MUTUAL MILLING CONTROL PROJECT

PROGRESS REPORT No. 3

By E. J. BUCHANAN, K. DOUWES-DEKKER and A. VAN HENGEL

Summary

Milling data for the 1963-64 season reveal the most significant improvement in milling performance over the past few years. The mean cane feed rate per unit volume of rollers has increased by 10 per cent from 1962-63 to 1963-64 without any significant increase in lost juice. This provides a clear indication that recent changes in milling techniques have been in the right direction.

This paper presents the mean 1963-64 data for each factory participating in the Mutual Milling Control Project. The results confirm the trends pointed out in the second Progress Report. An example of the increase in efficiency to be gained by the installation of a shredder is cited and discussed. An attempt is made to point out factors which may effect the drop in purity from first to last expressed juice.

Introduction

In presenting the third Annual Progress Report of the Mutual Milling Control Project, the authors wish to point out that this is only the second report for which sufficient milling data were available to enable conclusions of any significance to be drawn. Hence, the third Progress Report has been modelled on the second in order to facilitate the comparison of data and confirmation of former conclusions. Unfortunately the C.S.I.R. electronic computer analysis of earlier data has not been completed in time for inclusion in the present report and, for this reason, the conclusions must still be regarded as being of a preliminary nature, on a scientific basis. However, the fact that the present report confirms many of the previous conclusions is an indication that they must be of some practical significance.

The object of this report then is to present the average milling performance data for the 1963-64 season, to discuss some apparent trends in the relationship between milling variables and to consider their significance in the light of the 1962-63 data.

Frequency of Reporting Data

We are pleased to report that the response to our frequent requests for more data from the twenty milling tandems concerned in this project improved again during the 1963-64 run, as may be seen from Table 2. Factories new to the scheme were Umfolozi and Entumeni, both of which were able to submit a fair amount of data. Sezela also managed to submit data from both tandems — for *one* week. Opposed to these fresh sources of information, Umzimkulu and Illovo disappeared completely from the scene and we await with growing interest the receipt of the first data sheet from Gledhow.

The frequency of reporting data should be borne in mind when considering the significance of trends discussed below. For obvious reasons the results of Sezela have been omitted from the averages.

Accuracy of Data

In general, the results of the present and past seasons are consistent and this indicates a reasonable degree of accuracy. In several cases the calculated values of apparent bagasse density are obviously too high, indicating that either the fibre % bagasse or fibre index values are inaccurate. This would indicate that more attention should be paid to accurate measurement of lift and roller diameters. As an illustration, one of the authors of this paper has recently carried out a survey of a prominent Natal factory where he found a half inch error on the roller diameters measured by factory staff. This was due to complete absence of routine calibration of the zero setting of the spherometer type instrument employed. After proper calibration, the instrument was capable of measuring to within $\pm$ 0.004 in. of a known diameter. Naturally, errors of a high magnitude are dangerous for they could lead to erroneous conclusions. Fortunately, however, our final conclusions will be based on an electronic computer analysis, the significance of which will be tested statistically.

In general, the results are sufficiently accurate to provide a basis for indicating trends and these are discussed below.

Milling Performance 1959-64

As a general observation it must be pointed out that, in spite of the fact that the mean lost juice per cent fibre has increased from 37.4 for 1962-63 season to 37.5 for 1963-64, this result actually represents an appreciable increase in milling performance as gauged from Table 1.

Table 1

Milling Performance 1959-64

Season	Relative Performance
1959-60	105.8
1960-61	109.2
1961-62	109.6
1962-63	112.4
1963-64	122.5

$$\text{*Relative Performance} = \frac{100 \text{ lb. fibre/(hr) (T.R.V.)}}{\text{lost abs. juice \% fibre}}$$

The significance of these figures is immediately apparent from Figure 1. In this graph the mean annual lost juice per cent fibre figures are plotted against the corresponding specific feed rates. Following the path A B C D it is clear that from 1959-60 to 1962-63, the reduction in lost juice accompanied a gradual reduction in specific feed rate. However, the divergence from AG, the line of constant relative performance= 105.8 (i.e. 1959-60 performance) indicates that an overall improvement in performance occurred during this period. In other words, the reduction in lost juice was greater than that which could be attributed solely to the reduction in specific feed rate.

In contrast to these improvements in efficiency, DE, the trend line for 1963-64, indicates that a 10 per cent increase in specific feed rate occurred without any significant increase in lost juice. It is no exaggeration to state that this is the most remarkable technological achievement in milling performance for some years. If we compare points B and E, it is clear that we have increased our mean specific feed rate during 1963-64 to what it was in 1960-61 without any significant increase in the low lost juice figure attained in 1962-63. This gives us a very clear indication that our investments since 1960-61 in installed equipment are paying off and that changes in milling equipment and technique have been advantageous.

This is an appropriate opportunity to outline briefly some of the more notable changes which have occurred:

(*a*) A growing acceptance by executive and process staff of specific milling performance figures as a basis for comparison. Hence, for example, most executives in control of factories with low fibre cane and low specific feed rate tandems are no longer satisfied with an above average extraction. They are only satisfied when the lost absolute juice % fibre reaches a level commensurate with the specific feed rate. This has certainly in many cases paved the way for improvements.

(*b*) Improvements in cane preparation by the installation of shredders or rearrangement of knives and shredders, e.g. second set placed at the head of the carrier in the offset position and shredders preceding mills.

(*c*) The more general use of recognised methods for calculating mill settings.

(*d*) The recognition of the adverse effect of fluctuations in feed rate and their counteraction by placing the shredder ahead of crushing units and dispensing with 2-roller crushers. This also includes the development of automatic control of feed and closer attention to improved continuous feeding by the inclusion of correctly set feeder rollers and gravity chutes, as well as the increasing number of pressure feeders being installed.

(*e*) General optimisation of process variables.

Trends Noted from 1963-64 Data

(i) *Method of Analysis*

As mentioned earlier in this paper the computer analysis of the 1962-63 data has not been completed. A preliminary multiple regression analysis of the average data for each factory indicated that no relationships between process variables could be developed on a general basis applicable to all installations. Hence, it has been necessary to repeat the computer analysis using the more comprehensive weekly data dividing the tandems into groups with similar equipment. The programming of so much data prior to analysis by the computer is a lengthy process.

For these reasons a similar type of analysis as used in Progress Report No. 2[1] will be used for the indication of trends in the relationship between milling performance and the associated process variables. In this analysis the specific performance figures are set out as in Tables 4 to 7 in order of decreasing performance, together with their associated process variables. Trends may be detected by definite characteristic differences in magnitude between the process variables placed above and below the mean values.

The figures arranged in Tables 4 to 6 have all been taken from the average annual data shown in Table 3. There is, in fact, a wealth of information in these tables concerning individual millers and we would suggest that millers make a serious attempt to study these tables from their own particular point of view. In this paper we can only point out general trends.

(ii) *Variables related to Relative Performance*

The term "relative performance" was first introduced in Progress Report No. 2. In the absence of a definite relationship between lost juice and specific feed rate, which would provide a means of reducing the lost juice to correspond to a chosen specific feed rate, we make use of

$$\text{relative performance} = \frac{100 \times \text{lb fibre/(hr)(cu.ft. T.R.V.)}}{\text{lost absolute juice \%fibre}}$$

which takes into account efficiency and throughput both of which should be high for an economical tandem. There must, of course, exist an economic optimum specific feed rate, but since tandems must be treated individually in this respect, we shall have to be content for the present with the use of relative performance as our guide. This is the case where optimum throughput is reached when the rate of increase in lost juice exceeds the rate of increase in specific feed rate.

