ELECTRICALLY DRIVEN CANE CRUSHING MILLS AND SOME ADVANTAGES PERTAINING TO THEM.

ALSO,

A FEW ITEMS ON MILLING DATA

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Quite a number of interesting articles have been written on the subject of Electrically Driven Cane Crushing Mills. Motor drives for Cane Mills have now had sufficient practical demonstration for some years past and it can be taken that very satisfactory results have been obtained in this direction.

Before proceeding to set forth some of the advantages of the electric drive, it may be advisable at this stage to enumerate briefly some of the electric power systems applicable, and that have been applied to Cane Mills.

(1) D.C. Ward-Leonard System.
(2) D.C. Constant Voltage System.
(3) Variable Frequency System (A.C.)
(4) Three Phase Variable Speed Commutator Motors. (Schrage System).

It is not the intention of the writer to commence a discussion or controversy as to the advantages or otherwise between the different systems mentioned above, as he is not fully aquainted with the idiosyncracies or performances of all these systems.

The system which he will deal with concerns the Variable Speed Commutator Motor (Schrage), as this one is installed at Mount Edgecombe, and therefore, the following remarks will be centred on the operations at this factory.

Further, it is not the intention to create a controversy between steam and electric drives, as the choice of either drive rests entirely on the immediate and characteristic requirements of each individual factory in question.

In making the latter remarks, the writer has in mind the conditions prevailing in the Hawaiian Islands. It was surprising to observe that out of 38 factories in these Islands not one factory was equipped with electrically driven cane mills, yet they lead the world with mill extraction, i.e., 98.4%. It would be interesting to know whether a still higher mill extraction could be obtained if any of the milling tandems in these factories were electrically driven. The writer thinks not; as the fibre content there does not vary much, and the tonnage dealt with per tandem is not excessive.

However, there are several advantages in favour of the electric drives, such as:—

(1) Mill house free from steam pipes.
(2) Improved individual mill control.
(3) Starting and stopping operations made more quickly.
(4) Less space needed for motors.
(5) Less cylinder oil to contaminate evaporator plant, i.e., tubes and coils.
(6) Lower running maintenance costs.
(7) Centralised control.
(8) It is possible to ascertain immediate amount of power taken by each unit, which is a close index to mechanical adjustments.

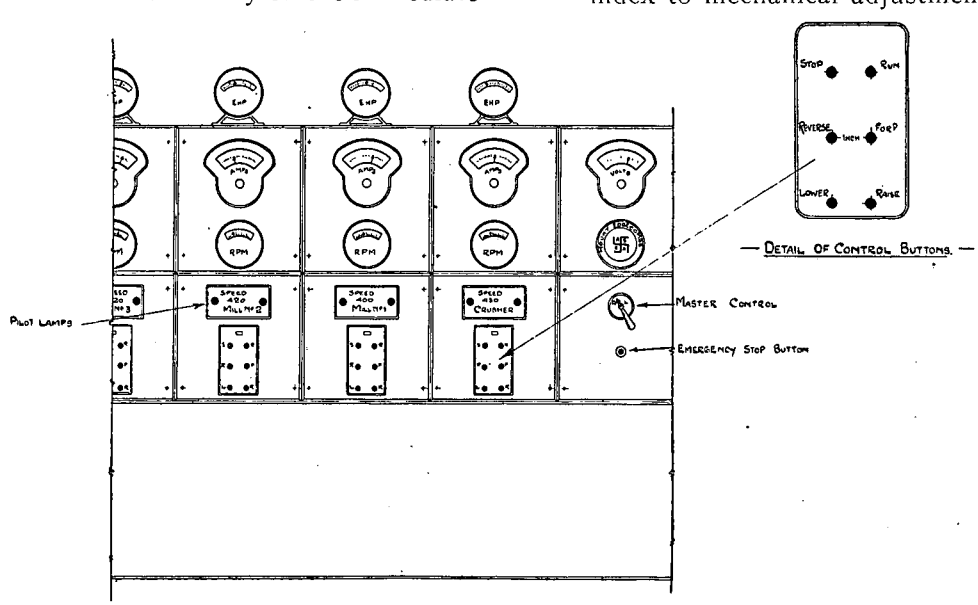

Fig. 1.

Further, steam turbines are used as the prime movers to generate the electric power supply, and they have fully demonstrated their economy, dependability, and soundness for power generation while operating with process steam.

According to the total load required for the factory and outside plant—irrigation principally—the turbines can be arranged of either the back pressure or condensing-passout type.

Where a large outside load is required during the non-crushing season for irrigation purposes it is essential to have condensing-passout turbines.

During the crushing season these turbines pass out process steam to the factory, and during the non-crushing season they work as full condensing sets.

The plant at Mount Edgecombe comprises two condensing-passout turbines, and one back pressure set—each of 2,000 K.W. capacity.

It is necessary to set out the principal features of the system as installed at Mount Edgecombe.

Motors.

The motors are Variable Speed Commutator (Schrage System), A.C. 550 volts, 3 phase, 50 cycles, with a speed range from 320 to 500 r.p.m., and at these two respective speeds the H.P. available is 272 and 420 respectively. Of course, should the speed be set at any point between the lowest and highest speeds, naturally, the available H.P. increases in proportion automatically.

