

# Problems Confronted in Erection and Commissioning of the New Multi-stage Bleach Plant

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## Description :

The Andhra Paper Mills was originally owned by the State Government and administered under the Department of Commerce and Industries for a long time. The installed capacity of the Old Mill was 10 tons of paper per day from admixture of Bamboo pulp and waste paper. The Mill was working at a loss. The Government of Andhra Pradesh thought of expanding the Mill to 70 tonnes of paper per day with a modern integrated sulphate mill with two Paper Machines and a Chemical Recovery Unit. The orders were placed for the plant and machinery through French Collaborators, sometime in the year 1960 and all plant and machinery were received at site by the end of 1962. Due to various factors the State Government could not even start the site clearance, factory buildings leaving aside the erection of plant and machinery until 1964. They decided to hand over this Project to Private Sector and accordingly the Management of the West Coast Paper Mills Limited took over this Project in July 1964 under a Joint Stock Company in the name and style of the Andhra Pradesh Paper Mills Limited.

The present Management assessed the economics of the Project and felt that a 70-ton per day Unit in the year 1964/65 could not be considered as an economic one and asked the Technical Department to review the entire planning keeping in view the installation already received to build up the capacity to 100 tonnes per day and at the same time to plan the expanded Unit to 150 tonnes per day with diversification for better profitability. This involved lot of ingenuity on the part of our

Technical Department to replan the entire engineering including the lay-out. Every installation, accessories, pipings, fittings, pumps, electrical installations, etc., had to be studied in all details to assess how much maximum capacity individually they have and what we have to do to fill-up the gap to integrate the Project for 100 tonnes per day capacity.

The Multi-Stage Bleach Plant was one of the major Sections which had to be balanced for higher productivity. It may not be out of place here to record that we could not approach the foreign Collaborators for re-doing the engineering or erecting and commissioning the re-designed plant and machinery because they would have charged exorbitant fees to be paid in foreign currency. Obviously, the entire burden of replanning, erection and commissioning of the plant had to be taken up by our Technical Department.

## Description of Process :

The Bleach Plant is a conventional multi-stage bleaching with Chlorination-Caustic extraction followed by Hypochlorite in two stages.

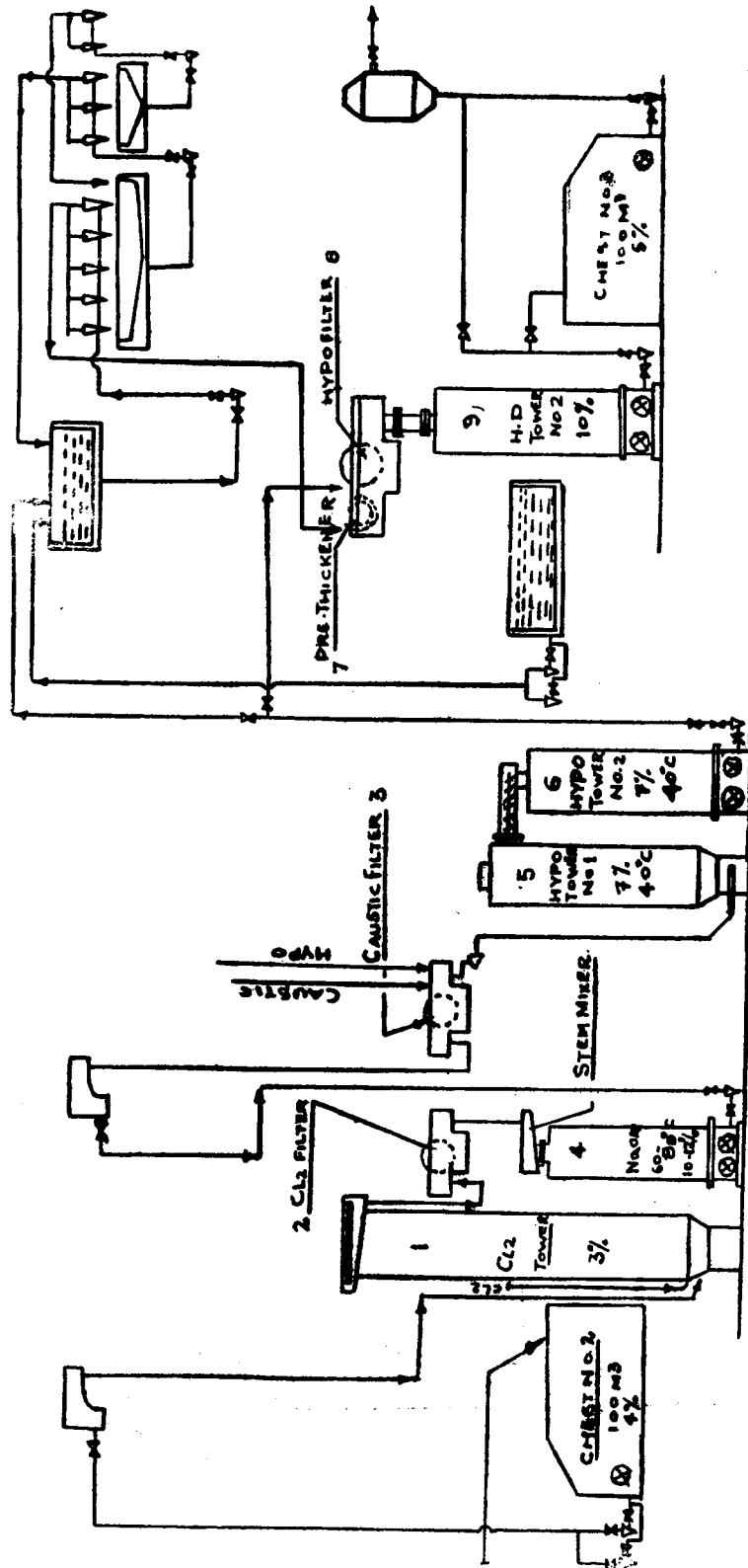
The screened unbleached pulp, after processing through Centricleaners, is fed to Chlorine Tower (100m<sup>3</sup>) through a Källe Flow Box where volumetric flow and consistency of pulp are automatically controlled. Chlorination of pulp is done in gaseous phase by directly injecting chlorine at the bottom of the Tower at a point between the Tower Agitator suction and the point of unbleached pulp

