Paper Machine Operation Based on Recycled Fibre

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ABSTRACT

This paper provides a general review of some of the ways in which secondary fibre affects paper machine runnability and sheet properties and point out some of the strategies the paper maker can adopt to overcome related problems.

INTRODUCTION

The depletion of wood based raw materials, high cost of virgin pulp and stringent pollution control measure have forced small paper mills to switch over to secondary fibre and integrated mills to add secondary pulping street to their existing system to replenish the pulp stock. During the change over to recycled fibre, many problems have cropped up in the paper m/cs affecting quality, runnability and profitability of the operations. Our mill experience on the same is documented below.

Secondary fibre cannot match the virgin fibre due to the reasons first, it looses its physical properties with every recycling and second, carries contaminants like sand due to handling, inherent accompanying contaminants like plastic, adhesives, wax latex, starch etc. which interfere in the paper making process. Some grades have high ash content, generate additional fines during process and have dissolved solids, which build up in the system, overtime and severely interfere in the process.

Our Mill

Brown Paper Technologies Ltd. (Table 1) have two Paper Machines. A MF Machine and a MG Machine. The effect of secondary fibre on both is discussed here. Till 1997, we were using virgin pulp and selected grade of secondary fibre. We had to shut down the bagasse pulping street as it was no more in competition with the secondary fibre cost, and pollution control measures were getting stringent.

RESULTS AND DISCUSSION

The introduction of secondary fibre into virgin fibre furnish affected the paper making process in two important ways.

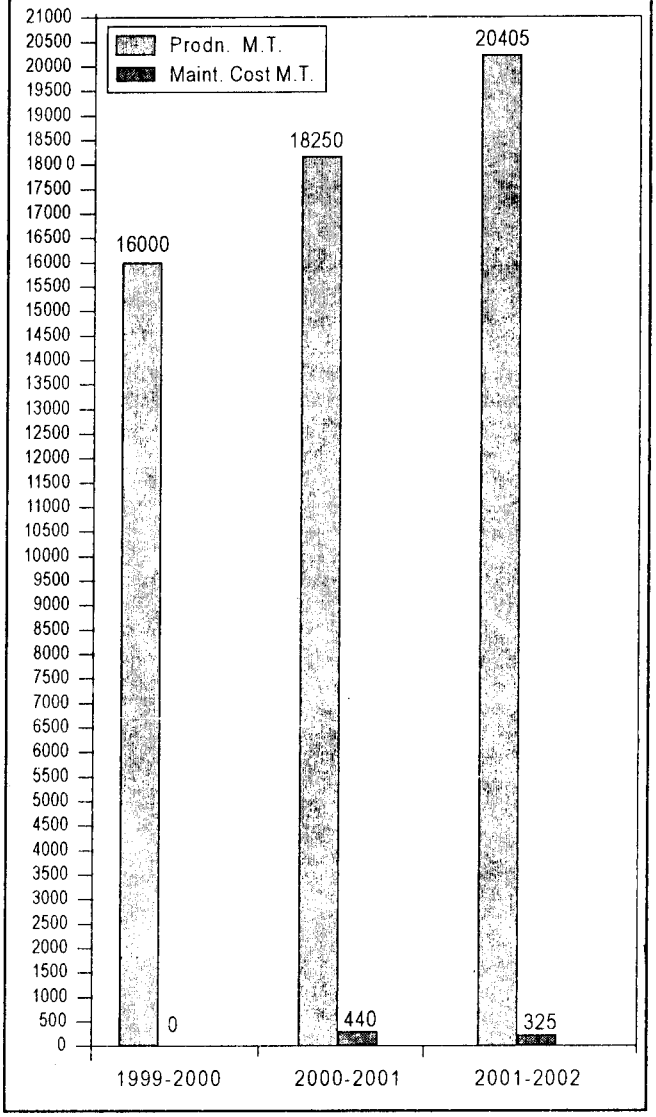
1. Machine runnability.

2. Sheet properties, appearance and performance.

Machine runnability

Table-1 Production Improvement

1. Production	1999-200	2000-2001	2001-2002
M.T.	16000	18250	20405
2. Maintenance Cost (Rs.)	---	440	325



The cost benefits from production improvement after stabilizing waste paper line is shown in Table 2.

