FURTHER NOTES ON MILL EXTRACTION RESULTS

(REVIEWED IN THE LIGHT OF INDIVIDUAL UNITS CONTROL)

By. J. RAULT

Introduction

Industry's Mill Extraction and Loss of Potential Production

The last paper presented on this subject (Proc. Ninth Annual Congress S.A.S.T.A.) dealt with conditions existing twenty years ago, when the average extraction for the whole industry stood at 91.07 per cent. with the composition of final bagasse brought down to 3.05 per cent. sucrose and 52.11 per cent. moisture.

From that time many changes have taken place, especially after the war years, and yet we are only up to 92.32 extraction with the bagasse at 2.91 per cent. average sucrose carrying to the furnace a moisture content risen to 53.18 per cent., probably one of the highest in the world cane sugar industry.

On the other hand, the efficiency of the more complex operations of sugar manufacture expressed by the term "boiling house recovery" has nevertheless risen from a level of 85.2 per cent. in 1934 to the present 90.5 per cent. of this season, notwithstanding many cases of an improved product placed on the market.

The major factor, slowing down the rate of possible progress in mill extraction, has been put down to the too-rapid expansion of the industry's production, out of proportion with the steps already taken to meet the progressive rise in factory crushing rates (60.8 tons per hour in 1934 and 102 tons in 1955).

A secondary factor is also the deteriorating state of cleanliness of the raw material sent to the mills, with ever-increasing amounts of extraneous fibrous matter, due to inadequate labour forces in the fields. We are admittedly the worst country in this respect, apart from those who are forced to fall back on mechanical harvesting.

The presence of 5 to 10 per cent. of extraneous matter in the way of dry trash, green leaves, roots and tops, sent in with the genuine cane stalk of the comparatively low-fibred N:Co. varieties, has not made milling conditions easier than previous to 1935, ably reviewed at the time of the Ninth Congress, by Mr. F. B. Macbeth, and qualified by the title "Milling Uba Cane."

Out of the final figures of the 1955-56 season, the extraction figures of the seventeen factories, issuing figures to the S.M.R.I., can be divided in order of progression as follows:

No. of Mills	Approximate Extraction shown	No. of Mills	Approximate Extraction shown
1	90.0	4	92.5
1	90.5	3	93.0
2	91.0	2	93.5–93.7
2	91.5	1	95.1
	(91.2–91.5)	—	———
1	92.0	17 season	92.32

It is not the first season when a level of 95 per cent. extraction has been maintained in the past by one factory or other, which means that the final bagasse was brought down to a sucrose content of 1.90 to 2 per cent. with a moisture of 50 to 52 per cent. Notwithstanding the comparatively high fibre ranges, 15 to 17 per cent., of the South African raw material—a factor discounted in at least two northern Zululand mills with 12.5 to 13.5 fibre—there is no insuperable condition preventing other factories reaching this excellent standard of performance, when equipped with the appropriate machinery.

By falling short of the 95 per cent. extraction, the last season's average of 92.32 per cent. represents a bulk shortage of 27,000 tons of commercial sugar that should have been in bags and not burned as fuel in the bagasse furnaces (calculated on the sucrose entering the cane carrier).

When this total loss is distributed *pro rata* of the individual factory shortfall, the potential increase in production is over 4,000 tons for at least three factories, and over 1,000 tons in the case of seven others.

We need no apology for stating that under present conditions of expansion, the capital outlay for improving the milling results of most factories, is a very sound investment which would bring immediate and high interest on this initial capital expenditure.

Capacity versus Extraction

With reference to the optimum conditions of equipment for capacity and extraction, there is no straightforward answer as to whether the size of the rollers, or the number of mill units, or the splitting of the work on two batteries is the most economical, as this must be answered according to local conditions.

Very seldom is a mill unit added, for the sole purpose of improving extraction, without the legitimate demand for an increase in production rate, obscuring the issue.