Bearing the above points in mind, we may now examine Table 4 in which data for each tandem are arranged in order of relative performance. The high performance tandems, according to relative performance, are arranged above the mean value and the low performance tandems are located below the mean.

In the column headed "Units" we see that with one exception (Gledhow) all tandems with the IIS1 preparatory arrangement fall into the high performance group. Next we see that the majority of large tandems also fall into the high performance group and there is a predominance of small tandems in the low performance group. Regarding the first mill performance, most of the tandems with a low residual absolute juice in the first mill bagasse are in the high performance group. Most of the tandems with a high dilution ratio also fall into the high performance group. The majority of tandems with abnormally high feeder ratio settings on the last mill fall into the low performance group.

(iii) *Variables Related to Residual First Mill Juice*

In Table 5 the tandems are tabulated in order of residual absolute juice % first mill bagasse. All first mills preceded by IIS (two knives and a shredder) appear in the high performance group and it is highly significant to note that these are in many cases better in performance than first mills preceded by one or even two double roller crushers. The only exception is TS_1 tandem. There is no apparent significance in the juice % cane. The pressure and speed appear significant and when grouped together into the term

$$\frac{\text{Specific pressure}}{\text{Surface speed}}$$

for the top roller, we find that these values show a very significant trend indicating that with few exceptions, mills with high pressures and low speeds are most efficient. Let us discuss briefly the few exceptions. Take Z S M tandem; this has a low pressure/speed ratio but nevertheless falls into the high performance group. Looking to the "Units" column we see a possible explanation; the mill is preceded by the efficient preparatory arrangement of two knives and a shredder. Take the other two exceptions, viz. FX_2 and DK; these have high pressure speed ratios but nevertheless fall into the low performance group. This could similarly be explained by the absence of a shredder preceding the first mill.

A similar relationship exists in the case of the fibre index, high values correspond to the high first mill performance group. Exceptions are again associated with the presence or absence of shredders.

(iv) *Variables Related to Lost Juice*

In Table 6, the tandems are tabulated in order of lost absolute juice % fibre in last mill bagasse. In the column headed "Units", we again find that most of the tandems having the IISI preparatory arrangement are located in the high efficiency group. Conversely, most of the tandems with one or even two double roller crushers preceding the first mill fall into the low performance group. The chief exceptions are ZSM and GH which are located in the low performance group in spite of the fact that these tandems are preceded by shredders. In the case of ZSM, the high throughput, high speeds and low pressures could explain this discrepancy. We have no data for GH.

Next we see that the majority of larger tandems appear in the high efficiency group and the smallest tandems appear in the low efficiency group. Regarding the specific feed rate, we find most of the tandems having a low feed rate per unit roller volume appear in the high efficiency group and conversely, the very heavily fed tandems are in the low efficiency group. Again we may note that all exceptions in the high efficiency group are tandems headed by shredders. We may also note that all exceptions in the low efficiency group are tandems either without shredders or in which a crushing unit precedes the shredder.

There is no apparent trend related to the imbitition % fibre data. In fact the averages of imbibition rates for the high and low efficiency tandems are almost identical. Hence, we cannot attach any significance to imbibition rate in general. The same applies to juice % fibre in cane.

The moisture per cent last mill bagasse figures show a clear indication that very low moistures contribute toward high efficiency and very high moistures reduce efficiency. It is very clear that the exceptions in this respect are those tandems which have abnormally high imbibition rates and/or a large number of units indicating that these particular millers prefer to "wash" out the sugar instead of squeezing it out efficiently after efficient cane preparation and efficient dilution.

This brings us naturally to a consideration of mill pressures and speeds. In Table 6 we see that most of the high efficiency tandems have above average specific pressures and below average surface speeds on both first and last units. This is reflected also in high values of fibre index.

Also associated with the high efficiency tandems are high first mill efficiencies and high values of dilution ratio.

(v) *The Effect of Efficient Milling on Juice Purity*

Since it appears that the future expansion of the sugar industry will be limited unless sugar quality can be improved, it is imperative that we should examine each unit operation in the process for possible sources of impurities or purity losses. For this reason we have extended the field of the M.M.C.P. analysis to cover the important relationship between milling efficiency and juice purity. This relationship is probably most appropriately based upon lost absolute juice % fibre in last mill bagasse and the drop in purity from first to last expressed juice as shown in Table 7. Here the tandems are arranged in order of purity drop. There is certainly a trend indicating that most of the low efficiency tandems show a low juice purity drop. Conversely, the majority of high efficiency tandems have high purity drops.

A striking feature of these figures is the vast difference between the maximum purity drop of 22.8 and the minimum drop of only 9.0.

An examination of the "Units" column does not reveal any dependance on the type of preparation — an equal number of tandems equipped with shredders appears in each group. Similarly there is no apparent dependance on the number of squeezes. There is a slight, but not very significant trend indicating that high pressures and high imbibition rates may have some effect on purity drop. However, we have seen that high pressure is related to high efficiency hence this may be only a secondary effect.

Hence this analysis does not go very far in explaining the primary causes of juice purity drop; high milling efficiency appears to be a contributory factor but there is no apparent connection between any particular type of equipment or method of operation which can be directly related to high juice purity drop except, possibly, excessively high imbibition rates. This is entirely logical since impurities in sugar which impede filtration are those which are removed by filtration. Since most of these substances are likely to have low solubilities the quantity leached from the cane will be in direct proportion to the amount of water added to the cane, i.e. the imbibition rate.

A comparison of the figures for purity drop and lost juice in Table 7 reveals several marked abnormalities. A striking example is the data for both Tongaat (TS) tandems. These tandems have a high efficiency but show an abnormally low juice purity drop. There is no apparent explanation from the data in Table 7. Hence we can only attribute this abnormality to

(*a*) a beneficial process or analytical characteristic outside of our observations or,

(*b*) a beneficial physical characteristic of the cane.

Discussion of Results and Observations

We shall now compare our present observations with those of the 1962-63 season and point out their practical implications concerning future changes.

(i) *Cane Preparation*

The results discussed in this paper confirm those of Progress Report No. 2 referring to the installation of shredders. When efficiency and throughput are considered together then all Natal tandems are divided into two distinct relative performance groups (*a*) high performance tandems with two knives and a shredder and (*b*) low performance tandems with either shredder or one set of knives (FX_2) absent. There is only one exception (TS_2) which has a two roll crusher preceding the shredder and to which we shall refer later.

At this point it is useful to provide a recent example of the improvement which may be expected by the installation of a shredder, i.e. at Umzimkulu. In Figure 2, we see the relationship between lost juice and throughput, with and without a shredder. It should be noted that in this case the shredder was installed *after the first unit*. On the average the lost juice has been reduced by 6 units for the same throughput. This is equivalent to an increase in *percentage* extraction (at the same crushing rate and fibre % cane) of 1.2. Calculating the increase in gross annual return achieved on the basis of 330,000 tons cane/year, 13.8 sucrose % cane and a conservative estimate of 75 per cent boiling house recovery on the additional sucrose extracted, we arrive at R28,690. The cost of the shredder installed with drive would have been about the same and this indicates an investment to be envied by any industrialist without considering the associated potential increase in throughput. On an economic basis it appears that this investment should have been made earlier and one wonders considering the discussion below whether further advantage would not have been gained by installing the shredder ahead of the first mill.

