

# Productivity Improvements in Packaging Board by Overcoming bottlenecks and technology upgradation - A Case study by M/s.JK Paper Unit: CPM



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## Abstract

The paper gives the various improvements and innovations done in Coated Duplex Board machine BM#4 in JK Paper Unit :CPM to increase the productivity by speed up the paper machine from 300mpm designed speed to 425mpm currently operating speed in a lower gsm of 190 to 270gsm. In JK paper unit :CPM is continuously doing modifications, capacity enhancement of equipments and process optimizations like drive gear boxes upgradation, good maintenance practises for condition monitoring, fabric life improvement, refiner tackles modification, reduction of washing time by installing showering system and quality defect rate reduction activities. These all modifications and improvements brought substantial savings in production cost and quality improvement.

**Key Words:** Productivity, Kaizen, drives, configuration.

## Introduction

JK Paper Limited is India's largest producer of branded papers and a leading player in the fine papers and Packaging Board segment. It operates 2 integrated Pulp and Paper Mills in India, JK Paper Mills in Rayagada Orissa and CPM in Songadh, Gujarat.

The CPM (Central Pulp Mills) was originally incorporated in 1960's by the Parkhe Group and had installed capacity of 40,000 TPA. It gone sick and was taken over by JK Paper Ltd. in 1992. The unit was rehabilitated in 1993-94 and was turned around into a profitable venture. CPM now has grown to capacity of 60,000 TPA of writing and printing papers and added 100000 TPA of Packaging Board at present. Mill utilizes bamboo and hardwood as the raw materials.

It is an ISO -9001, ISO 14001 and OHSAS 18001 certified unit and has received "TPM Excellence Award-1st category" in the year 2006 and "TPM Consistent Commitment award" in 2009. In the year 2011-12 unit received "Commendation for strong commitment to HR Excellence" from CII, Chairman's Best People Management Award of J K organization and Genentech CSR Gold Award.

## Back Ground

Productivity improvement is to do the right things better and make it a part of continuous process. Therefore it is important to adopt efficient productivity improvement technique so as to ensure individuals and organizations growth in productivity.

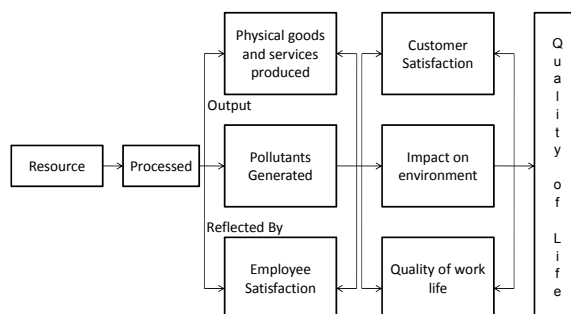
Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce.

Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people. Productivity denotes relationship between output and one or all associated inputs.

It is certainty of being able to do better than yesterday and continuously. It is constant adoption of economic and social life to changing conditions. It is continual effort to apply new techniques and methods. It is faith in human progress. In the words of Peter Drucker productivity means a balance between all factors of production that will give the maximum output with the smallest effort.

In countries where capital and skill are short, while unskilled labour is plentiful and poorly paid, it is especially important that higher productivity (improved) should be looked for by increasing the output per machine or piece of plant or per skilled worker. Improving productivity means increasing or raising productivity with the help

