Energy Conservation in ABIL-PCD

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The Indian Pulp & Pulp Industry is the sixth largest energy consumer in the Indian industrial sector and its energy costs account for about 30% of the total manufacturing cost. In every mill there exists the possibility to reduce energy costs usage. Performing a mill wide study will uncover many, many opportunities. Studies are not difficult and can be accomplished in a fairly short period of time, but do require a dedicated team and the application of operations expertise and engineering knowledge. Today powerful computer tools are available to simplify the tasks. Opportunities should be prioritized based on capital / non-capital, short- / long-term requirements investment return, and overall mill impact. The results of the study, when implemented, can save lot of money.

About the mill

M/s Abhishek Industries Ltd., (ABIL) is an integrated pulp and paper mill situated at Dhaula, District Sangrur, Punjab. It is a part of Trident group of companies. The mill produces Eco-friendly paper varieties using wheat straw, an agro based residue. The mill is a success story following the path of sustainable development and continuous improvement.

The paper division of ABIL was established at Dhaula, Punjab in the year 1993. The mill was initially established as a 75 tpd Writing and Printing grade paper mill, based primarily on Wheat Straw. The mill installed a new fourdrinier paper machine, a captive pulp mill with rotary batch digesters, brown stock washing, screening and cleaning, four stage bleach plant (C-E-(P)-H-H) and supporting utilities. ABIL has upgraded its paper mill to expand the capacity and make the operations more environmentally friendly. Presently the mill produces 117 tpd of printing and writing paper grades, which are widely accepted in the national and also international markets. Presently ABIL has embarked on massive expansion to go for 392 tpd with Eco-friendly and Energy efficient technologies.

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INTRODUCTION

Economic growth is desirable for developing countries, and energy is essential for economic growth. If India has to achieve the targeted growth in GDP, it would need commensurate input of energy, mainly commercial energy in the form of Coal, Oil, Gas and Electricity. India's fossil fuel reserves are limited. The known reserves of Oil and Natural gas may last hardly for 18 and 26 years respectively the current reserves to production ratio. India has huge proven Coal reserves (84 billion tonnes) may last for about 200 years but the increasing ash content in Indian Coal as well as associated greenhouse gas emission are the major concern. In the business as usual scenario, the exploitable Coal may last for about less than 100 years. India's fossil fuel reserves are limited. The slogan for the day is "Save Energy".

Many mills are facing the energy crisis, even though the impact is not as pointed as it was earlier. The European Union (EU) has developed comprehensive Eco-Labeling schemes that relate to energy consumption during the making of paper (1). Mills would have trouble meeting these standards. No matter what the cause of the crisis, mill can reduce their energy by taking some time to review their operations and applying a dose of common sense and engineering know how. "Energy saved is energy generated". The Energy Conservation Act – 2001 and BEE emphasize "Promoting the use of energy efficient hard wires and services for reducing energy intensities in a financially attractive manner are the major means".

Energy audits have to be conducted regularly as a means to identify opportunities to reduce energy consumption. Process Technologies i.e. Higher yield pulping, High consistency bleaching, Shoe presses, Electric drives etc., have caused a shift in the ratio of steam / electric energy consumption within a mill. Additionally, "good design" thermal efficiency for Recovery boiler, firing 80% solids is considered to be 69.5% while combination boilers (bark, Suspension firing with Hydrograte™) is 73.2% (2). Based on a recent survey (3,4), the best mills in US consume:

In India, only 55-58% of energy is used and the balance 42-45% is wasted. However, international plants use 75-78% of the energy and waste only 22-24% only (5).

To attain the international standards, we have to do the systematic energy audits and implement the suggestions for energy conservation. "Energy saved is energy generated".

