INVESTIGATION INTO IMPROVED EXTRACTION

By J. R. GUNN

The remarks and findings in this paper are limited to the crusher only. The purpose of the investigation was to attempt to establish an optimum ratio between the calculated bagasse state at the work opening of the discharge of the mill and the actual bagasse state as analysed by laboratory methods. As the observations were made on a full-scale milling plant, very little experimentation could be done. Initially the observations were made over the whole train but these had to be abandoned because there is no known way of evaluating the escribed volume for "woolly" rollers.

The following frequent observations were taken:

1. Lift of top roller by measuring opening between top and bottom halves of the mill roll bearing.
2. The total number of revolutions during the weekly runs as recorded directly by a mechanical counter.
3. Bagasse analysis as used in determining the individual extraction of the crusher.
4. By frequent measurements, the extent of wear on the rollers.
5. The centre distance between rollers at rest was measured every week, particularly after adjustments had been made.

All observations, except the actual bagasse analyses, were designed to establish, as accurately as possible, the escribed volume at the discharge of the mill. As everyone knows, it is extremely difficult to obtain the correct value for this volume and it is to be noted that in reports[2] on the experimental three-roller mill in Mackay, Queensland, mention is made of this difficulty even under ideal experimental conditions. However, the author claims that because of the very frequent observations, the average results must bear some relation to actuality and, if they are not strictly correct, they do reveal a trend on which some findings can be based.

The observations were taken in an endeavour to discover the value of pounds of dry fibre per cubic foot of escribed volume in the discharge opening of the crusher. The author considered that having calculated various values of this function and correlated these with the crusher's individual extractions, an optimum value would be reached. In the Java method of calculating mill settings[2] this figure plays a prominent part. Thomas Lowe[3] in his formula uses the dry fibre in bagasse discharged from each mill in his calculations. Hugot[4] uses the figure of natural fibre (dry fibre+brix-free water) for one method of arriving at the correct work opening values. Dr. Douwes-Dekker[5] in a recent communication analysed the results obtained in Java during 1940 and plotted an interesting graph relating extraction to the pounds of dry fibre per cubic foot of escribed volume.

Comparing the various methods of calculating mill settings, one finds the following differences:—

1. Java uses dry fibre in escribed volume.
2. Lowe used dry fibre in bagasse.
3. Hugot quotes one method using fibre associated with brix-free water.

The author considered all three methods of calculations and endeavoured to compare them. Method 3 was discarded because the brix-free water is not a constant and an assumed value must be used. Methods 1 and 2, although following similar lines, could not be compared because it cannot be said that the dry fibre in the escribed volume will be the same value as the dry fibre in bagasse. It is this difference which prompted the investigation under review. It is interesting to note that many milling experts in Mauritius use the Lowe formula but nearly every factory manager had his own different value for the weight of bagasse.

From basic principles it can be argued that, unless a mill is not working anywhere near its capacity, the pounds of dry fibre per cubic foot of escribed volume will always be higher than the pounds of fibre per cubic foot of bagasse discharged from the mill. Here the volume of bagasse is not taken as actually expanded but is calculated at its maximum density with no voids or air pockets. This is done from the bagasse analysis figures of moisture and sucrose in bagasse and the brix and purity of juice expressed by the discharge roller. As it is far easier to obtain fairly accurate bagasse and juice figures than it is to evaluate the escribed volume, the author set out to find whether there is a ratio which can be used for future calculations of crusher settings.

To substantiate the statement contained in the first sentence of the last paragraph, consider the passage of bagasse from the trash plate to the point of minimum area between the top and discharge rollers. Its volume decreases and it releases moisture and sucrose. As the volume decreases to its minimum value, pressure is built up to a maximum. There is no scientific reason why when the pressure is a maximum, the fibre should not have released a maximum quantity of moisture. However, unless this moisture can drain away no practical change takes place. It is obvious that some moisture drains away but what happens to the released moisture that does not get away? Having been released from the fibre it will move through the bagasse blanket away from the point of maximum pressure, thus, it must travel forward and backward. The juice travelling forward in the same direction as the bagasse will be reabsorbed by the fibre expanding away from the point of maximum pressure. This argument can bear critical examination and cannot be faulted provided the mill is working to capacity. Extreme cases of badly draining juice generate such terrific velocities that actual squirting occurs. Violent reabsorption is taking place when that is evidenced. It is stated in text books[6] that one possible cause is that the discharge opening is too small. The author does not agree that this is entirely correct because if the bagasse gets through the opening, it must be large enough. The fault is that the drainage is insufficient.

A theory has been developed by the Sugar Research Institute in Mackay,[7] that under adverse conditions actual extrusion takes place. Having produced a mathematical proof that this is possible, it is shown that the extrusion depends on the relationship between limiting coefficient of friction and pressure and between shearing strength and pressure. This implies that as the bagasse passes from the trashplate towards the point of minimum area a pressure peak is developed ahead of this point. From there on the blanket extrudes either by slipping forward (with the juice dissociated from the fibre travelling faster) or by shearing of the blanket similar to a steel rolling mill. It was also found in Queensland that in coefficient of friction tests with a grooved surface, the cane sheared rather than slipped on the surface at high pressures. Returning to the mill that is squirting, it may be a solution to drop the top roller pressure slightly to restore the point of minimum area. This is not difficult with modern hydraulics and is worthy of experimentation.

