IMBIBITION RE-CYCLING

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The generally accepted form of imbibition application considered at present to give optimum milling results is Quintuple Compound Imbibition, when referring to six-unit milling tandems. The Imbibition % Fibre applied varies from mill to mill and falls in the 200% to 400% range. The mean Imbibition % Fibre for all South African factories for the year 1968/1969 was 286%.

An on-site inspection of any operating milling train incorporating inclined inter-carriers and Donnelly chutes will reveal that with an Imbibition % Fibre application of 268% the bagasses in transit between mills after imbibition application is not saturated. Further imbibition is not usually possible due to lack of evaporator heating surface or an adverse factory steam balance.

With these two factors in mind Imbibition Re-Cycling was embarked upon. The object of re-cycling is to saturate the bagasse in transit between mills and an Imbibition % Fibre rate of at least 500% is necessary. This can be achieved in practice as indicated by re-cycle diagram (Fig. 1).

A weir is placed in the imbibition tank and a re-cycle pump installed. The re-cycle pump has first call on the imbibition and when re-cycle rate is achieved, imbibition will flow over the weir at the normal or applier imbibition rate and be pumped to the next mill.

Re-cycling was introduced to our mills Nos. 2, 3, 4, 5 and 6, using four pumps and varying the combinations thereof.

Indifferent results were obtained when re-cycle was applied to No. 2 and No. 6 mills.

Best results were obtained on a combination of mills 3, 4 and 5 to which re-cycling was applied simultaneously for a greater part of the 1969/1970 crushing season at an Imbibition % Fibre rate of approximately 500%.

At this imbibition rate drainage became a problem and reabsorption over the top mill roller occurred. This was overcome by the installation of deflection plates at the bottom of the Donnelly chutes which deflected the bagasse away from mill top roll flanges and nose plates. A void round the outside periphery of the rolls is formed and drainage through the mill is achieved. This is assisted by setting the front plate of the Donnelly chute tangentially to mill top roll as per Fig. 2.