NATAL ESTATES . MOUNT EDGECOMBE

AVERAGE WORK OF INDIVIDUAL UNITS OF THE MILLING TRAIN

TOTAL EXTRACTION (Up to Unit)								EXTRACTION BY UNIT Per cent. Sucrose entering Unit											
Year	Crusher	First	Second	Third	Fourth	Fifth	Extn. Last Mill	Crusher	First	Second	Third	Fourth	Fifth	Tons Fibre per Hour	Fibre per cent. Cane	Sucrose per cent. Cane	Tons Cane Crushed per Hour	Water Added % Cane	Year
1933	36.89	70.19	82.03	87.58	91.00	94.21	3.21	36.89	52.77	39.72	30.88	27.54	35.66	16.18	15.75	14.40	102.74	41.02	1933
1934	38.33	73.11	83.75	89.04	91.41	94.20	2.79	38.33	56.40	39.60	32.50	21.60	32.50	16.72	15.28	12.95	109.43	38.91	1934
1935	32.90	71.55	83.35	88.64	91.87	94.52	2.65	32.90	57.60	41.50	31.80	28.40	32.60	17.57	15.39	14.18	114.18	41.45	1935
1936	27.47	71.23	82.71	88.31	91.75	94.62	2.87	27.47	60.34	39.91	32.39	29.43	34.78	17.69	15.42	13.94	114.76	42.32	1936
1937	35.30	72.81	84.16	88.83	91.91	94.80	2.89	35.30	58.00	41.70	29.50	27.60	35.70	18.45	15.43	14.36	119.61	44.26	1937
1938	37.76	74.27	84.66	88.52	91.77	94.79	3.02	37.76	58.66	40.38	25.14	28.30	36.69	18.68	14.47	13.73	129.09	39.21	1938
1939	36.37	74.22	85.14	88.99	92.25	94.65	2.40	36.37	59.50	42.30	25.90	29.60	31.00	19.78	14.28	13.63	138.52	40.99	1939
1940	34.59	72.06	83.12	88.03	90.88	94.40	3.52	34.59	57.28	39.58	29.09	23.80	38.60	20.89	15.39	13.52	135.73	41.29	1940
1941	37.20	72.50	83.40	88.30	91.50	94.50	3.00	37.20	56.20	39.50	30.00	26.70	35.90	20.00	15.74	13.74	127.09	41.08	1941
1942	28.48	72.17	83.28	88.52	91.90	94.95	3.06	28.48	61.08	39.90	31.32	29.49	37.84	20.92	15.44	13.34	135.50	38.94	1942
1943	23.54	70.58	85.28	89.04	91.72	94.88	3.16	23.54	61.52	49.96	25.55	24.45	38.16	22.70	15.84	12.996	143.34	38.43	1943
1944	20.38	71.38	84.87	89.04	91.74	94.86	3.15	20.38	64.05	47.41	27.54	24.38	38.00	22.72	15.81	13.795	143.74	36.86	1944
1945	23.76	68.06	84.13	88.15	91.61	94.78	3.17	23.76	58.11	50.29	25.34	29.18	37.79	22.68	16.28	13.997	139.29	39.16	1945
1946	30.85	70.81	84.51	89.29	91.97	94.73	2.76	30.85	57.79	46.94	30.86	25.02	34.37	21.11	15.81	14.003	133.51	39.73	1946
1947	33.43	71.30	83.73	88.85	91.92	95.33	3.41	33.43	56.89	43.31	31.47	27.54	42.21	22.30	15.73	13.345	141.79	37.26	1947
1948	27.31	65.40	81.20	87.59	91.24	95.26	4.02	27.31	52.40	45.67	33.99	29.44	45.89	22.15	15.98	13.60	138.60	38.83	1948
1949	28.32	67.08	80.71	86.48	90.71	94.97	4.26	28.32	54.07	41.40	29.91	31.29	45.86	23.20	16.35	13.693	141.88	38.07	1949
1950	26.48	66.52	80.27	86.72	90.50	94.79	4.29	26.48	54.46	41.07	32.71	29.50	45.08	24.10	16.64	14.35	144.85	37.88	1950
1951	27.86	66.00	80.41	86.45	89.85	94.43	4.58	27.86	52.87	42.38	30.84	28.68	42.40	22.35	16.64	13.266	134.30	39.36	1951
1952	27.61	65.87	79.44	86.11	90.44	94.25	3.81	27.61	52.85	39.75	32.44	31.21	39.88	22.10	15.86	14.19	139.32	38.10	1952
1953	42.45	65.54	78.99	85.57	90.53	94.43	3.90	42.51	40.06	39.02	31.32	34.39	41.19	24.51	16.79	14.20	146.00	37.87	1953
1954	37.09	64.72	76.49	83.36	89.93	94.02	4.09	37.09	43.92	32.87	29.72	33.46	46.02	27.01	17.73	13.70	152.34	39.97	1954
1955	38.49	68.72	77.74	84.99	89.85	93.69	3.84	38.49	49.15	28.84	32.56	32.38	37.88	26.00	16.57	13.93	156.89	37.65	1955