All the above reasoning points to the fact that in the point of minimum opening the weight of fibre per cubic foot is higher than in the actual bagasse because reabsorbed juice occupies volume and displaces a proportion of the fibre volume. The problem remains to find what relationship exists between the two and what is the optimum value.

Firstly it was necessary to establish formulae to calculate the pounds of dry fibre per cubic foot of compressed bagasse using the laboratory analysis results. Here the specific gravity of dry fibre was assumed to be 1.53 per cubic ft., the density of water was assumed to be 62.4 and the density of the juice in bagasse was corrected for the brix and purity. Now, making the assumption that bagasse consists of moisture, fibre and brix-free water, the following formula was derived for the weight of one cubic foot of compressed bagasse:

Weight per cu.ft. =

$$\frac{F}{1.53}+(F\times W)+\frac{1-[(1+W)\times F]}{D}$$

Where F = ratio of weight of dry fibre expressed against unity

W = ratio of brix-free water expressed against unity

D = specific gravity of last expressed juice.

The value of F is obtained in the standard manner, viz.:

$$F = 1-M-\text{brix bagasse}$$

$$= 1-M-\frac{\text{Sucrose in bagasse}}{\text{purity last expressed juice}}$$

Where M = Moisture in bagasse expressed against unity

Having calculated F and thence the weight of one cubic foot of compressed bagasse, the weight of dry fibre per cubic foot of bagasse is:

$$Fc = (\text{weight/cu.ft.})\times F$$

This concludes step one of the calculations.

Step 2

From the crushing rate for the week, the pounds of dry fibre per minute passing through the train is easily calculated.

From frequent measurement of the roller lift, the average lift is assessed. To this is added the set opening of the mill corrected for wear of the rollers. This gives the work opening for the week.

The number of revolutions as recorded by the counter is divided by the number of minutes run. Here the total time of the run must be multiplied by the *time* efficiency to correct for all stops.

The roller speed is obtained by multiplying the revolutions per minute as obtained above by the diameter of the roller in feet. Here the diameter of the roller must be corrected for the grooving; to use the outside diameter would introduce an error.

Multiplying the surface speed by the length of the roller and the work opening both reduced to feet gives us the escribed volume per minute.

Dividing the escribed volume per minute into the pounds of dry fibre per minute gives the figure for pounds of fibre per cubic foot of escribed volume which will be termed Fa. (The letters c and a after the F signify "calculated" and "actual".)

Now, the ratio that the author set out to find is: –

$$\frac{Fa}{Fc} = K = \text{reabsorption ratio}$$

The author did not try to prove anything spectacular but merely endeavoured to correlate various values of reabsorption (having been convinced that there must be reabsorption) to the results of individual extraction.

A detailed calculation is contained in the Appendix.

As a natural development of these calculations, the author then added a further figure, that of Compression Ratio. This is the ratio between the non-void volume of cane and the escribed volume. It can also be argued that it is the ratio between the pounds of fibre per cubic foot escribed volume and the pounds of fibre per cubic foot of non-void volume of cane; the latter figures being calculated as for bagasse. In order to record all the features of the crusher, the following final figures were tabled. Extraction, Reabsorption K, work ratio, compression ratio and roller speed. These figures are shown on Table I.

TABLE I

Date	*Extraction*	*K Ratio*	*Work Ratio*	*Comp. Ratio*	*Roller Speed*
17.5.58	61.48	1.28	1.81	2.67	—
24.5.58	61.59	1.27	1.83	2.71	26.99
30.5.58	59.16	1.15	1.81	2.31	28.55
7.6.58	60.24	1.19	1.85	2.43	28.56
14.6.58	57.70	1.20	1.82	2.36	30.08
21.6.58	56.63	1.22	1.81	2.36	30.06
28.6.58	60.38	1.11	1.80	2.26	30.85
4.7.58	62.56	1.11	1.76	2.28	30.05
12.7.58	63.97	1.06	1.75	2.18	31.97
26.7.58	60.72	1.05	1.75	2.06	33.55
2.8.58	61.13	1.07	1.74	2.13	32.32
16.8.58	56.26	1.18	1.74	2.17	31.77
30.8.58	59.18	1.12	1.73	2.21	32.59
6.9.58	58.08	1.21	1.73	2.19	30.33
13.9.58	60.22	1.12	1.73	2.18	32.71
20.9.58	59.32	1.18	1.73	2.20	32.05

Plotting the information in Table I on a graph the following curves are obtained.

