ACCEPTANCE OF BILLETED CANE AT KOMATI MILL

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Abstract

The terrain of the eastern Onderberg lends itself to mechanical harvesting of sugarcane and consequent supply of billeted cane to the Komati mill. The rock removal system developed by Transvaal Suiker Beperk was installed at Komati mill and operated satisfactorily with whole stalk cane, but was not suitable for billeted cane without modifications. The challenge was to modify the existing system to accommodate the billeted cane with the lowest capital outlay and still maintain or improve the efficiency of the complete system. This paper covers an introduction to the TSB rock and sand removal system, the modifications to the system to accept billeted cane as well as observations on the changed performance of preparation equipment when handling billeted cane.

Keywords: Mechanical harvested cane, billeted cane, rock removal system

Introduction

Harvested sugar cane is transported to the Komati mill in cane trucks designed to off-load the cane by means of an hydraulic tippler onto the feeder table. Since the cane receiving area was designed without a cane yard, the harvested cane remains in the transport trucks until off- loaded at the tippler. This operation has advantages and disadvantages of which the advantages are in the majority. Once the cane is off-loaded, it is transported by means of a chain conveyor over the length of the feeder table (see Figure 1).

From the head of the feeder table the cane is fed over a rock removal drum onto the main cane carrier whereafter the process is fairly conventional, i.e. through the leveller knives and main cane knives to the shredder. Although the process is mainly conventional, some items different from most other sugar mills. These include the rock removal drum and its associated reclaim conveyor system (see Figure 2) and also the aero-belt used for conveying prepared cane on flat deck conveyor belts supported by a cushion of air.

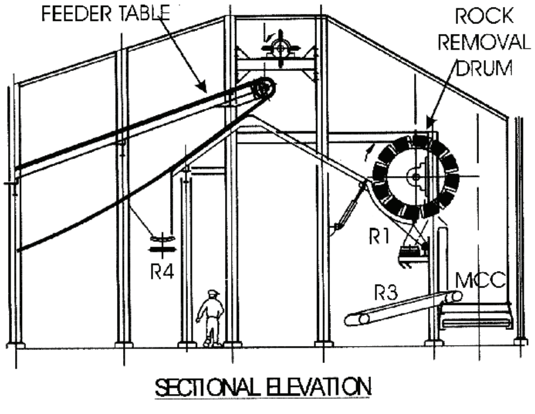

Figure 1. Sectional elevation of feeder table.

This equipment was installed and operated satisfactorily with whole stalk cane. With the introduction of mechanised cane harvesting in the eastern Onderberg region cane began to be delivered as short billets instead of whole sticks. Billeted cane is cane cut in lengths of approximately 150 mm to 250 mm. The lenghts vary from grower to grower, depending on how his machine was set up for his conditions. The consignments of the billeted cane are cut from burnt cane and are normally free from foreign matter. This change in the physical size and consistency of the cane supplied to the mill had to be addressed by the technical personnel of the mill because the existing rock removal system allows short lengths of cane sticks to be removed with the rocks and stones. These short lengths then have to be reclaimed by hand to reduce losses. Accepting billeted cane with the normal rock removal system would have resulted in most of the load of the billeted cane landing in the reclaim system, resulting in major chokes and the loss of cane. A new system or alterations to the existing system had to be engineered to accept the billeted cane.

Pre-development trials

With financial and time constraints it was agreed that the old system should be modified with the minimum cost whilst retaining the ability to accept billeted cane with minimal losses.

It was decided to tip a load of billeted cane onto the existing system without making any changes to the system in order to observe the behaviour of the billeted cane over the rock removal drum. This would give the design team a better understanding of the practical implications of this "new" product. Video cameras were placed at strategic positions to record the behaviour for later use in the design of the modified system . The following observations were made :

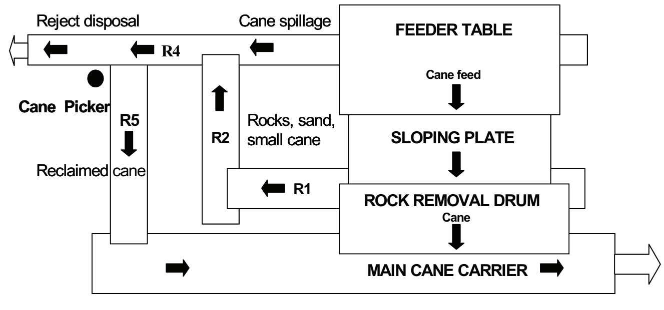

Figure 2. Plan view on R-conveyors.

