MAIDSTONE MILL FACTORY OPTIMISATION: USE IT OR LOSE IT

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Abstract

Maidstone mill cane estimates have reduced drastically over the past few years from a design capacity of 2.4 million tons cane crushed to below 1 million tons cane crushed in 2009. This has resulted in changes in both mindset and in operation of the factory. In this regard, the mill has taken into consideration its existing capacity and has downsized to compensate for the reduction in throughputs.

The changes have reduced residence time and improved exhaustions in the raw house. In addition, more focus has been placed on attention to detail with respect to optimisation of operations throughout the factory. The evaporation and crystallisation stations were re-configured to cater for the lower throughputs, and this has decreased undetermined losses, improved exhaustions and increased productivity.

This paper outlines the changes made and evaluates the effects it has had on performance criteria in the factory. It further highlights the need for flexibility in a modern sugar factory.

Keywords: cane estimates, optimisation of operations, residence time, capacity, exhaustions, performance criteria

Introduction

In 1995, Maidstone mill was re-designed to operate two diffusers in parallel at 440 tons cane per hour (tch), producing over 148 000 tons of raw sugar for consumption. The evaporation station was comprised of two trains of quintuple effect vessels that processed syrup at 85 tons per hour (tph). Vapour 1 was used as the heating medium in the factory. The syrup was crystallised in the pan floor utilising seed pans and continuous pans for A, B and C boilings respectively.

The A-massecuite was allowed to further crystallise in a series of 20 water-cooled horizontal crystallisers, totalling a volume of 640 m^3. The massecuite was cured in six A batch centrifugals producing raw sugar at 45 tph. The sugar was dried using two 30 tph sugar driers and dispatched to the packing station. B-massecuite was produced using a horizontal pan and discharged into two horizontal crystallisers. C-massecuite was discharged from the continuous pan into a series of five horizontal crystallisers, then pumped into the vertical crystallisers. Continuous centrifugals were used to cure C-sugar which was remelted and pumped to the syrup tank.

Changes in operational philosophy

As a result of the dwindling cane supply (Figure 1) Maidstone mill was forced to re-look at the equipment configuration and attempt to optimise operations to improve performance criteria.

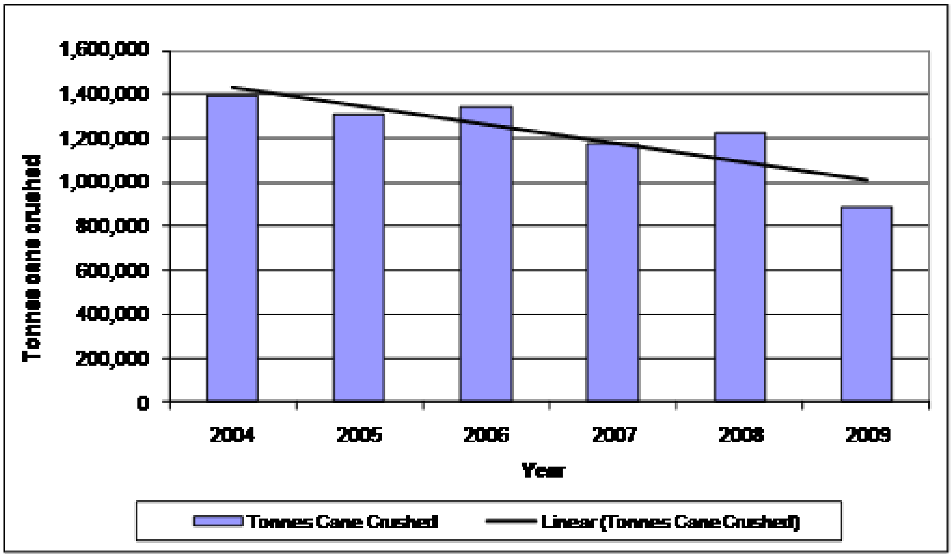

Figure 1. Tons cane crushed, 2004 to 2009.

Table 1 depicts the change in capacity of operating equipment from a crush rate of 440 to 260 tons cane per hour. Table 2 outlines the retention times for the respective boilings.

Table 1. Change in equipment capacity.