ENERGY – BEST OF CLASS IN PULP AND PAPER INDUSTRIES :

Area	Electric (kWh/T)	Steam (lbs/T)	Water (gal/T)
Woodyard	12.3		Nil
TMP, Southern Newsprint	3000	(4500)	
Kraft Mill, Bleached	115	1980	475
ECF Bleach Plant, Kraft	130	710	3170
Caustic Room	40	551	
Pulp Dryer	108	2155	608
Recycle	560	Nil	
Paper Machine, LWC	500	4860	4060
Paper Machine, Newsprint	580	3700	3350
Paper Machine, Liner	360	4700	5400
Paper Machine, P&W	590	6200	
Waste water Treatment	320	NA	Nil

- Review cost data – where / why is the energy being consumed
- Review practices and procedures – ask the questions "Why, Why and Why?"
- Survey the facility – several passes are better than one
- Review technology – potential for significant gains
- Get input from operators – they know what is happening
- Benchmark – how does the mill compare to others
- Allow time to develop and critique ideas
- Develop implementation cost and benefits for each opportunity
- Develop criteria for prioritization

ENERGY USAGE PATTERN IN A PAPER MILL IN INDIA:

(Per cent)	Power consumption		Steam consumed		Potential savings in power
	Large mills	Small mills	Large mills	Small mills	
Chipping	4	6	-	-	42
Pulping	22	29	21		11
Stock making	18	25	-	58	12
Recycling Chem.	16	-	44	-	33
Paper making	40	40	35	42	25

LARGE INDIAN PAPER MILLS: ENERGY EFFICIENCIES:

Area	Efficient Mills		Average Mills		Difference	
	Thermal (G.Cal)	Electrical (kWh)	Thermal (G.Cal)	Electrical (kWh)	Thermal (%)	Electrical (%)
Chipping	-	60	-	85	-	41.67
Pulping	0.98	350	1.65	353	68	0.86
Stock making	-	302	-	326	-	8.11
Chemical Recycling	1.88	180	2.16	250	15	38.89
Paper making	1.92	548	2.43	661	27	20.51
Total	4.78	1440	6.24	1675	31	16.31

Where to Start

A successful energy reduction study requires:

- Support from senior mill management
- Dedicated, Cross-functional team
- Stated, written objective
- Implementation – plan

There must be an owner/ champion for the study, otherwise the team will lack direction and purpose.

Once the team is assembled, it needs to:

- Review operations data with benchmarking data

IMPLEMENTED ENERGY SAVING ACTIVITIES IN ABIL-PCD:

Highlights of a few other Energy Conservation activities:

- Installation of Delta Star Starters on Digesters
- Modification in PCC Panel of Paper machine

