Energy Conservation by Way of Cogeneration Efforts at Sirpur Paper Mills Ltd.

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ABSTRACT

This paper describes how Sirpur Paper Mills developed the optimum utilization of cogeneration by adopting various energy conservation methods. Primarily increasing cogeneration from 75% to 98%, has helped us in utilizing energy optimally. Because of the measures taken, in the last 6 years as described in the body of the paper, cost of the power has come down by around Rs. 1000/- per tone of paper. We are planning to install 9.5 MW. Extraction Back Pressure T.G. set to replace two T.G. sets of 5 MW and 2.5 MW to further reduce the cost of fuel and power.

INTRODUCTION

Cogeneration reduces energy cost and offers fuel flexibility. It also protects from the effect of power cuts and improves quality of power. In olden times most of the paper mills in India were of very small capacity and they used to depend on Grid Power supplies of State Electricity Boards. Low Pressure steam boilers were used for supply of steam for cooking and drying purposes. Gradually the production capacity of mills increased. Since Grid Power was costly and not reliable, the concept of cogeneration was developed where by steam at higher pressure and temperatures were processed through Turbo Generator generating power and giving L.P. steam at various pressures through extraction or exhaust. It was found that if the ratio of steam demand to power is more than 6,the cogeneration process becomes attractive. In Sirpur Paper Mills today our power generation is 18 MW and processes steam requirement is 125 TPH. Ratio is around 7.

Many of the process industries including paper industry have recognized the advantages and cost effectiveness of cogeneration and we in SPM also have taken steps in that direction.

Background of Power Generation at SPM

In Sirpur Paper Mills (SPM) the first 10 TPD capacity paper machine was installed in the year 1940, at that time itself SPM was having its own Turbine of 2.2 MW giving an exhaust pressure of 1.8 kg/cm^2 suitable for use in drying cylinders. For digesters, the steam was obtained by reducing pressure with pressure reducing valve (PRV). 2 Nos. 7.5 MW pass out condensing Turbines were installed in 1953-54.

Due to further expansion of mill from time to time and extreme power restriction (60 to 80%) in Andhra Pradesh from 1979 onwards, it was decided to add on 2.5 MW. Back Pressure Turbine in 1979-80, and 5 MW extraction Back Pressure Set in 1985-86. After the installation of these two Turbines along with our old 7.5 MW pass out condensing Turbines, we were able to meet our process demand as well as power generation fully. One BHEL Soda Recovery Boiler of 220 TPD Solids capacity was added for better efficiency in 1983-84, 2 FBC Boilers were added to Steam plant in between 1996 to 1998.

The Sirpur Paper Mill had installed capacity of 61,550 TPA Paper and Board production till the end of Financial Year 2001-2002. One new Paper Machine was commissioned in March, 2002 along with new Bleach Plant and an additional Soda Recovery Boiler of Enmas/Andritz thus increasing the installed capacity to 83,550 TPA. Cogeneration is used to full extent in the mill as 90% of 32 kg/Sq cm (g) steam is passed through Turbine and pass out back pressure steam is utilized for process heating and cooking purpose. Before the installation of New Paper Machine of 60 TPD, our power generation demand was 15-15.5 MW and total process steam demand was 105 TPH. We were able to meet power and steam demand through cogeneration by running three Turbines only (Fig. 1).

After the commissioning of New Paper Machine, power demand increased to 18.0 - 18.5 MW with