Our results also confirm the previous observation that most of the tandems with shredders located directly after the knives (IISl arrangement) appear at the top of the high relative performance group. It would be expected that this arrangement should present a more consistent bulk density feed to the first unit and thus facilitate an optimisation of the process variables in general. As an example of the advantage to be gained by changing the position of the shredder and substituting a larger three roll unit for an existing two roll crusher, the data of Illovo are shown in Table 8.

Table 8
Comparative Data for Illovo 1962-64

Season	Tandem	T.R.V.	Relative Performance
1962-63	IICS5	625	110
1963-64	IIS6	750	124

The fibre feed rate was increased by nearly 30 per cent after the modification to the tandem and an overall improvement in relative performance was achieved.

It is gratifying to observe that a growing number of tandems are being changed to this arrangement and we may anticipate that this will achieve a further increase in throughput without increasing the losses.

(ii) *First Mill Performance*

The data presented in this Report confirm the observation that the highest first mill performance is attained by preceding the first mill by a shredder (IISl arrangement). Conversely, it is found that first mills preceded only by two knives have the lowest performance. The indication that higher pressures and lower speeds contribute towards high first mill efficiency is also confirmed together with the fact that high fibre indices, i.e. good feeding characteristics, are beneficial. This indicates that the use of gravity chutes and pressure feeders is to be encouraged.

The conclusions reached by observations from first mill data should apply equally to all other mills.

(iii) *Calculation of Mill Settings*

There is a strong indication that as data become more accurate, due to the location of errors, the calculated mean value of apparent bagasse density for Natal mills is approaching typical overseas values on which the formula for mill settings is based.

When we calculate the apparent density of bagasse from

$$\frac{100 \times \text{lb fibre/cu.ft. escribed volume}}{\text{fibre \% bagasse}}$$

for the first and last mills, we obtain the values tabulated on lines 32 and 33 of Table 3. The mean values are 112 and 116 lb/cu.ft. respectively, for all tandems represented and hence approach very closely to the mean overseas value of 110.[2] Hence there is little doubt that the formula

$$K = \frac{167.\ C.f}{n.D.L.F}$$

where C = tons cane/hr
D = roller diameter, in.
f = fractional fibre content of cane
F = target fractional fibre content of bagasse
L = length of rollers, in.
n = r.p.m. of top roller
K = work opening, in.

may be applied with confidence to the calculation of mill settings in Natal.

(iv) *Imbibition Stage Efficiency*

Again there is *no* indication that high imbibition rates contribute towards overall efficiency. In some cases, however, it is clear that high imbibition rates are applied in an attempt to counteract the adverse effects of low pressures, high speeds or poor preparation. This is not very realistic in a factory with a limited evaporator capacity and a high coal account.

Furthermore, there is an indication that very high imbibition rates may have an adverse effect on the purity of the expressed juice.

Low bagasse moistures are again associated with good overall efficiency and the statements in (ii) and (iii) should be borne in mind in this respect. A high dilution ratio is again found to be associated with efficient tandems.

We may conclude that efficient imbibition is more desirable than high imbibition rates.

Milling in 1964-65

Assuming that we are able to maintain the present high relative milling performance of 122.5 then (refer to Figure 1) projecting a line of constant relative performance equal to 122.5 from E to F we may predict that a further 10 per cent increase in specific feed rate will increase the mean lost absolute juice % fibre for the coming season to about 41. Hence, anticipating that further increases in throughput will occur during 1964-65 it will be necessary, in order to avoid increased losses, to increase the size of tandems or to carry out other improvements, e.g. points (*a*) to (*e*) discussed above, which will increase efficiency.

We may apply the conclusions of the Mutual Milling Control Project for the 1963-64 season as a guide to the most beneficial improvements.

The M.M.C.P. in 1964-65

This project will be continued during the coming season during which we anticipate that all factories will contribute complete data from the beginning to the end of the season. We wish to make a serious appeal to factory executives to assist us in our pursuit of a better understanding of the milling operation by:

(*a*) Taking an interest in the published data and propagating the use of specific performance figures associated with milling,

(*b*) ensuring that those involved directly in analyses and measurements for the tabulation of data understand the purpose of their work and take an interest in it,

(*c*) ensuring that the data submitted is accurate and that instruments are given the necessary maintenance,

(*d*) ensuring that the data is submitted regularly and,

(*e*) taking an interest in the annual progress report and examining the figures from their own aspect.

Conclusions

An analysis of the 1963-64 milling data confirms the indications from the 1962-63 data regarding the installation of shredders and their location directly after the knives. The data again indicate that it is advantageous to operate mills at higher pressures and lower speeds. Efficient feeding is also shown to be beneficial. Good first mill efficiency, low moistures and efficient imbibition play an important part in overall milling efficiency but high imbibition rates do not appear to be necessary for efficient milling under optimum conditions. The S.M.R.I. formula for the calculation of mill settings gains some justification from the data presented.

An examination of data over the past few years indicates that the 1963-64 season has shown the most significant improvement in milling performance. This indicates that recent changes in milling techniques are showing practical results. It is encouraging to observe that a number of factories are acting on the conclusions of this project.

The M.M.C.P. will be continued during the coming season in which it is hoped that increased response and accuracy will facilitate a complete statistical analysis.

Acknowledgments

The authors of this paper wish to thank the chemists and engineers of factories which submitted data during the 1963-64 season. They are also grateful to factory managers who have assisted in the growth of the project. Finally, they are pleased to note that a number of factories are making practical use of the conclusions from the M.M.C.P. and thank those involved for their confidence.

References

1 BUCHANAN, E. J., DOUWES-DEKKER, K. and VAN HENGEL, A., Proc. S.A.S.T.A., 1963, 62.
2 DOUWES-DEKKER, K. and VAN HENGEL, A., Proc. S.A.S.T.A., 1958, 57.

