Emerging Trends in Energy Management at Harihar Polyfibers

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ABSTRACT

Harihar Polyfibers a unit of Grasim Industries Ltd. produces dissolving pulp from Eucalyptus and mixed hard wood by prehydrolysis sulphate process. The industry has adopted two fold approach of reducing consumption and increasing generation of both steam & power. Higher steam generation achieved by increasing thermal efficiency of waste heat boiler, Power generation by better conversion efficiency in co-generation Turbine. The consumption is reduced by energy efficient operations. In this regard the industry has implemented several saving projects varying from very small to big based on Return on Investment through innovative technologies, intrinsic equipment efficiency improvements and modification in shop floor prodedures. The major and notable projects are Evaporator plant upgradation incorporating free flow falling film finisher, Recovery boiler modification with tertiary cold air combustion technology, platen screens and super heaters, Advanced Instrumentation & Controls, Process automation, High speed multi knife double anvil chippers, Incorporation of micro processor based energy saving devices & Secondary heat recovery. With this approach the requirement of purchased steam dropped from 1.8 T/t of pulp to 0.77 T/t of pulp & purchased power dropped from 269 kWh/ton of pulp to 194 kWh/ton of pulp i.e. reduction of 57% & 28% respectively.

To bring down the purchased steam & power to zero by the year 2005, The mill is evaluating various projects such as upgradation of second Recovery boiler, Replacement of existing extraction back pressure turbine with energy efficient double extraction bleed type condensing turbine, Slow motion slaker, Application of crystillizer technology in Evaporator, Vapour absorption chiller & Digester steam condensate heat recovery.

INTRODUCTION

Grasim Industries Ltd. is one of the leading producers of dissolving Pulp and Viscose staple fibre in South east Asia. Harihar Polyfibers, a unit of Grasim Industries produces 70,000 MT/year of dissolving pulp. Eucalyptus wood chips are cooked in batch digesters by prehydrolysis sulphate process, washed in four stage countercurrent pressure washers,

Harihar Polyfibers
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centricleaned and bleached with CE/OHEDSO2 sequence. The bleached pulp is dewatered, flash dried and baled as final product. The produced pulp has 91% ISO brightness and meets all requirements to produce quality viscose staple fibre.

Weak black liquor from pulp washers is concentrated in two streams of five stage multiple effect evaporators & Free flow falling finisher and fired in Recovery boilers. Salt cake is used as make-up for chemical loss during pulping and recovery process. The mill operates at Chemical recovery efficiency of 97.5%. The green liquor is recausticized and lime sludge is recycled & reburnt in Rotary lime kiln to produce high purity lime. High pressure steam generated in the Recovery boiler powers extraction back pressure co generation turbine. The extraction and back pressure steam are used in the process.

MILL APPROACH

The mill started its operation in 1972. The mill has been under a continuous process of improvement and has established quality management system, environmental management system & resource management system. Presently the mill is working on adopting World Class Manufacturing practices.

To keep in pace with the change in technology, the industry conducted periodical energy audits both by inhouse energy cell & foreign consultants such as Ekono consulting Engineers Finland, Indsutrial Process Consultants Sweden, Ahlstrom Finland, Emerging Technologies inc. USA, Fl Smidth Denmark, Babcock Wilcox USA. The mill engineers attended Seminars both national/International and visited mills abroad from time to time to evaluate the latest technologies for adoption and application in the mill. Several projects have been implemented based on Return on Investment.

EMERGING TECHNOLOGIES

(I) EVAPORATION PLANT UPGRADATION

The unit had Bertrams Scott design 2 identical streets each having 5 effect long tube vertical evaporator & one no. horizontal finisher using medium pressure steam. The horizontal finisher was replaced in 1986 with forced circulation finishers suitable for using low pressure steam as per IPK design. Each Finisher was driven by 200 HP motor to maintain required velocity of the liquor in the tubes. With this modification, the black liquor concentration increased from 57% dry solids to 60% dry solids & power generation increased by 8% due to use of low pressure steam instead of medium pressure steam. The evaporator plant was further upgraded in 1996 by incorporating Free Flow Falling Film Finisher of Enmas Ahlstrom, operated with 3 circulation pumps of 60 HP each, additional heaters and conical bottom storage tank. The solids concentration increased from 60% dry solids to 70% dry solids & power consumption in the finisher stage reduced by 55%.

(II) RECOVERY BOILER RETROFIT FOR IMPROVED THERMAL EFFICIENCY

Originally the Recovery boiler was designed for handling 60% dry solids. To operate the boiler at 70% dry solids, Recovery boiler No. 1 was modified through Enmas Ahlstrom in 1996 with new 3 level cold air combustion system, new membrane wall lower furnace, hearth spray, 2 spouts, platen type screens & super heaters and large parallel flow economizer. Electro static precipitator was modified replacing spiral emitting electrodes with multi peak electrodes & a new extended chamber with multi peak emitting electrodes was incorporated.