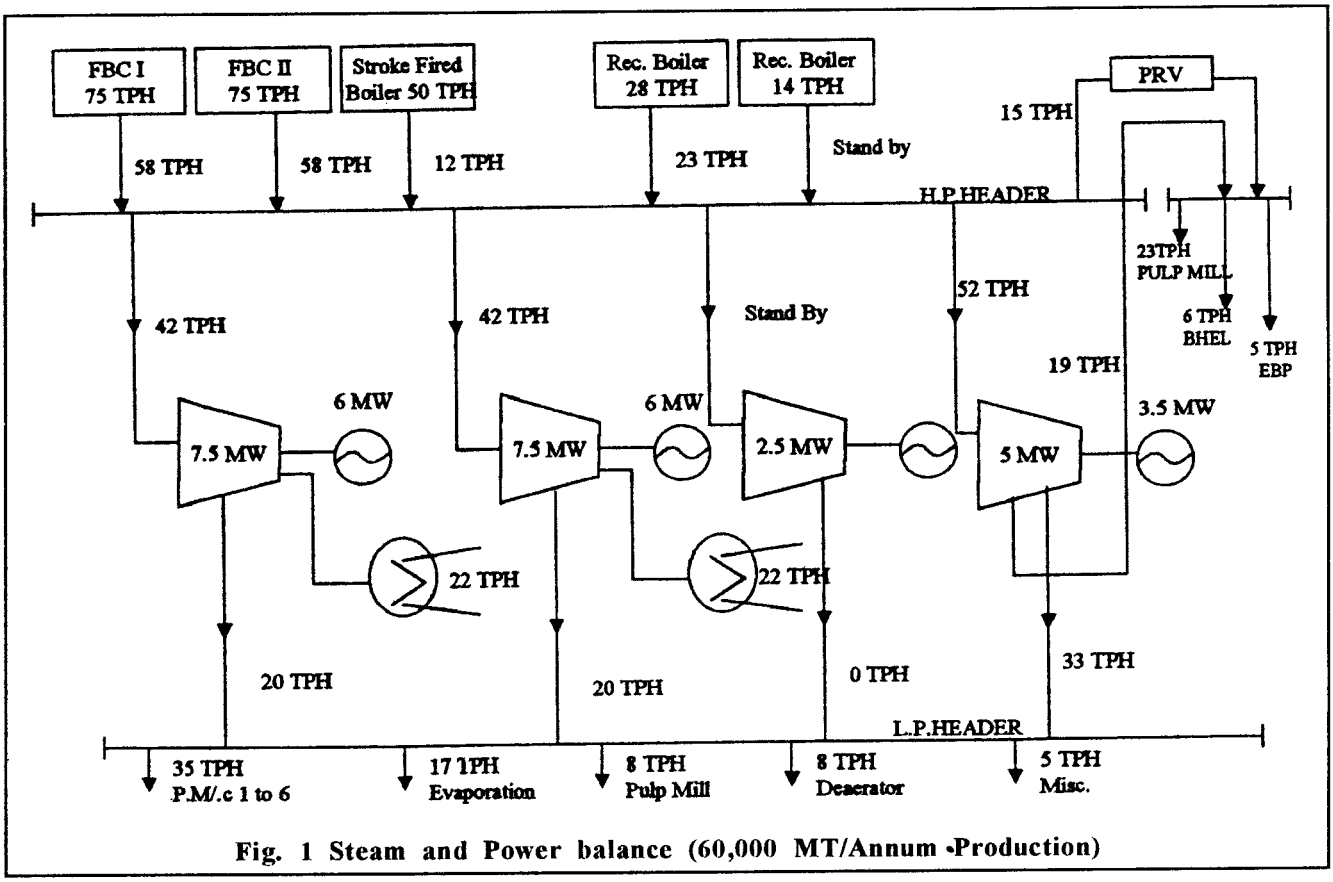

Fig. 1 Steam and Power balance (60,000 MT/Annum Production)

Table 1 Present details of boilers- June 2002

Description Make	FBC Boilers IBIL	Stoker Fired Boilers John Thompson	Recovery Boiler-1 BHEL	Recovery boiler-2 Bedcock & Wilcox (Retrofitting by Enmas)
No. of Boilers	2	6	1	1
Year of Installation	1994-99	1953	1984	1953 (Retrofitting in 2002)
Working Pressure (kg/sq. cm(g)	33	32	34	34
Superheated Temp°C	400	400	400	400
Maximum continuous Rating (TPH)	75	75	32.6	15.4
Gross Cal. Value (K.cal/kg.)	3600	3600	3300	3063

process steam demand gone up to 125 TPH. Out of these. one is 40 TPH at 8 kg/cm^2 and 85 TPH at 2.2 kg/cm^2. In our present system of Turbines we are able to meet only 20 TPH at 8 kg/cm^2 through extraction and rest 20 TPH is being passed through Pressure reduced value (PRV) (steam and power balance given in Fig. 2. Hence, SPM has decided to install a new 9.5 MW Extraction Back Pressure Turbine to eliminate PRV totally resulting in saving of 75 Tonne of coal per day (Fig. 3). The details of Boilers and capacity available are given in Table 1 and details of TG sets are given in Table 2.

