# MUTUAL MILLING CONTROL PROJECT PROGRESS REPORT No. 4

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## Introduction

The 1964-65 season has seen a number of significant changes in milling installations in local factories. A large number of gravity chutes have been installed, mill settings have been adjusted, shredders have been installed ahead of first mills and a pressure feeder has been installed at the head of one tandem. At the same time capacities have been increased and lost juice % fibre decreased. Hence the changes to milling installations carried out prior to this season have been advantageous.

This paper presents the annual average milling data for 1964-65 season, points out trends in the relationship between performance and process variables and discusses changes in particular installations which showed significant improvements in performance.

## Frequency and Accuracy of Data

The number of factories submitting data and the number of data sheets again increased for 1964-65. However, a number of factories submitted data during only a limited period. In many cases the data were inaccurate, particularly with respect to the lift of top rollers, and one factory, Umzimkulu, submitted no mechanical data. The data submitted are shown in Table 1.

As a general guide to broad trends, the data are considered sufficiently accurate. The values of variable are similar to earlier data and enable similar conclusions to be drawn from these data as were reached from earlier analyses.

## Milling Performance 1951-65

In the accompanying graph the progress in milling performance since 1951 is shown on the basis of a number of variables for complete comparison. The important conclusion is that in spite of a slight increase in specific throughput, the lost absolute juice has again for the 1964-65 season followed the decrease shown from the inception of the M.M.C.P. In fact the economy of the milling operation in South Africa has never been more favourable.

For the purpose of a recent paper[1], the saving due to the improvements in milling efficiency during the years 1962-64 has been estimated on a conservative basis as R1,172,500. In several cases, tandems which were markedly below average performance have been improved due to the installation or rearrangement of shredders and optimisation of process variables as suggested by trends noted from the M.M.C.P. These improvements are outlined later. Trends noted from the 1964-65 data are discussed below.

## Trends Noted from 1964-65 Data

### *Method of Analysis*

The method of analysis used for the purpose of earlier progress reports was again employed. A computer analysis has confirmed the significance of many of the observations made in earlier reports. However, it appears that the data are not sufficiently accurate to provide a basis for detailed analyses into the effect of mill grooving, Messchaert grooves and other variables of a secondary nature. Hence the approximate method of analysis has been used for noting trends. This involved the tabulation of data from Table 1 in order of performance as shown in Tables 2, 3 and 4. The values of independent variable could be compared, above and below the means, against the value of the dependent variable.

### *Variables Related to Relative Performance*

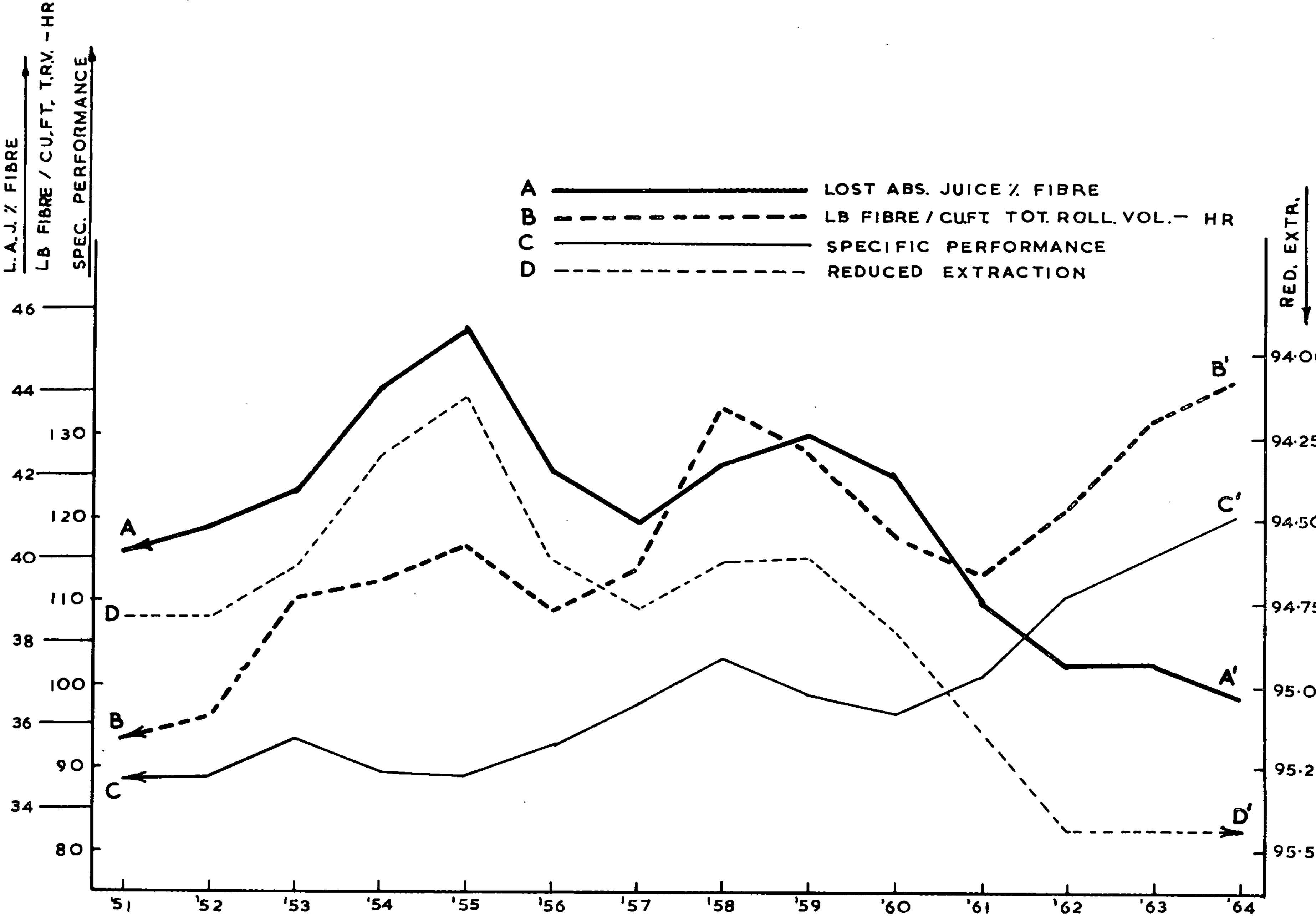
In Table 2 the data are tabulated in order of relative performance. With few exceptions tandems preceded by shredders have the higher relative performance. It is clear that factories without shredders have a lower overall performance than those which have installed these units. This is very clear in the case of $FX_1$ and PG tandems, neither of which make use of shredders — these two tandems have the lowest overall performance of all tandems included in the observations.

Another point to note is that tandems equipped with one or even two pressure feeders do not fall very high in the relative performance table. This is discussed later. Most units in the upper performance group are equipped with gravity chutes. There is an indication that larger tandems fall in the upper group. Imbibition rate does not appear to be of significance nor does the juice in cane. Moisture in final bagasse is significant in the extreme values in that very low values appear mainly in the upper group and high values in the lower. Mill ratios appear significant in the case of the first mills and lower feeder ratios are distinctly associated with the higher group.

