FINAL REPORT

INDIAN AGRO PAPER MILLS ASSOCIATION
NEW DELHI

TECHNO ECONOMIC FEASIBILITY REPORT OF A CENTRAL CHEMICAL RECOVERY PLANT OF 240 TPD PULP PRODUCTION FOR KASHIPUR REGION (U.P)

Chemprojects Design & Engg. Pvt. Ltd.
17, Panchshila Shopping Centre
New Delhi - 110 017

MAY 1997

CONFIDENTIAL

CHEM/S/1300/379 23rd May, 1997.

M/s. Indian Agro Paper Mills Association
1006, Pragati Tower
26, Rajendra Place,
New Delhi - 110 008.

Kind Attn : **Shri. P.G. Mukundan - Secretary General**

Dear Sir,

This is with reference to your assignment to conceive a bankable proposal for setting up a Centralised Caustic Soda Recovery Plant for a cluster of non-wood fibre based pulp mills in the region of Kashipur.

This perception has been conceived primarily with a view to safeguard the existence of small paper mills which are not in a position to set up a viable recovery system on stand alone basis and thereby subjecting the environment to high level of pollution by the discharge of black liquor on the surface which leads to contamination of sub-soil water and the streams.

A draft report was submitted during April, 1997 indicating the important technical parameters and the economic indicators. Subsequently after a series of discussions with IAPMA the financial viability has been estimated with different modes of financial structuring and rate of interest. The project is bankable if only the debt/equity ratio is 1:1 and 50% of equity is available as grant.

The project report amply highlights the benefits of implementing this concept which would lead to save the existing mills from being subjected to stringent pollution laws which have to be invariably to be exercised sooner or later. A cooperative effort by all the entrepreneurs in the region could set the pace of implementing such an idea in other cluster areas thus providing the Axion "Small is beautiful". This is all the more as the existing mill systems would require to be upgraded to obtain an acceptable quality of black liquor.

The important parameters and the economic indicators have been provided in the Executive Summary.

The project provides substantial social cost benefit to the society and we recommend that steps be taken to implement the same.

Thanking you for placing the confidence in our organisation and look forward to be associated bringing this to a successful implementation.

Yours faithfully,
for **CHEMPROJECTS DESIGN & ENGG. PVT. LTD.**

DR. S.L. KESWANI
MANAGING DIRECTOR

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CENTRALISED RECOVERY PLANT

PROJECT AT A GLANCE

1.	Product	:	Caustic Soda
2.	Proposed Capacity	:	14,200 TPA
3.	Location	:	In or around Kashipur.
4.	Capital Outlay	:	(Rs. in Millions)
4.1	Land & Site Development	:	6.50
4.2	Buildings & Civil works	:	22.00
4.3	Plant & Machinery	:	340.00
4.4	Technical knowhow fees & expenses on drawings etc. payable to technical collaborators	:	12.50
4.5	Misc. fixed assets	:	70.00
4.6	Promotional pre-operative expenses	:	40.00
4.7	Provision for inflation, escalation and contingencies	:	48.00
4.8	Margin money for working capital	:	8.00
	TOTAL	:	547.00
	SAY	:	545.00

5. Source of finance (Rs. in Millions)

	CASE I	CASE II	CASE III
Equity	136.25	13.625	136.25
Loan	408.75	308.75	272.50
Grant	Nil	100.00	136.25

6.	Man power requirement		
	a. Direct labour	:	108
	b. Adm. & Factory supervision	:	48
7.	Utilities		
	a. Power	:	9.94 Millions KWH/Year
	b. Fuel requirement/annum	:	650 m^3/Year
8.	Production Cost before interest & depreciation	:	Rs. 6238/- per tonne of Caustic.
9.	Production Cost after Interest but before Depreciation	:	Rs. 9358/-per tonne of Caustic.
10.	Production cost after Interest & Depreciation	:	Rs. 12,044/- per tonne of Caustic.
11.	Power available for sale	:	13.76 Millions KWH/Year
12.	Sales realisation	:	
	a. Caustic Soda	:	Rs. 12000/- per tonne.
	b. Surplus power	:	Rs. 2.20 per KWH
13.	Project implementation period	:	18 months.

14. Working results (Return on Project cost)

RATE OF INTEREST		CASE I	CASE II	CASE III
a.	6%	14.3%	15.4%	15.8%
b.	9%	12.0%	13.72%	14.3%
c.	12%	9.8%	12.02%	12.8%

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EXECUTIVE SUMMARY

1.0 The Indian pulp & paper industry has made a steady progress during its existence over a period of eight decades. Simultaneously the growth of demand of paper has been rising at a steadier rate.

In view of the shortages of forest raw materials, the industry has been using a variety of raw materials such as bagasse, straws, grasses, jute and kenaf as well as recycled secondary fibres. Based on the primary and dominant raw material used, the mills can be grouped into 3 categories, namely Forest, Agro and waste paper based. Of the total number of 380 units, 111 are agrobased, out of which nearly 80 units are of sizes of 30-50 TPD.

The Agrobased paper mills sector has made rapid progress since its beginning in 1970. The number of Agrobased paper mills started with 13 in the year 1970 and the number was 111 in 1995.

In view of the fact that govt. has continued to favour the policy of not making available land for plantation of wood to the paper mill owners, it is estimated that in future the share of agrobased paper would go up, while the forest based paper mills would retain their share more or less at the same level. This is on the assumption that India's per capita consumption of paper and board will increase to 5 Kg. in 2000 A.D. and 10 Kg. in 2010.

Due to bulkiness of agrobased raw materials, the transportation and harvesting bottlenecks associated with such raw materials, a majority of the agrobased pulp and paper mills have low capacity of sizes ranging from 20 to 50 TPD. A chemical recovery unit is not normally viable for a small sized mill.

2.0 For the Indian paper industry, there are new restrictions on use of water and quality of water for discharge. The small and medium mills drain the spent liquor, after treatment as they cannot afford chemical recovery units. Chemicals are used once and after that they are discharged into the water stream, causing a large environmental burden on the water stream. The pollution standards are likely to become more stringent coupled with stricter legal strictures. The industry has reached a point where the survival of the agro paper mills without chemical recovery has become difficult. It is estimated that an agro pulp mill without chemical recovery generates pollution loads three times that of a wood based mill of same capacity with chemical recovery and requires pollution treatment plant of very large size.

The loss of alkali in the unrecovered spent liquor is an economic burden because of the cost of chemicals as well as otherwise lost energy content of the spent liquor. It is possible to raise the profitability of a mill by lowering the chemicals and energy inputs to a totally different level by installing a chemical recovery plant. Any investment in a chemical recovery plant would improve the energy economy as well as reduce the environmental burden in the local water stream.

An analysis of the cost of production break down between a large forest based pulp mill with chemical recovery and an agrobased small mill without chemical recovery shows that the chemical cost alone is 30% of the total cost of production against a figure of 21% for forest based mills.

Recent efforts and developments by the Indian machinery manufacturing companies have shown that, when the mills reach a level of 100 TPD Black liquor solids, it is viable to set up a chemical recovery plant resulting in a desirable environmental approach and attitude.

However, pulp mills of small sizes (20-30 TPD capacity) cannot afford a chemical recovery unit however desirable it may be and without chemical recovery, they would continue to discharge chemical into the water stream. As the society and the state cannot allow continuation of discharge of polluted effluent, either they close down or find out alternative methods to stop pollution.

On the one hand, we face the inevitable adverse effects of pollution, while on the other hand we face closure of a large number of mills, retrenchment of workers, loss of production, and increase in the demand-supply gap, loss of revenues in form of excise duty and sales tax and more important financial loss for the loaning Banks and other financial institutions.

3.0 If individual pulp mills due to their size, cannot afford their own chemical recovery plants, one may conceive a so called central or common chemical recovery for a number of pulp mills, where Black liquor of individual mills can be collected and processed in a Central Recovery Plant. The white cooking liquor produced in the Central Chemical recovery plant can be transported to the individual mills for their use.

The Central chemical recovery unit shall be of a capacity which is technically desirable, as well as viable financially.

4.0 In order to make this concept implementable, one must identify a cluster of pulp mills suitably located within an economic zone. The cluster can harbour atleast 6-8 mills. The economic zone can be of a radius of 60-75 Km, which can vary from cluster to cluster. The Centralised Recovery unit can either be an independent unit or an integrated unit with one of large mills in the cluster.

There are advantages and disadvantages of setting up an independent central recovery plant.

A recovery plant, independent of the pulp mills, and nonintegrated with any pulp mill, must have its own infrastructural facilities, such as water supply, steam and power supply, workshop and laboratory in addition to its own Management. The Management which would control the functioning of the central recovery, is independent of the pulp and paper mill operation. Its function is to procure black liquor free of cost from the mills and in return sell the white (cooking) liquor to them at the market price.

It must generate its own steam and power required to run the various sections of the Recovery unit. Both at the mills as well as at the Recovery plant elaborate storage facilities for Black liquor must be made available.

In a Chemical Recovery system, consisting of evaporators, furnace and waste heat boiler and causticisers, demand of steam is large while demand of electrical power is small. Fortunately, in the case of a Recovery boiler generating high pressure steam, installation of a captive integrated turbo generator (T.G.) on cogeneration principle ensures production of more than sufficient power as well as nearly sufficient low and medium pressure steam required within the recovery system (evaporation, combustion air and black liquor heating, causticising and boiler soot blowing, ejector steam, etc.) The extra power can be sold to the state Electricity grid system.

5.0 The Indian Agro Paper Mills Association (IAPMA), the Apex body of pulp and paper mills based on agro residues and looking after their interests over various matters initiated a dialogue with Chemprojects Design and Engg. Pvt. Ltd., a Consulting Engineering Company specialising in agro residues pulping and papermaking. Chemprojects has then been assigned the task of preparing a Feasibility Report for a Centralised Chemical Recovery for a cluster of paper mills, based on bagasse in and around Kashipur, situated in Nainital District of Uttar Pradesh (U.P).

6.0 This Report, consisting of ten chapters, deals with the Development of the concept, location of a suitable site for the Recovery plant, Process Description, Plant and Machinery, Plant Layout, Implementation schedule and Manpower Requirement with capital cost and Financial viability estimations and finally the socio-economic impact Assessment of such a concept.

A cluster of six bagasse based integrated pulp and paper mills in the Kashipur region (Nainital district in U.P.) was identified for the present study, primarily because most of the paper mill owners more or less are in agreement with such a concept and none of them can afford a Chemical Recovery Plant independently. Secondly, recent installations of Chemical Recovery units and their smooth functioning in a number of bagasse based mills have instilled a feeling of technical security and safety of such installations.

7.0 This proposal envisages a Chemical Recovery unit of 240 TPD of pulp equivalent or 290 TPD of Black liquor solids.

Dilute Black liquor (8% solids) will be stored in open polylined lagoons in individual mills and then transported in Truck-Tankers to the Recovery plant, where the black liquor is again stored there in the same way.

With the existing equipment and system for pulp washing the mills generate very dilute black liquor, these must be updated through fresh capital investment, so that the dilute Black liquor has atleast 8% solids. While the cost of transportation of Black liquor is borne by the central recovery plant, the initial cost of tankers is to be met by the individual mills.

For concentration of black liquor, a 5 - effect tubular multiple effect evaporator system of a capacity of 135 TPD water evaporation is envisaged. The system is a combination of rising film and falling film LTV evaporators.

A Tomlinson type Recovery furnace and boiler with electrostatic precipitator (ESP) will burn the black liquor and generate steam at 46 ata. A Turbogenerator with single extraction back pressure turbine will generate 3 MW electrical power.