Various improvements made during last five years

• Our old 7.5 MW pass out condensing sets were

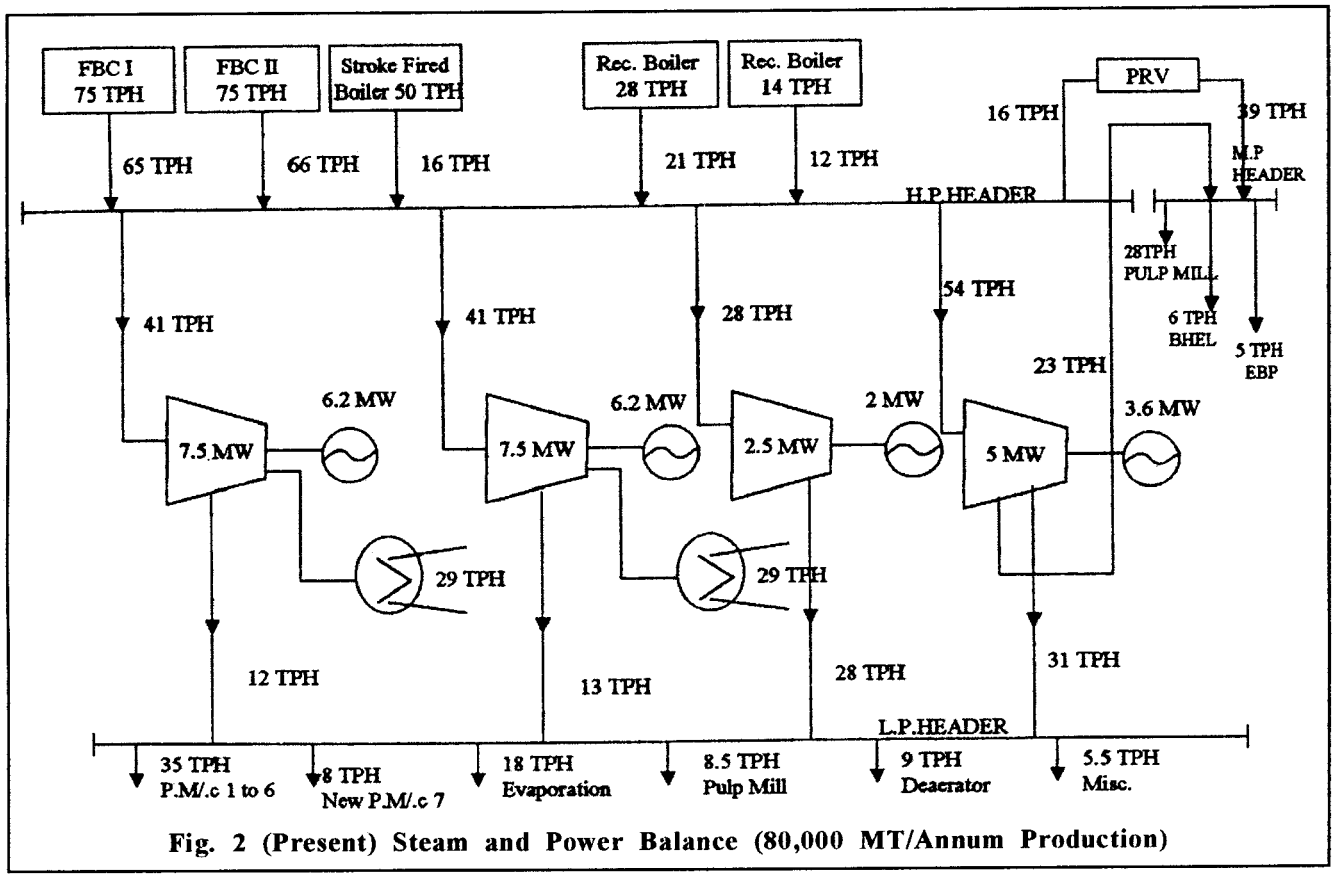

Fig. 2 (Present) Steam and Power Balance (80,000 MT/Annum Production)