Pressures and speeds appear to be of significance in extreme values. Residual juice in first bagasse appears to be more significant as is dilution ratio.

### *Variables Related to Residual First Mill Juice*

In Table 3 all higher performance first mills are preceded by shredders. The pressure-fed first mill at Tongaat does not achieve any improvement over other mills without pressure feeders. Absolute juice in cane does not appear to be significant. Lower mill ratios, feeder ratios and speeds and higher pressures are apparently significant in improving first mill performance. The pressure/speed ratio is high for high performance mills. A notable exception is Doornkop which in spite of a high pressure/speed ratio of 88 (average is 83) has the highest residual first mill juice. However, Doornkop is one of the few tandems retaining the first mill before the shredder. This could account for the lower first mill performance. On the other hand, this could also be due to analytical errors, as juice sampling is difficult at Doornkop.



PROGRESS IN ANNUAL MILLING PERFORMANCE

### *Variables Related to Lost Juice*

In Table 4 the variables are tabulated in order of lost absolute juice % fibre. Tandems without the shredder ahead of the first mill occupy the three lowest efficiency positions. Larger tandems fall mainly in the high efficiency group. $UF_1$ tandem has the first place with the remarkably low lost juice figure of 27.41, however, it also has the lowest specific throughput of only 31.2. Specific throughput shows a clearer relation to lost juice than in the past, probably due to the better standardisation of milling equipment and operation after several years of M.M.C.P. reports.

Final moisture is significant in that the excessively high values appear in the lower group. High pressures, low speeds, and low residual absolute juice also appear to be associated with efficient tandems.

### *Summary*

(i) High relative performance is associated with: tandems equipped with shredders (particularly when shredders precede first mills); larger tandems; low final moistures, mill and feeder ratios; low speeds and high pressures; low residual juice in first mill and high dilution ratios.

(ii) Similar conclusions are reached regarding the variables related to first mill performance with respect to the shredders, speeds, pressures and settings.

(iii) Similar conclusions apply to the efficiency of tandems rated in terms of lost juice. As tandems become more standard, a clearer picture of the relationship between lost juice and specific throughput is emerging.

## General Practical Observations from 1964-65 Data

### *Improvements in Milling*

A number of tandems have increased their relative performance during the 1963-65 period. It is thought that a discussion of the changes which appear to have been associated directly with these improvements would be of general interest and these are given briefly in Table A.

TABLE A

**Tandems which improved their Relative Performances considerably during 1964–1965 season**

| FACTORY | RELATIVE PERFORMANCE 1963/64 | RELATIVE PERFORMANCE 1964/65 | % IMPROVEMENT | REMARKS |
|---|---|---|---|---|
| $UF_1$ . . . . | 88 | 114<br>(108) | 29<br>(23) | Installation of shredder. Special attention to mill settings. |
| $FX_1$ . . . . | 78 | 111<br>(85) | 42<br>(9) | Installation of 3 enclosed chutes. |
| $FX_2$ . . . . | 95 | 143<br>(111) | 51<br>(17) | Installation of 3 enclosed chutes + installing of shredder ahead of the tandem instead of behind first mill. |
| GH . . . . | 119 | 145<br>(146) | 22<br>(23) | Installing of 6 tall chutes and continuous attention to milling operations. |
| $TS_2$ . . . . | 107 | 157<br>(122) | 47<br>(14) | Edward hydraulics, higher hydraulic loads, three tall chutes instead of Rivière carriers, woolly rollers, revised imbibition system. |
| IL . . . . | 124 | 171<br>(164) | 42<br>(32) | Alterations to heel of trash plate to improve drainage. Imbibition distribution changed, more accuracy, smaller feeder ratios. |
| RN . . . . | 115 | 138<br>(124) | 20<br>(8) | Installation of shredder ahead of the double crusher. |

N.B.—Figures in brackets indicate relative performance calculated on the same basis for both seasons. The percentage improvement in brackets is therefore most applicable to the remarks.

### *Pressure Feeders*

The performance of Natal tandems equipped with pressure feeders is in general disappointing. Considering the additional cost of extra rollers, the heavy chute and extra gearing, as well as increased power consumption and space occupied, little significant improvements have resulted from pressure-fed units at the final stage of a tandem as shown in Table B.

TABLE B
Last Units With and Without Pressure Feeders

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NATAL ESTATES (NE) | | | | | | | | |
| Season | | 58–59 | 59–60 | 60–61 | 61–62 | 62–63 | 63–64 | 64–65 |
| Pressure feeder | | No | No | No | No | Yes | Yes | Yes |
| Tons fibre/hr. | | 29.16 | 28.01 | 26.36 | 25.71 | 24.42 | 26.19 | 29.70 |
| Fibre % final bagasse | | 44.61 | 44.04 | 44.18 | 44.46 | 45.90 | 44.91 | 44.58 |
| UMFOLOZI (UF) | | | | | | | | |
| Season | | | 59–60 | 60–61 | 61–62 | 62–63 | 63–64 | 64–65 |
| Pressure feeder | | | No | No | No | Yes | Yes | Yes |
| Tons fibre/hr. | | | 18.42 | 17.08 | 16.04 | 16.53 | 19.39 | 18.54 |
| Fibre % final bagasse | | | 41.2 | 41.2 | 41.2 | 44.5 | 44.1 | 44.9 |
| TONGAAT ($TS_1$) | | | | | | | | |
| Season | 57–58 | 58–59 | 59–60 | 60–61 | 61–62 | 62–63 | 63–64 | 64–65 |
| Pressure feeder | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Tons fibre/hr. | 19.75 | 20.97 | 21.48 | 22.11 | 23.16 | 23.00 | 23.96 | 26.01 |
| Fibre % bagasse | 43.81 | 44.17 | 44.40 | 46.64 | 46.70 | 47.86 | 45.85 | 44.98 |

For Natal Estates, no improvement resulted from the pressure feeder (c.f. 58-59 and 64-65). In the case of Umfolozi, the fibre % final bagasse increased but this is hardly significant as the original mill was not fitted with any efficient feeder-device and therefore had to run with wide settings and low hydraulic pressures. This was discussed in an earlier paper presented at this congress[2]. Only at Tongaat has a slight improvement in throughput been accompanied with a very slight increase in fibre percent final bagasse which can possibly be attributed to the pressure feeder. On the other hand, other alterations have also been made. On the whole, last mill pressure feeders have not shown practical improvement over normal mills. It has been pointed out that good dilution is more important than good milling at the final stage[2]. Good milling is most beneficial in the first stage. However, Table 3 shows that the first mill pressure feeder at Tongaat has achieved only a small improvement and its performance is below the average for normal first three-roller units in Natal.

