sugar destruction has been demonstrated at MH where the lagging of the relatively short section of pipe from the clarifier to the mud pump resulted in a reduction of one point in purity drop from clear juice to filtrate. ME reports a lower purity drop (0,51) after modifications to shorten the filtrate piping and to return the filtrate to the hot liming tank instead of the mixed juice tank. There was no apparent effect on the performance of the clarifiers.

IL experimented with the use of bentonite clay as an additive to improve clarification. The bentonite was added to clarifier feed at the rate of about 0,2% on cane, and resulted in a decrease of 10 to 15% in turbidity. The cost of the product was too high to cover this relatively minor improvement.

Evaporation

New evaporator vessels were installed at DL and ME to replace old vessels. In both cases, improved results were noted. At DL entrainment was reduced by 40%, and at ME the high undetermined losses of previous seasons were reduced to a normal level of 1,46% of sucrose in cane.

Syrup brix ranged from 70,4 at UK to a low 58,3 at SZ and averaged 64,7 for South African mills. Although there is no doubt about the influence of a high syrup brix on steam economy, this effect can be considerably reduced if movement water has to be added to the A-pans because of poor circulation due to the high brix of the feed. The change in brix over the past two decades is shown in Figure 2.

There is a growing suspicion that high undetermined losses are often due to high temperatures and a relatively high retention time in evaporators. The first evidence of sucrose destruction is usually a drop in pH from clear juice to syrup, and inspection of the values reported by South African mills last season reveals a surprising picture. EN had a clear juice pH of 7,3 and a syrup pH of 6,8, the highest syrup pH reported by any mill. GD, UF and UC reported syrup pH values of 6,4 for clear juice pH's of 7,0 and 7,1. At the other end of the scale, MS had a syrup pH of 5,9 and NB and FX reported 6,0. It is difficult to tie up the pH drop with either evaporator capacities listed in Table K or with mixed juice % cane values, but it is worth noting that GD had the lowest evaporator capacity (22,2 m^2/tch) in the industry and that EN had a sealed downtake evaporator with a low retention time. The change in syrup pH over the past 18 years is shown in Figure 2.

There have been no new developments in cleaning of evaporators, and still only two mills (UF and FX) use chemical cleaning. The cost of mechanical cleaning has increased substantially and was reported at 6,5 cents per ton of cane by a mill, compared with 7,5 cents for chemical cleaning of the first two effects at FX by caustic soda only.

Boiling House

There has been a noticeable trend towards higher industrial average boiling house recoveries during the past four years as shown in Table 1.

Table 1
Boiling house recoveries

Season	1988	1987	1986	1985
Boiling house recovery	88,33	87,84	87,70	87,51
C.R.B.	86,7	86,5	86,5	—

Corresponding values of Corrected Boiling House Recovery (C.R.B.) indicate that the improvement form 1987 to 1988 was probably due to improved boiling house work rather than a higher mixed juice purity. Sucrose lost in final molasses % cane dropped from 9,64 in 1987 to 9,26 in 1988, in spite of an increase in final molasses (85 Bx % cane) from 3,70 to 3,73. The improvement was due to a decrease in TPD based on mixed juice from 6,1 to 5,8 for the same two seasons. Undetermined losses were also relatively low (1,85) and total boiling house losses were 11,39% of sugar in cane compared with 11,87 in 1987.

The highest boiling house recoveries in South Africa were reported by UC (90,95), NB (90,15) and UK (90,33). At the other end of the scale BHR values in the 86 range were reported by ML, PG, UF and GD. The scatter is reduced if the mills are compared on the basis of CRB which compensates for differences in mixed juice purities.

CRB over 87	: AK (87,74), SZ (87,55), UC (87,27), NB (87,13), FX (87,02).
CRB between 86,5 and 87,0	: DL, MS, ME, GH, UK.
CRB between 86,0 and 86,5	: PG, UF, EN, IL.
CRB below 86,0	: ML, GD.

Comparison with boiling house recoveries listed for affiliated mills is not possible because their recoveries are calculated from pol based data which tend to inflate BHR values. Nevertheless, the BHR reported by MH (92,92) and SM (92,46) are exceptionally high. The improvement in boiling house work at MH merits special mention. It improved from 91,88 in 1987 to 92,92 in 1988 and is attributed mainly to a better exhaustion of A-massecuite (Figure 3).

There has been a tendency to concentrate efforts on C-massecuite exhaustion and the target purity difference (TPD) to the exclusion of the other massecuites. Data on massecuite exhaustion listed in Table E show that last season's good boiling house recovery was obtained as a result of good exhaustion of all three massecuites. These results have been summarised in Table 2 below.

Table 2
Exhaustion of massecuites

	1988/89 season	5 year average (1984–1988)
A-massecuite	64,7	63,9
B-massecuite	62,8	62,6
C-massecuite	55,4	54,4

A-massecuite exhaustion depends not only on pan and crystalliser work but also on the colour and pol of the sugar.

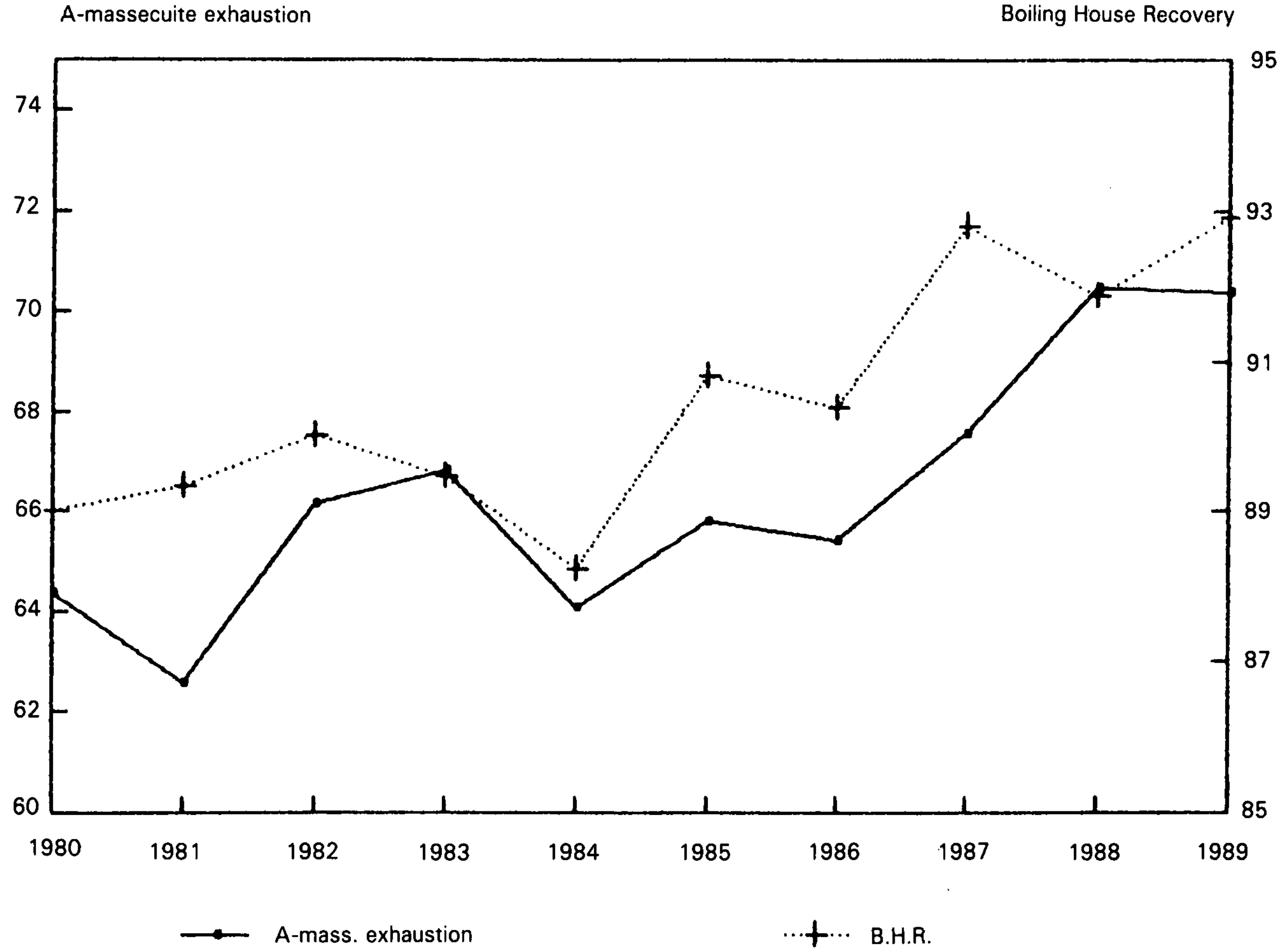

FIGURE 3 MH – A-massecuite exhaustion and BHR

It is easier to obtain high values at MH which produces sugar of 98 polarisation, and which has no colour problems than at South African mills where a purity rise of about 3 points occurs across the A-centrifugals because of the amount of wash water required to obtain a pol of 99,4 and a colour of less than 1350. The SMRI has carried out experiments at IL and MS which proved that evaporator syrup could be used to replace most of the wash water in A-centrifugals. The purity drop across the centrifugals was reduced by about one point, and the saving in steam required for evaporation of the wash water in the pans is estimated at 1,5 tons per hour for the average South African factory.

Interesting developments reported by the mills are listed below:

- The installation at MS of two Broadbent centrifugals driven by AC motors with pulse width modulated inverter speed control.
- A new two-stage continuous BMA centrifugal, which incorporates a melter, on A-massecuite supplying the refinery at ML.
- The cascading of continuous centrifugal screens from C-centrifugals to B-centrifugals at SZ which has extended screen life from 8 to 16 weeks.
- The addition of fixed cooling coils in the A-crystallizers at NB to improve A-massecuite exhaustion.
- The commissioning of computerised continuous C-pan control at GH.
- The conversion of a FCB continuous pan from C-massecuite to A-massecuite boiling at IL, and the straight seeding of the A-pan with B-magma without going through a batch seed pan.
- An increase of about 15% in the capacity of an old batch C-pan at UK by the installation of new condensate and incondensible gas draw-off piping.
- The commissioning of a new A-pan at GD.

Refining

The percentage of sugar refined by the six back-end refineries in South Africa (ML, UF, EN, GH, PG and NB) increased to 31,6% of all sugar produced during the 1988/89 season. Except for EN, which refined 53% of its production, the other back-end refineries processed almost all their raw sugar and NB refined about 63 000 tons of raws from UC in addition to its own production.

Three of the back-end refineries (ML, PG, GH) use the carbonatation-sulphitation process, two (EN and NB) the phosphatation process which is followed by ion-exchange decolorisation at NB, while UF processes its raws by melt sulphitation. These are indications that the type of decolorisation process used may have an influence on the colour transfer from the liquor to the crystals during boiling, and this may have important implications for the overall efficiency of the process used.