Table 2 Details of Turbines

Description	7.5 MW Sets	5 MW Set	2.5 MW Set
Make	Metrovicers, England	Triveni	Triveni
Year	1953-54	1985-86	1979-80
Capacity	7.5 MW	5.0 MW	2.5 MW
No. of Turbines	2	1	1
Inlet Pressure (Kg/Sq.cm(g)	31	31	21
Inlet Temp °C	390	380	350
Normal Loading	6 MW (each)	3.8 MW	2.0 MW
Pass out Pressure (Kg/Sq.cm.(g)	2.2 (Pressure increased by removing one LP stage blade)	9.0	--
Back Pressure (Kg/Sq.cm(g)	--	2.2	2.3
Remarks: One 9.5 MW BHEL make double extraction set ordered in March, 2002 for optimum utilization of Cogenerationi.			

designed for 1.8 kg/Sq cm (g) of pass out pressure and our paper machines and evaporators requirement was 2 kq/Sqcm^2 (g). For increasing the pass out pressure of these sets, Turbine rotor one stage blades were removed and pass out pressure has improved to 2.2 kg/cm^2. This has given better productivity at our paper machines.

- Installation of Desuperheaters in 8 kg/cm^2 steam line going to Pulp Mill.
- Installation of Desuperheaters at Paper Machines.
- Blow heat Recovery steam comissioned in Pulp Mill.
- Recovery of used Fresh Water for recycling by

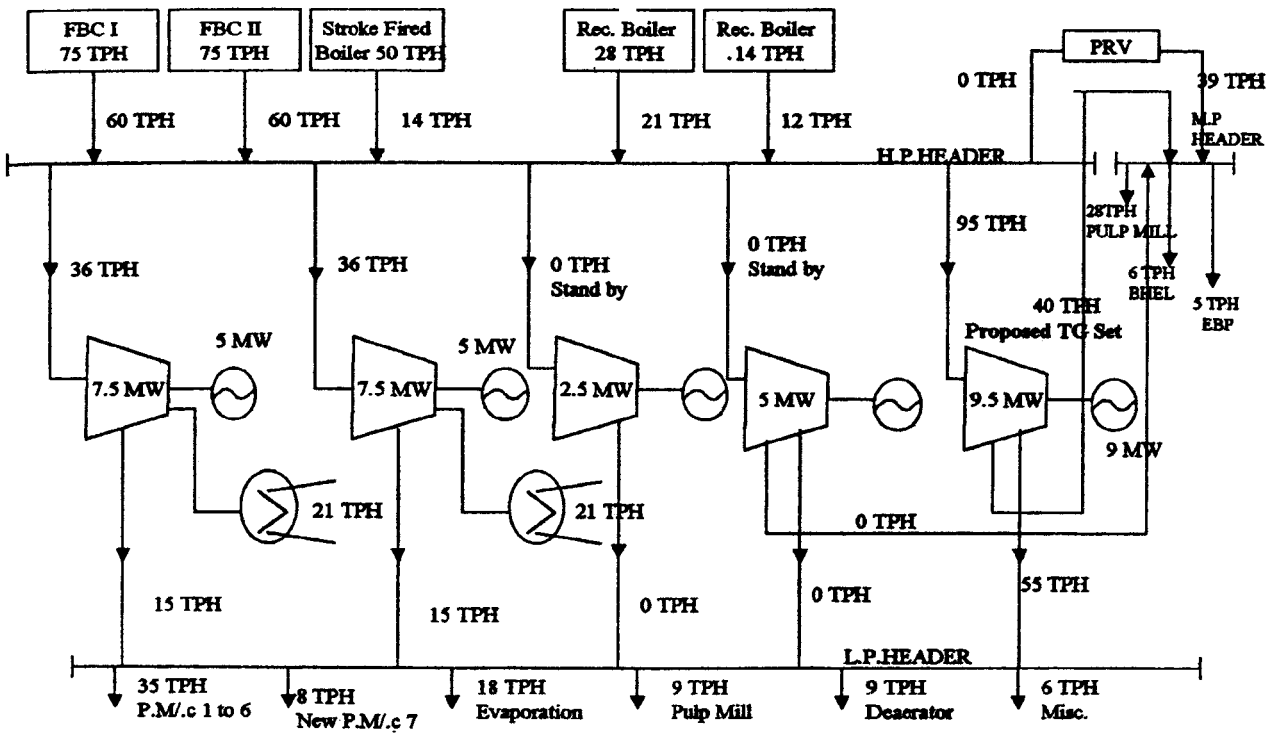

Fig. 3 (Proposed) Steam and Power Balance with new 9.5 MW BHEL Set (80,000 MT/Annum Production)

