

AN EXPERIENCE OF INSTALLATION AND OPERATION WITH FCG TWO ROLLER MILL

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ABSTRACT

The sense of energy conservation and the marathon among the sugar mills to achieve more crushing in minimum time period with good results has compelled them to adopt the latest available technologies. To achieve this purpose, MillMax is installed at Mehran sugar in 2011 off season. The project was monitored at every step to compare its significance and performance with the five roll conventional mill. The power consumption was observed with respect to the crushing rate, samples of the bagasse and juice were thoroughly analyzed to assess the mill performance, the operational and maintenance cost of the mill is also discussed in detail. Low power consumption, low maintenance cost, higher pressure on bagasse, low maintenance cost, easy and smooth operation is the significance of MillMax. The performance of the rigid rollers remained superior to the floating roller. The installation of MillMax is beneficial in terms of crushing, power saving, low maintenance cost and better results.

INTRODUCTION

The significant increase in energy requirement and raw material costs is compelling the sugar industry for enhancement in the crushing capacity. To meet this challenge, in 2010, Mehran sugar decided to add a MillMax to its main crushing plant of 5000 TCD, already equipped with four 5 roller mills of 38" x 78". The decision was taken in the light of power economy against crushing, low operational and maintenance cost and comparatively better results. The following are the significant features of the MillMax.

- ❖ Simple design and easy in operation.
- ❖ Only 2 pressure rollers and one feeder roller.
- ❖ Less component parts, no trash plate and no hydraulic system.
- ❖ Very similar performance to that of a best 5 roller conventional mill.
- ❖ Power consumption, maintenance cost and operation cost is low.

Following topics will be discussed in detail.

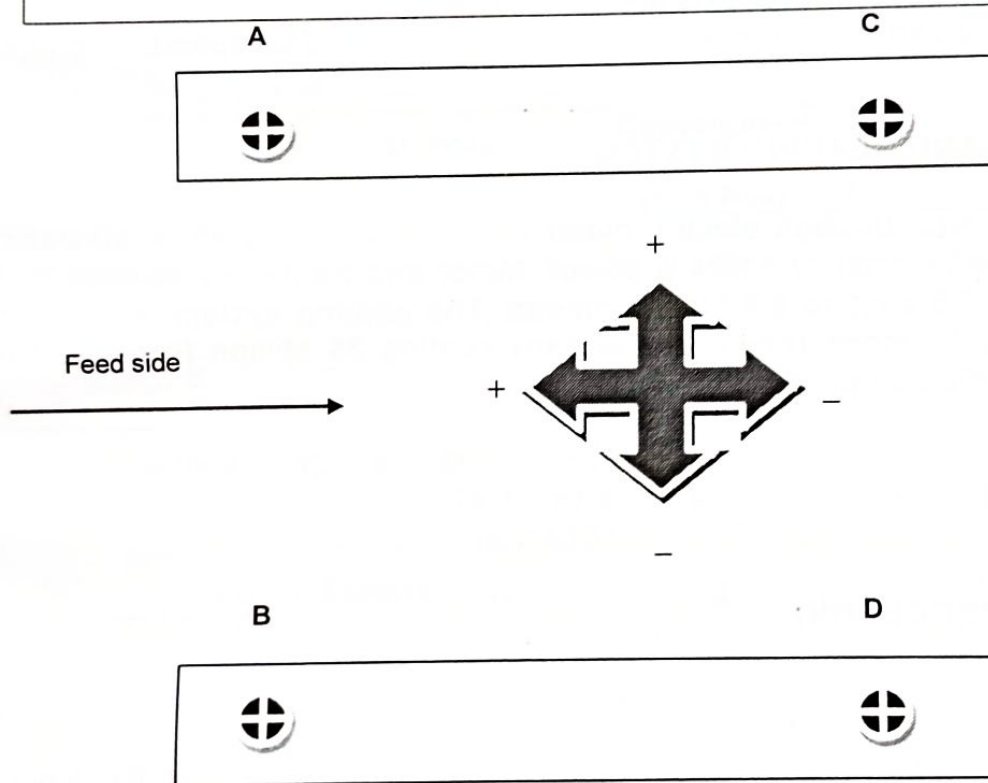
1. Civil foundation of the MillMax.
2. Drive with the gearing system
3. Installation procedure.
4. Operational significance.
5. Comparison of pressure on bagasse in the MillMax and conventional mill.
6. Areas of improvement.