As the power demand of the recovery system is 1.4 MW only, excess power will be sold to the state grid or any other agency. The system is likely to be self sufficient in steam demand.

8.0 A simple excercise as to whether dilute B.L. will be partially concentraterd at the pulp mill or not showed that transportation of dilute B.L. as such is more favourable than setting up an evaporation plant for partial concentration in the pulp mill.

9.0 Further, the location of the CRP (Centralised Recovery Plant) should be based on the basis of least cost on transportaion of BL. and a location around Kashipur is best suitable.

10.0 The capital cost of the project is estimated at Rs.545.00 millions. This includes items like land, building, plant and machinery, engineering charges, fixed assets, preoperative expenses, margin money for working capital and contingencies. It is as follows:

			(Rs.Million)
1.	Land & Site Development	:	6.50
2.	Building & Civil works	:	22.00
3.	Plant & Machinery	:	340.00
4.	Technical Know-how	:	12.50
5.	Expenses on Technicians & Training	:	0.00
6.	Miscellaneous Fixed Assets	:	70.00
7.	Preliminary & Capital Issue Expenses	:	0.00
8.	Preoperative Expenses	:	40.00
9.	Contingencies 10%	:	48.00
10.	Margin Money	:	8.00
	Total Project Cost	:	547.00
	Say	:	545.00

11.0 **MEANS OF FINANCING**

Three alternatives have been considered. They are:

CASE - I

Debt/Equity Ratio 3:1

Grant Nil

CASE - II

Debt/Equity Ratio	3:1
Grant	Rs. 100 Million

CASE - III

Debt/Equity Ratio	1:1
Grant	50% of Equity

3 different rates of interest (6,9 & 12%) have been calculated for each of the above case.

The percentage returns on estimated project cost for 9 cases have been calculated as follows:

Interest Rate	**6%**	**9%**	**12%**
Case - I	14.3	12.1	9.8
Case - II	15.4	13.7	12.0
Case - III	15.8	14.3	12.8

It can thus concluded that the project can be viable if softer conditions of loan as well as financial assistance in form of grant can be provided.

The project has the highest rate return on capital employed with funding arrangement with 1:1 debt/equity ratio and 50% of equity as grant and with a interest rate of 6%.

As the project concept provides substantial cost benefits to the society, its implementation is recommended.

12. As the socio-economic impact of such a concept is large and many-sided, the project should be assessed from standpoint both financial and social benefits.

First of all, it will bring down the pollution load of the cluster to a level acceptable to the state and the society.

The alkali recovered would reduce the caustic demand and hence there will be a power saving in the alkali industry on a national level. (Nearly 85,000 TPY of coal can be saved for this cluster on this account.) Saving of power entails reduction of air pollution as well as solid waste reduction.

Further the energy generated in the chemical recovery unit by burning the organic component of the B.L. would be equivalent to 64,000 TPY, of coal which a saving again.

If the units do not recover the spent liquor through a chemical recovery unit, the mills will surely face closure. In such a situation it will have a loss of about 79,000 TPY of paper production, which means Rs. 1584 million in foreign exchange would be required for import.

Closure of these units would result is a loss of directed and indirect employment of 12,000 persons, Rs. 27 million for nonutilisation of agrowastes, loss of exchequers income (Sales tax, Excise duty and cess) to the extent of Rs. 158 million and reduction in purchasing power of the people in employment in the mills.

A rough estimation gives the following figures of gains:

INDICATIVE SUMMED UP GAINS FOR THIS CLUSTER OF MILLS

		Rs. million/year	
1.	Foreign Exchange saving	1584	
2.	Exchequer Income	158	
3.	Farmers' Income	27	
4.	Total Employment		4800 Man years
5.	Energy saved		
	35 million units		
	Coal equivalent		
	85,000 T	170	
6.	Excess energy generated		
	13.76 million units	27.5	
	Coal equivalent		
	33,000 T	66	
	Total Coal saved		
	1,18,000 T	236	
7.	Taxes generated out of Farmers income	2.75	
8.	Savings by Farmers	16.5	
9.	Investment generated by Farmers	8.25	

Any investment in such innovative projects shall result in manifold and colossal social returns.

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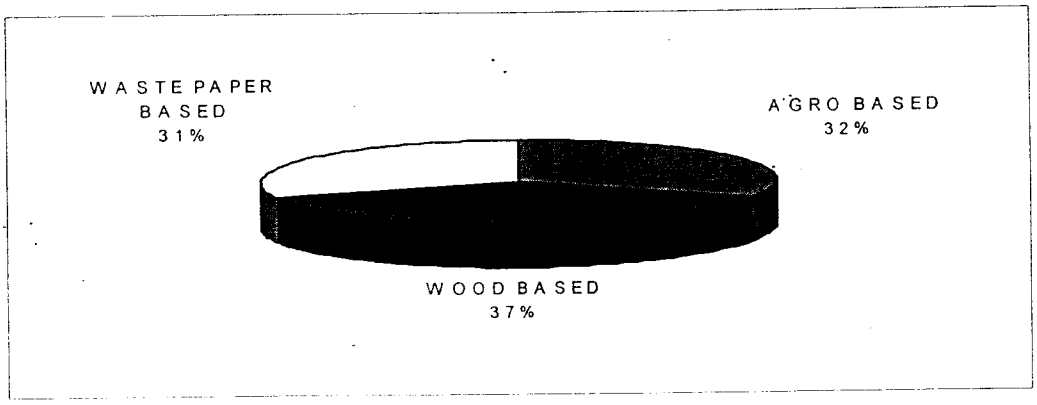
CHAPTER-1

INTRODUCTION

Indian Paper Industry is one of the core industries in India and has been playing important role in the industrial, economic, cultural and social development of country. At present , there are about 380 units in India producing paper. Based on raw materials wood based, agro based and waste paper based units are 37%, 32% and 31% respectively.

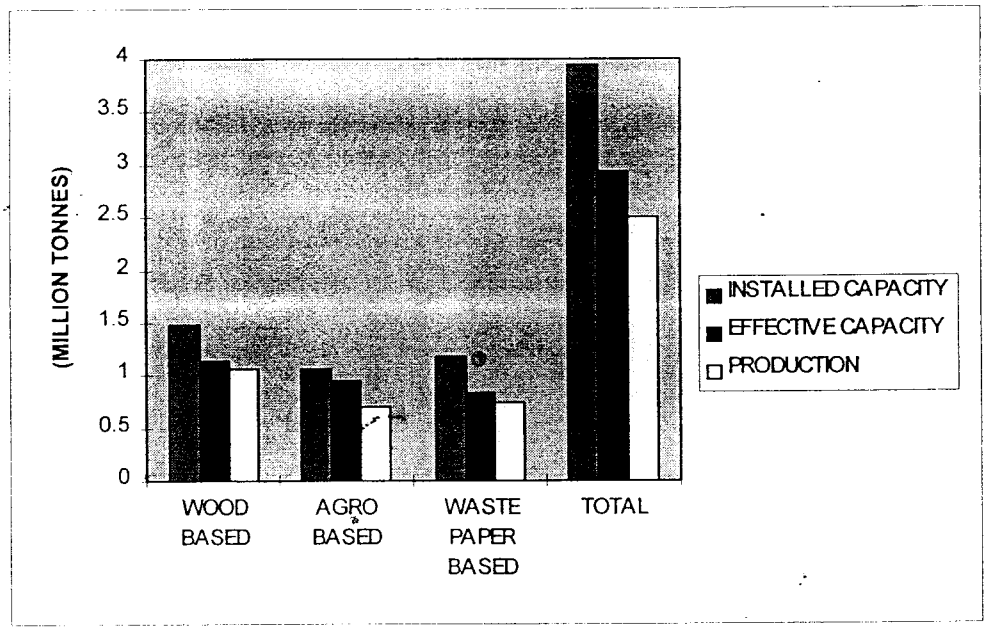


Paper units in India were originally designed for processing bamboo. As the supplies decreased, mills were forced to use hard wood and necessary modifications in plant were also carried on. On account of constraint of forest based raw material, use of alternate raw materials like bagasse and other cellulosic materials were encouraged to meet the growing demand of paper. Bagasse has received maximum acceptance for production.

Due to continued shortage of forest based raw material, their use in total production of paper declined over the years from 84% in 1970 to 37% at present (1994-95). The segmentwise installed capacity presently as follows:

(Million Tonnes)

S.No.	Category of Mills	Installed Capacity	Effective Capacity	Production	Effective Capacity Utilisation %
1.	Wood Based	1.47	1.14	1.07	83
2.	Agro Based	1.06	0.94	0.70	96
3.	Waste Paper Based	1.17	0.83	0.74	78
	Total	3.95	2.93	2.51	86



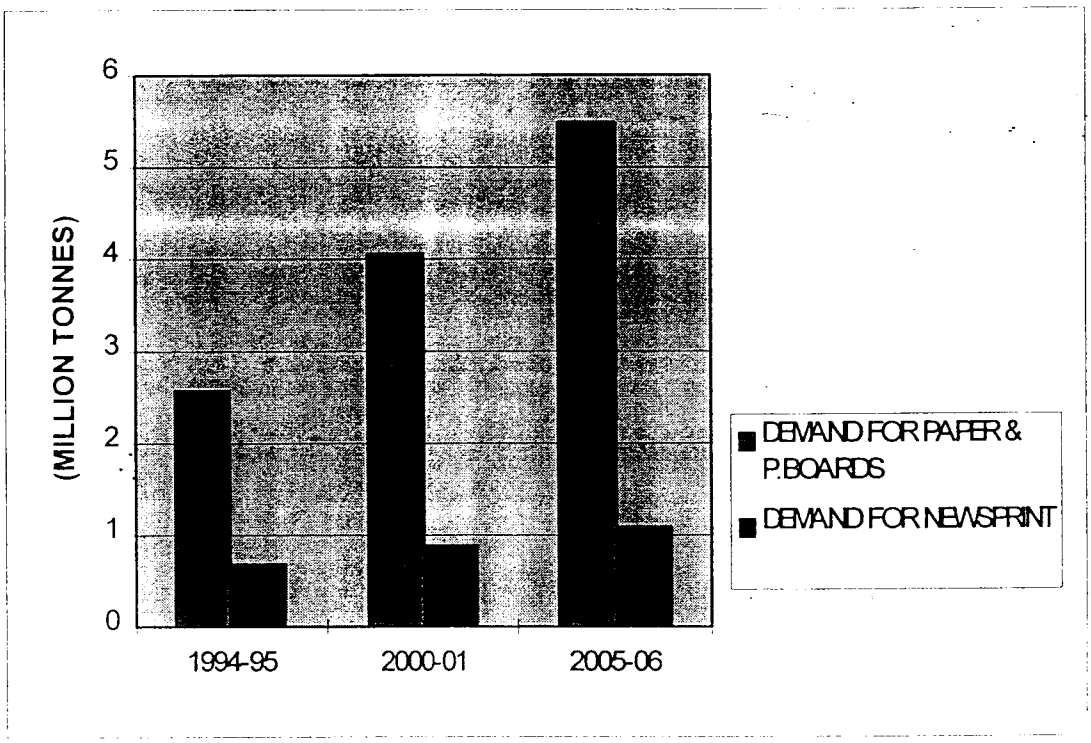
CONSUMPTION PATTERN & FUTURE PERSPECTIVE

Per capita consumption in India is low in comparison with the world average. In 1994-95, it was about 3.6 Kg in India as against 45.6 Kg. of world. Given the current stress on liberalisation growth in industry, packaging, export, literacy rates etc. will re reflected in growth levels in demand for paper, paper board and newsprint. According to a recent study the expected increase in demand over next 10 years is given below:

ESTIMATED DEMAND FOR PAPER & PAPER BOARDS AND NEWSPRINT

(Million Tonnes)

Year	Demand for Paper & Paper Boards	Demand for Newsprint
1994-95	2.58	0.69
2000-01	4.05	0.90
2005-06	5.48	1.09



AGRO RESIDUES BASED PAPER UNITS

As it is clear from above analysis that in this challenging scenario of the pulp & paper industry, role of agro residue based units becomes important. These units have to sustain and grow amidst this competitive environment. This would call for upgradation of technologies and enhancement of unit sizes through modernisation, capacity expansions and green field investments.

