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A REVIEW OF CANE CONVEYING SYSTEMS

D COATES

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Abstract

The reliability of a cane conveying system from unloading through to the extraction plant is fundamental to the cost and time efficient operation of any sugar mill. Developments, features and choices of equipment used in various South African sugar mills are reviewed.

Introduction

Innovations, improvements and changes in conceptual designs are often reported at technical congresses shortly after implementation, but some of the smaller alterations and design enhancements go no further than acceptance by individual operational centres. The objective of this review is to report on different features and types of equipment presently used to convey cane from the point of offloading through cane preparation to the extraction plant.

Loose cane spiller tables

Spiller tables used for conveying cane from the vehicle offloading to the first cane conveyor generally are all similar in principle, in that they incorporate a system of chains dragging the cane over steel deck plates, the angles of inclination varying from horizontal to 35°. Chain speeds are in the order of 0,20 to 0,35 metre per second. Installed powers obviously vary with specific applications and duty requirements. Examples are given in Table 1.

Table 1
Examples of spiller table installed powers

Mill	Design tch	Angle	Installed power (kW)
PG	210	20°	2 × 45
FX	300	35°	2 × 90
GH	200	15°	2 × 45
SZ	225	17°	2 × 47

The variations in design detail revolve mainly around the choice of chain. The chain types in use include loghaul chain, standard 09060/1796 roller chain and drag link block chains. The advantage of loghaul chain is the lower initial installation cost, but operational problems appear to outweigh this advantage and these systems are not commonly used.

The logic of using standard cane conveyor roller chain is that used chains can be cascaded down from the more critical mill intercarriers and bagasse carriers in a chain replacement programme for use on the spiller tables.

Both the loghaul and roller chain have tynes attached for gripping the cane and produce a fair amount of spillage on the underside of the headshaft requiring continual labour intensive cleaning and housekeeping efforts. Most of the more recent installations (FX, PG, KM) have used drag link block chain with steel slat bars. This design allows a return deck plate to be incorporated which facilitates the c spillage onto a riddlings conveyor resulting in a cle free operation.

Relatively little maintenance is required on t tables and mills report annual costs ranging fron R12 000. Some enhancements which have b mented include:

- Hinging "noseplates" to facilitate easy acces tenance of headshaft sprockets and bearings.
- Sections of perforated screens on the top de assist with sand removal.

Conveyors

Apron slat conveyors and conventional belt co commonly used for the conveying of both whol prepared cane. A more recent development is th cushion belt conveyors.

Air cushion belt conveyors

A relatively new innovation in the South Af industry, this type of conveyor was first introdu Felixton mill (1984) where whole stick cane is from the spiller tables to the cane knives. A fur opment in this field has taken place in the recent i of this type of conveyor at the new Komati mil difference is that the belts are flat, as opposed t as installed at Felixton. Figure 1 shows a typical tional detail of one of these conveyors. As an exam technical details for this type of conveyor are show 2. In order to reduce friction, belting without bott is used for this type of conveyor.

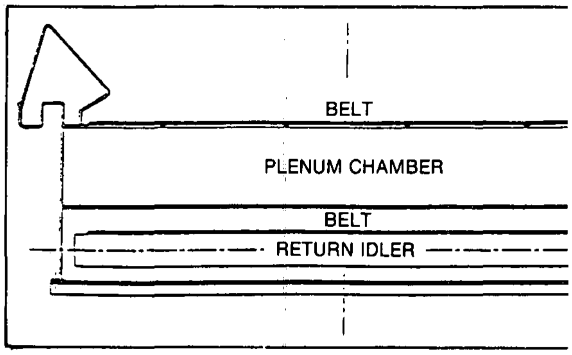

FIGURE 1 Cross section of air cushion belt conveyor

Contrary to logical expectation and manufacture from the above information it would appear that required for this type of conveyor (excluding fan considerably more (about 50%) than that require ventional conveyors. The reason for this phenom be that the air supply is inadequate to support th sulting in high friction losses.

Mill staff at Felixton report favourable operat formance and belt life of up to ten years. At th writing, only commissioning trials had been con

Table 2
Technical details for air cushion belt conveyors

		Felixton	Komati
Length (shaft centres)	(m)	53	22
Elevation	(m)	2	7.3
Belt width	(mm)	2 100	2 100
Designed capacity	(tch)	300	225
Belt speed	(m/s)	1.5	1.5
Installed drive power	(kW)	75	37
Absorbed power	(kW)	50	22
Theorectical power for conventional belt conveyor	(kW)	32	14

Komati, where approximately 25 000 tons were crushed with an average of 231 tch being sustained over a six hour period. Although no major operational problems were encountered during this period, it is felt that a meaningful assessment of the installation can only be done after a reasonable period of operation.