The speed range is obtained by push-button control, and when the button is pressed the "servo" motor which controls the movement of the brushes on the commutator is brought into operation and the speed is either increased or decreased as desired. The whole tandem speed can be raised or lowered as well, by the turning of a small Master Switch, which brings all the servo motors (for brush gear) into operation simultaneously, this switch is situated on the central control platform and is indicated on Fig. 1.

Starting Equipment.

The starting equipment is totally enclosed contactor gear, fitted with three relay contactors and is push-button controlled, the panel for controlling same is arranged as set out in Fig. 1. There are six operating buttons, as follows:—Start, Stop, Reverse, Forward (both these including) and Raise, Lower, and the whole operation is simplicity in itself.

In addition to the push-button control panels on the central control platform, there are duplicate panels situated opposite each mill as indicated on Fig. 2, so that any one mill can be operated from the mill platform as well.

There are four emergency stops situated along the mill platform at convenient intervals—indicated on Fig. 2—in addition to the one on the central control platform.

The motors can be interlocked or run independently and each can be run at different speeds over the range already mentioned.

The interlocking device is a great advantage, for instance, if the third mill motor should stop or trip out, all the preceding motors automatically stop also and therefore prevent the bagasse piling on to the intermediate carrier before the preceding motors could be stopped.

It will be seen that the whole control of the plant is practically perfect and foolproof.

When crushing Uba and soft canes, i.e., P.O.J.'s and Co.290, etc., in the one tandem, and at the present stage when the soft canes are being developed in this country, and the percentage of soft canes milled comprises approximately 12.8% of the total crop, and further, these canes are delivered in varying quantities from 0.11% to 49.5% per week during the crop, it is a great advantage to have a speed range equal to 180 r.p.m. (i.e., 320 to 500 r.p.m.), this range assists materially in the milling operations, when the various types of cane are being milled.

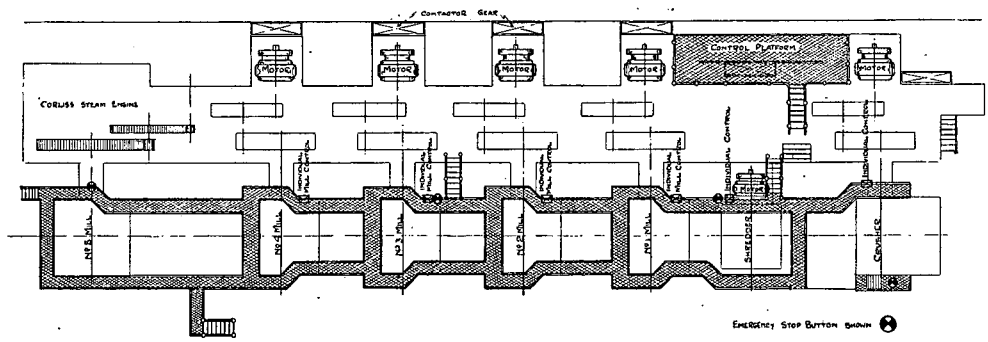

Fig. 2.

Owing to the lower fibre content of the P.O.J. canes it is possible to speed up the crusher and lower the speed of the mills and hence maintain a reasonable blanket of bagasse entering the mills.

The mills are set to accommodate the quantity of fibre that exists in Uba cane, and this runs from 15 to 17% (and even higher in Zululand) as against 11.0% to 13.5% in the soft canes.

Under these conditions the two outstanding advantages of electric drive, in the writer's opinion, are the individual mill control and the immediate registration of the H.P. taken by each unit.

There is another feature that enters into the category of unit control, not only between "Uba"

and "soft" canes, but between "Uba" and "Uba"—especially when high tonnages are milled and when the cane is taken from various sources of supply and far afield.

To illustrate the point the writer has in mind, a factory milling, say, 125 tons and another at 50 tons per hour respectively.

The supply of cane in both instances is delivered in S.A.R. trucks, and the average weight of cane per truck is 25 tons.

It is a fact that the factory crushing 125 tons per hour can have five changes in fibre as against the factory crushing 50 tons with two changes per hour.

This variation is most noticeable at Mount Edgecombe. The crusher speed for instance is running at, say, 450 r.p.m. with the mill speeds, say, around 430 r.p.m., and during the next 15 minutes it is necessary to reduce the crusher speed to 400 r.p.m. and raise the mill speeds, due to the fact that the mills will not take the feed owing to variation in fibre—yet again it is possible to run, at times, at the former speeds for two or three hours without a hitch.

These conditions are due in the writer's opinion to various causes:—

(1) Irrigated "Uba" cane.
(2) Non-irrigated "Uba" cane.
(3) Varying age of the ratoons.
(4) Varying quantities of trash.
(5) Cane produced on hills and flats.
(6) Climatic conditions (rainfall and drought).

All these conditions have a very great bearing on fibre content and when summarised out including soft canes the fibre content range can vary from 11% to 17%.

Soft Canes.