Equipment in operation	440 tch	260 tch	Percentage drop (%)
Kestners	3	2	33
Evaporators	10	6	40
A-seed pans being utilised	5	3	40
B + C-seed pans being utilised	4	3	25
A-crystallisers	20	11	45
B-crystallisers	2	2	0
C-crystallisers (horizontal + vertical)	9	4	55
A-centrifugals	6	3	50
B-centrifugals	7	3	57
C-centrifugals	5	3	40
Sugar drier	2	1	50

Table 2. Change in residence time.

Change in residence time	440 tch	260 tch	After crystallisers removed from operation 260 tch
Residence time (h) A-crystallisers	9.2	15.5	9.8
Residence time (h) C-crystallisers	40.0	67.0	41.0

Advantages of the changes made:

- Reduction of evaporator, pan and crystalliser capacities, thus retention times were reduced.
- Improved energy management since fewer electrically driven crystallisers.
- Transfer the major portion of the crystallisation to a better performing pan to improve on quality and exhaustions, thus pans 2, 3 and 4 were not utilised.
- Injection water demand was reduced, thus the performance of cooling towers increased.
- Less maintenance costs on the three batch pans and nine crystallisers.
- Less operational work for staff, thus more focus should be spent on A continuous pan performance and attention to detail.
- Not utilising all available juice heaters and evaporators meant that the vessel cleaning schedule for the evaporators needed to be changed to cleaning one every three weeks and not one every two weeks. This amounted to a savings of over R4500 per month.

Rationalisation of evaporator station

In 2006 Maidstone mill opted to improve on steam economy and began to utilise vapour 2 instead of vapour 1. The diffuser capacity was resized to 385 tons per hour and the evaporator station was reconfigured as per Figure 2.

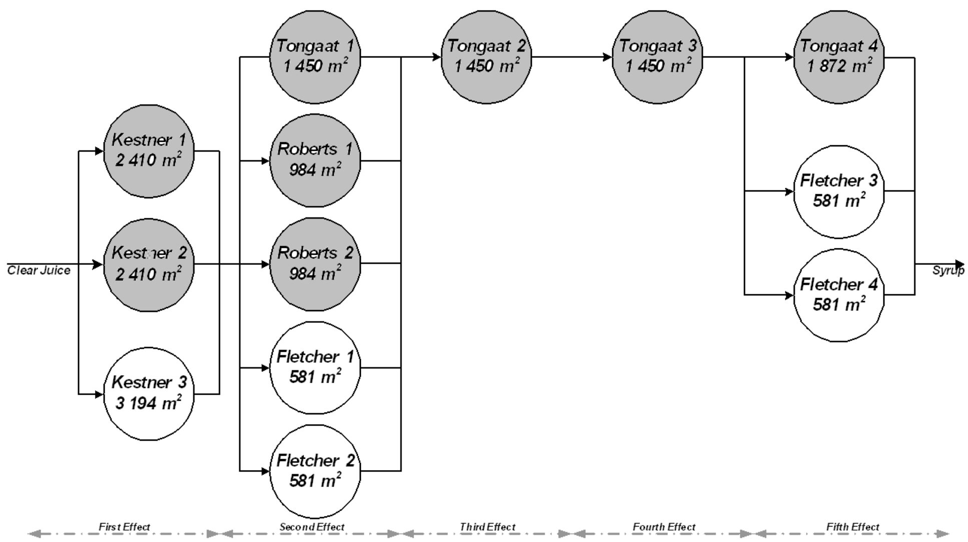

Figure 2. Evaporator station reconfiguration.

However, during off-crop of the 2008/2009 season, flexibility to downsize evaporator capacity was introduced, again due to the dramatic drop in cane supply. One Kestner evaporator, two of the five second-effect vessels, and two of the three fifth-effect vessels were isolated. Flexibility/downsizing was necessary because the lower throughputs resulted in longer residence times in the evaporators, and this resulted in an increase in sucrose inversion prior to the changes being made (refer to Figure 3). Undetermined losses were high at 1.68% and the syrup – mixed juice purity difference showed an urgent need for intervention before more sucrose was destroyed.