The addition of one or even two units of similar size to the existing ones, becomes a means of raising the crushing rate, by opening or speeding the front units, with a drop in the former individual performance, i.e. a redistribution of the total effort of extraction, with a small gain at the end.

Another controversial point is the relative importance of the front versus the final unit on total extraction results.

According to the S.M.R.I. calculations (Royston Formula) the factory with the highest standard of extraction (95.1 per cent.) deals with a fibre tonnage, 78 per cent. of its rated capacity—whereas the four factories with the lowest extraction, 90 to 91 per cent., are forcing their plant at a rate of 110 to 125 per cent. of the standard.

In the case we are particularly concerned with, the 115 per cent. rated capacity work is being carried out with an extraction still maintained between 93.7 and 94.0 per cent.

It is accordingly felt that the data on page 2, collected on the results of this same milling plant for over twenty years, could be of some interest to our fellow technologists. They are taken day after day on all the individual units and are true representative conditions of a very long period of years, including variables of crushing rates, fibre content and state of cleanliness of the canes, alterations in mill settings, groovings, hydraulics, etc.

In the course of its history two important alterations were carried out in this milling plant previously described in the Proceedings of the Tenth Annual Congress of the S.A.S.T.A. (Electrically-Driven Sugar Mills, by F. B. Macbeth) viz.:

(*a*) For the 1947 season, the only steam-driven unit (last mill) was brought into line with the others by being motor-driven. It also had its housings strengthened, allowing of better adjustments for the life of the rollers.

This alteration had an immediate beneficial effect on extraction which reached its optimum.

(*b*) In the year 1953 the front unit two-roller "zig-zag" crusher was replaced by a heavily-grooved three-roller crusher, driven by the same original motor and gear.

Although the addition of this one roller did show a rise of 10 to 15 per cent. on the poor extraction results of the first stage of crushing, this advantage was not apparent at the next stage (first mill) and was completely dissipated at the final stage.

It may be claimed that this addition of one roller was an economical means of raising the throughput of an overloaded milling plant.

This claim is somewhat weakened by the results previously realised (1950 season) by the two-roller crusher, which dealt with 24.1 tons fibre per hour, maintaining a final extraction of 94.79 per cent., in spite of the very poor start at 26.48 extraction from this very opened two-roller crusher.

These yearly statistics show a progressive rise in the hourly crushing rate from 103 to 157 tons, notwithstanding a general deterioration in the state of cleanliness of the cane from the fields.

This rise is equivalent to a progressive fibre intake of 16.2 to 27.0 tons per hour, which according to Royston's Formula means a stepping up from 70 to 115 per cent. of the rated capacity.

