

# Journey of Best Practices Adopted Towards Excellence in Super Batch Cooking & ECF Fiber Line at WCPM

**Rathi B.H. & Kekre Pradeep .V**

*The West Coast Paper Mills Ltd., P.B. No.5, Bangurnagar, P.O. Dandeli - 581325 (Karnataka) India*

## ABSTRACT

**New-Gen Fiber line with ECF bleaching sequence:** West Coast Paper Mills, Dandeli has recently expanded its pulp and paper capacity. The company's investment in a brand new 725 TPD Metso fiber-line, replacing the old unit with ecofriendly elemental chlorinefree (ECF) bleaching process has enabled to produce consistent quality of high-bright and hi-strength pulp with improved cleanliness & with least pollution load. The high degree of bleaching has also improved the optical properties of paper.

Metso has supplied state of art technology for the new 260,000 TPA (725 oven-dry tonnes per day) bleached hardwood pulp mill. The line consists of four Super Batch digesters, knotting, screening, washing by Twin Roll presses, oxygen delignification, ECF bleaching, and an oxidized white liquor plant. The mill also installed a 1,100 TPD chemical recovery plant, a high-efficiency electrostatic precipitator with a sophisticated causticizing plant, a rotary lime kiln, 11 TPD chlorine dioxide plant and the necessary effluent treatment systems.

The company's prudent investment in modernizing the pulp mill and chemical recovery plants have resulted in overall operational efficiency with improvement in quality parameters at reduced operational cost. This was made possible through enhanced economies of operating scale and the reduction in consumption of utilities like water, steam & power and the process chemicals.

This paper describes the journey of the best practices adopted in new generation fiber line at WCPM to reap the full benefits of the investment. It starts from the raw material end to Bleaching section. Specie wise Separate cooking, improvement in cooking cycle, increasing screening rate, reduction in screening reject, commissioning of on line Kappa analyzer and its control for controlling bleaching chemicals are the best practices implemented. Continual improvement is the vision of WCPM and it is the key to the success of all achievements done so far. It concludes with future action plan for increasing productivity and quality.

## The New Set up of Pulp Mill

Metso supplied the fiber line for the new 260,000 tpy (725 oven-dry tones per day) bleached hardwood pulp mill. The line consists of four Super Batch digesters, knotting, screening, washing by Twin Roll Presses, oxygen delignification, ECF bleaching and an oxidized white liquor plant. The mill also installed a 1,100 tpd chemical recovery plant, a rotary lime kiln, a chlorine dioxide plant (11TPD ) and the necessary effluent treatment systems.

The areas covered for Capacity expansion in Fiber line are  
Capacity in TPD

	Pre expansion TPD	Post expansion TPD
Chipper House	1000	3000
Cooking	330	800
Washing & Screening	330	800
Oxygen delignification		800
Bleaching	330	725
ClO <sub>2</sub>	4	15
Oxygen		24

### Plant Machinery

	Supplier
Chippers and auxiliaries	M/S Vecoplan Germany
Entire equipments of Fiberline	M/S Metso, Sweden
ClO <sub>2</sub> plant	M/S UHDE India
Oxygen & Nitrogen plant	M/S MVS Engineering, Delhi

- ◆ Improved Pulp quality.
- ◆ Increased Energy efficiency.
- ◆ Improved environmental performances.
- ◆ Capacity enhancement.
- ◆ Less dependence on purchased pulp.

## Chipper House

Raw material comes from state of Karnataka, Andhra & Tamilnadu. Transportation of wood is done by road as well as by Rail. Raw material furnish consists of mainly hard wood such as Eucalyptus, Subabul, Acacia, Casurina and marginal 1-2 % bamboo.

Chipper house consists of two sections

1. Old chipper House
2. New Chipper House

Fig 1.  
Mechanized Feeding



Vecoplan Chipper- 50T/hr Capacity



Fig 2.  
Chips screen- 50 T/hr Capacity

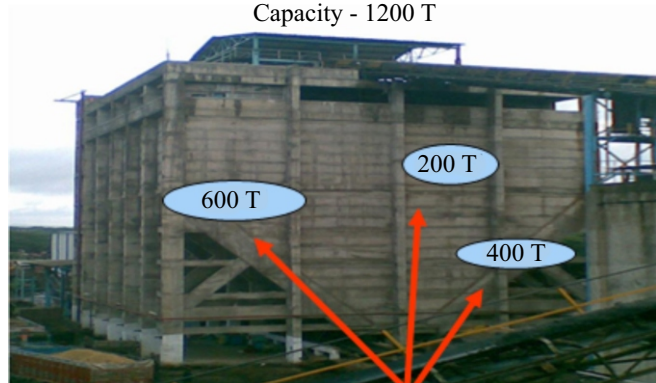


Rechipper



Old chipper House is having two nos. of Pallman chippers each of capacity 25 tph with auxiliaries like chips screening, rechipper, conveying system. To cope up chips requirement for increased capacity, two new Vecoplan chippers each of capacity 50 tph are installed with auxiliaries. ( **Fig 1, 2** ). Chips are stored in closed Silo with a capacity of 1100 Tons. ( **Fig.3** ) Dust generated is disposed off. Chips are extracted from chip silo in regulated way while charging the digester. ( **Fig.4** )

Fig 3.  
Chips storage/Silo  
Capacity - 1200 T



Total compartments - 3 Nos.

Fig 4.