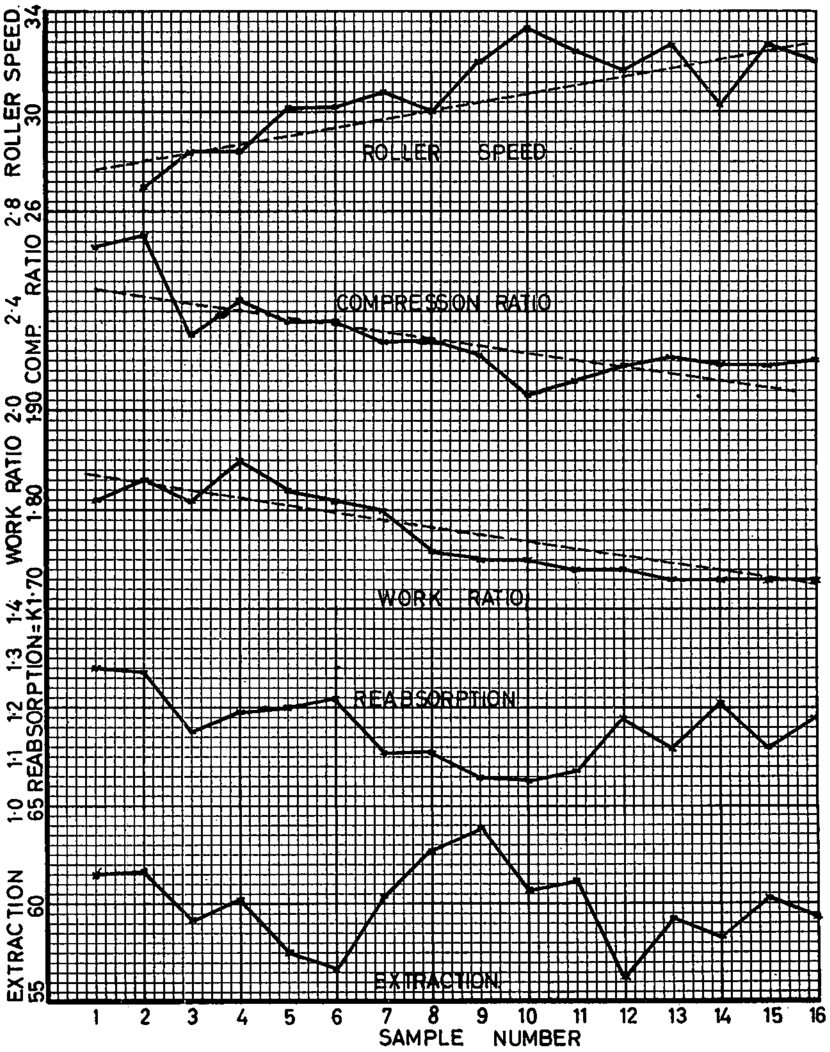


FIG. 1

At the outset the author wishes to draw attention to the fact that the escribed volumes were assessed to the best of his ability so much so that the figures assumed for wear of the roller were checked by comparing the wear figures used, with calculated figures derived after the total wear was measured at the end of the season. After 26th September, the author went on leave and so the observations were stopped. After his return the turbine driving the crusher showed signs of lack of power with corresponding drop in extraction. When that was rectified so great a period had elapsed that the experiment was not continued.

The graph reveals certain trends which have been shown by broken lines. It would appear there is reason to suggest that with increase in speed there is a drop in compression ratio and co-incident with this, there is a drop in work ratio. However the reabsorption curve does not seem to follow any pattern in relation to speed, compression ratio or work ratio as a general trend. It is interesting to notice that Samples 1, 2, 3, 4 and 10 are exceptions when comparing Extraction with Reabsorption. In every other case extraction increases with decrease in reabsorption and vice versa. In 5 out of 16 samples there is a diverging trend (31.3%) revealing that there is reasonable evidence to point to the fact that the extraction is inversely proportional to reabsorption. It is also interesting to note that there is no case where the ratio, K, (reabsorption), is less than unity, proving the author's statements at the beginning of this paper.

The author has deliberately drawn the graphs with Speed on top and Extraction on the bottom. Both these functions are independent of assumptions and calculating errors. The speed is physically counted revolution for revolution and the extraction figures are calculated by the laboratory. The other three figures are calculated and all, in various degrees, depend on the accuracy of the escribed volume. However, it is remarkable that the reabsorption follows, inversely, the extraction. The decreasing trend of the compression ratio may be due to two other factors other than speed. These are the rollers polishing and therefore allowing a certain amount of slip and roller wear, causing the discharge opening to increase. Roller wear will effect the work ratio materially because a small amount of wear will have a larger influence on the discharge opening than on the feed opening.

In Queensland,[8] a graph was drawn for the experimental three roller mill showing the relationship between compression ratio and reabsorption. By way of comparison, the author has plotted that graph and the results obtained in practice, as shown in Figure 2.