CIVIL FOUNDATION OF MILL MAX

The civil foundation is designed to sustain the loads mentioned in Table-1;

LOADS ON FOUNDATION (daN)				
LOADS LOCATION	A	B	C	D
STATIC LOADS	+ 15500	+ 15500	+ 26550	+ 26550
DYNAMIC LOADS DURING NORMAL OPERATION CONDITION (MILLING)	+ 89650	+ 89650	-105250	-105250

A & B are main frame bolts feed side and C & D are main frame bolts of discharge side.



Chemdur - 42 LP Epoxy Resin is used as grouting agent. Following are the outstanding advantages and benefits of this resin;

- ❖ Solvent free
- ❖ Good flow characteristics even in thin layers
- ❖ Rapid hardening
- ❖ Suitable for both dry and damp substrates
- ❖ Shrinkage free hardening
- ❖ Curing is not effected by high humidity
- ❖ High mechanical strength
- ❖ Tough vibration resistant material.

TECHNICAL DATA

- ❖ Compressive strength 70-85 N/mm² in 7 days
- ❖ Tensile strength 15-20 N/mm² in 14 days

Total cost of the civil foundation was Rs. 5.5 million.
(With out labor charges)

MAIN DESIGN CHARACTERISTICS OF THE MILLMAX²

- ❖ Only two pressure rollers.
- ❖ No trash plate.
- ❖ No hydraulic pressure on top roller.
- ❖ A feeder roller provides correct feeding with suitable compaction to the pressure rollers.
- ❖ A patented device called CAP limits the juice reabsorption.
- ❖ Top roller and bottom roller axis are immovable
- ❖ Cane feeding variations are met by adjusting the rotational speed.

MILLMAX DRIVE AND GEARING SYSTEM

The MillMax is driven through electric motor of 710 k.w having 95 % efficiency through frequency inverter of 810 k.w power. Motor and frequency inverter both are supplied by ABB costing 8.8 Million rupees. The gearing system is compact type, supplied by Siemens (Flunder) Germany costing 38 Million Rupees. The technical data of the compact gear is as under

Input RPM	=	825 -- 1500
Output RPM	=	3.16 - 5.47
Torque	=	707 kN-m

INSTALLATION PROCEDURE

Errection period 22-09-2011 TO 16-10-2011

The installation of the MillMax follows the same procedure as conventional mill but a few steps are:

- ❖ After the safe period recommended for the settlement of grouting material the main frame connection bolts were tightened up to 400 bars hydraulic pressure. After the bolts tightening all the levels of the Head stocks were rechecked against the impact of the bolt tightening.
- ❖ After the satisfaction about the head stock levels, the base plate for the bottom roller in the head stock housing was installed with the packing required for the 49 mm operating gap between the rollers of the MillMax, finally the RLD setting was done.

- ❖ After one week gap the main frame bolts were retightened up to 700 bar hydraulic pressure, the messchaert knives adjustment was the last major activity in the installation of MillMax.

OPERATIONAL SIGNIFICANCES OF THE MILLMAX

Power Saving

The two main reasons why MillMax power consumption is very low are;

1. Fewer number of rollers to be driven (two pressure rollers and one feeder roller)
2. No trash plate (where energy is lost)

The comparison of power requirement of same size (38" x 78") MillMax and conventional 5 roll mill at 5000 TCD is given in Table-2;

Table-2

	MillMax (Two Roll)	Conventional Mill (Five Roll)	Difference
Power (K.w)	210	350	140
k.w-h / tf	7	11.6	4.6

(Data based on average values)