Japanese Holistic View of Productivity Concept





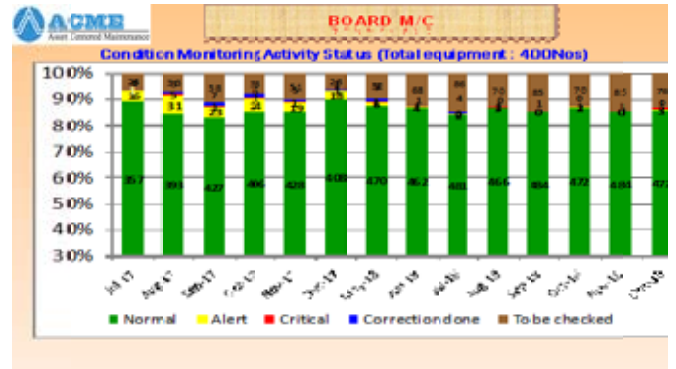


## After Speed up 425mpm the Drive Parameters:



## B) Condition Monitoring :

In Oct'15 onwards we have hired outside agency to conduct condition monitoring activity in our plant on regular basis. Based on their input breakdown preventive measures has been taken in the plant time to time. This activity improved shutdown efficiency and reliability of the plant. So, that these results reflect reduction in unplanned downtime.



S. No	Area	Equipment Name	Corrective Action Taken	(Before Correction) Max. Vibe mm/sec	(After Correction) Max. Vibe mm/sec
1	Power Block	Board Pump-1	Replaced the Pump both bearing & Alignment to be done.	8.0	3.1
2	Power Block	New Crusher-02	Replaced the Fluid Coupling & Pulley DE bearing.	11.8	2.9
3	Board M/C	PV FAB-02	Replaced the Motor & Pulley Belts.	11.4	5.1
4	Board M/C	Water Chilled Circulation PP-1	Replaced the Pump.	18.7	6.5
5	Board M/C	BWP-13	Replaced the Roll DE bearing.	4.5	2.4

## c) Basis weight Valve change and Line Modification:

During speed of machine top and bottom layer gsm is not maintaining as per the desired specification. Hence we have increase the size of top and bottom basis weight valve.

We have done other modifications to overcome the wet end approach systems like Bottom layer machine chest pump delivery line upto basis weight valve size increased.

Toplayer machine chest pump motor capacity is increased from 15kw to 22kw.

All three machine chest pump and fan pump rpm increased from 1500 rpm to 1800rpm.

Suction couch separate vacuum pump started for maintain the vacuum and sheet draw to press part.

Forming board and hydrofoils changed from HDPE to Ceramic for improve better drainage and wire life.

All layers pressure screens basket changed from hole to slot for quality improvement and better screening.

## D) New Innovative chemical introduction:

In higher grammages (280 gsm and above) we had a problem of steam limitation as steam valves are opening 100% and



we are unable to increase the throughput. Hence we have conducted different drainage chemicals study in Laboratory and worked out suitable drainage aid for BCTMP pulp. By introducing the drainage chemical in plant scale we have gained drainage improvement 50-60ml/30sec and subsequently the through put increased by 1.0TPH.


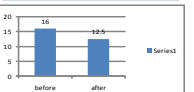
## Chemical Preparation and Dosing System

### Case Study-2

#### 1) Downtime reduction Activity

In Downtime reduction activity is broadly classified into three categories and worked on those areas consistently for derived results

- Washing
- Cleaning with Shower technology
- Enhancement of clothing life

KAIZEN SHEET		Activity		OK	JK	PM	QM	DM	SPM	SE	JK PAPER LTD Unit : CPM	
Plant : CPM	Machine : Board	Issue No.	Result Area	P	Q	C	D	S	M	E	Page	Process
<b>Kaizen Theme:</b> Reduction of bolout shut down time <b>Problem / Present status:</b> More time to clean all 12 stock chests		<b>Kaizen Idea:</b> Installing cleaning shower in chests <b>Countermeasure:</b>  Shower installed in all 12 chests Cost: 25 lakhs		<b>Bench mark:</b> Kaizen start: Jun-17 Kaizen completed: Oct-17 <b>Team members:</b> 1. S. Kannan 2. Sandesh Joshi 3. Ghosh 4. Jalandra 5. 6.								
<b>Analysis:</b> Delay in cleaning why? Hard to access area why? Manual cleaning why? Pulp lumps due to agitation and splashing		<b>Results:</b> Downtime reduction by 3.5 hrs/bolout 		<b>Cost:</b> Savings/Year: 21 Lakhs Delivery (D): Safety (S): Equipment Safety ensured Morale (M): Operator Morale Improved <b>Status:</b> (SS) SS maintained well <b>Scope &amp; Plan for Horizontal Deployment:</b> Sr. No. Target Resp. Status								

The Productivity improved by reduces the overall downtime on the machine by taking proactive measures.

