

ENERGY EFFICIENCY THROUGH MILLING OPERATION & STEAM UTILIZATION IN SUGAR INDUSTRY.

By

Mohammad Sarfaraz Khan

DGM (Technical)

Kamalia Sugar Mills Limited

INTRODUCTION:

In the existing era of cut-throat competition, all other means of controlling production cost is almost saturated except the energy cost. Therefore, energy measures can optimize the plant efficiency up to greater extent.

There are several ways & means which can contribute 15 - 25 % reduction in product cost through energy measures in the existing plants of our sugar industry.

WHY THE NEED ARISES?

- 1) Un-Control able Raw Material cost
- 2) Variation in yearly Cane Crop
- 3) Un-expected escalation of material prices for maintenance, Overhauling & process operational applications.
- 4) Addition of New Factories on same cane production.
- 5) Provision of Power export to National grid, a value added aspect integrated relates with saving of bagasse through energy measures.
- 6) To make sugar industry as yearly units in spite of 120 days season
- 7) Ensure, Cane is energy crop.

FOCUSING AREAS:

- ⦿ Cane Handling & Preparation
- ⦿ Milling Operation
- ⦿ Imbibition Limitation
- ⦿ Steam Utilization
- ⦿ Control & Measures

CANE HANDLING & PREPARATION

Course heterogeneous cane preparation requires higher pressure in the mill to break the unbroken juice cells. It will require higher mill speed due to lower bulk density. This will increase the re-absorption, power requirement & ultimately affecting the mill extraction.

Therefore, disciplined cane unloading in to the carrier having deep rectangular cross section will results in better bulk density of cane. This will allow to run carrier at low speed ultimately improve cane preparation and ensure reduction in power consumption of preparatory devices. Currently, installations classified are,

1. Unit Cutter plus shredder
2. Multi cutter plus shredder
3. Multi cutters plus Unigrator
4. Unit cutter plus Fibrizer
5. Fibrizer