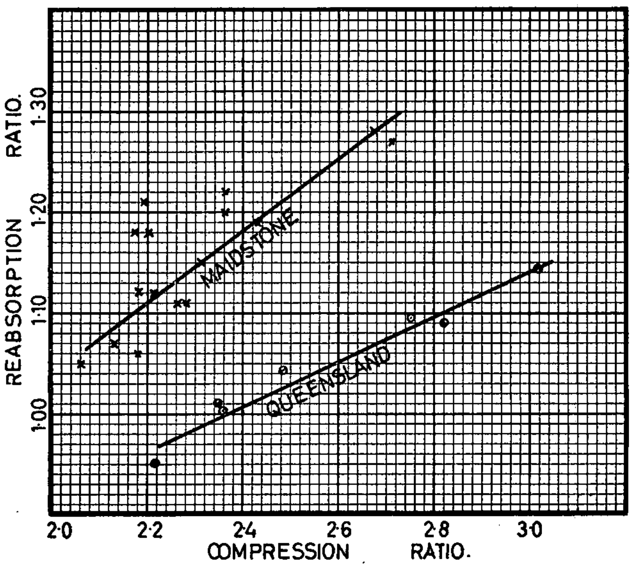


FIG. 2

It is to be noticed that for the full-sized crusher, reabsorption appears to take place sooner and increases more rapidly with increase of compression ratio. The Queensland K ratio however is the ratio of bagasse volume per minute to escribed volume per minute and this figure may differ somewhat from the ratio of pounds of dry fibre per cubic foot escribed volume to pounds of dry fibre per cubic foot of bagasse. Nevertheless, the two curves follow the same trend.

Figure 2 was so encouraging that the author then plotted figure 3, being the relationship of compression ratio to extraction.

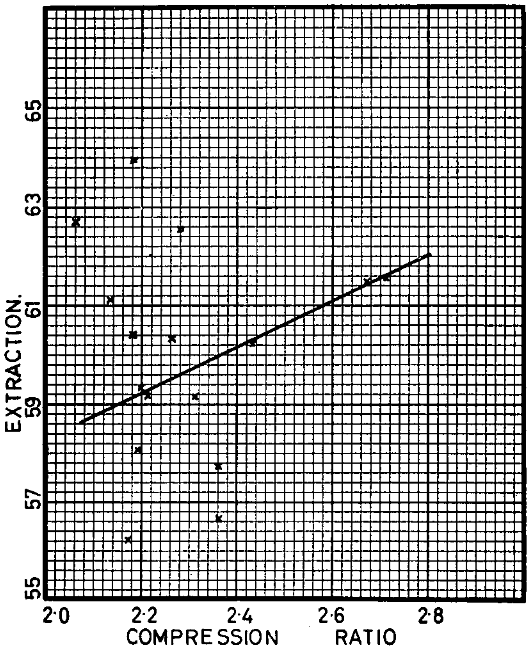


FIG. 3

Here a very wide scatter of points makes it difficult to really decide in which direction the line must point. Hoping that he can prove another point in agreement with the findings in Queensland, the line was drawn to reveal an increase of extraction with increase of compression ratio. The evidence of this in figure 3 is very very slight indeed so figure 4 was plotted showing extraction as a function of reabsorption.

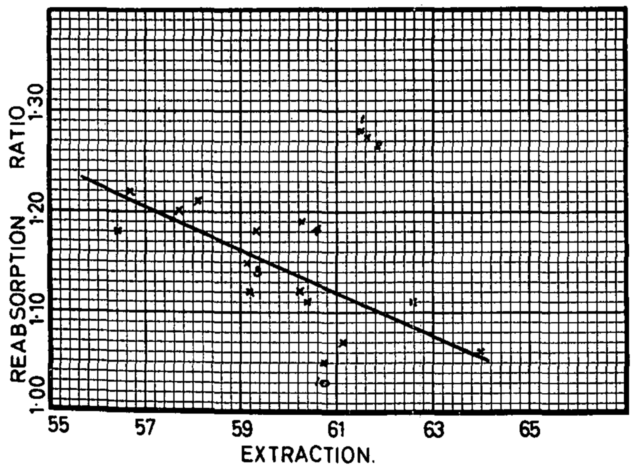


FIG. 4

Points 1, 2, 3, 4 and 10 were marked and discounted and the staggering evidence was revealed that the extraction increases with decrease of reabsorption. This evidence is stronger than the evidence in figure 3 and it may at first seem to be logical that extraction must increase with decrease of reabsorption. But as reabsorption increases with compression ratio and it has always been found by the Sugar Research Institute[9] of Mackay that extraction increases with increase of compression ratio, it follows that extraction must increase with increase of reabsorption. The author's results do not show this! It would seem that the technique of deriving the results must be carried on for another season before any concrete decisions can be made.

When calculating mill settings, using a formula based on the dry fibre, all that can be done is to anticipate the average quality of cane to be crushed. The anticipated fibre and brix-free water are used to calculate the non-void dry fibre per cubic foot of cane. As a result of this investigation the author has calculated the escribed (work) volume of the discharge of the crusher so that the dry fibre figure is 2.5 times that of the non-void figure for cane, or in other words, to accommodate a compression ratio of 2.5. As this figure was not exceeded more than twice during the period under review, the author intends reducing the opening between the underslung feeder roller and the crusher top roller so that it will exert more pressure on the cane blanket. It is confidently expected that the extraction of the crusher will increase.