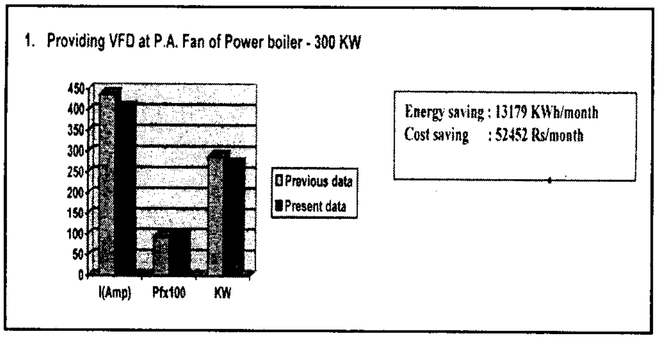

Fig. 1 : Providing VFD at P.A. Fan of Power boiler - 300 KW

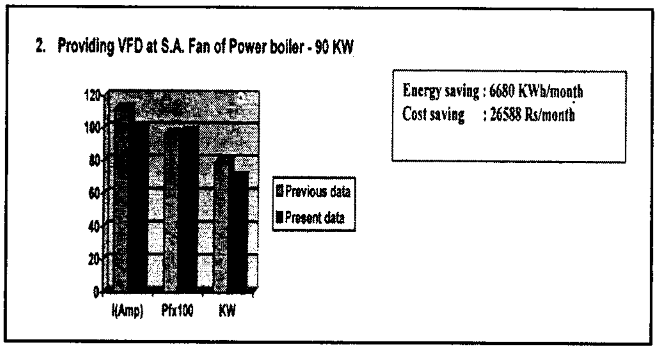

Fig. 2 : Providing VFD at S. A. Fan of Power boiler - 90 KW

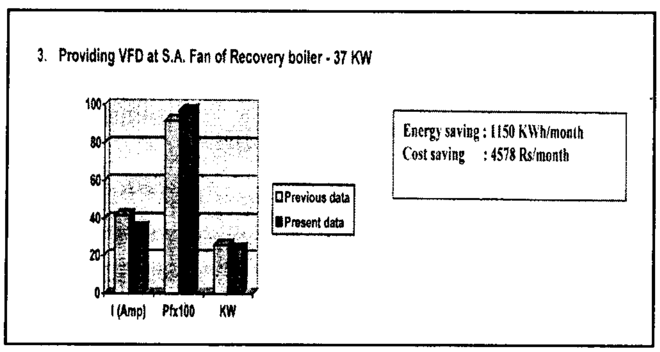

Fig. 3 : Providing VFD at S.A. Fan of Recovery boiler - 37 KW

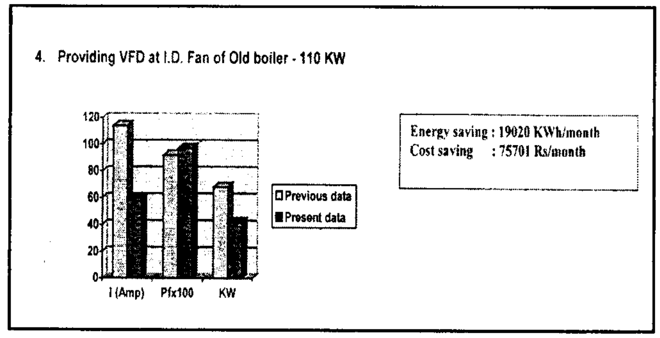

Fig. 4 : Providing VFD at I. D. Fan of Old boiler - 110 KW

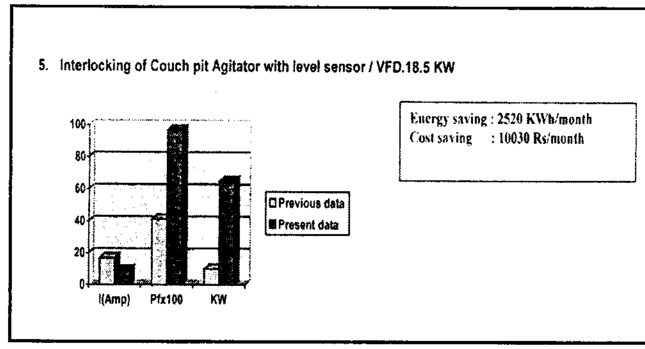

Fig. 5 : Interlocking of Couch pit Agitator with level sensor / VFD. 18.5 KW

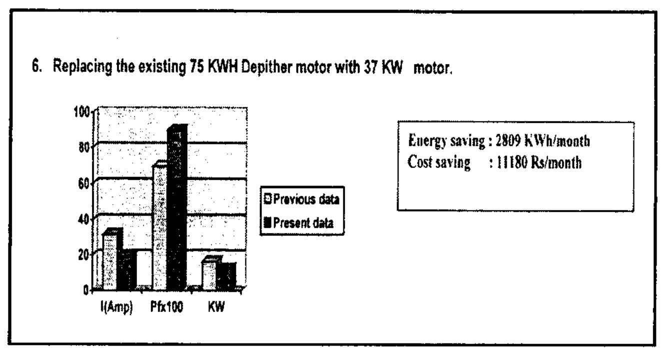

Fig. 6 : Replacing the existing 75 KWH Depither motor with 37 KW motor.

- Power factor improvement by installation of Capacitors
- Optimisation of Vacuum circuitry
- Optimisation of working Agitators at ETP
- Installation of Variable Frequency drive on Simplex Cutter, Duplex Cutter & Brown Stock Washer
- After analyzing the loading pattern of motors, corrective actions have been taken to improve the efficiency of motors
- Installation of Capacitor banks near load center to minimize the line