Four sets of Chips extraction screws Each set consists of Two Capacity of each set – 360 T/hr



## Super Batch Cooking

The cooking plant comprises four (4) batch digesters, each of 400 m<sup>3</sup> capacity. ( Fig.5) In each batch 150 –160 Tons of chips are charged at 38-45 % moisture and converted to 42 tons of unbleached pulp. The target kappa number is 15-16 with Active Alkali (AA) charge of 18.5 -19 % as Na<sub>2</sub>O on BD chips. Digester auxiliaries include one (1) hot black liquor accumulator of capacity 600 m<sup>3</sup>, one (1) hot white liquor accumulator (200 m<sup>3</sup>), one (1) displacement liquor tank of 1200 m<sup>3</sup> capacity and two (2) discharge tanks each of 1000 m<sup>3</sup> capacity. The steam consumption is around 700 kg/BDt pulp. Super Batch cooking process in the new fiber line facilitate to produce superior pulp quality imparting extra strength to the paper the much needed for functional superiority at the end user point. Entire cooking cycle is divided into five steps.

## Combined chips and Impregnation

Chips are extracted from silo & conveyed to cooking system. Chips are packed with steam packing. This removes the air in the chips and facilitates impregnation of liquor.

## Hot black liquor & hot white liquor charging

Hot black liquor and hot white liquor (Cooking Liquor) is charged replacing the cold black liquor. This brings the cooking temperature 145-148 degree C. This reduces the steam requirement in heating & cooking.

## Heating and cooking

M.P. steam is utilized for heating till the desired temperature is reached. Steaming gets cut off after reaching the target cooking temperature. Total contents are retained at cooking temperature 162 +/- 2 °C.

## Displacement

After the completion of cooking, the digester hot liquor is displaced with cold black liquor. Pulp in the digester is cooled down to 105 degree C. Hot liquor is stored in Hot Black liquor accumulator & reutilized for heating the chips for the next batch via Hot Black liquor accumulator.

## Pulp discharge

Pulp discharge is carried out by pump, diluting the pulp at the digester bottom. This ensures the pulp temperature below 100 degree thereby protecting the Pulp strength and viscosity.

Non-condensable gases (Mercaoptans) generated during process are diverted to Lime Kiln for burning. In conventional Batch digesters these were causing air pollution.

The advantage of Super batch over convention Batch cooking are:

1. Steam saving (1.4 T/T pulp to 0.8 T/T of Pulp)
2. Uniform cooking due to steam packing of chips.
3. Improved pulp strength & Viscosity due to cold blow. ( Pulp temp. below 100 °C )
4. Reduction of air Pollution due to Noncondensable gases.

## Washing Screening and Oxygen delignification

Pulp after cooking is stored in discharge tanks (1000 m<sup>3</sup> x 2 Nos.) and processed in hot screening and washing. Pulp is screened in four-stage screening to remove the coarse and fine rejects.) Sand coming with the pulp is removed in the cleaner system. Knots and fine rejects removed are recycled along with chips during charging. All the screens are pressure screens with 0.32 mm slot, which ensures the removal of impurities (Fig.6 & 7). Clean pulp from screen is washed in wash presses in two stages and supplied to Oxygen delignification.

Fig 5.: Super Batch Cooking



Delta Combi screen



Fig 6.

Secondary & tertiary screen



Fig 7. Reject Handling system



## Oxygen Delignification (ODL) Stage

Oxygen delignification system supplied by Metso is also called Oxytrac. Process is carried out to reduce the lignin content thereby reduction of Bleaching chemicals.. Oxygen is used along with caustic at high temperature 99-100 degree C. Around 40-45 % kappa reduction takes place which also reduces load on effluent because of less chemical requirement in bleaching. Pulp after ODL is washed in wash press and enters in bleaching.

## Bleach Plant

Today, most modern mills use an ECF bleaching sequence, where

ECF stands for **elemental chlorine free**, i.e. pulp which is bleached without chlorine,  $Cl_2$ . At WCPM, ECF Bleaching sequence adopted is Dhot EOP DnD. Bleach plant has three Metso wash presses of model TRPW-940 which facilitate better washing and removal of impurities. Final pulp brightness achieved is 88+ with an average viscosity 7.5. The chlorine dioxide consumption is around 1.85 % on pulp.

Process parameters achieved in ECF fiber line

Parameter	Value
WBL	11 m <sup>3</sup> /ton of pulp with 16 – 17% solids concentration at 85° C and 180 gpl
Yield	46.6 – 46.7% unbleached yield and 43 – 43.2% bleached yield
Washing	20 – 22 kg/ton as Na <sub>2</sub> SO <sub>4</sub>
Pulp viscosity	7.5 – 8 cp
Kappa	17 – 18 at cooking; 15 – 16 before ODL; 8 – 8.5 after ODL
Blow tank Cy	5 – 6%
Steam consumption	MP (7 bar) steam at Digestors: 0.7 T/T pulp LP (3 bar) steam at Digestores: 0.2 – 0.25 T/T Bleaching: 0.5 T/T pulp
Power consumption	420 kWhr/ton of pulp (including ClO <sub>2</sub> plant and chipper house) 225 kWhr/ton (Only ODL and fibre line)

## Journey of Best Practices

### Cooking

### Chips Impregnation with Hot liquor impregnation

Feed Temperature of B.L In normal process of impregnation is 83-84 °C. This was increased to 92-93. by doing line modification as shown in Schematic diagram. Trial of Hot Black liquor impregnation for Dig. No. 3 was taken in July'12. Followings are the observations and findings:

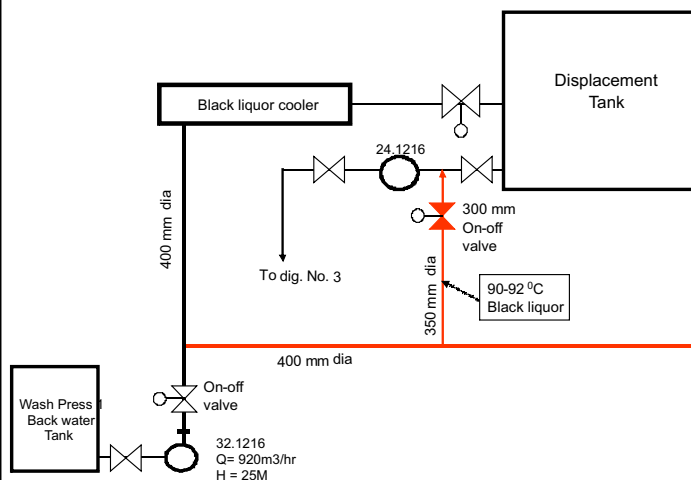
- During ILF temperature gain is about 8-10 degree C.
- After Hot liquor fill equalization temperature is raised by 6-8 degree C.
- Total cycle time is reduced by 8- 10 minutes

Since the results are +ve, it is planned to go for other three digesters to achieve overall gain in reduction of cycle time.

### Speciewise Separate Cooking

In most of the mills, wherever the raw material is more than one specie, it is normal practice to do mixed cooking. Every specie of wood has different characteristics. Hence cooking chemical requirement and yields are different. At WCPM also initially mixed cooking was started. Separate cooking was started by storing in three compartments of silo,

Schematic diagram for Hot liquor impregnation for Dig.no. 3



### Process parameters with Normal impregnation of Black liquor

Cook No.	AD Chips	Species	Temperature		HLF Volume	Equal. Temp.	Heating Time	Cycle Time
	Tons		After ILF	After 10 Minutes Circuln.	M3	°C	Minutes	Minutes
5	163	Mix	83	76	262	147	100	285
9	162	Mix	84	76	265	149	93	281
13	161	Mix	83	77	260	139	102	288
17	164	Casurina	84	76	254	142	104	291
21	181	Casurina	84	73	241	137	119	295
25	168	Casurina	83	77	262	146	109	294
29	164	Mix	84	75	235	138	110	304
33	169	Mix	83	76	261	143	98	289
37	171	Casurina	84	76	255	142	102	296
41	172	Casurina	83	75	286	144	96	281
AVG	167.5		83.5	75.7	258.1	142.7	103.3	290.4

### Process parameters with Hot impregnation of Black liquor

Cook No.	AD Chips	Species	Temperature		HLF Volume	Equal. Temp.	Heating Time	Cycle Time
	Tons		After ILF	After 10 Minutes Circuln.	M3	°C	Minutes	Minutes
276	136	Mixed	95	87	234	152	31	278
280	159	Casurina	92	85	288	154	24	272
284	143	Mixed	91	88	236	147	48	281
288	135	Mixed	92	87	241	150	33	275
292	146	Mixed	94	91	255	149	35	278
296	141	Mixed	94	88	290	151	23	265
300	147	Mixed	94	88	290	149	38	274
304	160	Mixed	94	83	241	146	44	297
312	150	Mixed	92	85	240	152	35	300
316	144	Mixed	94.84	85	237	154	26	281
AVG	146.1		93.28	86.7	255.2	150.4	33.7	280.1

### Data with Mixed cooking

Process Parameters	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12
AA %	21.22	21.29	21.59	22.13	20.9	21.02	21.14
AA KG/TON ub pulp	459.49	454.84	467.01	474.57	449.52	450.5	454.16
Raw Material/ Bleached pulp	3.99	3.88	3.98	4.03	3.68	3.92	3.94
WBL solids	2.19	2.19	2.27	2.24	2.19	2.18	2.17
Discharges	500	471	456	458	503	489	502
Discharges/day	16.67	15.19	15.2	14.77	16.23	16.86	16.19
BL pulp	19755	18644	18002	18091	19909	19320	19809

### Data With Separate cooking

Process Parameters	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
AA %	19.79	20.06	20.25	21.47	20.71	21.1
AA KG/TON ub pulp	424.97	430.78	426.62	455.9	438.77	447.28
Raw Material/ Bleached pulp	3.77	3.93	3.794	3.764	3.738	3.8
WBL solids	2.2	2.17	2.16	2.17	2.08	2.08
Discharges	362	535	495	498	500	492
Discharges/day	12.07	17.26	16.5	16.06	16.13	16.4
BL pulp	14331	21087	19998	20131	20206	19893

On an average cooking was done in following pattern as below:

- Clonal + Debark EC + Acacia ( Debark) ---- 55 % 10-11 Cooks/day
- Casurina ---- Bark ---- 35 % 6-7 Cooks/day
- Subabaul--- Bark ----- 10 % 1-2 cooks/day

This facilitated to increase discharge line Kappa no. 18-20 after cooking

Without affecting the screening rate. Targeting higher kappa in mixed cooking was having limitation due to higher reject rates and reduced screening rate. But there was no decrease in bleaching chemical as compared to earlier mixed cooking as mixed cooking was carried out relatively at low Kappa no. 15-16 (Discharge line).

