Adoption of Energy Efficient and Environmental Friendly Technology - A Case Study at JK Paper Mills

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INTRODUCTION

With an installed capacity of 18000 TPA paper production J.K. Paper Mills was started in 1962. During these years, with continuous growth efforts we reached to 75000 TPA paper. In 1994-95 came the idea of modernization for complete change over to state-of-the-art teechnology. Commercial production came into effect from the most modern pulp mill in early 1998. originally we had the system of con ventional digesters, two parallel streets of washing, screening and CEHH bleaching for 160 TPD. From 1998 we changed over to **EXTENDED DELIGNIFICATION COOKING AND SINGLE STREET FIBRE LINE** of 400 TPD. In place of old evaporator and causticizer we changed over to new FFFF tubular evaporator and modern causticizer. Old stoker type CF boilers No.1 and 2 were converted to FBC boilers along with installation of one new FBC boiler No.5 and one Liuquor fired boiler of 300 T solid firing capacity.

With the increased consumption level and finite availability, energy sources are depleting day by day. To subsist in the highly competitive buyers market it has become necessary to bring down unit price of the product and improve on quality as desired by the customer. Paper industries are one of the major consumers of all energy sources therefore it is the area which needs a serious look and efforts to be made in this direction to conserve energy. J.K. Paper mills considered it as the most important aspect, which compelled us to switch over to modern technology.

Energy efficient and eco-friendly nature of extended delignification cooking and fibre line gave us the courage to discard the running of old energy deficient pulp mill completely. The futuristic vision to conserve energy sources has helped us to meet stringent environmental requirement of the region also. In order to combat the energy crisis we have given equal priority to water conservation also along with heat and electric energy because water conservation has energy cum pollution load impact on us.

We are mentioning in brief the different measures taken by us with respect to water, electric energy and steam conservation.

WATER ENERGY

JK Paper mill is situated at the riverbank of NAGAWALI, which is a seasonal river of Orissa. Being a draught prone area water consumption level is always a great concern for us. Apart from merely consumption point of view we are bound by stringent pollution control regulations as the river water is the main source of drinking water in near by tribal locality. As it is a very sensitive issue, we always endorse all necessary priorities to keep a track on it. With our continuous efforts, our water consumption has come down as shown below :

	EARLIER	PRESENT
Volumetric Pattern	170M^3/T paper	120 M^3/T paper
Energy Pattern	30 kW/T Paper	21 kW/T Paper

In order to bring down the water consumption level to 70% with subsequent reduction of the pollution load we have taken following measures-

By incorporation of high tech system in our washing and bleaching plant water consumption in pulp mill alone has been reduced by almost 50% compare to consumption pattern per ton pulp in our

J K Paper Mills,
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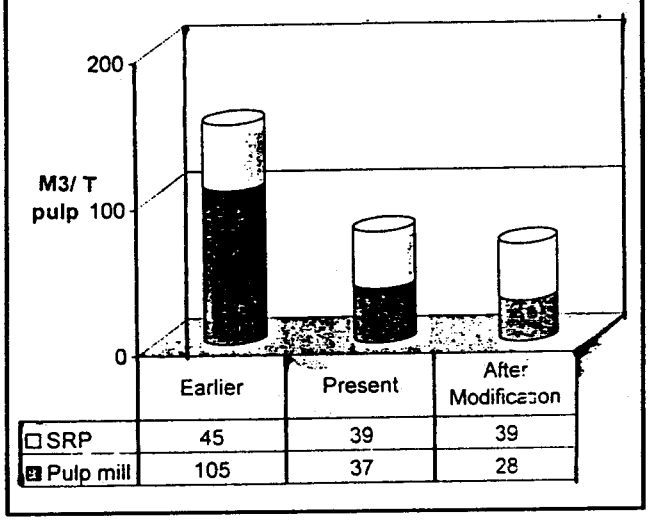
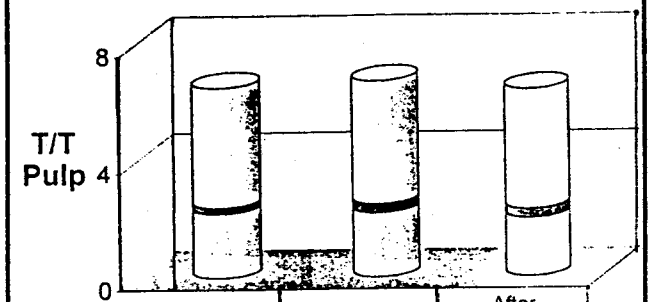
Fresh Water Consumption M³/T Pulp