(a) Tipping of the billeted cane went smoothly and no major modification was required at the tippler. The only small change that was made was to set the hydraulic pressure of the tippler slightly higher since the payload of the truck increased due to the bulk density of billeted cane being higher than that of long stick cane. A test was conducted to compare the load of whole stalk cane to billeted cane and the results showed up to 17% increase in the load with billeted cane. (Actual results for the same truck : 29 ton whole stalk versus 34 tons billeted cane). The arrangement with the growers supplying billeted cane is that the trucks are only loaded with billeted cane to a certain mark in the truck bin to limit the payload to approximately 28 tons. To date the co-operation between the miller and grower regarding this issue has been good. The actual off-loading of the billeted cane improved since the billets flowed very easy and no hang-ups of cane in the cane truck occurred.

(b) Due to the nature of the shorter stick billeted cane, it levelled itself out on the incline feeder table which resulted in an even distribution of cane onto the rock removal drum.

(c) Once the billeted cane landed on the rock removal drum it followed the route between the sloping plate and the rock removal drum tynes and only approximately 20 – 30% of the cane was pulled over the rock removal drum onto the main cane carrier. The remaining 70 – 80% of the billeted cane landed on the R1 reclaim conveyor designed to remove the rocks, stones and sand. This conveyor was not designed to handle such a load of cane.

(d) The next serious bottleneck was at the carding drum and flap arrangement at the R1 / R2 interchange. This area is to allow the rocks, stones and sand to drop out and the long stick cane to be reclaimed on the R3 reclaim conveyor. To prevent the billeted cane from being rejected at the R1 / R2 interchange, the flap was tied in the closed position which resulted in a choke and build up of billeted cane at the transfer point. The cane had to be assisted manually to feed onto the main cane carrier.

(e) The large stream of billeted cane from the reclaim conveyors caused uneven cross-sectional loading of the conveyor with consequential poor tracking, cane spillage and unacceptable friction to the side of the conveyor belt. From previous experience it was found that the side pressure exerted on the conveyor belt and the ingress of foreign matter reduced the life of the conveyor belt drastically.

Design

With the information gathered and with the aid of the video footage it was clear that it would be possible to solve the problem with a combination of plant modification as well as a few new designs. Although only one truck of billeted cane was used to do the test, enough personnel has been stationed at strategic positions to witness the characteristics of the cane, specific problem areas and the general conveyance of the billeted cane.

The overall philosophy adopted was that the billeted cane would be tipped normally, transported up the inclined feeder table and be allowed to pass behind the rock removal drum onto the sloping plate and fed onto the R1 reclaim belt. This belt would feed the majority of the billeted cane load across the R1 / R2 interchange onto the R3 reclaim belt. From there it would discharge onto the tail end of the main cane carrier and meet up with the smaller amount of cane that was carried over the rock removal drum.

The following changes were instituted :

(a) The hydraulic pressure of the tippler jacks was increased slightly to cater for the additional payload achieved with billeted cane.

(b) The old conventional R1 reclaim conveyor was replaced with a 1200 mm wide troughed aero-conveyor.

(c) The electrical motor of the R1 reclaim conveyor (and its switch-gear in the sub-station) was upgraded from 5.5 kW to 7.5 kW.

(d) The gearbox of the R1 reclaim conveyor was changed to a bigger size cyclo drive, CHH 4160. The ratio was still as per the original to keep the belt speed the same to achieve the correct trajectory for the cane, sand and stones at the R1/R2 interchange.

(e) The R3 reclaim conveyor was replaced with a wider 1200 mm conveyor belt on idlers.

The R1 / R2 interchange was identified as the single most important area where a new design was required. The basis of the new design is a hydraulically operated movable chute that allows rocks, stones and sand to drop out onto the R2 reclaim conveyor when in one position and in another position allows all the billeted cane to be transferred from R1 conveyor onto R3 conveyor which feeds the billeted cane onto the main cane carrier.