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# HYPOCHLORITE FLOW SHEET-A.P.P.M



ITEM NO.	CAPACITY	SIZE	ITEM NO.	CAPACITY	SIZE
1.	107 M <sup>3</sup>	3.08 φ x 18.9 M.	6.	156 M <sup>3</sup>	4.2 φ x 13.5 M.
2.	-	2.25 φ x 2.25 M.	7.	-	1.5 φ x 2.25 M.
3.	-	"	8.	-	2.25 φ x 2.25 M.
4.	78 M <sup>3</sup>	2.78 φ x 13.4 M.	9.	120 M <sup>3</sup>	4 φ x 10.5 M.
5.	127 M <sup>3</sup>	5.0 φ x 28 M.			

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ITEM NO.	CAPACITY	SIZE	ITEM NO.	CAPACITY	SIZE
1	9 M3	-	5	2 M3	-
2	-	10' x 2 M	6	-	-
3	4 M3	-	7	12.5 M3	-
4	4 M3	-	8	-	-

feed to Tower. The chlorinated pulp is washed on Kamyr Filter (type M54).

The washed pulp, after the addition of caustic, passes through steam mixer and hot alkali extraction is done in a downward flow tower, operating at 10-12% consistency and at 55 to 60°C. The pulp is diluted to 4-5% consistency at the bottom of the tower through dilution nozzles and pulp is pumped to alkali washer similar to chlorine washer. Hypochlorite is added in the caustic washer repulper buffered with caustic and pulp is pumped by high density stock pump at a consistency of 7-8 percent. The pulp flow in the first hypo tower is upward and in the second tower it is downward. A screw conveyor is provided for transferring pulp from hypo tower No. 1 to hypo tower No. 2. There is provision to add hypochlorite and caustic in the screw conveyor for finer adjustment of pulp brightness. The pulp from the hypo tower No. 2 is diluted to 4 to 5% at the bottom of tower by dilution nozzles and is pumped to centricleaner head box. The cleaning is done in a 3-stage centricleaners at a consistency of 0.6 to 0.7% and cleaned pulp is passed through a pre-thickener followed by hypo washer, similar to chlorine washer. The washed pulp can either be stored at 10-12% consistency or 4 to 5% consistency.

**Hypochlorite:** The hypochlorite preparation is based on the drawings and design of Messrs. Cellico. The slaker is a stationary one with three compartments and with rake arms. In the first compartment steam is admitted and in the second compartment milk of lime is cooled by circulating chilled water through coils. The milk of lime is diluted in the third compartment. The fine grits are removed in screw classifier and centricleaners. The milk of lime is passed through a P.V.C. Reactor where chlorine is injected. The proportioning of chlorine and milk of lime is controlled by a pH meter. The hypochlorite solution is clarified in a clarifier and clear hypochlorite solution overflows to a storage tank. The discharge of hypomud is done by electro valve operating at present intervals. In the existing hypochlorite plant, no washing arrangement is provided for recovering chlorine from the underflow.

