UTILIZING MODERN / UPDATED ENERGY SAVING TECHNIQUES TO EXPLOIT BY PRODUCTS FOR BETTER ECONOMY OF SUGAR INDUSTRY

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INTRODUCTION

The term Sugar cane byproduct comprises primarily on bagasse, Molasses & Press mud. However, their contribution would be more or less 30, 5 & 3 % on cane respectively. While, cumulative reflection remains 37– 38%.

Principally, byproducts contribute to curtail cost of production to measurable & even survival extent. Amongst all, bagasse due to their 30% larger share has greater opportunity is utilized as prime byproduct to reduce cost with energy efficiency.

By & large, bagasse itself utilize to generate power production on cheapest cost as compared to other sources of fuel. Currently, country – wide sugar industry, utilized bagasse to generate power @ 10 - 12 KG/KWH for self-generation. However, Cogeneration can reduce its consumption to 5 KG/KWH which is tremendous opportunity for sugar industry to make it proficient (Its Cogen mode steam consumption of extraction – condensing turbines having parameters 110 bar/ 540 Celsius with power output of 31.2 MW consumed steam at 5 Kg/KWH)

With latest techniques steam consumption can be reduced from conventional 50 to 36 – 42% on cane. In order to focus potential opportunities to save bagasse or energy, five distinct areas i.e. a) Mill house Electrification, b) Installation of FFE with integrated vapor distribution, c) capacity utilization, d) Milling equipment & finally e) Plant automation significantly contributes towards optimization with justified pay back.

TURBINE DRIVEN MILLING APPLICATIONS **Case study-1**

Description	Power data		Steam entry parameter			Steam Exit parameters			Efficiency		Actual steam consumption			Remarks
Application	Install-ed power kw	Consu-mption kw	Press-ure P Design	Temp-erature t Design/ working	Enthalpy h K Cal/Kg Design/ working	Pressure P Bar	Temp-erature T Real oC	Enthal-pyh1 Real K Cal /kg	Isen-tro Pic %	Mech-anical %	Speci-fic kg/ kwh	Total TPH calcu-lated	Total TPH meas-ured	Crushing 11000-11500 TCD Imbibition 30 % Fibre 14 %
Cutter-1	550		22/24	330/350	737.13/ 747.005	1.5	170	678.2	65	98	14.8	8.14	6.105	
Cutter-2	750		22/24	330/350	737.13/ 747.005	1.5	167	669.3	65	98	14.5	10.87	8.1562	
Shredder	2500		22/24	330/350	737.13/ 747.005	1.5	161	665.6	65	98	11	27.5	20.625	
Mill-1	850		22/24	330/350	737.13/ 747.005	1.5	164	667.5	65	98	14.3	12.15	9.1162	
Mill-2	850	8126	22/24	330/350	737.13/ 747.005	1.5	176	674	65	98	14.3	12.155	9.1162	
Mill-3	850		22/24	330/350	737.13/ 747.005	1.5	168	670	65	98	14.3	12.15	9.1162	
Mill-4	850		22/24	330/350	737.13/ 747.005	1.5	162	666.5	65	98	14.3	12.15	9.1162	
Mill-5	850		22/24	330/350	737.13/ 747.005	1.5	169	670.3	65	98	14.3	12.15	9.1162	
Mill-6	850		22/24	330/350	737.13/ 747.005	1.5	167	669	65	98	14.3	12.15	9.1162	
Boiler feed water (Cane handling, inter carriers, rotary, screens, Pumps, Belt, conveyors , carriers, elevators, farval dries	250 3052	1243	22/24	330/350	737.13/ 747.005	1.45	250	709	65	98	16	4	3	Enthalpy figures can vary ± 1-2 % from table due to excess operating temperature.
			40.72 % of installed power									0	13.971	
Total	12202	9369	76.61 % consumption installed power									123.4	106.55	
(Plus 3 % consumption variation)												127.1	109.74	

Calculated steam rate basically design rate with respect to unit consumption @ full capacity. However, measured rate @ on going rate of crushing which is under capacity crushing.

Isentropic efficiency is basically efficiency inlet & exit steam pressures. However, friction less adiabatic process is referred as isentropic.

Mechanical efficiency is basically gear box efficiency of transmit power.

MOTOR-VFD DRIVEN MILLING APPLICATIONS UNDER THE SUGAR POWER GENERATION Case study-2

Description		**Power Data**			**Remarks**
Application	**Motor / VFD**	**Installed power kw**	**VFD Power KW**	**Consumption operating load KW**	**Crushing 12000 – 12500 TCD Imbibition 27 % Fibre 14 %**
Cutter-1	Motor	1200	-	700	
Cutter-2	Motor	1000	-	800	
Cutter-3	Motor	1000	-	900	
Shredder (Master)	Motor / VFD	2500	2850 x 2	1174	
Shredder (Follower)	Motor / VFD	2500	2850 x 2	1017.29	
Mill-1	Motor / VFD	1200	1750	730	
Mill-2	Motor / VFD	1200	1750	482.68	
Mill-3	Motor / VFD	1200	1750	600.02	
Mill-4	Motor / VFD	1200	1750	499.87	
Mill-5	Motor / VFD	1200	1750	593.66	
Mill-6	Motor / VFD	1200	1750	629.33	
Mill, shredder, cutters, Drives		15400	1750	8126.85	
Feeding tables, Inter carriers, Rotary screens, Pumps, Belt, Conveyors, Carriers, Elevators, Farval drives		3052		1243	
Total power for mills house		18452		9369.85	
Steam consumption TPH				**103.059**	

5 Kg/kwh is @110 bar/540C with 827.35 Kcal/kg. However, actual efficiency attained at turbine where consumption reduce significantly.