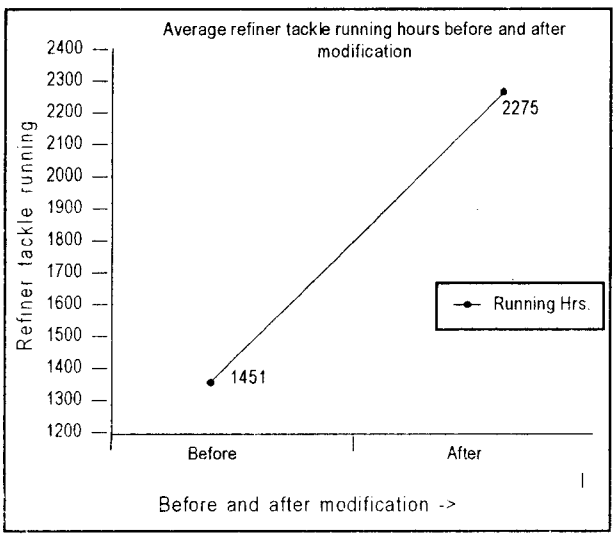
Table-2 Cost benefits from production Improvement after stabilizing waste paper line

Particulars	Before	After	Savings	Total
(A)				
M/c's Production/day (MT)	62	78	--	
M/c's Power/day(kWh)	32500	3100	--	
kWh/MT	524	408	118	
Savings (Rs.)/MT	-	-	-	495.60
(B)				
Power/MT in				
Stock preparation (kWh)	426	380	46	
Savings (Rs)/MT				193.20
(C)				
Steam (MT)/MT	2.8	2.6	0.2	
Savings (rs)/MT				100.00
(D)				
Maintenance Cost (Rs)	440	325	--	115.00
Total savings/MT =A + B + D + Rs.				903-80
Or Rs. 184.25/Year for 20405 MT Production.				

Table-3 Refiner tackle running hours before and after modification

Refiner tackle Running Hrs.

S.No.	Before	After
1.	1430	2100
2.	1155	2400
3.	1375	2150
4.	1845	2450
Cost benefits from Refiner Tackle		
No. of Tackle used/Year	6	4
In two Refiners		
Cost of Tackles/Years	158775	105848
Savings/Year (Rs)	52927	
	Rs. 2..59 / MT	



As bagasse was being used on Paper Machine we had to change over to 100% secondary fibre base for 90% of the grades manufactured on the machine. As we have no cleaning system and have single hole screening system, contaminants were carried out along the stock up to pope reel. During the processing these used to cause lot of disturbances due to build up of suspended solids like centricleaner jamming (nozzle and inlet), pressure screen basket jamming followed by weight variation and poor runnability and the paper produced also has poor appearance due to specks. We tried to bring down the speck count by increased refining. This resulted in high fines generation and aggravated the runnability problem.

The cost benefits from fabric and leets is shown in Table 4.

Apart from machine runnability, maintenance cost increased due to following reasons

1. Faster wear out of turbo screen plate and impeller.
2. Faster were out of refiner tackles

Table-4 Production from fabrics and felts before and after stock preparation modification.

Particulars	Fabrics	1st Press top felt	1st Press bottom felt	2nd Press felt
Before	5125	3535	3746	3094
	4775	4862	4339	4662
	5304	3903	4581	4654
After	6069	5339	5137	7145
	6692	5465	5328	6534
	6470	5705	5402	6454