The system comprises of the following :

(a) A selector switch mounted in the feeder table control room to select normal / billeted cane. The selection is made by the feeder table operator depending on the type of cane fed onto the feeder table.

(b) An hydraulic circuit with solenoid operated control valves and a hydraulic power cylinder which operates the movable chute. The hydraulic power pack is the same power pack used to open and close the rock removal drum washboard, thus reducing additional equipment and costs.

(c) A movable chute sliding on skids when operated by the hydraulic cylinder when activated from the selector switch in the control room.

(d) Control instruments to assist the operator in the positioning of the chute, indicating whether the chute is in the normal or billeted cane position. A closed circuit TV camera and monitor was also installed to improve his general vision of the R1 / R2 interchange and to prevent possible chokes or loss of product.

The new system has proved successful. The plant is robust, simple to operate, easy to maintain and was a cost effective installation. Making the system fail safe or failure proof would require more sophisticated controls which thus far are not warranted.

The cost of the whole project can be broken down into the following major cost components:

• Aero-conveyor structure in 3CR12 (R1)	R100 000
• Conveyor belting (R1 and R3)	R 25 000
• New gearboxes and motors	R 24 000
• R3 conveyor components	R 27 000
• Labour	R 95 000
• Other	R 19 000
	R290 000

Due to the time constraint of the off crop period, the whole project was initiated and planned during the 1997 season and the installation of the equipment was done during the 1997/ 1998 off crop. The commissioning of the system was done during the start up of the 1998 crushing season.

Evaluation

The design capacity of one extraction line is 250 tph and this was achieved with the billeted cane system. Higher throughput could be achieved but it increased the risk of chokes and overload conditions on the reclaim conveyors. The main cane carrier, being an aero-conveyor, is very susceptible to the distribution of the load on the belt and uneven spreading of billeted cane caused serious tracking problems and subsequent damage to the sides of the conveyor belt. Belt guides were installed to assist with the tracking of the belt under various conditions, i.e. type and quantity of cane.

An operational requirement is to leave a small gap between consignments of the normal whole stalk cane and the billeted cane on the feeder table. If the gap is too small or a mixture of cane types takes place, it results in the unnecessary spillage of cane sticks at the R1/ R2 interchange which quite often results in loss of the billeted cane. Although this loss is small, it is important to maximise the reclaim of cane from the reclaim system.

The “flow” of the billeted cane between the rock removal drum and the sloping plate is very smooth and the operators are able to control the feed from the feeder table to the rock removal drum effectively to obtain the maximum throughput with the minimum risk of plant operational delays. There is a risk that the operator leaves the movable chute in the wrong position for the type of cane in transit, but this risk is minimised by an indicator light and closed circuit TV in the control cabin, as well as the presence of a cane picker on the reclaim belts.

A factor that must be considered in the preparation of billeted cane is that the required height of the cane bed into the knives is much lower for billeted cane than that for long stick cane. This results in almost no work being done on the billeted cane at the leveller knives and no pinching of the cane between the feeder drum and the main cane carrier takes place. The latter means that the cane is presented loose to the main knives which results in a lower preparation index. The difference in the texture of the prepared normal cane and billeted cane is visible and the effects on the extraction must still be investigated further. At this stage the percentage billeted cane processed is relatively small and the effect on extraction is hidden by the preparation of the rest of the normal whole stalk cane.

Conclusion

The future of mechanical harvesting of cane in the eastern Onderberg is uncertain but Komati mill is able to accept billeted cane up to its full capacity. There are however a few aspects that can be improved on and there are other areas that need to be investigated further, if excellent performance figures are to be maintained with an appreciable increase in billeted cane.

The system introduced to accept billeted cane has been in operation for two seasons and has proved itself to be effective with minimum operational problems. The system was largely duplicated with the mill expansion project with the exception of a few changes to the reclaim system to reduce equipment and its associated costs and maintenance. The R3 reclaim conveyor was excluded and the new design allows the R1 conveyor to discharge directly onto the main cane carrier. The successful implementation and new ideas have enabled Komati to adapt to changing technology.

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