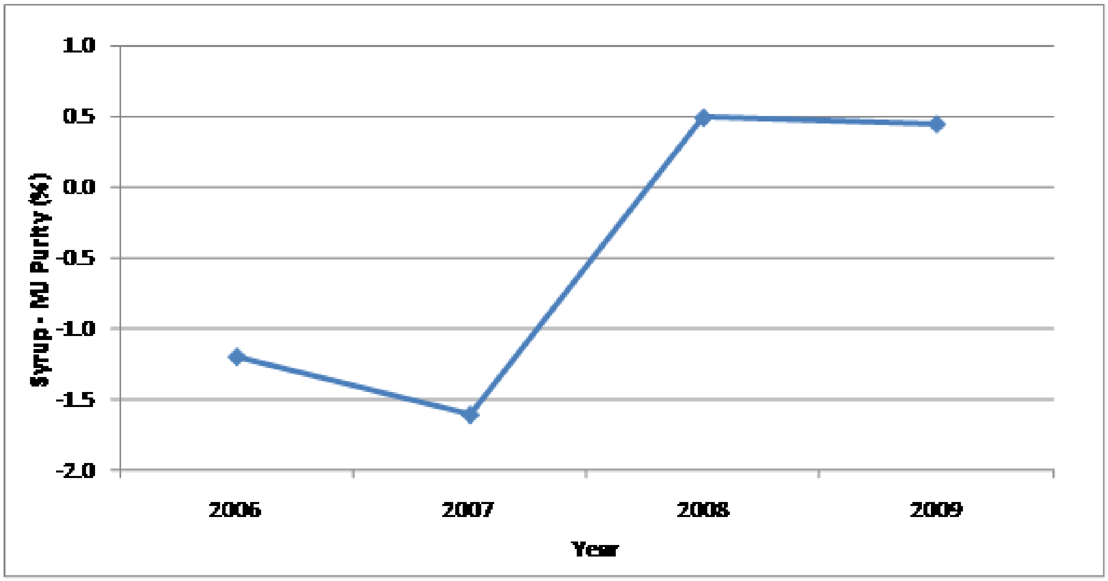

Figure 3. Syrup – mixed juice purities.

Rationalisation of A-crystallisers

As part of the Maidstone efforts to further rationalise equipment, nine A-crystallisers were removed from duty on 28 August 2009.

Figure 4 (red blocks) depicts the bank of crystallisers (i.e. AA1 to AA9) which were liquidated and removed from operation.

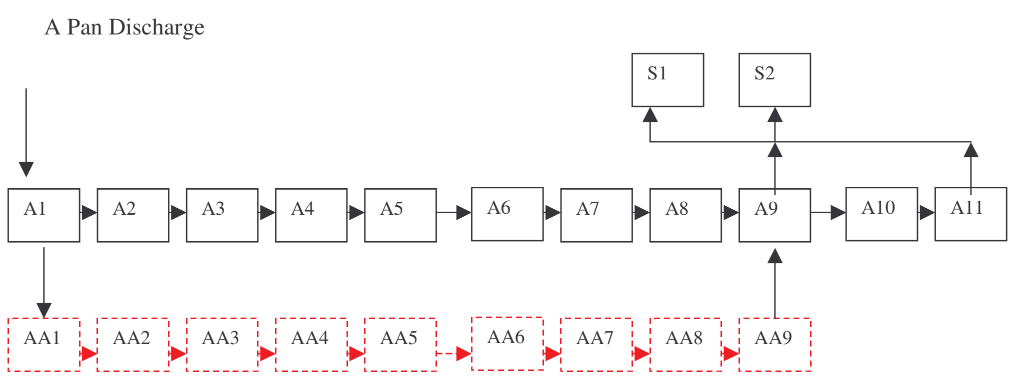

Figure 4. A-crystalliser layout.

The consequence of this change was that the A-exhaustion improved as per the Figure 5. This improvement in A-exhaustion is attributed to the following:

1. The initial layout (prior to removing the crystallisers) allowed for high retention times. This increased the massecuite viscosities. Hence, to make the A-massecuite more manageable for curing, dilution water was added to the last crystallisers feeding the A-centrifugals. This negative effect on A-exhaustion was eradicated when the bank of crystallisers were removed.

In addition, the cooling water on elements of the crystallisers were shut, to improve the curing ability of the A-massecuite. The cooling water was again turned on, when the bank of crystallisers were removed. This improved exhaustion.