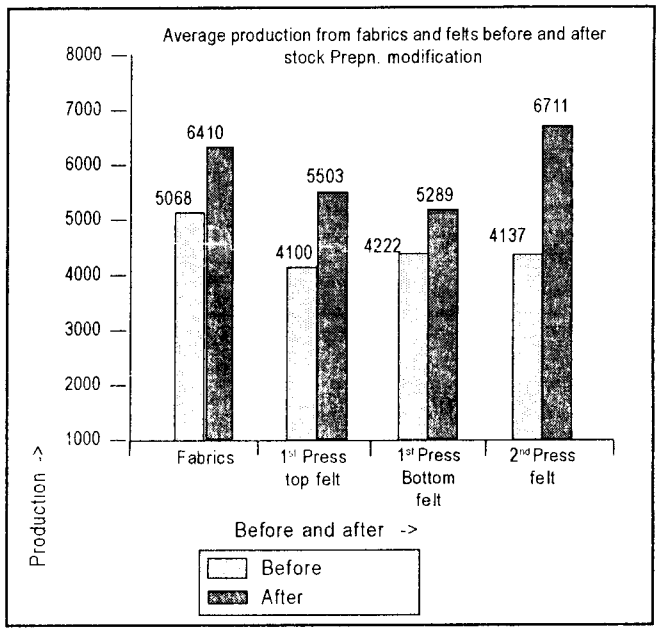


Table-5					
Parameters	**As such pulp**		**Recycling stages**		
		1st	**2nd**	**3rd**	**4th**
Initial °SR	11	21	23	25	28
Final °SR	30	30	30	30	30
Beating line, min	30	03	02	02	0.5
Substance gsm	62.5	63	61.5	62	59
Burst factor	53.08	43.75	38.2	32.5	30.3
Tear factor	118	114	110	100	93
Breaking length	7440	6115	5504	5048	4883
Stretch %	3.26	3.00	2.9	2.83	2.79
Tea J/m²	98.5	81.1	76	70.23	65
Porosity Sec/100 ml	28-30	18-21	15-16	12-13	10-11
	Fibre classification at 30 °SR				
+ 30	73.2	64.5	60.1	55.5	50.9
- 30, +50	5.9	6.2	5.9	6.2	6.0
- 50, +100	3.3	5.5	4.4	6.0	6.4
-100, +200	3.1	4.7	7.5	8.3	9.3
- 200	14.5	19.1	22.1	24	27.4

3. Damage of Centricleaner lags

4. Damage of fabric and felt.

5. Faster damages of pump's body and impeller.

At this juncture, a wastepaper line became inevitable for processing secondary fibre comprising following equipments;

- High consistency pulper-replacing high power consuming low consistency pulper.
- Poire-to remove larger size contaminants like plastic bags, canes, bottles etc.
- High density cleaner- to remove high density contaminants like sand, stiching pins and other metallic pieces.
- Three stage hole screens- to remove contaminants having size of more than 3 mm.
- Two stage high-density cleaner- again to remove high-density fine sand.
- Three stage fine screening system- to remove any contamination of size mores than 250 microns.
- Hot stock Disperser- to disperse contaminants like adhesive, hot melts, bitumen. They are pulverized in hot disperser to a size less than 40 microns. They are not visible to eye and the resulting paper formed with this pulp will be a clean sheet.

Following improvement were observed by introducing above equipments.

1. Augmenting production by 20% (Table 3)
2. Reduction in maintenance cost by Rs. 115/MT
3. Increase in refiner tackle life by 35%.
4. Increase in wire life by 20%.
5. Increase in first press top felt life by 25%.
6. Increase in first press felt life by 20%.
6. Increase in first press felt life by 38%.

After introducing fine screening and disperser, production was on increasing trend. Maintenance and machine accessories cost reduced. Problems though reduced could notbe overcome completely.

Further BPLT adapted following practices

All the chests are emptied and washed out thoroughly during quality changes.

- Cleaners are inspected for wear out.
- Cleaner nozzles are checked frequently and nozzles are changed, if outlet enlarge pressure drop monitored to ensure maximum efficiency of cleaners.

Still at this stage, machines were not fully stabilized as sometimes unexpected problems arose from the contaminants which are beyond the control of screening system i.e.

1. Suspended particulate materials.

Table-6 Utilities for per tonne of paper with diferent catagories of raw materials			
	Wood Based	Agro Based	Waste Paper Based
Power (kWh)	1500 - 1600	1000 - 1200	800 - 1000
Steam (Tonne)	11 - 14	5 - 6	3 - 4
Water m^3	200 - 250	150 - 200	20 - 60

Table-7 Cost benefits from Fabric and Felts

Per year arithmetical consumption of fabric and felts before and after modification

Particulars	Fabric	1st Press Top felt	1st Press Bottom flets	Second Press felt	Total
Before	4.34	5.37	5.21	5.32	
A. Cost/Year (Rs.)	2119326	728107	826379	564999	4238811
After	3.45	4.0	4.16	3.28	
B. Cost/Year (Rs.)	1674951	542552	659834	3225482	
Savings/ Year A x D					1011189
					Rs. 47,007

2. Microbiological deposits.
3. Build up of dissolved solids.

Problems by suspended particulate materials

Recycled waste consists low specific gravity material like rubber particles, adhesive, coating residues, plastics, tape, films and ink. Collectively these contaminants are refrered to as stickies. It is noticed, while processing through pulping, screening and cleaning system, the shear force break down them in to smaller particle resulting in their movement towards the Head box and entry in the forming fabrics, wet press felt, press rolls, vacuum boxes and dryer felts. Sometime, there are stickies floating in Head box which surge out intermittently and break the sheet at wire. Many times several problems were observed due to stickies and other suspended solid deposition on felts, boxes and felt rolls. Increased filling on felt resulted in decreased and non-uniform water permeability, resulting water streak on the sheet. Built up of stickies on felt rolls, resulted in sheet break. Many times deposition of stickies on the vacuum box caused vacuum break as well as faster felt deskining.

Above problems were minimised by changing the design of fabric and felts of high permeability, incorporating micro travel high pressure shower. Re-engineering the vacuum system.