These units are relatively smaller in size and the capital structure does not permit to accommodate chemical recovery plant. As a result, effluent treatment without recovery becomes an expensive and prohibitive for the units. At the same time, their cost of production is more, because of cost of chemicals is high without chemical recovery. In such background, M/s Indian Agro Paper Mills Association,. assigned a study to Chemprojects Design & Engg. Pvt. Ltd. on the concept of Centralised Chemical Recovery Plant.

INDIAN AGRO PAPER MILLS ASSOCIATION (IAPMA)

This is the apex body of paper mills based on agricultural residues like straws, bagasse, jute and jute waste, grasses etc. spread in the rural areas of India, manufacturing writing , printing and kraft varieties of paper over the last many years.

The Association is involved in various activities for technological upgradation of the industry, modernisation and pollution abatement.

The objective, scope and activities of the association are being high-lighted below. Besides, the association provides a common platform for a dialogue between government and industry representatives where decisions are taken jointly after deliberating over various matters.

OBJECTIVES

- To undertake professional, technical and management consultation services, to under take studies, surveys and research projects to organise facilities for its members like testing labs and R & D centre.
- To collect the informations on agro based paper mills, capacity, production and expansion plans.
- To sponsor trade delegations abroad for export purposes and technology upgradation and to have inter-action with those connected with the industry in India and abroad.
- To conduct research on agro based paper & pulp.
- To impart education and knowledge to develop skilled manpower - the shortage of which is felt very much at present.
- To establish libraries and keep the industry abreast with latest technologies in the world in the field of agro based paper mills.
- To study and find out remedial measures in operational levels etc.

IAPMA is headed by the President. The technical section is headed by Director Technical. All important issues are discussed at the executive committee meetings held periodically. All decisions are implemented by the secretariat. The secretariat is headed by Secretary-General. This secretariat is expected to maintain good liaison with government departments, international bodies and also amongst industry circle.

THE CONCEPT

The concept aims at identifying cluster of agro based paper mills without chemical recovery facilities within a conveniently procurable radius. Such economic procurement radius should preferably be less than 75 kms. from where the centralized recovery plant could be proposed to be established. The cluster will harbor atleast 8-10 agro paper based units without recovery. The basic approach is to procure black liquor from the pulping units, recover caustic soda and supply caustic soda in form of white liquor back to the units.

THE REPORT

This report contents 9 chapters, including first chapter of Introduction. Other chapters deals with Development of Concept, Site of Recovery Plant, Process, Plant & Machinery, Main outline of Project, Annual Requirement of Chemicals & Utilities, Financial Evaluation and Socio Economic Impact. The consultants tried to cover each and every techno-economic aspect of the concept in this report. After the development of concept, site selection & process selection, sufficient details are given about the main plant and machinery. In the chapter of Outline of Project, details of recovery plant are presented such as , layout of plant, implementation schedule, manpower requirement with management structure & details of

co-generation scheme. For the purpose of production cost, requirement of raw materials, chemicals & utilities is calculated.

The last chapter of the report deals with socio economic benefits from the projects. These benefits are important because the effects are multiple and have a multiplier effects on the society. This chapter deals with the overall impact of the project on the society. Indirect benefits which are not considered in the profitability calculations are highlighted in this chapter.

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CHAPTER - 2

DEVELOPMENT OF CONCEPT

For sustained growth of Indian Paper Industry, the continuing existence of small agrobased mills cannot be overlooked. Out of the total installed capacity of 3.95 million tonnes, the agro based, accounts for about 32%, which is almost at par with forest based mills accounting 37%. The Indian Agro based units are relatively smaller in size (30-50 TPD) and the capital structure of these units does not permit to accommodate any chemical recovery system. As a result, chemicals are used only once and after that they are discharged into the water streams. This causes a large environmental burden, and waste of chemicals is an economic burden. These two causes are the backbone of the concept of centralised recovery Plant. Further, it is possible to raise the profitability of the paper unit, in terms of chemicals and energy to a totally different level by installing a recovery plant.

In the above background, the idea of centralised recovery Plant, was developed with a basic approach of indentifying clusters of agro based paper mills without chemical recovery facilities within a conveniently procurable radius of 60-75 Km. The centralised recovery plant may be either an independent unit or installed at the works of an existing paper unit if found to be suitably located.

The tankers bringing black liquor to the recovery plant shall be filled by white liquor (Caustic Soda) and taken to the participating units. Hence, the member units shall be benefiting in procurement of caustic soda from a socalled captive unit, at the market rate.

While deliberating on above concept, the concept of co-generation was included with main concept. Primary estimations, about the steam consumption and generations show that steam quantity would be in balance in recovery plant itself. It is desirable that generation of steam would be done at higher pressure than that of consumption and advantage of this pressure difference can be transferred in power generation with the help of a turbine. The turbine would be of double stage extraction type and extraction pressure would be set according to the requirement of process.

All the technical aspects of the concept indicated that, it is a possible concept. The major practical difficulty is transportation of dilute black liquor from participating units. The quantity of black liquor, to be handled per day is a large quantity and at the same time cost of transportation would be a major factor, in techno - economie analysis of the project. Therefore, two options considered in this regard are:

1. Dilute black liquor may be concentrated in participating units itself and transported to centralised recovery plant. In this option, small evaporation plant would be installed in each unit, and partially concentrated to say 20% T.S.

2. Dilute black liquor may be transported directly to centralised recovery plant. In this case only one evaporation plant would be installed but transportation cost of dilute Black liquor would be considerable.

To study, these two options, a comparison has been made considering operating cost involved in both case (Annexure-II). This comparison shows that second option is more economical. Therefore, in the proposed concept, transportation of dilute black liquor is considered form. Some changes in washing system of individual mills are suggested with consequent improvement in the concentration of black liquor.

One important factor in this concept is the arrangement of power for centralised recovery plant. Exact power consumption can be calculated only after finalisation of equipments. But for present study, an average consumption figure is considered per ton of caustic soda. At this stage it seems that power generated, by co-generation plant would be not only sufficient for captive consumption but excess power can be for sale. But it is advisable that some load (at least for start up of boiler and turbine) should be taken from State Electricity Board. Although, this additional electrical load may not be consumed regularly, it is however, necessary for start up of plant and for various maintenance purposes.

For the transportation of black liquor from various participating units, ordinary tankers are being considered, which are being used for caustic soda. Number of tankers, which are required for a particular unit, is calculated on the basis of pulp production and solids concentration of black liquor. At this stage, standard norms of black liquor volume per ton of pulp is considered, but this may vary in actual practice. Some storage capacity for black liquor is provided in each participating unit to avoid these type of fluctuations.

ENERGY MANAGEMENT & CHEMICAL RECOVERY PLANT

The Indian pulp and paper industry is the sixth largest consumer of energy in the Indian Industrial Sector. Energy cost as a percentage of the manufacturing cost is well above 25%. It is a considerable element of cost of production. The industry consumes about 1500 KWH of electrical power and about 10 T of process steam for every tonne of saleable production.

Energy saving is the easiest, fastest and the most effective method of increasing the profits of a company. In small paper mills with annual energy bill of Rs.50 million, every 1% savings in energy increases annual profits by Rs. 0.5 million. Apart from the benefits to the individual paper mills energy saving helps to avoid capital investment for new power plants, transmission & distribution expenses at the national level. With such savings potential, it is imperative that each plant puts in their best efforts to save energy.

As far as chemical recovery plant is concerned, both type of energies, thermal as well as electrical, can be produced with a proper scheme. In the proposed project steam would be generated at high pressure and electrical energy would be produced by an extraction cum back pressure type turbine. The proposed scheme for steam and electrical energy indicates that project is self dependent for thermal and electrical energy. In fact electrical energy may be surplus, if all the equipments would be energy efficient. This surplus energy may be supplied to any near by industrial unit or by State Electricity Board.

Another advantage of the proposed project is the saving of electrical energy for production of Caustic Soda in Caustic Soda Industry. Production of one tonne Caustics Soda consume about 2500 KWH of electrical energy. As the proposed plant would produce about 40 T of Caustic Soda per day, about one lakh units of electric power would be saved per day. This is from one clusture, and it is possible that 7-8 clustures can be identified in the whole country, so, in that case there would be a considerable saving in electrical energy on a national level. It could be estimated as :

i.	Energy Consumed/T of Caustic	-	2500 KWH
ii.	Caustic Production/Year	-	14,200 T
iii.	Energy Savings/Year	-	35.5 million KWH
iv.	Amount Saving/Year (Rs.2.20/KWH)	-	Rs. 78.10 million
v.	Estimated Saving/Year at National Level, if 8 Clustures of same capacity, are possible.	-	Rs. 624.8 million
vi.	Excess power for sale (from proposed scheme)	-	Rs. 30.40 million

The chemical recovery plant would recover energy from black liquor solids. About 72,000 KWH/Day power can be generated, from 280 T black liquor solids, in the proposed scheme. Although power generation, per tonne of black liquor solids depends upon the cogeneration scheme, but for the proposed scheme it isabout 260 KWH.

IMPACT OF CHEMICAL RECOVERY ON ECOLOGY

In the Indian paper industry, most of the small units which are not equipped with chemical recovery plants, can use cooking chemicals only once. The used chemicals are discharged into the water stream. This waste of chemicals is an economic burden on the unit & environmental burden on the society.

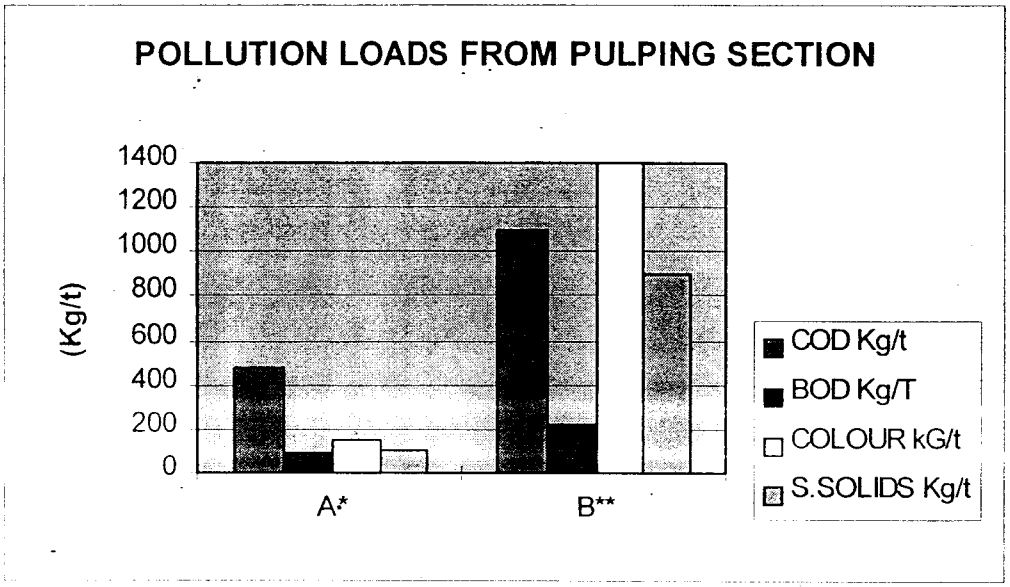
An analysis of the cost of production breakdown between a large forest based pulp mill (with recovery plant) and an agro based small unit (without recovery plant) shows that the chemical cost alone is 30% of the total cost of production against a figure of 21% for larger units.