2. The removal of the bank of crystallisers also allowed for reduced seasonal maintenance costs.
3. Electricity costs were reduced due to nine drives not turning. The approximate saving per drive is R68.40 per day.

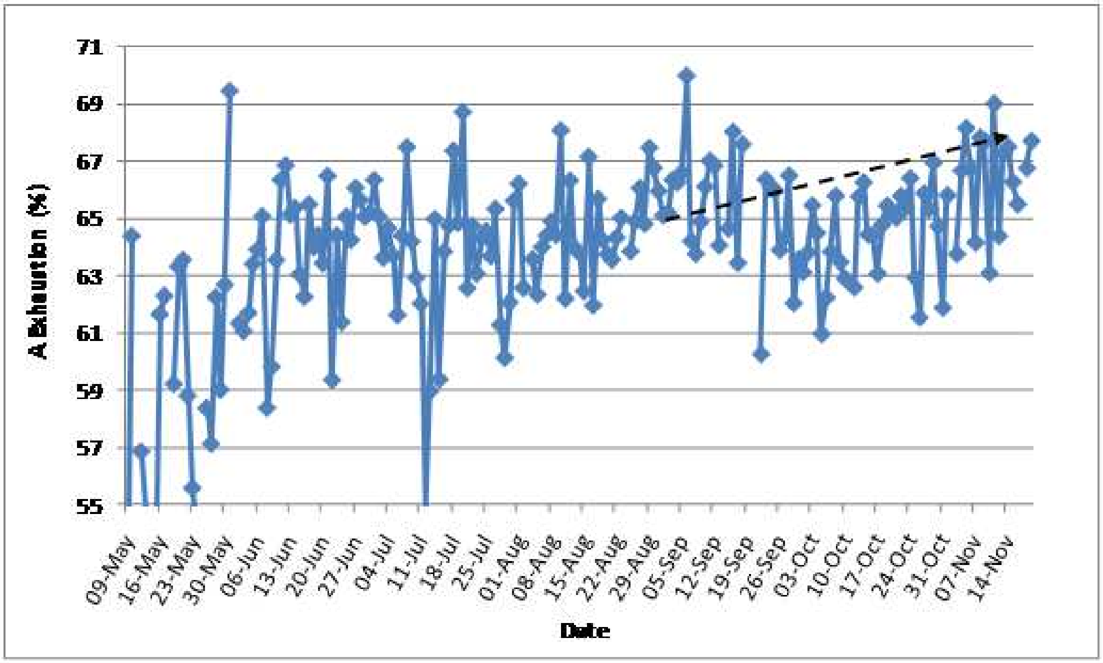

Figure 5. A-exhaustion, 2009 season.

Rationalisation of C-station

As a result of increased sucrose losses in final molasses from 2006 to 2008, as can be seen from the target purity difference (TPD) data in Figure 6, the C-station became a major focus area.

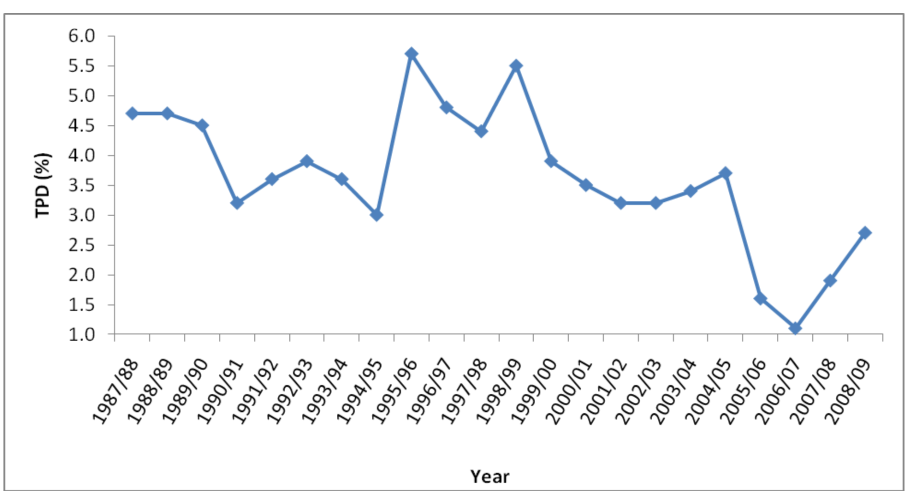

Figure 6. Target purity difference (TPD) at Maidstone mill.