Re-engineering the vacuum system depends on the process requirement and vacuum levels, Vacuum zones are segregated in to two different zones, High Vacuum and low. Accordingly, two vacuum pumps are selected to be more energy efficient. Also reengineered is the connecting piping network in order to have better effectiveness and also more dwatering at the water Separations. Above changes resulted in 8% Eelctrical Power Saving and improved runnability of the Paper Machine. Additiona advantages are the from of flexibility in isolating one vaccum pump at the time of high GSM Paper manufacfuring.

Problems by microbiological deposits

Microbiological deposits are another common problem which devolops from adhesive, starch, binder and some source from food like proteins, oil, and carbohydrates in secondary fibre and high moisture in recovered paper. They accelerate the slime formation.

Practices adapted to overcome microbiological problems are the rough, Purchase of waste paper with not more than 10% moisture, Repuling of recovered wate paper on 50-55° centigrade, Repulping at slightly higher pH=8.5-9.0 and System boil out at earliest opportunity.

Problems by build up of dessolved solids

Build up of dissolved solids from starch, adhesive, some additive used during paper making like Alum, Synthetic polymer, dyes, acid and bases. These aggregates of chemicals contained chlorides, sulphates and other ions which caused corrosion, retard sizing and retention on wire and coating on dryer surface. This problem is tackled by changing pipe lines and other wetted surfaces with stainless steel, pumping out the dissolved solids by replacing backwater from treated water and adapting neutral sizing with retention aids. Problems with dryer deposits is resolved by frequent batch cleaning of dryer fabrics and using release agent.

Sheet properties

There are basically two ways in which the addition of

secondary fibre to the furnish can influence sheet properties. First the residual contaminants and second the shorter fibre and higher fines contents of repulped paper. Residual contaminants are to be taken care by regular cleaning of Roll doctors, felt rolls and routine cleaning of fabrics and dryer screens. Before stabilisation of waste paper line press and felt roll coating was unpredictable with more frequency and for longer time lising Avg. 10hrs per week after stablisation showe dewater reduced to 3-4hrs per weak. Shorter fibres and higher fines are taken care by incorporating mechanical and chemical bindings which is discussed below.

Effect of shorter fibre and higher fines and remedy

In addition to the effect of nonfiberous contaminants the fibres and fines recovered from paper stock influences sheet properties although their effect on dirt count is minimal. Fines and undefibered flakes disturb formation and lead to microcrushing. It is observed in mill studies that furnish from secondary fibre produces a sheet of poorer strength. This is due to the fact that fibre cellwall loses water in the initial drying process, when lamellae are brought togehter. These lamellae are bonded in plains that are so tight that they lose flexibility resulting drops in tensile, folding endurance and stretch.

Our recycling exercise has taught us that in every recycling there is loses in strength properties but %, loss is in reducing trend so also the fines generation and the fibre loses flexibility on drying. This can be taken care by introducing higher press loading, which is specially experienced on OCC as a furnished component. Higher press loading contributes to develop the strength properties as from higher refined stock or in other word, equal strength of pulp can be obtained with less refined stock which will reduce fines generation, subsequently more water removal from the sheet with fines and other contaminants. Higher water removal in the press section results in higher dry sheets to dryers and ultimately lesser steam consumption.

Some of the measures adapted to rejuvenate the fibre quality are : Chemically swelling the fibre by using alkaline pulping condition, Increasing Refining energy/MT, Refining with less load, Selective use of chemicals improves drainage, increases retention, promotes fibre bonding and reduces the amount of desolved solids in the system.

Further actions which are in planning and under trial are:

1. Fractionation of stock to recover longer fibre.
2. Applying low concentration aqueous solution of low molecular weight cationic polymer on the face side of wire just ahead to the breast roll.
3. Top of Vacuum box replacement with Ceramic top.
4. Surface of Press rolls are to be tried with a cationic polymer which can be applied ahead of roll doctor at dosages as low as 0.5 to 1.0 ml/min/ft of roll width.
5. New design of wet press.
6. Dryer cleaning with alkaline solvent.

Apart from machine operation with cheaper secondary fibre over costlier virgin fibre there are advantages for utilities also (Table 6). The consumption of power, steam and water is much lesser compared to wood and agro based (Table 7).

CONCLUSION

Paper machine operation on secondary fibre today is the need of the hour for small and medium paper mills, but it will be a worldwide necessity, tomorrow. Manufacturing paper nearer to virgin pulp quality is possible, if proper defensive measures are taken to address potential problems. Fibre from waste paper can be effectively utilized in paper making more cheaply and with less capital cost than the virgin fibre. Knowledge of different contaminants, their method of removal plays a very significant role on this subject. It needs a continuous study and positive approach by a paper maker.

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