The yields of sugar per cubic meter of massecuite boiled in the back-end refineries are listed in Table D1. They range from a maximum of 744 kg/m^3 at UF to 542 kg/m^3 at NB. The differences are mainly due to the number of white massecuites boiled, and UF, which boils only three massecuites, has an advantage over NB which boils four massecuites. The reverse would have been true if yields were expressed in tons refined sugar per ton of melt. GH reported an increase of 20% in crystal yield after fitting a stirrer in a fourth massecuite vacuum pan.

The increase in colour across refinery melters has given cause for concern. An increase of as much as 25% has been measured at GH.

Steam and Power

The installed boiler capacity (M.C.R. tons steam/ton cane) and power generation equipment (kW/tch) of all South African factories are listed in Table K. Meaningful comparisons are almost impossible because of steam and power used for purposes other than raw sugar production. Additional fuels used by the mills are listed in Table D1. These data have been used for calculating the total steam generated by each mill for raw sugar production, and for other purposes using the calorific value of the bagasse and additional fuel burnt by each mill and its estimated boiler efficiency. The results of this exercise are listed in Table 3.

Table 3

Theoretical steam consumption of mills for raw sugar production and other purposes 1988/89 season

Mill	Steam % Cane	Other uses of energy
ML	62,4	Refinery, Particle board, Animal feed, Irrigation
PG	59,4	Refinery
UF	57,2	Refinery
EN	63,9	Refinery
FX	47,7	–
AK	51,5	–
DL	58,4	–
MS	58,4	Animal feed, Textile
ME	57,2	–
GD	57,1	–
GH	56,3	Refinery
NB	51,9	Refinery
UC	69,9	Wattle plant
IL	57,5	Syrup
SZ	71,7	Furfural
UK	54,4	–
Ind. Ave.	57,6	

The table shows that the average steam demand of the industry was 57,6% on cane while installed boiler capacity averaged 79%. The lowest value was reported by FX (47,7%), where the steam was used only for raw sugar production, and the highest by SZ (71,7), where the raw sugar factory supplied all the steam for a factory which transforms bagasse into furfural. The high value listed for UC (69,9%) applied only to the end of the season when both the sugar and wattle extract factories operated simultaneously. The energy calculations have also shown that only eight mills have a bagasse surplus, while the others have to burn coal. The industry as a whole showed a bagasse deficit of about 82 tons per hour (2% on cane) for the 1988/89 season.

There was very little new equipment commissioned during the season, one exception being a new 10 MW turbo alternator at UF. Corrosion of V1 and V2 piping has been reported at SZ and severe corrosion of vacuum pans at FX, while UK reports good results with a new 3CR12 fill for cooling towers.

Sugar Quality

The average pol of all raw sugar produced in South Africa was 99,37 while Malawi reported 98,44, Swaziland 98,86 and Zimbabwe 99,10.

The sugar supplied to the Sugar Terminal had a higher pol (99,45) and the average analysis of all sugars received by the Terminal during the 1988/89 season is listed in Table 4.

Table 4

Average analysis of sugar supplied to the Terminal 1988/89 season

Pol %	99,45
Moisture %	0,11
Colour (ICUMSA)	1375
Colour affinated	794
Starch ppm	110
Ash %	0,13
Fines %	28
Gums ppm	775

It was noted that the change in sugar quality as the season progressed was less marked than during previous years, and sugar quality seems to have followed the same trend as cane quality (Figure 1). There was also considerably less increase in colour (only about 4%) during bulk storage in the Terminal.

An interesting observation on the influence of vacuum pan seeding on the bulk density of sugar was reported by SZ, where experiments carried out during the season showed that the 50 ton railway trucks could not be filled to the rated capacity when the A-pans were seeded with slurry, while no difficulties were experienced when the A-massecuites were boiled on a B-magma footing. Surprisingly, the difference in bulk density was not related to a difference in the C.V. of the sugar.

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TABLE B_1
CANE CRUSHED AND SUGAR MADE, CANE COMPOSITION, SOUTH AFRICAN MILLS

SYMBOLS OF FACTORIES	ML *	PG **	UF	EN **	FX-A *	FX-B *	FX-AVE	AK *	DL	MS-A *	MS-B
TONS SUGAR MADE AND ESTIMATED	-	-	-	-	-	-	-	-	-	-	-
Refined % total sugar	99.63	100.00	92.69	52.97	-	-	-	-	-	-	-
Moisture raw sugar	-	-	0.31	0.17	-	-	0.14	0.11	0.12	-	-
Pol raw sugar	97.69	-	98.69	99.05	-	-	99.46	99.43	99.40	-	-
Tons cane crushed total							-				
Tons cane crushed per tandem	-	-	-	-	-	-		-	-	-	-
Season started on	11.04.88	13.04.88	10.05.88	14.04.88			14.04.88	12.04.88	8.04.88		
Season completed on	24.12.88	12.11.88	18.12.88	28.01.89			04.12.88	27.11.88	5.12.88		
Number of crushing days	257	213	222	289	-	-	234	229	241	-	-
TIME ACCOUNT											
Overal time efficiency %	79.33	80.18	67.55	61.53	76.34	77.40	76.87	81.41	80.81	81.60	75.30
Sched.stops% gross avail.time	5.89	5.89	6.36	12.70	7.42	8.96	8.19	9.79	7.40	4.87	4.40
Lack of cane % gross " "	7.84	8.87	11.81	8.50	13.23	10.98	12.11	7.69	6.72	4.59	10.72
Other stops % gross " "	6.94	5.06	14.28	17.27	3.01	2.66	2.84	1.10	5.07	8.94	9.59
Lost time % avail.crush.time	8.04	5.94	17.45	21.91	3.79	3.32	3.56	1.34	5.90	9.88	11.30
THROUGHPUTS / ACTUAL CRUSHING											
Tons of cane crushed	-	-	-	-	-	-	-	-	-	-	-
Tons of fibre milled	-	-	-	-	-	-	-	-	-	-	-
Tons of brix processed	-	-	-	-	-	-	-	-	-	-	-
Tons of sugar produced	-	-	-	-	-	-	-	-	-	-	-
Tons sucrose in mixed juice	-	-	-	-	-	-	-	-	-	-	-
Tons non-suc. in mixed juice	-	-	-	-	-	-	-	-	-	-	-
COMPOSITION OF CANE CRUSHED											
Sucrose % cane	13.02	12.33	12.37	12.82	12.24	12.26	12.25	12.69	12.52	11.80	12.06
Pol % cane	12.87	12.16	12.22	12.68	12.10	12.13	12.11	12.55	12.33	11.64	11.88
Fibre % cane	14.25	14.44	14.82	15.03	16.37	16.58	16.48	15.28	15.82	16.33	16.08
Brix % cane	15.44	14.77	14.56	15.07	14.81	14.87	14.84	15.11	14.90	14.25	14.49
Ash % cane	1.38	-	2.18	1.02	2.10	2.04	2.07	1.10	-	-	-
ERC % cane	11.26	10.57	10.72	11.14	10.38	10.37	10.37	10.92	10.76	10.00	10.28
ERC % sucrose in cane	86.49	85.74	86.73	86.89	84.80	84.63	84.72	86.06	85.95	84.80	85.23
EXTRACTION											
Extraction	97.77	97.60	96.89	97.85	98.05	98.09	98.07	98.06	97.63	97.60	97.31
Corrected reduced extraction	97.49	97.36	96.24	97.67	98.22	98.29	98.25	98.05	97.62	97.85	97.41
Imbibition % cane	44.81	45.31	43.75	54.52	60.96	58.73	59.85	63.18	48.66	55.13	59.62
Imbibition % fibre	321	328	349	382	375	357	366	416	325	341	389
Preparation index	92	88	90	90	91	91	91	92	91	91	91
Pol factor	99.32	99.39	99.86	99.79	100.91	100.55	100.73	100.19	99.68	99.40	100.71
Brix factor	100.41	100.15	100.72	100.64	102.54	102.23	102.38	100.87	100.48	100.50	101.55
RECOVERIES											
Boiling house recovery	86.31	86.35	86.77	88.75	-	-	87.41	89.05	88.62	-	-
C. R. B.	85.06	86.00	86.37	86.17	-	-	87.02	87.74	86.64	-	-
Overall recovery	84.39	84.27	84.07	86.84	-	-	85.72	87.32	86.52	-	-
Ton cane per ton sugar	9.10	9.61	9.61	8.94	-	-	9.48	8.97	9.17	-	-
Ton cane per ton 96 sugar	8.74	9.24	9.23	8.62	-	-	9.15	8.66	8.86	-	-
BALANCES											
Suc. lost % suc.in cane											
- in bagasse (a)	2.23	2.40	3.11	2.15	-	-	1.93	1.94	2.37	-	-
- in filter cake (b)	0.31	0.24	0.51	0.43	-	-	0.15	0.08	0.43	-	-
- in final molasses (c)	10.00	9.62	9.80	8.66	-	-	10.46	9.01	9.09	-	-
- undetermined (d)	3.08	3.46	2.50	1.91	-	-	1.73	1.65	1.58	-	-
Boiling house losses(b+c+d)	13.39	13.32	12.82	11.01	-	-	12.34	10.74	11.11	-	-
Sum of all losses(a+b+c+d)	15.61	15.73	15.93	13.16	-	-	14.28	12.68	13.48	-	-
Non sucrose ratio	1.02	1.02	0.97	1.00	-	-	0.98	0.94	1.01	-	-
Pol lost % pol in cane											
- in bagasse	2.25	2.44	3.15	2.17	-	-	1.95	1.96	2.40	-	-
- in filter cake	0.31	0.25	0.52	0.43	-	-	0.15	0.08	0.44	-	-
- in final molasses	9.12	8.60	9.42	8.45	-	-	9.80	8.40	8.45	-	-
- undetermined	2.97	3.29	1.81	1.09	-	-	1.43	1.28	0.86	-	-
Fructose ratio FM/MJ	0.94	0.85	0.73	0.77	-	-	0.86	0.88	0.80	-	-
Glucose ratio FM/MJ	0.76	0.60	0.59	0.73	-	-	0.71	0.73	0.65	-	-

* Cane diffuser

** Bagasse diffuser

THROUGHPUTS AND TIME ACCOUNTS, PERFORMANCES AND LOSSES (Season 1988—1989)