The effect of this increasing fibre intake has not altogether been detrimental to extraction, which starting at 94.2 soon increased to 94.7 and reached subsequently 95 per cent., and kept above this level for two years, but began to decline after 1950 until it fell down to 93.7 for this last season, with the highest cane throughput per hour which did not quite coincide with the highest fibre tonnage.

It is peculiar that during this last season when a record crop put a premium on speed of production, and crushing rates shifted between 150 to 170 tons per hour, the weekly extraction result was insensitive to this variation of 15 tons per hour and remained stable round 93.7 to 94.0 per cent. except at the end of the very long nine months campaign.

At this end period with the wear and tear of the rollers and increasingly trashy canes, a turn for the worse was experienced in extraction, in spite of crushing rates reduced to nearer 150 tons per hour.

One must come to the conclusion that a train of mills such as ours is a very flexible machine from which moderately good extraction can still be obtained within a fair range of crushing rates.

We believe that with the thick bagasse blanket on our carriers, imbibition has to be maintained between 35 to 40 per cent. cane, i.e. 230 to 240 per cent. fibre, for optimum efficiency, and we have not benefited by further increases of water.

We have never succeeded in obtaining from our first crushers, extractions of 50 to 60 per cent. shown lately by other South African factories, and still less the 70 per cent. claimed by overseas factories operating with closer settings on tropical canes, carrying fibres of 11 to 13 per cent.

Even with the two squeezes from our three-roller crusher the bagasse leaves this unit with a moisture content seldom less than 64 per cent.

It has been suggested that together with the large volumes of extraneous trash packing the genuine cane stalk and enforcing wide roller opening, the weakness lies with the limitations of the motor power at that stage and for this reason a proposed alteration to a more powerful steam turbine drive in the near future will be watched with interest.

Ewa milling results (tabulated in the paper by J. Rault, 1934 Proceedings) showed a consecutive drop of five seasons in crusher extraction from 72.5 to 61.4 per cent. without appreciable difference in the final extraction which remained at the remarkable level of 98.2 per cent.

The present position of the mill work, judged by individual units control, shows clearly that in the course of the past few years, in spite of the substitution of a three-roller for the old two-roller initial unit, the efficiency up to the third mill has practically declined to that reached up to the second mill, when optimum results were being obtained a few years back—a defficiency partly but insufficiently made good by the last two units.

The addition of a powerful sixth mill to be erected next season is the logical step from which much is expected, as it will be a challenge for obtaining a high individual extraction performance and not so much a further increase over the present rate of 160 tons per hour.

Our past experience confirmed by the exceptional performance of the last unit from another factory leading in extraction results, inclines us to attach a paramount importance to the last unit's performance as a more fruitful source of improved milling in more ways than one, rather than by expecting too much from the first crusher.

This may be an interpretation of results prejudiced by abnormal conditions of high fibre throughputs, and our opinion probably is not shared by milling experts, who, dealing with well-balanced milling plants, endeavour to extract the maximum possible by dry crushing in order to minimise the duty of the following units and the work of imbibition.

Through the courtesy of the milling company that regularly exchanges with us the details of their individual milling performance, it is possible to illustrate by actual results the validity of our statement, in the following tables.

It constitutes a remarkable example of one last unit performance, being able to raise the total extraction to a record high level, the more remarkable as the total extraction of the preceding four mills and crusher had not even equalled the "up to the fourth mill extraction" reached by the other larger milling train, dealing with the same-cane supply, controlled by the same technical staff, under the same roof.

A_1 and A_2 refers to the results of the two trains of mills of this factory for the 1955-56 season.

b_1 refers to Natal Estates results for five years from 1942 to 1946.

b_2 refers to Natal Estates results for three years from 1947 to 1949 (highest extraction).

b_3 refers to Natal Estates results for three years from 1952 to 1955 (working with three-roller crusher instead of two-roller crusher).

