

LABOUR SAVING CONVEYORS IN THE CANE TESTING SERVICE

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Abstract

Four types of equipment are used to convey samples of sugar cane, documents and waste products to and from the laboratory and sample point. Operating and maintenance problems are discussed as well as principal advantages and disadvantages of the different types.

Introduction

A significant portion of the Cane Testing Service wage bill is required for the manual labour involved in carrying documents, samples and waste products to and from the laboratory and sample point. It has long been realised that this cost could be eliminated by the use of suitable conveying systems and over the past five years a number of conveyors have been installed. By the end of 1976, equipment was in use at 7 mills for document conveying, at 3 mills for sample conveying and at 2 mills for waste product disposal.

Each document and sample conveying installation has been economically justified in that the cost of each system has been less than 5 times the annual wage cost of the labour it has replaced. (In most cases, considerably less.) The waste product disposal units are of relatively low cost and serve more to reduce the work load of laboratory staff than to replace staff.

Document Conveyors

A consignment of cane arriving in the mill yard has with it an identifying document in the form of either a weighbridge ticket or bundle tag. This document has to be conveyed to the sample supervisor when the cane is crushed. In most cases, the sample supervisor is in a cabin high in the gantry, remote from the cane off-loading site. The document must thereafter be conveyed from the sample supervisor to the sample point, to accompany the sample to the laboratory. This conveying used to be done exclusively by manual labour, sometimes not satisfactorily. It is now done with Lamson air-tube conveyors at seven mills.

Apart from the reduction in labour requirements resulting from the use of air tubes, there is a further advantage.

With a labourer, some time is required to walk backwards and forwards from point to point and it is common practice for documents to accumulate and for several documents to be carried at a time. With an air-tube conveyor, each document can be conveyed individually, reducing the possibilities of wrong identification of samples.

An air-tube conveyor is simply a continuous tube running from one point, or "station", to another. A "carrier", containing the document, is sucked (or blown) through the tube using a low vacuum (or pressure). The tubing is a thin gauge steel tubing of 55 mm internal diameter, butt jointed with a sleeve cover. Recently a system using PVC tubing has been installed. The speed of the carrier is approximately 8 m/sec. There are several different configurations of air-tube systems, of which two are used by the Cane Testing Service.

Note that at each mill, up to four such conveyors may be required i.e. one from each cane off-loading site to the sample supervisor's cabin and one from the sample supervisor to the sample point in the mill house.

The Double Tube System

The principle of the double tube system is shown diagrammatically in Figure 1. Air is sucked through the system, from the open ended tube at the central station A, through the vacuum tight out-station at B and back through a second tube to A. From A, the air goes into a manifold and to a turbine, exhausting to atmosphere. Thus, a carrier inserted at station A is sucked through to B, and a carrier inserted at B is sucked through to A. The turbine runs continuously and a very high number of carriers may be handled as they may be sent in both directions simultaneously and in fairly rapid succession. One turbine may serve a number of conveyors from one manifold.

One such system was installed at Tongaat mill and has been in operation for three seasons.

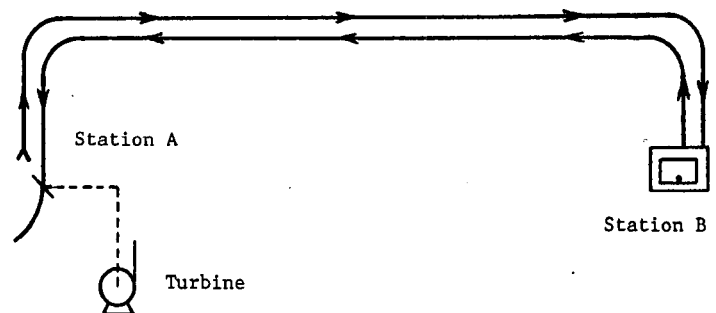


FIGURE 1 Double Tube System.

The Single Tube System

The single tube system is shown in Figure 2. This consists of one tube from stations A to B and the carriers are sucked or blown through the tube. Two motor/fan units are installed in series at the central station A. One unit sucks and the other unit blows. By pressing a start button at either station, the appropriate motor is switched on and runs for a pre-selected time. The motor uses 220v single phase power. In this type of system, the traffic is restricted as only one carrier may be handled at a time. The cost of this type of system is approximately 65% of that of a double tube system. It has been installed at six mills.