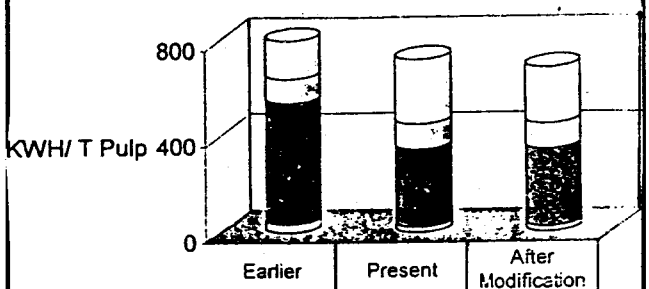
	Earlier	Present	After Modification
SRP	45	39	39
Pulp mill	105	37	28

Steam Consumption T/T Pulp



	Earlier	Present	After Modification
SRP	4.1	4.2	4.1
ClO2	0.2	0.3	0.3
Pulp mill	2.2	2.2	2.0

Power Consumption kWh/T Pulp



	Earlier	Present	After Modification
SRP	160	270	235
ClO2	100	105	105
Pulp mill	505	323	323
Chipper	35	22	22

conventional pulp mill.

Oxygen delignification stage prior to bleaching has reduced the pollution load by 35-40% from bleach plant thereby resulting in scope of reduction of energy requirement in effluent treatment plant.

Compare to conventional screening cum cleaning section, present fibre line is more water efficient because of non-requirement of centricleaning system and high consistency screening technology.

Apart from above hightech system of the plant our energy team adopted lots of steps to further bring down water consumption level. Brief description of some major steps is as below-

1. Reuse of 100% paper machine backwater after clarification in fibre line has further reduced fresh water consumption from 27 M³/T Ton of pulp to merely 9 M³/Ton of pulp in bleach plant.

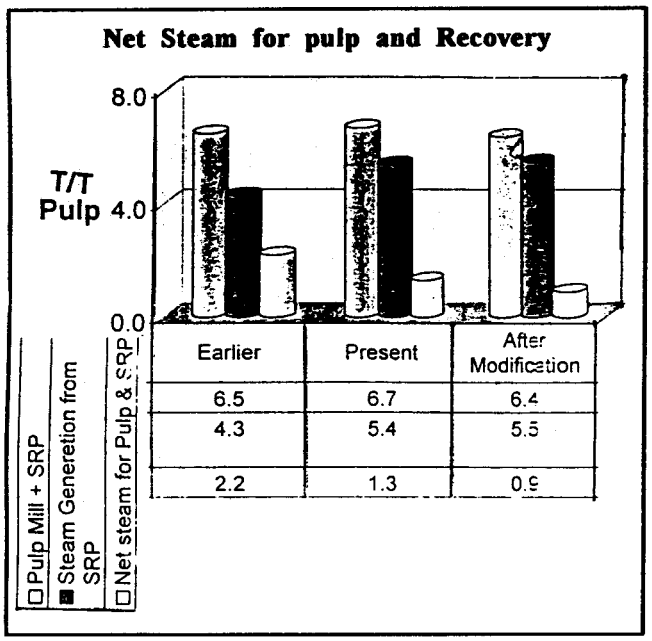
2. Closure of Post oxygen washing stage with liquor recovery system has been suggested that will further reduce 9 M³/Ton of pulp fresh water consumption in unbleached section. This will also reduce overall pollution load of fibre line by another 40%