- By providing cleaning showers in Chest and towers the downtime reduced by 4hrs per boil out in two months.
- Fabric life enhancement reduces the downtime of 3hrs per Month.
- Caustic wash frequency reduced from 4times / Month to 3times/Month resulted 4hrs downtime reduction.

#### 2) Fabric Life improvement:

Initially JK Paper Unit: CPM is using forming fabric of imported and life was 4-5months and changing as per the schedule. After conducting studies on removed fabric by the clothing suppliers and we found that there is a residual life in the fabric. Based on the report the forming fabric life increased 7-8 Months. In the same way press felts life increased from 3months to 5months. Subsequently we have taken a same approach and improve the dryer screen life from 8-10 Months to 15-16 Months. After getting confidence we have shifted 60-70% Fabric of indigenous in forming and drying section.

Maximum days life so far achieved				
Position	From	To	No.of days	Remarks
Top Forming	28-11-2016	07-07-2017	221	
Bottom Forming	28-12-2017	03-10-2018	280	
Middle Forming	06-10-2017	23-04-2018	199	
DuoFormer	06-10-2017	21-05-2018	227	
Bi-nip top	21-03-2018	01-09-2018	164	
Bi-nip bottom	14-07-2018	07-01-2019	177	
Jumbo press top	02-09-2016	13-02-2017	164	
Jumbo press bottom	08-06-2018	26-11-2018	171	
Nipco press bottom	05-08-2015	08-02-2016	188	
1st gp dryer	02-10-2015	28-11-2016	423	
2nd gp dryer	13-02-2017	23-04-2018	433	
3-5 th gp top dryer	05-05-2016	18-07-2017	439	
3-5 th gp bottom dryer	12-02-2016	07-04-2017	420	
6th gp top dryer	04-09-2017	30-01-2019	513	Still running
6th gp bottom dryer	06-12-2016	12-03-2018	462	
7th gp top dryer	18-07-2017	30-01-2019	561	Still running
7th gp bottom dryer	02-07-2016	06-10-2017	461	
MG overscreen	09-03-2017	23-04-2018	410	
MG glazing	13-10-2017	13-08-2018	304	
8th gp top dryer	10-11-2016	05-01-2018	421	
8th gp bottom dryer	13-10-2017	30-01-2019	474	Still running
Dryer no.51	04-09-2017	30-01-2019	513	Still running
9th gp top dryer	26-12-2014	08-02-2016	410	
9th gp bottom dryer	13-10-2016	05-01-2018	448	
10th gp top dryer	25-11-2017	30-01-2019	431	Still running
10th gp bottom dryer	13-10-2016	22-12-2017	435	
Dryer no.61(11th Gp.)	07-06-2017	23-04-2018	320	
Dryer no.63 (12 th btm )	06-10-2017	30-01-2019	481	Still running
Baby dryer	03-03-2017	12-09-2018	558	
13th gp top(11 top)	09-03-2017	10-05-2018	431	
13th gp bottom(11btm)	04-10-2016	10-05-2018	587	
K3-Dryer(12 Top)	04-10-2016	10-05-2018	587	
Broke conveyor	07-06-2017	12-09-2018	462	

### Run History of fabric from the supplier:

Present Previous fabric[s] Supplier: HMB Fabric No: 118912 Design: 1J2929 717PDY On Date: 9-Jan-18 Off Date: 24-Jun-18 Life (days): 166 Removal Reason: Low life