With this modification, thermal efficiency improved to 70%, Black liquor solids handling capacity increased by 16% & the boiler runnability enhanced from 2 to 4 months. The increased steam generation from Recovery boiler reduced the steam draw from ausiliary coal boiler, the steam inlet temperature to the turbine increased resulting in more power generation.

(III) ADVANCED INSTRUMENTATION & PROCESS AUTOMATION

❑ DIGESTER AUTOMATION

90 control loops were introduced in the batch digesters & the operations were automated with ABC batch Fisher Rosemount System in 1998. This resulted in better steam leveling in the digesters with improved turbine power generation, steam consumption in digester was reduced by 3% in addition to improvement in pulp quality.

❑ WASHING AUTOMATION

28 control loops were introduced & automated

with Yokogawa DCS system in 1992. The hot water flow in the final stage is controlled based on stock flow & alkali carry over optimizing the dilution factor. This has resulted in better chemical recovery & higher concentrated black liquor to evaporation plant, improving steam economy in the evaporator.

❑ BLEACHING AUTOMATION

24 control loops were introduced & automated withYokogawa DCS system in 1992. There are online analysers, chemical concentration & flow controls, steam, hot water & back water flow controls to optimize steam consumption

❑ EVAPORATION PLANT, RECOVERY BOILERS & CAUSTICIZING

In Evaporation plant there are 18 control loops with Single Loop & double Loop Programmable logic Controllers, temperature scanners to control the heat transfer in each stage to improve the steam economy.

In Recovery Boiler there are 24 control loops with Single Loop Programmable Logic Controllers to control combustion by monitoring air flow, air temperature & flue gas temperature, improving thermal efficiency.

In Causticizing there are 10 control loops with Double Loop Programmable logic Controller to maintain the liquor temperature optimizing the steam consumption.

(IV) HIGH SPEED MULTI KNIFE DOUBLE ANVIL CHIPPER

Earlier, chipping system consisted of 5 Nos. small capacity, low speed, single anvil disc chippers, 2 Nos. Drum rechippers and 5 Nos gyratory screens. A, New chipping system of Fulghum, USA was installed in 1999 comprising of 2 Nos. high capacity, high speed multi knife double anvil disc chippers, 1 No disc rechipper and 1 no rotary drum screen. With this new chipping system, electrical power consumption was reduced by 25%, the dust separation is better, improving steam generation from the saw dust boiler, the chips quality has improved, reducing raw material input, and load on effluent is also reduced due to improved dust recovery.

ECONOMICS

In the last 10 years 110 projects were implemented at an investment of Rs. 351 million & the savings achieved Rs. 124 million p.a. which are categorized in the table below:

Sl. No.	Category	No. of Projects	Investment Rs. Million	Saving Rs. Million p.a.	ROI %
1	Innovative technologies and new equipments of Intrinsic efficiency	28	266	101	30
2.	Recovery of energy	24	43	16	30
3.	Improvement of system reliability & modification in floor level procedures	58	42	7	9
	Total	**110**	**351**	**124**	**28**

(ROI: Return on investment after 15% interest on 50% block investment)

The projects belonging to category 1 are listed below which gives a glimpse of the several projects implemented:

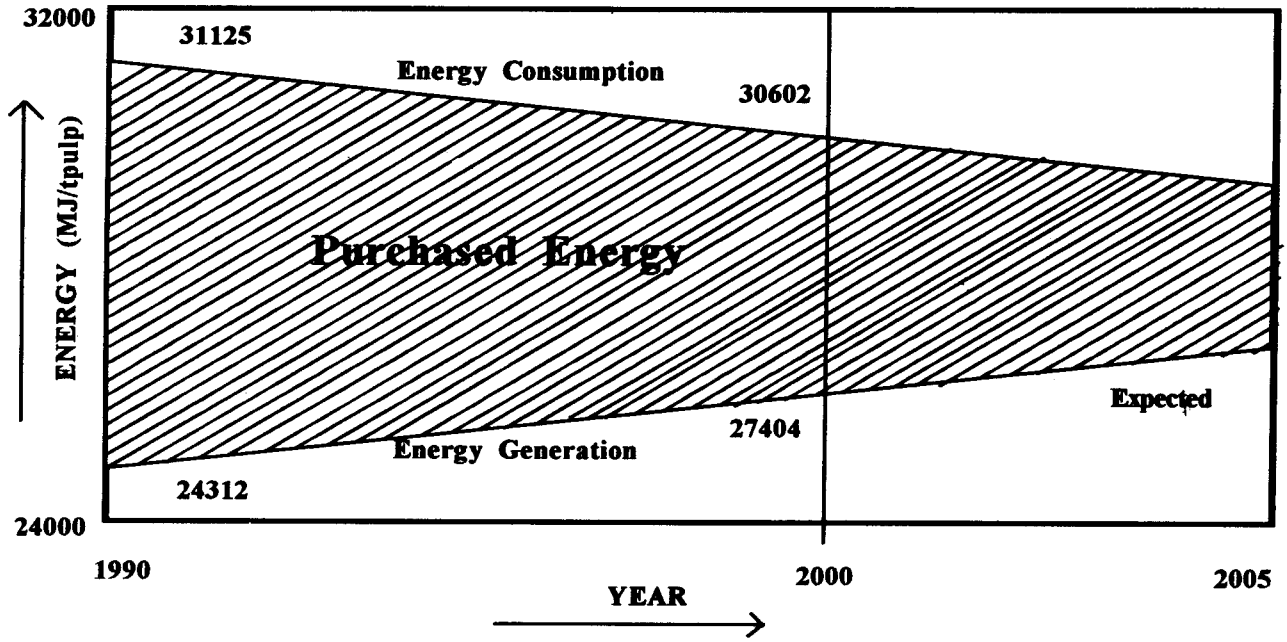
Sl. No.	Project	Savings
1.	Automation of washing bleaching & digester operations with DCS System.	Steam
2.	Modification in Evaporator finisher pump.	Steam
3.	Modification as per IPK proposal for secondary Heat recovery.	Steam
4.	Improving saw dust boiler steam generation using hot Digester Steam condensate in place of cold demin water.	Steam
5.	Modification in IPK finisher pumping system to maintain Higher velocity in the tubes for better steam economy.	Steam
6.	Coal boiler steam line modification for steam saving.	Steam
7.	Renovation of Rec. Boiler No. 1 with tertiary cold air combustion technology.	Steam
8.	Higher efficiency pump for sulphate vent heat recovery pump with temp. control loop.	Steam Power
9.	Hot alignment of Rotary Lime kiln for improved kiln reliability and lime quality.	Steam
10.	Optimisation of process pumps impeller size based on Process requirement	Power
11.	Higher capacity intake well pump to reduce running hrs of second pump.	Power
12.	Replacement of incandescent lamps by Sodium vapour lamps.	Power
13.	Replacement of inefficient motors with energy efficient motors in Pulp mill.	Power
14.	FRP fan in place of metallic fan in water plant & chilling plant cooling tower.	Power
15.	Modification in MOL sump box & installation of higher efficiency pump.	Power
16.	Energy saver/soft starters for agitators in reaction Towers.	Power
17.	Replacement of worm reduction gear boxes with energy efficient helical gear boxes in dewatering presses.	Power
18.	Retrofit of Evaporator Plant with FFFF Finisher for better steam economy and less power consumption.	Power
19.	Installation of micro processor based variable frequency drives in pressure washers, vacuum filters & lime kiln.	Power
20.	Replacement of old series motors with higher efficiency IP55 protection motors.	Power
21.	Replacement of Belt Filter with energy efficient Lime Mud Gravity Washer.	Power
22.	Installation of energy efficient pumps in process liquor & pulp application.	Power
23.	Replacement of existing 2 Nos. Medium white liquor pumps with higher capacity pump.	Power
24.	Replacement of V-belts with flat belts	Power
25.	Lime kiln ID fan modification for power saving.	Power
26.	Installation of high speed multi knife double anvil chippers.	Power
27.	Modification in Intake well pumping system to reduce friction loss through separate delivery lines for individual pumps.	Power
28.	Higher efficiency Screw press back water pump	Power

PRESENT SPECIFIC ENERGY CONSUMPTION

Energy		Steam		Power
	Unit	Per ton of pulp	Unit	Per ton of pulp
Generation	ton	7.71	kWh	658
Consumption	ton	8.48	kWh	852
Purchased	ton	0.77	kWh	194
Purchased/Total Consumption	%	9	%	23

ENERGY TREND

The purchased energy is continuously reduced as depicted below:



FUTURE PROJECTS

The mill is evaluating the following projects to further minimize the gap between energy generation and consumption.

- Upgradation of the second Recovery boiler with lower furnace replacement by new membrane wall furnace, hearth spray firing, two spouts and improved tertiary cold air combustion technology.
- Replacement of existing extraction back pressure turbine with energy efficient double extraction bleed type condensing turbine. The new turbine will be installed in March 2001 and as a result there will be more co generation power & high cogeneration efficiency.
- Replacement of existing conventional stationary slaker with slow motion slaker to reduce steam consumption.

- Incorporation of crystallizer technology in Evaporator for optimizing the evaporator plant operation.
- Replacement of existing ammonia compressor refrigeration system with steam driven vapour absorption chiller.
- Advanced instrumentation & control with heat exchanger and polishing unit for digester steam condensate heat recovery and reuse as boiler feed water.

CONCLUSION

The mill has been carrying out regular exercises to reduce energy consumption by regular evaluation of emerging technologies, through, in house Energy Cell & as well as Consultants from India & abroad. The reduction of purchased energy by two fold approach of reducing the consumption and increasing the generation has made the mill less dependant on external energy suppliers and fuel cost variations. this has helped the mill to remain competitive in the business.