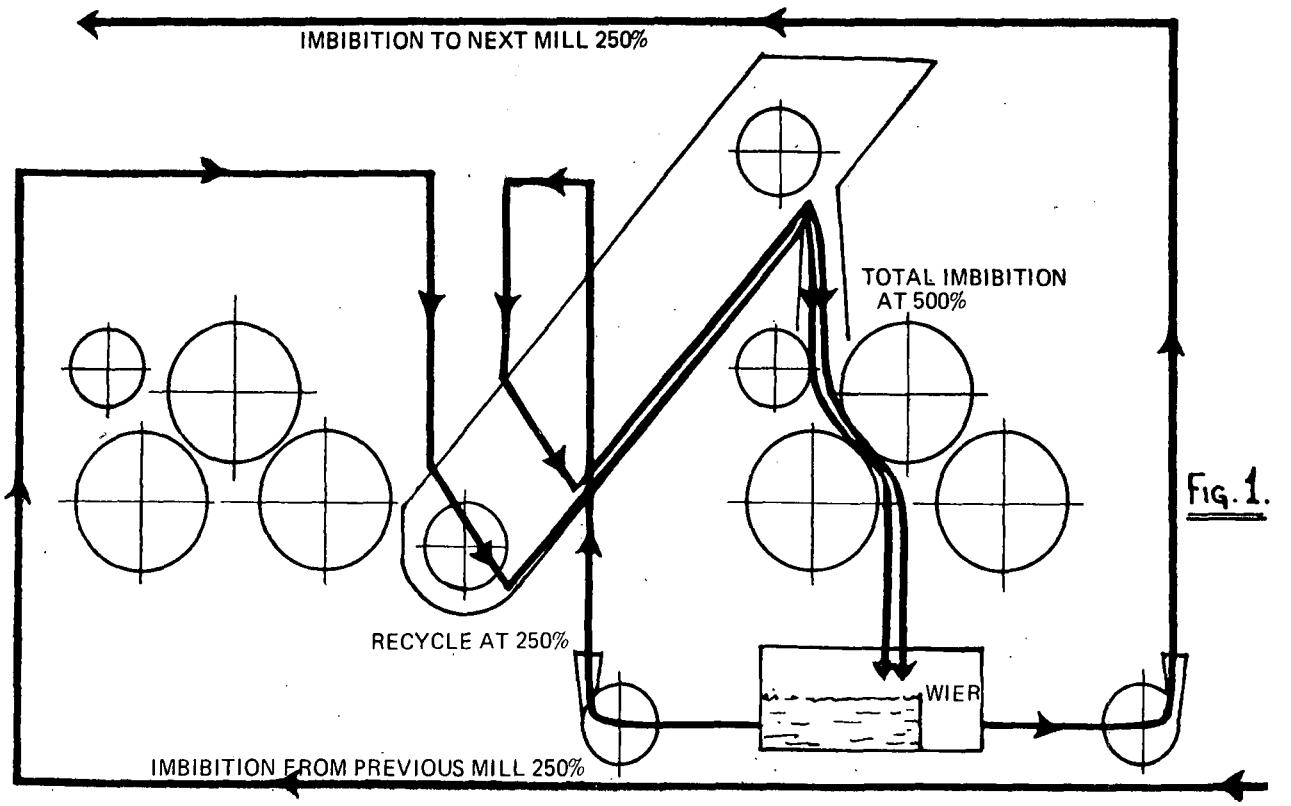

FIG. 1.