From the above discussion it is possible to conclude that the pressure feeder only achieves an improvement over normal milling when it replaces inefficient mills. Accepting this conclusion, then it is interesting to note (Table 1) that the surface speed of pressure fed units in Natal is in the 35 to 45 ft/min range which is higher than average and hydraulic pressures are in the 16 to 20 ton/sq ft range which is lower than average. In the case of the last mill, where bagasse voidage is minimum, it is not difficult to imagine that the amount of juice expressed for a given voidage and pressure is directly related to the time of compression i.e. the reciprocal of the roller speed. Hence for every roller speed value there must be a corresponding optimum pressure above which any further juice expressed is immediately reabsorbed. Is this the answer to the lack of improvement due to pressure feeders?

Summing up: in theory, milling improvements would be most beneficial to extraction in the first stages. Improved dilution (e.g. by diffusion) should be most advantageous in the latter stages. Hence from the aspect of extraction, pressure feeders on the last mill are anomalous. However, even on the first mill pressure feeders do not appear to achieve a significant improvement. This may be due to the fact that pressure feeders in South Africa are designed for high speed and low pressure operation. *Of course it can be argued that last mill pressure feeders are installed to increase fuel economy and not extraction. The theoretical argument above then no longer applies, but the fact remains that no significant improvement in moisture content has materialised in final pressure feeders.*

*Imbibition Stages*

In Table 2 it will be noted that in the high preformance group 7 out of 10 tandems have 5 or more imbibition stages. Only 3 have 4 imbibition stages. On the other hand in the low performance group only 2 out of 9 tandems have 5 or more imbibition stages, 3 out of 9 have only 4 imbibition stages. These low-stage tandems also have shredders. This clearly shows that owing to limited stage (dilution) efficiences a high number of imbibition stages is necessary in order to achieve good extraction.

Combined with the discussion in the previous section, this appears to present a strong argument against the installation of pressure feeders on all mills in a short 4-imbibition stage tandem to achieve good extraction.

*Apparent Density of Bagasse*

The apparent density of bagasse, taking the average figures in Table 1, is 112.9 lb/cu ft for first bagasse and 118.7 lb/cu ft for last bagasse. Combining these with previous annual averages the overall average is

Mill 1 : 114 lb/cu ft
Mill Z : 118 lb/cu ft
Average : 116 lb/cu ft

Hence the mill setting formula should read:

$$K = \frac{167.C.f}{n.D.L.F.} \times \frac{110}{116} = \frac{158.C.f}{n.D.L.F.}$$

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.

The error involved by replacing the present 167 by 158 is too small to be of consequence.

It is interesting to note that apparent densities for Cuba and Java are 120 and 110, respectively, so that the South African figure is the average of these two.

*Performance Terms*

The terms, specific feed rate in : lb/(hr) (cu ft t.r.v.) and relative performance (100 × specific feed rate/lost absolute juice % fibre) have both been criticised by various members of the local industry. The S.M.R.I. have no fixed views on this matter and fully realise the limitations of these figures. Specific feed rate does not completely specify the potential capacity rating of a tandem since there are many other factors (other than operational variables) such as feeder drums and pressure feeders which could have a bearing on the capacity limit for reasonable extraction. Relative performance is also limited since it assumes that throughput per unit roller volume is as important as lost juice % fibre. It has been stated that the capacity of a milling train is more likely to be related to the escribed surface, hence roller area and not volume should be considered. It has also been stated that a relative performance figure should be weighted in favour of lost juice rather than throughput.

Regarding the use of total (cross-sectional) roller area, t.p.a., this figure was calculated during the previous season as well as t.r.v. and the values are shown in Table 1. However a plot of t.p.a. *vs.* t.r.v. shows that for practical purposes these values lie on a straight line plot. Hence there is little to choose between the two systems. For continuity it is suggested that t.r.v. be retained until a better system is evolved. Correction factors could possibly be applied to the volume of units equipped with more or less than three rollers.

The relative performance figure cannot be weighted in favour of lost juice until the economic value of throughput against installation and operating costs and the cost of losses can be related. It would then be possible to determine relative performance ($P_r$) on the basis of specific feed rate ($F_S$) and lost juice ($J_l$) by the formula.

$$P_r = F_S/(J_l)^a$$

where $a$ is an exponential constant dependent on the relative economics of losses against throughput and installation. Until a complete economic survey has been made it is proposed that the present figure be retained.

(The relative performance has been calculated on the basis of mean and nominal diameters and both figures are given in Table 1 to facilitate comparison with previous data.)

## M.M.C.P. during 1965-66

At a meeting, attended by engineering and process staff members from most of the local factories, which was held at the S.M.R.I. on 17th February 1965, it was agreed that certain changes be made to the amount and method of submitting data. In particular it was agreed that, owing to the inconvenience caused to engineering staff, all data relating to roller diameters should be dropped from data sheets. New data sheets will be submitted prior to the next season and it is hoped that particular attention will be paid to the accuracy of reported data.

## Conclusions

In the fourth significant year of the M.M.C.P. improvements in milling performance have again been made. This indicates that improvements in milling installations and their operation have been justified. Many of these improvements have been carried out in accordance with the recommendations suggested by the analysis of M.M.C.P. data.

The data in this report again support earlier conclusions regarding the installation of shredders, operation and setting of mills and feeders and the efficiency of first mills. A comparison of data tabulated over several years operation of pressure feeders shows that little significant improvement has materialised after their installation. Unless some improvement is shown in the near future (for example by decreasing speeds and increasing pressures) it must be concluded that pressure feeders in South Africa are not an economic proposition. For good extraction, efficient dilution (e.g. by diffusion) is more important than efficient expression of juice. Tandems which have a high number of imbibition stages have a higher performance on the average.

It has been estimated that the increase in milling efficiency over the past three seasons has resulted in a saving in losses valued at R1,172,500.

## Acknowledgment

The authors are indebted to the managers of factories for their continued support in this project. Thanks are due to technical staff of factories for their efforts in submitting weekly data.

## Summary

This report presents the average milling data for 1964-65 season. An improvement in performance is again noted. Several factories show notable improvement in performance. Possible reasons are suggested.

The average data suggest similar trends in milling variables to those noted previously. Although the data are in some respects lacking the desired degree of accuracy to warrant computer analysis, it appears that standardisation of equipment will facilitate the establishment of relationships between variables.

Data quoted in this report suggest that pressure feeders are not an economic proposition under their present conditions of operation in Natal. Long tandems appear to be necessary for good extraction.

The method of reporting data will be revised for the 1965-66 season.

### References

[1] Buchanan, E. J., Douwes Dekker, K., and van Hengel, A. "Cane Milling Research and Development in South Africa 1961-64" Proc. XIIth Congress I.S.S.C.T., 1965—to be published.

[2] Buchanan, E. J., "The Significance of Stage Efficiency in a Cane Milling Tandem", Proc. 38th Congress, S.A.S.T.A., 1965 — to be published.