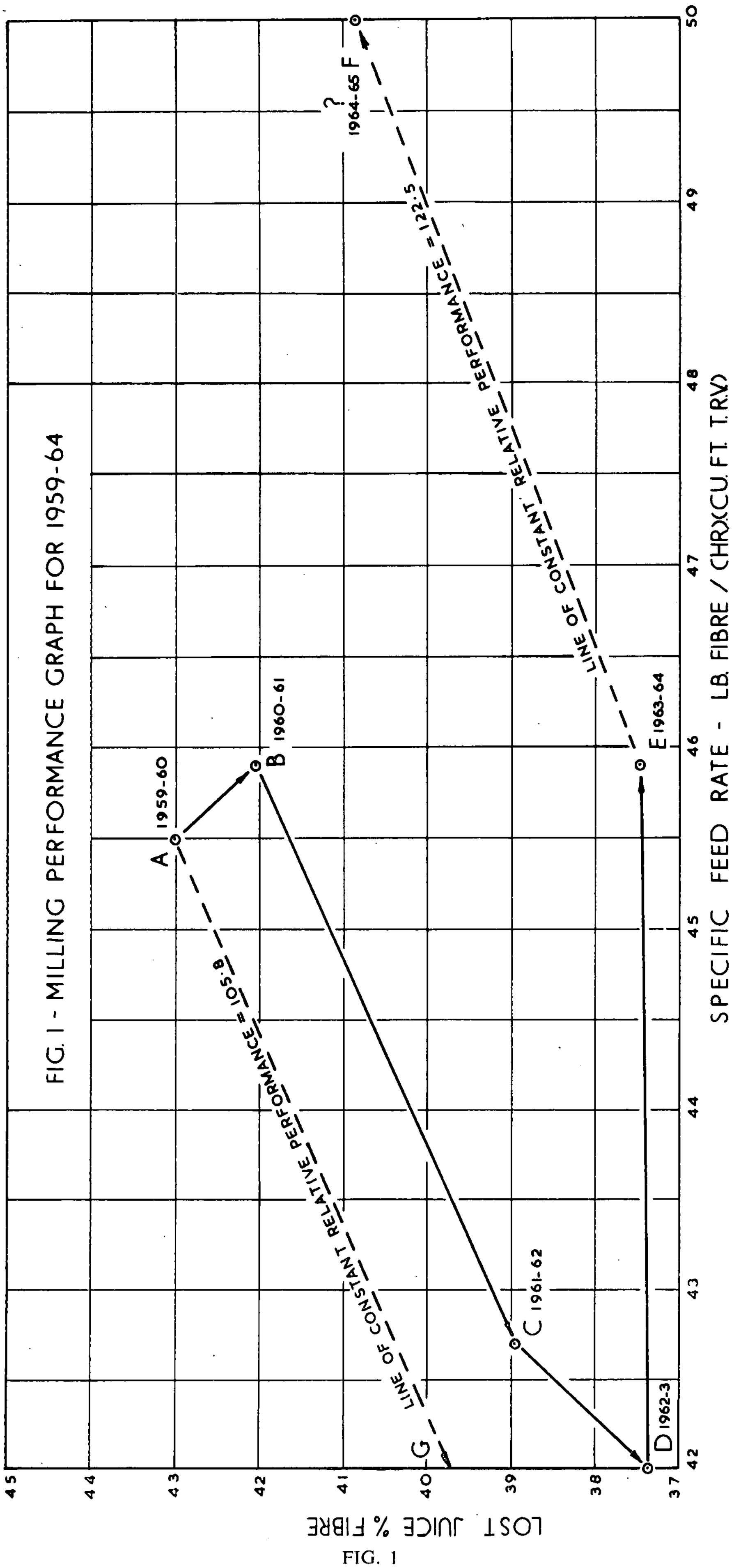
FIG. I - MILLING PERFORMANCE GRAPH FOR 1959-64
A 1959-60
B 1960-61
C 1961-62
D 1962-3
E 1963-64
? 1964-65 F
G
LINE OF CONSTANT RELATIVE PERFORMANCE = 105.8
LINE OF CONSTANT RELATIVE PERFORMANCE = 122.5
SPECIFIC FEED RATE - LB. FIBRE / (HR.)(CU. FT. T.R.V.)
LOST JUICE % FIBRE
42
43
44
45
46
47
48
49
50
37
38
39
40
41
42
43
44
45

FIG. 1

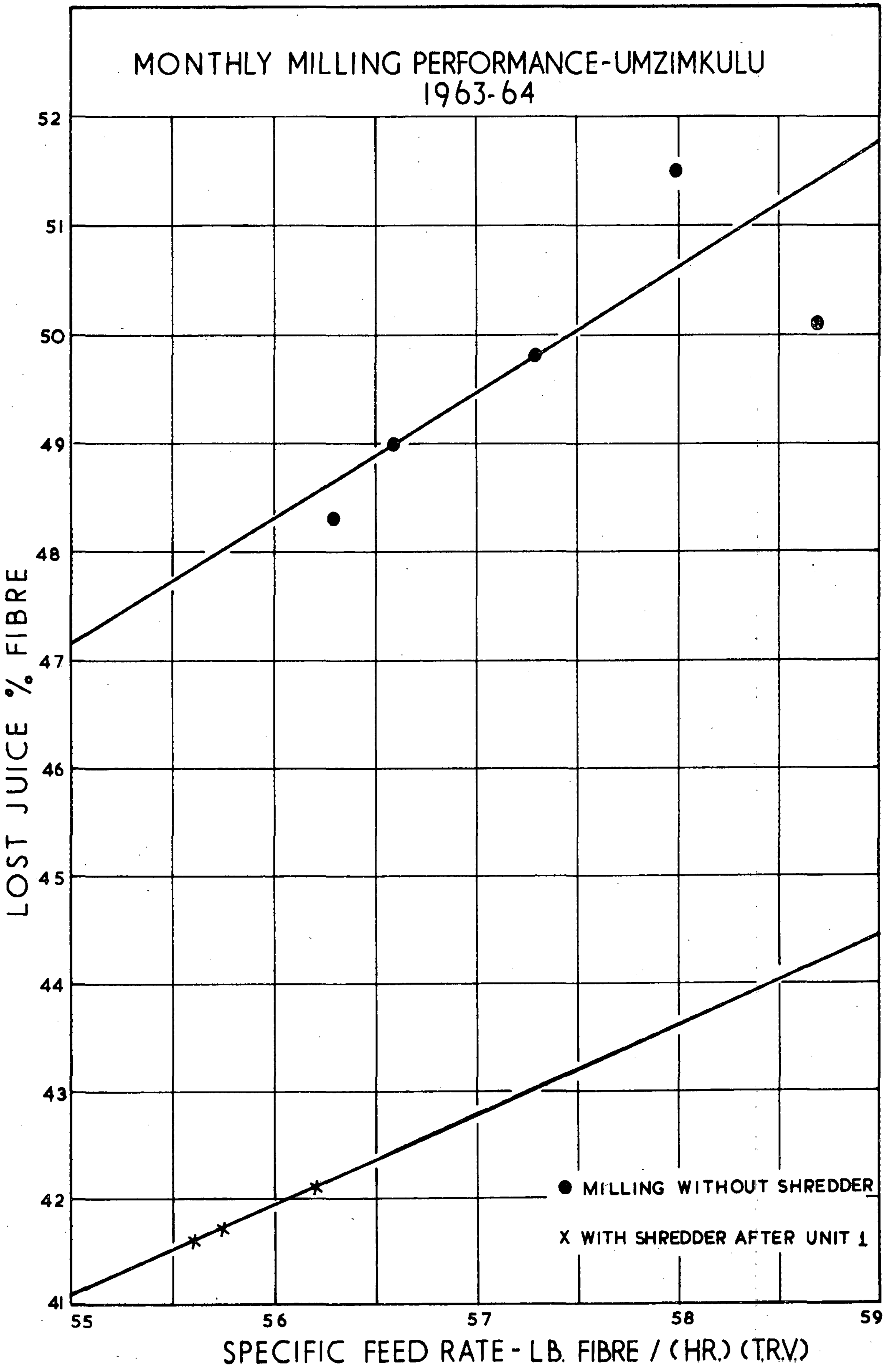
MONTHLY MILLING PERFORMANCE-UMZIMKULU
1963-64
LOST JUICE % FIBRE
52
51
50
49
48
47
46
45
44
43
42
41
55
56
57
58
59
SPECIFIC FEED RATE - LB. FIBRE / (HR.) (T.R.V.)
● MILLING WITHOUT SHREDDER
X WITH SHREDDER AFTER UNIT 1

