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RESOURCE CONSERVATION AS A KEY TO COMPETITIVENESS CASE STUDY FROM J K PAPER MILLS, UNIT RAYAGADA, ODISHA

Abstract

In the fast changing and highly competitive world, every player needs to meet the challenging expectation for sustainability as well as for survival. To face the customer dominated market with growing desire for quality, cost and services, Paper Industry in India also requires many reforms. It is witnessed in many other sectors that new entrants gallop the old giants of the recent past, with in no time.

Therefore staying update with latest technology for building competitive edge, caring for environment health and society, innovations for reducing cost of supply are the meaningful solutions.

J K Paper lead this motto in the country and installed Rs 1850 Cr project at its parental unit in Rayagada, Odisha. This expansion featured a complete switch over from decades old technologies to latest state of the art installation right from wood handling till product dispatch.

New pulp mill comprise with disc chipper, diamond back chip bin, continuous pulping, multistage washing with DD Washers and complete operation at medium consistency resulted in significant reduction in energy consumption as well as complete foot print size of the plant. Heat recovery from the bleach plant effluent has further reduced net heat requirement.

Two stage ODL, Acid stage before ECF bleaching sequence and addition of magnesium sulphate in ODL & EOP stage has helped in minimizing bleaching chemical by 30% and reduced AOX level to 1/3rd of its earlier level.

High pressure recovery boiler with 75% BL solid firing has improvised the biomass heat recovery by 33%. Balance energy demand is met by high pressure CFBC boiler. Old low pressure recovery and CF Boilers were phased out. This reform has improved the dependency on bio energy to a level of 59% from earlier 38% only.

Further, to cut down the impact on environment various innovative steps are also taken. Today solid waste disposal from the mill is nearly zero. Most of these are either reused in the process or taken as raw material by nearby ancillaries.

Details are highlighted in the paper.

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Introduction:

Amongst the emerging markets, India is topping the list with average 7.3% GDP in 2015.¹ The development pattern of India in the last two decades also shows an average growth of above 7%.² Growing awareness, literacy, urbanization is part and parcel of this growth.

Paper, being a necessary & an inevitable segment of growth, is projected to grow consistently in India. It is estimated that the demand of paper and paper board will be about 14 million tons in 2016-2017 and 24 million tons in 2025-2026.³

The Pulp and Paper industry has a strong dependence on natural resources and thus faces huge challenges to meet the demand and environment norms. Indian Paper Industry faces a tough competition from import as well. This industry is considered highly energy and water intensive. Therefore staying update with latest technology for building competitive edge, caring for environment health and society, making innovations for reducing cost of supply are the meaningful solutions.

J K Paper lead this motto in the country and installed Rs 18.5 Billion project at its parental unit in Rayagada, Odisha. This expansion featured a complete switch over from decades old technologies to latest state of the art installation right from wood handling till product dispatch.

Following are the key benefits derived from 2013 Expansion Project (Table-1)

Table-1: Expansion and its Benefits

Particulars	Units	Before Expansion	After Expansion	% Improvement
Pulp Production	TPA	110,000	215,000	96
Paper Production	TPA	125,000	286,000	129
Specific Coal Consumption	Ton/Ton of Paper	1.6	1.0	38
Water Consumption	M ³ /T of product	73	46	37
Steam Consumption	T/T	10.8	9.4	13
Power Consumption,	KWH/T	1360	1281	6

This paper features the major work carried out in Pulp and Recovery Island that was instrumental in conserving natural resources over the previous facilities.

