

MUTUAL MILLING CONTROL PROJECT

PROGRESS REPORT No. 1.

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

Summary

The project has been in progress for one year during which 5 out of 14 factories have submitted data to the Research Institute. This report outlines the preparatory organization. Some interesting trends are already apparent from the data. These are discussed briefly. Some general difficulties in installing the necessary instruments are described.

the preparations necessary for their active participation. The purpose of this report is to outline the preparatory work which has been carried out, to discuss the general difficulties encountered and to point out some preliminary conclusions from the 1961-62 crushing period.

Introduction

Since the inauguration of this project at the 1961 S.A.S.T.A. Congress, the Research Institute has concentrated its attention on assisting the factories with

Preparatory Organization

Preparations for the project have necessitated a considerable amount of planning and negotiation on the part of the Research Institute. The general organization of the project is shown graphically in Fig. 1. During the preparatory stages the factories listed in Table 1 were equipped with instruments

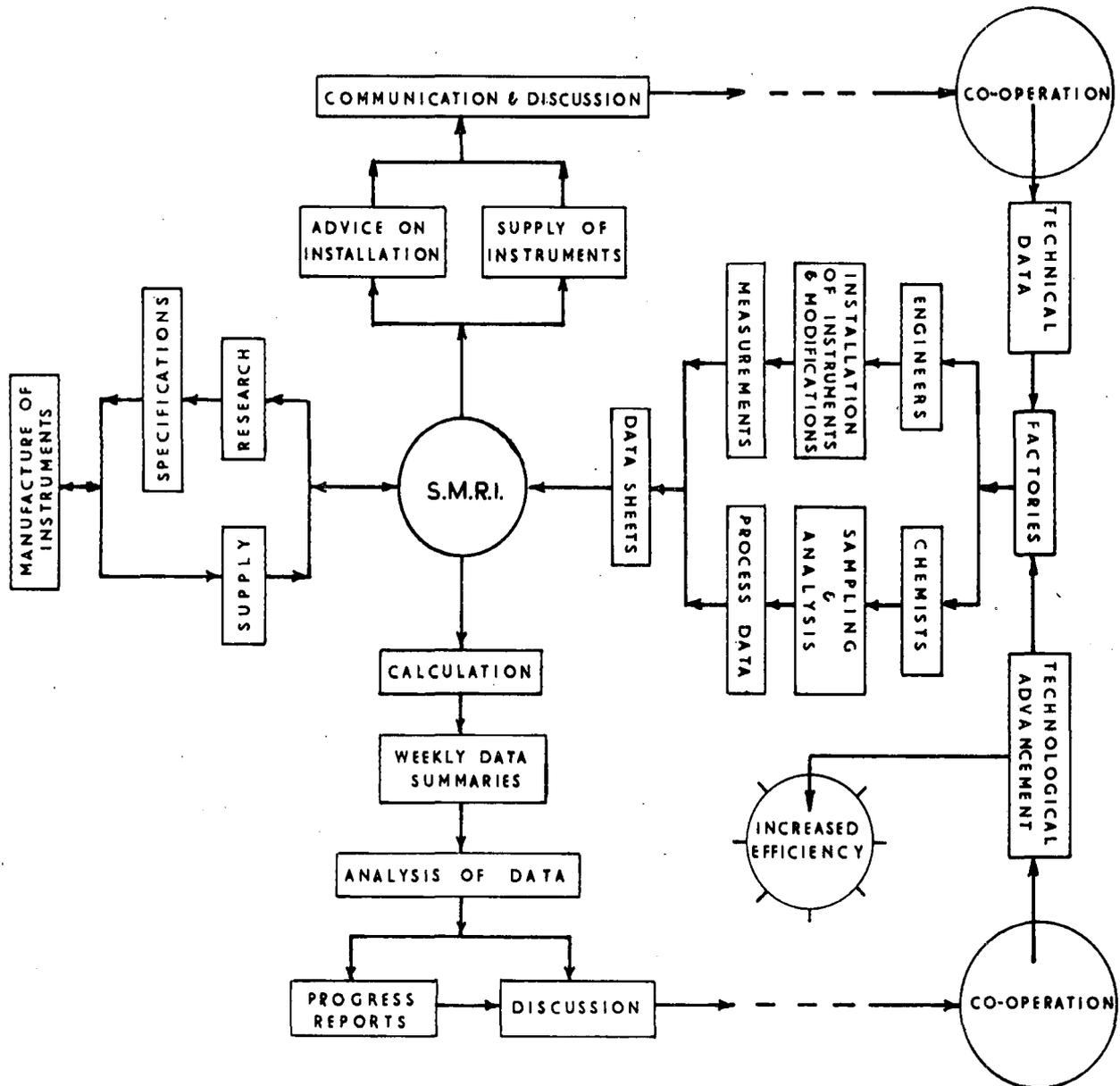


Fig.1. Project organization.

including a cyclometer and four lift integrators with accessories for each tandem. Apart from supervising the construction, delivery and installation of instruments, an efficient method of calculating specific performance figures from the data submitted and returning weekly and monthly summaries to the factories had to be devised. The final form of these summaries is shown in Table 2. The net result of this preparation was that 5 out of the 14 factories submitted data sheets during the 1961-62 crushing period.

Some General Difficulties