FIG. 2

TABLE 2

FREQUENCY OF REPORTING MILLING DATA

Week	PG	UF_1	UF_2	ZM	FX_1	FX_2	EN	AK	DK	DL	GH	MV	TS_1	TS_2	NE	IL	RN	SZ_1	SZ_2	UK	1963-4 Total	1962-3 Total
1	—	—	—	O	O	O	—	X	—	O	O	—	O	O	X	—	O	O	O	—	2	2
2	—	—	—	O	O	O	O	X	—	X	O	O	O	O	X	—	X	O	O	—	4	4
3	X	—	—	O	O	O	O	X	O	X	O	X	O	O	X	—	X	O	O	O	6	4
4	X	—	—	O	O	O	O	X	O	X	O	X	O	O	X	—	X	O	O	O	6	5
5	X	O	O	O	O	O	O	X	O	X	O	X	X	X	X	O	X	O	O	O	8	6
6	X	O	O	O	O	O	O	X	O	X	O	X	X	X	X	O	X	O	O	O	8	5
7	X	O	O	O	O	O	O	X	O	X	O	O	O	O	X	O	X	O	O	O	5	6
8	X	O	O	O	O	O	O	X	O	X	O	X	O	X	X	O	X	O	O	O	7	6
9	X	O	O	O	X	O	O	X	O	X	O	X	O	O	X	O	X	O	O	O	7	6
10	X	O	O	O	X	O	O	X	O	X	O	X	X	X	X	O	X	O	O	O	9	7
11	X	O	O	O	X	O	O	X	X	X	O	X	X	X	X	O	X	O	O	O	10	8
12	X	O	O	X	X	O	O	X	X	X	O	X	X	X	X	O	X	O	O	O	11	9
13	X	O	O	O	O	X	O	X	X	X	O	X	X	X	X	O	X	O	O	O	10	9
14	X	O	O	X	O	X	O	X	X	X	O	X	X	X	X	O	X	O	O	O	11	9
15	X	O	O	O	O	X	O	X	X	X	O	X	X	X	X	O	X	X	X	O	12	9
16	X	O	O	O	O	X	X	X	X	X	O	X	X	X	X	O	X	O	O	O	11	9
17	X	O	O	X	X	O	X	X	X	X	O	X	X	X	X	O	X	O	O	O	12	7
18	X	O	O	O	X	O	X	X	X	X	O	X	X	X	X	O	X	O	O	O	11	8
19	X	O	O	O	X	O	X	X	X	X	O	X	X	X	X	O	X	O	O	O	11	9
20	X	O	O	X	X	O	X	X	X	X	O	X	X	X	X	O	X	O	O	O	12	8
21	X	O	O	X	O	X	X	—	X	X	O	X	X	X	X	O	X	O	O	O	11	10
22	X	O	O	X	O	X	X	O	X	X	O	X	X	X	X	O	X	O	O	O	11	9
23	X	O	O	X	O	X	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	10
24	X	X	O	X	O	X	X	X	X	X	O	X	X	X	X	O	O	O	O	O	12	9
25	X	X	O	O	X	O	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	9
26	X	X	O	O	X	O	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	10
27	X	X	O	O	X	O	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	9
28	X	X	O	O	X	O	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	8
29	X	X	O	O	O	X	X	X	X	X	O	X	X	X	X	O	O	O	O	O	11	10
30	X	X	O	O	O	X	X	X	X	X	O	X	X	X	X	O	X	O	O	O	12	10
31	X	X	O	O	O	X	O	X	X	X	O	X	X	X	X	O	X	O	O	O	11	9
32	X	X	O	O	O	X	O	X	O	X	O	X	X	X	X	O	X	O	O	O	10	10
33	X	O	O	O	O	O	—	X	X	X	O	X	X	X	X	O	X	O	O	O	9	9
34	—	O	O	O	X	O	—	X	X	X	O	O	X	X	X	O	X	O	O	O	8	9
35	—	O	O	O	O	O	—	X	—	X	O	O	X	X	X	O	X	O	O	O	6	8
36	—	O	O	O	X	O	—	X	—	X	O	O	X	X	X	O	X	O	O	O	7	9
37	—	—	—	O	O	X	—	X	—	X	O	—	—	—	X	O	—	O	O	—	4	6
38	—	—	—	—	O	X	—	X	—	X	O	—	—	—	X	O	—			—	4	7
39	—	—	—	—	O	X	—	X	—	X	—	—	—	—	X	—	—	—	—	—	4	7
40	—	—	—	—		X	—	X	—	X	—	—	—	—	—	—	—	—	—	—	3	6
Total	31	9	0	8	14	16	15	38	23	39	0	30	29	30	39	0	28	1	1	0	351	311