The flow sequence of Bleach Plant and Hypochlorite are illustrated in the Flow-Sheet.

## **PROBLEMS:**

### **Multi-Stage Bleach Plant:**

The Multi-Stage Bleach Plant as supplied by our Collaborators was designed as a conventional chlorination-caustic extraction-two stage hypochlorite one. The Bleach Plant was supplied by Messrs. Kamyr but the Plant engineering was done by collaborators, who absolutely lacked the practical experience in the field because of which they missed lot of points.

Messrs. Kamyr gave the chlorine tower with a provision for injecting the gaseous chlorine on the bottom of the tower at a point between the Tower Agitator suction and the point of unbleached pulp fed to Tower. Our collaborators did not make any provision for gasifying the liquid chlorine.

They also calculated, for designing of the Plant, the unbleached bamboo kraft pulp at Permanganate Number of 9 to 11. While with the soft woods where the lignin content is very high, it would be possible to make the soft pulp in acidic cooking at low Permanganate Numbers. It is not so easy to cook Bamboo chips in conventional method of alkali kraft cooking process with such low Permanganate Number without adversely affecting the yield and strength properties. Without having any idea of Permanganate Number of Bamboo pulp and the nature of rejects in the unbleached pulp, they provided an inadequate screening system and a wrongly designed centricleaner plant ahead of the Bleach Plant.

Since the basic process designing of bleaching the unbleached pulp of 9 to 11 Permanganate Number was wrong in itself, the consequences was the arrangement for chlorine mixing with the pulp designed with the circulation pump was inadequate.

The instrumentations provided were all designed for low chlorine demand in bleaching in all stages.

The Calcium Hypochlorite Plant supplied by Collaborators is highly sophisticated and for continuous process based on the highly pure quality powdered burnt lime, without understanding whether such quality raw materials would be available in India.

Such a Plant wrongly designed without understanding the raw materials available in India and the characteristic and the resultant ultimate product was inherited by this Company posing insurmountable problems in re-designing the entire plant. Added to this we had to face another calamity when unexpectedly a fire broke in our Machinery Godown prior to the erection of the Plant engulfing more or less all vital installations of this Plant.

**Long Storage :—**Most of the vital equipments were in long storage for the reasons already mentioned. The equipments were damaged and rusted. The equipments had to be checked, overhauled at each stage before erecting. In some cases like lining material for Bleach Towers, alternate arrangement had to be made as originally supplied material was completely destroyed.

**Fire Damage :—**As most of the equipments arrived in 1962, they were stored in a Godown near the Rajahmundry Railway Station, four miles away from the Factory site. This Godown caught fire resulting in a serious damage to the vital equipments. Bleach Plant and MF Machine equipments were the worst to be affected. The fire damage was so severe, that one thought it would be hopeless job to erect the Bleach Plant. A new cell headed by a very senior Engineer was formed to go into the details to assess the nature of damage and to find ways and means for the rectification of the fire-damaged equipments. In order to avoid severe financial set back to the Company it was essential that all the equipments were rectified to enable the Plant to come to a production stage. The very fact that the Bleach Plant has been commissioned is itself a great tribute to the Engineering talent of the Andhra Pradesh Paper Mills. A brief mention of the nature of damage and rectification work is necessary to give an idea of the Herculean task we had to face.

All the three Bleach Filters, including the accessories were affected. The Bleach Filters supplied are of mild steel clad in stainless steel for the portion where it would come in contact with chemicals. The Filter journals were bent and Filter face was completely warped. The Press Roll and Pick-up Rolls were badly deformed. The main Gear Box and Pick-up Roll Gear Box were damaged. High Density Stock Pumps, Agitators, Screw Classifier and Milk of Lime Mixer were affected by the fire.

The greatest task which our Engineers had to face was the rectification of these Bleach Filters, as no assembly drawings were available. Only few photographs were sent along with the Shipping Documents. A survey was made to find out if any of the local Workshops could take up the rectification of the Filters. Most of the Workshops did not have proper facilities to take up the job and some of the Workshops were not even interested in taking up the complicated job. Left with no alternative, it was decided to take up the job in our mill itself. As no lathe big enough to take up the Filters was available, special attachments and beds had to be made to accommodate the Filters on the Roll Grinding Machine. The Journals which were bent were built up by welding and cutting. The Filter face was machined and ground to a tolerance of  $\pm 2/1000$  of inch. The undercloth and Filter surface was badly warped. The surface had to be made even by preparing special jigs.