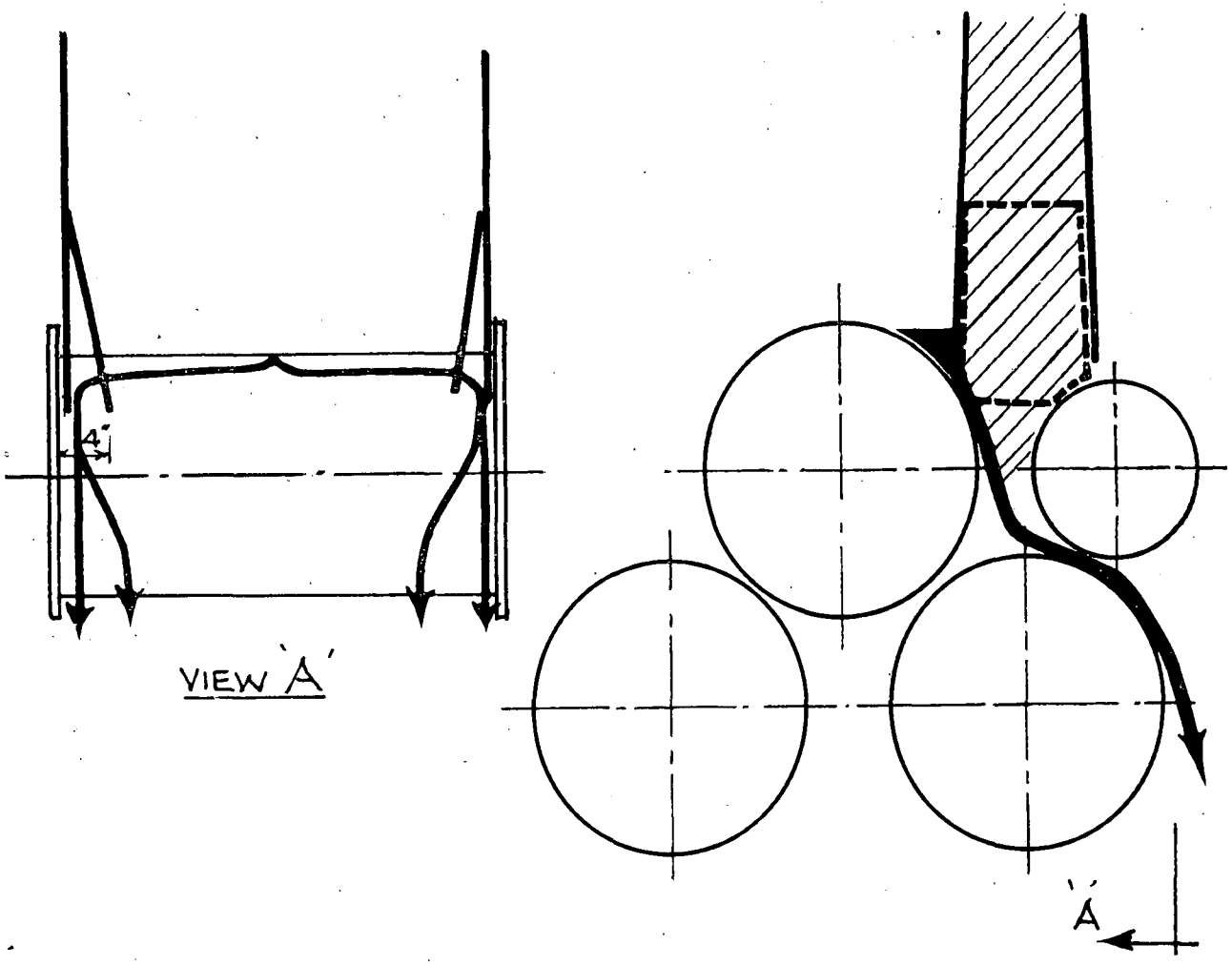

Fig. 2.

Test and Results—Observations

Table I shows tabulated individual milling results for week ending 23rd August, 1969, with no re-cycling.

Table II shows tabulated individual milling results for week ending 30th August, 1969, with re-cycling mills 3 and 4.

By comparison re-cycling appears to increase unit extraction by 6.64% for No. 3 mill and 6.33% for No. 4 mill, although last mill figures are inconsistent. Total increase in extraction for W.E. results under comparison was 0.34%.

TABLE I

Individual Mill Test Week Ending 23rd August, 1969, No Re-cycling

	1	2	3	4	5	6
Moisture	55.10	54.30	54.20	53.72	53.72	53.60
Sucrose % Bagasse	9.60	7.14	5.18	3.46	2.40	1.90
Total Extraction	70.99	80.31	86.54	91.51	94.19	95.53
Unit Extraction	70.99	9.32	6.23	4.97	2.68	1.34
Unit Extraction Efficiency	70.99	32.13	31.65	36.92	31.56	23.14

TABLE II

Individual Mill Test Week Ending 30th August, 1969, Re-cycle Nos. 3 and 4 Mills

	1	2	3	4	5	6
Moisture	55.80	54.20	53.50	52.33	52.21	53.47
Sucrose % Bagasse	9.33	7.13	4.78	2.92	2.03	1.79
Total Extraction	72.04	80.82	88.17	93.28	95.26	95.87
Unit Extraction	72.04	8.78	7.34	5.12	2.17	0.41
Unit Extraction Efficiency	72.04	31.40	38.29	43.25	32.38	9.13

TABLE III

Individual Mills Test No. 4 Mill with or Without Re-cycle

	No Re-cycle		Re-Cycling	
	3	4	3	4
Moisture	56.40	55.65	55.65	56.15
Sucrose % Bagasse ...	4.45	3.20	4.70	3.10
Total Extraction	88.22	91.97	87.72	92.15
Unit Extraction		3.75		4.43
Unit Extraction Efficiency		31.82		36.55

Further tests were run on individual mills separately. The re-cycle pump of a particular mill was run and then stopped at intervals of 30 minutes. Samples of bagasse and back roll juice were taken during the two conditions over a prolonged period and compared. Table III shows a comparison of No. 4 mill with and without re-cycle and Table IV shows a similar test on No. 5 mill.