**TABLE 1**

| | PG<br>*222* | UF$_1$<br>*S15*P | ZM<br>S*6* | FX$_1$<br>CC*1*/*121* | FX$_2$<br>S2*112* | EN<br>SC5 | AK<br>2S3*1* | DK<br>1S5 | DL<br>S*6* | GH<br>S*6* | MV<br>CS5 | TS$_1$<br>SP*1121P* | TS$_2$<br>CS2*3* | NE<br>S*6*P | IL<br>S*33* | RN<br>SCC5 | SZ$_1$<br>S*5* | SZ$_2$<br>S5 | UK<br>S5 | **Mean Average** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FEED RATES | | | | | | | | | | | | | | | | | | | | |
| 1. Tons cane crushed | 11,691 | 20,498 | 26,127 | 12,975 | 8,874 | 4,229 | 16,887 | 10,202 | 29,690 | 28,537 | 7,632 | 24,089 | 12,876 | 27,339 | 15,686 | 7,898 | 11,010 | 9,924 | 10,706 | 15,625 |
| 2. Tons cane/crushing hr | 86.4 | 136.9 | 198.6 | 93.6 | 64.5 | 29.0 | 117.6 | 74.2 | 213.2 | 197 8 | 57.5 | 165.1 | 83.9 | 192.8 | 120.5 | 56.9 | 80 2 | 74.2 | 79.3 | 111.7 |
| 3. Tons fibre/crushing hr | 10.7 | 18.1 | 31.8 | 14.6 | 10.7 | 4.1 | 18.2 | 10 7 | 33.6 | 30 9 | 8.9 | 26.6 | 13.6 | 30 0 | 18.9 | 9.0 | 12.3 | 11.4 | 12.0 | 17.2 |
| 4. Lb fibre/(hr) (t.r.v.) | 36.4 | 31.2 | 65.7 | 42.8 | 49.5 | 58.8 | 52.3 | 52.5 | 57.0 | 51.4 | 66.0 | 48.5 | 53.3 | 53.1 | 52.6 | 49.7 | 52.7 | 49.5 | 48.6 | 51.1 |
| 5. Imbibition % fibre | 282 | 262 | 308 | 270 | 244 | 239 | 263 | 253 | 370 | 188 | 260 | 198 | 224 | 247 | 281 | 206 | 213 | 212 | 198 | 248 |
| QUALITY OF MATERIALS | | | | | | | | | | | | | | | | | | | | |
| 6. Fibre % cane | 12.27 | 13.23 | 15.74 | 15.61 | 16.64 | 14.31 | 15.47 | 14.47 | 15.78 | 15.65 | 15.42 | 16.11 | 16.27 | 15.60 | 15.60 | 15.80 | 15.33 | 15.36 | 15.26 | 15.26 |
| 7. Absolute juice % fibre in cane | 716 | 656 | 537 | 541 | 502 | 599 | 547 | 588 | 534 | 539 | 549 | 521 | 515 | 542 | 541 | 532 | 553 | 551 | 556 | 559 |
| 8. Fibre % bagasse ex Unit 1 | 26.89 | 23.3 | 28.2 | 26.4 | 27.6 | 28.4 | 24.7 | 20.4 | 31.5 | 27.5 | 26.6 | 25.2 | 35.4 | 22.2 | 23.5 | — | 35 0 | 35.3 | 28.4 | 27.6 |
| 9. Fibre % bagasse ex Unit Z | 43.59 | 45.6 | 40.4 | 45.0 | 44.2 | 46.9 | 45.4 | 42.4 | 45.2 | 43.9 | 42.3 | 45.4 | 46.5 | 44.0 | 44.8 | 46.1 | 45.7 | 45.5 | 43.0 | 44.5 |
| 10. Moisture % bagasse ex Unit Z | 53.29 | 52.05 | 55.95 | 51.61 | 52.69 | 49.73 | 50.95 | 53.85 | 52.14 | 52.89 | 53.44 | 51.52 | 50.30 | 52.59 | 52.59 | 50.46 | 50.84 | 50.89 | 53.49 | 52.17 |
| 11. Average top roller lift Unit 1, in | 0.16 | 0.15 | 0.16 | 0.20 | 0.20 | 0.27 | 0.29 | 0.13 | 0.21 | 0.61 | 0.13 | 0.17 | 0 22 | 0.36 | 0.16 | 0.08 | 0 34 | 0.27 | — | 0.23 |
| 12. Average top roller lift Unit Z, in | 0.21 | 0.22 | 0.27 | 0.29 | 0.13 | 0.12 | 0.16 | 0.08 | 0.42 | 0.10 | 0.12 | 0 15 | 0.13 | 0.20 | 0.17 | 0.14 | 0.18 | 0 17 | — | 0.18 |
| 13. Dis. work opening Unit 1, in | 1.34 | 0.84 | 1.28 | 1.85 | 1.71 | 0.77 | 1.35 | 1.08 | 1.85 | 2.06 | 1.10 | 2.02 | 1.41 | 1.89 | 0.83 | 1.30 | 1.34 | 1.27 | — | 1.41 |
| 14. Dis. work opening Unit Z, in | 0.76 | 0.62 | 1.14 | 0.68 | 0.55 | 0.36 | 1.17 | 0.50 | 1.33 | 0.86 | 0.51 | 1.40 | 1.12 | 0 84 | 0.90 | 0 54 | 0 68 | 0.68 | — | 0.81 |
| 15. Mill ratio (between work opening) Unit 1 | 2.04 | 3.42 | 2.40 | 1.99 | 1.79 | 2.03 | 1.95 | 2.29 | 1.73 | 1.88 | 2.67 | 1.64 | 1.93 | 2.17 | 2.19 | 2.07 | 1.93 | 1.99 | — | 2.12 |
| 16. Mill ratio (between work opening) Unit Z | 1.91 | 1.88 | 2.13 | 1.97 | 2.03 | 1.86 | 1.89 | 2.23 | 2.44 | 2.16 | 2.42 | 1.73 | 2.20 | 2.26 | 2.00 | 3.15 | 2.14 | 2.38 | — | 2.15 |
| 17. Feeder ratio (on dis. work opening) Unit 1 | — | 7.81 | 7.55 | 4.56 | 4.43 | 4.84 | 7.52 | — | 4.47 | 4.62 | 7.76 | — | — | 5.22 | 7.31 | — | 7.57 | 7.95 | — | 6.28 |