The Auto-valve synthetic material was completely burnt. Ferrobestos was fixed in the Auto-valve after taking initial cut and then final polish cut was given to make surface true.

The rubber lining of most of the Agitators and Pumps were completely burnt. They were relined at Bombay.

**Hypochlorite and Gassifier Plant :** In the original planning complete Gassifying Plant was omitted. The entire Gassifying Plant, with Gassifier, Filters, were fabricated basing on the data available from Pennsalt Chemical Corporation Bulletins.

P.V.C. Chlorine reactor was broken in transit. As no supplier came forward to supply this, we made one out of Rigid P.V.C. pipes which is working since one year.

Chlorine valves posed another serious problem as no chlorine valve were included in the supply. Locally made needle valves were used, which did not last more than one month. The liquid chlorine cylinder valves manufactured by Modern Stores Suppliers, Calcutta-2 are being used. The life is about three months. For gaseous chlorine cast steel valves were used but they were lasting only for about a month. We tried rubber pinch valves but the rubber muffs got hardened due to chlorine action and gave way within a week. Similarly was the case with diaphragm valves. The P.V.C. valves

also gave way; though they served for a period of about three months. The P.V.C. valve sealing got blistered and gave way. This particular problem is not yet solved. The chlorine leakage through glands and threaded joints were solved by using Tebon universal rope gasket and 0.003" Teflon thread sealant tape<sup>3</sup>.

In Hypochlorite Preparation Plant, the Lime Slaker supplied was designed to handle lime of very high purity free from any unburnt stones and grit. The burnt lime containing stones and grit could not be used in the Slaker. The lime had to be sorted and screened manually before it could be used which limited Hypochlorite production. As a stop-gap arrangement, we installed two tanks (16-18m<sup>3</sup>) with Agitator and cage for feeding lime. The milk of lime prepared batchwise is Pumped to Slaker for further processing.

**Material of Construction:** Bleach Plant—Excepting in few places, most of the pipelines had to be procured indigenously. In addition, the location of many equipments were altered and required additional piping. In our re-planning, pipelines were designed to take care of 100 tonnes bleached pulp production per day. In general, pipelines produced and fabricated as follows:

Dry Chlorine lines	... Mild steel (extra thick) seamless.
	... Grouting pipe in the Chlorine Tower Stainless Steel 316 quality.
Hypo Preparation Plant	... P.V.C. Pipes.
Chlorine pipe at the inlet of Chlorine Tower and pipelines upto Bleach Centrifugers Head Box and Grouting pipes.	... Stainless Steel 316 quality.
Rest of the pipelines including Hypo distribution pipes.	... Stainless Steel 304 quality.

After running for three to four months, it was found that chlorine line to chlorine tower was severely corroded including grouting pipe and it

was replaced by P.V.C. pipes<sup>4</sup>. Hypochlorite distribution pipes were also changed from stainless steel 304 quality to P.V.C. Chlorine back water pipes had to be replaced by rubber-lined pipes.

**Civil Problems in Bleach Towers:** The Civil construction also posed its own problem.

All the Towers were designed to be lined with the imported synthetic resinous cement emulsions Norcot with glass cloth as base. The Norcot resin was completely spoiled due to long storage. We had to look for alternate lining arrangement. Mandana stones<sup>5</sup> were tested at Alipore Laboratory. For all the Towers and Chests Mandana stones were used. The bedding and pointing materials were obtained from Messrs. Coromandel Portland Cement Company, Madras. As most of the tiles were in the range of  $\frac{1}{2}$ " to  $1\frac{1}{4}$ " thickness, it posed problem as Towers were constructed to take up lining of 3 mm. thick.

Bleach Towers were leaking heavily, when water test was taken. Sodium silicate was added (1-2 percent) to Tower filled with water and kept agitated for 3 to 4 hours and then was allowed to remain for 24 hours, with the idea that silicate would plug the fine pores. The chlorine tower and Hypo-tower tile lining where corrosion condition were more severe were re-pointed. Silicate addition and repointing was done 3 to 4 times. As leakages were persisting chlorine and Hypo Towers were pressure grouted from outside by pumping cement slurry hydraulically. The rectification of civil Towers took nearly 2½ months.

We may mention here that the 70 tonnes per day Project was re-designed the fire affected parts were repaired and the entire plant and equipments were erected by the Indian Engineers and Technicians in a fairly record time. We started the erection in the beginning of 1966 and on 11th March, 1966 the entire Plant was commissioned. To-day the mill has achieved 100 tonnes per day production with 50% bleached varieties of papers.