Observations on separate cooking of species in April'12:

- Overall cooking chemical (Active .Alkali.) was reduced 1. -1.2 % on **B.D. chips basis** ~ 30 -40 Kg/Ton of Bleached pulp.
- Cooking was more uniform than earlier due to separate cooking % rejects have come down 31 Trips/day to 19 Trips/day ~ 35-40 % reduction.
- Raw material/ton of Pulp was reduced
- Because of A.A. charge reduction, Steam generation in soda recovery was improved.

### Screening & Washing

#### Feed Forward Screening

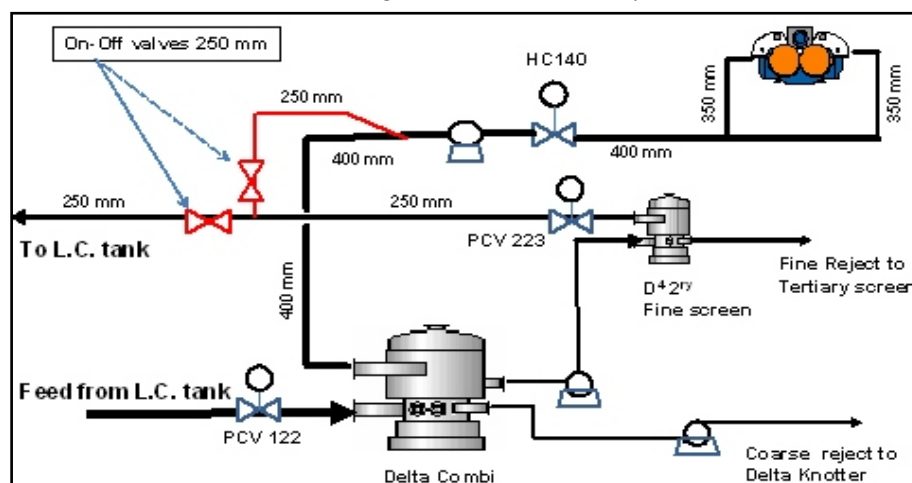
Conventionally screening system is supplied as cascade system where the accept of the forward stage is recycled back. Feed forward screening is the screen room configuration where accept from the secondary screen is combined with the accepts from primary screen, instead of cascaded. Benefits of Feed Forward are

- Rate of screening increases by 8 - 10 %
- Hydraulic load on Primary screen/delta reduces.
- Reduction in fiber going along with reject.

Based on the envisaged benefits Rate of screening increased from 32 T to 34.5 T/hr



Schematic Diagram for Feed Forward system



### Reduction of Fiber Going With Tertiary Rejects

In the Screening system, fine rejects from tertiary screen is processed through tail screen to recover the fiber and rejects are finally pressed in screw press and collected in trolleys to feed back along with chips during chips charging. Due to inadequate capacity of screen dilution pump, fiber going with the reject was as high as 35-40 %. Separate pump was installed exclusively for coarse screen and tail screen. This has reduced the fiber content to 19-20 %

Screw Press Rejects analysis before putting separate dilution Pump

SI No	Particulars	Unit	Screw Press rejects
1.	Moisture	%	63.7
2.	Ash	%	14.4
3.	Fiber	%	37.7
4.	Rejects	%	37.4
5.	Silica	%	0.40

Screw press rejects analysis after putting separate dilution pump

SI No	Particulars	Unit	Screw Press rejects
1.	Moisture	%	69.5
2.	Ash	%	16.0
3.	Fiber	%	19.4
4.	Rejects	%	54.7
5.	Silica	%	0.10

### Reduction of Fiber in Brown Stock Press 1 Back Water Tank

In the original system, pulp leakage from longitudinal seals was going to BSW press 1 back water tank. In practice, vat pressure of BSW 1 press is always high than Press 2 & 3 due to more solids. This caused more leakage of pulp from longitudinal seals and increased fiber content in Black liquor. This has also affected filtering capacity of Black liquor filters. This has increased load on Liquor filter. Line modification was

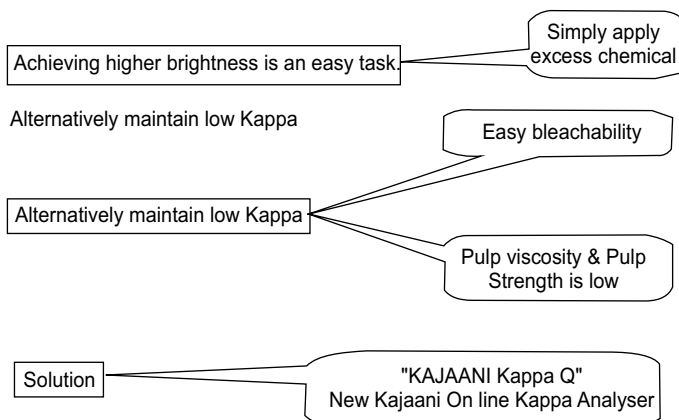
carried out to take this fiber in to the Press 1 stand pipe. This has reduced the fiber content from 600 ppm to 200 ppm

### Bleaching

Online kappa monitoring and control at multiple locations:

The new **Metso Kappa Analyzer (Metso Kappa Q)** launches several new features and measurements to improve the total pulp mill quality management. Metso Kappa Q is a new online analyzer for chemical pulp mills utilizing the newest Metso analyzer platform technologies and measurement capabilities. Metso Kappa Q measures pulp lignin content and brightness faster than ever before. The measurement capacity of Metso Kappa Q is easily expanded by adding measurement modules and sampling points. Furthermore, Metso Kappa Q introduces a new measurement capability - online fiber and shive analysis

**Our requirement: Higher brightness with Stable pulp Quality**



**Metso Kappa Q Analzer Installed at WCPM Have The Following Highlights:**

- Three sampling points with one analyzer to save cost. (models available up to six points)
- The proven Kappa and brightness measurements online
- Measurement capacity alternatives: 10, 20, 30 or 40 per hour
- Compact size
- Cost effective sampling arrangement
- New interfacing for high availability

Chemical pulping is a harsh process for cellulose fiber. The pulp maker's challenge is to run the fiber line cost effectively, preserving the virgin fiber quality properties for papermaking; the process management without online analyzers and controls is quite difficult. At West Coast there are three sampling points for analyzing online Kappa.