MS-AVE	ME	GD **	GH-A *	GH-B	GH-AVE	NB	UC *	IL *	SZ-A *	SZ-B *	SZ-AVE	UK	AVERAGE
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	96.47	100.00	-	-	-	-	-	-	31.61
0.07	0.25	0.13	-	-	0.10	0.00	0.10	0.11	-	-	0.12	0.17	0.13
99.39	98.98	99.33	-	-	99.37	0.00	99.54	99.47	-	-	99.46	99.12	99.37
-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.04.88	20.04.88	25.04.88			20.04.88	11.04.88	5.04.88	7.04.88			9.04.88	7.04.88	5.04.88
21.12.88	22.01.89	30.01.89			5.11.88	21.12.88	21.12.88	19.12.88			8.01.89	23.12.88	30.01.89
251	277	280	-	-	199	254	260	256	-	-	274	260	300
78.61	72.50	72.14	90.46	91.40	90.93	83.85	87.97	89.20	84.66	85.34	85.01	82.06	79.12
4.64	11.57	2.22	4.80	4.54	4.67	7.41	4.95	3.03	5.30	7.77	6.57	10.86	7.12
7.50	9.51	18.84	3.59	3.18	3.38	3.94	3.10	3.74	5.57	2.63	4.06	1.59	7.44
9.25	6.42	6.79	1.16	0.88	1.02	4.80	3.99	4.02	4.47	4.25	4.36	5.49	6.33
10.53	8.13	8.60	1.26	0.95	1.11	5.41	4.33	4.31	5.01	4.75	4.88	6.27	7.41
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.90	12.35	12.91	11.87	11.97	11.94	13.26	13.77	13.31	12.56	12.46	12.51	12.78	12.61
11.74	12.16	12.76	11.74	11.82	11.79	13.08	13.64	13.18	12.41	12.31	12.36	12.65	12.45
16.23	14.85	15.06	16.50	16.24	16.32	14.52	13.56	15.50	16.13	16.34	16.24	15.57	15.44
14.35	14.71	15.31	14.22	14.25	14.24	15.40	15.79	15.44	15.01	14.99	15.00	14.92	14.96
-	0.51	-	-	-	-	1.98	1.14	2.98	1.46	1.18	1.32	1.23	1.57
10.11	10.62	11.15	10.13	10.27	10.22	11.63	12.21	11.67	10.76	10.62	10.69	11.14	10.87
84.98	86.04	86.35	85.32	85.75	85.61	87.74	88.69	87.70	85.67	85.22	85.44	87.16	86.20
97.48	97.54	97.04	98.02	98.10	98.07	97.17	98.07	97.93	97.45	97.44	97.45	96.59	97.60
97.68	97.34	96.89	98.24	98.21	98.22	96.70	97.62	97.88	97.61	97.65	97.63	96.44	97.55
56.94	45.14	44.06	57.05	52.22	53.78	35.92	43.57	66.89	64.78	68.57	66.75	48.44	52.95
359	323	298	348	336	340	264	327	436	403	422	413	330	355
91	91	87	91	91	91	91	91	92	91	92	92	91	91
99.93	99.31	99.80	99.52	99.77	99.69	99.94	100.52	99.61	99.84	99.53	99.68	99.64	99.85
100.93	99.76	100.86	100.17	100.07	100.11	101.29	101.63	100.22	100.89	101.13	101.01	100.42	100.84
87.54	88.78	86.23	-	-	87.25	90.15	90.95	89.56	-	-	88.78	90.33	88.33
86.70	86.57	84.01	-	-	86.67	87.13	87.27	86.33	-	-	87.55	86.87	86.69
85.33	86.60	83.68	-	-	85.57	87.60	89.19	87.71	-	-	86.51	87.25	86.21
9.79	9.26	9.19	-	-	9.78	8.60	8.10	8.52	-	-	9.19	8.89	9.16
9.45	8.98	8.89	-	-	9.40	8.26	7.82	8.22	-	-	8.87	8.61	8.83
2.52	2.46	2.96	-	-	1.93	2.83	1.93	2.07	-	-	2.55	3.41	2.40
0.26	0.20	0.32	-	-	0.37	0.59	0.13	0.08	-	-	0.12	0.33	0.27
10.19	9.29	10.89	-	-	10.40	7.90	7.19	8.45	-	-	9.14	7.41	9.26
1.70	1.46	2.15	-	-	1.74	1.08	1.55	1.69	-	-	1.67	1.60	1.85
12.15	10.94	13.36	-	-	12.51	9.57	8.87	10.22	-	-	10.93	9.34	11.39
14.67	13.40	16.32	-	-	14.43	12.40	10.81	12.29	-	-	13.49	12.75	13.79
0.96	0.99	1.02	-	-	1.02	1.00	0.99	1.03	-	-	1.01	0.99	0.99
2.56	2.49	3.00	-	-	1.95	2.87	1.95	2.09	-	-	2.58	3.44	2.43
0.26	0.20	0.33	-	-	0.37	0.60	0.14	0.08	-	-	0.12	0.33	0.27
9.53	8.77	10.29	-	-	9.91	6.98	6.35	7.93	-	-	8.45	6.90	8.60
1.12	0.60	1.70	-	-	1.16	0.77	1.55	1.27	-	-	1.25	1.18	1.43
0.82	0.79	0.91	-	-	0.86	0.89	0.82	0.85	-	-	0.93	0.82	0.86
0.67	0.71	0.77	-	-	0.73	0.63	0.42	0.66	-	-	0.79	0.64	0.69

TABLE C_1
ANALYSIS OF BAGASSE, JUICES, FILTER SOUTH AFRICAN MILLS

SYMBOLS OF FACTORIES	ML *	PG **	UF	EN **	FX-A *	FX-B *	FX-AVE	AK *	DL	MS-A *	MS-B
FINAL BAGASSE											
Pol % bagasse	0.99	1.10	1.39	0.95	0.68	0.66	0.67	0.74	0.92	0.76	0.94
Moisture % bagasse	50.47	46.77	52.18	48.76	52.12	51.76	51.94	52.74	51.39	54.93	53.49
Fibre % bagasse	47.66	51.11	45.32	49.30	46.23	46.60	46.41	45.74	46.67	43.58	44.54
Bagasse % cane	29.27	27.04	27.66	28.95	35.15	35.33	35.24	33.23	32.12	37.13	34.43
Ash % bagasse	3.72	-	2.63	2.01	-	-	3.99	2.44	3.45	-	-
LCV in kJ per kg bagasse ##	7044	-	6883	7730	-	-	6693	6836	6905	-	-
MIXED JUICE											
Mixed juice % cane	115.53	118.28	116.08	125.57	125.81	123.40	124.61	129.95	116.54	118.00	125.20
Brix	12.89	12.01	11.95	11.56	11.31	11.58	11.44	11.24	12.26	11.61	11.03
Sucrose purity	85.47	84.74	86.40	86.48	84.34	84.14	84.24	85.22	85.59	84.02	84.94
Apparent purity	84.49	83.57	85.32	85.48	83.35	83.26	83.31	84.27	84.27	82.88	83.66
Purity difference(MJ - DAC)	0.21	0.60	0.69	0.65	0.34	0.30	0.32	0.62	0.86	0.32	0.99
Reducing sugars/pol ratio	8.68	6.25	5.98	5.11	-	-	5.57	5.70	5.69	-	-
Pol/sucrose ratio	0.9885	0.9861	0.9875	0.9883	0.9883	0.9896	0.9890	0.9889	0.9846	0.9864	0.9849
Suspended solids % mixed juice	0.26	0.52	1.97	0.60	0.10	0.10	0.10	0.06	0.71	0.12	0.60
CLARIFIED JUICE											
Brix	13.01	11.69	12.41	11.67	-	-	11.03	10.91	11.51	-	-
Apparent purity	84.43	82.74	84.99	86.05	-	-	82.95	84.23	84.53	-	-
Purity difference(CJ - MJ)	-0.06	-0.82	-0.32	0.58	-	-	-0.36	-0.04	0.26	-	-
Reducing sugars/pol ratio	8.66	6.51	6.32	4.82	-	-	5.75	6.05	5.43	-	-
Average pH	7.1	7.0	7.1	7.3	-	-	7.1	7.0	7.0	-	-
FILTER CAKE											
Pol % filter cake	2.21	0.79	1.30	1.28	-	-	0.69	0.84	1.08	-	-
Moisture % filter cake	76.00	69.80	69.99	77.56	-	-	75.81	77.76	74.65	-	-
Filter cake % cane	1.82	3.79	4.91	4.31	-	-	2.65	1.23	5.03	-	-
Filter wash index	99.1	102.7	96.2	99.0	-	-	103.7	103.0	106.5	-	-
Purity diff.(CJ - filtrate)	0.98	1.55	1.52	-0.26	-	-	2.32	1.20	1.73	-	-
SYRUP											
Brix	66.72	62.26	62.56	61.05	-	-	63.54	65.54	63.16	-	-
Apparent purity	84.60	83.05	84.93	86.07	-	-	83.26	84.33	84.95	-	-
Purity difference(Syrup - MJ)	0.11	-0.52	-0.39	0.60	-	-	-0.05	0.05	0.67	-	-
Reducing sugars/pol ratio	8.91	8.36	6.66	4.16	-	-	5.77	6.20	4.96	-	-
Average pH	6.2	6.3	6.4	6.8	-	-	6.0	6.1	6.2	-	-
FINAL MOLASSES											
Refracto brix	89.18	77.96	79.89	83.99	-	-	82.78	81.91	82.04	-	-
Pol/refracto brix purity	33.41	30.90	38.01	35.32	-	-	34.54	33.69	32.93	-	-
Suc/refracto brix purity	37.05	35.05	40.05	36.63	-	-	37.27	36.55	35.97	-	-
Pol/sucrose ratio	0.9019	0.8815	0.9493	0.9643	-	-	0.9267	0.9216	0.9156	-	-
TPD based on molasses	5.9	3.4	3.5	4.9	-	-	4.1	3.5	3.8	-	-
TPD based on mixed juice	7.0	5.5	5.9	7.3	-	-	5.5	4.9	5.9	-	-
Reducing sugars %	17.45	12.99	8.89	12.83	-	-	13.21	14.15	13.80	-	-
Sulphated ash %	14.40	14.01	17.67	13.58	-	-	14.07	14.62	14.37	-	-
Reducing sugars/ash ratio	1.21	0.93	0.50	0.94	-	-	0.94	0.97	0.96	-	-
Fructose %	9.13	7.44	5.21	6.95	-	-	7.41	7.98	7.83	-	-
Glucose %	8.32	5.55	3.69	5.88	-	-	5.80	6.17	5.97	-	-
Final mol at 85 brix % cane	4.13	3.98	3.56	3.57	-	-	4.04	3.68	3.72	-	-

* Cane diffuser

** Bagasse diffuser

LCV = 18 309 — 31,14 Bx % bagasse — 207,63 moisture % bagasse — 196,05 ash % bagasse

CAKE, SYRUP AND FINAL MOLASSES
(Season 1988—1989)