| 18. Feeder ratio (on dis. work opening) Unit Z | 10.51 | — | 4.55 | 5.76 | 6.03 | 7.47 | 5.16 | 13.0 | 4.17 | — | 6.14 | — | — | — | 5.26 | — | 10.18 | 10.22 | — | 6.48 |
| 19. Total hydr. load, Unit 1, ton | 383 | 456 | 359 | 272 | 280 | 85 | 380 | 296 | 578 | 668 | 201 | 351 | 319 | 317 | 386 | 217 | 358 | 340 | — | 347 |
| 20. Total hydr. load, Unit Z, ton | 451 | 417 | 385 | 401 | 299 | 210 | 393 | 393 | 595 | 544 | 176 | 337 | 396 | 453 | 475 | 275 | 319 | 310 | — | 379 |
| 21. Specific hydr. load, Unit 1, ton/ft | 70 | 65 | 51 | 49 | 56 | 28 | 58.1 | 54 | 82 | 97 | 44.5 | 50 | 58 | 45 | 64 | 48 | 65 | 62 | — | 58.1 |
| 22. Specific hydr. load, Unit Z, ton/ft | 82 | 59 | 55 | 73 | 60 | 52 | 71.2 | 72 | 85 | 78 | 39 | 48 | 72 | 65 | 79 | 55 | 58 | 56 | — | 64.4 |
| 23. Specific hydr. press. Unit 1, ton/sq ft | 25.2 | 22.0 | 16.8 | 18.3 | 22.1 | 17.0 | 19.4 | 20.6 | 24.0 | 27.4 | 21.6 | **16.5** | 20.3 | 13.9 | 20.8 | 23.4 | 24.4 | 23.1 | — | 20.9 |
| 24. Specific hydr. press. Unit Z, ton/sq ft | 29.8 | **18.9** | 17.1 | 25.5 | 23.7 | 23.3 | 24.6 | 27 | 24.1 | 19.2 | 17.5 | **16.1** | 24.3 | **20.0** | 28.4 | 21.8 | 21.7 | 21.1 | — | 22.5 |
| 25. Top roller surf. speed Unit 1, ft/min | 21.7 | 32.2 | 56.7 | 20.3 | 21.1 | 19.5 | 34.9 | 23.5 | 35.4 | 30.4 | 25.0 | **33.8** | 29.6 | 33.6 | 31.6 | 18.6 | 19.2 | 18.8 | — | 28.1 |
| 26. Top roller surf. speed Unit Z, ft/min | 23.4 | **32.1** | 45.9 | 21.5 | 24.2 | 26.1 | 26.2 | 23.3 | 28.7 | 41.6 | 28.6 | **45.7** | 22.8 | **40.5** | 29.0 | 21.0 | 23.5 | 23.8 | — | 29.3 |
| SPECIFIC PERFORMANCE DATA | | | | | | | | | | | | | | | | | | | | |
| 27. Resid. abs. juice % fibre in bag. Unit 1 | 261 | 315 | 245 | 269 | 251 | 226 | 296 | 380 | 204 | 256 | 265 | 288 | 193 | 349 | 321 | — | 183 | 184 | 235 | 262 |
| 28. Lost abs. juice % fibre in bag. Unit Z | 35.61 | 27.41 | 41.82 | 38.89 | 34.76 | 39.38 | 39.99 | 43.53 | 29.00 | 35.52 | 49.34 | 35.69 | 34.15 | 39.75 | 30.87 | 38.66 | 38.80 | 39.20 | 38.61 | 37.42 |
| 29. Fibre index Unit 1, lb fibre/cu ft escr. vol. | 26.8 | 39.6 | 24.5 | 29.2 | 24.2 | 37.4 | 23.8 | 31.8 | 29.6 | 28.9 | 28.8 | 23.3 | 23.8 | 28.0 | 50.0 | 32.7 | 34.7 | 34.7 | 40.2 | 31.2 |
| 30. Fibre index Unit Z, lb | 43.6 | 58.6 | 33.6 | 66.8 | 66.3 | 46.9 | 43.1 | 67.5 | 50.9 | 50.3 | 54.4 | 50.4 | 43.2 | 51.5 | 52.1 | 62.1 | 57.2 | 50.7 | — | 52.7 |
| 31. Dilution ratio | 79 | 85 | 79 | 73 | 79 | 69 | 70 | 74 | 84 | 78 | 68 | 76 | 72 | 74 | 82 | 70.5 | 70 | 69 | 78 | 75.2 |
| RELATIVE PERFORMANCE DATA | | | | | | | | | | | | | | | | | | | | |
| 32. Relative Performance (t.r.v.) | 102.3 | 114.3 | 155.6 | 110.6 | 142.5 | 151.3 | 130.5 | 121.0 | 196.8 | 144.9 | 134.0 | 136.1 | 157.1 | 132.7 | 170.8 | 138.1 | 136.5 | 126.9 | 124.7 | 138.2 |
| 33. Relative Performance (t.r.v. nominal) | 102 | 108 | 152 | 85 | 111 | 121 | 121 | 119 | 192 | 146 | 119 | 129 | 122 | 125 | 164 | 124 | 122 | 112 | 150 | — |
| 34. Relative Performance (t.p.a.) | 331.0 | 427.6 | 566.3 | 350.9 | 410.7 | 336.3 | 449.4 | 353.6 | 722.6 | 587.4 | 343.4 | 489.1 | 515.6 | 490.6 | 571.5 | 390.6 | 425.4 | 391.3 | 383.1 | 449.3 |
| 35. T.r.v. = Total Roller Volume | 589 | 1160 | 968 | 723 | 432 | 142 | 696 | 409 | 1180 | 1167 | 269 | 1096 | 512 | 1132 | 720 | 362 | 468 | 460 | 495 | 683 |
| 36. T.p.a. = Total Pressure Area | 182 | 310 | 266 | 220 | 150 | 63 | 202 | 140 | 284 | 288 | 105 | 305 | 156 | 306 | 216 | 128 | 150 | 149 | 161 | 199 |
| No. of weeks | 30 | 20 | 5 | 10 | 6 | 28 | 33 | 16 | 30 | 16 | 17 | 22 | 22 | 19 | 15 | 27 | 21 | 27 | 15 | 20 |