1. Before oxygen delignification
2. After Oxygen delignification.
3. After EOP stage i.e. Pulp entering to D1 stage.

The benefits achieved by WCPM for installing online kappa analyzer are as follows :

Chemical consumption reduction of 8% in  $\text{ClO}_2$  and 8% in  $\text{H}_2\text{O}_2$ .

- a. 3 -4 kg/ton of  $\text{ClO}_2$  as active chlorine
- b. 1.5 kg/ton of  $\text{H}_2\text{O}_2$
- c. 2 kg/ton of caustic

Reduction in cost of production of bleached pulp ~ Rs. 120–130 /Ton.

WCPM operational experience of Kappa Analyzer:

After putting Kappa control into operation the monitoring and control of chemical was much easier.

Brightness control at each stage was better than earlier.

Reduction in chemical has also resulted in improvement of pulp strength.

Future challenges and Road map

Continual improvement is the vision of WCPM and it is the key to the success of all achievements done so far. It concludes with future action plan for increasing productivity and quality. Few of them are:

1. New chipper of 50 T/hr capacity with auxiliaries such as screen & rechipper This will also facilitate specie wise cutting of raw material without affecting chipping & separate cooking.
2. One dig of 400  $\text{M}^3$  capacity to increase pulping capacity to 800 T/day bleached pulp production.
3. Addition of one press for improving washing and reduction of carry over. This will also reduce the bleaching chemicals.
4. New tower at Dhot stage & Retention tube at EOP stage for coping up increased bleached pulp production.

### Conclusion

The company's investment in a brand new 725 TPD Metso fiber-line, replacing the old unit with eco friendly elemental chlorinefree (ECF) bleaching process has enabled to produce consistent quality of high-bright and hi-strength pulp with improved cleanliness & with least pollution load. The high degree of bleaching has also improved the optical properties of paper.

This paper describes the journey of the best practices adopted in new generation fiber line at WCPM to reap the full benefits of the investment. It starts from the raw material end to Bleaching section. Specie wise Separate cooking, improvement in cooking cycle, increasing screening rate, reduction in screening reject, commissioning of on line Kappa analyzer and its control for controlling bleaching chemicals are the best practices implemented.

### Acknowledgement

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Chemical consumption prior to Kappa analyzer control April'11-Aug'11

Sl No	Chemical	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Average April'11-Aug'11
1	Chlorine Dioxide	19.60	19.58	18.86	19.64	19.58	19.45
2	NaOH at Bleaching	15.83	16.3	17.6	17.3	15.1	16.44
3	$\text{H}_2\text{SO}_4$	20.53	20.17	22.75	19.59	21.61	20.93
4	$\text{H}_2\text{O}_2$	12.55	9.92	12.53	10.43	10.62	11.21
5	Oxygen	27.86	28.07	27.9	28.67	27.50	28.00

Chemical consumption after Kappa analyzer control Sept'11- March'12

Sl No	Chemical	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Av Aug'11-March'12
1	Chlorine Di Oxide	18.18	17.8	17.44	17.57	17.76	17.81	17.6	17.74
2	NaOH at Bleaching	14.5	13.4	12.98	14.48	13.94	14.03	15.58	14.13
3	$\text{H}_2\text{SO}_4$	19.93	17.78	17.38	16.32	16.49	16.68	18.99	17.65
4	$\text{H}_2\text{O}_2$	10.05	10.37	8.91	8.88	10.81	9.89	10.95	9.98
5	Oxygen	24.15	25.03	24.86	26.15	27.08	27.26	26.27	25.83

Chemical savings

Sl No	Chemical	Average April'11-Aug'11	Av Aug'11-March'12	Savings Kg/Ton
1	Chlorine Di Oxide	19.45	17.74	1.71
2	NaOH at Bleaching	16.44	14.13	2.31
3	$\text{H}_2\text{SO}_4$	20.93	17.65	3.28
4	$\text{H}_2\text{O}_2$	11.21	9.98	1.23
5	Oxygen	28.00	25.83	2.17

Note:  $\text{ClO}_2$  consumption is expressed as  $\text{ClO}_2$ . Hence savings as active  $\text{Cl}_2 \sim 4\text{--}4.4$  Kg/Ton Bleached pulp