APPENDIX

Laboratory results:

Tons cane per hour = 149.60
Fibre % cane = 13.73
Sucrose % cane = 12.94
Maceration = 27.74
Extraction = 95.18
Time efficiency = 97.20
Mech. efficiency = 97.20
Brix-free water = 33.94

Crusher samples:		
	Back roller brix	18.61
	Sucrose Bagasse	9.48
	Moisture	61.19
	Individual extraction ...	63.97
	Purity back roller juice	86.9

From observations—Roller lift $= \frac{1}{4}''$
No. of revolutions of roller = 24495

To ascertain escribed volume:

Measured centre distances of roller shafts at rest:

Front 38.50″
Back 37.50″

	Roller dia.	*Groove depth*	*Equivalent dia.*	*Radius*
Front	38.375	3″	35.375	17.6875
Top	38.625	2.625	36	18
				35.6875

Front setting = 38.50 − 35.6875 = 2.8125″
Front work opening = 2.8125 + .2 = 3.0125
(0.2 used = 0.25 × sine 78°)

	Roller dia.	*Groove depth*	*Equivalent dia.*	*Radius*
Top	38.625	2.625	36.0	18.0
Discharge ...	39.0	3.0	36.0	18.0
				36.0

Discharge setting = 37.50 − 36.0 = 1.50
Work opening = 1.50 + 0.2 = 1.70

$$\text{Work Ratio} = \frac{3.0125}{1.70} = 1.77$$

Running Time = 5 days or 7,200 minutes.
Time efficiency = 97.20
Actual running time = 7200 × 0.972
= 6998 mins.

$$\text{Roller speed} = \frac{24495}{6998} \times \pi \times \frac{36}{12} = 32.97 \text{ feet/min.}$$

$$\text{Excribed volume} = 32.97 \times 7 \times \frac{1.70}{12} = 32.70 \text{ cu.ft./min.}$$

(Mill is 7 feet wide).

$$\text{Fibre rate per minute} = \frac{149.6 \times 2000}{60} \times .1373$$

$$= 684.7 \text{ lb./min.}$$

$$\text{Fa} = \frac{684.7}{32.70} = 20.94$$

Non-void volume of cane. (Fnv)

$$\text{lb./cu.ft.} = \cfrac{62.4}{\cfrac{0.1373}{1.53} + .3394 \times .1373 + \cfrac{1 - 1.3394 \times .1373}{1.076}}$$

(1.076 = density at 18.61 brix)
= 69.74 lb./cu.ft.
Fnv = 69.74 × 0.1373
= 9.58

Compression ratio $=\dfrac{20.94}{9.58}=2.19.$

To find dry fibre in bagasse/cu.ft.

$$\text{Moisture}=0.6119$$

$$\text{Brix bagasse}=\frac{.0948}{.869}=\frac{0.1091}{0.7210}$$

$$\text{Fibre}=1-0.7210=0.279$$

$$\text{Wt./cu.ft.}=\frac{62.4}{\dfrac{0.279}{1.53}+.3394\times .279+\dfrac{1-1.3394\times .279}{1.076}}$$

$$=72.58.$$

$$\text{Fc}=72.58\times .279=20.25.$$

Reabsorption K $=\dfrac{20.94}{20.2}=1.03.$

Results: K = 1.03. W.R. = 1.77. C.R. = 2.19.
Speed 32.97 feet/min.

BIBLIOGRAPHY

[1] Anon.: Report No. 49, Sugar Research Institute, Mackay.

[2] Van Hengel and Douwes Dekker: "Some Notes on the Setting and Operation of Mill". S.A.S.T.A. Proceedings, 1958.

[3] Thomas Lowe: "Mill Settings for Factories in Lousiana". Sugar, August, 1946.

[4] Hugot: "La Sucriere de Cannes".

[5] Douwes-Dekker: "Some Notes on Cane Sugar Factory Control". S.M.R.I.

[6] Hugot: "La Sucriere de Cannes".

[7 8 9] Anon.: Report 41. Sugar Research Institute, Mackay.

For discussion on this paper, see page 58.

SOME DENSITY MEASUREMENTS ON BAGASSE AND FIBRE

By R. POLE

This paper presents some data obtained of bulk densities of bagasse after imbibition for use in pusher roll or feed chute opening calculations. Some fibre density measurements under various pressures are also given, and the possible use of this data in mill setting calculations is discussed.

Bagasse Bulk Densities

The apparatus used consisted of a galvanized iron box having a slide-door top, so that the enclosed volume would be exactly one cubic foot. The bagasse was sampled after imbibition, thoroughly mixed, and compacted into the box by shaking. The slide-door was inserted so that the box contained exactly one cubic foot of bagasse under no external pressure. The weight of the bagasse contained was the bulk density, this was measured for each mill. The results obtained are given in Table I.

TABLE I

Entering 1st mill	19.3 lbs./cu.ft.
Entering 2nd mill	19.9 lbs./cu.ft.
Entering 3rd mill	21.5 lbs./cu.ft.
Entering 4th mill	22.8 lbs./cu.ft.
Entering 5th mill	25.2 lbs./cu.ft.

Where feed-chutes are used and pressures are exerted at the base of the chute proportional to the head of bagasse in the chute, then the bulk densities used to calculate the openings should be measured at these pressures.