NOMENCLATURE: P = Unit with pressure feeder
C = Two-roller crusher
S = Shredder
1–6 = Three-roller units
*P* or *1–6* = Units preceded by gravity chutes

Unit 1 = first three-roller unit
Unit Z = last three-roller unit

## TABLE 2

## 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 | 196.8 | DL | **S6** | **1180** | 370 | 534 | 52.14 | **1.73** | 2.44 | **4.47** | **4.17** | **24.0** | **24.1** | 35.4 | **28.7** | **204** | 29.6 | 50.9 | **84** |
| | 170.8 | IL | **S33** | **720** | 281 | 541 | 52.59 | 2.17 | 2.26 | **5.22** | **5.26** | 13.9 | 20.0 | 33.6 | 40.5 | 349 | 28.0 | 51.5 | 74 |
| | 157.1 | $TS_2$ | CS23 | 512 | 224 | 515 | **50.30** | **1.93** | 2.20 | — | — | 20.3 | **24.3** | 29.6 | **22.8** | **193** | 23.8 | 43.2 | 72 |
| | 155.6 | ZM | **S6** | **968** | 308 | 537 | 55.95 | 2.40 | 2.13 | 7.55 | **4.55** | 16.8 | 17.1 | 56.7 | 34.9 | **245** | 24.5 | 33.6 | **79** |
| | 151.3 | EN | **SC5** | 140 | 239 | 599 | **49.73** | **2.03** | 1.86 | **4.84** | 7.47 | 17.0 | **23.3** | **19.5** | **26.1** | **226** | 37.4 | 46.9 | 69 |
| | 144.9 | GH | **S6** | **1167** | 188 | 539 | 52.89 | **1.88** | 2.16 | **4.62** | — | **27.4** | 19.2 | 30.4 | 41.6 | **256** | 28.9 | 50.3 | **78** |
| | 142.5 | $FX_2$ | **S2112** | 432 | 244 | 502 | 52.69 | **1.79** | 2.03 | **4.43** | **6.03** | **22.1** | **23.7** | **21.1** | **24.2** | **251** | 24.2 | 66.3 | **79** |
| | 138.1 | RN | **SCC5** | 362 | 206 | 532 | **50.46** | **2.07** | 3.15 | — | — | **23.4** | 21.8 | **18.6** | **21.0** | — | 32.7 | 62.1 | 71 |
| | 136.5 | $SZ_1$ | **S5** | 468 | 213 | 553 | **50.84** | **1.93** | 2.14 | 7.57 | 10.18 | **24.4** | 21.7 | **19.2** | **23.5** | **183** | 34.7 | 57.2 | 70 |
| | 136.1 | $TS_1$ | **SP1121P** | **1096** | 198 | 521 | 51.52 | **1.64** | 1.73 | — | — | 16.5 | 16.1 | 33.8 | 45.7 | 288 | 23.3 | 50.4 | **76** |
| **Mean:** | 138.2 | | | 629 | 248 | 559 | 52.04 | 2.12 | 2.15 | 6.28 | 6.87 | 20.9 | 22.5 | 28.1 | 29.3 | 262 | 31.2 | 52.7 | 75 |
| Low Performance Tandems | 134.0 | MV | **CS5** | **242** | 260 | 549 | **53.44** | **2.67** | 2.42 | **7.76** | 6.14 | 21.6 | **17.5** | 25.0 | 28.6 | **265** | 28.8 | 54.4 | **68** |
| | 132.7 | NE | S6P | 1132 | 247 | 542 | **52.59** | **2.17** | 2.26 | 5.22 | — | **13.9** | **20.0** | **33.6** | **40.5** | **349** | 28.0 | 51.5 | **74** |
| | 130.5 | AK | **2S31** | 696 | 263 | 547 | 50.95 | 1.95 | 1.89 | **7.52** | 5.16 | **19.4** | 24.6 | **34.9** | 26.2 | **296** | 23.8 | 43.1 | **70** |
| | 126.9 | $SZ_2$ | S5 | **460** | 212 | 551 | 50.89 | 1.99 | 2.38 | **7.95** | **10.22** | 23.1 | **21.1** | 18.8 | 23.8 | 184 | 34.7 | 50.7 | **69** |
| | 124.7 | UK | S5 | **495** | 198 | 556 | **53.49** | — | — | — | — | — | — | — | — | 235 | 40.2 | — | 78 |
| | 121.0 | DK | **1S5** | **409** | 253 | 588 | **53.85** | **2.29** | 2.23 | — | **13.0** | **20.6** | 27.0 | 23.5 | 23.3 | **380** | 31.8 | 67.5 | **74** |
| | 114.3 | $UF_1$ | S15P | 1160 | 262 | 656 | **52.05** | **3.42** | 1.88 | **7.81** | — | 22.0 | **18.9** | **32.2** | **32.1** | **315** | 39.8 | 58.6 | 85 |
| | 110.6 | $FX_1$ | **CC11121** | 723 | 270 | 541 | 51.61 | 1.99 | 1.97 | 4.56 | 5.76 | **18.3** | 25.5 | 20.3 | 21.5 | **269** | 29.2 | 66.8 | **73** |
| | 102.3 | PG | ***222*** | **589** | 282 | 716 | **53.29** | 2.04 | 1.91 | — | **10.51** | 25.2 | 29.8 | 21.7 | 23.4 | 261 | 26.8 | 43.6 | 79 |

$$*\frac{\text{100 lb fibre/(hr) (t.r.v.)}}{\text{lost abs. juice \% fibre}}$$

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

## TABLE 3

## 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 | 183 | SZ$_1$ | **S*5*** | 553 | **1.93** | 7.57 | **24.4** | **19.2** | 34.7 | **127** |
| | 184 | SZ$_2$ | **S5** | 551 | **1.99** | 7.95 | **23.1** | **18.8** | 34.7 | **123** |
| | 193 | TS$_2$ | **CS2*3*** | 515 | **1.93** | — | 20.3 | 29.6 | 23.8 | 69 |
| | 204 | *DL* | ***S6*** | 534 | **1.73** | **4.47** | **24.0** | 35.4 | 29.6 | 68 |
| | 226 | EN | **SC5** | 599 | 2.03 | **4.84** | 17.0 | **19.5** | 37.4 | **87** |
| | 235 | UK | **S5** | 556 | — | — | — | — | 40.2 | — |
| | 245 | ZM | **S*6*** | 537 | 2.40 | 7.55 | 16.8 | 56.7 | 24.5 | 30 |
| | 251 | FX$_2$ | **S2*1*12** | 502 | **1.79** | **4.43** | **22.1** | **21.1** | 24.2 | **105** |
| | 256 | GH | **S*6*** | 539 | **1.88** | **4.62** | **27.4** | 30.4 | 28.9 | **90** |
| | 261 | PG | ***222*** | 716 | **2.04** | — | **25.2** | **21.7** | 26.8 | **116** |
| **Mean:** | 262 | | | 559 | 2.12 | 5.35 | 20.9 | 28.1 | 31.2 | 83 |
| Low Efficiency First Mill | 265 | MV | **CS5** | 549 | **2.67** | **7.76** | 21.6 | 25.0 | 28.8 | 86 |
| | 269 | FX$_1$ | **CC1*1*121** | 541 | 1.99 | 4.56 | **18.3** | 20.3 | 29.2 | 90 |
| | 288 | TS$_1$ | SP*1*121*P* | 521 | 1.64 | — | **16.5** | **33.8** | 23.3 | **49** |
| | 296 | AK | 2S3*1* | 547 | 1.95 | **7.52** | **19.4** | **34.9** | 23.8 | **56** |
| | 315 | UF$_1$ | S*1*5P | 656 | **3.42** | **7.81** | 22.0 | **32.2** | 39.7 | **68** |
| | 321 | IL | S*33* | 541 | **2.19** | **7.31** | **20.8** | **31.6** | 50.0 | **66** |
| | 349 | NE | S*6*P | 542 | **2.17** | 5.22 | **13.9** | **33.6** | 28.0 | **41** |
| | 380 | DK | **1S5** | 588 | **2.29** | — | **20.6** | 23.5 | 31.8 | 88 |
| | No Data | RN | — | — | — | — | — | — | — | — |