Week 1: 13 — 18 May, 1963

Week 40: 3 — 8 Feb., 1964

O=No data submitted, X=Data submitted, — = Not crushing

TABLE 3

AVERAGES OF WEEKLY MILLING DATA 1963/64

	PG IIG5 588	UF_1 II6P 1220	UF_2 IIC6 777	ZM IIS6 1001	FX_1 IICC6 886	FX_2 IIS5 549	EN IISC5 173	AK II2S4 745	DK II1S5 411	DL IIS6 1212	GH IIS6 1212	MV IICS5 304	TS_1 IIS6P 1157	TS_2 IICS5 653	NE IICS5P 1212	IL IIS6 750	RN IICC5 379	SZ_1 IIS5 520	SZ_2 IIS5 520	UK II5 378	**Mean Average** 733
FEED RATES																					
1. Tons cane crushed	11,039	22,030	No	26,264	12,952	8,415	4,070	15,055	9,570	26,711	No	7,861	22,612	11,304	24,350	No	7,521	11,159	11,159	No	14,982
2. Tons cane/crushing hour	84.5	145.8	data	185.5	93.6	62.7	27.6	110.6	71.5	202.5	data	60.9	156.8	75.9	173.3	data	56.4	77.5	78.6	data	111.7
3. Tons fibre/crushing hour	11.0	20.1		31.5	14.6	10.5	4.0	17.8	11.2	32.6		9.3	24.4	11.9	26.0		8.5	12.2	12.3		22.7
4. Lbs. fibre/(hour) (T.R.V.)	37.4	33.0	(27.6)	64.0	33.0	38.4	47.7	47.9	54.7	53.8	(48.1)	61.6	41.6	36.4	43.0	(46.5)	44.9	46.9	47.3	(56.5)	45.5
5. Imbibition % fibre	293	274		278	285	268	228	252	244	371		217	223	221	230		202	206	206		256
QUALITY OF MATERIALS																					
6. Fibre % cane	13.00	13.80		17.01	15.62	16.81	14.80	16.14	15.67	16.08		15.37	15.59	15.69	15.08		15.14	15.71	15.71		15.41
7. Absolute juice % fibre in cane	670	625		488	541	496	576	520	539	522		551	542	538	564		561	537	537		552
8. Fibre % bagasse ex Unit 1	27.38	18.87		27.74	29.01	22.33	29.07	24.21	21.13	30.62		26.73	23.10	33.50	23.01		—	32.36	32.03		25.90
9. Fibre % bagasse ex Unit Z	43.81	44.13		41.90	43.40	44.75	46.85	44.62	44.58	45.05		42.54	45.90	47.06	44.89		45.17	46.29	46.29		44.62
10. Moisture % bagasse ex Unit Z	53.05	52.63		54.73	53.24	51.85	49.59	52.13	51.75	52.49		53.66	51.36	49.95	52.28		51.61	50.56	50.56		52.17
11. Average top-roller lift unit 1, in.	0.30	0.24	AVERAGE FOR UF1 AND UF2	0.23	0.10	0.17	0.27	0.25	0.23	0.21		0.11	0.13	0.17	0.42		0.11	0.30	0.31		0.21
12. Average top-roller lift unit Z, in.	0.18	0.13		0.18	0.21	0.19	0.18	0.21	0.15	0.45		0.20	0.14	0.12	0.27		0.09	0.18	0.36		0.19
13. Discharge work-opening unit 1, in.	1.13	1.84		1.31	1.72	1.66	0.92	1.30	1.14	1.85		0.84	1.66	1.24	1.86		1.42	1.55	1.44		1.42
14. Discharge work-opening unit Z, in.	0.66	0.77		0.93	0.69	0.71	0.42	1.31	0.58	1.44		0.58	0.61	0.79	0.74		0.71	0.68	0.86		0.78
15. Mill ratio (between work-opening) unit 1	2.30	1.86		2.22	1.82	1.71	1.77	2.03	2.45	1.90		3.01	2.42	2.85	2.02		2.06	1.48	1.60		2.17
16. Mill ratio (between work-opening) unit Z	1.95	2.04		2.20	2.04	1.81	1.59	1.89	2.11	2.24		2.60	2.80	2.70	2.09		2.34	1.91	2.16		2.17
17. Feeder ratio (on discharge work-opening) unit 1 . .	—	5.38		6.09	5.93	6.73	4.05	7.27	—	4.69		9.99	7.63	—	—		—	9.00	9.00		6.42
18. Feeder ratio (on discharge work-opening) unit Z . .	11.46	—		5.35	8.17	4.83	5.91	4.51	10.69	4.03		6.28	—	10.58	—		—	7.00	7.00		7.18
19. Total hydraulic load, unit 1, ton	380	460		389	272	280	85	353	287	595		186	331	321	347		217	400	300		322
20. Total hydraulic load, unit Z, ton	439	431		431	401	299	210	398	395	608		176	293	430	460		268	400	350		374
21. Specific hydraulic load unit 1, ton/ft.	69	66		56	49	56	28	55	53	85		41	47	58	50		48	73	55		54
22. Specific hydraulic load unit Z, ton/ft.	80	61		61	73	60	52	72	72	87		39	42	78	66		54	73	64		64
23. Specific hydraulic pressure unit 1, ton/sq. ft. . . .	25.1	20.0		17.7	17.8	22.7	16.6	18.6	20.1	25.9		19.9	16.1	20.8	14.3		23.4	28.4	35.1		19.9
24. Specific hydraulic pressure unit Z, ton/sq. ft. . .	29.0	19.0		20.1	24.3	23.8	22.8	24.8	27.0	25.3		17.4	14.0	27.2	20.2		21.1	27.0	23.5		22.6
25. Top-roller surface speed unit 1, ft./min.	22.0	31.0		51.1	21.0	21.4	21.2	33.7	21.7	33.1		25.6	33.2	19.1	38.9		18.3	19.7	19.3		28.0
26. Top-roller surface speed unit Z, ft./min.	26.7	27.9		44.9	22.2	22.2	19.9	26.1	23.4	30.5		30.2	37.4	22.5	34.5		20.5	24.6	25.0		27.8
SPECIFIC PERFORMANCE DATA																					
27. Residual absolute juice % fibre in bagasse, unit 1 . .	265	426(!)		252	230	345	228	308	373	217		261	325	215	324		—	198	205		290
28. Lost absolute juice % fibre in bagasse, unit Z . .	33.18	37.55	(39.4)	39.57	42.25	40.30	39.65	38.40	42.72	28.23	(40.5)	47.11	31.34	34.17	33.88	(37.4)	39.10	34.7	34.7	(47.3)	37.68
29. Fibre index unit 1, lb. fibre/cu. ft. escr. vol. . .	32.4	20.3		28.0	30.1	24.2	28.2	25.1	33.5	30.8		39.3	25.6	37.3	20.9		29.1	29.0	32.2		28.9
30. Fibre index unit Z, lb. fibre/cu. ft. escr. vol. . .	46.4	53.8		43.4	73.9(!)	56.0	49.0	38.5	60.4	43.2		47.3	56.2	49.9	59.7		45.9	53.0	41.8		51.7
31. Dilution ratio	80	76		78	73	71	67	73	68	84		70	80	71	79		72	74	74		74
32. Apparent density of bagasse, unit 1	118	108		101	104	108	97	104	159(!)	101		147	111	111	91		—	90	101		112
33. Apparent density of bagasse, unit Z	107	122		104	170(!)	125(!)	105	86(!)	136(!)	96		111	122	106	133(!)		102	114	90		116
34. Relative Performance 100 (4/28)	113	88	(73)	162	78	95	120	125	128	191	(119)	131	133	107	127	(124)	115	135	136	(119)	122

KEY:
- P = Unit with Pressure Feeder
- G = Unit with Gravity Feed Chute
- I = Set of knives
- C = Two-roller crusher
- S = Shredder
- 1–6 = 3-roller mill units
- T.R.V. = Total roller volume

Unit 1 = first 3-roller unit

Unit Z = last 3-roller unit

Figures shown in (brackets) are averaged from general weekly returns and are therefore not included in above averages.

N.B.—Sezela data not included in averages since too limited.

! Improbable value

TABLE 4

MILLING DATA IN ORDER OF RELATIVE PERFORMANCE

Data:	Relative Performance*	Tandem	Units	T.R.V.	Imbibition % fibre	Absolute juice % fibre in cane	Moisture % bagasse ex Unit Z	Mill ratio (between work-opening) unit 1	Mill ratio (between work-opening) unit Z	Feeder ratio (on discharge work-opening) unit 1	Feeder ratio (on discharge work-opening) unit Z	Specific hydraulic pressure unit 1, ton/sq. ft.	Specific hydraulic pressure unit Z, ton/sq. ft.	Top-roller surface Speed unit 1, ft./min.	Top-roller surface speed unit Z, ft./min.	Residual absolute juice % fibre in bagasse, unit 1	Fibre index unit 1, lb fibre/cu. ft. escr. vol.	Fibre index, unit Z, lb fibre/cu. ft. escr. vol.	Dilution Ratio
High Performance Tandems	191	DL	**IIS6**	**1212**	371	522	52.49	1.90	2.24	4.69	4.03	25.9	25.3	33.1	30.5	**217**	30.8	43.2	**84**
	162	ZM	**IIS6**	**1001**	278	488	54.73	2.22	2.20	6.09	5.35	17.7	20.1	51.1	44.9	**252**	28.0	43.4	**78**
	136	SZ_2	**IIS5**	520	206	537	50.56	1.60	2.16	9.00	7.00	35.1	23.5	19.3	25.0	**205**	32.2	41.8	**74**
	135	SZ_1	**IIS5**	520	206	537	50.56	1.48	1.91	9.00	7.00	28.4	27.0	19.7	24.6	**198**	29.0	53.0	**74**
	133	TS_1	**IIS6P**	**1157**	225	542	51.36	2.42	2.80	7.63	—	16.1	14.0	33.2	37.4	325	25.6	56.2	**80**
	131	MV	IICS5	304	217	551	53.66	3.01	2.60	9.99	6.28	19.9	17.4	25.6	30.2	**261**	39.3	47.3	70
	128	DK	II1S5	411	244	539	51.75	2.45	2.11	—	10.69	20.1	27.0	21.7	23.4	373	33.5	60.4	68
	127	NE	IICS5P	**1212**	230	564	52.28	2.02	2.09	—	—	14.3	20.2	38.9	34.5	324	20.9	59.7	**79**
	125	AK	II2S4	745	252	520	52.13	2.03	1.89	7.27	4.51	18.6	24.8	33.7	26.1	308	25.1	38.5	73
	(124)	IL	**IIS6**	750	(258)	—	(53.27)	—	—	—	—	—	—	—	—	—	—	—	—
Mean:	122	**Means:**	—	733	256	552	52.17	2.17	2.17	6.42	7.18	19.9	22.6	28.0	27.8	290	28.9	51.7	74
Low Performance Tandems	120	EN	IISC5	**173**	228	576	49.59	1.77	1.59	4.05	4.91	16.6	22.8	21.2	19.9	228	28.2	49.0	67
	(119)	GH	IIS6	1212	(201)	—	52.36	—	—	—	—	—	—	—	—	—	—	—	—
	(119)	UK	**IIS**	**378**	(221)	—	52.68	—	—	—	—	—	—	—	—	—	—	—	—
	115	RN	**IICC5**	**379**	202	561	51.61	2.06	2.34	—	—	23.4	21.1	18.3	20.5	—	29.1	45.9	72
	113	PG	**IIG5**	**588**	293	670	53.05	2.30	1.95	—	**11.46**	25.1	29.0	22.0	26.7	265	32.4	46.4	80
	102	TS_2	**IICS5**	**653**	221	538	49.95	2.85	2.70	—	**10.58**	20.8	27.2	19.1	22.5	215	37.3	49.9	71
	95	FX_2	**IIS5**	**549**	268	496	51.85	1.71	1.81	6.73	4.83	22.7	23.8	21.4	22.2	345	24.2	56.0	71
	88	UF_1	**II6P**	**1220**	274	625	52.63	1.86	2.04	5.38	—	20.0	19.0	31.0	27.9	426	20.3	53.8	76
	78	FX_1	**IICC6**	886	285	541	53.24	1.82	2.04	5.93	**8.17**	17.8	24.3	21.0	22.2	230	30.1	73.9	73
	(58)	UF_2	**IIC6**	777	(286)	—	(52.2)	—	—	—	—	—	—	—	—	—	—	—	—