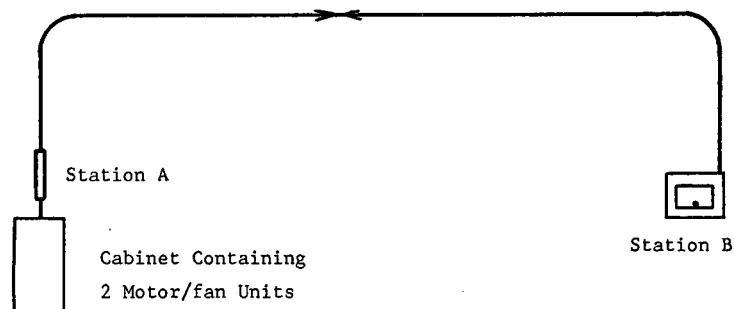


FIGURE 2 Single Tube System.

The Carrier

Figure 3 shows a typical document carrier. The body is of clear plastic and a smaller diameter than the tube (38 mm). This is to enable the carrier to negotiate the bends in the tube

system. The accelerator disc provides a seal round the inside of the tube. The leather skirt opens for insertion and removal of documents.

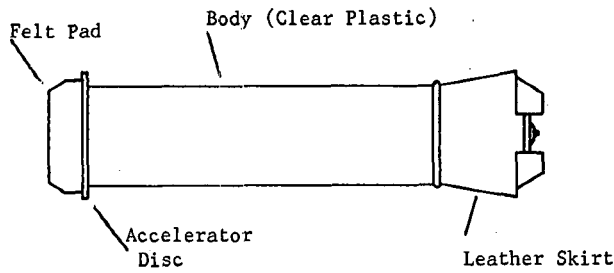


FIGURE 3 Air-tube Document Carrier.

Problems Encountered

With the double tube system at Tongaat, the only cost incurred in maintenance has been for the replacement of carriers and carrier parts and expenditure to date for 3 seasons has been less than R80. With the single tube systems however, the rate of wear is much higher and accelerator discs, for example, have to be replaced every two weeks at a cost of approximately R50 per season per mill. Skirts also need more frequent renewal. A probable cause is thought to be the fine dust sucked into the system from the out-stations in the mill yard. Another cause, in some cases, is rainwater entering the tube joints under vacuum. The light rust that results prevents the internal walls of the tubing from becoming highly polished. This problem arises particularly where the tube crosses from a gantry to a mill house. The movement of the gantry relative to the mill house causes the joint seals to open. A further item in the single tube systems that requires regular replacement are the motor brushes. These are now being replaced twice per season. The total cost of these normal maintenance replacements is of the order of R100 per mill per season.

At only one mill have other types of breakdown occurred. This has been at Gledhow, where, in two seasons, four (out of a total of eight) motors have had to be replaced, due to either seized bearings or burnt out armatures or coils. The manufacturers feel that these faults have been caused by very intensive use, coupled with long tube runs and unfavourable conditions (dust and moisture). Two timers have also been replaced. The recent installation of a diffuser at Gledhow meant that alterations had to be carried out and the opportunity was taken to re-route the tubes with a view to reducing the length of runs and overcoming the problem of leaking joints.

A more expensive problem has been due to tubing being damaged. The tubing is of a light gauge and it does not require a very heavy blow to dent it. The smallest dent necessitates a length of tubing being replaced. Attention is now being focused on affording more protection to the tubing in exposed areas.

Sample Conveyors

The sample of shredded cane has a mass of 1 500g to 2 000g and occupies a volume of approximately 3 000cm³ to 4 000cm³. At some mills more than 20 such samples have to be transported to the laboratory each hour. To facilitate this, three types of conveyor are currently in use.

At Empangeni mill, an overhead cableway has been in operation for four seasons. At Umzimkulu mill, an overhead cableway was installed along with a chain conveyor 5 years ago. The chain conveyor took samples from the sample point to the sample supervisor's cabin and the cableway took the sample on to the laboratory. The chain conveyor was soon discarded as being unworkable. In 1976 a Lamson air-tube conveyor was installed in place of the chain conveyor. Also in 1976 a Telelift conveyor was installed at Amatikulu mill.

Overhead Cable Conveyors

The two cable conveyors are slightly different in concept. At Empangeni, an endless wire cable is suspended between two pulleys, one at the laboratory and one at the sample supervisor's cabin. A box for carrying the sample is attached to this cable and the cable is driven to and fro through a gearbox by a reversible motor. At Umzimkulu, the sample carrier is suspended from wheels running on a cable fixed at both ends. The carrier is merely pulled to and fro by an endless cable on pulleys, also driven through a gearbox by a reversible motor. As the mass of the sample carrier and samples is borne by the fixed cable, this makes for less wear and stretching and the installation at Umzimkulu has required virtually no maintenance since it was commissioned. At Empangeni, the cable requires to be shortened approximately three times per season and has been replaced every two seasons.

