ABSTRACT

Labour shortage is forcing the Brasilian sugar industry to fully mechanise harvesting. After careful study, Usina Santa Lydia has selected an Australian built chopper-harvester as the basis of the harvesting system. A very flexible system of cane reception, storage and transport has been devised, to enable the mill to handle, at the same time or separately, both whole stalk and chopped cane.

To achieve this, the mill yard floor, lined with 6 mm steel plates, is 3 m below ground level. Over the storage pit thus formed, 2 overhead traveling cranes, of 12 ton capacity each, were installed, to handle any type of cane, through 2 suspended and hydraulically operated cane grabs, of 8 ton capacity each.

Whole stalk cane is dumped into the storage pit from the right, by a very simple and low cost mechanical unloader, its use being possible due to a swinging pole and steel cable device fitted to the side of a standard transport unit.

Chopped cane is normally fed directly to a cross conveyor feeding the main mill carrier after the washing station. If, however, the mill is stopped, chopped cane is stored in the pit and then handled by the grabs. A simple and light steel frame and wire mesh body is fitted to the chopped cane vehicles, which are side dumped at the mill yard by an automatic hydraulic unloader.

The system has worked well and smoothly from the beginning, and Sta Lydia plans in 1974 to harvest mechanically all cane from its own fields.

INTRODUCTION

In the last few years sugarcane harvesting has become a difficult problem for Brasilian mills, specially in the Southern regions, in the states of Sao Paulo, Parana and Minas Gerais, due to labour shortage and increasing wages. Mechanical harvesting is becoming not only economically advisable, but, in some places, is already essential. In order to prepare Usina Sta Lydia to handle mechanically harvested cane efficiently a careful study was started in 1968.

The scope of the study was:

1) To determine the type of harvesting system best suited to local conditions;
2) To choose a particular harvester;
3) To provide adequate means of transporting, handling and storing both mechanically harvested and hand cut, mechanically loaded, sugarcane.

The system should ensure an efficient and dependable supply of cane to the mill, in order to overcome labour shortages and maintain the cost at an economic figure. It should be suitable both for plantation requirements and the
independent grower, who should still be able also to use his trailers or trucks with the conventional equipment used at other mills.

Characteristics of Usina Sta Lydia

The enterprise is located in the North-eastern part of Sao Paulo State (300 km from the capital of the state), covering 2,500 hectares of red volcanic soil with transition to sandy soil. The factory produces 30,000 tons of white crystal sugar, during a season of 180 days. Cane supply is of the order of 270,000 tons, 150,000 tons of which is from mill owned or controlled land, the balance of 120,000 tons being from 35 independent growers. The estate has its cane fields spread over rolling country, and the maximum hauling distance is 16 km.

Cane Harvesting

Cane is harvested from June to December, starting in the dry and cold season and ending in opposite climatic conditions. Plant cane is harvested at 18 months and ratoons at 12 months, but sometimes there is left over cane from both plant and ratoon. Yields recorded fall in the range from 200 t/ha for an excellent first crop, to 50 t/ha for a poor fourth ratoon. All cane is harvested burnt, and should have a minimum sucrose content of 16% Pol in the first expressed juice.

The traditional harvesting system consisted of hand cutting burnt cane (4.2 tons of cane/man/day), and laying it on the ground in heaps; mechanical loaders picked it up in grabs of 300 to 500 kg, dumping it on trucks or trailers which took it directly to the mill. The trucks had 5 steel cables under each load, thus tying the cane into a large bundle. The cane was handled at the mill by overhead travelling crane, in bundles of 8 to 10 tons.

Usina Sta Lydia also used 2 Santal CTE whole-stick harvesters which cut unburnt cane, there being 5 cane rows to one strip. The cane on the ground was burnt and then loaded on trucks to be transported to the mill as previously described.

DEVELOPMENT OF THE NEW SYSTEM

By 1970, the following conclusions were reached:

1) That the system of mechanical harvesting best suited to Santa Lydia's conditions was the Australian chopper-harvester method which could efficiently handle all types of sugarcane normally grown in the area, could deliver very clean cane to the mill, and would dispense with the cleaning plant normally required by other methods;

2) That the most suitable harvester was the Australian Don Mizzi 741, which is a very rugged but mechanically simple machine.