POWER ASSESSMENT

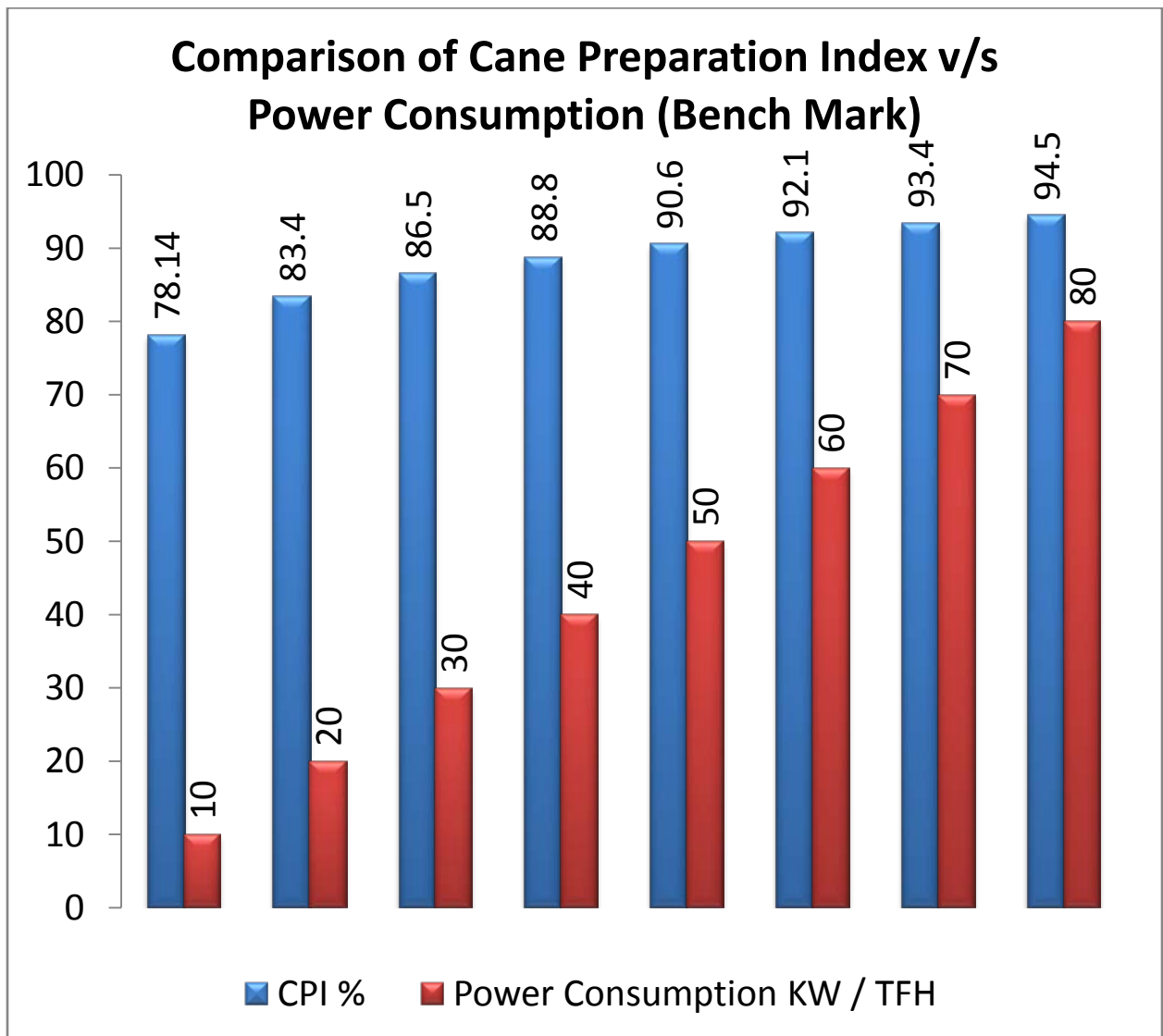
Installed Power ranges 80 – 100 KW/TFH

Power consumption 55 – 75 % of installed capacity (For normal & peak demands)

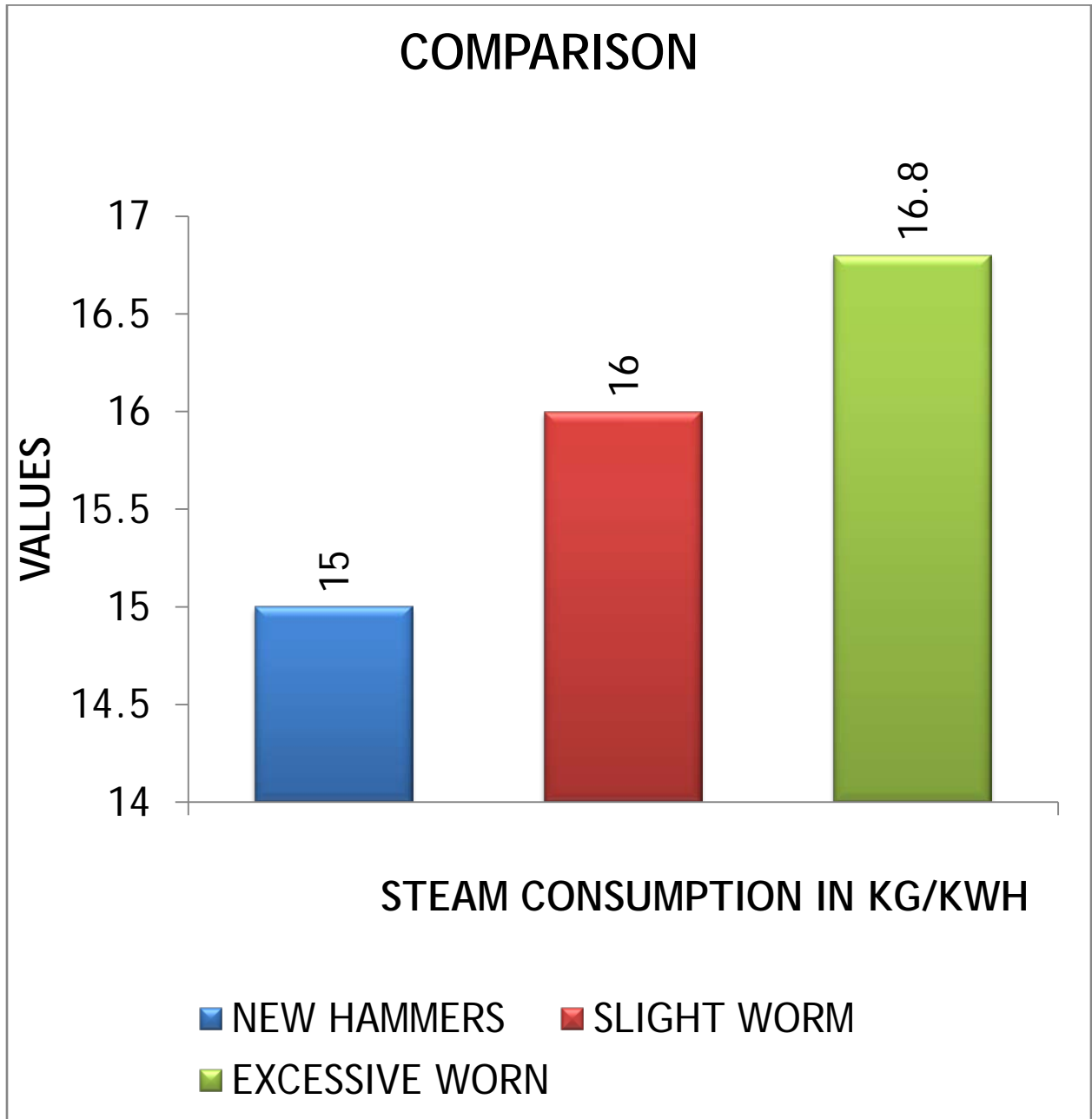
Conventional cutter plus shredder power consumption in ratio of 46 : 54 respectively.

An analysis is followed reflects the relation between Power & Cane Preparation Index and subsequent assessment that how much power beneficent to attains CPI.