	A_1	A_2
Tons cane per hour	130.00	68.00
Tons fibre per hour	20.41	10.47
Tons fibre per hour rated capacity	23.39	14.07
Actual crushing per cent. rated capacity...	87.30	74.50

	Total Extraction up to Unit		Extraction by Unit		Extract on per cent. Sucrose entering Unit	
	(3-roller)	(2-roller)	(3-roller)	(2-roller)	(3-roller)	(2-roller)
	A_1	A_2	A_1	A_2	A_1	A_2
Crusher ...	52.38	52.67	52.38	52.67	52.38	52.67
First mill...	71.87	70.27	19.49	17.60	40.9	37.2
Second mill	81.26	80.56	9.39	10.29	33.8	34.6
Third mill .	87.28	85.83	6.02	5.27	32.1	27.1
Fourth mill	91.02	90.11	3.74	4.28	29.4	30.2
Fifth mill...	94.73	95.76	3.74	5.65	41.3	57.1

Period	b_1 1942 to 1946	b_2 1947 to 1949	b_3 1952 to 1955
Tons cane per hour	139.10	140.80	151.70
Tons fibre per hour	22.03	22.55	25.84
Tons fibre rated capacity ...	21.84	21.84	23.39
Actual crushing per cent. rated capacity	100.90	103.30	110.50

	Total Extraction up to Unit			Extraction by Unit			Extraction per cent. Sucrose entering Unit		
	b_1	b_2	b_3	b_1	b_2	b_3	b_1	b_2	b_3
Crusher ...	25.40	29.69	39.34	25.40	29.69	39.34	25.4	29.7	39.3
1st mill ...	70.60	67.93	66.33	45.20	38.24	26.99	60.6	54.4	44.5
2nd mill ...	84.42	81.88	77.74	13.92	13.95	11.44	47.0	35.7	33.9
3rd mill ...	88.81	87.64	84.64	4.39	5.76	6.90	28.2	31.3	31.0
4th mill ...	91.78	91.29	90.10	2.97	3.65	5.46	26.5	29.6	35.5
5th mill ...	94.80	95.19	94.05	3.02	3.90	3.95	36.7	44.8	39.9

The above comparative statistics of the Natal Estates and the other factory, indicate a different set of milling conditions, where a more favourably equipped capacity versus actual crushing rate, plays an important role in the other factory.

This factory starts in consequence with a first unit extraction 15 to 25 points ahead of the Natal Estates efficiency, invariably poor at that stage for reasons already explained.

The poort start of Natal Estates is apparently no lasting impediment to final good results specially during the 1947 to 1949 seasons. There is, however, a definite falling-off, after the crushing rates have been further increased to 110 per cent. of the fibre rated capacity.

The record of 95.76 per cent. extraction of the one milling train, is the result of a remarkable effort of the last unit, which extracts 57 per cent. of the sucrose entering that unit.

In conclusion it is hoped that a larger number of factories will also undertake this type of control that should be the means of collecting valuable data on this aspect of sugar technology.

The time-consuming method of sucrose and moisture determination in bagasse can now be considerably shortened by the use of laboratory shredders, and Dietert moisture tellers, which allow a larger number of tests to be carried out on one individual mill bagasse, thus enhancing the service value of chemical control to the milling section of the factory.

Mr. J. B. Grant thanked Mr. Rault for his paper and said that although this work had been carried out very systematically and over a long period, Mr. Rault was still, however, unable to reach irrefutable conclusions. If more mills carried out these individual mill tests and these were available to Mr. Rault, he had no doubt that we would be a long way towards finding the final answers to our extraction problems.

He pointed out that the loss of so much sugar, some 27,000 tons per annum, meant a tremendous amount of money lost to the industry. It was the intention to carry out such tests at Felixton. He considered that the loss of efficiency shown over the last few years was due to the increased output expected of these plants. Owing to the recent rapid expansion in the last few years, the mills were not properly equipped and until the full equipment was installed good results could not be expected.