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

N.B.—The bold figures show significant trends

## TABLE 4

## MILLING DATA IN ORDER OF LOST JUICE

| **Data:** | Lost absolute juice % Fibre in bagasse, unit Z | Tandem | Units | t.r.v. | Lb 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 | 27.41 | UF$_1$ | **S*15P*** | **1160** | **31.2** | 262 | 656 | 52.05 | **22.0** | 18.9 | 32 2 | 32.1 | 315 | **39.7** | 58 6 | **85** |
| | 29.00 | DL | **S*6*** | **1180** | 57.0 | 370 | 534 | 52.14 | **24.0** | **24.1** | 35.4 | **28.7** | **204** | 29.6 | 50.9 | **84** |
| | 30.87 | IL | **S*33*** | **720** | 52.6 | 281 | 541 | 52.59 | 20.8 | **28.4** | 31.6 | **29.0** | 321 | **50.0** | 52.1 | **82** |
| | 34.15 | TS$_2$ | CS2*3* | 512 | 53.3 | 224 | 515 | 50.30 | 20.3 | **24.3** | 29.6 | **22.8** | **193** | 23.8 | 43.2 | 72 |
| | 34.76 | FX$_2$ | **S2*1*12** | 432 | **49.5** | 244 | 502 | 52.69 | **22.1** | **23.7** | 21.1 | **24.2** | **251** | 24.2 | 66.3 | **79** |
| | 35.52 | GL | **S*6*** | **1167** | 51.4 | 188 | 539 | 52.89 | **27.4** | 19.2 | 30.4 | 41.6 | **256** | 28.9 | 50 3 | **78** |
| | 35.61 | PG | *222* | 589 | **36.4** | 282 | 716 | 53.29 | **25.2** | **29.8** | 21.7 | **23.4** | **261** | 26.8 | 43.6 | **79** |
| | 35.69 | TS$_1$ | **SP*1*121*P*** | **1096** | **48.5** | 198 | 521 | 51.52 | 16.5 | 16.1 | 33.8 | 45.7 | 288 | 23.3 | 50.4 | **76** |
| **Mean:** | 37.42 | | | 629 | 51.1 | 248 | 559 | 52.17 | 20.9 | 22.5 | 28.1 | 29.3 | 262 | 31.2 | 52.7 | 75 |
| Low Efficiency Tandems | 38.61 | UK | S5 | **495** | 48.6 | 198 | 556 | **53.49** | — | — | — | — | 235 | 40.2 | — | 78 |
| | 38.66 | RN | SCC5 | **362** | 49.7 | 206 | 532 | 50.46 | 23.4 | **21.8** | 18.6 | 21.0 | — | 32.7 | 62 1 | **71** |
| | 38.80 | SZ$_1$ | S*5* | **468** | 52.7 | 213 | 553 | 50.84 | 24.4 | **21.7** | 19.2 | 23.5 | 183 | 34.7 | 57.2 | **70** |
| | 38.89 | FX$_1$ | **CC1*1*121** | 723 | 42.8 | 270 | 541 | 51.61 | **18.3** | 25.5 | 20.3 | 21.5 | **269** | **29.2** | 66.8 | **73** |
| | 39.20 | SZ$_2$ | S5 | **460** | 49.5 | 212 | 551 | 50.89 | 23.1 | **21.1** | 18.8 | 23.8 | 184 | 34.7 | 50 7 | **69** |
| | 39.38 | EN | SC5 | **140** | **58.8** | 239 | 599 | 49.73 | **17.0** | 23.3 | 19.5 | 26.1 | 226 | 37.4 | 46.9 | **69** |
| | 39.75 | NE | S*6*P | 1132 | **53.1** | 247 | 542 | 52.59 | **13.9** | **20.0** | 33.6 | **40.5** | **349** | **28.0** | 51.5 | **74** |
| | 39.99 | AK | **2S3*1*** | **696** | **52.3** | 263 | 547 | 50.95 | **19.4** | 24.6 | 34.9 | 26.2 | **296** | **23.8** | 43.1 | **70** |
| | 41.82 | ZM | S*6* | 968 | **65.7** | 308 | 537 | **55.95** | **16.8** | **17.1** | **56.7** | **45.9** | 245 | **24.5** | 33 6 | 79 |
| | 43.53 | DK | **1S5** | **409** | **52.5** | 253 | 588 | **53.85** | **20.6** | 27.0 | 23.5 | 23.3 | **380** | 31.8 | 67.5 | **74** |
| | 49.34 | MV | **CS5** | **242** | **66.0** | 260 | 549 | **53.44** | 21.6 | **17.5** | 25.0 | 28.6 | **265** | **28.8** | 54.4 | **68** |

N.B.—The bold figures show significant trends

**Mr. Gunn** (in the chair): I must congratulate the Sugar Milling Research Institute on the progress they have made in solving milling problems. In the mill setting formula, 167 was the figure initially established and after five years of critical analysis they have arrived at a figure of 158.

There are indications that some other factors in milling should be investigated. I would suggest that the S.M.R.I. investigate grooving, particularly the effect of Messchaert grooves. Those of us using Messchaert grooves damage our rollers much faster than others who do not use them, but I think they are very important in the discharge rollers at the back of the tandem.

The authors mention that the pressure on T.S.I. unit Z is low. This is not quite correct, as the pressure shown in Table 2 is the upward pressure on the discharge roller, not the pressure on the top roller.

**Mr. Pole:** The M.M.C.P. has been the basis for giving a great deal of assistance to the mills and the S.M.R.I. deserves thanks for this.

At Illovo mill there are six mills driven by 3 engines, each driving 2 mills.

The fact of having two mills geared in tandem creates quite a lot of problems. A close control is kept, by means of analyses, etc., so that the mills in tandem are properly set in relation to each other.

Factors concerned with extraction are closely tested, such as sucrose per cent bagasse, and the Central Board does complete duplicate analyses on bagasse.

Many mechanical problems affecting top roll lift and mill feeding have been tackled.

In our recent expansion throughput was increased mainly by changing only peripheral roller speed. We were then, however, not getting the drainage we required and all the mills were spitting badly. One measure taken was to alter the heel of the trash plate and this proved successful.

Closer feeder roll settings helped feeding and increased extraction.

Better maceration distribution also proved an important factor.

**Mr. van Hengel:** Speaking on my own behalf and on behalf of Dr. Douwes Dekker and Mr. Buchanan I must remove any impression that might have been given that M.M.C.P. achievements are S.M.R.I. achievements.

They are joint achievements of the industry and of course local improvements by each factory are just as important.

The participation of factories in the M.M.C.P. has created an exchange of data which has stressed the importance of paying attention to the milling process and this has achieved the results. There is no credit due to the S.M.R.I. simply for working out a weekly data sheet.

**Mr. Ashe:** Before Umfolozi installed a pressure feeder, moisture per cent final bagasse was between 55 and 56, but last season we averaged 52.

We cannot decrease mill speeds without further damaging gearing and for the same reason we cannot increase pressure on the last pressure feeder.