MS-AVE	ME	GD **	GH-A *	GH-B	GH-AVE	NB	UC *	IL *	SZ-A *	SZ-B *	SZ-AVE	UK	AVERAGE
0.83	1.03	1.21	0.72	0.75	0.74	1.27	0.98	0.89	0.96	0.94	0.95	1.39	0.96
54.37	50.43	51.11	48.50	47.25	47.67	51.56	49.15	48.87	49.87	50.13	50.01	50.32	50.92
43.95	47.46	46.68	50.02	51.24	50.83	45.98	49.16	49.51	48.21	47.96	48.08	47.04	47.17
36.04	29.47	31.67	32.77	30.34	31.13	29.60	27.13	30.96	33.32	33.92	33.63	31.23	31.64
-	-	-	-	-	-	4.40	2.29	5.35	-	-	3.48	2.21	2.62
-	-	-	-	-	-	6666	7604	7063	-	-	7185	7346	7165
120.91	115.67	112.40	124.28	121.87	122.65	106.32	116.44	135.93	131.46	134.65	133.11	117.20	121.30
11.37	12.18	13.00	11.05	11.32	11.23	13.80	13.17	10.99	10.93	10.65	10.79	12.03	11.83
84.39	85.52	85.72	84.71	85.13	84.99	87.82	88.05	87.28	85.18	84.66	84.91	87.54	85.70
83.19	84.19	84.66	83.78	84.03	83.95	86.61	87.22	86.37	84.11	83.59	83.84	86.62	84.64
0.59	1.13	0.48	0.65	0.86	0.79	0.52	-0.11	0.50	0.58	0.18	0.37	1.21	0.57
6.50	6.68	6.11	-	-	6.26	2.58	4.36	4.64	-	-	4.90	4.63	5.60
0.9858	0.9844	0.9877	0.9890	0.9871	0.9877	0.9863	0.9906	0.9895	0.9875	0.9873	0.9874	0.9895	0.9876
0.32	0.74	0.25	0.08	0.56	0.41	0.86	0.19	0.12	0.05	0.05	0.05	0.75	0.42
10.64	11.06	12.23	-	-	10.86	12.99	13.66	11.02	-	-	10.49	11.56	11.52
82.73	84.27	85.08	-	-	83.54	87.10	87.30	85.77	-	-	83.39	86.81	84.47
-0.46	0.08	0.42	-	-	-0.41	0.48	0.07	-0.60	-	-	-0.45	0.19	-0.17
6.62	7.15	6.98	-	-	6.60	2.50	4.54	4.88	-	-	5.50	4.53	5.82
7.1	7.1	6.8	-	-	7.0	7.1	7.0	7.2	-	-	7.2	7.1	7.1
0.78	0.55	1.85	-	-	1.07	1.43	1.42	0.79	-	-	0.76	0.95	1.05
74.81	73.68	0.00	-	-	71.14	69.90	77.45	75.97	-	-	77.20	77.67	72.90
3.98	4.42	2.26	-	-	4.11	5.46	1.30	1.37	-	-	1.98	4.36	3.24
106.9	110.1	106.3	-	-	103.4	106.3	96.4	99.7	-	-	102.8	104.1	102.7
2.51	0.51	2.55	-	-	1.55	1.05	2.38	0.77	-	-	0.50	0.58	1.23
66.73	67.37	66.50	-	-	65.36	68.75	68.76	62.92	-	-	58.35	70.45	64.68
84.00	84.95	85.54	-	-	83.73	87.28	87.68	86.00	-	-	83.80	87.28	84.79
0.81	0.76	0.88	-	-	-0.22	0.66	0.46	-0.37	-	-	-0.04	0.66	0.16
6.45	6.50	6.37	-	-	6.42	2.54	5.06	5.42	-	-	5.99	4.73	5.95
5.9	6.3	6.4	-	-	6.2	6.0	6.4	6.2	-	-	6.1	6.2	6.2
83.28	80.48	80.21	-	-	80.69	81.40	81.81	80.66	-	-	80.75	82.27	82.12
34.89	34.48	37.75	-	-	34.83	32.26	31.40	34.45	-	-	31.88	33.50	33.78
37.80	37.10	40.45	-	-	37.01	37.00	35.89	37.06	-	-	34.90	36.38	36.83
0.9230	0.9294	0.9333	-	-	0.9411	0.8720	0.8750	0.9295	-	-	0.9135	0.9209	0.9172
4.7	4.4	7.3	-	-	4.1	3.6	2.2	4.7	-	-	3.2	2.8	4.1
6.6	6.5	8.5	-	-	5.9	5.8	5.5	6.7	-	-	4.3	5.3	5.8
13.51	12.99	12.61	-	-	13.77	12.98	9.72	11.53	-	-	14.57	12.57	13.43
14.40	13.60	12.43	-	-	13.93	13.07	13.48	12.74	-	-	13.20	15.14	14.07
0.94	0.96	1.01	-	-	0.99	0.99	0.72	0.91	-	-	1.10	0.83	0.95
7.67	7.52	7.53	-	-	7.77	8.11	6.76	6.84	-	-	8.27	7.34	7.67
5.83	6.00	5.75	-	-	6.00	4.87	2.96	4.69	-	-	6.30	5.22	5.80
3.77	3.64	4.09	-	-	3.95	3.33	3.24	3.57	-	-	3.85	3.06	3.73

TABLE D₁

MASSECUITES, EXHAUSTIONS, CLARIFYING AGENTS AND ADDITIONAL FUELS
SOUTH AFRICAN MILLS (Season 1988—1989)

SYMBOLS OF FACTORIES	ML	PG	UF	EN	FX	AK	DL	MS	ME	GD	GH	NB	UC	IL	SZ	UK	AVERAGES
Brix in mixed juice % cane	14.89	14.20	13.87	14.51	14.26	14.60	14.28	13.75	14.08	14.62	13.78	14.67	15.34	14.94	14.36	14.10	14.36
A - MASSECUITE																	
m3 per ton brix in mixed juice	1.00	1.09	0.99	1.16	1.00	0.95	0.95	1.00	1.06	0.97	0.96	1.08	0.98	1.00	1.03	0.97	1.01
Ref brix of massecuite	92.58	91.29	92.58	92.59	92.46	92.74	93.39	92.74	91.51	91.74	91.72	92.16	92.61	93.17	92.53	91.94	92.42
Purity of massecuite	86.01	83.85	86.18	86.52	83.33	85.50	85.62	83.82	85.31	85.55	86.15	87.40	87.20	86.85	84.15	86.49	85.40
Purity of A - molasses	70.79	65.83	70.93	70.16	64.94	65.24	65.76	65.62	69.51	69.92	66.48	68.35	68.86	68.18	65.96	68.67	67.37
Purity drop	15.21	18.02	15.25	16.35	18.39	20.26	19.86	18.20	15.80	15.63	19.67	19.05	18.34	18.67	18.20	17.81	18.03
Exhaustion	60.56	62.89	60.88	63.35	62.95	68.16	67.74	63.16	60.74	60.75	68.10	68.86	67.54	67.56	63.52	65.75	64.71
Pty of A-mass - purity syrup	1.40	0.80	1.25	0.44	0.07	1.17	0.67	-0.18	0.36	0.01	2.42	0.12	-0.48	0.85	0.35	-0.80	0.61
Pty of remelt	87.60	82.73	86.31	81.23	82.93	85.57	85.68	81.44	86.62	87.89	84.35	84.70	85.69	84.86	84.93	85.87	84.87
B - MASSECUITE																	
m3 per ton brix in mixed juice	0.46	0.38	0.43	0.34	0.28	0.25	0.38	0.30	0.41	0.37	0.37	0.32	0.32	0.30	0.29	0.33	0.34
Ref brix of massecuite	94.66	93.01	94.75	93.84	94.78	94.41	94.86	94.11	92.43	93.63	93.63	94.32	95.25	94.41	94.11	93.68	94.20
Purity of massecuite	72.07	65.54	71.27	70.62	66.02	66.15	66.84	64.67	69.83	70.68	67.20	68.47	69.39	68.82	66.09	68.84	68.12
Purity of B - molasses	47.09	40.56	51.19	50.72	43.31	42.08	43.55	43.80	47.16	47.92	43.52	43.51	43.08	43.12	39.75	44.55	44.30
Purity drop	24.97	24.97	20.08	19.90	22.71	24.08	23.29	20.87	22.67	22.76	23.68	24.96	26.31	25.70	26.34	24.28	23.81
Exhaustion	65.50	64.11	57.72	57.18	60.67	62.83	61.72	57.43	61.43	61.83	62.39	64.53	66.62	65.65	66.15	63.62	62.77
C - MASSECUITE																	
m3 per ton brix in mixed juice	0.25	0.28	0.24	0.25	0.27	0.25	0.25	0.26	0.26	0.24	0.25	0.25	0.18	0.22	0.28	0.23	0.25
Ref brix of massecuite	98.25	95.77	95.28	97.82	97.06	96.61	95.50	96.75	96.02	96.12	96.14	96.07	96.52	96.19	95.91	96.52	96.45
Purity of massecuite	52.86	50.91	53.55	53.83	54.88	53.32	52.40	54.38	55.05	53.31	51.15	54.87	50.67	52.72	53.50	52.23	53.34
Purity of C - molasses	33.41	30.90	38.01	35.32	34.54	33.69	32.93	34.89	34.48	37.75	34.83	32.26	31.40	34.45	31.88	33.50	33.78
Crystal content	28.70	27.73	23.88	28.00	30.16	28.60	27.72	28.96	30.15	24.02	24.07	32.06	27.11	26.81	30.44	27.19	28.50
Exhaustion	55.26	56.88	46.81	53.17	56.61	55.52	55.39	55.05	57.03	46.88	48.95	60.82	55.43	52.87	59.33	53.93	55.39
TOTAL VOLUME ALL RAW MASSECUITES m3 per ton brix in mixed juice	1.71	1.76	1.66	1.74	1.55	1.44	1.58	1.57	1.72	1.58	1.58	1.65	1.49	1.52	1.59	1.53	1.59
WHITE SUGAR MASSECUITES Kg sugar per m3 massecuite	624	551	744	699	-	-	-	-	-	-	664	542	-	-	-	-	611
Tons limestone per 1000 tons white sugar	-	66.6	-	-	-	-	-	-	-	-	38.5	-	-	-	-	-	-
Tons coke/1000 tons white sugar	-	7.3	-	-	-	-	-	-	-	-	3.5	-	-	-	-	-	-
Tons phos acid/1000 tons white sugar	-	-	-	0.48	-	-	-	-	-	-	-	0.91	-	-	-	-	-
Tons sulphur/1000 tons white sugar	0.04	0.12	5.16	-	-	-	-	-	-	-	0.11	-	-	-	-	-	-
Phos. acid ppm mixed juice	-	-	-	-	-	-	-	-	-	-	0.0	9.3	-	-	-	-	-
Flocculant ppm mixed juice	2.1	0.0	6.8	1.9	8.0	4.0	3.9	2.4	1.6	7.3	3.3	5.9	3.1	4.6	6.9	1.0	4.3
Tons lime per 1000 tc	#1.7	-	1.4	#0.5	0.8	0.6	0.7	0.9	0.6	0.6	-	#0.6	0.5	0.6	0.6	0.5	0.7
Enzyme ppm sugar	-	-	-	-	-	0.3	19.1	13.4	4.9	18.2	14.0	1.3	5.4	1.8	2.8	6.1	4.9
ADDITIONAL FUELS PER 1000 TC																	
Tons of coal	*17.00	9.71	12.10	*23.49	*14.70	1.27	0.04	*18.47	0.81	9.79	-	3.29	2.68	0.67	-	0.51	-
Tons of wood	-	0.41	-	0.94	0.09	-	0.65	0.03	0.13	3.89	-	-	0.83	0.28	-	0.15	-
Converted into bagasse **	68.02	39.32	48.41	95.08	58.93	5.09	0.95	73.91	3.39	43.83	-	13.16	11.71	3.01	-	2.23	-