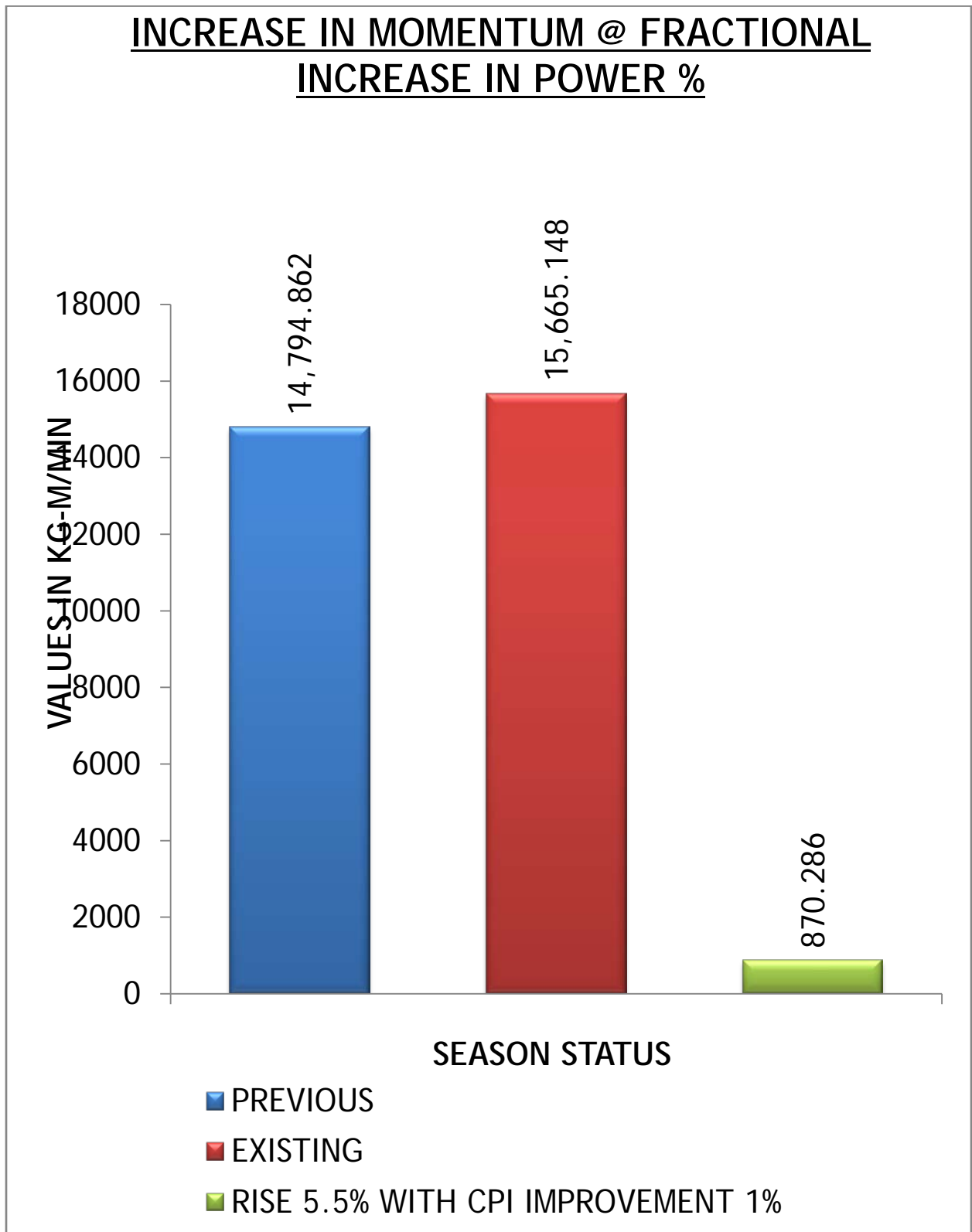
COMPARISON OF CANE PREPARATION INDEX V/S POWER CONSUMPTION (BENCH MARK):



ASSESSMENT OF ENERGY CONSUMPTION WITH HAMMERS PROFILE (COMPARATIVE FIGURES OF UNIT STEAM CONSUMPTION IN KG / KWH):