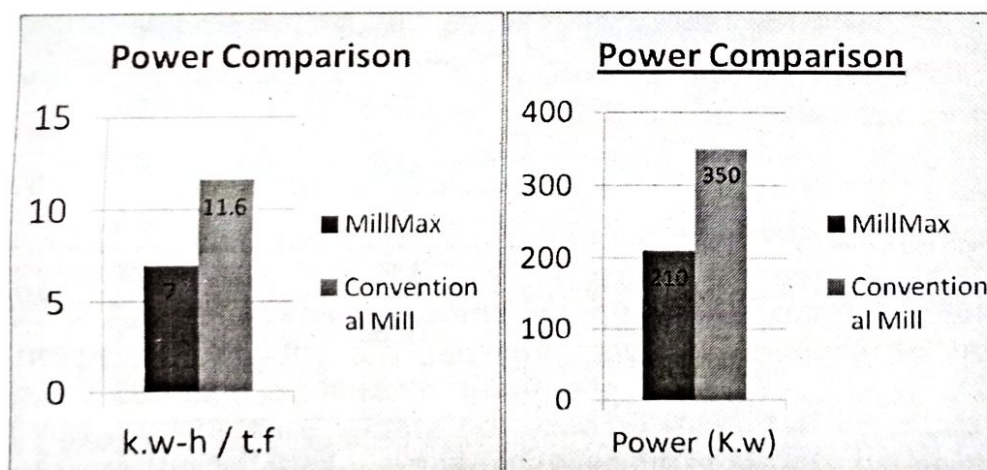


Fig-1, showing graphical comparison of power requirement of MillMax and conventional mill.

LUBRICANT SAVING

High class roller bearings sealing arrangement is provided to protect the wastage of lubricant as well as the entrance of juice and bagasse particles causing scratches on the bearing surface.

Table-3

Mill Type	Lubrication points Nos	Lubricant consumption (mg/h-point)	Total Lubricant (mg/h)
Ordinary six roller Mill	10	90	900
MillMax Two Roller	6	90	540

Table-3. Showing comparison of number of lubricant points and quantity.

The saving of lubricant per day is 8.64 kg.
 For the whole season (120 days) 1036.8 kg
 Saving in rupees. 1,29,600 Rs. @ Lubricant price Rs. 125/kg

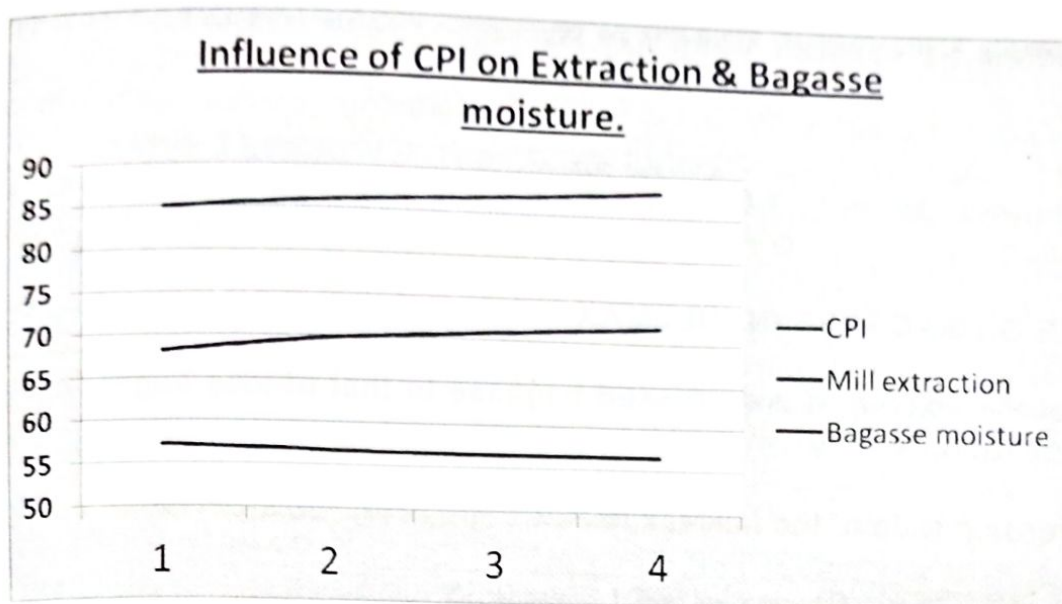
MILL EXTRACTION

The Pol extraction of MillMax is comparable to conventional mill with ideal conditions. Manufacturer claims 75 % extraction with +90 % CPI. Due to some reasons our average CPI remained 88%. The average Pol extraction of the unit remained 70 %. We observed a constant wet layer of discharged bagasse which affected the mill extraction; this has been discussed briefly in the last topic of the article. The results are briefly discussed in the last topic of the article.