All of the participating factories have been visited at least once during the previous season by officers of the Research Institute and this has provided an opportunity for free discussion of the problems peculiar to each plant. Those of a general nature are discussed briefly below:

(1) Sampling of Primary and Secondary Mill Juices

By means of the brixes of the above juices fibre per cent first mill bagasse may be calculated. At factories where imbibition is applied before the first three-roller unit, this method cannot be applied. However, tests carried out at several such factories, viz. Umfolozi, Tongaat and Illovo, indicated that, under normal operating conditions, imbibition applied before the first three-roller unit could be removed without loss in efficiency. The factories concerned have removed this imbibition stage.

In cases where no simple solution could be found, a very simple bagasse analysis has been developed by the Research Institute. This can be adopted by factories carrying out milling tests and requires little extra work. It has been successfully applied by Darnall.

(2) Measurement of Set-opening

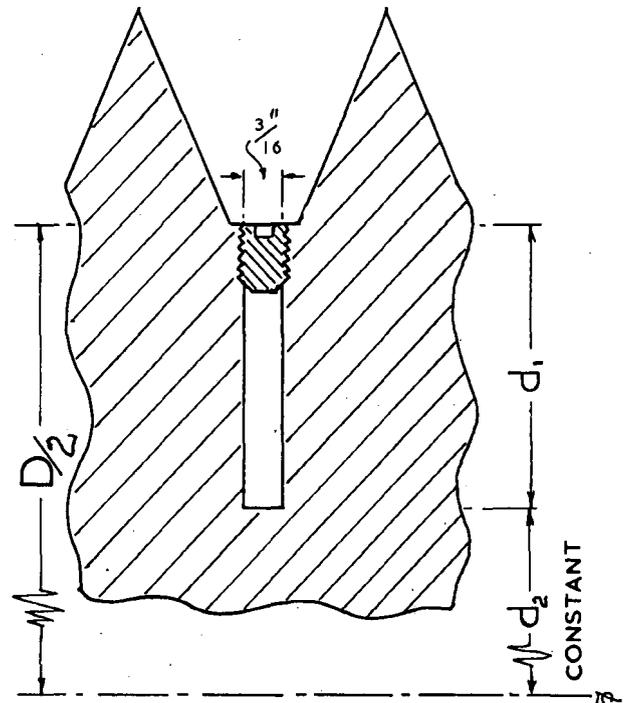
The original method required measurement of the roller diameters as well as the centre to centre distances of the first and last units. The set-opening was then found by difference.

Experience with the above method has indicated that it is apparently too cumbersome for routine measurement and this applies also to the cyclometer. It is important that this set-opening should be obtained with as much accuracy as possible. The most logical procedure is to resort to some accurate method of direct measurement. The Research Institute is at present developing a suitable instrument which will measure the distance between the bottoms of the grooves rather than from the tips of the teeth of one roller to the bottom of the grooves of the other. This would avoid inaccuracies due to roller wear.

The instrument has been described in a communication to the factories.