* Part of bagasse used for by-products
** 1 ton coal equivalent to 4 tons of bagasse
1 ton firewood equivalent to 1,2 tons of bagasse
\# Includes lime used in refinery

TABLE B2

CANE CRUSHED AND SUGAR MADE, CANE COMPOSITION, THROUGHPUTS AND TIME ACCOUNTS, PERFORMANCES AND LOSSES SWAZILAND, MALAWI AND ZIMBABWE MILLS (Season 1988—1989)

SYMBOLS OF FACTORIES	MH-A	MH-B *	MH-AVE	UR-A *	UR-B	UR-AVE	SM	NH-A **	NH-B	NH-AVE	DW	HV-A *	HV-B *	HV-AVE	TR-A *	TR-B *	TR-AVE
TONS SUGAR MADE AND ESTIMATED	-	-	148888	-	-	157906	130630	-	-	100796	69607	-	-	227608	-	-	199489
Refined % total sugar	-	-	-	-	-	19.40	-	-	-	42.23	79	-	-	13.45	-	-	13.89
Moisture raw sugar	-	-	0.22	-	-	0.31	0.26	-	-	0.18	0.12	-	-	0.20	-	-	0.17
Pol raw sugar	-	-	97.96	-	-	98.80	98.74	-	-	98.85	98.88	-	-	98.96	-	-	99.25
Tons cane crushed total			1247615			1331538				907037				1724277			1820314
Tons cane crushed per tandem	646268	601347		664130	667408		1110360	358951	548086		597065	843293	880984		1195958	624356	
Season started on	-	-	2.05.88	-	-	4.05.88	22.04.88	-	-	5.04.88	18.05.88	-	-	10.05.88	-	-	5.04.88
Season completed on	-	-	2.12.88	-	-	22.12.88	17.11.88	-	-	25.11.88	8.11.88	-	-	13.11.88	-	-	16.11.88
Number of crushing days	-	-	214	-	-	232	209	-	-	234	174	-	-	187	-	-	225
TIME ACCOUNT																	
Overal time efficiency %	85.59	77.74	81.66	79.10	87.01	83.06	79.37	74.58	83.05	78.81	88.83	93.00	94.32	93.66	91.78	86.10	89.20
Sched.stops% gross avail.time	4.35	4.82	4.59	2.84	2.60	2.72	4.16	3.95	3.90	3.93	6.16	3.35	2.99	3.17	4.72	4.97	4.84
Lack of cane % gross " "	7.39	11.33	9.36	4.57	2.67	3.62	13.05	10.77	8.20	9.49	1.36	0.30	0.14	0.22	0.15	3.02	1.45
Other stops % gross " "	2.67	6.12	4.39	13.49	7.72	10.60	3.42	10.69	4.85	7.77	3.65	3.35	2.55	2.95	3.34	5.91	4.51
Lost time % avail.crush.time	3.02	7.29	5.11	14.57	8.15	11.32	4.14	12.54	5.52	8.98	3.94	3.48	2.63	3.05	3.51	6.43	4.81
THROUGHPUTS / ACTUAL CRUSHING																	
Tons of cane crushed	146.07	149.45	295.52	151.53	138.43	289.97	278.00	85.48	117.28	202.76	162.75	209.08	214.28	423.36	241.60	161.87	403.47
Tons of fibre milled	20.91	20.33	41.24	21.47	18.77	40.23	34.09	13.28	18.31	31.59	24.32	31.06	31.87	62.93	37.80	24.74	62.54
Tons of brix processed	21.79	21.79	43.58	22.78	20.70	43.49	41.09	12.53	17.05	29.58	26.74	34.26	35.32	69.58	37.15	24.92	62.07
Tons of sugar produced	-	-	35.25	-	-	34.31	32.71	-	-	22.72	18.97	-	-	55.89	-	-	40.56
Tons sucrose in mixed juice	18.54	18.62	37.16	19.47	17.70	37.08	34.93	10.62	14.45	25.28	22.87	29.78	30.81	60.60	32.03	21.31	54.67
Tons non-suc. in mixed juice	3.25	3.17	6.42	3.32	3.00	6.32	6.16	1.91	2.60	4.50	3.88	4.48	4.51	9.00	5.12	3.61	8.73
COMPOSITION OF CANE CRUSHED																	
Pol % cane	12.95	12.85	12.90	13.19	13.19	13.19	12.91	12.81	12.68	12.73	14.36	14.54	14.68	14.61	13.56	13.69	13.60
Fibre % cane	14.77	14.63	14.70	14.49	14.36	14.43	13.41	15.96	16.26	16.14	14.94	15.36	15.38	15.37	15.85	15.66	15.79
Brix % cane	15.41	15.27	15.34	15.69	15.72	15.71	15.42	15.53	15.03	15.23	16.77	16.96	17.05	17.01	15.96	16.25	16.06
Ash % cane	-	-	-	-	-	-	1.18	-	-	-	-	-	-	-	-	-	-
ERC % cane	11.16	11.08	11.12	11.37	11.37	11.37	11.12	10.86	10.92	10.89	12.56	12.72	12.90	12.81	11.76	11.81	11.78
ERC % sucrose in cane	86.18	86.27	86.22	86.25	86.20	86.22	86.14	84.82	86.11	85.60	87.49	87.52	87.82	87.68	86.77	86.32	86.61
EXTRACTION																	
Extraction	97.99	96.98	97.50	97.42	96.93	97.18	97.34	97.03	97.21	97.14	97.85	97.98	97.92	97.95	97.79	96.19	97.24
Corrected reduced extraction	97.81	96.55	97.22	97.12	96.41	96.78	96.57	97.08	97.29	97.21	97.61	97.74	97.66	97.70	97.76	96.03	97.18
Imbibition % cane	61.72	52.94	57.49	49.87	44.99	47.42	46.26	46.61	40.69	43.04	48.38	54.46	51.43	52.92	55.85	55.83	55.84
Imbibition % fibre	431	389	411	352	332	342	377	300	261	276	324	367	346	356	357	365	360
Preparation index	91	90	91	91	91	91	86	85	87	87	90	93	93	93	91	90	90
Pol factor	99.75	99.20	99.48	97.92	98.18	98.05	99.26	-	-	-	98.85	99.86	100.19	100.03	-	-	-
Brix factor	102.18	101.33	101.77	98.85	99.08	98.96	100.22	-	-	-	97.70	100.60	100.77	100.68	-	-	-
RECOVERIES																	
Boiling house recovery	-	-	92.92	-	-	91.62	92.46	-	-	89.35	-	-	-	91.40	-	-	-
Overall recovery	-	-	90.60	-	-	89.04	90.00	-	-	86.80	-	-	-	89.52	-	-	-
Ton cane per ton sugar	-	-	8.38	-	-	8.43	8.50	-	-	9.00	-	-	-	7.58	-	-	-
Ton cane per ton 96 sugar	-	-	8.21	-	-	8.18	8.26	-	-	8.69	-	-	-	7.34	-	-	-
BALANCES																	
Pol lost % pol in cane																	
- in bagasse (a)	-	-	2.50	-	-	2.82	2.66	-	-	2.86	2.15	-	-	2.05	-	-	2.76
- in filter cake (b)	-	-	0.12	-	-	0.10	0.18	-	-	0.21	0.08	-	-	0.08	-	-	0.15
- in final molasses (c)	-	-	6.24	-	-	6.59	7.07	-	-	11.55	-	-	-	7.26	-	-	-
- undetermined (d)	-	-	0.54	-	-	1.45	0.09	-	-	-1.42	-	-	-	1.09	-	-	-
Boiling house losses(b+c+d)	-	-	6.90	-	-	8.14	7.34	-	-	10.34	-	-	-	8.43	-	-	-
Sum of all losses(a+b+c+d)	-	-	9.40	-	-	10.96	10.00	-	-	13.21	-	-	-	10.48	-	-	-
Non pol ratio	-	-	1.04	-	-	0.94	0.91	-	-	1.01	-	-	-	0.95	-	-	-
Red .sug. in F.M.% R.S. in M.J.	-	-	-	-	-	-	95.02	-	-	-	-	-	-	74.34	-	-	-

* Cane diffuser

** Bagasse diffuser

TABLE C_2

ANALYSIS OF BAGASSE, JUICES, FILTER CAKE, SYRUP AND FINAL MOLASSES SWAZILAND, MALAWI AND ZIMBABWE MILLS (Season 1988—1989)