Table 3

Year	Finished Production MT	Power Generation kWh	Power Purchased kWh	Total Power kWh	Cost of Generation / kWh in Rs.	Cost of Grid Power /kWh in Rs.	Cost of Coal/ton in Rs.	Energy Consumption /ton of paper (Exclud.E.B. plant & Colony) kWh	Coal Consumption MT	Fuel and Power cost ton of paper in Rs.
1996-97	5360	122007860	9932040	131939900	1.17	3.66	1040	1995	273165	5612
1997-98	58457	122973675	4139400	127113075	1.05	4.58	1113	1867	241855	4949
1998-99	57334	117367205	2394320	119761525	1.06	5.72	1103	1793	233841	4735
1999-2000	58839	122675941	1950300	124626241	1.19	6.51	1013	1798	249565	4532
2000-01	60197	1297825778	2118168	131900746	1.15	6.91	989	1855	254864	4454
2001-02	60921	129975135	2265590	132240725	1.23	6.35	1066	1841	248525	4603

Remarks: 1. From the table it is concluded, that inspite of rise of Rs. 26/- per ton in coal and Rs. 2.69 per kWh in grid power our final fuel and power cost in reduced by 18%.
2. As inferior coal of "E" grade is being used after the commissioning of FBC Boiler, Increase in coal cost is less.

gravity instead of pumping, which resulted in net saving of 150 KW.

- Using of L.P. steam for water heating in Pulp Mill instead of M.P. steam.
- Stopping of 2.5 MW set along with old stroker fired boiler of 20 kg/sq. cm fully and thus saving 350 to 400 KW load and full utilization of 7.5 MW sets by extracting maximum pass out.
- Improving the vacuum of 7.5 MW set by reducing the inlet water temperature upto maximum possible extent.
- Reduction of contract demand with Andhra Pradesh Electricity Board (APSEB) from 10,000 KVA to 3500 KVA in the year 1997-98.
- Using of minimum Grid Power, only in an emergency.
- Some of the old and obsolete MCCs and PCCs were replaced.
- Installing vacuum pump in Black Liquor evaporator in place of steam ejector.

- Total active alkali (TAA) concentration was raised to 70 gpl from 65 gpl, which gave slightly higher solids of weak black liquor in return helping evaporation and rejects at Knotters in cooking Kappa Number was also found low in Pulp Mill.
- Installed efficient and higher capacity vacuum pumps in Paper Machines to save energy.
- Number of inefficient pumps and motors replaced with energy efficient pumps and motors to save energy.
- 2nd FBC Boilers was commissioned. Hence, there is substantial saving on account of coal.
- Plate heat exchanger installed in caustic evaporator to preheat the first effect feed liquor.
- Condensate Polish Unit was stopped by using D.M. Water directly in Recovery Boiler.
- Energy Saving effected by modifying 1st Grade Effluent system.
- Installation of Thyristor drives and variable frequency drives at some places for efficiency and energy saving.

All the above measures having given a substantial reduction in Power Cost/MT of paper produced Table 3.

CONCLUSION

We have been able to achieve better utilization of energy by maximizing cogeneration of power, primarily because of the important steps taken by regularly monitoring steam and power demand.

1. Installation of BHEL Recovery Boiler.
2. Installation of Two Extraction Back Pressure Turbine for minimizing steam through Pressure Reducing Valve (PRV).
3. Installation of Desuperheaters at all process steam consumption areas.
4. Installation of two Fluidized Bed Boiler.
5. Retrofitting of old Recovery Boiler.

Still efforts are on to optimize utilization of cogeneration, as Energy Saved is equivalent to Energy produced.

ACKNOWLEDGEMENT

The authors are very much grateful to the management of the Sirpur Paper Mills Ltd., Sirpur - Kaghaznagar, for permitting us to present this paper in IPPTA Seminar.