Advantages of this type of conveyor are reduced maintenance costs (no idlers), smoother operation with little disturbance of the product profile and longer belt life. Disadvantages include the high initial installation cost (approximately 40% more than a conventional conveyor), and the neccessity to allow for increased installed power to cater for high starting torques which are experienced when restarting after production stoppages.

Care needs to be taken to ensure that there is no side thrust at the loading point and special consideration must be given to the design of side seals.

Conventional belt conveyors

Conventional belt conveyors are widely used for conveying of either whole stick or prepared cane in several of the mills. Generally either class 630/3 with 6,4/3,2 mm covers or second hand class 1 000/4 mining belt is used.

Some specific features when used for whole stick cane are:

- Variable speed drives with maximum speeds of 0,5 m/s
- Close spacing (500 mm) of heavy duty support idlers in the loading area where cane falls from the spiller table onto the belt.
- Stainless steel beater plates where cutting is done over the belt, to reduce belt damage caused by dislodged knives or tramp iron.
- Design of the skirting sealing arrangements. Two typical arrangements are shown in Figure 2, either side of the belt.
- Anvil drums where cane knives are cutting off the head shaft area. An example is shown in Figure 3.

Specific features for conventional belt conveyors used for prepared cane are:

- Variable speed drives with belt speeds averaging 1,5 m/s
- Troughing angles usually 20 or 35 degrees but 45 degrees in one installation (Felixton).
- Stainless steel beater plates supporting the belt where cane is discharged from knives or shredders onto the belt.

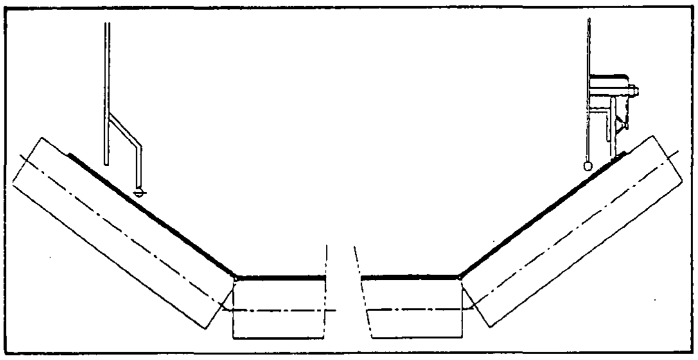

FIGURE 2 Conveyor belt skirting details

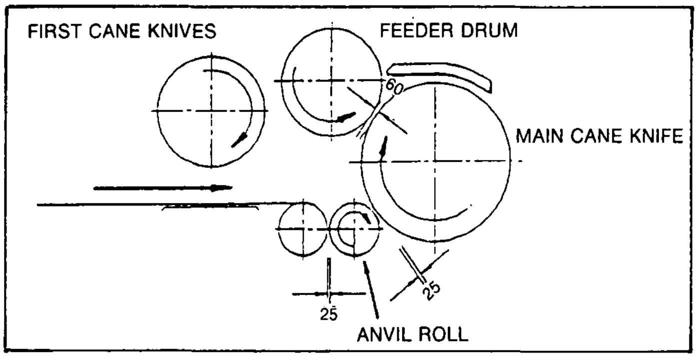

FIGURE 3 General arrangement of anvil drum

Slat carriers

Slat carriers are considerably more expensive to install and maintain. These are used for conveying shredded cane where layouts and elevations exclude the option of using belt conveyors. The design of slat carriers is fairly standard at most mills, the most notable difference being the selection of chain type, and chain material specification. Generally two types of chain are used, either the standard roller (1796/09060) or the BFP/BOP type chains. Material specifications vary with application but carbon steel side plates with stainless steel components are common for this application. Stainless steel side plates are preferred where carriers are operating in hot moist conditions (e.g. diffuser feed conveyors).

Slats and slat attachments vary with individual mill preferences, and slats are generally spaced every 6th or 7th link.

Control strategies

Speed control

Developments in control logic for the throughput control on cane preparation lines have evolved from manual control, to the use of knife/shredder absorbed power as a feedback to control conveyor speeds, to using belt weighers and compensation for erratic feed. A description (Figure 4) of a typical control strategy is as follows. The following assumptions have been made:

- The main cane and shredder conveyors are variable speed conveyors
- All drives are electrically driven
- Tachometers are installed on the tail shafts of the conveyors.