On both cableways, microswitches at each end of the conveyor stop the motor when activated by the sample carrier reaching the switch. A start button at each end starts the motor running in the appropriate direction. The Empangeni conveyor carries one sample at a time, while the Umzimkulu conveyor carries four samples simultaneously.

Lamson Sample Conveyor

The Lamson sample conveyor at Umzimkulu is similar to the double tube system described under "Document Conveyors". The largest diameter tube system normally marketed in South Africa by Lamson is 138mm, but the carrier for this size tube is too small for a sample of shredded cane to be accommodated comfortably. Accordingly, a system with a tube diameter of 150mm was developed by Lamson Engineering specifically for the Cane Testing Service application. This included also the development of a special carrier, suited to the transporting of cane samples (See Figure 4.) It was necessary to use polyethylene rings at the front and back of the carrier as bearing surfaces in place of the accelerator disc and

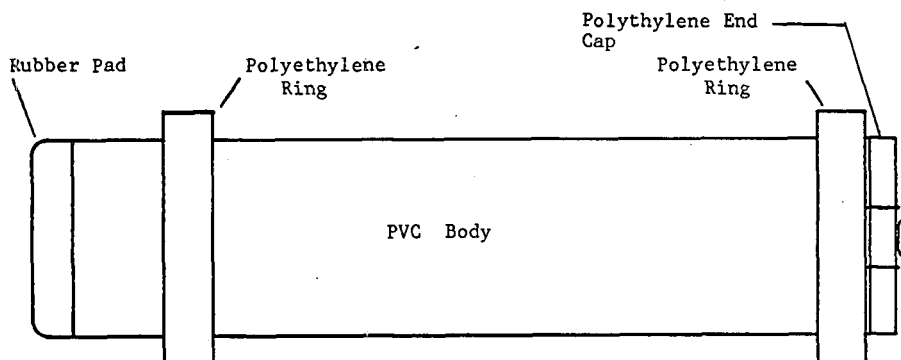


FIGURE 4 Air-Tube Sample Carrier.

leather skirt used on the document carrier and a rubber buffer in place of the felt pad on the front end. The station had to be designed to eliminate the danger of an operator putting his hand in where it might be crushed by an incoming carrier.

The original carrier bodies were found to be of insufficient strength and various modifications were made to prevent them from breaking. This problem has been virtually solved but it is still intended to try using an aluminium body in place of the original PVC body to make the carrier even more robust. A further problem was caused by droplets of juice, from the shredder and cane knives, entrained in the air being sucked into the system. This coated the inside of the tubes causing carriers to stick in the tubing on a number of occasions. It has been overcome by moving the air intake to outside the mill house and by the use of a specialised carrier which is dipped into water and sent back and forth through the tubes to clean them at regular intervals.

Telelift Sample Conveyor

The Telelift conveyor consists of a car, running on four rubber tyred wheels on a plastic track. Figure 5 shows a cross section of the track with a car in place. The car picks up 24V DC power from brass rails set in the track and is driven by a motor through a gear and worm drive. A third rail is used for control purposes. Side rollers set in the centre of the wheels help to guide the car. In normal installations (shops and offices, etc.) the track is installed "right side up" i.e. with the car running on top of the track. On vertical sections of track the car is driven by a pinion engaging in a toothed rack set in the track. Otherwise, the drive is by a rubber tyred drive wheel.

As it was felt that the principal problem in a sugar mill environment would be dirt on the track, at Amatikulu the track was installed upside down and was also covered with steel sheeting. To prevent slip on the drive wheel, the toothed rack was made continuous throughout the track. The body of the car was designed to carry two billy cans of shredded cane.

Up to the end of the 1976/77 season, problems were experienced due to dirt on the track. The conveyor operated for some time before the covering of the track was completed and a lot of the problems were probably as a result of this. The dirt causes short-circuiting of the power supply in the brass rails or prevents the brushes from making contact with the rails. It is felt that this problem can be overcome.

The track is made of extruded PVC and the straight lengths are extruded in one piece. However, the bends were made of three extrusions welded together longitudinally. On some of

the original bends, the welded joints starting cracking and the bends had to be replaced. The replacement proved to be satisfactory.

Shortly before the end of the 1976/77 season after approximately 4 months service, the car became unserviceable due to a worn gear in the gear box. It was returned to the manufacturers for their comments. The manufacturers admitted that the gear may have been slightly off-centre on the worm, causing more rapid wear. Also that the grease in the gear box was unsatisfactory for the intensive 24-hour usage and high ambient temperatures. However, it was also the manufacturer's contention that under these service conditions, the amount of wear and tear was not unreasonable and that the car was certainly due for a major overhaul. Apart from the worn gear, the brushes (motor and power pick-up) required replacement, along with some of the wheels and rollers. Thus it can be expected that the car will require to be overhauled two to three times per season and the cost of this maintenance will be of the order of R100 to R150 per season.