In pulp mill alone including Clo_2 generation plant our fresh water consumption pattern is as follows-

With conventional system	105M³/T of pulp
With extended delignification cooking and Fibre Line	55 M³/T of Pulp
After employing scheme 1	37 M³/T of PUlp
After employing scheme 2	28 M³/T of Pulp

ELECTRICAL ENERGY

Earlier we were using 30% imported softwood pulp to meet production demand of 75000 TPA paper production. Now not only we have displaced imported pulp completely with our own mill pulp in respect to quantity and quality to produce 90000 TPA paper but also we are prodcuing high quality saleable pulp. With the enhanced pulp producing capacity followed by installation of one more recovery boiler our co-generation has also increased from 10 MW to 15.0 MW by improving TG sets operating level.



	TG power generation MW	% of total power demand
Earlier	10	67%
Present	15	82%

EFFORTS FOR SYSTEM STABILITY OF ORISSA GRID POWER SUPPLY

It is accepted fact that the eastern zone faces severe power cuts and quality of supply is poor, due to various factors. Moreover the Rayagada sub-station was commissioned 39 years back with low rupturing capacity, old design breakers and aging of distribution transformers, feeding rural feeders, passing through terrains.

Due to poor quality of power supply, frequent power cuts, interuption, restrictions, frequent power changeover and shuts J K Paper mills sustained huge production losses. Hence to over come loss of production and meet OSEB requirement for large industries and to improve the power supply system stability 132 KV power systems was commissioned in 1998.

Original fibre line plant of 400 TPD pulp production capacity is presently running at 300 TPD causing energy deficits at the moment. Moreover as compared to our old two streets of washing, screening and bleaching of 80 TPD each, a single street fibre line is certainly more efficient.

Present system has indeed invited adoption of electrical energy conservation methods to bring down power demand further. Keeping this in mind we went ahead with trimmed impellers of all pumps for the highest efficiency utilization right from the beginning. Power consumption pattern in pulp mill including chipper is as follows.

With conventional pulping	540 kWh/Ton of Pulp
With extended delignification cooking and Fibre line	345 kWh/Ton of Pulp

We installed centralized compressed air system by incorporating the state of the art energy efficient screw compressors in place of multiple small sized reciprocating air compressors. The centralized system under Phase-1 of the expansion programme has covered Chipper House. Digester House, New Fiber Line, Soda Recovery and Power Block. In Phase - 2 the compressed air system will cover the whole plant including paper machines with the addition of two more screw compressors.

In chipper house we installed single Vecoplan drum chipper of 25 TPH capacity in place of 2 No. of Disc chipper and 2 No. of Vecoplan drum chipper of 5 TPH capacity each for Hard Wood. Three No of octagonal Screens of Johnson's in place of rectangular inclined screens of Grasims were also installed.

Apart from this also our energy team has audited entire plant and identified certain equipments to be stopped/ interlocked for running without affecting the normal plant operation. It is also proposed to replace the conventional methods of air flow control viz. dampers and fluid couplings with variable frequency speed drives (VFD) in our CF and LF boilers fan applications. With this power conspumption is expected to further come down by 0.5 MW

STEAM ENERGY

After global escalation of fuel prices and faster deplection of fossil fuels it has become imperative to improve fuel efficiency as well as to reduce steam consumption.

Extended delignification cooking & Fiberline has got inherent system quality to have reduced steam demand due to cold blow system and intermediate heat recovery from hot black liquor through various

heat exchangers. In place of old six - effect LTV evaporator and causticizers were installed seven - effect tubular FFFF evaporator with designed improved steam economy and modern causticizers. Our net steam consumption for pulp and recovery has come down from 2.22 T/T to 1.3 T/T of pulp. However, our total steam consumption is still on higher side because of old system in paper machines.

Our energy team has suggested following measures in various to bring steam consumption are as follows:

1. Utilization of EOP backwaterheat to generate hot water by passing through heat exchanger. Expected steam savings are to the tune of 1.8 T/Hr.