MOTOR-VFD DRIVEN MILLING APPLICATIONS UNDER COGENERATION SCENARIO Case study-3

Description		**Power Data**			**Remarks**
Application	**Motor / VFD**	**Installed power kw**	**VFD Power KW**	**Consumption operating load KW**	**Crushing 12000 – 12500 TCD Imbibition 27 % Fibre 14 %**
Cutter-1	Motor	1200	-	700	
Cutter-2	Motor	1000	-	800	
Cutter-3	Motor	1000	-	900	
Shredder (Master)	Motor / VFD	2500	2850 x 2	1174	
Shredder (Follower)	Motor / VFD	2500	2850 x 2	1017.29	
Mill-1	Motor / VFD	1200	1750	730	
Mill-2	Motor / VFD	1200	1750	482.68	
Mill-3	Motor / VFD	1200	1750	600.02	
Mill-4	Motor / VFD	1200	1750	499.87	
Mill-5	Motor / VFD	1200	1750	593.66	
Mill-6	Motor / VFD	1200	1750	629.33	
Mill, shredder, cutters, Drives		15400	1750	8126.85	
Feeding tables, Inter carriers, Rotary screens, Pumps, Belt, Conveyors, Carriers, Elevators, Farval drives		3052		1243	
Total power for mills house		18452		9369.85	
Steam consumption TPH				**46.84**	Generation @ 5 KG/

SPECIFIC STEAM % FOR PROCESS sections

Process applications are classified with ± 3 – 4% variation at individual plants. While reference base scenario to save energy to produce bagasse as follows;

Juice heating	=	8.2 %
Evaporators	=	20 %
Vacuum Pans	=	12 %
Miscellaneous (Pan washing, Centrifugal)	=	5 %
Total	**=**	**45.2 % on cane**

FALLING FILM EVAPORATORS

FFE is an established feature to bring down steam% with certain design & operational advantages,

Short residence time

High heat transfer coefficient
Minimum effective temperature difference

Flexibility at capacity fluctuations
Local design & manufacturing facility

10 - 20 % factories have inducted

Automation

Automation provides the best optimum control of any equipment or process. Comparing to manual control, where performance fluctuates in between two extremes, i.e. optimum best control and worst control due to the various reasons.

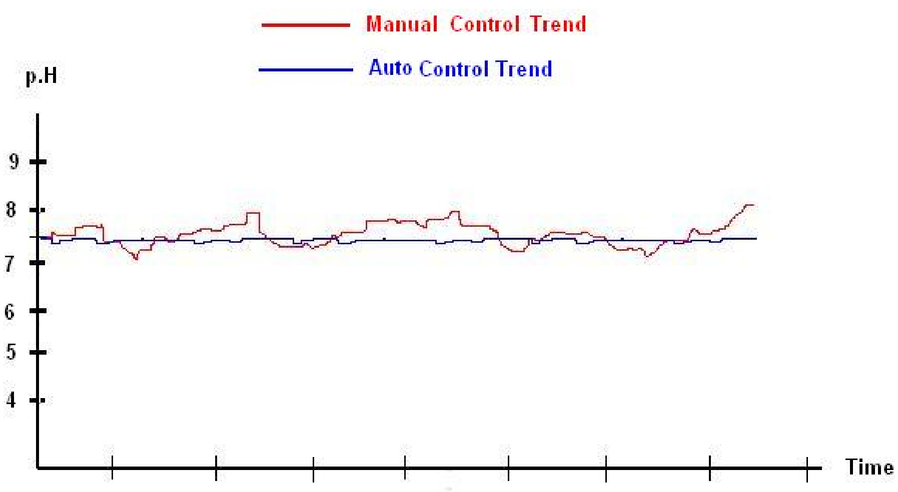
Automation facilitates 3 – 5 % capacity enhancement at milling applications to overcome momentary stoppages

Consistency at process applications stabilize quality and phase changes.

Data control monitoring leads to 4 - 6 % improvement.

Automation controls the equipment or process to highest possible level. A graphical reflection regarding manual and auto control of defecation juice p.H

Process p.H Control Trend graph



APPLICATION OF 2 ROLLER MILL

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 COMPARISON

There are two logics of 2 roller mill's induction, enhance crushing @ of reduce power. Incidentally, due to design non-availability of trash plate which consumed on or around 30 – 40% steam consumption in conventional mill. However, low RPM also contributes for more extraction due to larger size mill install at the head of tandem. It's recommended at duty # 1 rather than center or in last where moisture cannot control due to excess imbibition in most of cases. Higher juice extraction 74% is ideal reflects in overall extraction around 96% for tandem.

BASE LINES FOR EFFICIENT STEAM UTILIZATION IN SUGAR PLANTS (ESTIMATIONS)

These are estimated figures with 5 – 10% variations at different sugar plants

Energy Inputs from Bagasse	91.7%
Energy Inputs from way of condensate return	8.3%
Energy recovered in steam of total Energy	64.6%
Contributed by de-superheating water	0.4 %

Total heat available in steam from boilers distributed as;

For Process heating, boiling	71.8 %
or Prime Movers	6.9 %
Recovered in hot exhaust condensate	13.3 %
Radiation, leakages and Others	8 %

CONCLUSION

Entire aspects as discussed ultimately reflects the significance of bagasse saving. A crucial byproduct will be going to be a costly commodity in coming years due to switching of multiple conventional sugar mills to Cogen mode. However, availability since November 2015 ranges between Rs. 3000 – 5000/ton shows the rising trend. Therefore, Bagasse as energy fuel can contributes for the future - survival of sugar industry.

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