*100 lb. fibre/(hr.) (T.R.V.) / lost abs. juice % fibre

N.B.—The bold figures show significant trends.

TABLE 5

MILLING DATA IN ORDER OF RESIDUAL FIRST MILL JUICE

(AFTER FIRST 3 ROLL UNIT)

Data:	Residual absolute juice % fibre in bagasse, unit 1	Tandem	Units	Absolute juice % fibre in cane	Mill ratio (between work-openings), unit 1	Feeder ratio (on discharge work-openings), unit 1	Specific hydraulic pressure unit 1, ton/sq. ft.	Top-roller surface speed unit 1, ft./min.	Fibre index unit 1, lb. fibre/cu. ft. escr. vol.	100 pressure/speed ratio,* unit 1
High Efficiency First Mills	198	SZ_1	**IIS5**	537	1.48	9.00	**28.4**	**19.7**	**29.0**	**144**
	205	SZ_2	**IIS5**	537	1.60	9.00	**35.1**	**19.3**	**32.2**	**182**
	215	TS_2	IICS5	538	2.85	—	20.8	**19.1**	**37.3**	**109**
	217	DL	**IIS6**	522	1.90	4.69	**25.9**	33.1	**30.8**	**78**
	228	EN	IISC6	576	1.77	4.05	16.6	**21.2**	28.2	**78**
	230	FX_1	IICC6	541	1.82	5.93	17.8	**21.0**	**30.1**	**85**
	252	ZM	**IIS6**	488	2.22	6.09	17.7	51.1	28.0	35
	261	MV	IICS5	551	3.01	9.99	19.9	**25.6**	**39.3**	**78**
	265	PG	IIG5	670	2.30	—	**25.1**	**22.0**	**32.4**	**115**
Mean:	290	**Means:**	—	552	2.17	6.42	19.9	27.8	28.9	72
Low Efficiency First Mills	308	AK	II2S4	520	2.03	7.27	**18.6**	**33.7**	**25.1**	**55**
	324	NE	IICS5P	564	2.02	—	**14.3**	**38.9**	**20.9**	**37**
	325	TS_1	IIS6P	542	2.42	7.63	**16.1**	**33.2**	**25.6**	**49**
	345	FX_2	**I1S5**	496	1.71	6.73	22.7	21.4	**24.2**	106
	373	DK	**II1S5**	539	2.45	—	20.1	21.7	33.5	93
	426	UF_1	**II6P**	625	1.86	5.38	20.0	**31.0**	**20.3**	**65**
	No Data	IL	—	—	—	—	—	—	—	—
		RN	—	—	—	—	—	—	—	—
		UK	—	—	—	—	—	—	—	—
		GH	—	—	—	—	—	—	—	—
		UF_2	—	—	—	—	—	—	—	—

$$^*\frac{100 \times \text{lb./sq. ft. projected area (of top roller, unit 1)}}{\text{ft./min.}}$$

N.B.—The bold figures show significant trends

TABLE 6

MILLING DATA IN ORDER OF LOST JUICE

Data:	Lost absolute juice % Fibre in bagasse, unit Z	Tandem	Units	T.R.V.	Lbs. fibre/(hour) (T.R.V.)	Imbibition % fibre	Absolute juice % fibre in cane	Moisture % bagasse ex unit Z	Specific hydraulic pressure unit 1, ton/sq. ft.	Specific hydraulic pressure unit Z, ton/sq. ft.	Top-roller surface speed unit 1, ft./min.	Top-roller surface speed unit Z, ft./min.	Residual absolute juice % fibre in bagasse, unit 1	Fibre index, unit 1, lb fibre/cu. ft. excr. vol.	Fibre index, unit Z, lb. fibre/cu. ft. escr. vol.	Dilution Ratio
High Efficiency Tandems	28.2	DL	**IIS6**	**1212**	53.8	371	522	52.5	**25.9**	**25.3**	33.1	30.5	**217**	**30.8**	43.2	**84**
	31.3	TS_1	**IIS6P**	**1157**	**41.6**	223	542	**51.4**	16.1	14.1	33.2	37.4	325	25.6	**56.2**	**80**
	33.2	PG	IIG5	588	**37.4**	293	670	53.1	**25.1**	**29.0**	**22.0**	**26.7**	**265**	**32.4**	46.4	**80**
	33.9	NE	IICS5P	**1212**	**43.0**	230	564	52.3	14.3	20.2	38.9	34.5	324	20.9	**59.7**	**79**
	34.2	TS_2	IICS5	653	**36.4**	221	538	**50.0**	**20.8**	**27.2**	**19.1**	**22.5**	**215**	**37.3**	49.9	71
	34.7	SZ_1	**IIS5**	520	46.9	206	537	**50.6**	**28.4**	27.0	19.7	**19.3**	**198**	**29.0**	53.0	74
	34.7	SZ_2	**IIS5**	520	47.3	206	537	**50.6**	**35.1**	23.5	**24.6**	**25.0**	**205**	**32.2**	41.8	74
	37.4	IL	**IIS6**	**750**	46.5	(258)	—	(53.3)	—	—	—	—	—	—	—	—
	37.6	UF_1	II6P	**1220**	**33.0**	274	625	52.6	**20.0**	19.0	31.0	27.9	426	20.3	**53.8**	**76**
Mean:	37.7	**Means:**	—	733	45.5	256	552	52.2	19.9	22.6	28.0	27.8	290	28.9	51.7	74
Low Efficiency Tandems	38.4	AK	**II2S4**	745	**47.9**	252	520	52.1	**18.6**	24.8	**33.7**	26.1	**308**	**25.1**	**38.5**	**73**
	39.1	RN	**IICC5**	**379**	44.9	202	561	51.6	23.4	**21.1**	18.3	20.5	—	29.1	**45.9**	**72**
	39.6	ZM	IIS6	1001	**64.0**	278	488	**54.7**	**17.7**	**20.1**	**51.1**	**44.9**	252	**28.0**	**43.4**	78
	39.7	EN	IISC5	**173**	**47.7**	228	576	49.6	**16.6**	22.8	21.2	19.9	228	**28.2**	**49.0**	**67**
	40.3	FX_2	**I1S5**	**549**	38.4	268	496	51.9	22.7	23.8	21.4	22.2	**345**	**24.2**	56.0	**71**
	(40.5)	GH	IIS6	1212	**(48.1)**	(201)	—	**(52.4)**	—	—	—	—	—	—	—	—
	(41.2)	UF_2	**IIC6**	777	(27.6)	(285)	—	**(52.5)**	—	—	—	—	—	—	—	—
	42.3	FX_1	**IICC6**	886	33.0	285	541	**53.2**	**17.8**	24.3	21.0	22.2	230	30.1	73.9(!)	**73**
	42.7	DK	**II1S5**	**411**	**54.7**	244	539	51.8	20.1	27.0	21.7	23.4	**373**	33.5	60.4	**68**
	47.1	MV	**IICS5**	**304**	**61.6**	217	551	**53.7**	**19.9**	**17.4**	25.6	**30.2**	261	39.3	**47.3**	**70**
	47.3	UK	**II5**	**378**	**56.5**	221	—	52.7					—	—	—	—

