

FLANGELESS TOP ROLLERS AT TONGAAT

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Abstract

A brief history is given of the development of flangeless top rollers at the Tongaat Sugar Factory. Costs and maintenance are considerably lower than on conventional flanged top rollers. Description of design and performance are given of the "dummy flange" versus conventional top roller flange.

Introduction

Tongaat factory incurred considerable lost time and high costs from broken flange bolts with resulting buckled top roll flanges on the larger milling train (2 100 mm "Maidstone tandem"). Ideas were considered either for improving the design of the flanges or even the complete elimination of these high maintenance items.

It was observed that the fixed stainless steel plates outside the pressure feeder rolls in the five-roll Walkers mills served exactly the same purpose of containing the cane between the pressure feeder rolls as did the flanges in containing the cane between the top roll and the feed roll, trashplate and discharge roll in the conventional three roll mill. Wear on these stainless steel side plates was not excessive and the fact that the plates were stationary did not cause any tendency to choke.

It was decided in 1970 to design and fit a set of fixed "flanges" to the mill which was causing most problems with breaking flange bolts, namely the final mill on the Maidstone tandem. This is a pressure-fed Walker mill, and a set of fixed flange plates for this mill was therefore prepared for installation during the 1971 off-crop.

However, when good rains resulted in an increased crop estimate for the following season, the chief engineer decided to defer the test rather than risk a disastrous start up, so no changes were made to the mill that off-crop.

First installation

During the following season (1972), it was decided to conduct the first tests on one of the intermediate mills rather than the final mill. There were four reasons for this decision:

- (1) These intermediate mills are of the conventional three-roll mill type, fitted with a light underfeed drum. The pressures generated over the trashplate and between the top and two side rolls on this mill are not as high as on the pressure-fed mill, so that if wear was to be a problem it would not be so severe.
- (2) If choking were to result, the effects on the pressure-fed mill would be far more severe, almost certainly resulting in a burst pressure feed chute.
- (3) Should the experiment fail and serious damage to the mill result, the experimental mill could be by-passed while extensive repairs were undertaken. The final mill could not easily be by-passed as the loss of this powerful unit at the end of the train would result in high bagasse moistures.
- (4) There would be an additional benefit from flangeless top rolls on the conventional mills, in that drainage of surplus juice from above the top roll would be made easier. The flanges normally dam up a pool of juice between the Donelly chute and the top roll, and with

high imbibition levels this juice dams up so much that it spills over the top roll back into the bagasse discharged from the mill. This is not a problem with the pressure-fed mill where there is ample drainage for the juice from in front of the top roll.

Tongaat's first "flangeless top roll" was therefore installed during the following off-crop on a conventional three-roll Mirreles mill, fitted with a Donelly chute and underfeed drum. The design of the "dummy flange" is illustrated in the sketch (see Fig. 1).

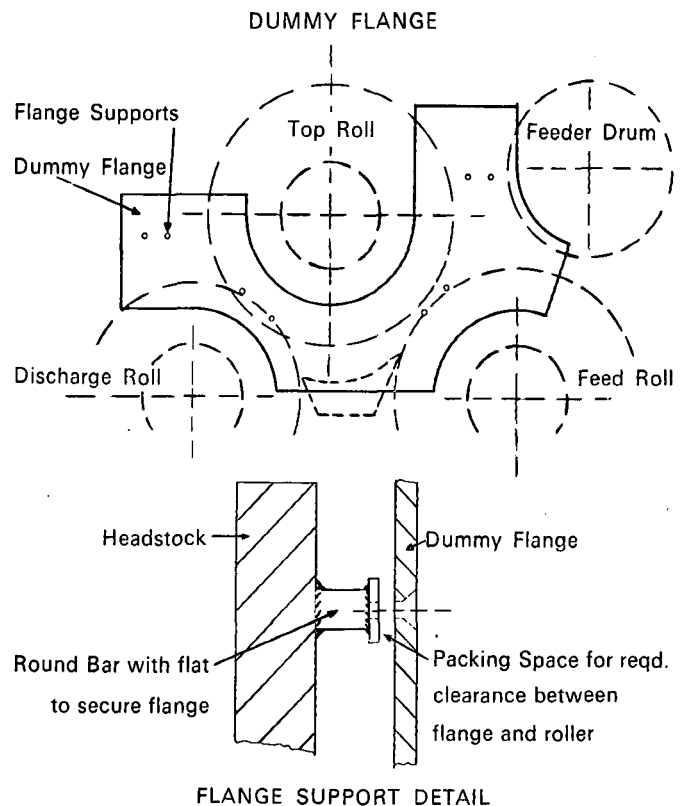


FIGURE 1

Experimental results

The uncertainty and apprehension felt by many people proved to have been unnecessary. The trial was an immediate success and the following observations could be made from the first season's operation:

- (1) The mill feeding characteristics were completely normal and no chokes occurred.
- (2) After about five weeks of operation the top roll was removed from the mill and it was noticed that some of the mounting brackets (supports) by which the fixed flanges were attached to the mill cheeks had bent. These brackets were therefore strengthened and no further mechanical problems were experienced.
- (3) The mild steel "dummy flange plates" fitted were heavily worn only at the high compression zones between rollers. The depth of wear at the end of the first ten month season was approximately 12 mm at the deepest point. The total area of heavy wear was about 75 mm x 100 mm at each of the high pressure zones between rolls.

- (4) The worn areas of the "dummy flange plates" were easily repaired by building up with electric welding. Stainless steel was used for the building up, and the repaired areas were afterwards hand-ground to reasonable smoothness.
- (5) A certain amount of wear (about 3 mm) occurred on the ends of the roller shells where they passed next to the fixed "dummy flange plates". This appeared to cause no problems and no repairs were made even to roll shells that were to be re-used the following season. Wear on the ends of the trashplate was normal.
- (6) Drainage of the pool of juice above the top roller was, as expected, greatly improved. However, at high imbibition levels (280% on fibre) this juice still sometimes spilled over the top roll.

As a result of these favourable observations, it was decided to proceed with the conversion of the other mills on the tandem to the "flangeless roll" design, altering two mills a year.

Discussion

1. The author is convinced that the breaking of flange bolts with conventional flanges is not caused by the sideways pressure of the cane being extruded between rollers. The deep grooves on the rollers effectively contain the bagasse and prevent extreme lateral pressures against the flanges. A much more likely cause of breaking flange bolts is roller misalignment, resulting in either the feed or discharge roll (or possibly even the trashplate) thrusting directly against the flange on the top roll. The forces from this can easily be sufficient to break even high tensile flange bolts.

The roller misalignment can be caused in various ways. With worn roller bearing fillets, a feed roll can be forced sideways by tramp iron in the trashplate (or the trashplate itself can be forced sideways against the flange). Even more likely is that the separating forces in the drive coupling could force the top roll away from the drive side.

Yet another common form of misalignment is that resulting from canting of an hydraulically loaded roll (usually the top roll). If hydraulic pressures are not properly controlled, or a seal, pipe or valve leaks, or even if the mill is unevenly fed with cane across its width, the floating roll can cant sideways. This canting may itself take up all the available clearance inside the flanges or else it may give rise to large side thrusts from the mat of unevenly compressed fibre in the mill.

Some of these problems do not affect the fixed "dummy flanges", but to allow for some misalignment, it was decided to fit the "dummy flange plates" approximately 4 mm clear of the rolls. This has proved sufficient to avoid any mechanical problems but has not resulted in dropping bagasse.

2. The stationary "dummy flanges" eliminate the need for noseplates, as the sideplates of the Donnelly chute can be attached directly to the "dummy flange".

3. At the time of writing, a hard surfacing overlay as the final layer of built up material on worn "dummy flange plates" is being tried for the first time on five mills. It is expected that this will result in considerably reduced wear during the 1977-78 season.

4. The maintenance savings alone (flanges, high tensile flange bolts 36 off 115 mm x 40 mm diameter per top roll, saving on drilling and tapping new top roller shells) fully justify the decision to convert the mills to fixed "dummy flanges".

5. In addition to the maintenance savings, better juice drainage has been achieved. This has not only resulted in less juice spilling over the top roll and perhaps being reabsorbed in the discharge bagasse, but, by reducing the pool of juice trapped over the top roll, appears to have improved the feeding of the mills. It is thought that the pool of juice over the mill tends to "float" the cane coming down the Donnelly chute and so destroy some of the feeding force which would otherwise be caused by the chute.

6. A point which may have contributed to the success of the fixed "dummy flange plates" at Tongaat is that the width of the Donnelly chutes feeding the mill is approximately 50 mm narrower than the roller length. This was done to improve side drainage when conventional flanges were still being used, and the chutes have not been widened for the fixed flanges. This is obviously likely to reduce compression slightly at the sides of the mill which will have a slightly adverse effect on extraction but a beneficial effect on flange wear, whatever type is used.

7. Numerous visitors to the Tongaat factory during the 1974 ISSCT Congress expressed great interest in the flangeless top rolls as a solution to problems in their own factories.

Gledhow Mill experimented at about the same time as Tongaat, and it is also learned that the idea is being considered and may by now have been tried in Australia (it in fact originated from observation of an Australian pressure feeder), but as far as is known no other experiences have been published.