During the past crop it has been possible to tabulate and summarise out some interesting figures in connection with speeds, H.P.s and other data with reference to Uba and soft canes.

The are average weekly figures, and it will be observed the difference in the H.P. registered. As the percentage of soft cane increased the H.P. per ton of cane milled drops.

Glancing through the columns under the heading of H.P.s and the percentage of soft cane milled per week it is noticed that the H.P. taken for the week ending 5th November, 1935—when 0.11% of soft canes was milled—8.54 H.P. per ton was registered, and for the week ending 22nd December, 1935—when 49.5% of soft canes was milled—7.46 H.P. per ton was registered.

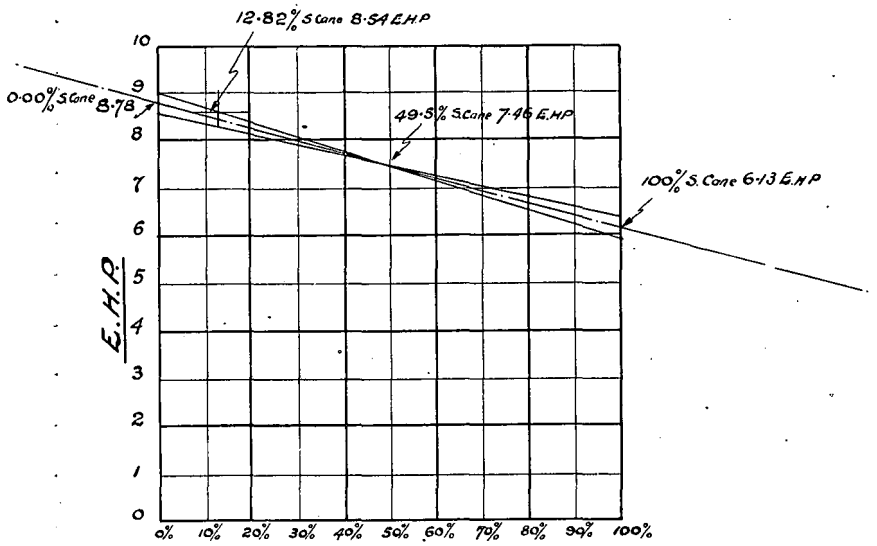

Fig. 4.

These figures are set out in graph form for the above two instances quoted, as shown in Fig. 4.

Although the graph is set out for the figures obtained, it may prove to be a very different proposition, if all soft canes had been milled for one week; as the 49.5% of soft canes was not milled separately—but were loaded on the carrier in varying quantities, that is to say, three to six trucks (small) soft cane and then a similar quantity of "Uba."

In spite of the extra facilities of speed range control, the extraction figures show scarcely any improvement for the week when 49.5% of soft cane was milled, and it is difficult to account for