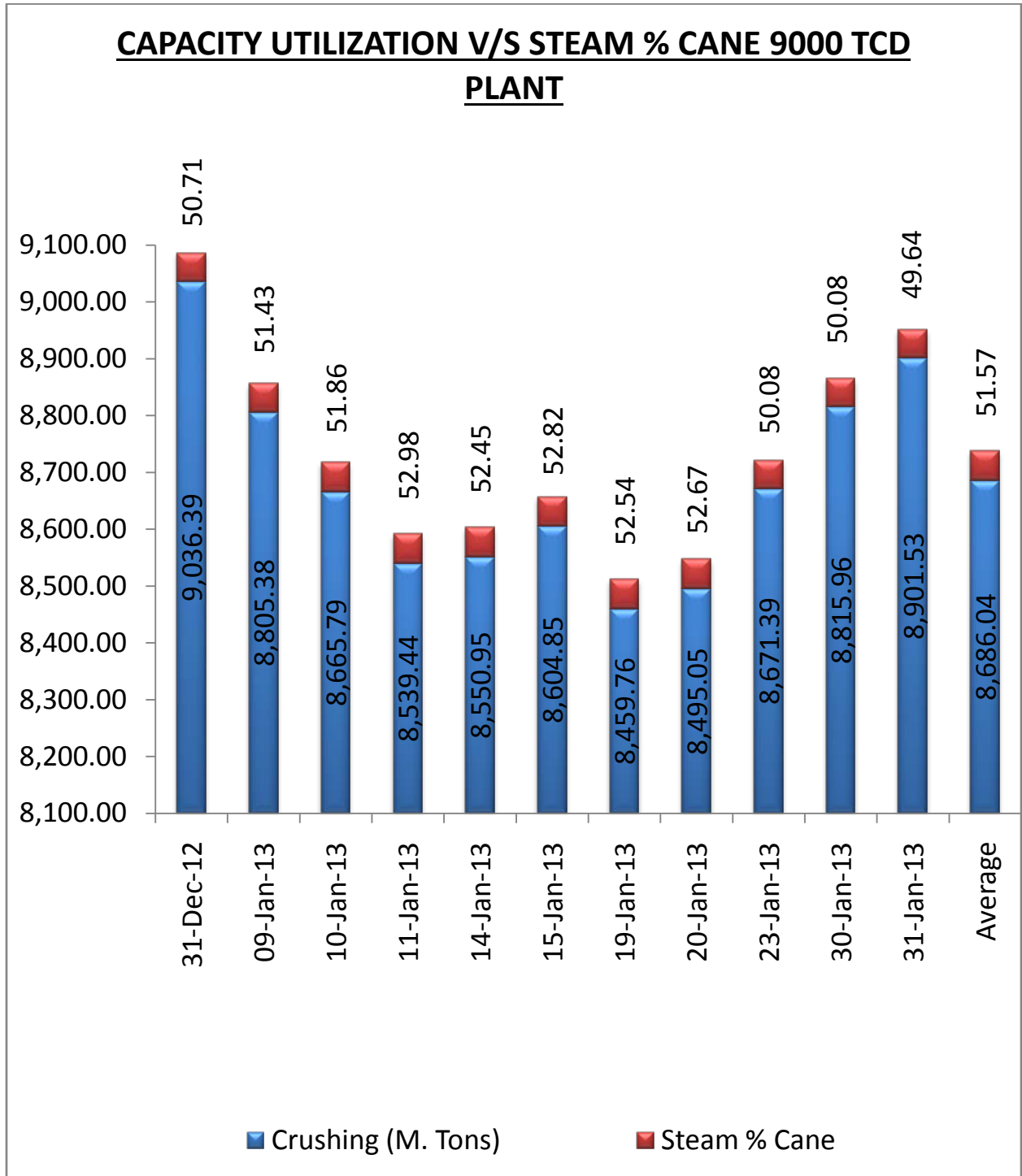
MOMENTUM ENHANCEMENT:



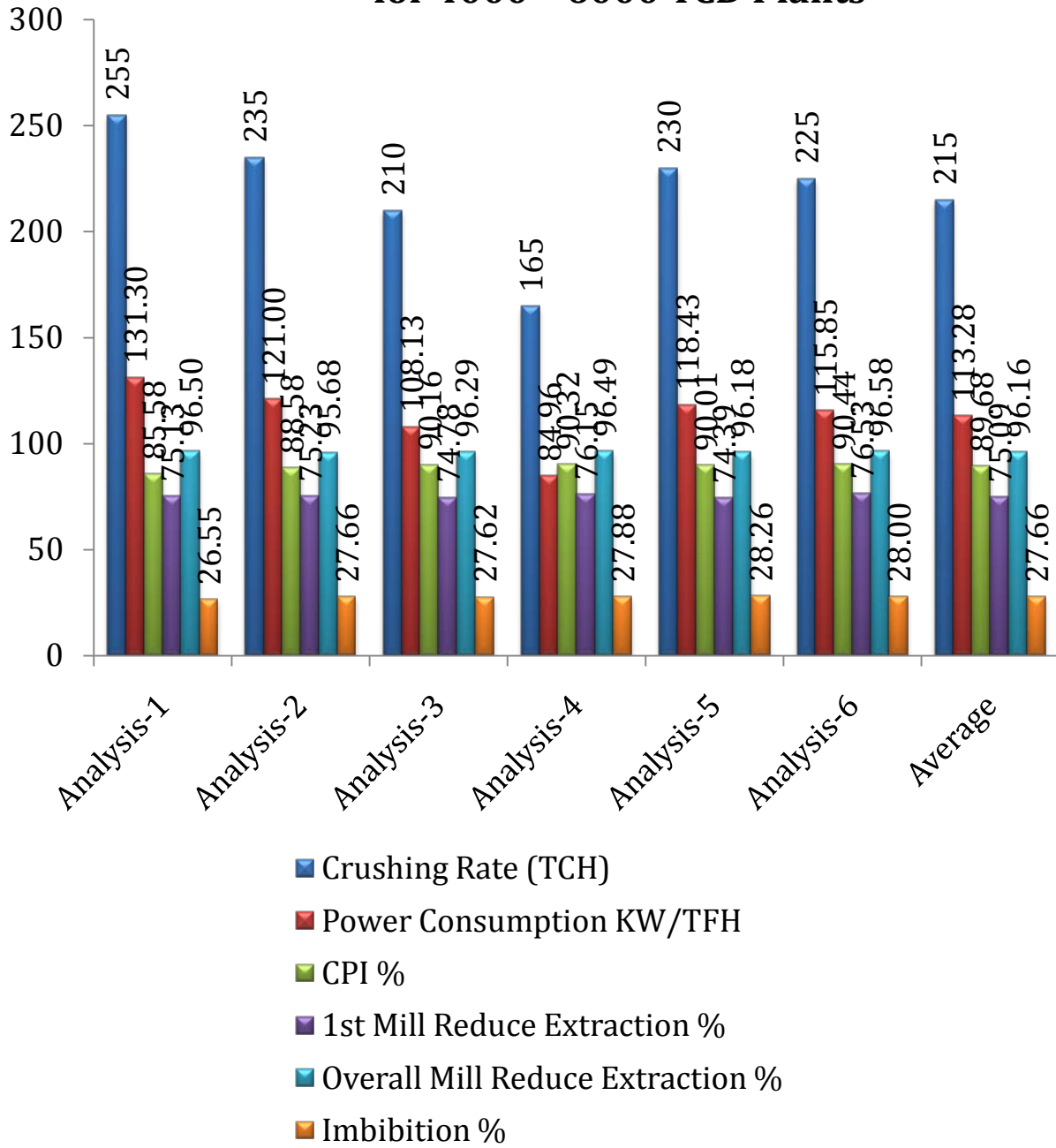
MILLING OPERATIONS:

- ⦿ Milling is massive contributor for power consumption in sugar plants. Capacity utilization is the key of energy saving in sugar plants in the existing scenario.
- ⦿ Power can be justified at milling station as follows,
- ⦿ Installed Power for mill (A) (18 – 23 KW/TFH)
- ⦿ Normal Power utilization A x 65%
- ⦿ Peak Power utilization A x 69 – 71% maximum
- ⦿ Normally, the power consumption exceeds 4 - 5% with respect to 25% acceleration in crushing rate.
- ⦿ An analysis regarding capacity / under capacity utilization reflects the energy consumption in next slide.

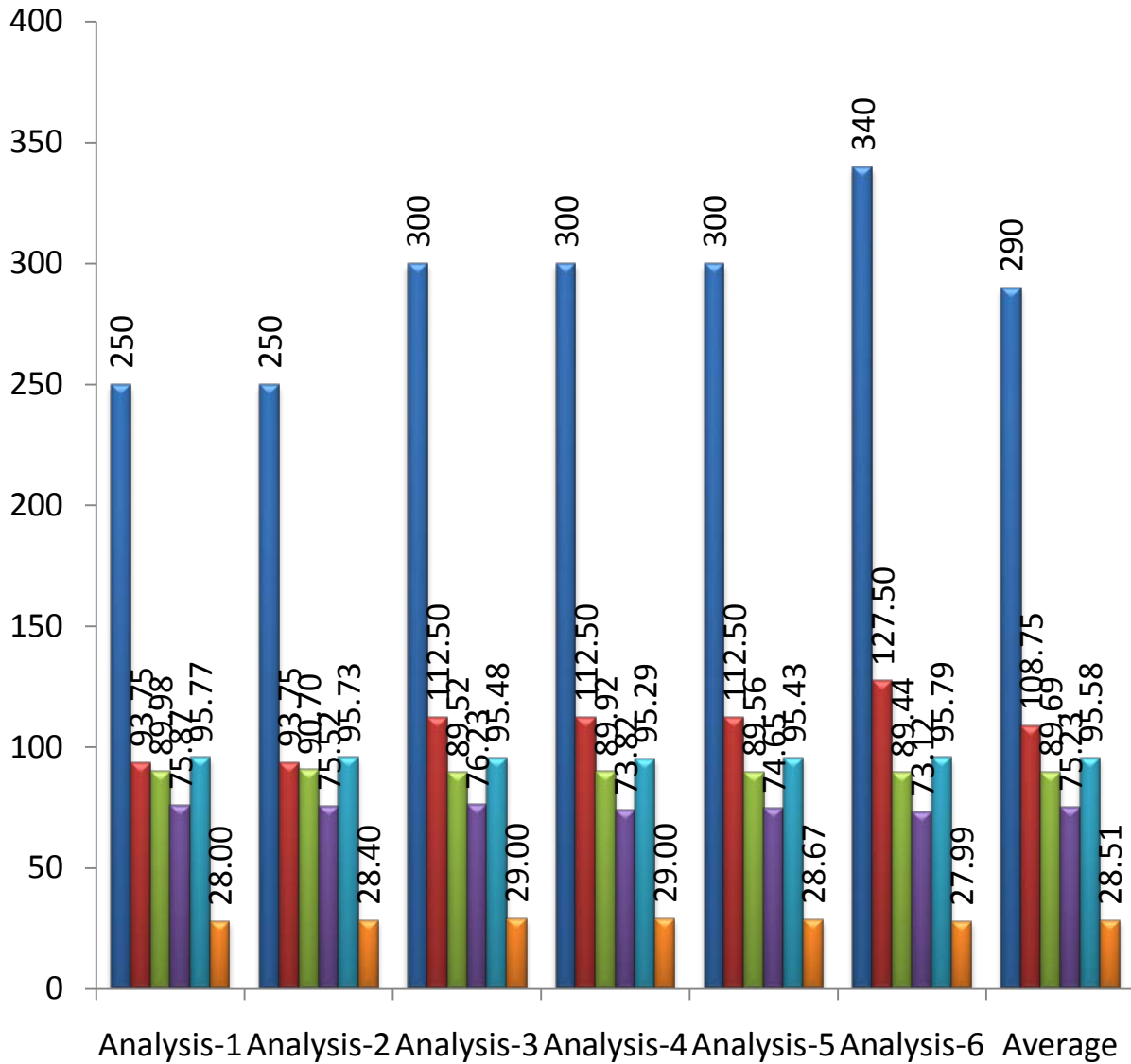
MILLING OPERATIONS:



Comparison of crushing rate - CPI - First Mill Extraction - Over all extraction - Imbibition % for 4000 - 6000 TCD Plants



**COMPARISON OF POWER CONSUMPTION V/S CPI-
FIRST MILL EXTRACTION-OVERALL EXTRACTION-
IMBIBITION FOR 6000 – 8000 TCD PLANTS**



- Crushing Rate (TCH)
- Power Consumption KW/TFH
- CPI %
- 1st Mill Reduce Extraction %
- Overall Mill Reduce Extraction %
- Imbibition %

HYDRAULIC LOADS:

- ⦿ The power consumption in the mill is directly proportional to the applied hydraulic load. However, application of lotus roller, a value aspect use along with deep messchaert grooves facilitate the juice drainage to greater extent with extraction rise of 0.2 – 0.3 %.
- ⦿ However, this activity use to facilitate drainage significantly. This design aspect, use to reduce hydraulic load from 20 – 25% on conventional arrangements. While, subsequent reduce power consumption on prime movers.



SMILL OPENING & SPEEDS:

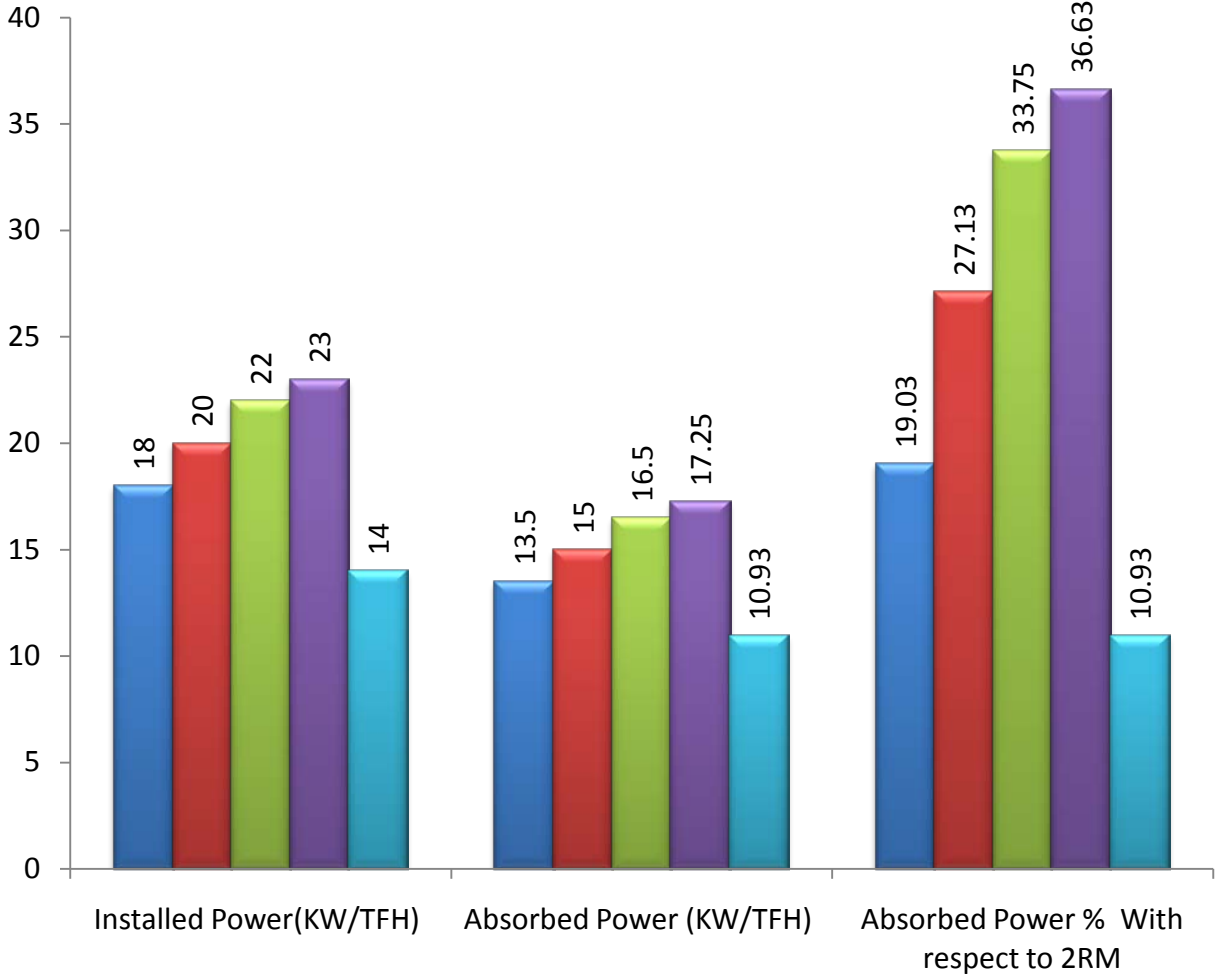
- ⦿ The power consumption is proportional to the square root of specific opening.
- ⦿ Power consumption is directly proportional to mill speeds. Lower mill speeds reduce the coefficient of friction of bagasse with roller surface for better feed ability and reduce the reabsorption which ultimately reduce the power consumption.
- ⦿ Other tangible aspects lower speed reduce the roller wear & oil consumption in bearings too.