SYMBOLS OF FACTORIES	MH-A	MH-B *	MH-AVE	UR-A *	UR-B	UR-AVE	SM	NH-A **	NH-B	NH-AVE	DW	HV-A *	HV-B *	HV-AVE	TR-A *	TR-B *	TR-AVE
FINAL BAGASSE																	
Pol % bagasse	0.87	1.35	1.09	1.11	1.42	1.26	1.33	1.14	1.11	1.12	1.07	0.99	1.01	1.00	0.94	1.65	1.18
Moisture % bagasse	50.76	50.21	50.50	51.34	49.72	50.56	49.99	50.63	49.41	49.90	46.99	47.93	49.00	48.48	49.28	48.84	49.13
Fibre % bagasse	47.58	47.39	47.49	46.49	47.59	47.02	47.53	46.73	49.03	48.10	51.83	50.13	49.13	49.62	48.89	48.46	48.75
Bagasse % cane	30.09	28.70	29.42	30.47	28.49	29.47	25.80	33.25	31.83	32.39	28.83	29.63	30.27	29.96	32.00	31.53	31.84
Ash % bagasse	-	-	-	-	-	-	3.65	-	-	-	-	-	-	1.64	-	-	-
LCV in kJ per kg bagasse ##	-	-	-	-	-	-	7137	-	-	-	-	-	-	7863	-	-	-
MIXED JUICE																	
Mixed juice % cane	131.63	124.24	128.07	119.40	116.50	117.95	120.47	113.37	108.86	110.64	119.55	124.83	121.16	122.96	123.85	124.29	124.00
Brix	11.33	11.74	11.52	12.59	12.84	12.71	12.27	12.93	13.35	13.18	13.75	13.13	13.61	13.37	12.42	12.39	12.41
Apparent purity	85.09	85.45	85.26	85.44	85.51	85.47	85.00	84.79	84.77	84.78	85.50	86.91	87.22	87.07	86.22	85.50	85.97
Purity difference(MJ - DAC)	-0.99	-0.50	-0.76	0.63	0.83	0.73	0.49	-	-	-	0.89	0.57	0.61	0.59	-	-	-
Reducing sugars/pol ratio	-	-	4.68	-	-	2.42	5.15	-	-	2.42	6.05	-	-	4.50	-	-	2.42
Suspended solids % mixed juice	0.34	0.83	0.57	0.27	0.69	0.48	0.96	-	-	-	-	0.41	0.42	0.41	0.17	0.31	0.22
CLARIFIED JUICE																	
Brix	-	-	11.68	-	-	12.84	12.09	-	-	13.62	13.10	-	-	13.89	-	-	12.35
Apparent purity	-	-	85.04	-	-	85.63	83.47	-	-	87.33	85.85	-	-	87.71	-	-	85.91
Purity difference(CJ - MJ)	-	-	-0.23	-	-	0.16	-1.53	-	-	2.55	0.35	-	-	0.64	-	-	-0.07
Reducing sugars/pol ratio	-	-	4.61	-	-	4.05	5.12	-	-	4.05	6.05	-	-	4.23	-	-	4.05
Average pH	-	-	7.2	-	-	7.1	7.3	-	-	7.1	6.9	-	-	7.0	-	-	7.1
FILTER CAKE																	
Pol % filter cake	-	-	0.70	-	-	0.52	0.65	-	-	0.84	0.59	-	-	1.46	-	-	0.86
Moisture % filter cake	-	-	66.33	-	-	0.00	62.96	-	-	72.58	73.54	-	-	72.49	-	-	-
Filter cake % cane	-	-	2.24	-	-	2.58	3.60	-	-	3.20	2.02	-	-	0.77	-	-	2.30
Filter wash index	-	-	0.99	-	-	0.99	1.01	-	-	0.97	1.05	-	-	0.96	-	-	1.00
Purity diff.(CJ - filtrate)	-	-	0.39	-	-	1.01	-0.14	-	-	2.58	-	-	-	-2.09	-	-	-0.09
SYRUP																	
Brix	-	-	61.00	-	-	65.73	65.98	-	-	67.59	63.49	-	-	65.94	-	-	67.15
Apparent purity	-	-	85.38	-	-	86.60	84.08	-	-	87.13	86.34	-	-	87.54	-	-	85.95
Purity difference(Syrup - MJ)	-	-	0.12	-	-	1.13	-0.93	-	-	2.35	0.84	-	-	0.47	-	-	-0.02
Reducing sugars/pol ratio	-	-	5.28	-	-	3.62	5.52	-	-	3.62	6.38	-	-	4.69	-	-	3.62
Average pH	-	-	6.3	-	-	6.3	6.2	-	-	6.8	6.3	-	-	6.2	-	-	6.1
FINAL MOLASSES																	
Refracto brix	-	-	83.07	-	-	83.62	84.43	-	-	77.62	-	-	-	85.55	-	-	-
Pol/refracto brix purity	-	-	28.30	-	-	30.70	32.48	-	-	40.20	-	-	-	35.63	-	-	-
Suc/refracto brix purity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Purity difference(true-target)	-	-	-	-	-	5.26	-	-	-	-	-	-	-	8.13	-	-	-
Reducing sugars %	-	-	23.28	-	-	18.88	18.47	-	-	12.17	-	-	-	13.75	-	-	-
Sulphated ash %	-	-	-	-	-	15.32	16.42	-	-	-	-	-	-	14.17	-	-	-
Reducing sugars/ash ratio	-	-	-	-	-	1.23	1.12	-	-	-	-	-	-	0.97	-	-	-
Final mol at 85 brix % cane	-	-	3.35	-	-	3.33	3.31	-	-	4.30	-	-	-	3.50	-	-	-

* Cane diffuser

** Bagasse diffuser

LCV = 18 309 — 31,14 Bx % bagasse — 207,63 moisture % bagasse — 196,05 ash % bagasse

TABLE D_2

MASSECUITES, EXHAUSTIONS, CLARIFYING AGENTS AND ADDITIONAL FUELS SWAZILAND, MALAWI AND ZIMBABWE MILLS (Season 1988—1989)

SYMBOLS OF FACTORIES	MH	UR	SM	NH	DW	HV	TR
Brix in mixed juice % cane	14.76	14.99	14.78	14.58	16.43	16.44	15.38
A - MASSECUITE							
m3 per ton brix in mixed juice	0.89	1.03	0.92	1.28	1.19	1.11	0.96
Ref brix of massecuite	92.70	92.50	93.38	92.31	91.63	91.78	92.50
Purity of massecuite	86.13	85.24	84.53	85.82	89.57	88.81	86.77
Purity of A - molasses	64.78	67.18	64.95	72.41	78.59	73.28	70.90
Purity drop	21.35	18.06	19.58	13.41	10.98	15.54	15.87
Exhaustion	70.38	64.56	66.09	56.63	57.24	65.46	62.85
Purity of A-mass - pty syrup	0.75	-1.36	0.46	-1.31	3.23	1.27	0.82
Purity of remelt	-	84.43	83.29	98.64	93.06	87.68	-
B - MASSECUITE							
m3 per ton brix in mixed juice	0.34	0.33	0.27	0.52	0.62	0.42	0.36
Ref brix of massecuite	94.53	94.02	95.64	95.20	92.63	93.35	93.49
Purity of massecuite	66.94	67.64	65.19	73.69	75.42	74.68	72.15
Purity of B - molasses	40.84	49.65	43.17	54.61	50.04	52.07	54.40
Purity drop	26.10	17.99	22.02	19.08	25.37	22.61	17.75
Exhaustion	65.91	52.82	59.44	57.04	67.35	63.16	53.95
C - MASSECUITE							
m3 per ton brix in mixed juice	0.22	0.23	0.23	0.33	-	-	-
Ref brix of massecuite	98.02	97.76	97.97	98.30	-	96.34	-
Purity of massecuite	50.80	53.15	52.49	58.92	-	53.48	-
Purity of C - molasses	28.30	30.70	32.48	40.20	-	35.27	-
Crystal content	30.77	31.67	29.03	30.77	-	27.10	-
Exhaustion	61.79	60.95	56.46	53.12	-	52.60	-
TOTAL VOLUME ALL RAW MASSECUITES							
m3 per ton brix in mixed juice	1.45	1.59	1.42	2.13	-	-	-
WHITE SUGAR MASSECUITES							
Kg sugar per m3 massecuite	-	564	-	478	607	-	-
Tons phos acid/1000 tons white sugar	-	-	-	0.84	-	-	-
Tons sulphur/1000 tons white sugar	-	0.11	-	0.23	0.15	-	-
Phos. acid ppm mixed juice	-	-	-	-	-	-	-
Flocculant ppm mixed juice	2.2	1.4	1.4	2.2	1.5	2.2	-
Tons lime per 1000 tc	0.4	0.6	0.4	1.2	1.6	1.2	0.5
Enzyme ppm sugar	-	-	1.7	-	4.2	-	-
ADDITIONAL FUELS PER 1000 TC							
Tons of coal	1.34	2.51	0.15	-	-	0.71	5.20
Tons of wood	-	-	-	0.13	0.06	-	-
Converted into bagasse *	5.37	10.05	0.61	0.15	0.07	2.86	20.82

* 1 ton coal equivalent to 4 tons of bagasse
1 ton firewood equivalent to 1,2 tons of bagasse
Includes lime used in refinery

TABLE E
COMPARATIVE MANUFACTURING DATA OF RECENT YEARS (SOUTH AFRICAN MILLS)

Season	1988/89	1987/88	1986/87	1985/86	1984/85
Throughput and time efficiency					
Tons cane per hour	-	-	-	253.19	251.28
Tons fibre per hour	-	-	-	37.44	37.56
Time efficiency	79.12	74.73	81.41	79.60	77.06
Cane					
Sucrose % cane	12.61	12.00	12.80	13.13	12.27
Fibre % cane	15.44	15.23	15.24	15.38	15.62
Mixed juice					
Sucrose purity	85.70	85.25	85.44	84.55	85.69
Reducing sugars/pol ratio	5.60	6.28	6.15	6.71	5.76
Milling					
Imbibition % fibre	355	357	368	358	344
Extraction	97.60	97.63	97.66	97.47	97.42
Pol % bagasse	0.96	0.91	0.95	1.04	0.99
Moisture % bagasse	50.92	51.24	51.27	51.64	51.35
Bagasse % cane	31.64	31.41	31.53	31.93	31.97
LCV bagasse kJ/kg	7165	7081	7158	7140	7174
Avail. kJ in bag./kg brix in M.J.	15792	16182	15430	15055	16438
Recoveries					
Boiling house recovery	88.33	87.84	87.70	87.51	88.23
Overall recovery	86.21	85.76	85.65	85.30	85.96
Tons cane per ton sugar	9.16	9.67	9.08	8.88	9.43
Filter cake					
Pol % filter cake	1.05	0.99	1.15	1.14	1.13
Filter cake % cane	3.24	3.28	3.39	3.50	3.70
Final molasses					
Brix	82.12	82.37	82.48	82.39	82.58
Gravity purity	36.83	36.82	36.67	36.35	36.95
Fin. mol. - tons 85 Bx % cane	3.73	3.70	3.90	4.23	3.67
Average sugar polarisation	99.55	99.54	99.52	99.51	99.50
Sucrose balance					
Lost in bagasse	2.40	2.37	2.34	2.53	2.58
Lost in filter cake	0.27	0.27	0.30	0.30	0.34
Lost in final molasses	9.26	9.64	9.51	9.95	9.40
Undetermined losses	1.86	1.96	2.20	1.91	1.73
Lost in boiling house	11.39	11.87	12.01	12.16	11.47
Total losses	13.79	14.24	14.35	14.69	14.05
M3 massecuite per ton Bx in M.J.					
A - massecuite	1.01	1.00	1.00	0.98	1.04
B - massecuite	0.34	0.35	0.36	0.35	0.39
C - massecuite	0.25	0.26	0.26	0.26	0.26
Total	1.60	1.61	1.61	1.59	1.69
Exhaustion of massecuites					
A - massecuite	64.71	63.87	64.10	63.28	63.65
B - massecuite	62.77	62.59	63.08	62.48	61.83
C - massecuite	55.38	54.55	53.81	54.60	53.88
Brix of syrup	64.68	64.95	66.33	66.65	66.48

TABLE F

AVERAGE MANUFACTURING RESULTS BY MONTHLY PERIODS FOR SOUTH AFRICAN MILLS (Season 1988—1989)