Week ending	CRUSHER.		1st MILL.		2nd MILL.		3rd MILL.		4th MILL.		5th MILL.	Gross E.H.P.	Total Tons Cane.	% Soft Cane.	Tons Cane per Hour.	K.W.H. per Ton Cane.	Rainfall in Inches
	R.P.M.	E.H.P.	R.P.M.	E.H.P.	R.P.M.	E.H.P.	R.P.M.	E.H.P.	R.P.M.	E.H.P.	Steam Engine Drive.	Average Motor R.P.M.	Tons Soft.	Mill Extraction.	E.H.P. per Ton Hour.	Cost per ton at 2d.	
1/ 6/35	405	158	370	240	364	150	364	127	357	115		790 372	10,439 987	9.46 93.68	91.31 8.65	6.45 1.29d.	0.05″
8/ 6/35	419	137	385	265	371	142	385	141	381	121		806 389	12,920 510	3.95 93.52	96.83 8.32	6.21 1.24d.	0.08″
15/ 6/35	452	160	407	293	415	157	434	145	419	132		887 425	7,907 301	3.80 93.28	106.93 8.29	6.18 1.24d.	16.76″
22/ 6/35	496	168	411	313	441	178	468	199	454	150		1,008 454	6,083 229	3.77 93.93	108.39 9.30	6.94 1.39d.	Nil.
29/ 6/35	429	151	425	329	450	206	474	217	457	157		1,051 447	15,820 868	5.49 94.68	111.32 9.44	7.04 1.41d.	0.03″
6/ 7/35	439	161	435	315	460	208	478	200	466	161		1,045 456	16,302 848	5.20 94.60	113.78 9.18	6.85 1.37d.	0.65″
13/ 7/35	458	158	428	306	471	187	481	189	474	185		1,025 462	16,393 1,055	6.43 94.70	115.30 8.89	6.63 1.33d.	0.28″
20/ 7/35	448	148	433	291	464	198	464	204	468	194		1,035 455	15,985 1,167	7.30 95.54	112.70 9.18	6.85 1.37d.	Nil.
27/ 7/35	454	165	438	256	467	193	463	171	468	180		965 458	16,165 1,266	7.83 94.25	113.57 8.50	6.34 1.27d.	0.07″
3/ 8/35	446	157	445	278	464	219	468	237	464	210		1,101 457	16,421 1,193	7.26 94.29	114.91 9.58	7.15 1.43d.	0.48″
10/ 8/35	453	168	430	233	462	180	461	200	463	201		982 454	16,405 1,128	6.88 94.34	116.32 8.44	6.30 1.26d.	0.95″
17/ 8/35	441	145	432	265	464	203	470	230	474	205		1,048 456	16,519 1,654	10.01 94.62	116.11 9.03	6.74 1.35d.	0.16″
24/ 8/35	464	153	441	280	473	216	480	198	487	256		1,103 469	17,096 1,566	9.16 94.65	118.78 9.27	6.93 1.39d.	1.52″
31/ 8/35	450	163	435	230	458	193	465	193	472	196		975 456	16,714 1,305	7.80 94.72	116.53 8.37	6.24 1.25d.	0.20″
7/ 9/35	447	149	432	223	468	204	470	190	473	208		974 458	16,700 1,278	7.65 94.61	116.22 8.38	6.25 1.25d.	Nil.
14/ 9/35	438	163	433	208	475	220	475	195	493	225		1,013 463	16,584 573	3.46 94.69	114.61 8.84	6.59 1.321d.	0.43″
21/ 9/35	445	148	433	245	468	227	470	188	488	228		1,036 461	16,695 239	1.43 94.72	117.60 8.81	6.57 1.31d.	0.23″
28/ 9/35	447	164	440	241	480	215	477	213	487	238		1,071 466	17,074 26	0.15 94.82	120.25 8.91	6.65 1.33d.	0.30″
5/10/35	453	160	457	238	483	202	485	187	495	246		1,033 475	16,915 19	0.11 94.52	120.29 8.58	6.40 1.28d.	0.39″
12/10/35	462	151	438	266	480	187	478	184	505	221		1,009 472	16,841 581	3.45 94.74	122.34 8.25	6.15 1.23d.	0.72″
19/10/35	438	157	428	208	457	182	450	178	462	210		935 447	16,841 1,962	11.77 94.82	116.92 8.00	5.97 1.19d.	0.16″
26/10/35	512	222	427	242	452	193	460	192	483	216		1,065 469	15,600 2,679	17.17 94.97	114.77 9.28	6.92 1.38d.	0.45″
2/11/35	428	155	418	231	465	177	458	190	476	229		982 449	16,685 2,777	16.60 94.72	116.09 8.46	6.31 1.26d.	1.25″
9/11/35	425	147	416	213	450	180	448	175	460	205		920 440	16,337 2,337	14.30 94.62	114.39 8.04	6.00 1.20d.	0.68″
16/11/35	442	148	432	220	467	195	468	202	477	230		995 457	16,553 2,680	16.20 94.45	116.93 8.51	6.35 1.27d.	Nil.
23/11/35	437	152	418	201	442	182	438	190	463	208		933 440	16,782 3,582	21.30 94.36	118.06 7.90	5.89 1.18d.	1.38″
30/11/35	433	139	410	194	438	175	432	166	455	190		864 434	16,644 4,600	27.60 94.42	115.48 7.49	5.58 1.12d.	0.06″
7/12/35	413	136	408	154	432	152	422	157	450	220		819 425	15,686 6,155	39.20 94.50	112.66 7.27	5.42 1.08d.	0.68″
14/12/35	410	128	403	170	422	162	420	176	435	191		827 418	15,893 7,635	48.00 94.60	111.34 7.43	5.54 1.11d.	Nil.
22/12/35	405	128	395	160	405	162	407	186	415	201		837 405	17,121 8,477	49.50 94.58	112.10 7.46	5.57 1.11d.	1.37″
Averages	**443**	**155**	**423**	**243**	**451**	**188**	**454**	**187**	**461**	**198**		**971** **446**	**15,531** **1,989**	**12.41%** **94.47%**	**113.76** **8.54**	**6.37** **1.27d.**	**0.98″**

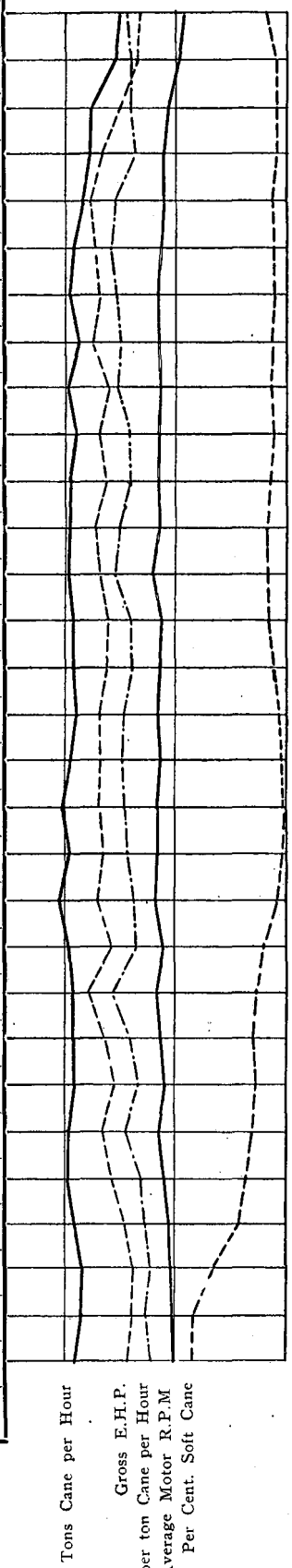

Fig. 3.

so little improvement in this respect, and the writer attributes the cause as being due to irregular supplies, unsuitable mill settings, and that this quantity was milled at the end of the crop.