(3) Measurement of Roller Diameters

Alternative methods of roller diameter measurement were discussed in a communication to the factories. The direct methods included measurement by means of callipers or by draping a string fitted with plumb bobs over the roller.



$$D = 2(d_1 + d_2)$$

Fig. 2.

An indirect method suggested by the Research Institute makes use of a hole drilled in the roller shell at the bottom of a groove. The base of such a hole would provide a constant reference point which together with the depth, measured by means of a depth gauge, would enable calculation of the diameter as in Fig. 2. The hole could be protected by an Allen-screw between successive measurements. It would be necessary to distribute say three of such holes in each of the three grooves to be measured since it is difficult to stop a roller in any pre-determined position. The holes should be about 3/16 in. × 1 in. deep.

(4) Integrators

The roller bearings on the followers of the lift integrators installed so far appear to wear out rather rapidly. Several engineers have overcome this by replacing them with solid rollers. A simple construction adopted by Z.S.M. factory makes use of a ferro-bestos bush mounted in a solid M.S. roller and running on a stainless steel pin. We suggest that this modification should be applied in general.

Another difficulty experienced is that the lamps have a somewhat short life at factories where voltages fluctuate above the rated voltage. The Research Institute will look into the possibility of using 250V. lamps where necessary.

(5) General

Other difficulties of a less general nature have been met by various factories and in each case officers of the S.M.R.I. have given these their personal attention. Most of the factories are confident of submitting the necessary data at the start of the 1962-63 season.

Preliminary Observations

The somewhat limited data available so far does not warrant a comprehensive summary of the weekly figures. However, in Table 2, typical values are shown for the four factories which submitted data. Although it would be presumptuous to make any general conclusions under the circumstances, we should not lose this opportunity of pointing out some of the more striking observations:

(i) Immediately apparent is the extremely low residual absolute juice per cent fibre figure for the first mill at Darnall. In an attempt to explain this we would point out the following:

- (a) The first mill is preceded by a shredder which materially assists maintaining a constant bulk density feed to the first mill.
- (b) The fibre index is comparatively high for the first mill. This is probably due to (a) and (c).
- (c) The specific hydraulic pressure on the first mill is relatively high.
- (d) The feeder ratio is low and (b) indicates good feeding of the mill.
- (e) Correct mill settings.

(ii) The lost absolute juice per cent fibre of the final mill at Darnall is extremely low. This is apparently due to:

- (a) The efficient expression of primary juice by the first unit.
- (b) Low peripheral speed of top-rollers.
- (c) Factors mentioned under (b), (c), (d) and (e) of (i).

(iii) The data collected so far indicate that very high imbibition rates are not justified. For example, during a period of two weeks at Darnall the imbibition was reduced from 380 to 280 per cent on fibre while the lost absolute juice per cent fibre increased from about 26 to 27 only. This increase is insignificant whilst the vast reduction in imbibition could save a considerable amount of fuel and increase the economy of any factory which burns coal or wood.

Conclusion

Although the above observations confirm some of the opinions held by the Research Institute on the subject of milling, we would prefer to have them substantiated by data from more factories. We must therefore appeal to the factories to ensure that they are able to submit accurate data at the start of the next crushing season.

There is every indication from the data submitted so far that the Mutual Milling Control Project will provide a positive and specific basis for comparing the merits of various milling innovations attempted by factory engineers. In this way, we hope that many misconceptions will be eliminated whilst the value of useful modifications will be recognized.

Finally, we wish to thank the staffs of the factories which have submitted completed data sheets during the 1961-62 season for their co-operation.