Advantages and disadvantages of the different types

From the cost point of view, it would be difficult to quantify the maintenance costs of the Lamson and the Telelift conveyors, as they were installed towards the middle of the 1976/77 season. However, the cableways are certainly very economical to maintain. The capital costs of all three systems are very similar.

A serious disadvantage of the cableway system is that the cableway must operate in a straight line from starting point to end point. This limits the situations where a cableway might be used and at Empangeni, for example, the sample attendant has to transport the samples some distance to the conveyor. It would be difficult to envisage the cableway entering the laboratory in view of the heavy anchorage structure that the cable requires. Both the Lamson and Telelift conveyors can transport samples from the sample point directly into the laboratory.

The tubing for the Lamson conveyor can be routed almost anywhere (underground as well, if necessary) but this system has the disadvantage that the samples must be placed in a cylindrical carrier which is relatively long and narrow. This makes it more difficult to use from the operator point of view, particularly for emptying the sample out and subsequently washing and drying the carrier.

With the Telelift conveyor, the car is fairly exposed as it moves along the track. It is doubtful that this system could

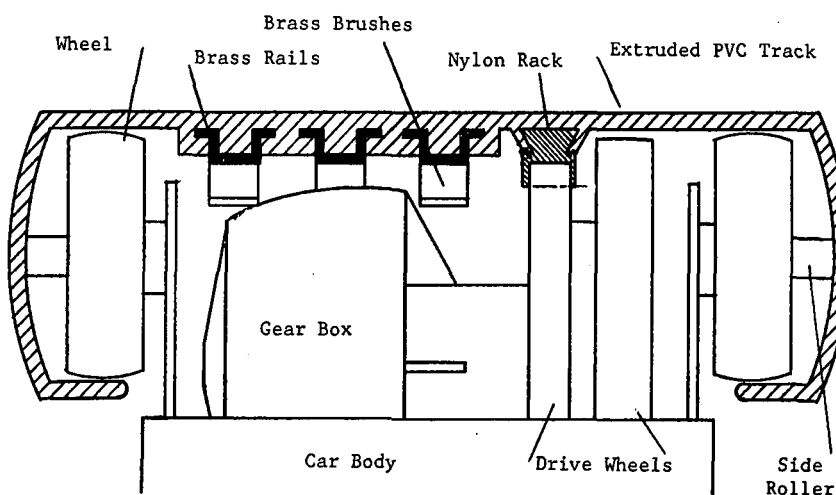


FIGURE 5 Diagrammatic Cross-Section of Telelift Conveyor.

be successfully employed where it has to be routed alongside a mill main carrier, etc. A further problem is the susceptibility of the track to dirt, causing short circuiting across the power rails. For the operator it is very convenient as a standard size billy can is used as a sample container.

Waste product disposal units

The products to be disposed of after analysis, consist of excess sample (shredded cane), dried cane (after moisture determination) and the wet fibre (after digestion with water). These products can all be pumped back to the mill by means of the disposal unit. The first unit was installed at Entumeni mill as, at that time, this was the only mill which was weighing bagasse and the return of unweighed water to process would not have upset the mass balance. Since then a unit has been installed at Amatikulu mill and with the use of DAC fibre to calculate bagasse mass, it is feasible now to instal them at any mill.

The unit consists basically of a square tank of approximately 300 l capacity. A stirrer is fitted to the tank to keep the slurry of fibre and water well mixed and the bottom of the tank is

semi-circular to aid the circulation of slurry. A Mono pump is connected to the tank for pumping the slurry back to the mill.

Waste product is flushed into the tank from the laboratory and the stirrer keeps the solids in suspension. When the level in the tank is high enough, the pump is switched on by a level sensing probe and the slurry is pumped back to the mill. When the level drops to just above the pump intake, the pump switches off. The impeller of the stirrer is placed close to the pump intake to break up lumps of fibre before they can enter the pump and choke it.

Conclusions

All the installations described above are operating reasonably well. Some require little or no maintenance while others still have problems that are being investigated. The investigations may result in some minor modifications. There is no doubt, however, that the investment has been worthwhile in that the conveying equipment has made possible a reduction in the Cane Testing Service labour requirements of 30 units. Further installations are being considered wherever manual labour is used to convey documents and samples.