In addition to the above, it is surprising to find that the average fibre content for this week did not drop. Below are shown the figures for the last three weeks for the 1935 crop.

	Per cent Soft Canes	Fibre % Cane	Mill Extraction
	39.3	15.15	94.5
	48.0	15.36	94.67
	49.5	15.61	94.58
Average for year	12.85	15 39	94.52

The H.P. taken was approximately 20% less than when "Uba" was milled.

The bagasse samples were taken half-hourly, and the chemical analysis were as follows:—

	Uba	Soft-Canes
Tons per hour	107 tons	127 tons
Sucrose % Cane	14.55	14.56
Fibre % Cane	15.75	10.6 to 13.1%
Maceration	43.1	37.5
Moisture	53.1	53.5
Sucrose % Bagasse	2.25	1.72
Extraction	94.2	96.7%

The extraction up to the 1st mill was 81.4% as against 70.4% when crushing Uba cane.

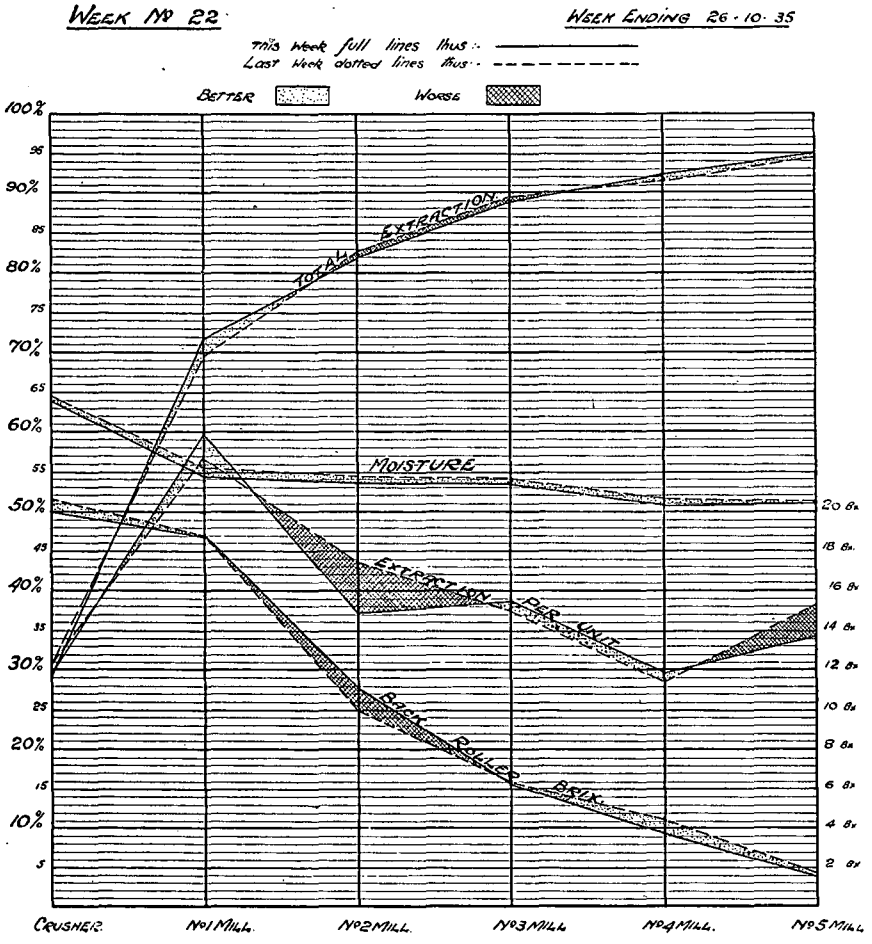

Fig. 5.

It may not be without interest to give at this stage the results obtained on a test run with soft canes on 24th October, 1933.

The duration of test was 4½ hours. The type of canes milled were D1135, 176 tons, and P.O.J.'s and Co.290, the latter two in approximately equal quantities.

The tonnage per hour of "Uba" cane milled previously to the test was 100 tons per hour. The rate for the test was 127 tons per hour, an increase of 27 tons per hour. The fibre content was somewhat low, i.e., 10.6 to 13.1%

It would be interesting to have a week's run on soft canes as far as the Mount Edgecombe factory is concerned, but unfortunately I do not think this is possible at this juncture—until the quantity of soft canes increase—without a considerable amount of disorganisation of the field arrangements. However, it may be undertaken at the end of the crop, when readjustments to mills could be made to suit the soft canes.

Further, as the quantity of soft cane increases it may be advisable to set the mills to accommodate the fibre content of the soft canes and not that of

Uba. Or perhaps a point may be reached between the two extremes which would be beneficial to extraction. It would mean that when milling Uba cane the rate per hour would be down; but this would be compensated for when soft canes were milled.