## Spare Items for Sale at Century Pulp & Paper

S NO	ITEM NAME	TECH SPEC	Unit	Quantity
		<b>MECHANICAL ITEMS</b>		
50761	METERING ROD	5400LG-12D PROFILE C-20	NOS	2.000
53214	LIP SEAL	12 X 9.5	NOS	10.000
53218	SEALING RING F -DOORS	DN 350 X 450	NOS	1.000
53219	ROUND CORDS	5 X 550 F .L	NOS	1.000
53314	FILTER ELEMENT	HC 7500 SDT-84 B	NOS	1.000
53363	FILTER ELEMENT	7500 H SPT 8 HP	NOS	1.000
53507	S.S. BLADES	5710 X 50 X 1.2	NO	4.000
50201	DEAD KNIFE HOLDER	FOR SERKANDA CUTTER	NOS	2.000
50785	WELLMAN BIBY GEAR COUPLING	TYPE GFS SIZE -25	SET	1.000
62342	IMPELLER	FOR CENTRIFUGAL BLOWER	NOS	1.000
78049	FILTER FOR NIPCO CALENDER HYDRAULIC	1300R003BN/HC-2 46/93MAKE HYDA	NOS	2.000
30921	O,RING	91401015	NOS	2.000
30926	PISTON SEAL	91120048	NOS	1.000
30927	ROD SEAL	91509012	NOS	8.000
30928	WIPER SEAL	91009024	NOS	4.000
30929	BACKUP RING	91220003	NOS	4.000
30930	BEARING RING	91809024	NOS	5.000
32964	PIPE END HDPE	315 MM OD PR. 4.0 KG/CM	NOS	1.000
13761	BEND HDPE	90 MM, 3", 80 DN	NOS	5.000
17671	COLLAR HDPE STUB END	110 MM OD,PR. 10 KG/CM <sup>2</sup>	NOS	4.000
09441	BEND FRP HEAVY	80 MM 3D RADIUS	NOS	2.000
54150	TAPE ASBESTOS		ROLL	6.300
54415	GEAR BOX WORM REDUCTION	2 1/4" RATIO 70:1	NOS	1.000
75004	GEAR BOX FLEND MAKE	SDA 180, RATIO 88.043:1	NOS	1.000
50172	PIPE HDPE	63 MM	MTR	106.000
50566	SWIVEL BANJO	12 MM * 3/8" OD	NOS	50.000
73047	STEAM TRAP WCB,FLOAT BK 15,FL END	50 NB,CL 150,INLET PRESS:2 TO 3 BAR	NOS	24.000
72338	FIBER GLASS		SQMT	541.360
72340	FIBER SHEET MOLDED		NOS	75.000
72413	ASBESTOS MILL BOARD STRIP	20MM,3MM	NOS	29.000
79465	TENSION CONTROL SYSTEM		SET	2.000
50860	YOKE	200 MM	PES	1.000
50881	YOKE	450 MM	PES	1.000
74109	FLAT/STRIP COPPER	100 * 12 MM	KGS	60.850
78979	JACK FOR PM I & II	RATIO 6:1 001 199454	NOS	1.000
78980	GEARED MOTOR	MR 2140, FCIA 71BA 440 BS7,	NOS	2.000
79505	SPRAY NOZZLES WITH ELBOW AND NIPPLE		NOS	15.000
79721	IMPELLER WITH CONIC AC COVER P.L	40501	NOS	1.000
79740	NICKEL PLATED ELECTRODE WITH CARBON PAD		NOS	20.000
79741	FRONT GUIDE INSULATOR		NOS	20.000
79745	HAMMER ASSEMBLY FOR COLLE.ELECTRODE RAPP		NOS	2.000
79746	HAMMER ASS. FIR DISCH. ELECTRODE RAPP		NOS	2.000
79747	ROLLER ASS. COMPRISING 2 ROLLER WITH NUT		NOS	2.000
79510	FILTER PART FOR HYDRAULIC PONEER PACK	UNIT OF WIRE SEEM LESS (R005)	NOS	1.000
79511	FILTER PARTS FOR HYDRAULIC PONEER PACK	UNIT OF PRESS (1300-R003/HC2	NOS	1.000
79513	FILTER PARTS FOR HYDYLIC PONEER PACK	UNIT OF PRES PART HYD CON-0660	NOS	2.000
79422	REXTHOMAS COUPLING	SERIES 52SIZE 350DRG952-250-00	NOS	2.000
79431	COUPLING MAKE FLENDER	TYPE NEN-235	NOS	2.000
79553	CROSS KITS FOR CARDEN SHAFT	587.5	NOS	6.000
79580	FILTER CARTRIDGE FOR PRESSURE FILTER		NOS	4.000
79462	FLAT HEATER[8SECTIONS]		NOS	1.000
78873	HYD. FILTER	OFM-202-10-IN24	NOS	1.000
80153	BELT PLASTIC FABRIC SANDWICH	180 * 5660 MM	NOS	1.000
80508	COMPLETE COUPLING	60 HPC	NOS	1.000
80551	SPARE TYPE FENNER	F- 45	NOS	1.000
30127	MAGNETIC TRAP FOR SEPARATING THE IRON	PARTICLE FROM BLEACH STOCK PUMP FOR:300 NB	NOS	1.000
20298	MS RING IN TWO HALF	SIZE:OD=120MMXID-81MMXTHICKNESS-12MM	NOS	17.000
32691	TEFLON SEAL	SIZE.ID 194MMX199.9XTHIC 7.2MM	NOS	6.000
45263	TEFLON	SIZE:OD-248MM.ID-200MM THICK-20 MM	NOS	1.000
20181	BUSH UHMWPE IN TWO HALF	ID:180.1 -+0.05,OD:360 -+0.05,WIDTH:98MM	SET	2.000
20354	S.S. 316 L PERFORATED PLATE	350MMX210X6X6	NOS	2.000
30269	M.S.BUSH	O.D.202,ID191,185 LENGTH	NOS	1.000
19335	ACTUATOR FOR CALENDER STOCK	15TON STROKE-100MM **DISPOSABLE**	SET	2.000
19337	SPARE IMPELLER WITH SHAFT	3-012	NOS	1.000
19338	SPARE IMPELLER WITH SHAFT	FOR TYPE ADBB-3-012	NOS	1.000
19604	SPARE IMPELLER WITH SHAFT	HDBB-3-010-6-1	NOS	1.000
32417	AIR DIFFUSER	HOT AIR SUPPLY	NOS	2.000