Retention time was reduced on the C-station by removing five of the horizontal crystallisers, thus decreasing viscosities of the massecuite. The fluidity of the massecuite increased thus there was no need to add water in the crystallisers, to lower C-massecuite Brixes or to increase reheater temperatures. The C-massecuite was also found to be over-heating across the pump and thus destroying sucrose. More focus was placed on B and C-seed graining and quality of crystals being produced. Slurry preparation was fine-tuned and staff operations improved. All of the above factors contributed to a significant improvement in TPD, as shown by Figure 7.

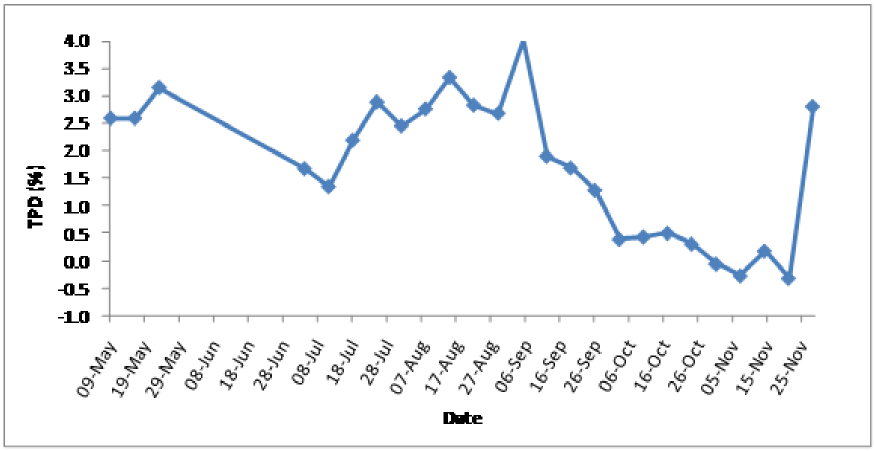

Figure 7. Improvement in target purity difference (TPD) at the end of 2009 season.

Conclusions

Significant decreases in TPD and undetermined losses were evident over the past few years as a result of changes made in factory operations and efficient utilisation of available resources (Figure 8). Focus has now been placed on further improvement in corrected reduced boiling house recovery (CRB) and sugar quality.

Like other industries, it is vital that modern day sugar factories be flexible in the event of dwindling cane supply. Efficient asset utilisation will ensure improved technical and financial performance.

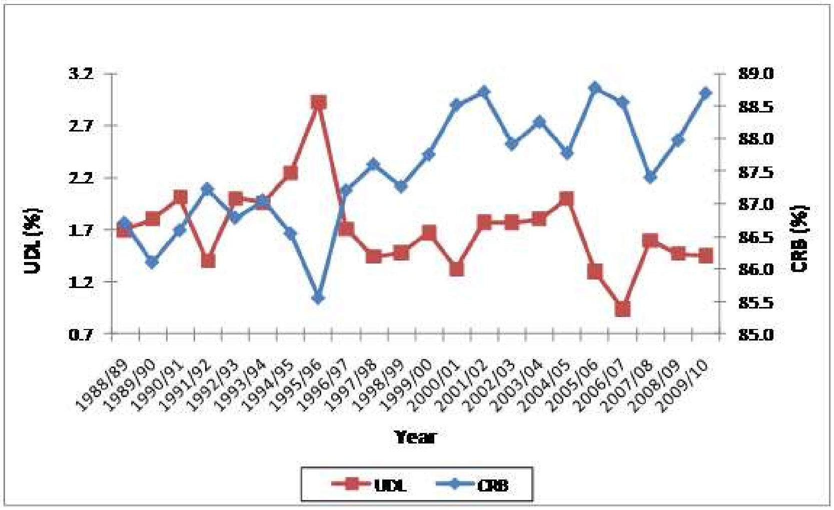

Figure 8. Improvement in factory performance.

Acknowledgements

The authors would like to place on record their sincere thanks and appreciation to Maidstone mill management for allowing publication of this information, Maidstone mill staff for their efforts and determination to improve operations, and George Govender and Nomusa Nyirende for collection of performance data.