Accordingly, part 3 of the study was started in conjunction with Santal Equipamentos S/A, a company that already produced sugarcane harvesters and loaders. By the end of 1971 when the study was ready, the first Mizzi 741 was ordered from Australia, and negotiations for manufacturing the harvester in Brasil were started between Metcon, the Australian exporter, and Santal. Modification of the sugar mill yard and transport equipment was carried out to enable Santa Lydia to operate the first chopper-harvester during the 1972 campaign.
FIGURE 1. Case handling at the mill yard. Cross section.
DESCRIPTION OF THE NEW SYSTEM

The design of the new system was based on 3 premises:
1) The same mill yard and handling devices should be able to store and feed the mill whole-stalk and chopped cane;
2) The chopped cane should be fed to the mill directly, while the whole-stalk cane should be fed to the mill through a conventional washing system;
3) The existing standard cane transporting units (trailers and trucks) should be able to handle and dump chopped cane and bulk whole-stalk cane into the mill yard with a minimum of modifications.

The new system required the following modifications to Sta Lydia's equipment:

(a) Sugar mill yard

Taking advantage of the terrain, the mill yard was constructed about 3 m below ground level and lined with 6 mm steel plates.

Above the yard, 2 overhead traveling cranes of 12 ton capacity handle both chopped and whole-stalk cane by means of 2 suspended, hydraulically operated, cane grabs of 8 ton capacity each, designed and built by Santal.

The storage capacity of this pit is about 1,500 tons, sufficient for a 15 hour milling period. A sketch is shown in Fig. 1 and Fig. 2.

(b) Bulk whole-stalk cane transporting units

To enable conventional (8 ton) trucks and trailers to unload by side dumping bulk whole-stalk cane, a device was bolted to the side of existing standard cane transport units (Fig. 3).

It consists of 5 vertical swinging metal poles, fitted to a horizontal U steel beam, and having, attached to the bottom of each pole, a steel cable about 4.5 m long terminated by a ring.

The cane is placed over the steel cables lying across the floor of the transport units; unloading is done by pulling up on the rings at the end of the 5 cables, lifting the whole cane bundle and dumping it laterally over the horizontal U bar.

The swinging poles ease the lateral dumping movement, reduce the weight and height of the unloading device, and prevent cane spillage. This device was fitted to all the mill and growers' transport units that would handle only whole-stalk cane.

(c) Chopped cane transport units

For chopped cane a low cost lateral dumping steel body was designed to fit both standard trucks and trailers. It consists of a light tubular steel body covered with mesh, measuring $5.20 \times 2.40 \times 2.00$ m capable of holding 8 to 10 tons of chopped cane. The whole body pivots over 4 points along the side, for dumping purposes, and the side panel swings open.

The entire body weighs only 1,300 kg; Fig. 4 shows one of the trailers being unloaded, while Fig. 5 shows a schematic construction plan. A bigger cart of 12-15 tons capacity is being presently tested with chopped cane. It uses the same light steel frame with wire mesh design and is
CHOPPED CANE
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BE STORED.

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FIGURE 2. Layout of the mill yard.

TRANSIT OF CHOPPED CANE TRAILERS

HYDRAULIC GRAB

TRAVELING CRANE

STORAGE

AREA

HYDRAULIC GRAB

TRAVELING CRANE

TRANSIT OF WHOLE STALK CANE TRAILERS

UNLOADING STATION FOR WHOLE STALK

MAIN CARRIER

HORIZONTAL FEEDING HOPPER

CROSS CONVEYOR FOR CHOPPED CANE

WASHING STATION

PIT FOR CHOPPED CANE TO BE STORED IN YARD

MIN. 7.50 m

18.00 m

SCALE 1:200
Figure 4. Chopped cane trailer being dumped.

supported by four 15,50 x 20 aircraft type tyres, placed on 2 fixed axles. This trailer can be seen in Fig. 6 being loaded by a Santal Don harvester.

(d) Whole-stalk cane unloader

The swinging pole device fitted to the whole-stalk cane transport vehicles permits a very simple and light unloading hoist design. The mechanical unloader is only 8.5 m high and uses a 15 hp electric motor driving a standard winch; two such units are installed on the right side of the storage pit. Fig. 7 shows one of the unloaders at work.