New Fiber Line of 215,000 BDMT Capacity was commissioned in 2013 by phasing out 110,000 BDMT fiber line which was taken in operation in 1998. New pulp mill comprise with disc chipper, diamond back chip bin, continuous pulping, multistage washing with DD Washers, two stage oxygen delignification followed by screening and bleaching. Acid stage before ECF bleaching gives a perfect match for Indian raw material for producing high quality bleached Pulp with 89% ISO brightness. (Fig 1)

Fiberline

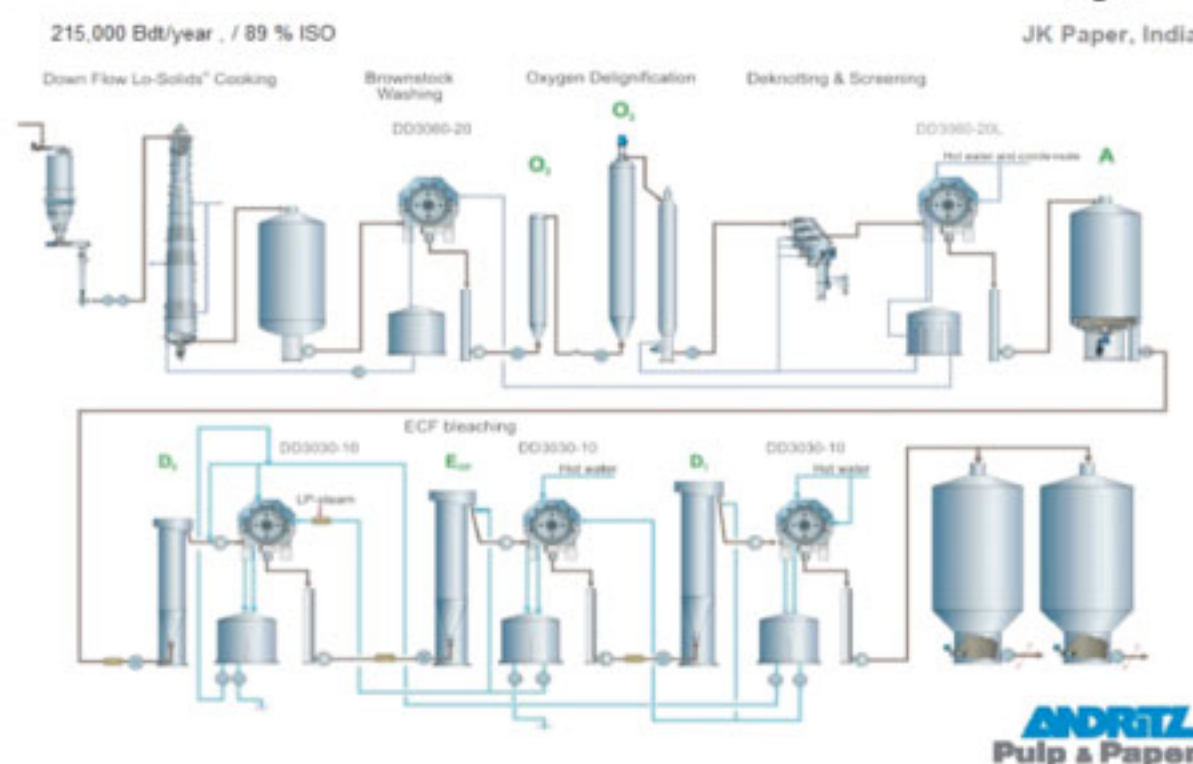


Fig 1

JK Paper, India

Salient features of the expansion project, which has given advantage on resource conservation over the previous technology includes

HHQ-Disc Chipper

In comparison to existing small drum chippers, one Disc chipper of 100 TPH produces lesser fines and thus conserves raw material. To meet the total chips demand old chippers are also in operation.

Diamond Back chip bin (Pre steaming vessel)

With no moving parts, the Simple & unique geometry of this atmospheric pressure operated vessel helps in better movement of chip flow before feeding to digester. Pre-steaming of the chips is also carried out here for improving the chemicals impregnation in digester. (Fig 2)

Fig 2



Continuous Digester (Down flow LO-SOLID Cooking)

Switching from batch digester to continuous cooking has made the digester house operation much safe and operation friendly. This single vessel continuous digestion system consists of impregnation, Lo solid cooking cooking & counter current washing zones.