We could probably get better results from the pressure feeder but we had no trouble with it at all last season. The previous season, with increased pressure at low speeds, the pressure feeder was giving us excellent results, even better than Australia reported.

We have found imbibition rate to be significant in regard to extraction. During shortage of steam the imbibition rate has to be cut down on one tandem and always extraction falls.

An imbibition ratio of 275 seems to be right for Umfolozi. Above that results are no better, but below that are worse.

**Mr. Royston:** Gledhow has not hesitated to try out various recommendations of the S.M.R.I. and has achieved a lot of success as a result.

We were instructed by our management that, in stages, the Gledhow tandem would have to increase throughput to 250 tons cane per hour.

We achieved eradication of slip in three ways. First, adherence to 45 degree pitch grooves, without using chevrons. Second, high level chutes and, third, bigger grooves. The first mill has 2½" grooves and gives about 65 per cent primary extraction. We are now doing 220 tons per hour, but as when we get up to 250 tons extraction will almost certainly drop we will probably consider diffusion also, to maintain extraction.

Grooving certainly needs further investigation. By using chevrons on the top roller, in combination with the feed roller, there is a 25 per cent loss of effective pressure area.

We introduced automatic brix control of imbibition for a period of a fortnight and obtained amazingly uniform milling figures.

When talking about feed rates we should use roller areas and not roller volumes.

**Mr. Cargill:** By using a pressure feeder we have been able to reduce the speed of the turbine of the last mill from 4,000 r.p.m. to 2,800 r.p.m., which reduced the surface speed from 48 to 34 feet per minute. Throughput was increased from 158 to 168 tons cane per hour, moisture was reduced by 1 per cent and extraction increased by ½ per cent, and pressure on the top roller increased from 300 tons to 500 tons.

This is a fine achievement for any piece of equipment and so I think serious consideration should be given to fitting pressure feeders.

**Mr. van Hengel:** The S.M.R.I. will investigate grooving, although it is a very complex subject, owing to the variables involved.

In 1962 I wrote that the pressure feeder was the most powerful feeder mechanism yet evolved, and I stand by that.

But if Umfolozi, instead of fitting a pressure feeder had installed a feeder roller, say of the Darnall type, and a vertical or open chute, the increased fibre per cent bagasse figure of 44.5 might well have been achieved, as it is still within normal range.

Can Mr. Cargill say that the mill equipped with a pressure feeder consistently gave better results than the mills that have been equipped with high chutes?

We feel that pressure feeders do their job, but that other machinery could be made to do the job also.

**Mr. Cargill:** Before fitting the pressure feeder on the mill we had tried, without success, an apron feeder and two different types of underfeed rollers, but no Donnelly chute was fitted. We now have fitted six Donnelly chutes with underfeed rollers, but have not yet perfected a technique to get the best possible feeding. We are not as yet getting the optimum feeding on the pressure fed mill either. I cannot yet decide whether the feeding from an underfeed roller and a tall chute is as good as that from a pressure feeder.

**Mr. Renton:** Surely the more power you put into feeding the better it must be and therefore a pressure feeder should be the answer.

I think it should be fitted to the first mill and not the last one.

The dilution ratio is regarded as significant and this must be related to imbibition.

There are five imbibition stages at Darnall and our dilution ratio of eighty-four is comparable with other mills with six stages, so imbibition rate must be significant.

**Mr. Steffen:** What is the effect at Tongaat of using woolly rollers?

**Mr. Gunn:** We do use them, just as some people use Messchaert grooves and some do not. We think the drainage is better if the top roller is woolly. But as the rollers wear out just as quickly as others it is obvious that the bagasse adhering to the roller is moving in the high pressure area. Also we do not have any maintenance on the straight scraper blades.

There has been argument today as to whether a pressure feeder is a feeder or a mill and there was reference to one placed at the beginning of a mill which gave no benefit at all. This is true, but it must be remembered it is the first year of its operation. It was installed according to the manufacturers' instructions, but it did not work. It can now, however, absorb approximately 200 horse power and do some work and we are beginning to get results.

In the paper, in remarks about Illovo, it is mentioned that alterations were made to the heel of the trash plate to improve drainage. At Tongaat the installation of Edwards hydraulics in the second tandem was regarded as making a significant improvement.

**Mr. Pole:** I don't think that alterations to the trash plate at Illovo was the chief cause of any improvement in milling results, but it certainly improved drainage.

**Dr. Douwes Dekker:** I cannot agree with Mr. Renton that the feeding device with the most power should be the best. Dr. Kerr, when he was out here, said that a mill will take what it is given but only up to a certain point. By putting more power into a feeding device we must get to a point where the mill will choke. In a pressure feeder some of the power might be used to express juice but in other feeders this may not be the case.

**Mr. Renton:** I based my remarks on our experience at Darnall. We started with underfeed rollers driven by 2″ chain, with a breaking strain of about 50 h.p. We worked up gradually with stronger chains and stronger shafts, in conjunction with closer feed settings on the underfeed rollers and got continual improvement. We are at present using the biggest sprockets and strongest chain available and use about 120 h.p., which is still a lot less than the Walker mill uses. We are now going for gear drives with more power, but we aim also at expressing juice with the underfeed roller, so that it will also be a working roller.

**Dr. Douwes Dekker:** When the feeder roller is being used to express juice and lower the moisture content of bagasse, I can see the reason for more power, but not when the roller is used for feeding purposes only.

**Mr. Dent:** The pressure feeder at Tongaat was originally set in accordance with recommendations. It did not work well at first — we had difficulty feeding the pressure feeder. The accepted Australian practice is to have a chute about 11 feet high. Ours is now only 4 feet 6 inches high, and we have repositioned it and have been able to close the pressure feeder setting and increase throughput.

The setting was reduced by 1⅝ inches and only then did the pressure feeder itself start expressing juice and we were able to keep the tray clean. We hope to give a much more optimistic report about pressure feeders next year.

**Mr. van Hengel:** According to the conclusions of our paper we would readily accept a properly working pressure feeder, squeezing juice, at the head of a tandem.

When we are considering feeding on its own, without juice extraction, then with a mill with three openings our aim is at all times to have the same weight of fibre per unit of time passing through every opening. If we can get this then in the openings all we have to deal with is the ratio of pounds fibre per cubic foot.

Feeding is merely the problem of matching all three openings such that under the conditions of pressure and speed, without any slip taking place, the same amount of fibre goes through each opening all the time.

This has no reference to squeezing of juice. Feeding and squeezing of juice must be considered entirely separately.

**Mr. Fourmond:** In Table A it is mentioned that Tongaat replaced Rivière carriers. In Dr. Douwes Dekker's paper "Again Imbibition" he remarks on the advantage of these carriers. Why were they discarded?

**Mr. Gunn:** At Tongaat the Rivière carrier did not operate anything like it was claimed it would. It was exceptionally expensive to maintain and was prone to chew up its macerator and cause lengthy break downs. The rubber bands did not stand up well, but the main thing was that extraction dropped.