A study by Central Pulp & Paper Research Institute, indicates that pollution loads in agro based small mills having no chemical recovery is almost three times to that of pollution load in large integrated paper with chemical recovery. Result of this study are shown in Fig.-2.01. Because of the growing awareness about the clean environment. Modern pulp and paepr mills now coming up will have to satisfy stringent pollution control standards and meet exacting requirements of the environment impact. At the same time existing pulp and paper units will have to take essential steps to control the pollution. In this direction, it is a well established fact that chemical recovery plant would reduce about 50% pollution load, in terms of SS, BOD & COD.

Beside the environmental advantages, there would be saving of about Rs. 200/- per ton of pulp, in the effluent treatment cost. It would be much easier to achieve the standards set by pollution control board after a recovery unit has been installed. For about 200 TPD Pulp, the estimated saving is about Rs. 13.2 million per year.

The conceptualisation of this project is based, on past experience, present practices adopted in the paper industry and on a brief study of the identified cluster of small agro based paper mills. Problems which are being faced in the chemical recovery from spent liquor of agro residues pulp are considred during the conceptualisation. After the indepth study of the concept, the consultant would like to recommend to Governent and Financial institutions to grant special assistance as it is a measure towards energy conservation and maintenance of ecological balance. The benefits that will accrue will not only be to individual enterprise but to the nation as a whole.

FIG- 2.01



COD	Kg/t	480	1100
BOD	Kg/t	90	225
COLOUR	Kg/t	150	1400
S.SOLIDS	Kg/t	100	900

A* - WOOD BASED MILL WITH CHEMICAL RECOVERY
B** - NON-WOOD MILL WITHOUT CHEMICAL RECOVERY

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CHAPTER-3

SITE OF RECOVERY PLANT

The selection of suitable site has considerable influence on techno-economic feasibility of the project. There are a number of economic and technical factors required to be considered so that production cost is minimum. The delivered cost of raw materials at site, availability and cost of utilities such as power, coal, oil, water are the primary factors which control the production cost directly. The available infrastructure at site, controls the production cost indirectly as this affects the capital investment pattern. Availability of sufficient land with easy acquisition at reasonable rate is also an important consideration.

For the proposed project of Centralised Recovery Plant, some other factors would have to considered apart from the above factors. For example, this project would be based on the supply of black liquor from 8-10 mills, therefore it should be located at an optimum distance from each unit. Although, economic procurement radius is considered about 75 km, but efforts should be made to reduce it for minimum cost of transportation.

In selecting the suitable site for the proposed recovery plant the following primary factors need consideration as the main guideline.

- Adequate transport facilities for the transportation of black liquor, chemicals, fuels, etc.
- Availability of skilled and unskilled labour.
- Availability of adequate area of well drained land which should be suitable for heavy foundations.
- Suitable facilities for sludge disposal.(In case of lime kiln not in position).
- Climatic & topographical suitability of the site.

As it is stated that the concept aims at identifying cluster of agro based paper mills without chemical recovery facilities, therefore region of location is fixed with identification of cluster. For the proposed project, a cluster is identified in the region of Rampur - Moradabad - Kashipur. Most of the mills are situated in & around Kashipur. Approximate distances for mills from Kashipur & Rampur is being given in Table - 3.01.

TABLE - 3.01

COMPARATIVE DISTANCE OF VARIOUS PROPOSED LOCATIONS FROM VARIOUS UNITS

S. N.o	Name of Mill	Capacity TPD	Location of the Mill	Distance from Kashipur K.M	Distance from Rampur K.M	Distance from Suar K.M
1.	Shiva Paper Mills	35	Dhamora	50	15	45
2.	Cheema Paper Mills	25	Bazpur	30	45	25
3.	Chadha Paper Mills	60	Bilaspur	60	35	40
4.	Multiwal Paper Mills	25	Kashipur	10	50	35
5.	Banwari Paper Mills	30	Kashipur	5	50	40
6.	Shree Shyam Paper Mills	60	Kashipur	5	50	40
7.	Vishva Karma Paper & Boards Ltd.	15	Kashipur	5	50	40

As it is clear from the table that about 65% of total capacity of cluster is concentrated around Kashipur (within 30 Km. from Kashipur). In Rampur, only Shiva Paper Mills is located. Chadha Paper Mills is located about 35 Km. from Rampur. Although, these two units are producing about 95 TPD of pulp, but combined capacity of other mills are more than that of these two units. Therefore, best location would be in or around Kashipur, as far as cost of transportation is concerned. However, this aspect will have to be worked out specifically once the investment decision has been taken. If any existing unit would provide the land for the recovery plant, then special consideration may be given for that particular site.

About 15 acres, land is recommended to be required for the proposed project . There is sufficient land available around the Kashipur.

In this situation two points can be considered as final site, first is in Kashipur and second is in Rampur. Another place named Suar, situated centrally can also be consdered so, for the estimation of cost of transportation, three proposals are as follows:

PROPOSAL - I

If Plant is situated in Kashipur

a. Cost of Transportation (Rs./Ton of Pulp/KM) (Operating Cost) — Rs.12.00

b. Black Liquor would have to be transported from Shiva (Rampur) & Cheema Paper Mills (Bazpur)

- Cost of Transportation from Shiva Paper Mills (35 TPD Pulp, 60 KM) — Rs.8.3 Million/Year

- Cost of Transportation from Cheema Paper Mills (Bazpur) (25 TPD Pulp, 30 KM) — Rs.3.0 Million/Year

PROPOSAL - II

If Plant is situated in Rampur.

a. Cost of transportation from Kashipur to Rampur (130 TPD Pulp, 60 KM) — Rs.30.9 Million/Year

b. Cost of Transportation from Cheema Paper Mills (Bazpur) to Rampur (25 TPD Pulp, 45 KM.) — Rs. 4.5 Million/Year

PROPOSAL - III

If Plant is Situated in Suar

Estimated Cost of Transportation Cost from various Mills:

1. From Kashipur (130 TPD Pulp, 35 KM) — Rs.18.0 Million/Year

2. From Rampur (35 TPD Pulp, 40 KM) — Rs.5.5 Million/Year

3. From Bazpur (25 TPD Pulp, 20 KM) — Rs.2.0 Million/Year

By the analysis of above estimation, it is clear that cost of transportation would be minimum if the plant is situated in Kashipur. But for the estimation of total cost of transportation, capital cost of tankers would have to added in operating cost.

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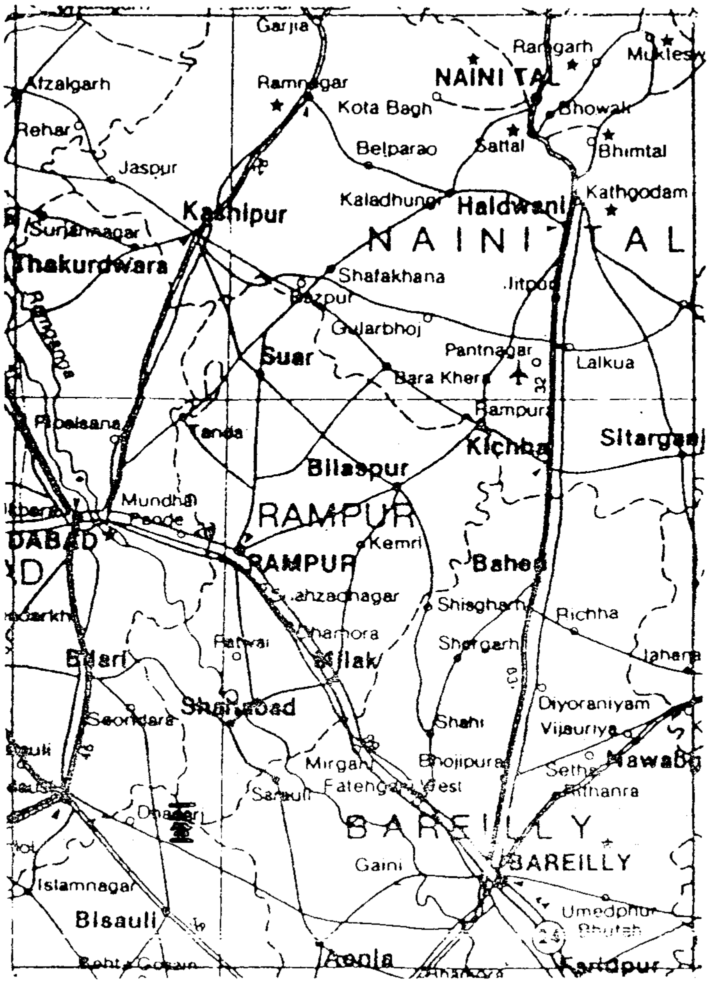

Garjia
Ramgarh
NAINI TAL
Ramnagar
Kota Bagh
Afzalgarh
Rehar
Jaspur
Belparao
Sattal
Bhimtal
Kathgodam
Kashipur
Haldwani
Thakurdwara
N A I N I T A L
Shafakhana
Gularbhoj
Suar
Pantnagar
Bara Khera
Lalkua
Kichha
Tanda
Bilaspur
RAMPUR
Kemri
RAMPUR
Shisgarh
Richha
Shergarh
Milak
Bilari
Diyoraniyam
Shahi
Mirganj
Bhojipura
Fatehganj West
B A R E I L L Y
BAREILLY
Gaini
Islamnagar
Bisauli
Aonla

CHAPTER - 4

PROCESS DESCRIPTION

The chemical recovery plant is as important as other sections in a pulp and paper mill, namely pulping and paper making departments.

The process that has been selected for this feasibility study is the conventional alkali recovery process. This is a well proven and well accepted process, for the chemical recovery, and is very much suitable for the considered capacity of recovery plant. There are three main sections in this process. Black liquor received from pulp mill is concentrated in Evaporation section. This semi-concentrated black liquor goes to Recovery Boiler, where after increasing its concentration, organic part of black liquor is burnt and inorganic part converted in to green liquor. Heat generated from the burning of organic compounds of black liquor , is recovered in the form of steam. This steam , can be used for co-generation of power, if generation is at high pressure. In third and last section, green liquor is reacted with lime and converted in to white liquor . This section is known as causticizing section. Description of each section in details are given below:

STORAGE OF BLACK LIQUOR & EVAPORATION

Dilute black liquor, would be collected from various participating units in centralised recovery plant, . For the storage of this black liquor, Open Lagoon type storage with polythene lining is proposed.

Multiple effect evaporators are installed in the centralised recovery plant. These are long tude vertical type evaporators and the vapour generated from one effect becomes a steam supply to the next effect in the series. In rising film type evaporation system the liquor enters at the bottom of the respective effects, steam enters at the upper part of calendria section. Hot liquor rises up whereby heat exchange occurs with condensing steam. The heating elements are, M.S/ S.S tubes. Due to heat of the steam, evaporation takes place and generated vapours are transferred in next effect, where it acts like steam. The complete unit is erected outdoor. In falling film type evaporators, black liquor is distributed from the top of the body and it comes down in the form of thin film; steam flows from downwards to upwards of the body and heat transfer takes place in between. In falling film evaporator liquor and steam flows in opposite direction (counter current heat transfer) while in rising film type, liquor and steam flows in same direction (co-current heat transfer).