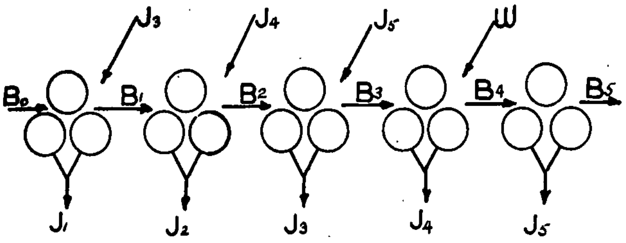
In order to calculate the pusher roll or feed-chute openings, it is necessary to know or assume: (1) top roll sizes; (2) tons of cane per hour; (3) fibre per cent cane; (4) imbibition per cent cane; (5) fibre per cent bagasse of each mill; (6) roll speed. Starting with the last mill, a material balance is calculated over each mill to obtain the weight of bagasse plus imbibition entering. The set opening is then calculated from:

$$\text{Opening} = \frac{\text{lbs. bagasse/min.}}{\text{lbs./cu.ft.}} \quad \frac{1}{\text{S} \times \text{L}}$$

To give an example of the calculations, the following conditions are assumed; roll sizes 72" x 36"; 70 t.c.h.; fibre per cent cane 16; imbibition per cent cane 35; fibre per cent bagasse, 1st mill 32 percent, 2nd mill 40 per cent, 3rd mill 45 per cent, 4th mill 48 percent, 5th mill 50 per cent; peripheral roll speed 21 ft./min.

Calculating a material balance over each mill, we refer to Figure 3.

FIG. 3



$$\text{B5} = \text{C} \times \frac{\text{fibre \% C}}{\text{fibre \% B5}}$$

$$= 70 \times \frac{16}{50}$$

$$= 22 \text{ tons/hr.}$$

$$\text{B4} = \text{C} \times \frac{\text{fibre \% C}}{\text{fibre \% B4}}$$

$$= 70 \times \frac{16}{48}$$

$$= 23 \text{ tons/hr.}$$

$$\text{J5} = \text{B4} + \text{W} - \text{B5}$$

$$= 23 + 24.5 - 22$$

$$= 25.5 \text{ tons/hr.}$$

Similarly, B3=25 tons/hr., B2=28 tons/hr., B1=35 tons/hr., and J4=27.5 tons/hr., J3=30.5 tons/hr., J2=37.5 tons/hr.

No. 5 mill pusher roll opening is thus:

$$\frac{\text{B4} + \text{W}}{60 \times 25.2} \times \frac{1}{\text{S} \times \text{L}}$$

$$= \frac{(23 + 24.5)}{60 \times 25.2} \times 2000 \times \frac{1}{21 \times 6}$$

$$= 0.5 \text{ ft.}$$

The required openings for the other mills can be calculated in a similar manner.

Fibre Density Measurements

The apparatus used in this experiment consisted of a brass cylinder, 2 inches diameter and 6 inches length, with a close fitting plunger and a plate, having $\frac{1}{16}$ inch holes, to allow juice drainage, bolted to the bottom flange. This was filled with bagasse to be tested, placed between the faces of a hydraulic press and subjected to the desired pressure.

The procedure consisted of sampling the bagasse and juice leaving each mill, the juice being analysed for sucrose and brix, the bagasse being analysed for moisture and sucrose. The bagasse was placed in the cylinder and compressed to the desired pressure in the hydraulic press, the height of the compressed bagasse in the cylinder being measured by difference by means of calipers. The pressures to which the bagasse samples were subjected were, 1030 p.s.i., 2060 p.s.i. and 4130 p.s.i.

The total volume of the compressed bagasse was calculated, and the weight of solution (dissolved solids and water) obtained using the moisture analysis and brix (sucrose ÷ purity of mill juice). The volume of solution in the sample was obtained by dividing the weight by the corresponding density. The volume and weight of fibre in the compressed sample was calculated by subtracting the volume and weight of the solution from those of the compressed sample. The data in Table 2 represents the calculated fibre densities for each mill.

TABLE II

Mill	*Initial Bagasse Moisture*	*Sucrose % Bagasse*	*Pressure Exerted p.s.i.*	*Final Moisture*	*Calculated Fibre Density (lbs./cu.ft.*
Cr.	61.0	12.0	4120	49.7	91.5
No. 1	58.0	8.4	4120	43.5	99.5
No. 2	55.0	4.4	4120	42.7	101.0
No. 3	57.0	4.0	4120	40.7	103.0
No. 4	52.0	2.9	4120	41.3	108.0
No. 5	50.0	2.6	4120	42.8	105.0
Cr.	61.0	12.0	2060	50.1	82.5
No. 1	58.0	8.4	2060	44.3	96.5
No. 2	55.0	4.4	2060	45.7	97.5
No. 3	57.0	4.0	2060	41.5	93.0
No. 4	52.0	2.9	2060	41.3	98.5
No. 5	50.0	2.6	2060	42.4	99.2
No. 1	59.0	7.6	2060	49.0	81.0
No. 2	57.0	6.0	2060	50.0	83.6
No. 3	56.0	2.7	2060	44.4	84.0
No. 4	52.0	2.3	2060	46.8	90.0

The fibre densities are plotted on Fig. 1 as a function of moisture content in initial bagasse with pressures 4120 p.s.i., 2060 p.s.i. and 1030 p.s.i. as parameters. The assumption is made that moisture content is determined to some extent by the degree to which the cell structure is broken down, which in turn determines the degree to which the fibre can be compressed. It can be seen from Fig. 1 that the density of the fibre decreases with increasing moisture in the original bagasse.

