

STEPS TAKEN AT SEZELA SUGAR MILL DURING 1988 CRUSHING SEASON TO REDUCE BAGASSE MOISTURES

Author: J. P. Hulley

C G Smith Sugar Limited: Sezela Factory

Abstract

Historically, unacceptably high final bagasse moistures have been achieved at Sezela, with the exception of the 1984 crushing season. Unfortunately, due to staff changes and poor record keeping, the expertise and experience that produced the 1984 results were no longer available to Sezela.

This prompted extensive investigation to ascertain what the causes of the unacceptable bagasse moistures were. This paper discusses the various steps taken at Sezela to decrease bagasse moisture from about 51% at the start of the 1988/89 season, to about 49% towards the end of the season.

Introduction

Various steps were taken at Sezela to reduce the bagasse moistures from the 51% weekly averages achieved during the 1985 - 1987 seasons to the 49% weekly averages currently being achieved.

Improvements made in the following areas contributed towards better bagasse moistures and these improvements are discussed in this paper.

- Basis upon which to calculate initial mill settings and an overview of the moistures obtained for the season
- Pressure chute settings
- Mill speed
- Trashplates and scrapers
- Cane preparation
- Attention to detail

In order to provide an idea of the extraction plant and, in particular, the dewatering mills at Sezela, brief descriptions are given.

Description of plant

There are two extraction lines which are similar in construction and each consists of the following equipment. The two lines are referred to as the East and West Lines.

Cane Preparation

One 200 kW electric motor driven primary leveller knife set comprising 18 knives

One 500 kW electric motor driven secondary leveller knife set comprising 40 knives

One 1040 kW turbine driven main knife set comprising 72 knives (all the above knife elements are of the fixed palm configuration)

One 1840 kW turbine driven Smiths shredder, designed to operate with 200 hammers, currently being operated with 100 hammers.

Diffusion

One 250 ton/hour Egyptian type B.M.A. Diffuser per line.

Dewatering mills

Two 42 × 84" pressure fed Walker dewatering mills in parallel fed by chain slat carriers. The mills are driven by 560 kW Worthington multistage tubines via primary, secondary and final drive gearboxes. The pressure feeder and mill are driven via the same final drive gearbox. The top and feed roll positions are fixed while the hydraulically loaded discharge roll is able to float during operation, depending on mill and hydraulic loading.

Improvements

Basis for mill settings

The traditional calculation for obtaining a mill setting or work opening (setting during operation, including float) is as follows:

$$\text{Work opening} = \frac{\text{kg fibre per minute} \times 1000}{\pi \times \text{mean roll diam. (m)} \times \text{roll rpm} \times \text{fibre fill (kg/m}^3\text{)} \times \text{roll width (m)}}$$

Instead of using "standard" fibre fill figures to calculate the required settings the following method was adopted:

- The previous season's weekly average results were reviewed in terms of bagasse moistures, tons fibre per hour, actual settings, and average mill speed at the time of the results being achieved.
- The best moistures were achieved during weeks 21 to 24 of the 1987 season and by substituting actual values into the setting formula for kilograms fibre per minute, mean roll diameters, roll width, roll speed and mill settings, optimum fibre fills were arrived at
- These fibre fills of pressure feeder, 480 kg/m³; feed 680 kg/m³; and discharge 1200 kg/m³ were then used to calculate the 1988 season base settings.

The required throughput per line for the 1988 season was 34 tons fibre per hour, and it was initially estimated that 17 tons fibre per hour would pass through each mill. The following settings were used at the start of the 1988/1989 season:

Pressure feeder	54,3 mm
Feed	47,3 mm
Discharge	26,8 mm

The average combined East and West line moistures for the first 7 weeks of the season were 51,56%. The main causes of this were:

- Excessive roll lifts allowed in the mills during off crop assembly, resulting in incorrect work openings
- Tailbar thrust problems resulting partly from misalignment between the top roll and gearing, causing mills to be bypassed for lengthy periods and resulting in the remaining mill being operated at higher than normal speeds to achieve throughput
- Insufficient hardfacing applied to the pressure feeder rolls before start up due to the likelihood of bursting pressure chutes, which had occurred during previous start-ups.

The best weekly results were achieved at actual fibre fills of pressure feeder 520, feed 730 and discharge 1200, giving fibre fill ratios for pressure feed to feed of 1,40 and feed to discharge of 1,64. This is somewhat higher than the initial calculated fibre fills of 480, 680 and 1200 kg/m³.

Pressure chute settings

During past seasons and the 1987 season in particular, numerous problems were experienced with pressure chutes. Examples of these problems were pressure chutes bursting and inability to arc pressure feeder rolls adequately due to abnormally high chute deflections occurring, which resulted in poor mill feeding and consequently high bagasse moistures and low fibre throughputs.