End of month period		APRIL 30 1988	MAY 28 1988	JULY 2 1988	JULY 30 1988	AUGUST 27 1988	OCT. 1 1988	OCT. 29 1988	NOV.26 1988	DEC. 31 1988	JAN. 28 1989
Tons of sugar made and estimated	Month	-	-	-	-	-	-	-	-	-	-
	To-date	-	-	-	-	-	-	-	-	-	-
Tons cane crushed	Month	-	-	-	-	-	-	-	-	-	-
	To-date	-	-	-	-	-	-	-	-	-	-
Tons cane crushed per hour actual crushing	Month	-	-	-	-	-	-	-	-	-	-
	To-date	-	-	-	-	-	-	-	-	-	-
Sucrose % cane	Month	10.62	11.16	12.22	12.97	13.56	13.47	12.99	12.99	12.30	11.49
	To-date	10.62	10.97	11.55	11.95	12.29	12.53	12.59	12.63	12.61	12.61
Fibre % cane	Month	14.82	14.59	14.55	15.03	15.13	15.82	16.39	16.51	16.99	16.95
	To-date	14.82	14.67	14.62	14.73	14.82	15.02	15.19	15.33	15.43	15.44
Tons cane per ton sugar . . .	Month	11.40	10.49	9.45	8.79	8.41	8.50	8.87	8.90	9.59	9.43
	To-date	11.40	10.74	10.10	9.69	9.39	9.19	9.15	9.12	9.15	9.16
Extraction	Month	97.29	97.67	97.73	97.71	97.72	97.59	97.64	97.46	97.08	97.41
	To-date	97.29	97.54	97.63	97.65	97.67	97.69	97.65	97.63	97.60	97.60
Imbibition % fibre	Month	373	349	346	344	354	353	367	367	350	394
	To-date	373	358	352	350	351	351	353	355	354	355
Pol % bagasse	Month	0.91	0.86	0.93	0.97	1.01	1.00	0.92	0.97	1.03	0.88
	To-date	0.91	0.88	0.90	0.92	0.94	0.95	0.95	0.95	0.96	0.96
Moisture % bagasse	Month	52.35	51.29	50.85	50.88	50.44	50.71	50.43	51.20	51.01	50.42
	To-date	52.35	51.67	51.29	51.17	51.01	50.95	50.88	50.91	50.92	50.92
Boiling house recovery	Month	84.30	87.04	88.24	89.39	89.40	89.12	88.50	88.31	86.98	-
	To-date	84.30	86.62	87.42	88.02	88.34	88.51	88.51	88.50	88.41	88.33
Overall recovery	Month	82.02	85.01	86.24	87.34	87.36	86.98	86.42	86.07	84.44	-
	To-date	82.02	84.48	85.35	85.95	86.28	86.44	86.43	86.40	86.29	86.21
Mixed juice sucrose purity . .	Month	82.01	82.52	84.86	86.59	87.09	87.26	86.58	86.09	85.57	84.25
	To-date	82.01	82.35	83.56	84.46	85.06	85.54	85.67	85.72	85.71	85.70
RS/pol ratio in mixed juice .	Month	8.94	8.84	6.94	5.45	4.55	4.22	4.28	4.55	4.50	5.31
	To-date	8.94	8.87	7.92	7.17	6.55	6.03	5.80	5.67	5.60	5.60
Pol/sucr. ratio in mixed juice	Month	0.9790	0.9782	0.9812	0.9867	0.9901	0.9933	0.9928	0.9919	0.9914	0.9885
	To-date	0.9790	0.9785	0.9798	0.9819	0.9838	0.9859	0.9868	0.9874	0.9876	0.9876
Purity final molasses	Month	35.21	33.51	35.23	36.96	37.38	38.41	38.28	38.04	39.67	38.43
	To-date	35.21	34.11	34.61	35.22	35.67	36.21	36.46	36.63	36.81	36.83
Sucrose lost in final molasses % sucrose in cane	Month	11.08	10.26	9.30	8.49	8.58	8.64	9.19	9.26	10.41	13.07
	To-date	11.08	10.57	9.95	9.51	9.29	9.15	9.15	9.16	9.23	9.26
Undetermined lost sucrose % sucrose in cane	Month	2.58	2.15	1.94	1.63	1.51	1.68	1.75	1.87	1.92	-
	To-date	2.58	2.21	2.08	1.94	1.84	1.80	1.80	1.80	1.81	1.83
Pol/sucrose ratio FM	Month	0.8804	0.8680	0.8648	0.8970	0.9263	0.9511	0.9599	0.9558	0.9630	0.9716
	To-date	0.8804	0.8727	0.8691	0.8766	0.8874	0.9007	0.9084	0.9136	0.9167	0.9172

TABLE G

CANE VARIETIES AND RAINFALL
(Season 1988—1989)
PERCENTAGE BY WEIGHT

MILL	N 8	N 11	N 12	N 13	N 14	N 16	N 17	N 18	N 19	N 52/219	N 53/216	N 55/805	NCo 293	NCo 310	NCo 376	NCo 382	J 59/3	MIXED VARIETY	UNKNOWN AND OTHER	* RAINFALL mm
ML	-	0.6	0.1	-	80.0	-	8.7	-	1.9	3.2	-	-	-	0.1	2.1	-	1.9	-	1.5	221
PG	-	0.2	-	-	69.1	-	4.2	-	1.5	1.3	-	-	-	0.1	11.4	-	-	0.9	11.2	248
UF	0.5	0.2	10.2	0.5	20.8	-	2.0	0.9	0.3	0.6	0.1	0.7	-	7.9	48.1	0.2	0.4	6.1	0.6	446
EN	-	0.2	9.1	2.9	0.1	0.9	-	-	-	-	-	0.2	12.8	-	73.5	-	-	-	0.3	746
FX	0.6	0.2	3.1	0.2	6.2	0.1	0.1	0.6	-	0.1	-	0.7	0.1	1.7	42.8	-	-	1.0	42.6	670
AK	0.1	0.1	7.3	0.9	0.5	0.5	-	0.1	-	-	-	1.4	0.1	0.6	53.6	-	-	4.3	30.4	486
DL	0.3	0.1	3.8	1.2	0.3	1.0	-	0.2	-	-	-	2.2	-	0.2	87.7	-	-	3.0	-	480
MS	0.2	0.6	3.9	1.5	0.8	2.3	-	0.3	-	0.1	-	4.0	0.5	0.2	81.0	0.1	0.1	3.5	0.9	678
ME	0.4	0.9	6.4	1.5	0.3	1.4	-	0.1	-	-	-	1.9	10.6	0.6	68.7	-	-	3.4	3.6	857
GD	0.1	0.1	0.9	-	0.7	0.1	-	-	-	-	-	0.2	-	-	97.5	-	-	0.3	-	603
GH	0.2	-	5.2	0.6	0.7	1.1	-	0.5	-	-	-	3.4	-	0.2	83.1	0.2	-	1.4	3.4	297
NB	0.1	4.1	28.8	0.5	0.5	1.6	-	0.1	-	-	0.5	0.3	33.0	-	15.5	4.8	-	0.1	10.2	967
UC	-	2.2	24.0	0.5	-	0.6	-	-	-	0.1	0.9	-	49.9	0.1	18.6	1.8	-	1.1	0.2	616
IL	-	1.3	18.0	0.6	0.3	0.9	-	0.1	-	-	-	1.0	15.9	-	38.1	-	-	4.5	19.1	636
SZ	-	1.7	5.0	0.7	0.3	1.2	-	0.1	-	0.1	-	0.9	-	0.2	81.7	-	-	2.6	5.6	570
UK	-	0.4	6.8	1.2	0.7	0.7	-	0.2	-	0.1	-	0.1	4.9	0.2	59.2	-	-	0.6	24.9	627
Average SA Mills	0.2	0.9	7.8	0.7	11.6	0.8	1.0	0.2	0.2	0.4	0.1	1.2	6.2	0.7	53.0	0.5	0.2	2.2	12.0	-
MH	-	-	-	-	25.2	-	13.4	-	1.6	-	-	-	-	-	59.3	-	-	0.4	0.1	329
UR	-	-	-	-	37.4	-	5.8	-	1.3	0.6	-	-	-	-	47.6	-	-	7.3	-	454
SM	-	-	-	-	23.7	-	1.9	-	-	-	-	-	-	-	73.2	-	-	-	-	271
NH	-	-	-	-	29.9	-	-	-	-	-	-	-	-	2.3	65.2	-	-	1.1	1.1	282
DW	-	0.1	-	-	20.3	-	-	-	-	0.2	-	-	-	-	58.3	-	-	4.5	16.7	20
HV	-	-	-	-	5.4	-	-	-	-	0.5	-	-	-	-	93.5	-	-	-	0.6	78
TR	-	-	-	-	5.1	-	-	-	-	-	-	-	-	-	94.7	-	-	-	0.2	149

* Rainfall during the crushing season

TABLE H

TRANSPORT SUMMARY SOUTH AFRICAN MILLS
(Season 1988—1989)
PERCENT OF CANE TRANSPORTED

MILLS	ML	PG	UF	EN	FX	AK	DL	MS	ME	GD	GH	NB	UC	IL	SZ	UK	AVERAGE
SOUTH AFRICAN RAILWAYS	-	-	36.0	-	0.5	-	-	-	-	-	-	-	-	-	-	-	1.7
TRAMS	-	-	63.7	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9
ARTICULATED TRUCK DRIVEN VEHICLES																	
- Interlink	-	-	-	-	59.0	32.9	35.5	39.5	55.1	1.3	3.8	34.2	18.7	95.4	18.9	30.6	30.3
- Tri-Axle	-	-	-	-	2.5	2.8	5.2	40.1	31.4	-	5.6	1.8	1.2	0.5	-	-	6.2
- Hilo	91.8	51.1	-	-	13.0	25.5	30.2	9.3	4.5	52.4	66.6	4.2	1.5	3.8	69.7	20.1	31.0
RIGID CHASSIS VEHICLES																	
- Truck	-	-	-	-	-	0.7	-	-	-	1.3	-	14.0	18.9	-	10.5	40.3	5.4
- Lorry	-	-	-	12.3	0.9	0.3	4.3	0.4	5.7	14.3	1.7	15.3	30.9	-	0.7	4.0	3.9
TRACTOR DRIVEN VEHICLES																	
- Hilo	-	15.0	-	-	1.9	4.5	0.7	2.4	1.6	-	16.8	6.4	3.3	-	-	0.6	3.1
- Rig	-	-	-	87.6	22.0	16.9	22.2	5.9	1.0	27.5	5.4	20.1	16.2	0.1	-	1.0	10.3
- Interlink	8.1	33.7	-	-	-	15.9	1.5	2.1	0.3	2.9	-	3.8	8.9	-	-	3.1	4.4