19602	SPARE IMPELLER WITH SHAFT	HDBB-3-025-6-1 **DISPOSABLE**	NOS	1.000
19581	SIPHON ELBOW **DISPOSABLE**	3/4 "	NOS	30.000
11107	CRANE PINION FOR ELECTRIC HOIST 2 TON	64.2 CS	NOS	1.000
19203	NON WOVEN FILTER FALISIT OBSOLETE	VT/45 .885 M/M	NOS	100.000
19773	LONG KNIVES FOR GUILLOTINE M/C	54X5X178X5X 2 CONV 001	NOS	2.000
19511	HEAD BOX SPRAY NOZZLE (O)		NOS	15.000
19512	HEAD BOX MICRO ADJUSTING SCREW (O)		NOS	2.000
19468	AIR TUBE CLUTCH FOR M/C CONE PULLEY	18" OR 1800*500 MM	NOS	1.000
<b>ELECTRICAL ITEMS</b>				
62187	ADAPTOR FOR PG 2100/30CPU	PG 1363J2	NOS	1.000
62190	RELAY	TEKREL 24/I/1	NOS	5.000
62191	SIGNAL CONDITIONER	240V 50HZ	NOS	1.000
62195	POWER SUPPLY MODULE 240V/24V/60W	5PK 124	NOS	1.000
62642	WATER COOLING JACKET	FOR PHOTO CELL	SET	2.000
63105	RELAY O/P MODULE	MODULE NO.6ES5 452-8MR 11	NOS	1.000
27191	BLACK PORCELAIN BASE BAKELITE SOCKET	5 AMPS	NOS	53.000
27221	SWITCH PORCLINE BASE BAKELITE TUMBLER	15 AMP	NOS	16.000
27371	JUNCTION BOX P.V.C	3/4" X 2 WAY	NOS	12.000
27381	JUNCTION BOX P.V.C	3/4" X 3 WAY	NOS	10.000
27391	JUNCTION BOX P.V.C	1" X 1 WAY	NOS	20.000
27401	JUNCTION BOX P.V.C	1" X 2 WAY	NOS	20.000
27411	JUNCTION BOX P.V.C	1" X 3 WAY	NOS	16.000
27471	WOODEN ROUND BLOCK	3"	NOS	94.000
27851	CONDUIT CHECK NUT	3/4"	NOS	82.000
27861	CONDUIT SOCKET M.S.	3/4"	NOS	344.000
27871	CONDUIT REDUCER	3/4" X 1/2"	NOS	188.000
33335	JUNCTION BOX		NOS	58.000
76255	PORCELAIN SOCKET (POWER)	15 AMP	NOS	85.000
77614	DISTRIBUTION BOARD	16 AMP HAVELLS MAKE	NOS	4.000
79743	TRANSFORMER		NOS	2.000
<b>INSTRUMENTATION ITEMS</b>				
30917	COPPER WASHER	92101013	NOS	2.000
30918	COPPER WASHER	92103339	NOS	2.000
30919	COPPER WASHER	92101418	NOS	2.000
81035	SPANNUGSVERSORGUNG 5V/20A		NOS	1.000
81036	SPANNUGSVERSORGUNG 5V/8A		NOS	1.000
81037	SPANNUGSVERSORGUNG 24V/6A		NOS	1.000
81038	SPANNUGSVERSORGUNG 16V/8A		NOS	1.000
81039	SPANNUGSVERSORGUNG 24V/2.5V		NOS	1.000
81040	SPANNUGSVERSORGUNG 12V/8A		NOS	1.000
81044	LICHTSCHRANKENINTERFACE		NOS	1.000
81048	DISTRIBUTION CARD		NOS	1.000
81050	CORE CABLE LENGTH 7.1M		MTR	1.000
81051	MEMBRANE FUR I-KAMMER	KR-85 FOR 7.4& 14.8 GBQ	NOS	2.000
81052	MEMBRANE FUR QUCLLC	KR/ 85FUR 7.4& 14.8GBQ	NOS	5.000
81053	ELEKTROMETERVERSTARKER	KR. 85(14.8 GBQ)	NOS	1.000
81058	MEMBRANE DS		NOS	4.000
79754	ACCESS DOOR	FOR ABL	NOS	1.000
79755	INSPECTION DOOR	FOR ABL	NOS	4.000
54106	CUPPER TUBE	ASSTD	MTR	18.000
78993	ALPHALINE DIFF. PRESSURE TRANSMITTER	WITH REMOTE DIAPHRAGM SEAL	NOS	1.000
94470	KIT MOISTURE TRAP	PNO-9095044500	NOS	1.000
78971	VALVE MANIFOLD SS 316	3 WAY OR 2WAY 1500 PSI	NOS	2.000
<b>CIVIL ITEMS</b>				
70319	TAIL PIECE PVC	140 MM	NOS	51.000
70351	TAIL PIECE PVC	280 MM 6 KG	NOS	18.000
71407	REDUCER PVC	110X63	NOS	6.000
50328	SOCKET PVC/PVC COUPLER	50 MM	NOS	39.000
51437	SOCKET PVC /COUPLER PVC	40 MM	NOS	187.000
70639	COUPLER PVC	140 MM 10 KG	NOS	26.000
70642	COUPLER PVC	225 MM	NOS	1.000
70935	TEE PVC	140 MM	NOS	2.000
70161	PIPE PVC	225 MM / 8"	MTR	198.000
71122	BEND PVC	140 MM 10 KG	NOS	4.000
71151	BEND PVC	280 MM 6 KG	NOS	11.000
13391	FLANGE PVC	200 MM	PCS	18.000
13401	FLANGE PVC	160 MM	NOS	23.000
13431	FLANGE PVC PRINCE MAKE	63 MM	NOS	68.000
13601	SOCKET PVC PRINCE MAKE	250 MM	NOS	27.000