From the last effect, vapours are condensed in a surface condenser.

Vacuum for operation is created by means of an steam jet ejector assembly. Non-condensibles are continuously removed through this vacuum installation.

DIRECT CONTACT EVAPORATOR & RECOVERY BOILER

The semi concentrated black liquor from the evaporator plant is first taken to a direct contact evaporator to further concentrate to about 58-62% of total solids. It is then sprayed into the furnace, where the black liquor gets dehydrated and drops to furnace heath as dry solids. The combustion of organic compounds of black liquor is controlled by the temperature of black liquor and air flow at primary and secondary levels. When required auxiliary fuel oil is used to commence furnace operation or to support combustion. Inorganic compound come out from the bottom of furnace, in the form of molten smelt. This smelt is dissolved with weak white liquor to form green liquor.

Heat generated in combustion zone, goes in boiler zone with flue gasses. In the boiler zone, steam is generated. After the boiler zone, flue gasses pass through direct contact evaporator where balance heat is used to concentrate the black liquor.

CAUSTICIZING & STORAGE OF WHITE LIQUOR

In this section, green liquor is converted in to white liquor after the reaction with lime. The major constituents of green liquor is sodium carbonate (Na_2CO_3). This sodium carbonate is converted in to sodium hydroxide (NaoH) with the reaction of Calcium Hydroxide $Ca(OH)_2$. In causticizing reaction, calcium carbonate formed. But in Indian economic conditions, installation of lime kiln depends on the cost of lime. Otherwise, calcium carbonate would have to be disposed in the form of sludge.

Major chemical reactions which occures in causticising section are:

1. $CaO + H_2O$ - $Ca(OH)_2$
2. $Na_2CO_3 + Ca(OH)_2$ - $2NaOH + CaCO_3$

Controlled quantity of green liquor is fed in a rotary slaker where lime is added and allowed to mix. The homogeneous slurry of lime and liquor is now passed through a rake classifier to remove grits which will otherwise harm the process if allowed to go with slurry. Slurry is fed to causticizers, where a retention time of 1 to 1.3 hour is provided to complete the reaction of conversion of sodium carbonate to sodium hydroxide.

After the causticizers the slurry is continuously fed to a white liquor clarifier. Form the clarifier the settled lime sludge is removed and the clear supernatant white liquor overflows to the storage tank from where it can be taken to the digesters for cooking.

After mud washing system, washed sludge continuously is pumped into an tank, from where it is pumped in the vat of vacuum filter. First wash, which is more concentrated, is known as weak white liquor and used in recovery boiler. The filtrate of the vacuum filter is fed back in the washing system, for sludge washing. The thick sludge forms the filter mat.

If the process is properly controlled, recovery of chemicals can be as high as 95 percent on the total input of chemicals but considering all the margins, it has been considered that 90 percent recovery will be possible on a consistent basis.

CHAPTER - 5

PLANT & MACHINERY

This chapter deals with the requirement of plant and machinery for recovery plant. In order to carry out the operations to recover caustic soda, the main equipments can be divided as follows:

1. Evaporator Plant

2. Recovery Boiler

3. Causticizing Plant

Apart from these there would be co-generation plant and storage tanks for furnace oil & white liquor. In co-generation plant double stage extraction type turbine would be the main equipment.

In evaporator plant, dilute black liquor of 7-8% total solids would be concentrated to 45% with the help of steam. This steam would be supplied from the turbine house. Falling film evaporators are being considered for evaporation plant.

Semi-concentrated black liquor would be stored in storage tanks at the CR Plant and would be supplied to the recovery boiler. Concentration of black liquor would be increased in cascade evaporators up to 62 - 65%. Black liquor solids would be burnt in the recovery boiler. Inorganic part of solids is converted in to molten smelt and organic part is burnt. Molten smelt is mixed with weak white liquor to produce green liquor and steam is generated from the heat of Black liquor combustion.

In the causticizing section green liquor is converted in to white liquor with the mixing of lime in double decomposition reactions.

The miscellaneous fixed assets in the project include power distribution equipments, turbine, water supply & distribution equipments, workshop, laboratory and material handling equipments.

The lists of the equipments required for this project and miscellaneous fixed assets are being given in this chapter with estimated cost (Table No. 5.01 & 5.02).

TABLE - 5.01

LIST OF MAIN PLANT & MACHINERY

S.No.	Equipment	Capacity Size	Approx. Cost (Rs.Million)	Basis of Estimation Cost
A.	**EVAPORATORS**			
1.	Dilute Black Liquor 3 Nos. screens	$3M^2$ each	0.50	Estimated
2.	WBL Storage Tanks, 2 Nos. with insulation	$200M^3$ each	0.80	Estimated
3.	Evaporators street. (Comprising heating surfaces, liquor distri-bution system and vent headers,entrainment separator, necessary liquor, steam and condensate inlet and outlet connections) - 3 Nos. tubular falling film evaporator with 2 working and one standby - 4 Nos. LTV rising flilm evaporators	135 TPH water evapora-tion	80.00	M/s. Swetha Engg. Ltd Chennai, Offer No. SEL 139/2076/96-97 Dated, 28.01.97
4.	Pre-heaters (Comprising heating surface, shell & other components, liquor and steam inlet/outlet connections and external steel structure etc.)	$170M^3$/Hr. weak black liquor.	Included in No.3	-
5.	Surface condenser	According to design of evapor-ators.	Included in No.3	-

6.	Vacuum ejector,complete with steam control valves, guages and fittings.	According to design of the system.	Included in No.3	-
7.	Second stage ejector or booster ejector complete with valve & guages.	If required according to design of the plant.	Included in No.3	-
8.	Vapour Piping (Inter-Connections) (M.S. piping, interconnecting the several effects and surface condenser. All flanges, bolts and joints are included)	-	Included in No.3	-
9.	Steam Piping & Valves (M.S)(Internal)	-	Included in No.3	-
10.	Condensate Piping & Valves (Internal) (M.S.Pipe Work, with steam traps, strainers, sight glasses and by passes together with all necessary valves and fittings)		Included in No.3	-
11.	Instrumentation - Pressure Indicators - Condensate Conductivity indicator with alarm - Liquor flow recorders and controllers. - Steam flow recorder with controller - Liquor level indicator and controller - Condensate level indicator and controller - Motor annunciator alarm	-	All necessary instrumnets are included in offer of No.3	-

12.	Supporting structure, platforms and stairs etc.	-	Included in No.3	-
13.	Insulation Rockwool/ mineral wool with aluminium cladding to all equipments	-	Included in No.3	-
14.	One set of pumps - W.B.L. feed pumps - Extraction pumps - Recirculation pumps - Product extraction pumps - Clean condensate pumps - Combined condensate pumps	-	5.00	Estimated
	TOTAL		**86.30**	
B.	**RECOVERY BOILER**			
1.	SCBL Pumps, 2 Nos.	$30M^3/Hr$	0.5	Estimated
2.	ESP, Ash Mixing Tanks,2Nos.	$10M^3$	0.1	Estimated
3.	Liquor Feed Pump to Cascade Evaporator, 2 Nos.	$30M^3/Hr.$	0.5	Estimated
4.	Recovery Boiler (Comprising pressure parts of boiler, furnace, economiser, superheater, inlet,outlet headers, B/L firing system,chemical dosing system,deaerators, smelt mixing tank, air heating system, I.D. Fan, F.D. Fan, furnace oil system etc.)	300 Ton. Black Liquor solids per day.	126.00	M/s Trident Engg.Pvt.Ltd. Madras. Offer No. TEP/0036/97 Dt.25.01.97
5.	Cascade evaporators, 2Nos.	-	Included in No.4	-

6. Electrostatic Precipitator 2 Nos., with ash handling system.	-	Included in No.4	-
7. Soot blowers with controlling system of boiler.	According to design	Included in No.4	-
8. Air ducting & wind boxes	-	Included in No.4	-
9. Flue gas ducting with dampers & valves	-	Included in No.4	-
10. Pumps - Black liquor pumps - Green liquor pumps - Spout cooling water pumps - Boiler feed pumps - Furnace oil pumps	-	5.0	Estimated some pumps are included in offer of Recovery Boiler.
11. All interconnecting piping for liquor, air and steam with valves & other fittings.	-	Included in offer as non critical piping.	-
12. Instrumentation & Controls	-	15.0	Estimated
13. Safety interlocks	-	Included in No.4	-
14. Air compressor and air dryer	-	1.0	Estimated
15. Feed water treatment equipments & condensate tanks	-	2.5	Estimated
16. Insulation & lagging and refractory material	-	2.5	Estimated
TOTAL		**153.10**	

C. RECAUSTICIZING PLANT

Green Liquor Handling

1.	Green Liquor storage tanks, 2 Nos.	400m³ each	1.5	Estimated
2.	Green Liquor clarifier with rake mechanism	-	15.0	M/s Swetha Engg. Ltd.,Madras Offer No. SEL/139/2076/ 96-97,Dt.28.1.97.
3.	Dregs Mixer	-	Included in No.2	-
4.	Dregs washer	-	Included in No.2	-
5.	Green liquor heater (Direct/Indirect)	-	Included in No.2	-
6.	Splitter box	-	0.05	Estimated
7.	Drum slaker	-	Included in No.2	-
8.	Rake classifier	-	Included in No.2	-

White Liquor Preparation

9.	Sump Box	1M³	0.05	Estimated
10.	Causticizers 3 nos. with agitators and inlet, outlet connections for slurry.	-	Included in No.2	-
11.	White liquor clarifier with rake mechanism, feeding system and sludge disposal system	-	Included in No.2	-

Sludge washing System

12.	Mud Washer - I with rake mechanism & sludge disposal system.	-	Included in No.2	-
13.	Mud washer - II with rake mechanism & sludge disposal system.	-	Included in No.2	-
14.	Sump box	-	0.05	Estimated
15.	Weak white liquor clarifier with rake mechanism & sludge disposal system	-	Included in No.2	-
16.	Sludge mixing tank with agitator	$100M^3$	0.20	Estimated
17.	Lime Mud filter - Filter vat - drum - Agitator - Filtrate receiver	-	Included in No.2	-

Lime Handling System

18.	Conveyor to Lime Kiln	-	2.00	Estimated
19.	Bucket elevator to lime bin.	-	.080	Estimated
20.	Table feeder	-	Included in No.2	-
21.	Table feeder chute to drum slaker	-	0.05	Estimated

22. Pumps - Hot water pump - Dregs washer over flow pump - Green liquor transfer pump - White liquor pump - Weak white liquor pump - Filtrate pump - Emergency centrifugal pumps - Slurry pumps		-	1.20	Diaphram type pumps are included in No.2. Cost for other pumps is estimated.
23. Interconnecting piping for slurry, green liquor, white liquor & hot water		-	2.50	Estimated
24. Instruments & controls with alarm & rack lifting system, temperature gauges.		-	1.00	Estimated
TOTAL			**24.40**	
D. STORAGE TANKS				
1. Dilute black liquor tanks				
Total volume required	11000M³		3.50	Estimated
2. White Liquor Storage tanks				
Total volume required Volume of one tank Nos. of tanks Estimated cost of tanks	1500M³ 500M³ 3		3.00	Estimated
3. Furnace Oil				
Storage Capacity Volume of One tank Nos. of tanks Estimated Cost of Tanks	360M³ 100M³ 4		1.50	Estimated
TOTAL			**8.00**	

TOTAL ESTIMATED COST OF MAIN PLANT & MACHINERY

(Rs. in Million)