The relationship between the load applied to the top roll and the maximum pressure exerted on the bagasse has been discussed by G. H. Jenkins[2]. For a 38-inch diameter roll an applied load of 218 tons per roll foot results in a maximum pressure of 5000 p.s.i. If we assume that the maximum pressure is roughly proportional to the applied load on the top roll, then the corresponding roll loads for the pressures used in the compression tests are given in Table III.

TABLE III

Pressure on Bagasse	*Top Roll Load*
1030 p.s.i.	45 tons per roll ft.
2060 p.s.i.	90 tons per roll ft.
4120 p.s.i.	179 tons per roll ft.

Using this information, the fibre density for individual mills with specified hydraulic loads can be obtained from the graphs on Fig. 1, if the moisture in discharge bagasse is assumed or determined.

Mill Setting Calculations from Fibre Densities

A full description of the method of calculating mill settings from fibre densities is given by P. V. Tippet[3] If the moisture content of the bagasse leaving each mill is assumed or determined, the density of the fibre under compression can be obtained from a graph such as that on Fig. 1. Each discharge mill setting is assumed to be made up of the opening to allow the fibre to pass through Th f, and the opening to allow the solution to pass through Th m. The thickness of the fibre blanket is obtained from:

$$\text{Th f} = \frac{200 \times \text{T} \times \%\text{f}}{\text{Wt f} \times \text{S} \times \text{L}}$$

Where T is short tons of cane per 24 hours
%f is fibre per cent cane
Wt f is the fibre density in lbs./cu.ft.
S is the peripheral roll speed in ft./min.
L is the roll length in inches

The thickness of the solution blanket is calculated from—

$$\text{Th m} = \text{Th f} \times \frac{\text{Wt f}}{\text{Wt m}} \times \frac{\text{m}}{\text{f}}$$

Where Wt m is the density of the solution in the bagasse
m is the fraction of solution in the bagasse
f is the fraction of fibre in the bagasse

The total work opening is thus; Th f+Th m. The set opening is obtained by subtracting the allowance for lift from the work opening. The composition of the bagasse leaving each mill is usually assumed to be as follows:

Mill	*1st*	*2nd*	*3rd*	*4th*	*5th*	*6th*
m	65	58	53	50	48	46
f	35	42	47	50	52	54

In order to determine the optimum roll speeds, some mills in Louisiana and the West Indies use graphs similar to that on Fig. 1, which is drawn from one of a series of graphs developed by Farrel-Birmingham for different size mills. They have found that optimum extraction and operation is obtained when the roll speed is that which is obtained by extending the fibre throughput ordinate to cut the 6.0 blanket thickness parameter. These graphs are available from Farrel-Birmingham.

Summary

Sume measurements of bulk densities of bagasse under no external pressure show that the densities vary from 19.3 to 25.2 lbs./cu.ft. An example of the use of this data in calculating pusher roll or feed chute openings is given.

Density measurements of fibre under varying pressures were made and an attempt made to relate these to the hydraulic load. Use of this data in mill setting calculations was discussed.