N.B.—The bold figures show significant trends.
(!) Improbable Value

TABLE 7

MILLING DATA IN ORDER OF JUICE PURITY DROP

Data:	Juice Purity Drop*	Tandem	Lost Absolute Juice % fibre	Units	Number of Squeezes	Specific hydraulic pressure unit 1, ton/sq. ft.	Specific hydraulic pressure unit Z, ton/sq. ft.	Imbibition % fibre
Tandems with low purity drop	9.0	UK	**47.3**	II1S4	10	—	—	**221**
	9.0	TS_2	34.2	IICS5	11	20.8	27.2	**221**
	10.4	EN	**39.4**	IISC5	11	**16.6**	22.8	**233**
	10.7	AK	38.3	II2S4	12	**18.6**	24.8	**253**
	10.9	TS_1	31.3	IIS6P	14	**16.1**	**14.0**	**223**
	11.3	MV	**47.3**	IICS5	11	19.9	**17.4**	**216**
	12.6	$UF_{1}/_{2}$	**39.4**	II69	14	20.0	**19.0**	280
	13.0	DK	**43.9**	II1S5	12	20.1	27.0	**244**
	14.0	RN	**39.6**	IICC5	12	23.4	**21.1**	**203**
Mean:	14.2	**Means:**	38.8	—	12	19.9	22.6	258
Tandems with high purity drop	14.3	ZM	41.4	IIS6	12	17.7	20.1	**282**
	14.4	$FX_{1}/_{2}$	41.4	IICC6	14	**20.5**	**24.3**	**273**
	14.8	PG	**33.6**	IIGS	12	**25.1**	**29.0**	**281**
	15.3	NE	**33.9**	IICS5P	13	14.3	20.2	230
	16.3	DL	**28.4**	IIS6	12	**25.9**	**25.3**	**372**
	18.0	GH	40.5	IIS6	12	—	—	201
	20.8	IL	**37.4**	IIS6	12	—	—	**258**
	22.8	$SZ_{1}/_{2}$	**36.3**	IIS5	10	**31.0**	**26.0**	221

*(Purity first expressed juice)—(purity last expressed juice)

Mr. Boyes: Experiments at Tongaat with a Rose & Downs oil expeller on final bagasse produced 43 per cent. moisture but the juice expressed had a higher purity than the normal last expressed mill juice. This indicates that some inconsistency exists in the juice purity determination at Tongaat.

Mr. Buchanan: The authors have pointed out that the discrepancy in juice purity drop for the Tongaat tandems might be due to an analytical abnormality. I suggest that Mr. Boyes investigate the analysis further.

Mr. Fourmond: Determination of last expressed juice is influenced by percentage of dilution. It is well known that the higher the dilution the higher will be the relative brix or total solids dissolved. Therefore, would one associate a lower last expressed juice with a high imbibition?

Mr. Buchanan: Although dilution does have an effect on the brix determination, in this particular case the method of analysis is standard and I do not think that the variation from one factory to another of either first or last expressed juice would account entirely for the trend relationship between purity drop and imbibition rate.

Mr. Ashe: In table 3 of the M.M.C.P. it will be noted that for Umfolozi the residual absolute juice percent fibre in bagasse unit 1 is shown as 426. This is probably brought about by the fact that at Umfolozi we are troubled with silt and sand in our primary juice, whereas our secondary juice does not contain the same amount of solids and difficulties are experienced in obtaining a true brix in the primary juice. Would it not be possible to use a Refractometer for the purpose of obtaining the brixes for the M.M.C.P.?

Mr. Buchanan: The Refractometer can be used for determining the brix of juices and I have made use of the instrument in milling investigations. I think that Dr. Douwes Dekker would like to enlarge on this.

Dr. Douwes Dekker: It is important that whatever method is used must be standard since the magnitude of the result changes with different methods and apparatus. I want to support strongly Mr. Buchanan's request for the full co-operation of the factories in the M.M.C.P. When several years ago the S.M.R.I. decided to draw milling performance into its field of activities two ways were open, namely, the direct experimental method consisting of a pilot plant mill and a system based on the statistical interpretation of a maximum number of factory data, accurately determined according to a standardised plan. The latter method was accepted and, so far as everybody can see, the results are most interesting and of practical significance. However, the basic requirements for getting reliable results is that all the mills contribute their data. The number of factories in Natal is relatively small and for this reason it is even more important that all co-operate.

Mr. Alexander: I wish to congratulate the authors on an excellent paper. In referring to accuracy of data, reading the last sentence on page 1, column 2, paragraph 2 it might be misconstrued that an electronic computer could correct mistakes made in measurement data.

In regard to purity differences I suggest that the effect of the relatively large amounts of optically active substances in last expressed juices should be investigated, together with the soluble solids brix relationship.

Mr. Buchanan: I thank you for your comments and agree with both the points you mention.

Mr. Bentley: Mr. Buchanan mentioned that higher efficiency of milling may affect recovery at the back end of the factory.

As the important feature of factory work is the quantity of sugar produced from a given quantity of cane, care must be exercised to ensure that the mill work does not reach such a high degree of efficiency as to detract from the work of the back end of the factory.

If this aspect could be included in future M.M.C.P. reports it would help to make this excellent project still better.

Mr. Buchanan: Thank you Mr. Bentley for your remarks. I think you suggestion is a useful one. This is, in fact, what the authors are attempting to do.

Mr. Hicks: When specifying mill surface speeds consideration should be given to the practicability of these speeds in relation to the size of mill. Gearing and shafts cannot be made practically to take this load at such slow speeds.

Mr. Buchanan: Nowhere in the report have the authors stipulated the use of any particular limiting speed. The figures quoted are those of operating conditions taken from existing milling tandems which indicate a distinct trend between low mill speeds and high milling efficiency. It is realised that these results should not be extrapolated beyond the practical limit, but in any case the question is really an economic balance. It is doubtful, for example, if the increased capital cost of larger gear faces and mill drive shafts would be greater than, say, that of 0.1 per cent. extraction.