1.	Evaporation Plants	86.30
2.	Recovery Boiler	153.10
3.	Causticizing Plant	24.40
	TOTAL	**263.80**
	a. Duties 13%	34.30
	b. Taxes 4%	11.90
	c. Packing & Forwarding, Freight & Insurance etc. 2.0%	5.27
	d. Erection charges	7.50
	Estimated Erected Cost	**322.77**
4.	Storage tanks etc.	8.00
5.	External piping which is not included in individual section	12.00
	TOTAL	**342.77**
	SAY	**340.00**

TABLE - 5.02

MISC. FIXED ASSETS

(ESTIMATED COST)

(Rs. in Million)

1.	Furniture	0.50
2.	Office Machinery & Equipment	1.00
3.	Misc. Tools & Equipments, Erection Tools	2.00
4.	Cars, Trucks etc.	2.00
5.	Railway Siding	-
6.	Electrical (4500 H.P)	22.50
	+ Turbine (Table - 5.03)	+35.00
7.	Water Supply	2.50
8.	Laboratory Equipments	0.50
9.	Fire Fighting Equipment	2.00
10.	Effluent Collection & Treatment etc.	-
11.	Other Misc. Fixed Assets. (Workshop etc.)	2.00
	TOTAL	**70.00**

TABLE - 5.03

ESTIMATED COST OF TURBINE

(Rs. in Million)

SCOPE OF SUPPLY

1.	3 Mw Extraction Back Pressure Type Turbo-Alternator including control panel		26.00
2.	Misc. Items		
a.	Controls & Power Cables		1.500
b.	Crane & Gantry		0.50
c.	Steam & Water internal piping		0.10
3.	Transportation, Packing & Forwarding		1.00
			29.10
	Excise Duty 13%		3.80
	Sales tax 4%		1.30
			34.20
	Erection & Commissioning		1.00
			35.20
		SAY	**35.00**

CHAPTER - 6

PLANT LAYOUT,IMPLEMENTATION SCHEDULE & MANPOWER

6.01 PLANT LAYOUT

Normally the plant layout of soda recovery section should be such that it can be integrated with the existing pulp mill. But in the case of the proposed project, it is not the case because centralised recovery plant is considered as an independent project, located a Central location of 7-8 small paper units.

The proposed layout of plant is prepared according to following priorities:

a. Minimize material handling.

b. Maintain flexibility of arrangement and of operation.

c. Effective utilisation of manpower.

e. Provision for employees convenience, safety and comfort in doing the work.

f. Provision for future expansion.

BLACK LIQUOR STORAGE

The total volume of storage space would be about 11000 Cu.m. This is an open area and some platform type space would be provided for unloading purpose.

EVAPORATOR SECTION

This area is shown by No.9 in the proposed layout. Weak liquor storage space for only immediate requirement in evaporators is considered with equipment space. It will have four floors, out of which three will be in M.S. grating, only one operating floor will be of R.C.C. Equal area is considered for future expansion.

RECOVERY BOILER

The recovery boiler would be put near the Evaporation plant, in a space of 50 x 17.5 m. In the length of 50m., all the auxiliaries like, direct contact evaporator, ESP & Chimney etc. would be accommodated. Out of 17.5 m. width, actual equipment size will be less, but surplus space is provided for Deaerators & Control panel etc. 50 x 17.5 m space is provided for future expansion. In this building ground and first floors will be of R.C.C and other floors will be of M.S. grating.

RECAUSTICIZING

This section will have two houses,namely slaker house and filter house. The total expected area requirement for this section would be about 75 m x 40 m. Covered area is required only for above mentioned two houses, other major equipments like white liquor thickeners and mud washer etc. would be located in open space.

Therefore R.C.C Constructed area would be much less.

TURBINE HOUSE

The location of turbine house is selected near the recovery boiler and electrical sub station. This will be, two floors R.C.C. building. Total 20 m. x 15 m. area is considered for the purpose.

OTHER NON- FACTORY BUILDINGS

Other main buildings, Mechanical workshop, Administrative building, stores etc. are considered in proper locations. As it is shown in proposed plant lay out, open space between Administrative building and weak black liquor storage, would be used for the movement of tankers. Approach roads are shown for weak black storage, white liquor storage, lime godown and for furnace oil storage.

In the proposed lay out there is provision of three main entries, this is considered in the view of, movement of large number of tankers & trucks. Although, this concept will depend upon the location of the site and may be changed at a latter stage. A tentative scheme for Civil construction is enclosed.

TENTATIVE SCHEME FOR CIVIL CONSTRUCTION

S.No.	Section	Space Provided L x W	Constructed Area L x W x H	Floors	Plinth Area Sq.m	Total Floor Area Sq.m	Rate Per Sq.m	Eastimated Cost (Rs.in Million)	Remark
A.	**MAIN PLANT AND BUILDING**								
1.	Evaporator House	40x10m	40mx10mx10m.	Two	400	800	3000	2.40	
2.	Recovery Boiler	50x17.5m	50mx17.5mx10m	Two	875	1750	3000	5.25	
3.	Recausticising	75x40m.	15mx10mx8m	Four	150	600	3000	1.80	Two floor each, Slaker Filter House.
4.	Laboratory	8x6m	8mx6mx4m	One	48	48	3500	0.16	
B.	**BUILDING FOR AUXILIARY SERVICES**								
1.	Electrical Substation	10x10m	10mx10mx4	One	100	100	3500	0.35	
2.	Turbine House	20x15m.	20mx15mx8m	Two	300	600	3500	2.10	
3.	Workshop	8x6m.	8mx6mx6m	One	48	48	3500	0.16	
4.	Water treatment Plant.	15x10m	15mx10mx5m	One	150	150	3000	0.45	
C.	**ADMINISTRATIVE BUILDINGS**								
	Adm. Building	15x10m	15mx10mx8m	Two	150	300	5000	1.50	

S.No.	Section	Space Provided L x W	Constructed Area L x W x H	Floors	Plinth Area Sq.m	Total Floor Area Sq.m	Rate Per Sq.m	Eastimated Cost (Rs.in Million)	Remark
D.	**GODOWN & STORAGE**								
1.	Weak black liquor storage	90x30m.	-	-					Open storage
2.	Store	8x6m.	8mx6mx6m.	One	48	48	3500	0.16	-
3.	Furnace Oil Service tank.	5x5m	-	-			@750.00	0.01	-
4.	White liquor Storage tanks	25x25m	-	-			@750.00	0.46	Foundation for M.S. Tanks.
5.	Furnace Oil Storage	15x10m.	-	-			@750.00	0.11	Foundation for M.S Tanks.
6.	Lime storage	25X20m	25x20x6.0	One	500	500	3000	1.50	
E.	**MISC. NON FACTORY BUILDINGS**								
1.	Canteen	15x10m	15mx15mx4m	One	150	150	4000	0.60	
2.	Weigh bridge room	5x5m	5mx5mx3m	One	25	25	3500	0.08	
3.	Time office	5x3m	5mx3mx3m	One	15	15	3500	0.05	
4.	Security office	5x3m	5mx3mx3m	One	15	15	3500	0.50	
5.	Water storage tank (1500m3)	-	-	-				1.50	
6.	Pump House	10mx10m.	10mx8mx4m	One	80	80	3000	0.24	
F.	**SILOS, TANKS, WELLS, CHESTS, BASINS, BINS & OTHERS (CHIMNEY)**	5mx5m	5m dia on base 40m. Height	-				1.00	
G.	**GARRAGES**							0.20	

S.No.	Section	Space Provided L x W	Constructed Area L x W x H	Floors	Plinth Area Sq.m	Total Floor Area Sq.m	Rate Per Sq.m	Eastimated Cost (Rs.in Million)	Remark
H.	SERVICES SUCH AS SEPTIC TANK, DRAINS, SEWERS ETC.	-	-	-				0.50	
I.	INTERNAL ROADS	-	-	-				1.00	
J.	BOUNDARY WALL & GATES ETC. (Included in I)	-	-	-					
K.	LAND SCAPING & SITE GRADING							0.22	
								21.89	
				SAY	:			22.00	

6.02 PROJECT IMPLEMENTATION SCHEDULE

The total implementation period for the proposed project is estimated about 18 months. Zero date is considered, when investment decision would be taken by the board of directors. Before the starting of the project, final selection of participating units would be done and a board of directors would be formed. After the investment decision, the major activities involved in implementation of the project and their estimated duration is indicated below:

1. **Design Conference**

   Design conference would be organised to finalise all the basic concepts regarding the project.Senior persons from management side, technical consultants, financial adviser, would discuss the basic concept of the project in detail and fix the approach for implementation of the project. Complete activity would consumed about two weeks.

2. **Process & Basic Engineering.**

   This activity involves preparation of basic engineering documents like, final flow sheets, P & I diagrams, material balance and broad specifications of main plant & machinery. This activity is expected to take 6 months.

3. **Selection of main plant & machinery.**

   After receiving offers from various suppliers, Quotation Comparison Statement (Q.C.S) for each equipment would be prepared, and then order placement would be done for long delivery items, first and then for balance items. In between, all the drawings of fabricated items would be prepared. One month is estimated for the ordering of long delivery equipments. Ordering of balance items may be done according to delivery schedule. In the mean time fabrication of various items would be started at site. Delivery of all equipments would be complete in 16th month.

4. **Civil Engineering**

   After the finalisation of the site, development of the site would be started. Equipment layout would be fixed in 5th month, after receiving the drawings from vendors, foundation design would be completed. In the mean time other civil drawing would be prepared and civil contractor would be finalised. This activity would be started in 2nd month and completed in 16th month.

5. **Electrical Engineering**

   Based on the information available in the basic engineering and in the documents received from suppliers, a detailed single line diagram would be prepared. This would be followed by enquiries for the equipments. Offers received, would be analysed for their suitability. On receipt of the equipments at site electrical cabling work would be taken up, based on cabling layout drawings. These cable layout drawing would be prepared on the basis of final equipment layout. The total electrical engineering activity would be completed by 16th month.

6. **Erection and Piping**

This involves erection of all major equipments, preparation of piping drawings accordingly, procurement of items etc. This activity is expected to be complete by starting of 18th month.

7. **Test runs and commissioning.**

During the erection and piping various raw materials like lime and furnace oil would be procured, and after completion of erection and piping, test runs would be started in 18th month. After the test runs, it is expected that plant would be commissioned from 19th month.

6.03 MANAGEMENT STRUCTURE AND MANPOWER REQUIREMENT

The successful functioning of any organisation depends on its management and manpower.

The proposed concept of centralised recovery plant is owned by different participating units, which are competetors in the same field. But they face a common problem of pollution. As, the concept of Centralised recovery plant is being developed to search a solution of their common problem, their full hearted coperation and team work is very necessary to make this concept success.

The location of centralised recovery plant, may be integrated with any participating unit or may be as an independent unit but its management would work as an independent management. Although, every participating unit would also participate in management, but this company would be a new and independent company. For financial purposes the company could consider as a self-profit making centre.

MANAGEMENT STRUCTURE

After the indepth study of the concept and taking investment decision, a new company would be formed. All the participating units would participate in the management of this new company. The board of directors will be headed by a chairman. The Managing Director would be the chief executive of the new company and also a member of the board. A representative of the financial institutions and also of IAPMA would be in board as members. This board would take every policy making decision and would review the performance of the new company.

As board of directors would have representation from every participating unit cordination between different units would be better. At this stage, some responsiblities of participating units can be proposed, but each and every point would be discussed in detail before any investment decision. Some responsibilities are given below :

1. Modernisation and upgradation of pulp washing process, so concentration of dilute black liquor will increase up to 8%.