Mr. Rault stated that more complete details on the equipment of the factories listed in his paper, would give a better insight into the factors influencing some of the variations in efficiency of South African Mills, which were admittedly poor in the way of extraction. He hoped that this information would be collected in the near future by such an institution as the S.M.R.I.

He had been able to quote the results of one factory, which had volunteered to supply him with relevant facts, together with their mutual milling control figures.

Mr. J. Antonowitz said that loss of milling efficiency was intimately tied up with the extraneous matter such as trash on cane which increased the tons fibre per hour. He thought that one of the difficulties was to persuade the mill management to enable the milling staff to carry out trash testing experiments on say 200 lbs. of cane from each consignment.

Mr. Rault replied that the determination of the extraneous fibrous matter sent to the mills had already been carried out at one of the mills by a select committee studying this very controversial subject between manufacturers and cane growers. His company had also investigated this question and accumulated accurate date in the course of the 1954 season. Notwithstanding the well known damaging effect of excessive fibrous matter on factory efficiency, he had been occasionally puzzled by the loose relationship of fibre content of cane and tonnage througput. Apparently the numerical expression of fibre content was insensitive to the different action on milling, from the compact genuine fibre of the cane stalk, and that of the loose fibre brought in by the extraneous dry and green leaves, roots, tops, and the like.

This determination of extraneous fibre at all mills would however consume a large labour force.

Mr. D. W. W. Hendry said that at the other factory quoted in the paper he was not surprised that there had been no increase in the efficiency of extraction by the third mill as they had tried everything in the past to improve upon it. He would like to know what the individual maceration figures were for each tandem.

Mr. Rault considered that the record total extraction of the smaller plant studied in his paper, was made possible by the comparatively low throughput of that mill, 74.5 per cent of rated capacity. Such a statement was not belittling the successful effort of the staff, who had the foresight of providing themselves with an equipment proportionate to the dictates of expansion in the near future.

The outstanding performance of the last unit of this milling train, had confirmed his experience on the popularity of a powerful final unit, as a "goal keeper," making up for the deficiency of the other units of the team.

He also referred to a most up to date and lucid publication (*La Sucrerie de Cannes*) with a chapter on milling written in French by Mr. E. Hugot, an eminent sugar technologist from our neighbour island of Reunion. This book deserved a wider recognition in the English language and he hoped that at some future congress, Mr. Hugot would be a welcome guest invited by the industry.

It happened sometimes, that one mill unit appeared to show an abnormally high or low performance which was not confirmed in the course of the following weeks, although no alteration had been carried out on that special unit. The interpretation of such results should not be too dogmatic, and required a certain amount of experience, for the sampling of a material of variable composition for calculating an average set of conditions was seldom perfect, and conclusions should not be hastily drawn on a small number of tests, for altering mill settings.

Dr. C. van der Pol inquired what sort of liaison existed between the milling staff and the Laboratory.

Mr. Rault replied that there was a very great degree of co-operation between the milling and laboratory staff, in carrying out this control, where there was a risk of unrepresentative samples or interrupted production nullifying the value of this work.

Apart from the usual moisture and sucrose content of final bagasse, imbibition, sucrose content of cane, issued to the shift engineer's office, the total extraction and tonnage per hour was also worked out every eight hours shift, including the percentage of various varieties crushed.

The average individual mill performance was in in the hands of the chief engineer every Saturday night, for the constant readjustments of the week-end stop, and in the course of the week, the relative drop of moisture and sucrose from unit to unit was closely watched. Any particular unit requiring investigation, had numerous consecutive tests so as to eliminate the disturbing effect of hourly cane variations in passing judgment on a fair average of those tests.

Mr. Main said he did not really want to speak on this subject until some of the engineers had expressed their views, particularly as mill extraction should really be a subject of more direct concern and interest to the engineer than to the chemist.