Before concluding, and whilst on the subject of milling data, in connection with the weekly extraction figures supplied by the laboratory and published in proceedings 9th Annual Congress, South African Sugar Technologists' Association, page 17, by J. Rault, esq. It is interesting to observe that these figures are now set out in graph form every Sunday morning for each week's work, and shows at a glance whether each unit has given a better or worse result. The one illustrated in Fig. 5 has been taken at random from the set compiled during the crop, and represents the figures of the 22nd week ending 26th November, 1935. It will be seen that the 2nd and 5th mills show worse results, while the 1st, 3rd and 4th mills show better results. The total extraction for this week is 94.95%, which was slightly better than that of the previous week, the curves for the moisture and back roller juice are shown; the latter, however, is not as practical a guide as the previous ones.

In conclusion, it is safe to say that it is not possible to ascertain with a sufficient degree of accuracy the true value of the soft canes from a milling point of view.

Until further practical tests have been carried out and more data obtained, and as things stand at present it is difficult to say what would be the correct procedure to adopt to meet all these irregularities.

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Mr. WILSON: Gentlemen, once again Mr. Macbeth has come forward with a paper on Milling, a very interesting paper indeed. Unfortunately last year the time for discussion was very limited and I hope that this year we shall have a little more time at our disposal for discussion.

Mr. PATRICK MURRAY: I should like to thank Mr. Macbeth for his paper, on Mount Edgecombe Milling Plant. It is a pity Mr. Macbeth did not give the total power of the Milling Plant, including knives, shredder and last mill, and give us then the horsepower per ton of Cane per hour, as with these there might have been shown a greater differerence in power between Uba and Soft Canes. Uba Cane he shows has 15 to 17% fibre and Soft Cane 11 to 13.52 fibre giving averages of 16 and 12.25 respectively. The Electrical horse-power for Uba is 8.78 and Soft Cane 6.13. One should expect the horse-power to vary as the fibre, so taking 8.78 for hard cane would give:—

$$8.75 \times \frac{12.25}{16}$$

for soft cane = 6.71 h.p., and taking 6.13 for Soft Cane would give you for hard cane:—

$$6.13 \times \frac{16}{12.25} = 8 \text{ H.P.}$$

showing that the Uba Cane takes more power than soft cane even allowing for the difference in quantity of fibre.

We should like to know what hydraulic loads Mr. Macbeth has on his Mills, as this has an important bearing on the horse power.

With regard to hydraulic loads, we all expect to see the hydraulic accumulator floating but with a properly fed Mill such as Mount Edgecombe I cannot see how there can be much movement of the top roller. If the load is light enough to show movement then I am sure the Mill hydraulic load is too small. One must have a free lifting top roller in case of feed differences. In many Mills the top roller is practically immovable due to unbalanced loads and the top bushes jamming also due to friction of the hydraulic packing. The friction load to move the top roller we have seen in the neighbourhood of 30 to 40 tons which means the mill will choke before the top roller lifts and also the roller does not return quick enough and puts too light a load on the blanket until the mill balances again.

Mr. MACBETH: I thank Mr. Murray very much for taking part in the discussion. With reference to the horse power of the Milling Plant, actually we have only put down the figures for the crusher and the first four mills which are electrically driven, naturally the fifth mill being a steam driven unit means Indicator cards to obtain the h.p. In regard to the Shredder I shall be only too pleased to give you the horse-power and furthermore the loading of the hydraulics. I did not insert them because the paper really speaking is not dealing with hydraulic loads, and therefore they are not included but I shall be only too pleased to let you have them. There is just one point I would like to ask Mr. Murray and that is this—I wonder whether he could let me have the extraction of the Empangeni plant up to the fourth mill and the hydraulic loads on the fifth and sixth mills.

Mr. PATRICK MURRAY: The hydraulic loads are 500 to 550 tons, I have no information of the extraction figure up to the fourth mill.

Mr. MACBETH: There is a point in the paper that I cannot quite fathom and may be members can shed some light on it. With reference to the fibre content of the soft canes when the large quantities of soft canes were milled for the three last weeks of the crop you will see that are 15.15, 15.36 and 15.61% respectively. Fibres which are pretty well equal to Uba, as far as quantity is concerned.

Mr. CAMDEN SMITH: In regard to the point on fibre. I think it has been the experience elsewhere that the fibre content of the new canes has not been so very low, certainly not so low as expected. During the Chakas Kraal test in the middle of last November. it was also found that the fibre content was not so very much below and was actually equal to the Uba which was crushed the week previously. This paper of Mr. Macbeth's deals primarily with the advantages pertaining to electrically driven cane crushing mills and it is obvious that the one great advantage of the electrically driven system is the ease with which these figures can be taken. It simply means reading off an ameter—that bears out the fact that Mr. Macbeth has not given us figures from the fifth mill which is steam driven. Mr. Macbeth has shown many atvantages of electric drive with regard to the ease of control, the obtaining of definite power and performance figures and so forth. Of course, the matter of cost viewed from any economic point of view would no doubt form the subject of another paper. I wish to thank Mr. Macbeth for the contribution he has made to the milling part of this Congress of ours. It is a paper which has been very much appreciated. It is a good sign that more interest has been taken in this branch of the Industry than has been the case hitherto.