2. Some storage capacity for the dilute black liquor would have to be arranged in the mill itself. However, this storage may be lagoon type open storage.

3. Arrangements of loading and unloading of black liquor and white liquor would have to be done by individual unit.

These responsibilities and normal day-to-day working require active cordination between different units. Therefore above concept of management is developed on the same basis.

MAN POWER

Sufficient number of competent personnel should be employed to operate the plant. The personnel should have necessary qualifications and experience and their salaries and benefits should be commensurate with their qualifications. However, it should also be kept in mind that no employee is over-burdened so that efficiency does not suffer.

Keeping in view these aspects, an organisation chart has been developed, and enclosed with estimated annual salary and wages bill.

CHIEF EXECUTIVE

He will be the overall plant incharge and will report to board of directors. His main responsibility will be the implementation of policy decisions, taken by the board. He will be assisted by Works Manager & Manager (Procurement).

WORKS MANAGER

He will be responsible for the operational activities related to process. He will take care of day- to-day problems, and will do planning for daily working with the help of Superintendent (Recovery) and Chief Engineer.

MANAGER (PROCUREMENT & ADMINISTRATION)

Black Liquor collection from different participating units, is the back bone of this project. This person will responsible for proper collection and transportation of black liquor to recovery plant and white liquor supply to participating units. Besides this, he will take care of stores, security arrangements and time office. For the quality of black liquor, he will coordinate with Works Manager.

SUPERINTENDENT (RECOVERY)

He will report to Works Manager for day to day working and will guide the Shift Engineers according to management policy.

CHIEF ENGINEER

Proper day-to-day maintenance, and a well organized preventive maintenance schedule is very necessary for smooth running of the plant. The Chief Engineer will be responsible for electrical, mechanical and instrumentation maintenance. He will be assisted by electrical and mechanical supervisors.

OTHER STAFF AND DIRECT LABOUR

For the operation of the complete plant, personnel at all levels have been provided, all types of skilled, semi-skilled and unskilled labour have been considered. For the lime handling and sludge removal, contractact labour is proposed. It is estimated that 4 workers will be required in the general shift for lime handling and about 3 workers each per shift will be necessary for sludge removal.

Contract labour is also considered for transportation of black liquor and supply of White liquor to individual units. Arrangement of tankers and payments to workers involved in the transportaion, may be decided at latter stage.

ANNUAL BILL FOR SALARY & WAGES

No.	Grade	Personnel	Nos.	Monthly Salary (Rs.)	Annual Amount (Rs.in Million)
1.	A	Chief Executive	1	25000/-	0.30
2.	B	Works Manager, Manager (Procurement)	2	20000/-	0.48
3..	C	Superintendent, Chemical Engineer.	2	15000/-	0.36
4.	D	Shift Engineers, Store Incharge, Field Officers etc.	7	8000/-	0.67
5.	E	Supervisors, Chemists, Security and Time office Incharge etc.	20	4000/-	0.96
6.	F	Skilled Worker	51	3500/-	2.14
7.	G	Semi skilled, Security Guards etc.	45	2500/-	1.35
8.	H	Unskilled	28	2000/-	0.67
		Total 1 to 8	**156**		**6.93**
		50% Other Benefits			3.46
		Total			**10.40**
		Contract Labours (Lime & Sludge Handling)	45	1500/-	0.81
		Grant Total			**11.21**

6.04 SCHEME FOR CO-GENERATION

Co-generation is defined as the simultaneous or sequential produciton of two or more forms of useful energy from a single primary fuel source. It is almost always used to refer to the production of electrical power and steam from the same process. Any manufacturing plant requiring a large quantity of medium or low pressure process steam lands itself to co-generation. Steam generated at higher conditions can be efficiently reduced to the process conditions by converting some of the thermal energy to electrical energy.

In proposed project process steam requirement is about 34 TPH, at pressure of 10.5 Kg/Cm2 and 3.5 Kg/Cm2. Therefore, concept of co-generation can be considered for this centralized recovery plant. Steam requirement at 10.5 Kg/Cm2 is less, and most of the quantity is required at 3.5 Kg/Cm2. So if steam is generated at 45 Kg/Cm2, almost all the thermal energy from 45 Kg/Cm2 to 3.5 Kg/Cm2, can be converted into electrical energy. This electrical energy can be used in plant itself. Pressure and temperature of steam are determined on the basis of any primary analysis of initial investment and benefit in power generation.

As it is shown in enclosed scheme, about 3.0 MW power may be generated without any additional source of steam. At 100% capacity utilisation, it is expected that about 288 Ton of Black Liquor Solids per day, would be burnt in Recovery Boiler and about 34 Ton steam would be generated per hour.

In turbine section, two stage extraction type turbine is proposed. First extraction would be done at 10.5 Kg/Cm2 and this would be used for steam jet ejector of evaporators and air heater of recovery boiler etc. At second stage, steam would be extracted at 3.5 Kg/Cm2, for the evaporation plant, Black liquor heating, Green liquor heating and Causticizers, etc. Estimated quantities of consumption in various sections are also shown in enclosed scheme and it is expected that total steam requirement would be full filled by the steam generated in recovery boiler. Although, this total scheme is based on the estimated values and exact values can be calculated only after finalisation of major equipments.

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CHAPTER - 7

RAW MATERIAL, CHEMICALS & UTILITIES

The main raw material of chemical recovery plant is black liquor, which is a waste product of pulp mill. Chemicals & utilities like lime, furnace oil, power etc. are additional inputs.

In proposed project, consumption of different chemicals & utilities is estimated on the basis of per ton of caustic soda recovered. For this estimation about 90% recovery is considered, 10% would be makeup chemical, which would have to be added in the pulp mill, as fresh caustic soda.

In this chapter, basis of various estimations and various assumptions are given as follows:

Quantity of recovered caustic soda

1. Consumption of caustic soda (for 240 TPD production) (Annexure I) : 48.32 TPD
2. recovery efficiency : 90%
3. Recovered caustic soda : 43.48 TPD
4. Recovered caustic soda per year (330 working days) : 14200 TPA

INPUTS

1. **LIME**

1.25 T consumption of lime is estimated per ton of caustic soda, with 60% available CaO, and including handling losses.

Annual requirement : 14,200x1.25 T : 17,820 TPA

2. **STEAM**

Total steam requirement is estimated about 34 TPH at two pressure,one is 3.5 Kg/cm^2 and other is 10.5 Kg/cm^2. Major area of steam consumption is evaporators. Details are given in scheme for co-generation. it is also estimated that 34 TPH steam may be generated from recovery boiler, from 288 TPD black liquor solids.

Steam consumption at 3.5 Kg/cm²

i. Evaporator	:	22 TPH
ii. Recovery Boiler	:	4 TPH
iii. Causticizing	:	2.5 TPH
iv. Miscellaneous & Losses	:	0.5 TPH
		29.0TPH

Steam Consumption at 10.5 Kg/cm²

i. Evaporator (Steam Jet ejector)	:	0.5 TPH
ii. Recovery Boiler (Air heater, Soot blowing)	:	4 TPH
iii. Miscellaneous & Losses	:	0.5 TPH
TOTAL	:	5.0 TPH

Total steam requirement	:	34.0 TPH
Steam Generation (2.8 T/T of Black Liquor Solids)	:	33.6 TPH
SAY	:	34 TPH

3. **FURNACE OIL**

Requirement of this depends on the plant operating conditions. its main requirement is during start & stoppage of recovery boiler. However, its requirement is not continuous during running of boiler. On the basis of experience its requirement is estimated about 45 Litre per ton of caustic soda.

Annual requirement	:	45 x 14200
	=	639000 Lits.
SAY	=	640M³

4. POWER

Estimation of power consumption in Soda Recovery Plant is very critical, because consumption of power depends upon the efficiency of equipment, layout of equipment and efficiency of operation. At this stage power consumption can be estimated on the basis of present norms of industry, theoretical calculations &consumption norms of the equipments. On the basis of theoretical calculations, power consumption comes in the range of 400-500 units per ton of caustic, trend of the industry shows this range from 400 units to 850 units. Therefore, for present project consumption is estimated on the basis of 700 units per ton of caustic soda.

i.	Requirement of power (Per year)	:	700 x 14,200 9.94 Million KWH
ii.	If consumption is 60% of the connected load	:	9.94 ------- 0.6
iii.	Connected load	=	16.60 Million KWH
iii.	Power generation	:	3.0 MW
		:	23.76 Million KWH

Therefore connected load is about 70% of generation capacity.

These are the major inputs for proposed project. Other inputs are small in quantity, such as chemicals for water treatment etc. Cost of production is calculated on the basis of above consumption norms of major inputs and estimated cost of other minor inputs.

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CHAPTER - 8

FINANCIAL PROJECTIONS

The cost of project is estimated on the basis of the concept that the centralised recovery plant would be an independent unit located at an approximate equal distance from all participating units. The main plant and machinery is considered according to proposed process and the cost is estimated on the basis of offers from various suppliers. The estimates of the building cost and other such items have been done on the basis of experience and on the current rates.

COST OF PROJECT

The capital cost of the project is estimated at about Rs. 545.00 Million. This includes items like land & site development, buildings, plant & machinery, technical know how & miscellaneous fixed assets. Various financial expenses like pre-operative expenses, and margin money for working capital are also a part of cost of project and Rs. 48.00 Million are provided as contingencies.

MEANS OF FINANCING

As proposed project has many social advantages and is a well recognized scheme for pollution abatement; therefore, grant from various government agencies can be expected for the same. Apart from the grant, soft terms and conditions may be considered for loans.

Following three alternatives are considered for funds arrangements:

1. CASE - I

   With debt equity ratio : 3:1 and no grant.

2. CASE - II

   With debt equity ratio 3:1 and grant of Rs. 100 million.

3. CASE - III

   With debt equity ratio 1:1 and 50% grant out of equity participation .

Three rate of interest are considered for each case and estimated working results are being given in this chapter.

SALES REALISATION

For profitability statement, cost of recovered caustic soda is considered Rs. 12000/- per tonne. In cost of production, it is assumed that cost of transportation of black liquor would be borne by centralised recovery plant. The initial investment for purchase of tankers will be borne by the participating mills. However, this point can be discussed in detail after taking the investment decision.

ESTIMATED WORKING RESULTS

For working results of proposed project 90% recovery efficiency is considered with Rs. 12000/- as price of caustic soda, per tonne. Details are given in tables 8.01, 8.02 & 8.03.