2. Take oxygen blow tank condenser return water in hot water tank. 0.4 TPH steam saving is expected.

3 Stop taking Non Condensable Gasses cooler return water in hot water tank in Digester House. This has reflected a steam saving of 1.0 TPH.

Now I would like to take the advantage of this forum to explain the salient features of extended delignification cooking and Fibre Line plant at JK Paper Mills in brief specifically from energy and environmental point of view.

EXTENDED DELIGNIFICATION COOKING

In Kraft cooking process OH ions and SH ion are two main constituents of cooking liuquor. SH ions attack lignin more selectively as compare to OH ions. In conventional cooking total W/L is charged at a time thus at the beginning of cooking concentration of OH - ions remains high and reduces gradually at the end. In extended delignification cooking process like RDH four basic rules of cooking are followed-

1. Concentration of OH-ions is kept lower during the initial delignification phase and as even as possible through out the cook.

2. Concentration of SH-ions is kept as high as possible initially and at the beginning of bulk delignification.

3. Concentration of dissolved lignin and Sodium is kept as lower as possible, especially at the residual delignification stage.

4. Temperature is kept low especially towards the beginning and end of bulk delignification.

Comparison of extended delignification cooking Vs conventional Cooking system-

Apart from this complete automation and DCS control operation with on line controllers like H-Factor for cooking and alkali analyser for liquor charging has helped to keep W/L consumption to optimum level while maintaining uniformity of the pulp characteristics.

EXTENDED DELIGNIFICATION COOKING	CONVENTIONAL COOKING
● Preference given to SH-ions	● No preference is given to SH-ions. High OH- & low SH- ions in the beginning and Low OH- & High SH-ions at the end of cooking.
● OH-& Sh- ions concentration is maintained as uniform as possible through out the cook.	● Pulp strength is low compare to EXTENDED DELIGNIFICATION COOKING pulp.
● Pulp strength is high.	● No pulp washing in the digester.
● In digester washing before discharging.	● Pulp blowing at cooking temperature results in fibre damage mechanically and loss of heat during blow.
● Cold blowing at less than 100°C thus minimum damage of fibre and no requirement of blow heat recovery system.	● Non-uniform cooking due to no displacement and low bath ratio.
● Uniform cooking due to high bath ratio and continuous displacement.	● High Cooking Cycle Time
● Low Cooking Cycle Time.	● Cooked pulp Kappa is maintained 22-24.
● Cooked pulp Kappa ia maintained 16-17.	● Kappa variation is high.
● Low Kappa variation	

FIBER LINE

Fibre line plant is also Completely automized and controlled through DCS for all vital parameters viz. temperature, pressure, level, pH, residual chlorine along with on line brightness controller in C+D and D stage, which has helped in keeping chemical consumptions in optimum range while maintaining consistently uniform pulp in all respect.

Comparison of fibre line Vs conventional pulping system.

FIBRE LINE	CONVENTIONAL
• Environmental friendly Closed pressurized disc knotter - no emission losses.	• Open knoter - emission losses are high.
• Pressurized delta screens with Nimega slotted baskets , which features. 1. High screening efficient 2. Non-requirement of centricleaning system due to high cleaning efficiency over 98% with screens only	• Centrifugal screens along with four -stage centricleaning system.
• Pulp washing with displacement presses-2 Nos that features- 1. Low power consumption. 2. High washing efficiency	• Pulp washing with open vacuum washers only 1. High power consumption. 2. Low washing efficiency
• Oxygen Delignification stage prior to bleaching, which features- 1. Reduces pulp kappa by 35-40%. 2. Reduces bleach plant chemical demand to the same extent. 3. Reduces AOX level. 4. Increases BLS concentration as closed to liquor recovery system.	• Not applicable.
• Bleaching sequence is C+D, EOP, D	• Sequence was C,E,H,H
• Post colour number is <1.0.	• Post colour number is 5-8
• Final pulp brightness 88-89° EI	• Final pulp brightness 86-87° EI
• High strength properties.	• Pulp strength properties were low.