Appendix

Table 1
Participating Factories

Factory	No. of Tandems	Data Submitted by	No. of Data Sheets
PG ..	1	—	0
UF ..	2	—	0
ZSM ..	1	—	0
FX ..	2	—	0
AK ..	1	1	14
DK ..	1	—	0
DL ..	1	1	7
MV ..	1	1	15
TS ..	2	—	0
NE ..	1	—	0
IL ..	1	1	2
RN ..	1	1	2
SZ ..	2	—	0
UK ..	1	—	0
Total 14 ..	18	5	40

Table 2

Typical Data For 1961-62 Season

Factory	AK IIS4*	DL IIS6*	MV IICS5*	RN IICC5*
Code No.	745	1,212	304	379
Roller volume in cu. ft.				
Data submitted from	1st Oct.	20th Nov.	1st Oct.	13th Nov.
Feed Rates				
1. Tons cane crushed (week)	14,066	23,759	7,077	7,209
2. Tons cane/crushing hour	103	192	54	53
3. Tons fibre/crushing hour	16	30	8	7
4. Lbs. Fibre/(hour)(T.R.V.)	44	49	53	39
5. Imbibition % fibre	255	340	245	220
Quality of Process Materials				
6. Fibre % cane	16.0	15.6	14.8	14.0
7. Absolute juice % fibre in cane	525	550	585	605
8. Fibre % bagasse ex unit 1	25.5	31.3	25.8	—
9. Fibre % bagasse ex unit Z	45.2	47.0	43.6	46.2
10. Moisture % bagasse ex unit Z	51.8	50.7	52.8	50.7
Mechanical Data				
11. Average top-roller lift unit 1, in.	0.35	0.16	0.15	0.03
12. Average top-roller lift unit Z, in.	0.20	0.45	0.15	0.06
13. Discharge work-opening unit 1, in.	1.42	1.57	1.13	1.29
14. Discharge work-opening unit Z, in.	1.05	1.15	0.61	0.69
15. Mill ratio (between work-openings) unit 1	1.91	1.99	2.21	2.36
16. Mill ratio (between work-openings) unit Z	1.86	2.28	2.36	2.50
17. Feeder ratio (on discharge work-opening) unit 1	—	6.3	7.5	—
18. Feeder ratio (on discharge work-opening) unit Z	—	5.0	6.5	9.4
19. Total hydraulic load, unit 1, ton	340	611	186	218
20. Total hydraulic load, unit Z, ton	340	611	176	275
21. Specific hydraulic load unit 1, ton/ft.	52.3	87.0	41.3	48.4
22. Specific hydraulic load unit Z, ton/ft.	61.7	87.0	39.1	55.0
23. Specific hydraulic pressure unit 1, ton/sq. ft.	18.3	26.4	19.3	23.0
24. Specific hydraulic pressure unit Z, ton/sq. ft.	21.6	25.1	17.9	21.8
25. Top-roller surface speed unit 1, ft./min.	31	30	24	18
26. Top-roller surface speed unit Z, ft./min.	28	25	28	19
Specific Performance Data				
27. Residual absolute juice % fibre in bagasse, unit 1	295	208	270	—
28. Lost absolute juice % fibre in bagasse, unit Z	34.5	26.0	42.6	34.0
29. Fibre index, unit 1, lb. fibre/cu. ft. escr. vol.	23.2	35.5	28.5	28.0
30. Fibre index, unit Z, lb. fibre/cu. ft. escr. vol.	41.0	50.5	44.6	45.3

*Roman numerals: knife sets

C: crusher
S: shredder

Arabic numerals: three-roller units

While the paper was being read and during the discussion following, a sample of the lift integrator roller was demonstrated, also a caliper instrument constructed by the S.M.R.I. for measuring the gap between rollers, and a micrometer type of instrument for measuring the diameter of rollers was also exhibited.

Mr. Gunn, in the chair, stated that removing the imbibition from the first milling unit behind a two-roller crusher did in effect give a slightly less cleansing effect on the bed-plate due to less juice coming from the front roller, but did not in actual practice make any difference to the final extraction of the mill.

Messrs. Byard and Ashe discussed the modification to the roller on the lift integrator and recommended that it should be altered from the Sugar Milling Research Institute's design and it was also recommended

that the diameter of the roller should be made as large as possible.

Mr. Fourmond enquired whether any results had been obtained from using the lift integrators.

Mr. van Hengel stated that as a preliminary result, it did appear that the S.M.R.I. formula for mill settings should be changed from the figure of 167 to 180, to cater for the conditions as they prevailed at the mills at present.

Mr. Kramer related that he had used the S.M.R.I. formula, and had found that by improving his feeding devices on the mill and with arcing the top rollers, the figure of 167 appeared to be the correct one.