(e) Chopped cane unloader

To unload the side dumping steel bodies, Santal designed and built a fully automatic, hydraulically driven device. Two pistons engage and hold the fixed frame of the vehicle, while a third central piston engages the swinging body lifting it through a 37° angle. Fig 8 shows such an unloader at work. Two such units driven by one single 7.5 hp electric motor, are installed on the left side of the storage pit.

OPERATION

The 1972 campaign proved that our principles were sound, and in 1973 only minor changes were necessary. The present (1973) operation is as follows:

Two harvesters (the original Mizzi 741 and a new Brazilian-made Santal-Don) are operating, averaging 640 tons of cane per day of 16 hours (2 shifts). Fig. 9 shows the harvesters operating. The chopped cane is loaded on the 8-10 ton trailers and trucks which go directly to the mill.

After weighing, the chopped cane is unloaded at station no. 2 (see Fig. 2) over a cross conveyor which feeds the main cane carrier after the washing station.
FIGURE 5. Construction plans for chopped cane containers.
Unloading station no. 1 is used for whole-stalk cane transported eventually in trailers designed for chopped cane. If the mill stops, unloader no. 1 is used for chopped cane, which is then picked up by one of the suspended grabs and stored in the mill yard. About 1200 tons/day comes as whole-stalk cane, supplied by mill properties and independent growers. Again, the transporting vehicles are first weighed and then unloaded at nos. 3 and 4 stations (see Fig. 2). Unloader no. 3 feeds a
FIGURE 8. Hydraulic unloader at work.

FIGURE 9. Santal Don harvesters at work.

FIGURE 10. Hydraulic grab holding 8 tons of cane.
hydraulically driven washing and feeding hopper, while unloader no. 4
dumps the cane into the pit for storage, being handled by the grabs. Fig 10
shows one of the grabs holding approximately 8 tons of whole-stalk cane.
The whole-stalk cane is fed to the main carrier by hydraulically
driven feeding hoppers. On the main carrier water at the rate of 4-5
litre/kg of cane, is poured over the whole-stalk cane.
Comparative tests conducted at Sta Lydia have shown an average
3-4% sugar loss on washing burnt whole-stalk cane, but the amount of soil
with the cane makes the washing mandatory.

CONCLUSIONS
As a result of careful planning, problems were avoided at Sta Lydia when
chopper-harvesters were introduced.
However, suitable preparation of the mill yard, transport units, roads and
and field conditions are of paramount importance. A flexible system, permit-
ting the simultaneous operation of the mill on both whole-stalk and chopped
cane, is essential when a gradual change over to mechanical harvesting is desired.
In this regard, we can only say that Sta Lydia’s experience was extremely
successful, and in 1974 all of the mill-owned sugarcane will be mechanically
harvested.

MANEJO DE CAÑA A GRANEL EN CENTRAL STA. LYDIA
Luis A. R. Pinto y Franz Brieger

RESUMEN
La escasez de obra de mano está forzando a la industria brasileña a
completamente mecanizar la cosecha. Después de cuidadoso estudio,
Central Santa Lydia seleccionó una cosechadora trozadora como la base de
su sistema de cosechar.
Un sistema muy flexible de recogimiento almacenaje y transporte fué
desarrollado para capacitar el molino para manejar simultáneamente e
indiferentemente, tanto caña entera como trozada.
Para lograr esto el patio del Central se bajó tres metros bajo el nivel
del piso del contorno y fué cubierto con plancha de acero de $\frac{3}{4}$". Sobre este
foso se instalaron dos grúas viajeras de 12 toneladas de capacidad cada una
manejando cualquier tipo de caña por medio de dos garfios hidráulicamente
operados de 8 toneladas de capacidad cada uno.
Caña entera se descarga en el foso de almacenamiento por medio de un
descargador mecánico sencillo y de bajo costo que se hace posible por una
pártila móvil y un cable de acero acoplado a un lado de una unidad
transportadora standard.
La caña trozada es normalmente alimentada al conductor transversal el
cual alimenta al conductor principal, después de la estación lavadora. Solo
en caso de interrupción en el molino la caña trozada es depositada en el
foso para almacenamiento y manejada por garfios. Una simple y liviana
estructura de acero y tejido de alambre forman los vehículos de caña trozada
los cuales son descargados lateralmente en el patio por un descargador
hidráulico automático.
Desde el principio el sistema funcionó bien y sin dificultades y Santa
Lydia planea, para 1974, cosechar mecánicamente todas las cañas de sus
propiedades.