#### Future Plans :

The working experience of the West Coast Paper Mills, who are the Technical Collaborators to the Andhra Pradesh Paper Mills, helped to a great extent to pinpoint the bottle-neck for achieving production of 100 tonnes per day.

**Hypo Plant :** We are planning, to instal Rotary Drum Slaker and Rake Classifier for the preparation of milk of lime. These will replace the originally supplied stationary Slaker and Screw Classifier. Vibrating Screen is planned to remove fine grit. 60m<sup>3</sup> Storage Tank made out of mild steel is planned to facilitate cooling of milk of lime. From the underflow of the existing Hypo Clarifier we are losing 8 to 10% chlorine and we want to take this underflow into one more Clarifier for further washing and recovery of chlorine and partially lime.

**Pennsalt Mixer :** Due to the difficulties in chlorination of the pulp at higher rate of production, we are installing Pennsalt Chlorine Mixer with disperser. This will also enable us to go for higher yield and higher K. No. Unbleached pulp since a Chlorine Premixer could take care of further absorption of chlorine for better delignification.

#### Chlorine Dioxide Bleaching :

In conventional bleaching arrangements we have at present, no doubt, we have taken care of the pipelines and accessories to gear up the Plant for higher production upto 100 to 120 tonnes of bleached pulp per day. However, the retention time for bleaching would be reduced which may affect the brightness of the pulp adversely, especially at higher rate of production. Besides, we have got to orient our manufacturing programme for export purposes wherein very high quality of pulp is desired.

In order to fulfill the above requirement, we decided to go in for Super-bleaching with chlorine dioxide which will boost the brightness by 6 to 8 points without impairing the strength properties of the pulp. The negotiations for the Chlorine Dioxide Generating Plant as well as the Chlorine Dioxide stage bleaching equipment have made considerable progress and the orders for the equipment are likely to be finalised very shortly.

#### 1. Ferrobestos :

Supplier : Hindustan Ferrodo Limited,  
Bombay.

Rate : Rs. 170/- per Sq. Ft. for 1" thick.

#### 2. Chlorine Cylinder Valve :

Brass Chlorine Cylinder Valve with stainless steel Spindle and without fusible plug.

Supplier : Modern Stores Suppliers  
42/44 Zakaria Street, Calcutta.

Rate : Rs. 55/- each.

#### 3. Teflon Universal Rope, Gasket and Teflon Thread Seal-ant Tape :

Supplier : Plastic Products Engg. Co, Lyand  
Mithakali Railway Crossing.  
Behind Ahmedabad Medical Society Hall, Ahmedabad-9.

Rate : Threaded Sealand Tape  $\frac{1}{2}$ " wide  
× 10 m long Rs. 10/- each Roll.

Universal Rope Gasket  $\frac{1}{8}$ " dia. ×  
10 m long Rs. 65/- each Roll.

#### 4. Mandana Stones :

Supplier : Kajal International  
Ramganj,  
Dist. Kota, Rajasthan.

#### 5. Binding, Acid and Alkali Resisting Materials :

Supplier : Coromandal Prodorite Pvt. Ltd.,  
25/33, Jehangir Street,  
P.O. Box 1296, Madras-1.

Rate : Corocem P203/P103	Powder	Rs. 1-20 per kg.
"	Syrup	Rs. 25-00 " "
"	Accelerator	Rs. 120-00 " "
"	Catalysist	Rs. 16-00 " "
B-100	Syrup	Rs. 33-00 " "
B-100	Hardner	Rs. 35-00 " "
C. N. S. L.		Rs. 2-80 " "

For all Towers Mandana Stones—

Surface of Tower to be prepared before Tile lining.

(a) For Chlorine Tower Mortar of Corocem P 102/203.

(b) For Alkali Tower & Chest—Cement mortar bed, Pointing with B-100 or Prodo Floor.

Size	Wall Thickness	Rate per Metre	
1"	1.8 mm.	3-55	
2"	2.45 mm.	8-80	
3"	4.50 mm.	19-10	} For 6 Kg/cm 2
4"	4.50 mm.	31-10	
2"	1.70 mm.	6-60	
3"	2.42 mm.	13-15	} For 6 Kg/cm 2
4"	3.05 mm.	21-15	

#### 6. P.V.C. Pipes & Fittings :

Supplier : Wavin India Limited  
Industrial Estate Ambattur,  
Madras-58

#### 7. Plastic and Nylon Spares and Accessories :

Supplier : Polypick Industries,  
38, Police Court Lane  
Handloom House Avenue  
Fort Bombay-1.