Mr. PATRICK MURRAY: Last year Mr. Macbeth gave us figures on the hydraulic loads—I wonder whether he found any difference in extraction with changing hydraulic loads? Also last year his power factor was not too good and he thought about increasing this. I was wondering if he had made any improvement in the power factor.

Mr. MACBETH: With reference to your first question, I have tried all sorts of things as far as hydraulic loads are concerned and it comes back to the same old position, that is I do not find any marked improvement in the mill extraction with increased hydraulic loads, this is possibly due to the cane having been shredded. I have increased the hydraulic loads on the various mills and I find practically no difference at all. With reference to the power factor, the power factor has increased slightly on last year's figures. It is very difficult to make alterations and adjustments over one crop. The point is you have only got a Sunday to do all these alterations in and it would be a very different proposition if you had two tandems where you could experiment on one tandem; but when you have only the one tandem and you crush the whole week it is very difficult to carry out alterations and adjustments without loss of crushing time. The power factor has increased slightly but we are trying further alterations this year with the object of trying to increase the power factor and we can supply results to you at some future date.

Mr. HILL: I should just like to remark that last year we were taking some Indicator cards and it so happened at that time we were crushing some Uba and soft canes and taking an average over three cards for each variety of cane and on a drop in fibre of from 17 to 14.5, I find that the soft cane took about 15% less horse power in the first unit, that is two engines driving five mills (one engine drives three mills), that engine took 15% less horse power. The other engine drives three mills and it took 19% less horse power. These figures are minus the frictional h.p. taken up by the gears, etc. I do not know if Mr. Macbeth has allowed for that in his percentages.

Mr. MACBETH: Yes, that has been taken into consideration.

Mr. HILL: Did you take the horse power for both canes. It brings your percentage up a bit, your drop in horse power raises that.

Mr. PORTEOUS: Mr. President, we can always rely on Mr. Macbeth to give us some very solid information and I would like to add my congratulations to Mr. Macbeth for a very able paper, and Mr. Macbeth like Dr. Hedley is just on the threshold of some experiments on the crushing of cane. I think he would do the industry a lot of good if he could carry out a test on Uba cane for a week and get some very reliable figures on horse power and fibre content and other important facts one must have, and carry that on with soft canes and make some very certain deductions which would give the Industry some very valuable information indeed. It is very interesting to hear Mr. Hill and I should like to have some of those figures.

One thing I should like to ask Mr. Macbeth, those canes that showed a high fibre content, were they 12 month canes?

Mr. MACBETH: Yes.

Mr. PORTEOUS: Is the youth an indication of the high fibre content?

Mr. MACBETH: I cannot answer that question with any degree of authority as it is outside my sphere. Up to the present time we only have 12.8% soft canes of the total crop, naturally from our point of view we would like very much to have a test over a week so as to gain further information. With reference to the milling of soft canes, where you have a supply coming in so irregularly, it makes it difficult to obtain data on the milling of soft canes. The figures which were obtained on the 4½ hour test we were never able to obtain whilst crushing soft canes under the conditions as described in the paper. One of the canes we crushed during the test is not in existence to-day, i.e., D.1135. It seemed a very easy milling cane.

Mr. PORTEOUS: With regard to this graph. Fig. 3. There are no figures given and I was wondering whether those horizontal lines are averages.

Mr. MACBETH: The graph coincides with the figures shown in the table and is based on averages.

Mr. WALSH: There is just one point that struck me on the comparative test run on soft and Uba cane, that is the very high moisture. We all expected the moisture to come down and other countries are getting them down, and I was wondering whether there was any explanation.

Mr. MACBETH: The only explanation I can give, is, we did not alter any mill settings, the final moisture is governed by the fifth mill and in our case is a steam driven unit, there was no tightening up of the mill when that test went through, but it is equal to the average moisture to-day when we are crushing Uba cane, we find very little difference in the moisture, which is still round about 50%.

Mr. WYLES: The point that appears apparent (take Figure 3) i.e., the horse powers of the variable speed motors, it seems to be proved and Mr. Macbeth will agree that the motors chosen are too large for driving mills he has installed at Mount Edgecombe and some very interesting information is obtained as to what size motors should be installed. 420 h.p. at 500 r.p.m. is much too large. Anyone contemplating putting in motors of this size should be advised to put in smaller motors. This particular machine makes a big difference.

Mr. MACBETH: When the motors were ordered I must admit we were a little bit at sea as to what should be specified as regards the correct horsepower. We had no data previous to the installation of these motors as to the horse-power required for milling 130 tons an hour of Uba cane at 16% fibre. Instead of being on the short side we agreed to have a motor of ample capacity which is not a very great fault. When you take into consideration the amount of horse-power taken by the first mill you will find these figures are averages. The horse-power of the first mill has been in the vicinity of 300, according to the quality of the fibre and tonnage ground. Furthermore the horse-power would increase with the speed, but I will admit that from those figures it would appear that our motors are slightly on the large side but at that time we did not know what exactly would be required when we got up to 130 tons an hour, and I think you will find the horsepowers will still go up when the rate per hour increases.