An important feature of the pressure chute is that a minimum divergence from inlet to outlet of 3,5° be maintained. Although the Sezela pressure chutes conformed to this Walker standard when under no load, it was discovered halfway through the 1987 season that while under load the divergence was being reduced to as little as 2°. This was due to the slotted bolt holes in the top and bottom covers having become worn, and allowing the chute to alter its position under load. During the 1988 off crop, the chute top, bottom and side plates were refurbished to overcome this problem. A schedule has been implemented whereby the pressure chutes are checked at the commencement of each off crop to determine whether the refurbishment exercise is necessary. A standard sheet for recording the relevant settings has

MILL SETTING SHEET

MILL NUMBER DATE SETTING TAKEN
 TIME SETTING TAKEN

PRESSURE FEEDER SETTING

Setting from tip of bottom pressure feeder roll to bottom of groove of top pressure feeder.

SETTING MEASURED			SETTING NUMBER
G/S	C	P/S	
			1
			2
			3
			4
3/TOTAL = Setting		TOTAL	TOTAL 5/TOTAL

FEED ROLL SETTING

SETTING FROM TIP OF FEED ROLL TO BOTTOM OF TOP ROLL GROOVE

SETTING MEASURED	SETTING NO.					TOTAL	5/TOTAL
	1	2	3	4	5		
P/S							
C							
G/S							
TOTAL						3/TOTAL = Setting	

DISCHARGE ROLL SETTING

Setting from tip of discharge roll to bottom of groove of top roll. Setting from tip of roll to bottom of groove of discharge roll.

SETTING NO.	SETTING MEASURED			TOTAL	3/TOTAL = SETTING	SUM OF THE TWO SETTINGS	TOTAL	SETTING MEASURED			SETTING NO.
	P/S	C	G/S					G/S	C	P/S	
1											1
2											2
3											3
TOTAL 3/TOTAL				TOTAL	3/TOTAL = SETTING	SUM OF THE TWO SETTINGS	TOTAL				TOTAL 3/TOTAL
2 SUM											

Setting taken by

FIGURE 2 Sheet for recording mill settings

been formulated to simplify the procedure for the fitter concerned. This exercise of correcting the pressure chute settings has perhaps been the single most important contributing factor towards our improved bagasse moistures.

Mill speed

Different mill roll speeds seemed to have an effect on moisture results achieved. Due to the East mill drive trains having a slightly higher gear ratio than the West mills, the East mill speeds were generally slower than the West for the same turbine average input speed. Average East mill speeds ranged from 1,25 rpm - 1,5 rpm compared to West mill averages of 1,62 rpm - 1,95 rpm.

It can be seen from Figure 3 that the moistures achieved by the East line were consistently better than the moistures achieved by the West line. Due to the similarity in design, processing rates and operating parameters of the 2 lines, it can be concluded that the slower mill speeds were responsible for the better moistures achieved on East line.

Trashplates and scrapers

It used to be common practice at Sezela to operate trash plates and scrapers until it was no longer possible to continue operating with them, due to the furring of rolls and the spillage of solids into the presswater system.

This practice obviously had a detrimental effect on final bagasse moistures because of the blocking of feed roll meschaert grooves resulting in poor mill drainage. The decision was taken to select a suitable frequency at which to schedule

scraper and trashplate changes. The aim was to optimize trashplate and scraper life without jeopardizing bagasse moistures. The season commenced with trashplates being replaced every 4 weeks and scrapers every 8 weeks. The method of taking up free play in the trashplates was changed towards the end of the season from flogging to hand tightening with a spanner, and the interval between changing the trashplates subsequently improved to 6 weeks.

Experiments are being conducted with trashplate materials and methods of installation to try to improve their life.

Cane preparation

Various improvements were made in this area during the 1988 season which are believed to have assisted in obtaining lower bagasse moistures. After comparisons with samples taken from Illovo Sugar Mill, it was decided that the cane preparation by the knives needed improvement. The following changes were then made:

It was clear by observing the nozzle box pressure on the cane knife turbines that there was a large amount of power in reserve, and therefore it was decided to start improvements in this area. The main knife length was increased by 50 mm, increasing the tip velocity from 56 m/sec to 59 m/sec and decreasing the clearance between cane knife tip and the carrier headshaft from which it was cutting to 20 mm, which prevented whole stick cane bypassing the knives. The cane knife design was also changed to a hammer-like design by attaching a 50 mm square bar tip to the knife shank as shown in Figure 4. The advantages of this were easier re-

