

Experience of cost saving by replacing 2nd hand Steam Turbine with Electric Motors at Cane Cutter

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A- Introduction:

This is general trend in sugar Industry to use 2nd hand machinery, especially electric drives and steam turbines. The option is used to cut down the capital cost at the moment, whereas operational cost is not considered. Ranipur Sugar Mills has also installed 2nd hand single stage steam turbine of un known power at 2nd Cutter. The Cutter is equipped with 36 knives and operated at 600 rpm with option to operate with 2 nos. 550 volts, H.T electric drives of 220 Kw each installed at other end of the shaft. The steam turbine was installed in 2004-5 to reduce the electric load at power house.

B- Material and Methods:

During crushing Season 2014-15, mechanical fault was occurred in steam turbine gear and operation of 2nd cutter shifted on electric drives for 11 days. In those 11 days, It was noticed that the average motor power remained 261 kw whereas the steam consumption reduced from 45.88 %(average of 55 continuous good crushing days prior to the gear fault) to 43.30 % on cane(average of 11 continuous days running with Electric Motors). No make steam was provided to process house in those days. (see Exhibit A and B).

With average crushing of 3950 tons per day, the steam consumption per hour was observed with:

Description	Calculations	Results
Steam Turbine at 2 nd Cutter	= 45.88 x 3950/2400	= 75.51 tons per hr
Electric drives at 2 nd Cutter	= 43.30 x 3950/2400	= 71.26 tons per hr
Extra Steam Consumption at 2 nd Cutter Steam Turbine per hr	= 75.51 – 71.26	= 4.25 tons per hr.
Extra Steam consumption per Kwhr at 2 nd Cutter Steam Turbine as compared with Power House Turbines	= 4.25x 1000/261	= 16.28 kg/kwhr

Note: As steam consumption at 2nd Cutter Turbine is compared with Power House Turbines , pressure and temperature loss effect of steam from boiler to 2nd Cutter Turbine is not considered.

C- Cost Saving with Electric Drives at 2nd Cutter:

Considering consumption of 1 ton bagasse to generate 2 tons of 25 bar steam and bagasse sale price of Rs. 2300 per ton:

Description	Calculations	Results
Bagasse saving per day	$= (4.25 \times 24)/2$	= 51.0 Tons
Cost saving per day	$= 51.0 \times 2300$	= Rs. 117,300 per day
Cost saving per ton of cane	$= 117300/3950$	= Rs.29.70 per ton cane

D- Discussion:

During the period of 2nd Cutter operation with Electric Motors, the Power House load in average increased to 261 kw and process house demanded makeup steam for process requirements. No make steam was served to Process House but it was felt tough operation of process during those days.

E- Recommendations:

- 1-Cut off application of 2nd hand Single Stage Steam Turbines.
- 2- Use multistage efficient Steam Turbines if deem necessary.
- 3- For economy run, extend the Power House capacity and replace Steam Turbines with Electric Motors at cane preparation and milling and ultimately switch over to high pressure Boiler operation with no Steam Turbine other than of Power House .
- 4- Replace high steam consumption process house equipments with less steam consumption equipments.
- 5- Increase multiple use of steam and vapours at process house.
- 6- Adopt secondary sources to cut off supply of 6 bar steam to process house.
- 7- Use automation and VFD where is applicable in the plant.

Exhibit- A

Data Sheet of Steam Consumption including Steam Turbines at 2nd Cutter , Power House Load and Mill Stoppages

Date	Power House Load, K.W/TCD	Steam% Cane	Stoppage (Hrs)	Reason
15/12/2014	18.504	47.68	Nil	
16/12/2014	18.408	49.27	Nil	
17/12/2014	18.408	47.48	Nil	
18/12/2014	17.832	46.29	Nil	
19/12/2014	17.448	46.16	Nil	
20/12/2014	18.216	46.02	0.40	
21/12/2014	16.896	42.97	Nil	
22/12/2014	17.304	44.72	0.10	
23/12/2014	17.184	44.86	Nil	
24/12/2014	17.232	44.12	0.10	
25/12/2014	18.12	45.86	1.00	
26/12/2014	18.216	46.46	0.45	
27/12/2014	17.04	45.06	Nil	
28/12/2014	16.584	43.03	Nil	
29/12/2014	16.920	44.15	Nil	
30/12/2014	16.992	43.31	Nil	
31/12/2014	17.64	45.88	2.30	

Exhibit-A, continued

Date	Power House Load K.W/TCD	Steam% Cane	Stoppage (Hrs)	Reason
01/01/2015	16.548	42.57	Nil	
02/01/2015	18.744	42.51	Nil	
03/01/2015	16.368	41.86	Nil	
04/01/2015	16.176	40.74	Nil	
05/01/2015	16.368	40.82	Nil	
06/01/2015	37.320	72.73	16.10	Strike
07/01/2015	No crushing		24.00	Strike
08/01/2015	No crushing		24.00	Strike
09/01/2015	No crushing		24.00	Strike
10/01/2015	No crushing		24.00	Strike
11/01/2015	No crushing		24.00	Strike
12/01/2015	15.948	47.26	0.55	
13/01/2015	23.112	59.37	17.10	No Cane
14/01/2015	17.664	51.68	0.20	
15/01/2015	19.512	53.57	9.45	No Cane
16/01/2015	16.512	47.54	1.00	
17/01/2015	16.896	49.26	0.45	
18/01/2015	17.616	47.54		
19/01/2015	16.584	44.19	Nil	
20/01/2015	17.880	48.14	Nil	
21/01/2015	18.504	51.58	Nil	
22/01/2015	18.504	48.51	0.55	
23/01/2015	18.000	47.41	1.25	
24/01/2015	18.264	48.18	1.30	
25/01/2015	16.776	45.11	0.30	
26/01/2015	17.448	45.41	0.10	

Exhibit- A, continued

Date	Power House Load K.W/TCD	Steam% Cane	Stoppage (Hrs)	Reason
27/01/2015	17.112	44.65	Nil	
28/01/2015	17.56	41.25	Nil	
29/01/2015	17.784	47.70	1.25	
30/01/2015	16.752	45.81	Nil	
31/01/2015	17.304	46.16	0.50	
01/02/2015	16.656	45.7	0.30	
02/02/2015	17.232	45.21	Nil	
03/02/2015	19.776	48.48	0.35	
04/02/2015	18.816	48.31	Nil	
05/02/2015	19.416	48.92	Nil	
06/02/2015	16.46	45.08	Nil	
07/02/2015	16.728	46.08	Nil	
08/02/2015	16.896	45.49	Nil	
Average	17.57	45.88		

Note:- The crop days with more than 8 hrs Mill stoppage are not included in the average.

Exhibit – B

Data Sheet of 2nd Cutter Motors and Power House Load, Steam % cane and Mill Stoppages 2014-15

Date	2nd Cutter Motor Load (Amp)	Power House Load Kw/TCD	Steam % Cane	Stoppages (Hrs)
10/02/2015	35.6	19.10	43.3	0.35
11/02/2015	32.7	18.96	44.0	1.55
12/02/2015	31.5	19.14	42.1	Nil
13/02/2015	31.1	19.78	42.1	Nil
14/02/2015	30.4	19.63	45.6	3.15
15/02/2015	29.5	19.67	42.3	0.35
16/02/2015	20.8	19.06	43.4	0.10
17/02/2015	30.6	18.84	42.7	0.10
18/02/2015	31.5	18.71	42.8	0.10
19/02/2015	30.8	18.94	42.6	0.10
20/02/2015	31.0	19.15	45.4	2.10
Average	30.5	19.18	43.3	