Dr. Douwes Dekker stated that the figure of 167 was based on results obtained in Java. For last mills, it corresponds to a fibre index of 55 lbs. per cu. ft.

scribed volume, and it had been found that maximum performance was obtained when this figure was attained. Feeding a mill at this rate sometimes required special measures, and if this was not possible, it was sometimes necessary to be satisfied with a lower fibre index until such time as conditions at the mill could be altered.

Mr. van Hengel stated that the S.M.R.I. did not at this stage know how to treat woolly top rollers or what corrections had to be made for the use of Messchaert grooves.

Messrs. Buchanan, Kramer, van Hengel and Hulett discussed the measurement of the diameter of the rollers using the micrometer chord measuring instrument. It was recommended that this type of instrument be used and that in order to avoid irregularities a number of measurements should be taken around the diameter of the roller to achieve the correct diameter. It was pointed out that the measurement of the diameter of the roller was only important in order to find the roller surface speed, provided that the set-opening of the rollers was measured by some other accurate means.

Mr. Cargill stated that with Messchaert grooves in every groove on the discharge rollers, it would be impossible to measure from the bottom of the top roller groove to the bottom of the discharge roller groove. He recommended that the measurement from the tip of the discharge roller to the bottom of the top roller groove should be used.

Mr. van Hengel said that wherever possible the measurement should be from the bottom of the top roller groove to the bottom of the discharge roller groove, because he considered this to be a more accurate measurement. Where Messchaert grooves were in existence, this would be impossible. He stated that the accurate measurement from the bottom of one groove to the bottom of the other groove was not impossible, and the measurement of the tooth height would be quite possible if a steel rule was placed across the teeth and a caliper measurement was taken from the bottom of the groove to the steel rule. This would introduce the same error in all measurements taken throughout the Industry.

Dr. Douwes Dekker mentioned the possibility of using a piece of lead and then assessing the set-opening from this lead.

Mr. Cargill said that he had attempted to obtain the set-opening by using lead on three inch pitch rollers and had found this to be completely unsatisfactory.

Mr. van Hengel suggested that the lead had worked very well in Java where the grooving was very small in relation to the actual set-opening, but where the

grooving was large compared with the set-opening he did not consider this would be a feasible way of measuring the setting.

Mr. Hulett stated that he recommended that the setting should be measured from the tip of the groove of the discharge roller to the bottom of the groove of the top roller, and this should be standardised throughout the Industry, because this measurement could be taken fairly accurately and would actually be measuring the set-opening and would not bring in the error of the tooth height, particularly when the same pitch of roller were used.

He claimed that this method would be as accurate as any method so far discussed.

Mr. Byard said that any measurements from the tip of the discharge roller to the bottom of the groove in the top roller would cancel errors which would be caused through the chevrons in the top roller.

He considered that chevrons in the top roller grooving could account for an increase of up to eight per cent in the settings as measured.

Mr. Kramer stated that if the rollers were properly carbon-arc'd there would be no necessity for using chevrons. He had done this at Amatikulu for the last three years.

Mr. Gunn said that it was all a matter of getting a proper feed into the mill and that with a pressure-fed mill there was no necessity for chevrons on the top roller.

Mr. van Hengel stated that it appeared that the general opinion was that the measurement should be taken from the tip of the discharge roller to the bottom of the top roller and he appealed to the Director of the Sugar Milling Research Institute to make a decision.

Mr. Gunn summarised the discussion by saying that the following points had become evident. Firstly, the S.M.R.I. lift indicator rollers had to be altered to give better service than they gave at present and it was preferential to make the roller which runs on the roller flange as large as possible; the next point was that the measuring of the set-opening must be done as accurately as possible and where Messchaert grooves were used, the measurement would have to be from the tip of the discharge roller groove to the bottom of the top roller groove. Where Messchaert grooves were not used, the S.M.R.I. method of measuring from the bottom of the one roller groove to that of the other roller was recommended. It was also necessary to establish a means of measuring the diameter of the rollers as accurately as possible, and it would appear that the micrometer gauge demonstrated was the most satisfactory instrument for this purpose.