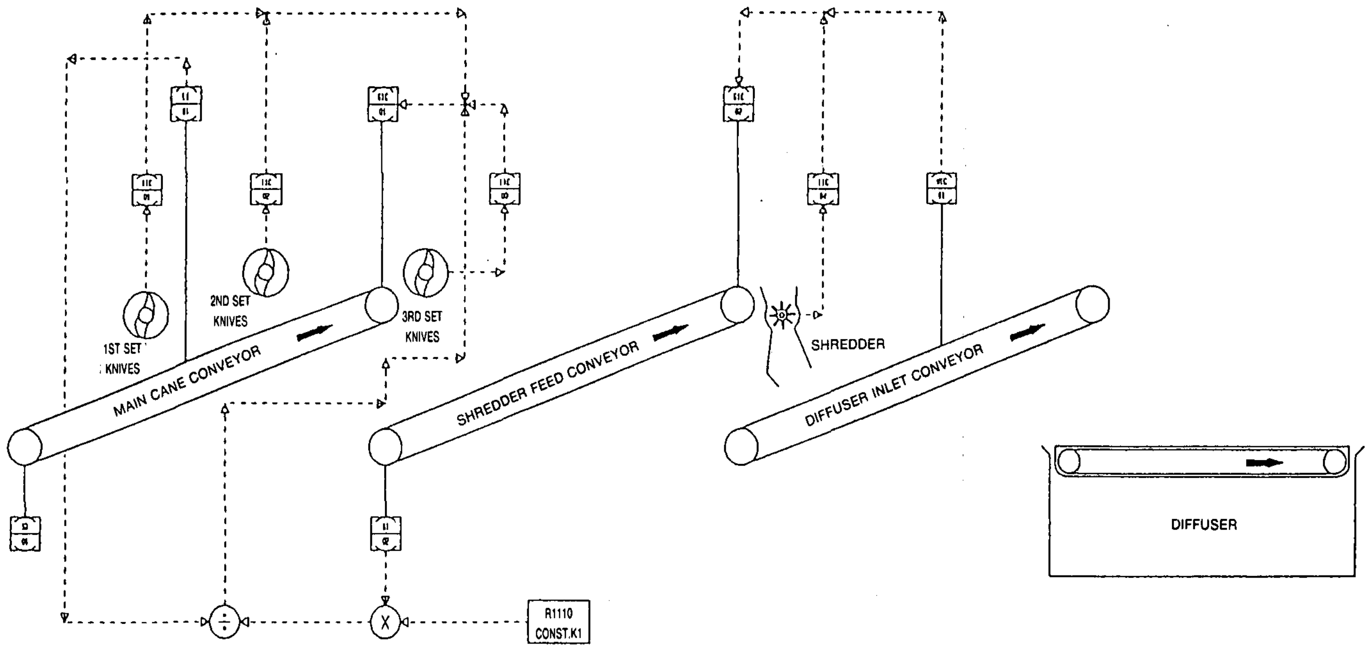

FIGURE 4 Cane carrier control system

Throughput control

The philosophy for controlling cane throughput is to set the crush rate on the throughput controller (WIC-01). The mass flow rate of cane is measured after the shredder by a mechanical belt weigher that comprises two load cells. This signal is used to control the speed of the shredder feed and main conveyor.

In addition, the output of this belt weigher is also used as a feed forward trim to set the diffuser bed speed (within prescribed limits).

Override control

The shredder power is monitored by controller (IIC-04). If the output of this controller reduces below the throughput controller (WIC-01) output, then the shredder power controller (IIC-04) will take over control and reduce the speed of the shredder feed conveyor (SIC-02).

Whilst this is taking place, the throughput controller will track the shredder power controller output. When the output of controller (IIC-04) increases again, the throughput controller (WIC-01) will again take over control of the shredder feed conveyor (SIC-02).

The power absorbed is also monitored on the first, second and third cane knives. If any one of the outputs of these three current controllers (IIC-01, 02 and 03) reduces below the speed of the shredder feed conveyor (SI-02), then the lowest signal will reduce the speed to the main cane conveyor (SIC-01). As this condition returns to normal, the speed feedback signal (SI-02) from the shredder feed conveyor will again control the main cane conveyor.

Compensation for variation in cane feed

A level monitoring device is installed on the main cane conveyor. The output signal from the shredder tachometer is ratioed by value K1 (factor 0,5 to 2,0). The resultant signal would under normal conditions represent the setpoint to the main cane conveyor (SIC-01). To allow for the above compensation, this signal is divided by the level signal (LI-01) on the main cane conveyor which compensates for cane level variations. This resultant is then used to set the final speed of the main cane conveyor.

Conclusions

A well designed, efficient cane conveying system is vital to the efficient operation of any sugar mill. This requirement has led to a high degree of refinement in design of feeder tables and slat carriers.

The advantages of cost and superior operational characteristics of belt conveyors has led in new installations to a trend to the use of belt conveyors as opposed to apron and slat carriers. The performance of the new air cushion conveyors at the Komati mill will be observed with interest and could well become the standard for future installations.

Acknowledgements

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