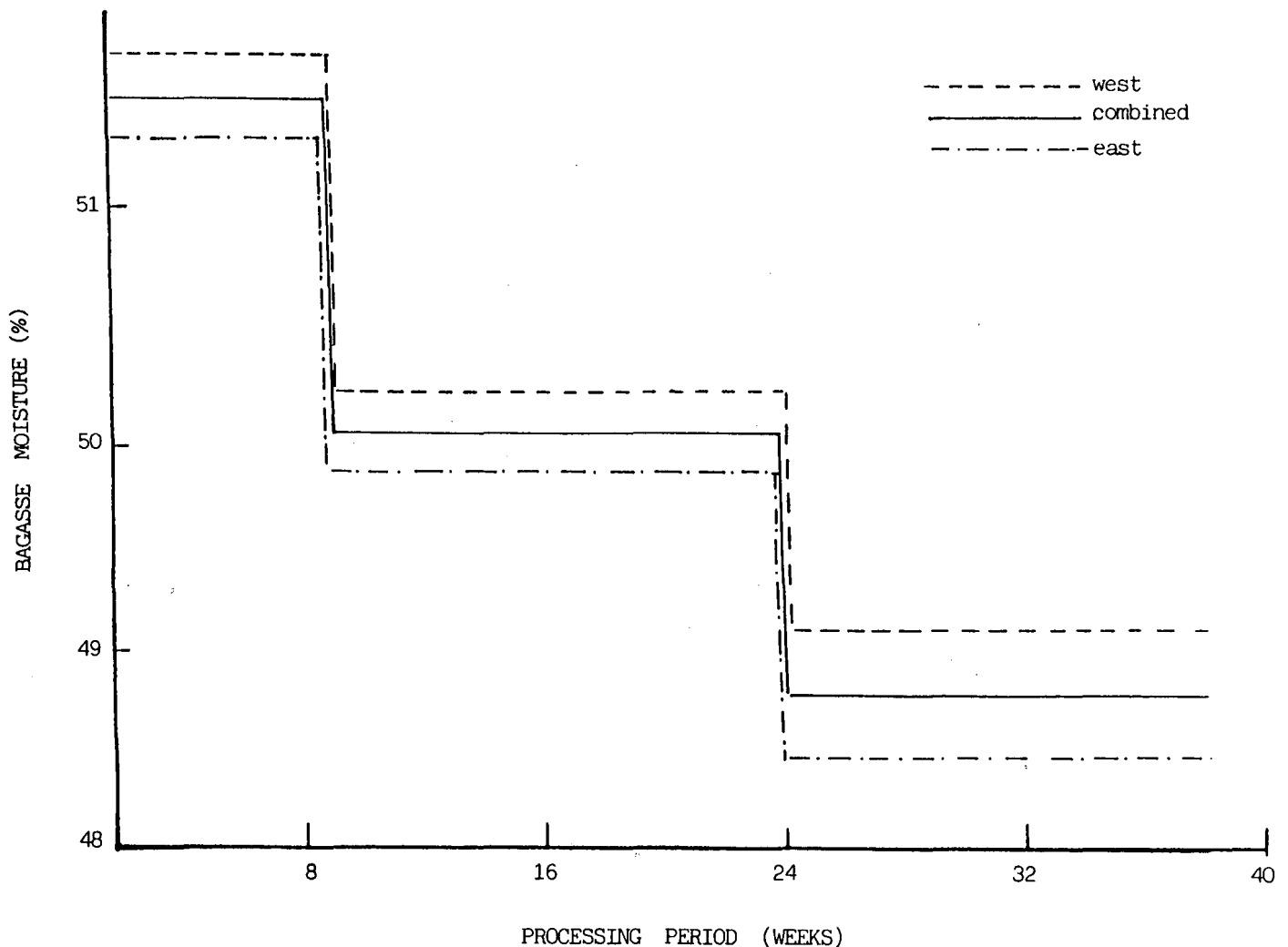


FIGURE 3 Sketch showing the bagasse moisture trend over the season

refurbishing of knives by the maintenance crew and increased cane knife area in contact with the cane, with the emphasis being on shredding the cane rather than cutting it. The main knife set was being operated with half a set of knives installed. This was changed to a full set of 72 "Hammer knives". Various deflectors were modified in the knife house to optimise cane distribution over the belt width to assist with shredding. The secondary leveller knives were extended by 50 mm, increasing tip velocity from 50 m/sec to 55 m/sec and reducing the clearance between knife tip and conveyor belt cutting surface. The knife retained its conventional knife design for cutting.