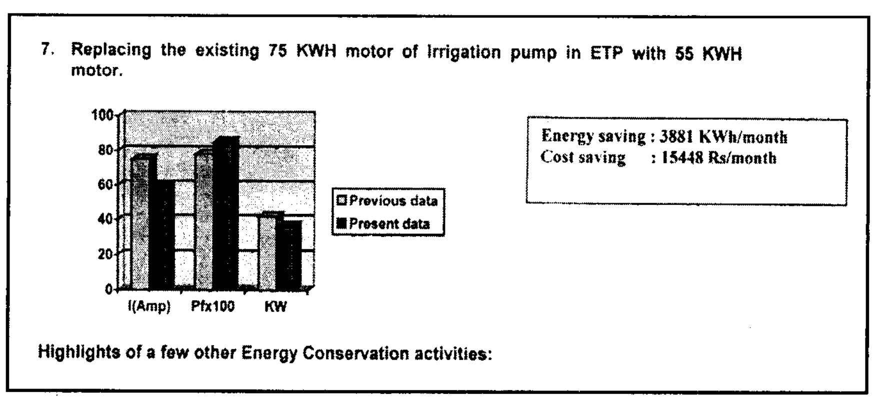

Fig. 7 : Replacing the existing 75 KWH motor of Irrigation pump in ETP with 55 KWH motor.

losses

- Interlocking of Bucket elevator with Conveyor in Causticizing plant
- Optimisation of working of Support insulator heaters in ESP
- Replacing the under loaded motors with lower capacity motors
- Installation of Variable Frequency drive at Fan Pump of Paper machine
- Connecting some of the under loaded motors in star connection to improve their efficiency
- Auto start / stop system for Couch pit pump of Paper machine.

Potential areas for implement of Energy Conservation in ABIL- PCD:

Boilers

The paper division is equipped with 4 Rice Husk fired and one Black Liquor fired (Soda Recovery) boilers. It is proposed to carry out the performance testing by measuring all data such as Oxygen, Carbon Monoxide content, Carbon Dioxide, flue gas temperature etc either by portable instruments or data can be taken from operation panel to apply an exhaustive heat balance across the boiler to find out heat losses due to intrinsic moisture content of fuel, unburnt losses, structural loss, etc. in order to improve the efficiency by minimising heat loss through stack, heat recovery, improving existing insulation, using high efficiency burners, and proper instrumentation and controls will be examined.

Steam distribution system

The main steam lines in the existing distribution system in paper divisions will be reviewed from the generation center to the utilisation centers. The aim would be to identify the major energy losses taking place due to excessive surface temperature or degraded insulation. Surface temperature of major steam and condensate pipelines ("2" pipe dia.) will be measured around the pipelines at every 10-15 metres interval. The temperature of damaged/bare portions of the lines will be checked thoroughly and the surface area noted down. The heat losses from the lines as well as possible reduction in heat loss from degraded surfaces will be quantified.

Air compressors

The paper division is equipped six Screw-Compressors. The actual operating efficiency of compressors (pump-up test or FAD) will be evaluated and compared with the design. For this method, pump-up test will be carried out by measuring the air velocities at the suction filters of the compressor. Based on this, efficiency of the compressors would be established. Actual specific power consumption would also be worked out by measuring the power consumption, simultaneously.

Cooling Towers

Two Cooling Towers are installed at the plant catering to the Turbine condenser and Evaporator surface condenser etc. The study of Cooling Towers will evaluate the performance by measuring various parameters. Range and approach would be calculated to assess the actual performance and to improve the same. Installation of various energy-efficient devices and new materials will be studied and technically feasible and economically attractive measures will be recommended.

Pumps

The plant has total of around 50 pumps above 30 HP of different types and capacities. The performance of selected pumps would be evaluated by obtaining data on discharge, pressure/ head and input energy to the electrical drives. The actual power taken by the motor will be measured with help of a highly accurate digital power meter. The actual performance of pumps would be compared with the rated performance obtained from characteristic curves to assess the deviations, based measurements and subsequent analysis, recommendation for improving the energy efficiency/ reducing input power consumption's of pumps shall be made. These would range from downsizing pumps to optimization techniques like installation of VFDs (Variable Frequency Drives). These recommendations will be based on detailed techno economics evaluations.

Electric motors

Measurements of the electrical parameters pertaining to the motors would be carried out at operating load condition. Based on these measurements and the subsequent analysis recommendations about replacement of the over-sized motors by the appropriately sized ones will be provided. Besides, it is also proposed to field test 10 rewound / old inefficient motors at no-load conditions as well. The operating characteristics such as load, efficiency, power factor etc. of these motors would be worked out and performance curves would be developed through latest simulation software. Other energy conservation options such as delta-star changeover, use of variable speed drives, soft starters-cum-controllers, improved transmission drives (like fluid couplings, eddy current couplings, modern flat belts etc.) will also be explored.