Dr. HEDLEY: Mr. Chairman, I am sorry I was not here for the reading of the paper. Mr. Macbeth and I have discussed the question of writing this paper very often and I should like to say I really appreciate his having given us this paper together with the data it contains. It is the first time we have had any measure of the horse power required for crushing. I hope that as the years go on we shall be able to get more figures from Mr. Macbeth when we get these soft canes coming in greater quantities. If you had heard all I have heard in the course of the last two months about soft canes, how they are going to ruin the Industry, put the fires out and use up all the horse-power, you would appreciate having some reliable data.

An exceedingly interesting problem has been raised by these figures. As the percentage of soft canes went up towards the end of the crop in Natal Estates they found very little difference in the fibre content of the cane as can be seen from this Table, the fibre changed very little during the season and it is an interesting question as to why it did not change. With the soft canes one expects on an average say 13% of fibre. With Uba cane you expect on an average 16% fibre, a difference of 3 points, between the fibre of the two classes. One would therefore expect (mathematically) that with 50% soft cane, a 14½% fibre would be shown. But as I have said there is very little difference shown in the fibre percentage all through the season. In fact the lowest fibre was shown when only 0.11% of soft canes were crushed. Why is this so? The solution is a chemist's job. The question of bagasse moisture is also very interesting. It is a question that has interested me as well as my fellow members of the Boiler Committee. Mr. Camden Smith will deal with it later on to-day when he comes to dealing with the Mills. They get down to such low figures in other countries and we have got to find out why our moistures are so high. The more moisture that can be removed from the bagasse the easier will the bagasse burn and the more B.T.Us. will be realised in the furnace. It is not a serious problem for Natal Estates to address itself to, but when I tell you in Chakas Kraal we had 59% moisture during the week's run you will appreciate it is very difficult to raise steam when the stuff you are putting in the furnaces is water. I should like to thank Mr. Macbeth for the trouble he has taken and he took a lot of trouble over it—it has been worth doing.

Mr. MACBETH: With regard to the question of the moisture content in the bagasse and why it was they can get a lower moisture in other countries. During my trip to Hawaii, naturally I was very surprised to see the very low moistures they obtained there, and in some of the factories they obtain moistures as low as 39%. The trouble in this country at most of the factories as far as I can see is they are working their mills up to the highest capacity possible. In a lot of these other countries they do not do that. In Hawaii they are quite content to put 60 tons an hour through a tandem 34in. x 78in. mills. If they have any more cane to crush the tendency is to put in another tandem. You will find the thickness of blankets between 4in. to 5in. The average fibre does not go above 12.7 and here we are struggling with canes of 16 fibre and trying at the same time to crush as much as possible, and as I mentioned last year, there are economical limits to all crushing plants, and as far as milling Uba cane is concerned quantity and quality do not blend too well. That is why in other countries they obtain some of the figures they do. If we had to crush the same cane as they do over there and at the same quantity per hour, we should get the same low results. Naturally to obtain higher tonnages we have large grooving—when you go in for the larger size

grooving the moisture is not going to be 39, that is obvious.

Mr. DUCHENNE: I would like to ask Mr. Macbeth the horse-power of the shredder when crushing Uba and soft cane.

Mr. MACBETH: With reference to the horse-power of the Shredder when crushing Uba and soft canes, there is practically no differenre. If anything a little more horse-power is taken by the soft cane. We find the harder the canes the better as far as the shredding is concerned. There seems to be more of a tearing and dragging action on the soft canes. This is noticeable when the hammers are worn, we have been caught in the middle of the week with the shredder refusing to take its feed, simply because it would not shred Uba irrigated cane properly due to worn hammers, and yet just previously to this when shredding hard Uba cane no trouble was experienced whatsoever. The horse-power is a little higher with the soft cane than with the Uba, especially if the hammers are worn.

Mr. RAULT: I may volunteer some explanation about the variation of fibre when crushing. If you look at our figures earlier in the season where we had 6 to 7% of soft canes when we were doing Uba our fibre was already low, lower probably than other mills' records. The Uba we are crushing in our district has a low fibre content and is nearer the softer tropical canes so that later on when we crush the supposed-to-be lower fibre cane we don't find the very big differences which other mills have been experiencing.

Mr. MACBETH: In connection with that point raised by Mr. Rault in regard to the higher fibre in soft canes towards the end of the crushing season, is it not a fact that the soft canes are changing in their characteristics due to the different environment?

Dr. HEDLEY: I expected that question when I was dealing with my paper—it has always had the negative reply. Dr. McMartin answered it very fully this morning in the discussion on my paper dealing with the Physical Properties of Sugar Cane.

Mr. WILSON: That evidently closes the discussion. The discussion has been very interesting also the paper excellent. Mr. Macbeth always gives us something new and I hope he will be long spared to continue the good work. It is papers such as these coming along with something new in them that makes our proceedings more valuable. Mr. Macbeth I congratulate you on the excellent paper and I thank the speakers who have joined in the discussion. I ask you to join me in a hearty vote of thanks.