Observations: Low life 18,900 x 2,930mm JK Paper Returned Fabric Analysis - Forming 16-Jul-18 No fabric number supplied, but based on the fabric width it was determined to be either 118912 or 118913 . The fabric was heavily contaminated with mill residue and was washed in a mild detergent prior to analysis. Wear to the ps was minimal and consistent throughout the piece, apart from a wear band located 1.87m from the fs edge. Here the yarns exhibited drag burrs to the facets . The same level of wear could be found on the seam strip that was returned with the sample. In general the ms surface had light to moderate wear across both the body and the seam. There was no movement or distortion to the warp/weft yarns across the seam. The caliper profile was uniform in the centre of the fabric, dropping slightly in the first and last 0.6m of the wire. There were no other samples in our database





are formation in the middle ply is improved without dropping of ply bond values. The Before and after refining of pulp with tackles the fines content is less with New design.



#### New Innovative ECO-R filter installation at coating supply units:

In JK Paper Unit: CPM Previously we are using candle filters of 7 no's at coating supply stations. The frequency of these filter







damages are high and resulted defect of blade line increased on regular basis. Apart from this the wastages of the solution is high during manual cleaning. Hence we have replaced those filters with ECO-R filters for better filtering of coating solution and no manual interference during cleaning. This will help us to improve coating yield and reduction of blade line rejection.

#### Case Study :4

In JK Paper Ltd Unit: CPM we consider quality is the key parameter for the success of our Organization. Customer is becoming quality conscious and more demanding. In pursuit of customer satisfaction we take all steps to produce high quality, Pulp, Paper and Paper Board for this the Quality Management system is at its best. We also obtained ISO: 9001:2015 certification for Quality Management systems. We are working Quality Maintenance activity under TPM to reduce the defect modes elimination on continuous basis by doing kaizens.



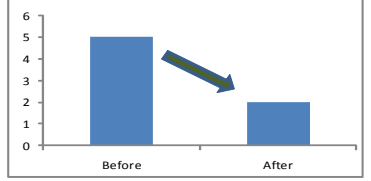
#### Quality Defect reduction Activity Kaizen1:

In Middle layer Pressure screen basket is changed from hole to slot to avoid passing of lumps and contaminants through screen. In Hole screen we have regular problem on blotches in the final product and huge rejection and customer complaints are received. After Modification the generation blotches has reduce by 50% and customer complaints reduced by 80%.

KAIZEN SHEET		Activity	KK	JH	PM	QM	DM	OTPM	ET	SHE	JK PAPER LTD Unit : CPM																		
Plant: CPM		Loss No./ Step																											
Machine: Board		Result Area	P	Q	C	D	S	M	E	Dept:																			
Kaizen Theme: Reduction of Quality defect		Kaizen Idea: New design of screen basket																											
<b>Problem / Present status:</b> Blotches on the product - %  <p>Middle Layer primary and secondary basket - Hole size - 1.8mm</p>		<b>Countermeasure:</b>  <p>Middle Layer primary and secondary basket - Slot size - 0.35mm</p> <p>Cost of both baskets: 6 Lakhs(4+2) Basket changed in June-2017</p>								<b>Bench mark</b> Target Kaizen start Kaizen Completed Team members																			
<b>Analysis:</b> 		<b>Results:</b> Quality Defect Reduction - No of Blotches 								1 S.Kannan 2 Sandesh Joshi 3 Ghosh 4 Jitendra 5 6 <b>Benefits:</b> <b>Productivity (P) :</b> Productivity enhanced due to quality defect reduction <b>Quality (Q) :</b> Quality of product found improved (50% Reduction) <b>Cost (C) :</b> Productivity Cost Improved <b>Delivery (D) :</b> Delivery (D) : <b>Safety (S) :</b> Equipment Safety ensured <b>Morale (M) :</b> Operator Morale Improved <b>Status (SS) :</b> SS maintained well <b>Scope &amp; Plan for Horizontal Deployment</b>																			
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## Kaizen2 Quality Defect reduction Activity:

During Speed up of machine we have face the problem in size press like starch splashing and pond level variation. Due to these issue quality rejections are increased .The team has done brainstorming and find the solution to increase the no.of nozzles from 5no's to 10 No's in Bottom side starch application. After increase the no. of nozzles avoid starch splashing, reduction of starch wastage and better bonding on the surface improved.