Transformers

It is proposed to take up audit of all distribution transformers to optimise their loading and improve the operating efficiency by studying the existing loading patterns and its distribution as well as future load demand. Quanlification of transformer losses and efficiency would be possible after such a study, based on which recommendations will be made to increase the overall system efficiency and cut down the losses.

Power factor and demand management

The purpose of this study will be to suggest ways and means to improve the existing power factor and optimise the contract demand by studying the various loads and their loading pattern in different sections of the plant. Average power factor of the plant is 0.95 lagging. Power factor improvement possibility and better regulation at feeders would be explored under this study. The power factor improvement will release the additional load and also reduce the losses in associated cable, transformers and other control equipments. A complete techno-economics of such improvement will be worked out under the proposed study. Other useful suggestions regarding size of the capacitor banks and their locations would also be studied. Possibility of reducing load demand and simultaneously setting optimum contract demand for the plant would be suggested under the study. The capacitors would be checked to calculate the kVAR delivered by them against their rated capacity. Corrective measures could be taken by the plant like replacement of faulty capacitor banks to improve the kVAR delivered into the system after this analysis.

Harmonic analysis

It is proposed to carry out a Harmonic analysis of the distribution system with the following specific objectives:

- Evaluation of the harmonic distortions and power factor at concerned feeders
- Comparison of the distortion with available standards
- Providing various optimal solution to the harmonic problems

Three phase harmonic analyzers would be used to measure operating load, harmonic distortions (both current and voltage) and the harmonic spectrum upto a maximum of 30th harmonic. These measurements shall be carried out on different feeders. Feeders shall be selected based on non-linear load (like VFD, rectifiers), location of PCC (point of common coupling) and various switching condition of the plant load. Results obtained from field measurements would be used to simulate different operating conditions including effects of capacitors installed in the plant. This simulation will help in identifying the worst harmonics in the system. Harmonic simulation would be carried out using simulation tools.

Harmonic distortions shall be compared with standards IEEE 519, to access the deviations from the specified limits. Optimal solutions in terms of reducing the distortion as well improving power factor of the plant would be provided. The optimal solution would primarily involve recommendation of appropriate filters (tuned and detuned).

Lighting:

In the proposed study, the characterisation of total lighting load of the plant with reference to the type and wattage of different lamps under use will be carried out, which will form the basic building block upon which other energy saving options will be based. The objective of the lighting audit will be check the existing illumination levels and comparing these values with available norms. Suitable recommendations will be provided to conserve energy by regulating illumination levels without affecting the working conditions. The choice of the existing light sources and luminaries will be reviewed and improvements.

Solar Thermal Energy Systems

Solar Thermal Energy Systems, which can generate hot water/low pressure, steam now available in Indian Market. These systems are being used for hot water/steam generation meet industrial requirements. These are commercially viable systems with typical payback period of 2-5 years depending on the type of conventional fuel saved. Under proposed Energy audit study we plan to undertake the detail feasibility study to explore the use of solar energy in the plant.

OBSERVATIONS & CONCLUSIONS

On account of the above mentioned measures taken, considerable saving in power cost has been achieved.

Energy saving proposals:

- Power saving by providing step down transformer/automatic voltage stabilizer in lighting circuit. Total lighting load=250 kw Saving anticipated = 10-15% Total saving per day = 250x0.10x12=300 units per day (considering 12 hours running of light load).
- Installation of 45 kW VFD Variable Torque at ETP agitators
- Installation of Solar System for preheating of process water.
- Power saving by making a load study of individual motors.
- Power saving by fitting power saver on air conditioner
- Power Factor improvement at load centres i.e. MCCs thereby eliminating line losses
- Installation of 500 kW VFD at ABB Blower.
- Installation of Cyclic Timers in Submersible pump circuit at paper machine
- Power saving by replacing conventional chokes with electronics chokes. Saving per choke=10watt/hour.
- To conserve Energy by Elimination of losses and Optimizing the process parameters, Data collection, analysis and identification of higher consumption areas and then priority wise initiation of energy conservation steps in various sections.

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