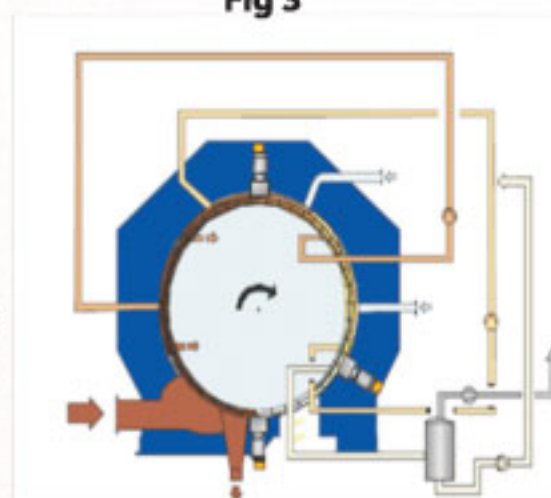
Excellent heat recovery system from the extracted liquor with the use of Heat Exchangers & Reboiler has cut down the steam consumption significantly. Lesser and efficient rotating parts e.g. Closed impeller chip pumps, Blow tank design without agitator, operating at medium consistency requires minimal power for operation in cooking section.

Drum Displacer Washer

With the compact design & the ability of DD Washer (Fig 3) to incorporate multiple stages washing in a single unit simplifies Fiber line layout i.e. much less space requirement. Power consumption for the similar duty is nearly 60% than other types of rotary washers. High washing efficiency due to fractionated & counter-current washing and also

- ✓ **Better control of filtrate circulation.**
- ✓ **Segregation of filtrate with different pH & temperature.**

Fig 3



Two Stage Oxygen Delignification followed by screening

Lignin is removed from the cooked pulp by oxygen delignification two reactors. After this, the pulp is screened in three stage screening and washed before bleaching. It substantially reduces the consumption of bleaching chemicals and the amount of dissolved organic material in the bleach plant i.e. COD, BOD & AOX emission which makes the process very environment friendly. By performing oxygen delignification prior to screening, a considerable fraction of shives is converted into good pulp with merely 0.3-0.4% rejects losses from screen room. Knots are pumped back to digester for re-pulping.

A – Stage followed by ECF Bleaching

Before entering the main ECF bleaching sequence, ODL pulp is processed through Acid stage using sulphuric acid as initial bleaching chemical to remove the Hexanuronic acid and lowers the kappa by 2-4 units. In addition the major advantage that we observed is removal of NPE's from the pulp and hence the scaling tendency in the subsequent stages is almost eliminated. D0- EOP- D1 is the proven bleaching sequence with all up-flow reaction towers and counter current washing utilizing 100% D1 back water and nearly half of EOP back water for intermittent stage counter current pulp washing, keeps the water consumption well under control for bleach plant.

Table-2: Comparison of Pulp Mill Steam/Power & Pollutants - Before and after Expansion

Particulars	Units	Before Expansion	After Expansion	% Improvement
Specific steam consumption	T/T of pulp	2.4	1.5	38
Specific power consumption	KWH/T of pulp	414	360	9*
AOX	kg/t product	0.45	0.15	67

*Net impact on power before and after looks to be very nominal, because we adopted ECF technology by eliminating elemental chlorination earlier. Power increase in integrated ClO₂ plant itself amounts for about 100 kWh/ T pulp. Otherwise there is sizable reduction in power consumption in rest of the Pulp Mill (~40%)

Bleach Effluent coolers

This is one of the examples of successful energy conservation measures that also maintain the good health of the ET plant. Warm water is produced by use of effluent coolers prior to sending the effluent to the Effluent treatment plant. It has a land mark impact for reducing the mill's steam consumption.