Activity		KK	JH	PM	QM	DM	OTPM	ET	SHE	JK PAPER LTD Unit : CPM																				
Loss No./Step																														
Result Area		P	Q	C	D	S	M	E																						
Plant: Board Plant	Machine: Board Plant	Dept: Board Maint																												
Kaizen Theme: Easy to operate		Kaizen Idea: New shower																												
Problem / Present status:		Countermeasure:																												
 <p>At long total length of size press roll only 5 nozzle for starch</p>		 <p>Prepare a new shower of 1 nos of nozzle for starch</p>																												
<b>Analysis:</b> Reduction in Quality defect why? Due to less number of nozzle starch is not evenly coat the paper why? Provide maximum number of nozzle so that where need more starch easy to operate why? Save in quality defect due to starch splashing.		<b>Results:</b> Reduction in quality defect due to starch splashing 																												
		<b>Bench mark</b> 2 Minutes <b>Target</b> 2 Minutes <b>Kaizen start</b> 18.07.2018 <b>Kaizen Completed</b> 21.07.2018 <b>Team members</b> 1 Deepak Nemade 2 Rakesh Gamit <b>Benefits:</b> <b>Productivity (P) :</b> Efficiency of the system improved <b>Quality (Q) :</b> Quality of equipment increased <b>Cost (C) :</b>  <b>Delivery (D) :</b>  <b>Safety (S) :</b> Safety of equipment ensured <b>Morale (M) :</b> Morale of operator improve <b>Status (SS):</b> <b>Scope &amp; Plan for Horizontal Deployment</b> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>M/c No.</th> <th>Target</th> <th>Resp.</th> <th>Status</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>									Sr. No.	M/c No.	Target	Resp.	Status															
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## Results& Discussion:

In JK Paper Unit :CPM the improvements and developments have been done with less investment and giving considerable benefits interms of reduction in manufacturing cost and improved quality. These modifications and improvements done with very little investment of RS 225lakhs in 2years has given considerable return of Rs 750 lakhs by improvement of productivity, in addition to considerable reduction in steam, power ,water and chemical consumptions.

## ROI Calculation Sheet:

### 1) Total Investment in 2 years is 225 Lakhs

- |  |           |
|--|-----------|
| a) Drives Modification :                   | 75 Lakhs  |
| b) Chest /Tower cleaning showers :         | 43 Lakhs  |
| c) Wetend Approach flow modification :     | 55 Lakhs  |
| d) Condition Monitoring :                  | 20 Lakhs  |
| e) New Chemical for Drainage :             | 5.0 Lakhs |
| f) Steam &Condensate system modification : | 18 Lakhs  |
| g) Deflaker and Pumps changing :           | 9.0 Lakhs |

### 2) Total returns on Investment : 750 Lakhs

- |  |             |
|--|-------------|
| a) Machine Speed Increase (8000Mt/Annum)     | : 600 Lakhs |
| b) Downtime Reduction(108 Hrs)               | : 90 Lakhs  |
| c) Quality Rejection Reduction( 800Mt/Annum) | : 60 Lakhs  |

## Conclusion:

- a) Continuous improvements and modifications in the process resulted productivity improvement.

- b) Regularly doing kaizens on the Process equipments resulted defect reduction and improve the life of equipment.
- c) Adoption New technology in the cleaning of chests and towers saved Downtime reduction, Manpower and safety and cleaning efficiency improved.
- d) Fabric life improved by doing regular study and measurements with the help of fabric suppliers.
- e) Better Maintenance practises and regular conditioning monitoring help to reduce the failures.

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