In this case, the author of this paper is a chemist and all the observations to-day have thus far come from chemists or men on the process side, but since Mr. Rault had kindly invited his expression of opinion he would give his views at this stage of the discussion.

He found Mr. Rault's paper most interesting and it was worthy of our deep consideration. It was of personal interest to him also as Mr. Rault had kindly sent him a copy in 1935 of his previous paper on mill extraction. So, to-day, we meet again to face the startling fact that for 21 years mill extraction in Natal has remained practically unchanged. This surely must be a challenge to our Engineers to start a fresh drive to equal the mill extraction achieved in many other countries.

In the Begg Sutherland group of Sugar Mills in India the mill extraction had also remained below standard for many years previous to the advent of Noel Deerr and Alexander Brooks, who introduced a very stimulating system of Mutual Technical Control in their group of factories.

This quickly improved all recovery figures and seasonal averages of 1.5 per cent sucrose in bagasse and 45 per cent moisture in bagasse became quite commonplace in 17 roller mills under identical conditions as regards cane and with the same personnel who had previously considered such high mill extraction figures quite unattainable.

When he went to Umfolosi Mill in 1947 he found that by a fortunate co-incidence Umfolosi at that time had similar large percentages of Co.281 and P.O.J.2878 canes to that which were milled in the Indian mill he had recently left. This made it easy to intiate comparative tests.

The Umfolosi mill extraction responded to the same efforts which had achieved such good results in India and despite many major mechanical handicaps in the old Umfolosi milling plant, it proved possible to raise the mill extraction up to 95 per cent. Further progress was halted by the critical staff position with the result that the drive for increased mill extraction had to give way to the large reconstruction programme.

He had carried out subsequent research at the Natal Technical College on the fibre stress ratios of different cane varieties under Natal conditions and this evidence had further convinced him that equally good mill extraction results could be achieved in Natal if the correct milling technique and system of Mutual Technical Control could be followed.

He realised that the diversity of mill ownership in Natal made it difficult to apply any system of Mutual Control in the same way as Noel Deerr had done in India. The Sugar Milling Research Institute was obviously faced with that problem here and despite the fact that technical data is already being circulated among the Natal mills, the same stimulating system of enforcement could not be introduced.

Many variable factors have to be closely controlled to achieve high mill extraction and this cannot easily be achieved by individual effort in any Mill. It required suitably experienced technical direction with a permanent system of teamwork and specially trained milling technique.

Mr. Rault had pointed out that 27,000 tons of commercial sugar was lost in Natal each year due to the low mill extraction. At roughly £25 per ton, this equal to an annual financial loss of £675,000. In the case of three mills, the loss of over 4,000 tons of sugar is therefore equivalent to a loss of £100,000 each per annum. If the Natal Sugar Millers decided to capitalise this at 12½ per cent for interest and redemption, a total sum of £5,400,000 could be provided for new milling equipment, if it were needed.

This enormous sum was quite unnecessary however for improved mill extraction, as our milling machinery in Natal was already equal to the best he had seen elsewhere.

Mr. M. Hill stated that the practical engineer knew what sort of extraction he could expect, if the mills were working within a reasonable capacity and properly loaded and the rollers had a good

gripping surface. The chemist could tell the engineer what his extraction was, and also which mill in a train was lagging, something which the engineer probably already knew but he could not tell him what to do to improve things, and all the engineer could do then was to check back upon his settings. He therefore considered that the only thing that could be done to improve extractions was to have an experimental unit so that the settings, etc. could be experimented with. He aimed, as far as pressures were concerned, at a 50 tons per foot of roll on 54 inch rolls but this was not always possible on certain varieties of cane, when loading would have to be reduced to 40 tons or sometimes less, in order to maintain continuity, a very important factor in milling efficiency. If the engineer could get maximum loading with top roll floating and his mills were working smoothly, that was all he could do.

He agreed with Mr. Main that a lot depended upon personnel on shift.