TABLE IV

	No Re-cycle		Re-Cycling	
	4	5	4	5
Moisture	57.40	55.15	56.90	55.90
Sucrose % Bagasse ...	3.80	2.80	3.50	2.30
Total Extraction	89.64	92.95	90.71	94.21
Unit Extraction		3.34		3.49
Unit Extraction Efficiency		32.24		37.61

Discussion

Mr. van Hengel (in the chair): I would like to ask three questions:—

(i) How do you define unit extraction efficiency, and is imbibition liquid included or excluded?

(ii) Is saturation prior to imbibition necessary?

(iii) Will not the deflector plates, four inches apart, reduce the size of the mill by eight inches, with a consequent loss of throughput, although there is a possible gain in extraction?

Mr. Phipson: Unit extraction efficiency is the percentage of available sucrose extracted by each mill.

I think saturation is necessary before imbibition. At Pongola there are old apron carriers between mills and the imbibition rate is 300% and the recycling is at 700 or 800%.

The deflection plates do reduce the width of the mill but the plates do not go into the throat of the mill so the bagasse balls out and its density is reduced, allowing drainage.

Mr. Moor: The author mentioned that samples were taken at particular points across the last mill and that high sucrose and moisture in bagasse were found on the edges. If the experiment was repeated, even without the reduction of the chute on the final mill, he would probably get the same result because the deflector plates would cause a lack of compression on the edge of the mill.

Regards recycling, there is a sufficient difference in the brix between juice extracted from any one mill and the free juice in the bagasse leaving that mill to warrant recycling juice back onto that mill in the hopes of improved extraction.

We carried out trials at Tongaat but did not have adequate drainage in the mills and we did not have laboratory capacity to get sufficient results to come to any conclusions on recycling.

I understand Mount Edgecombe has also tried recycling but without showing any improvement.

Tongaat intends to study recycling again now that we have sufficient drainage.

Mr. Hulett: Mr. Phipson says recycling on the last mill pushed up moisture in bagasse so much as to almost put the boiler fires out. And yet from the tables recycling appears to have no effect on the bagasse moisture of the other mills.

Hippo-Valley is also recycling through the apron carrier and they claim increased extraction.

In a five roller Walker mill, where it is easy to separate the juice from the feeder rollers, this juice only can be recycled.

Mr. Phipson: I do not know why the moisture in bagasse of the last unit increased so appreciably seeing it did not do so on the preceding mills. However, we stopped the imbibition recycling immediately.

Mr. Kramer: The author presupposes that the imbibition water does not mix properly with the bagasse layer. But is this so? When the bagasse goes through the two rollers of a mill, the maceration present in the blanket is forced out in a solid stream and so all the bagasse particles are saturated.

Mr. van Hengel: The Australians are convinced that imbibition takes place when bagasse enters the first opening of the mill. Such a strong stream of liquid pushes forward against the bagasse that saturation must take place.

Could not recycling assist in drastically reducing the amount of water applied to mills while retaining the same extraction?

Mr. Phipson: We are not taking a chance on whether the imbibition water comes in contact with the bagasse or not so we increase the imbibition and apply recycling.

Regarding reducing imbibition by applying recycling, as imbibition and extraction are directly related, the more imbibition applied the more chance there is of good extraction.

Therefore, recycling will not replace imbibition — it is merely an attempt to improve extraction without installing additional plant.

Mr. Newton: The more water you apply the more work you have to do in the boiling house. Nevertheless I feel we should support recycling because there is a prospect of gain and we do ensure saturation of bagasse.

It is very important to have adequate drainage of the milling tandem.

I think we should experiment by applying less maceration and less recycling and this would partly solve the drainage problem.

What is the optimum value of recycling?

It must be borne in mind that the juice expressed contains highly abrasive materials which are being recirculated and cause extra wear.

Mr. Phipson: I am not sure what the optimum value of recycling should be.

Mr. Renton: Huletts mills have for a long time been geared to take high imbibition rates and because of the value now being attached to fibre this recycling technique could become useful.

Recycling can be achieved without additional pumps by modifying existing piping arrangements.

Mr. Phipson: Pipes can be modified for one mill, but for more than one mill you require an additional weir or an additional pump.