PROCESS ITEMS				
32361	SEPARATING PLATE	FOR PACKING M/C	NOS	1.000
32362	STREP GUIDE SET	FOR PACKING M/C	SET	1.000
32363	TOP COVER HOLDER	FOR PACKING M/C	NOS	1.000
32364	ROUND BELT	FOR PACKING M/C	NOS	5.000
32365	PLUNGER ASSEMBLY	FOR PACKING M/C	NOS	1.000
32366	BEARING SET	FOR PACKING M/C	NOS	1.000
32367	24PIN EDGE CONNECTOR	FOR PACKING M/C	NOS	2.000
79457	HOT GLUE APPLICATOR	FOR PACKING M/C	NOS	1.000
TRUCK TRIPLER ITEMS				
30931	O. RING	91401302	NOS	2.000
30932	GASKET	92800500	NOS	2.000
30933	HOSE AASSY	90405400	NOS	1.000
30937	O.RING	91402003	NOS	12.000
30939	ROD SEAL	91503024	NOS	2.000
30941	BACKUP RING	91205515	NOS	12.000
30942	ST.UNION	25001100	NOS	5.000
30943	HOSE ASSY	94003800	NOS	4.000
30944	FILTER	90500100	NOS	2.000
31304	SS-316 GLAND FOLLOWER PT.NO-4	3-B-PC-002	NOS	1.000
31374	GUIDE RING	2300400	NOS	6.000
31376	FILTER UNIT ASSY.	PART NO. 905 50200 (UAH)	NOS	1.000
31379	ROD SEAL	91504024	NOS	5.000
31380	WIPER SEAL	91004006	NOS	2.000
31407	THRUST LINK ASSY.(TRIPPLER PARTS)		NOS	1.000
90997	OIL FILTER	ITEM NO-00090713060	NOS	4.000
31406	LIFTING ARM ASSY.(TRIPPLER PARTS)		NOS	2.000
31855	RUBBER BUFFER FOR TRUCK TRIPLER		NOS	5.000
PIPE FITTINGS				
70577	BEND SS 316	600 NB	NOS	2.000
70581	BEND SS 316	900 NB	NOS	1.000
70343	COLLAR SS 316L LONG STUB END	600 NB,SCH 5	NOS	1.000
70345	COLLAR SS 316	700 NB,	NOS	6.000
70347	COLLAR SS 316	900 NB,	NOS	1.000
70767	REDUCER SS	350 * 300 MM	NOS	4.000
70769	REDUCER SS 304	450 * 350 MM	NOS	3.000
54110	TEE SS.	ASSTD	NOS	11.000
50505	ELBOW M.S. WELDEDEND,SCH-40,	3/8",	NOS	11.000
71328	FLANGE FLAT FACE SLIP-ON M.S.	900 MM	NOS	2.000
50367	REDUCER IBR	88.9 MM *168.3 MM	NOS	1.000
70779	REDUCER M.S	65 X 80 MM	NOS	2.000
50506	FERRULE M.S.	6 MM	NOS	129.000
50601	ELBOW IBR	88.9 MM	NOS	17.000
71115	ELBOW M S	500 MM	NOS	6.000
70617	SOCKET M.S	50 MM	NOS	14.000
50508	TEE EQUAL M.S.	12 MM	NOS	3.000
50502	UNION M.S.	100 MM	NOS	6.000
50339	UNION G.I.	100 MM OR 4"	NOS	2.000
71009	UNION G.I.	100 MM OR 4"	NOS	8.000
50377	REDUCER G.I.	1"X 2"	NOS	9.000
70703	REDUCER G I	1"X 2"	NOS	22.000
70607	SOCKET G.I.	50 MM OR 2"	NOS	11.000
70611	G.I. SOCKET	150 MM	NOS	6.000
70910	TEE G.I	100 MM	NOS	10.000
70961	TEE REDUCING G.I.	3/4"X 2"	NOS	99.000
VALVES				
73127	VALVE DIAPHRAGM RUBBER LINED	200 MM	NOS	4.000
73159	VALVE GATE/SLUICE CI	500 NB	NOS	2.000
73206	VALVE CHECK SS,SWING	300 NB	NOS	1.000
19138	CHECK VALVE WEIGHT	HDO	NOS	1.000

**ADDRESS: -**  
CENTURY PULP & PAPER  
GHANSHYAM DHAM, LALKUA - 262402  
DISTT. NAINITAL (UTTRAKHAND)

**CONTACT PERSON: -**  
Mr. S.D. BAHUGNA  
(Sr. G. M. Purchase)  
Ph : (05945) 268044, 268043\*247, EPABX No. 112  
Fax : (05945) 268047  
Mob : +91 9358191366  
E-mail : sdbahuguna@centurypaper.org.in