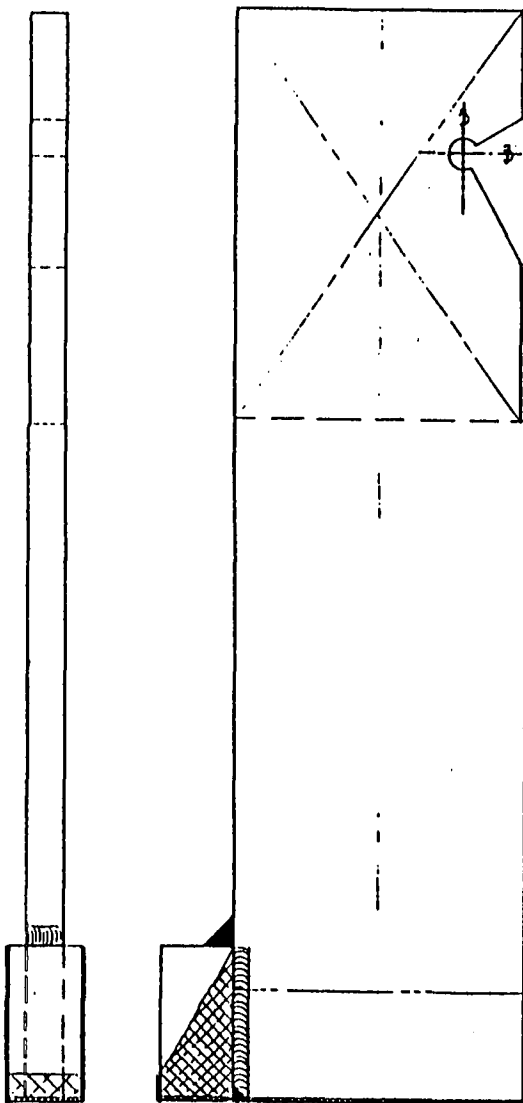


FIGURE 4 Sketch of cane knife element used at Sezela

The clearances between shredder hammer tips and the shredder washboard were reduced until shredder power became the limitation. The washboards consist of 5 anvil bars and were initially set up to be converging with the flow of cane, the top anvil bar to hammer clearance being 16 – 20 mm reducing to a final anvil bar clearance of 1 – 3 mm. It was later found that improved cane preparation could be obtained by having the washboard diverge with the flow of cane with top anvil bar clearances of 2 – 4 mm diverging to final anvil clearances of 8 – 10 mm. Preparation indices of 93 were readily achieved by this method of setting up the washboards.

Attention to detail

There are various parameters that need to be monitored on continuing basis by operations staff if good results are to be achieved.

The most important of these are as follows:

Arcing of Rolls: It is imperative that roll surface roughness be maintained. A smooth roll will affect feeding and consequently the required fibre fills and throughputs will only be obtained by operating the mill at higher than average speeds which will in turn adversely affect bagasse moistures. It is recommended that a record be kept on a shift basis of the number of rods arced on each roll.

Once the required mill and pressure feeder settings are achieved, the amount of arcing applied to the pressure feeder rolls becomes the most important single variable that will affect the load to which the mill is subjected.

General Housekeeping: All juice gutters and troughs need to be kept clear of blockages as any obstruction may cause juice to be diverted to parts of the mill that contain dry dewatered bagasse. It follows that trashplates and scrapers need to be kept correctly adjusted to minimise solids spillage causing juice gutter blockage.

Discharge Roll Hydraulic Lift: Insufficient discharge lift will indicate that the mill is not being sufficiently fed to achieve the fibre fill required at the discharge setting. Another reason for insufficient lift would be an excessive discharge set opening. Both of these conditions will yield higher than normal bagasse moistures.

Mill Performance: Turbine nozzle box pressure, pressure chute deflection and turbine average operating speeds need to be continually monitored to ensure that they are operating between the limits found by experience to give the best results.

Discussion and conclusion

The improvements carried out during the 1988/89 season resulted in bagasse moistures at Sezela being reduced from an average 51,5% to approximately 48,8%. This reduction in moisture is sketched in Figure 3. A number of improvements have been carried out and it is difficult to pinpoint the biggest contributor to good bagasse moistures. However it is believed that correct pressure chute settings have played a very important role.

Sezela exports bagasse and steam to the adjoining by-products plant and burns a large quantity of coal to achieve the required energy demand of the complex. In monetary terms, decreasing the season bagasse moisture by one unit resulted in a saving of about R160 000 in the coal bill alone in the past season. The other benefits of lower bagasse moisture are an increase in extraction and an increase in its value as a feedstock in the byproducts plant, which results in more revenue for the mill.

Finally, there is no "secret-formula" for the obtaining of good results from milling equipment. The application of sound engineering knowledge to the basic requirements is essential, but the real answer is "Attention to Detail".

Acknowledgement

The support and assistance offered by the Chief Engineer and Extraction Department staff of Sezela Sugar Mill are gratefully acknowledged.