Table-3: Steam Savings from bleach plant effluent

Particulars	Acidic Cooler	Alkaline Cooler
Effluent quantity	12-13 m ³ / T Pulp	5-6 m ³ / T Pulp
Steam Savings	0.4-0.45 T/ T Pulp	0.2-0.25 T/T Pulp

Use of Magnesium Sulphate in Fiber Line

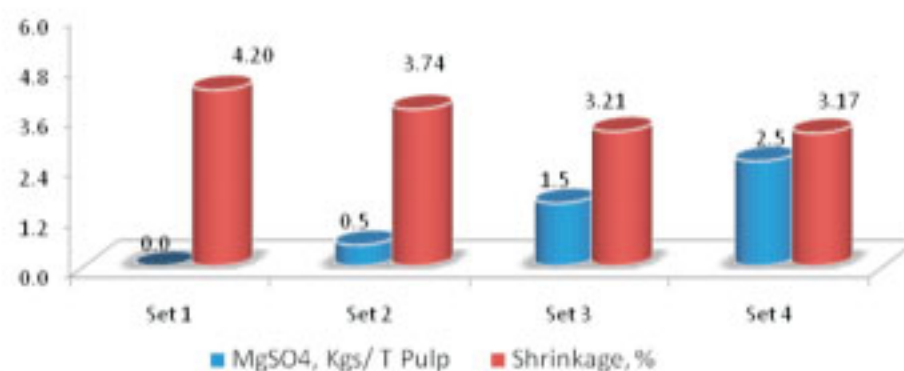
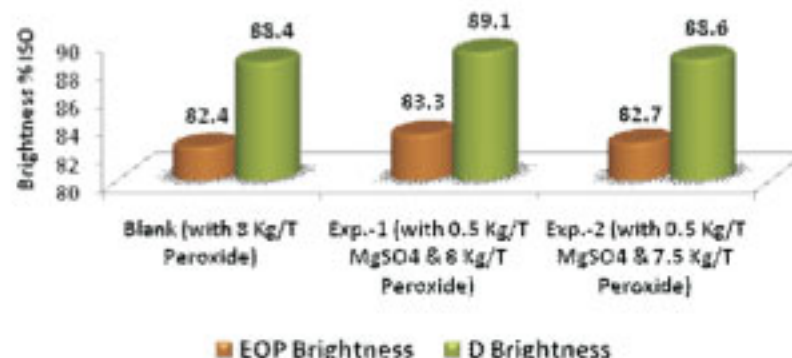
Use of Magnesium Sulphate in the Oxygen delignification stage improves the selectivity of reaction towards the lignin hence protect the cellulosic fiber from degradation results in better yield (Fig 4)⁴ & strength properties of pulp. Similarly MgSO₄ addition in EOP stage has also given visible improvement sign by achieving better reactivity of H₂O₂ and reducing peroxide consumption. (Fig 5)⁵

Chemical Recovery

Multiple Effect falling film Evaporator with crystallization technology

To process the spent liquor generated in pulping process, seven effect falling film evaporator with crystallization technology was installed having the following features:

- ✓ Energy-efficient evaporators for optimum mill operation

Fig 4: Effect of MgSO₄ on Shrinkage in ODL**Fig-5: Effect of Magnesium Sulphate as Peroxide Stabilizer**

- ✓ High firing liquor dry solids using crystallization technology
- ✓ Clean reusable condensates at optimum temperatures using the minimum amount of steam

High Pressure Recovery Boiler

With over 75% BLS, old smaller and medium pressure recovery boilers were replaced with single high pressure recovery boiler. This stood to be the leading difference maker and trend setter for cost effectively justifying massive expansion. Following are the key indicators for before and present

Table-4: Comparative between Old (2 Nos.) and New Recovery Boiler

Particulars	Units	Before expansion	After expansion
Black liquor solid	%	52 & 65	75
Steam pressure	Kg/cm ²	36	65
temperature	° C	400	450
Steam generation from Recovery	T/T of B/L dry solids	2.4	3.2
Power from Recovery (of Total Mill consumption)	%	38	59
Coal consumption for Power Boiler	T/T of paper	1.6	1.0

Following also contributed for reduction of specific coal consumption per ton of product:

- ◁ Higher steam pressure and temperature in CF boiler.
- ◁ Multiple boiler and turbine replaced with single boiler.