Table-4

Bagasse moisture	Mill extraction	CPI
27.25	68.71	88
28.5	70.96	88
27.25	68.50	88
28.5	71.88	88
28.97	71.31	88
28.67	68.69	88

Table-4. Showing relation of CPI with Mill results.



Graph-2, showing relation of CPI with mill extraction and bagasse moisture.

COMPARISON OF TOTAL PRESSURE ON BAGASSE

In the conventional mill the compression ratio is flexible. To maintain pressure on the bagasse, top roll takes lift accordingly to adjust the compression ratio corresponding to the hydraulic pressure.

But In the case of Mill Max we have to deal with the rigid rollers, a constant pressure on the bagasse is attained by predetermined compression ratio. The compression ratio is adjusted by the opening of the chute relative to the opening of pressure rolls.

PRESSURE ON BAGASSE IN CONVENTIONAL MILL¹

The hydraulic pressure on the top roller implements through the metallic pistons on the roller journal so the area of the pistons and of the roller journal both counts much to calculate the pressure on the roller.

The two facts should be kept in mind regarding the hydraulic pressure in the mills

1. The same hydraulic pressure in the two different sizes of the mills produce different pressure on the corresponding bagasse, in the larger mill the force applied by the roller is distributed on the larger area.
2. The hydraulic pressure should not exceed 100 - 110 kg/cm² at the roller journal from the point of view of safety and proper lubrication of the roller bearings.

The total hydraulic pressure on the top roller in the 38" x 78" mill installed at Mehran is:

$$F = 357.35 \text{ Tons}$$

Specific hydraulic pressure on bagasse is:

$$\text{SHP} = 186 \text{ kg/dm}^2$$

$$\text{Pressure on roller journal (460 x 570 mm)} = 68.14 \text{ kg / cm}^2$$

PRESSURE ON BAGASSE IN MILLMAX

The ratio of the volume of compressed bagasse to that of loss bagasse is called compression ratio.

The compression ratio of the MillMax is:

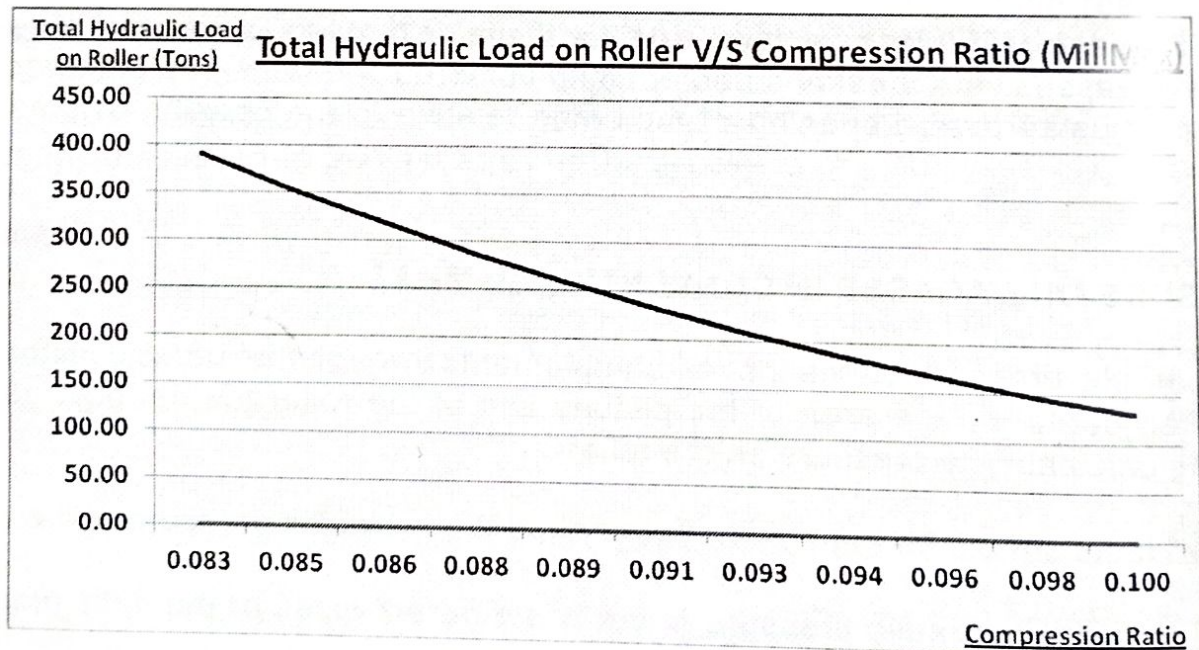
$$C = 5 / 60 = 0.08$$

The total pressure exerted by the roller on the bagasse in tons is:

$$F = 467.2 \text{ Tons}$$

$$\text{SHP} = 245 \text{ kg/dm}^2$$

$$\text{Pressure on roller journal} = 89 \text{ kg / cm}^2$$



Graph-3, showing relationship of compression ratio with the total load on roller.

The comparison shows that the pressure exerted on bagasse by the top roller in MillMax is 1.3 times greater than the conventional mill.

The analysis of the power consumption, lubricant consumption, milling results, and pressure on bagasse proves the ascendancy of MillMax over conventional 5 roll mill.

MAINTENANCE COMPARISON

Less component parts of the MillMax reduces not only the maintenance cost but the maintenance time as well. Table-5 describes the comparison of maintenance cost details, excluding labour cost. MillMax saves about 31% maintenance cost than the conventional 5 roll mill.

Table-5

	MillMax	Conventional mill	
Maintenance activity		Trash plate replacement and hard facing	
	Messchaert knives	Scrappers replacement 2 No	
	Nose plates replacement	Nose plates replacement	
		Hard facing of fixed top collar	
	Arcing of 1 No rollers	Arcing of 1 No rollers	
	Life reduction cost of 4 Bearings	Life reduction cost of 6 Bearings	
	Life reduction cost of 2 Mill Pinion	Life reduction cost of 3 Mill Pinion	
	Roller re shelling (2 rollers)	Roller re shelling (3 rollers)	
	Total Cost	8,62,500	Total Cost 12,50,000

AREAS OF IMPROVEMENT

Beside the better performance MillMax still requires improvement to overwhelm some critical issues, which are discussed below;

1- Problem

A layer of wet bagasse about 50 mm thick on the bagasse blanket was observed, which indicates the reabsorption.

Cause

The extracted juice flow towards the low pressure zone at the delivery side, through the messchaert grooves of the Top roller and is reabsorbed by the expanding bagasse before reaching to RLD. The analytical results of wet and dry bagasse are given in

Table-6.

Wet Bagasse		Dry Bagasse		Composite Bagasse		
Moisture %	Extraction %	Moisture %	Extraction %	Moisture %	Extraction %	CPI
61.00	63.70	56.00	69.80	56.50	70.96	88
60.50	64.50	55.80	73.50	56.50	71.88	88
60.80	62.40	55.30	71.80	56.97	71.31	88

It is obvious from the data that the wet layer of bagasse is affecting the mill results.

POSSIBLE REMEDY:

- ❖ The replacement of top roller by lotus roller for better drainage of the extracted juice.
- ❖ Re designing of the messchaert grooves, to allow bagasse compaction in the grooves to stop the flow of juice towards the low pressure zone.

2- Problem

The pressure rollers of MillMax are of immovable axis, so the greatest disadvantage is associated with the passage of foreign material and damage of roller grooves. This also affects mill extraction.

Remedy.

- ❖ The magnetic iron separator is very essential for the protection of the rollers and obtaining results.

DISCUSSION & CONCLUSION

MillMax has proved its competence for reducing power consumption and better results with minimum maintenance, low operational cost and supervision. Though there are some areas that need to be considered for further improvement in results. By and large MillMax is a very attractive choice for addition of mills in a tandem.

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