BAGASSE STORAGE IN CYLINDRICAL SILOS

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Introduction

The paper covers the principles and design aspects of cylindrical bins for the storage and reclaimation of bagasse.

The system described (fig. 1) was originally designed and drawn up by the author in 1963 for the Mossman sugar mill. The design was not adopted, favour being given to the more conventional rectangular system with travelling suspended reclaimer.

The first circular system, with a capacity of 800 tonnes, was constructed in 1970 to a general scheme proposed in conjunction with Kalamia mill at Ayr. In 1972 similar systems of 450 tonnes capacity at Haughton and 650 tonnes at Mulgrave were installed. The Kalamia system is described by Muir (1971).

It is the intention in presenting this paper to invite discussion on the principles incorporated in the circular bin system and, hopefully, to improve any systems planned for the future.

Systems Used

The most controversial aspect of bagasse handling encountered by the author relates to the flow system adopted in the mill, i.e.,

either (1) Supply bagasse to boilers direct from mill with surplus going to the storage bin for further reclaiming (Fig. 2) or (2) Send all bagasse to the storage bin and reclaim to boilers returning the surplus to the storage bin for further reclaiming (Fig. 3).

System 1 Has the prime advantage of reliability, the delay between mill and boiler being the lesser.

Disadvantages are:
(1) Bagasse of higher moisture content is fed to boilers. (2) Greater time lag in bringing bagasse from storage bin to boilers following a mill stoppage.

System 2 Has the prime advantage of maintaining a constant supply of bagasse to the boiler.

Disadvantages are:
(1) Due to varying properties of bagasse, it is difficult to maintain an even feed. (2) Power consumption and, consequently, wear, maintenance and operating costs are greater than with System 1.
Storage Space

At first glance the circular system appears to have considerable waste space relative to more conventional systems. The following table, which gives the percentage of waste space encountered in some typical handling systems, illustrates that this is not the case.

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**Fig. 1—Automatic cylindrical storage reclaim system.**
<table>
<thead>
<tr>
<th>Type of system</th>
<th>% waste space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular bagasse system (NQEA)</td>
<td>53</td>
</tr>
<tr>
<td>Rectangular bagasse system (controlled feed)</td>
<td>77</td>
</tr>
<tr>
<td>Rectangular bagasse system (avalanche feed)</td>
<td>61.5</td>
</tr>
<tr>
<td>Bulk sugar shed (as used in principal Queensland ports)</td>
<td>43</td>
</tr>
<tr>
<td>Calcined bauxite storage (Weipa)</td>
<td>70.2</td>
</tr>
</tbody>
</table>

Fig. 2—Bagasse supplied direct to boilers.

Fig. 3—Bagasse supplied direct to storage.
Circular systems built so far have had controlled feed without avalanching—i.e. stacking is done within the repose angle so as to give a more uniform feed rate.

A circular storage bin has the following advantages over a rectangular system:

1. No ends of building to incur waste space.
2. The void central section of the storage capacity to accommodate the reclaim stacker arms occupies only one-third of the cylindrical level volume.
3. Capacity rapidly increases with small increases in diameter. Figure 4 shows these capacities for varying densities of bagasse.

**Structural Considerations**

The support structure for the entire rotating system has been designed to withstand a fully stalled reclaimer on one side combined with maximum out-of-balance loading. To provide the required stiffness to achieve control of the system, the lateral deflection at the bottom of the rotating system was maintained at 0.002 of the diameter, and it is considered that this figure is by no means conservative. To obtain such limits the slew bearing used is of a pre-stressed type, and this allows no rocking movement whatsoever.

**Internal Drives**

Both the stacker reclaimer units and the rotating drive are driven by low-speed, high-torque hydraulic motors, so that fully stalled conditions of either drive can occur while maintaining full torque to the drive. In this way, the operation can continue immediately the automatic sensing gear has varied the attitude of the reclaimer arms to relieve the stalled condition. Hydraulic motors are suitable for operation without difficulty in dusty, humid conditions.

**Control Systems**

The circular system is simple to automate. The rotating arms and stacker reclaimers are kept at constant speed in the one direction. The attitude or depth of cut or clearance above the bagasse stack is controlled by the hoist on signals from a belt sensor situated above the bin outlet conveyor, and after the mill feed point on the boiler feed conveyor for system (Fig. 1). The principle used relies on raising or lowering the stacker reclaimers to give a constant feed rate to the boiler regardless of the surplus return. The reclaim rate is therefore set at maximum boiler demand. Should a continual surplus be obtained, the set point (control of depth of cut from stock pile by the reclaimers) can be adjusted manually.

**Sensor**

The actual sensor system used incorporates a set of trailing fingers over the belt actuated by the varying depths of bagasse on the belt. The sensor is coupled to a linear transducer, the output of which is compared against a manually adjustable potentiometer (set point) incorporating a solid state circuit which then signals the hoist to either raise or lower the reclaimer arms depending on the depth of bagasse on the belt and that depth required. The hoist operation is limited to a set time, generally one to three seconds, and a further timer allows the hoist to be operated at intervals of 30-150 seconds, so as to give incremental movement to the
Fig. 4—Nett capacity circular bin fitted with rotating stacker reclaimed

Bagasse Density On Conveyor Belt

\[ = 104^\circ - 120 \text{ Kg/m}^3 \]
stacker reclaimer arms and prevent hunting and the development of an uneven surface to the stock pile. The two hoist timers are adjusted to suit the system, the length and speed on the conveyors having a function on control. The set point is available for manual adjustment in the boiler house control centre.

Conclusions

The circular system is relatively simple to automate, and evidence is available that little difficulty is encountered in maintaining fully automatic operation.

With the recent trend towards energy conservation, and the recent fuel price rises, larger storage capacity could be a proposition. As capacities increase, the cost of cylindrical bagasse storage becomes lower than that of equivalent conventional rectangular storage for the 600 to 2000 tonne range. A disadvantage of the system is the difficulty of expanding the capacity at a later date. Nevertheless, it should be possible to calculate what fuel reserves are required for boiling out, minor mill stoppages and start up, then build accordingly.

Three systems are already in operation and two systems of 1000 tonnes capacity each for Inkerman and Babinda are under construction.

Acknowledgements

The author thanks the management and engineers of the mills where cylindrical systems are now working: Kalamia Estate, Haughton Sugar Co. and Mulgrave Central Mill.

REFERENCES