- ◁ Continuous operation
- ◁ Very small foot print wrt conventional clarifiers
- ◁ Clean and hot white liquor
- ◁ Fully automated
- ◁ Higher white liquor yield
- ◁ Reduces water circulation
- ◁ Less white liquor dilution

X Filter (Green Liquor filtration)

With the tightening of system closure it is difficult for the conventional green liquor clarifiers to give finest cleanliness of clarified Green liquor of 20 ppm level. X-filter with cross filtration technology effectively serves the duty with very less space requirement & helps in system closure.

Compact Disc filter (White Liquor filtration)

In continuation, for a cleaner white liquor of 20 ppm level clarity, pressurized disc filter performs both white liquor filtration and lime mud washing in a single unit. Because of the high discharged mud solids it is an ideal selection for mills with tight water balances. Features of CD filter

Lime mud disc filter

LMDF is used for washing of lime mud & drying of lime mud which is to be fed to lime kiln. In the washing of lime mud generated weak white liquor is used in smelt dissolving tank. Features of LMDF:

- ◁ High capacity in a single unit
- ◁ Reliable, continuous feed to kiln
- ◁ Continuously high dry solids

Utilization Screen Reject from PCC Plant as Make up in Lime Kiln

Paper manufacturing industry generates huge quantity of waste in the form of solids, liquids and gaseous. All the three form of waste has a great environmental impact. As the environmental

norms are become stricter and stricter hence it is essential for the manufacturing industry to reduce, recycle and reuse the different form of waste.

Putting up the satellites, PCC plant not only reduces the cost of filler but also save the environment. Carbon dioxide is mainly responsible for global warming. Presently the carbon dioxide from flue gas is tapped and utilized for PCC generation by carbonation process.

During the carbonation process of PCC generation, PCC sludge (Grits) is generated which was generally thrown outside for land fill application. With the initiatives of JKPM and PAPRI, the sludge (screen rejects) was analyzed to see the feasibility for reutilization and the results are given in Fig-6.

From the analysis results it was found that the sludge contain valuable amount of calcium oxide.

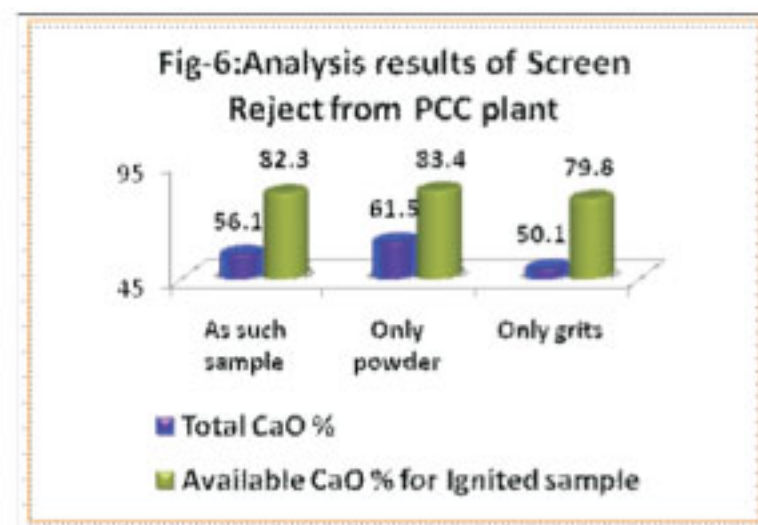


Table 5: Benefits projected from PCC rejects recycling

Generation of sludge from PCC plant	8.5 ton (As such basis)
Dryness	83.4%
OD sludge generated per day	7.09 ton
Quantity of lime generated per day	4.75 ton

Conclusion

Moving ahead with focused approach and timely investment for staying update with technology to meet customer demand and mitigate with environmental norms, will certainly pay off and will keep you leading in competitive world.

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