APPLICATION OF 2 ROLLER MILL:

1. First Mill extraction up to 75 % achievable
2. Power requirement 30 – 40 % reduce from conventional Mill
3. Elimination of Trash Plate resulted significant reduction in power consumption.
However around 30 - 40% Power consumed on trash plate in a conventional mill.
4. Application of VFD' S with Electric Motors also contributes 20 - 30 % power reduction.
5. Induction of RLD (Re-absorption limit device) in a mill to improve efficiency further.

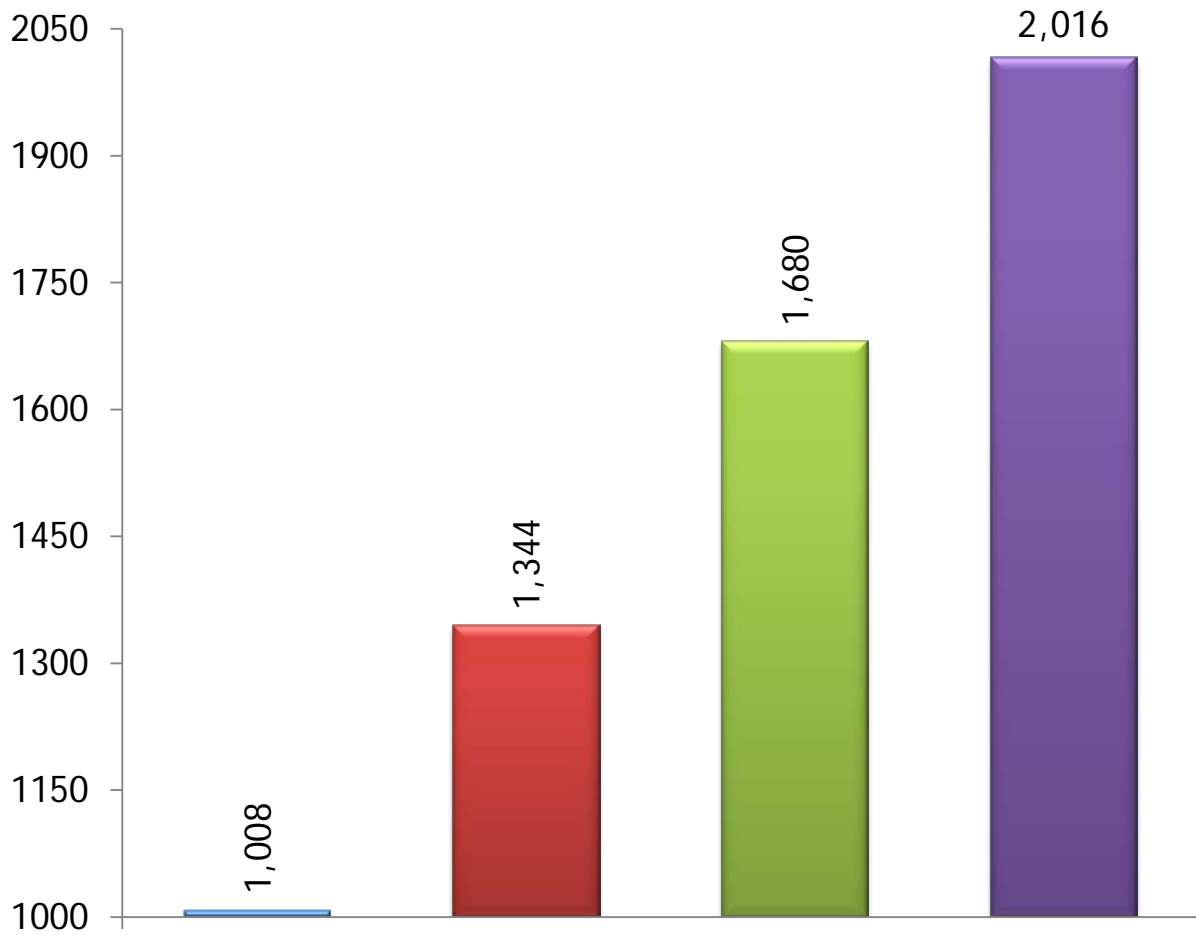
Comparison of Conventional Mill Units of various configuration operating in Pakistan Installed/Absorbed Power calculations based on 8000 TCD crush rate @ 14% fibre					
Mill Type	Conventional	Conventional	Conventional	Conventional	(2 Roller Mill)
Pressure Rollers	3	3	3	3	2
Additional Roller (Pressure Feeder / Under Feed)	1	2	3	3	1
Unit Configuration	Three Roller with under feed	Three Roller with Toothed Pressure Feeders	Three Roller with grooved M.D.P.F plus U. F	Three Roller with grooved HD P.F plus U. F	2RM
Installed Power(KW/TFH) *Turbine driven **(Motor-VFD driven)	18*	20*	22*	23*	14**
Absorbed Power (KW/TFH)	13.5	15	16.5	17.25	10.93
Absorbed Power % With respect to (2RM)	19.03	27.13	33.75	36.63	Comparison (Reference (10.93))
Maintenance Cost	Moderate	High	High	High	Low
First Mill Extraction(%) Plain/Reduce Mittal	71.06/ 74.87	72.38/75.71	70.31/71.87	71.00/73.46	74.14/77.38