Acknowledgement

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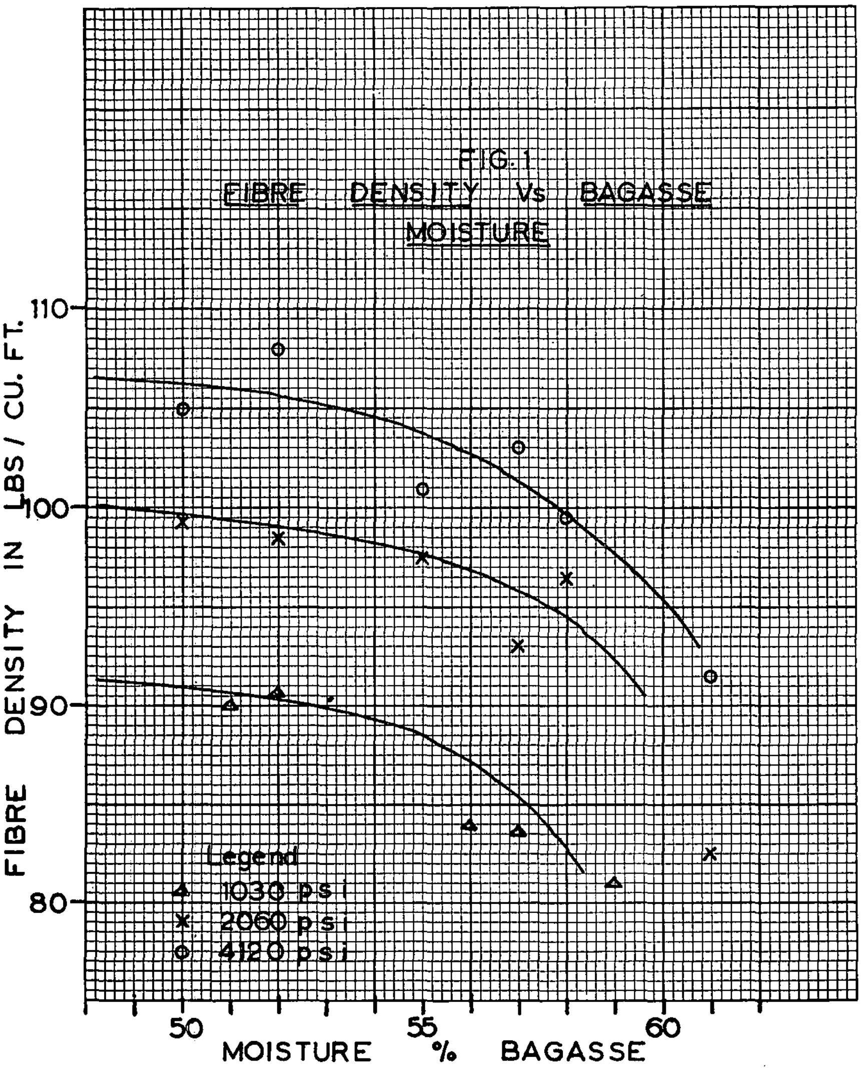
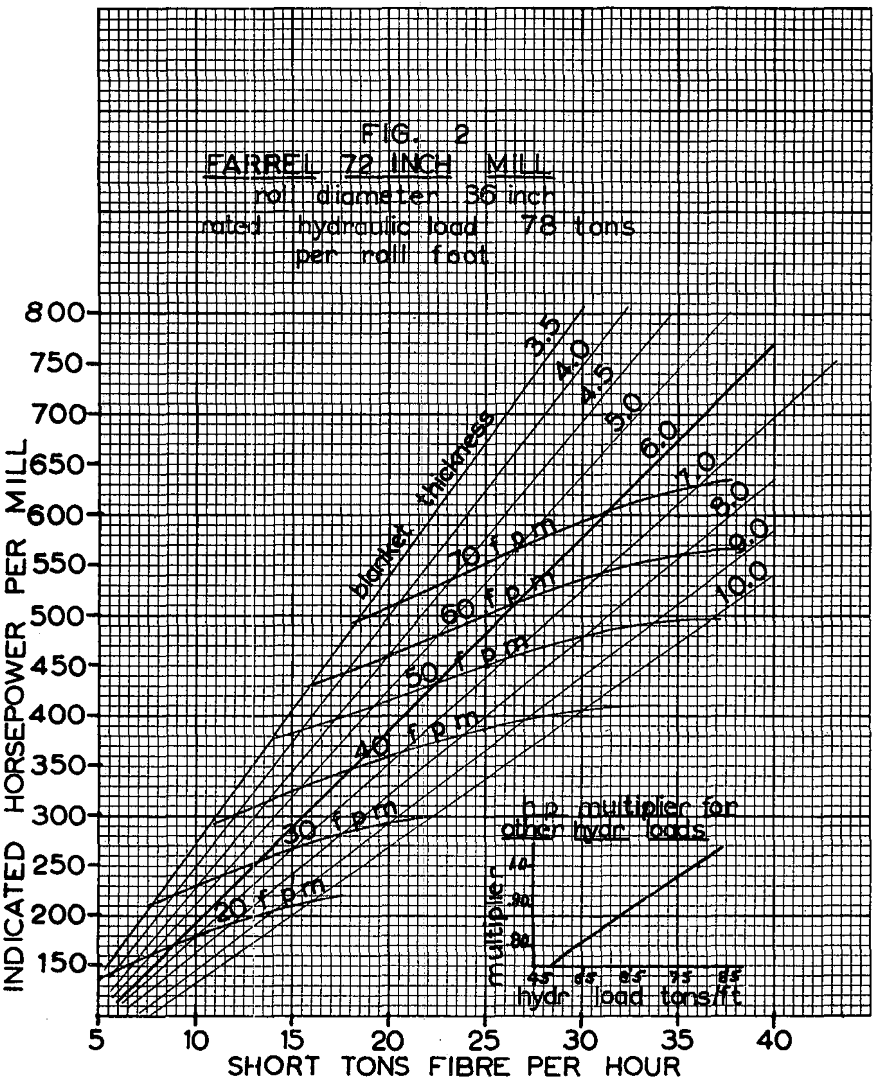
REFERENCES

[1] Jenkins, G. H., (1956): A Basis for Assessing Power Requirements in Cane Milling. Proc. 9th Congr. I.S.S.C.T.

[2] Jenkins, G. H. (1957): Pressures in the Three-Roller Mill. The Sugar Journal, 20 No. 2, 12.

[3] Tippet, P. V., Sugar Mill Roll Openings and Settings. (1955). The Sugar Journal, 18 No. 5, 20.





For discussion on this paper, see page 58.