TABLE J
COMPARATIVE DATA OF REPORTING S.A. MILLS FROM 1925 ONWARDS

PERIOD (SEASON)	Percent Cane		Cane / Sugar Ratio		Extraction	Pol % fibre in Bagasse	Percent Bagasse		Imbibition Percent		Mixed Juice		Final Molasses Purity	Boiling House Recovery	Overall Recovery
	Sucrose	Fibre	Tel Quel	96 Pol Sugar			Pol	Moisture	Cane	Fibre	Purity	Reducing Sugar Ratio			
Average 1925 - 1934	13.19	15.78	9.86	9.64	89.83	8.86	3.88	50.57	27.6	175	85.09	3.65	45.3	83.67	75.12
Average 1935 - 1944	13.53	15.30	8.96	8.73	92.05	7.05	3.11	51.60	32.6	213	86.01	3.22	43.3	88.36	81.34
Average 1945 - 1954	13.79	16.06	8.60	8.36	93.04	5.95	2.69	51.32	33.8	210	85.95	3.29	40.7	89.46	83.23
1955	13.87	15.74	8.51	8.28	92.32	6.76	2.91	53.18	32.1	204	85.96	3.40	39.6	90.51	83.56
1956	13.35	15.81	8.87	8.62	92.93	5.98	2.60	53.12	35.2	222	85.49	3.32	39.9	89.79	83.44
1957	13.11	15.38	8.93	8.67	93.36	5.66	2.47	53.06	34.5	224	85.10	3.69	38.5	90.43	84.42
1958	13.12	15.92	9.09	8.82	92.87	5.89	2.55	52.38	32.9	207	84.46	4.3	39.1	89.49	83.11
1959	13.66	15.92	8.74	8.44	92.86	6.16	2.66	53.26	34.6	218	85.52	3.51	40.3	89.42	83.04
1960	13.69	15.22	8.70	8.41	93.35	5.98	2.60	53.01	36.2	238	85.63	3.31	40.3	89.40	83.45
1961	13.75	14.52	8.51	8.26	94.21	5.50	2.43	52.54	36.7	253	86.04	3.31	39.5	89.72	84.53
1962	13.29	15.49	8.97	8.73	94.15	5.02	2.24	52.17	41.2	266	83.36	5.11	39.6	87.81	82.67
1963	13.55	15.50	8.66	8.42	94.08	5.16	2.29	52.46	39.8	258	85.30	3.44	39.4	89.60	84.30
1964	13.90	15.38	8.42	8.20	94.16	5.23	2.34	52.64	39.4	256	85.52	3.32	39.9	89.65	84.42
Average 1955 - 1964	13.53	15.49	8.75	8.49	93.43	5.73	2.51	52.78	36.3	235	85.24	3.67	39.6	89.58	83.69
1965	12.99	15.57	9.20	8.97	93.99	5.00	2.20	52.98	40.6	261	84.22	3.73	39.9	87.67	82.40
1966	13.72	15.09	8.63	8.40	94.22	5.24	2.29	53.52	39.9	262	85.06	3.63	40.6	88.38	83.27
1967	12.92	15.01	9.28	9.06	94.15	5.04	2.19	53.47	39.2	261	83.41	3.81	38.8	87.52	82.33
1968	13.11	15.32	9.06	8.83	94.74	4.51	1.98	53.32	41.1	268	83.60	4.23	39.4	87.40	82.72
1969	12.88	15.03	9.10	8.86	94.98	4.30	1.89	53.30	41.2	274	84.25	4.17	38.3	88.58	84.13
1970	13.61	15.34	8.64	8.34	95.41	4.06	1.80	53.07	43.2	285	84.99	3.80	38.9	88.57	84.51
1971	12.97	14.82	8.93	8.63	95.91	3.58	1.61	52.66	41.1	277	85.14	4.20	39.4	89.41	85.76
1972	13.26	14.82	8.77	8.47	95.55	3.98	1.75	52.85	41.3	279	86.66	4.17	40.0	89.48	85.50
1973	13.08	15.64	8.93	8.62	95.55	3.87	1.69	53.19	45.0	288	85.66	4.70	39.2	89.13	85.17
1974	13.08	15.59	8.97	8.65	95.49	3.94	1.73	53.10	44.6	286	85.01	5.05	38.4	88.76	84.76
Average 1965 - 1974	13.16	15.22	8.95	8.68	95.00	4.35	1.91	53.15	41.7	274	84.80	4.15	39.3	88.49	84.06
1975	12.60	15.67	9.33	9.00	95.38	3.87	1.68	53.52	43.7	279	84.70	5.31	38.8	88.68	84.58
1976	12.43	15.52	9.41	9.08	95.48	3.79	1.66	53.20	41.7	281	84.47	5.58	38.2	88.99	84.97
1977	12.83	15.79	9.12	8.80	95.87	3.51	1.56	52.55	45.6	302	84.39	5.67	38.3	88.62	84.96
1978	12.64	15.22	9.07	8.77	96.63	2.95	1.35	51.59	45.4	314	85.36	5.27	38.0	89.58	86.55
1979	12.96	15.49	8.85	8.54	96.92	2.70	1.23	52.04	49.1	333	85.40	5.11	38.3	89.48	86.73
1980	13.34	15.95	8.73	8.42	96.89	2.73	1.24	52.10	52.2	344	84.80	5.25	38.7	88.17	85.42
1981	12.30	16.13	9.50	9.18	97.02	2.38	1.10	51.57	52.4	341	85.67	5.27	37.1	87.75	85.14
1982	12.86	15.61	9.10	8.79	97.02	2.57	1.19	51.35	51.5	345	85.12	5.80	36.6	87.64	85.03
1983	12.33	16.15	9.74	9.40	97.02	2.37	1.08	52.68	55.0	356	84.20	6.06	38.2	85.37	82.83
1984	12.27	15.62	9.43	9.11	97.42	2.12	0.99	51.35	51.5	344	85.69	5.76	37.0	88.23	85.96
Average 1975 - 1984	12.66	15.71	9.23	8.91	96.57	2.90	1.31	52.20	48.8	324	84.98	5.51	37.9	88.25	85.22
1985	13.13	15.38	8.88	8.57	97.47	2.25	1.04	51.64	52.9	358	84.55	6.71	36.3	87.51	85.30
1986	12.80	15.24	9.08	8.76	97.66	2.03	0.95	51.27	54.3	368	85.44	6.15	36.7	87.70	85.65
1987	12.00	15.23	9.67	9.33	97.63	1.94	0.91	51.24	52.6	357	85.25	6.28	36.8	87.84	85.76
1988	12.61	15.44	9.16	8.83	97.60	2.04	0.96	50.92	53.0	355	85.70	5.60	36.8	88.33	86.21

TABLE K
EQUIPMENT AND POWER USED SOUTH AFRICAN AND SWAZILAND MILLS

SYMBOL OF FACTORIES		ML		PG		UF		EN		FX A	FX B	AK		DL		MS A	MS B
EXTRACTION PLANT																	
Total installed power	kW/tfh	152		145		257		131		180	181	132		181		125	223
Cane preparation	kW/tfh	90		102		94		59		122	123	95		84		89	98
Mills:Total roller volume	m3/tfh	0.24		0.38		1.21		0.53		0.33	0.33	0.25		1.03		0.18	1.34
Diffuser:Screen area	m3/tch*	(C)2.02		(C)2.05		-		(B)0.94		(C)3.01	(C)3.08	(C)1.84		-		(C)1.91	-
CLARIFICATION AND EVAPORATION																	
Juice heaters:Heating surface	m2/tch#	11.7		3.9		8.0		8.1		11.1		6.0		5.8		7.0	
Clarifiers:Volume	m3/tch	(E) 2.7		(T) 1.0		(T) 1.8		(E) 2.2		(T) 1.2		(E) 1.6		(E) 1.7		(E+T) 1.9	
Evaporators:Heating surface	m2/tch	31.9		47.8		46.8		35.9		56.6		38.8		34.8		47.8	
Filters:Screening area	m2/tch	0.32		0.73		0.67		0.57		0.65		0.43		0.50		0.52	
BOILING HOUSE																	
Vacuum pans:Volume	m3/tch	1.5		1.6		1.6		1.8		0.5	& 1.1	1.6		1.1	& 0.3	0.9	& 0.5
Crystallizers:Volume A	m3/tch	-	1.10	0.98	0.79	-	1.27	0.44	0.70	1.59	-	1.05	1.57	-	1.32	0.31	0.86
Volume B	m3/tch	0.49	0.38	1.42	0.79	-	0.64	0.61	0.44	1.06	-	0.92	0.38	-	1.07	0.76	-
Volume C	m3/tch	1.46	0.38	1.58	0.64	0.57	1.19	-	2.36	2.00	-	1.95	0.50	2.07	-	1.57	0.16
CENTRIFUGALS																	
Batch:A - massecuite	D3H/tch**	68.6		95.8 ###		59.7		45.3		32.3		56.1		41.7		43.8	
Continuous:B - massecuite	W2V/tch##	158.8		153.7		182.4		233.3		200.0		136.6		176.6		98.3	
C - massecuite	W2V/tch	215.0		307.4		218.9		312.8		300.0		358.5		238.9		278.4	
STEAM AND POWER GENERATION																	
Electricity	kW/tch***	79.0		36.8		60.6		46.2		39.2		23.3		43.6		74.1	
Boilers: M.C.R.	Tons steam/tc	1.00		0.74		0.82		0.82		0.59		0.67		0.72		0.92	

* C-Cane diffuser, B-Bagasse diffuser
** D-Basket diameter, H-Basket height
*** Electricity generated by steam driven prime movers
E-Conventional clarifiers, T-Trayless clarifiers
M-Average milling tandems, d-Average diffusers
\# Excluding diffuser juice heaters
\## W-Speed of rotation, V-Volume of cone formed by basket
\### Continuous 'A' centrifugals
N-batch 'B' centrifugals
& Continuous pans

Crystallizers: Underlined figures denote water cooled.

FOR RAW SUGAR PRODUCTION (Season 1988—1989)

ME	GD	GH A B	NB	UC	IL	SZ A B	UK	TOTALS SA MILLS	UR A B	MH A B
153 70 1.20 -	127 48 0.71 (B)1.47	254 187 195 90 0.41 1.27 (C)2.23 -	182 89 0.99 -	184 99 0.60 (C)1.95	182 105 0.28 (C)1.74	167 164 108 105 0.35 0.34 (C)1.97 (C)1.95	168 84 0.88 -	191(M) 151(d) 87 - 1.11 - 2.18(C) 1.22(B)	183 83 0.31 1.44 1.42(C)	160 216 93 84 0.35 1.00 1.55(C) -
7.2 (E) 2.6 39.8 0.73	6.9 (E) 2.0 22.2 0.55	8.0 (T) 1.3 43.1 0.65	6.7 (E) 1.5 40.9 0.69	7.3 (E+T) 2.2 35.7 0.63	9.2 (E+T) 1.9 43.4 0.33	14.3 (T) 0.9 57.0 0.48	6.5 (E) 2.2 31.0 0.50	8.5 2.4(E) 1.4(T) 43.3 0.55	7.4 (E) 1.3 34.6 0.45	9.9 (E+T) 1.8 41.5 0.50
1.9 - 1.37 0.55 0.82 1.65 0.55	1.9 - 2.02 - 1.60 - 1.80	& 1.4 0.4 - 2.33 - 1.56 1.40 -	1.3 1.48 - 0.55 0.55 1.64 0.27	1.7 - 1.21 0.89 0.61 1.33 0.61	& 1.0 0.9 1.25 0.74 1.54 - 2.02 -	& 1.3 0.4 1.63 0.41 1.09 0.36 1.45 0.29	1.5 0.87 0.45 0.87 0.45 1.22 0.41	- - - -	& 1.1 0.3 - 1.33 - 1.72 1.72 -	1.6 - 1.58 - 1.04 1.54 0.51
54.2 200.8 286.8	61.8 70.6 211.9	40.3 123.2 308.0	37.3 159.4 259.1	76.9 149.8 435.2	53.1 192.0 306.0	33.4 156.0 268.0	38.7 130.9 261.8	46.7 158.1 281.1	41.1 6.4(N) 133 199.2	61.0 107.1 184.6
44.1 1.03	50.2 0.56	47.9 0.74	58.4 0.86	25.6 1.07	49.1 0.90	46.0 0.70	35.6 0.71	48.8 0.79	34.5 0.71	22.0 0.62