**POWER CONSUMPTION COMPARISON BETWEEN
CONVENTIONAL & 2 ROLLER MILL**



- Conventional
(Three roller with underfeed)
- Conventional
(Three Roller with Toothed P. Feeders)
- Conventional
(Three Roller with grooved M.D. P.F plus U.F)
- Conventional
(Three Roller with grooved H.D. P.F plus U.F)

**COMPARISON OF LUBRICATION -
CONSUMPTION IN (LITRES) BETWEEN 2ROLLER
MILL AND CONVENTIONAL MILL UNITS
25, 40, 50% SAVING RESPECTIVELY**



- 2 ROLLER MILL
- 3 ROLLER WITH UNDERFEED
- 5 ROLLER MILL
- 6 ROLLER MILL

OPTIMUM IMBIBITION:

- ⦿ The main intention of imbibition is to dilute the juice contained in the blanket of bagasse so that, more sugar can be extracted in the next mill.
- ⦿ When the blanket of bagasse is coming out of the top roll & discharge roll, it comes out in a highly compressed form and hence, as soon as it emerges out, it expands.
- ⦿ During the expansion, bagasse can absorb water as much as seven times the weight of fiber it contains. During the expansion of bagasse, air enters bagasse.
- ⦿ Once, air enters and fills all the gaps in the interior of bagasse particles, it is difficult to replace the air by any amount of water, even under high pressure. Therefore, ensuring effective imbibition is most important to reap the benefits of imbibition.
- ⦿ By & large, quantity & application of imbibition at mill is the most debatable topic amongst professionals. Every person has their own experiences to justify their approach.

But meanwhile saving of bagasse is also of great significance as a value added commodity regarding co-gen aspect.

BASE LINES FOR EFFICIENT STEAM UTILIZATION IN SUGAR PLANTS

(ESTIMATIONS):

- | | |
|--|-------|
| 1. Energy Inputs from Bagasse | 91.7% |
| 2. Energy Inputs from way of condensate return | 8.3% |
| 3. Energy recovered in steam of total Energy | 64.6% |
| 4. Contributed by de-superheating water | 0.4 % |

Total heat available in steam from boilers distributed as;

- | | |
|--|--------|
| 1. For Process heating, boiling | 71.8 % |
| 2. For Prime Movers | 6.9 % |
| 3. Recovered in hot exhaust condensate | 13.3 % |
| 4. Radiation , leakages and Others | 8 % |

CONTROL & MEASURES:

- ① The best way to control & measures at milling section to concentrate on performance of CPI – First Mill extraction & quantity of undiluted juice. This arrangement identify the rate of power/energy consumption consuming for extraction. Its base line assessment.
- ① Steam & Power load gives the reflection on regular basis to assess the milling performance.
- ① Normally, Power consumption KW /Ton of cane ranges between 18 – 20 at milling stations. However, this how much curtail to bring down termed as efficiency.
- ① Things cannot be manage till gets measures.