TABLE - 8.01

COST OF THE PROJECT

(Rs. in Millions)

1	Land & Site Development	6.50
2.	Building & Civil works	22.00
3.	Plant & Machinery	340.00
4.	Technical Know-how	12.50
5.	Expenses on Technicians & Training	0.00
6.	Miscellaneous Fixed Assets	70.00
7.	Preliminary & Capital Issue Expenses	0.00
8.	Preoperative Expenses	40.00
9.	Contingencies 10%	48.00
10.	Margin Money	8.00
	Total Project Cost	**547.00**
	SAY -	**545.00**

TABLE - 8.02

COST OF PRODUCTION

(330 WORKING DAYS PER YEAR, 14,200 TPA CAUSTIC SODA PRODUCTION, 90% RECOVERY)

S . No	ITEMS	QUANTITY TPA	RATE Rs/Unit	AMOUNT (Rs.inMillions)
	A. RAW MATERIAL			
1.	Black Liquor	Free of Cost from various participating units.		-
	B. CHEMICALS			
1 .	Lime	17820	2500.00	44.55
2.	Other Chemicals for water treatment etc.	(Rs.150/-per ton of caustic)		2.130
	C. UTILITIES			
1.	Steam	Free of Cost from black liquor solids		-
2.	Power * (MillionUnits)			
a.	Required	99.40		
b.	Generation (3.0 MW)	23.70		
c.	Purchased	-		3.00
3.	Furnace Oil(M^3)	650	6000.00	3.90
	Total - A+B+C			**53.58**
	COST OF PRODUCTION RS. / TONNE OF CAUSTIC			**3773/-**

TABLE - 8.03

CASE - I

WITH D/E RATIO 3:1, NO GRANT PROFITABILITY (AT 90% RECOVERY EFFICIENCY)

(Rs. in Million)

COST OF PROJECT : 545.00
EQUITY 25% : 136.25
LOAN 75% : 408.75

SNo	Particulars/ Interest	Amount At 6%	Amount At 9%	Amount At 12%
1.	Cost of production	53.58	53.58	53.58
2.	Salaries & Wages	11.21	11.21	11.21
3.	Administrative Overheads	1.42	1.42	1.42
4.	Repairs & Maintenance	3.55	3.55	3.55
5.	Packing & Forwarding	-	-	-
6.	Selling Expenses (Cost of Transportation)	25.50	25.50	25.50
7.	Total cost of sales	95.26	95.26	95.26
8.	Sales realisation	170.40	170.40	170.40
9.	Surplus power (13.76 Million KWH)	30.40	30.40	30.40
10.	Gross Profit	105.54	105.54	105.54
11.	Interest on Term Loan	24.52	36.78	49.05
12.	Interest on Working Capital	3.00	3.00	3.00
13.	Depreciation	38.15	38.15	38.15
14.	Profit after Interest & Depreciation	39.86	27.60	15.34
15.	Profit after interest	78.01	65.75	53.49
16.	Return on project cost (Rs. 545.00 Million)	14.31%	12.06%	9.81%
17	Return on equity (Rs. 136.25 Million)	57.26%	48.26%	39.26%

CASE - II

WITH D/E RATIO 3:1, GRANT RS.1000 LAKHS
PROFITABILITY
(AT 90% RECOVERY EFFICIENCY)

(Rs. in Million)

COST OF PROJECT : 545.00

EQUITY 25% : 136.20

LOAN 75% : 308.70

GRANT : 100.00

SNo.	Particulars/Interest	Amount At 6%	Amount At 9%	Amount At 12%
1.	Cost of production	53.50	53.50	53.50
2.	Salaries & Wages	11.21	11.21	11.21
3.	Administrative Overheads	1.42	1.42	1.42
4.	Repairs & Maintenance	3.55	3.55	3.55
5.	Packing & Forwarding	-	-	-
6.	Selling Expenses (Cost of Transportation)	25.50	25.50	25.50
7.	Total cost of sales	95.26	95.26	95.26
8.	Sales realisation	170.40	170.40	170.40
9.	Surplus power (13.76 Million KWH)	30.40	30.40	30.40
10.	Gross Profit	105.54	105.54	105.54
11.	Interest on Term Loan	18.52	27.78	37.05
12.	Interest on Working Capital	3.00	3.00	3.00
13.	Depreciation	38.15	38.15	38.15
14.	Profit after Interest & Depreciation	45.86	36.60	27.34
15.	Profit after interest	84.01	74.75	65.49
16.	Return on project cost (Rs. 545 Million)	15.42%	13.72%	12.02%
17	Return on equity (Rs. 136.25 Million)	61.66%	54.86%	48.06%

CASE - III

WITH D/E RATIO 1:1, 50% GRANT OUT OF EQUITY PARTICIPATION PROFITABILITY (AT 90% RECOVERY EFFICIENCY)

(Rs. in Million)

COST OF PROJECT : 545.00

EQUITY 25% : 136.25

LOAN 50% : 272.50

GRANT : 136.25

SNo.	Particulars/Interest	Amount At 6%	Amount At 9%	Amount At 12%
1.	Cost of production	53.58	53.58	53.58
2.	Salaries & Wages	11.21	11.21	11.21
3.	Administrative Overheads	1.42	1.42	1.42
4.	Repairs & Maintenance	3.55	3.55	3.55
5.	Packing & Forwarding	-	-	-
6.	Selling Expenses (Cost of Transportation)	25.50	25.50	25.50
7.	Total cost of sales	95.26	95.26	95.26
8.	Sales realisation	170.40	170.40	170.40
9.	Surplus power (13.76 Million KWH)	30.40	30.40	30.40
10.	Gross Profit	105.54	105.54	105.54
11.	Interest on Term Loan	16.35	24.52	32.70
12.	Interest on Working Capital	3.00	3.00	3.00
13.	Depreciation	38.15	38.15	38.15
14.	Profit after Interest & Depreciation	48.04	39.86	31.69
15.	Profit after interest	86.19	78.01	69.84
16.	Return on project cost (Rs. 545.00 Million)	15.81%	14.31%	12.81%
17	Return on equity (Rs. 136.25 Million)	63.26%	52.26%	51.26%

CHAPTER - 9

SOCIO ECONOMIC IMPACT ASSESSMENT

GENERAL

The growth of paper industry in India has been a roller coaster ride. Being a capital intensive unit, it experienced indifference of large investment particularly during the period 1960-75. The demand continued to grow at its own level. To fill the emerging vacuum, the need for small units with relatively lower investment proposition was felt. This trend gave birth to the mushrooming growth of small paper mills ranging between 5 to 40 TPD capacity.

During the aforesaid transition period, pollution and environmental factors were conceived as pseuedo technical jargons. Resultantly, these units of smaller capacities substantially based on agro residues like the other small and medium size enterprises did not consider these aspects.

Awareness on Environmental Pollution has increased all over the world and today, ecological balance has become watch word for progress. The trend is resulting in a threat to the pollution prone industries even to the extent of their closure. Paper industry based on agro residues on one hand protects environment by using agro residues as raw material and consequently reducing load on scarce forest raw material, which is already having pressure on environment. On the other hand the industry due to lack of proper Chemical Recovery system and resulting in high pollution load is causing a threat to the aquatic life. Hence, the situation becomes paradoxical and requires an investment friendly remedy.

However, the active steps have been energised recently and hence this study is sponsored by Indian Agro Paper Mills Association. The objectives and approach of this study has already been elaborated in preceeding chapters. The socio-economic impact of the concepts are discussed in succeeding paragraphs. The benefits highlight only for one proposed demonstration plant and will have overall benefit of 8 to 10 times after it is introduced in all Agro based paper mills within permissible economic clusters.

EMERGING SOCIO-ECONOMIC IMPACTS

FOREIGN EXCHANGE ORIENTED

The present study endeavours to study seven /eight agro based units in Moradabad, Kashipur region on Economic procurement zone (EPZ) concept. The selected units harbor a capacity of about 240 TPD of papers of different varieties. The annual production hence emerges to be about 79,200 Tons. Closure of these units on pollution grounds may deprive the nation of 79,200 TPA of paper production. Being an essential commodity the same will have to be imported to meet the demand. Hence, even at bottom line price of Rs. 20,000 per ton, the country will require the precious foreign exchange equivalent to Rs. 1,584 million per annum which will be a burden on the nation.

EMPLOYMENT ORIENTED

Paper industry normally generates two types of employment:

i. Direct Employment

ii. Indirect Employment

Direct employment could be defined as the personnel involved directly in production, planning and marketing. The indirect employment is generated through ancillary and auxilliary activities of the unit. For example, the people involved in transportation,loading and unloading of raw materials and finished products could be considered as indirect employment. Similarly, the inhabitants engaged in other activities such as hotels/restaurants/Dhaba, Grocery, Vegetables business etc. emerging out of the grown township due to existence of unit, benefit through the indirect employment opportunities.

Closure of these mills may result in loss of direct employment upto the level of about 1200 people and indirect employment of almost three times of the same.

EXCHEQUERS INCOME ORIENTED

Production of paper fetches excise duties and cess. These are one of the major incomes to the exchequers to meet its expenses to run the government as well as undertake infrastructural development and provide services to the citizens. The agro based units are dutied at about 5 to 10% of ex-mill price of paper and a cess of 0.125% on an average., Considering the paper prices averaged at Rs. 20,000 per ton there will be an excise duty loss of approximately Rs. 158.4 million per annum if these mills are allowed to close down.

FARMER'S INCOME ORIENTED

The cluster choosen for the study harbours about 240 TPD of paper requiring about 550 TPD of agro-residues. These residues are procured from the farmers, against an averaged delivered price of Rs. 400/- per ton. Even if Rs. 150/- per ton goes to the farmers, the farmers earn about Rs. 27.0 million from the wastes. The earnings further have their own multiplier effects.

INVESTMENT LOSS ORIENTED

Closure of these mills shall result in a huge capital loss, particularly the fixed assets and the circulating capital. Further, creation of a fresh capacity of 240 TPD may require an investment of more than Rs. 5000 millions. The interest component alone on this investment shall incure to the level of about Rs.1000 million per annum plus the loss of social benefits as the same amount could be diverted to some other infrastructural projects.

In light of the above socio-economic impacts, the idea of a centralized chemical recovery plant has been mooted out. The prime features of the approach has been outlined in succeeding paragraphs.

SOCIO-ECONOMIC FALL OUT OF CENTRALISED CHEMICAL RECOVERY PLANT.

In agro-based paper mill without chemical recovery, the lignin contributes to about 200-225 Kgs. per ton in discharged water which is the largest contributor to pollution and at the same time it is bio-refractory in nature. The gains of a Chemical recovery plant in terms of pollution control could be deciphered from the comparative factors highlighted in table below:

CHARACTERISTICS OF EFFLUENT OF MILLS WITH & WITHOUT CHEMICAL RECOVERY BEFORE E.T.P

Parameter		Large integrated paper mill with Chemical recovery	Agro based paper mill without Chemical recovery
COD	Kg/t	480	1100
BOD	Kg/t	90	225
COLOUR	Kg/t	150	1400
S.S.	Kg/t	100	900

With the pollution control laws becoming more and more stringnent today, with the higher judicial interventions for the application of these laws, the growth and survival of small agro based mills has been entirely contingent upon finding a viable solution to handle black liquor.

RECOVERY ASPECTS

The black liquors treated at effluent treatment plants of the individual units do not yield any output excepting minimisation of the pollutant levels. However, the centralised chemical recovery plant shall be recovering caustic soda (white liquor), a raw material being used in paper manufacturing. The plant being discussed shall have a recovery efficiency of about 90% resulting in a gross recovery of about 42-43 TPD of caustic soda. The units being studied, altogether consume about 45-48 TPD of caustic soda. Requirement of the targetted units could be catered through caustic soda recovered in the plant.

The prevailing market rate of caustic soda is about Rs. 12,000/- per tonne. Caustic soda in centralised recovery plant shall also be about Rs. 12,000/- per ton. The proposition for this cluster shall result in a recovery of about 14,200 TPA of NaOH worth approximately Rs. 170 million which otherwise would have been lost.

ENERGY ASPECTS

The treatment of black liquor at ETP at individual units require an expense of about Rs. 500/- per ton of paper. Power is the major part of this expense. The power consumption at centralised chemical recovery is generated through co-generation, cost of which is minimal.

Production of 1 ton of caustic soda requires about 2500 KW of power. The concept will save about 36 million KWH power which is a national gain. As per energy conservation measure 1 KW of power saved is equivalent to 1.25 KW of power generated.

2500 KW of power generation requires approximately 25 tons of steam which is generated from around six tons of coal. Hence, the recovery plant in this cluster shall save six tons of coal which otherwise is required to produce one ton of caustic soda. Collectively, the plant shall save about 85,200 TPA of coal which is an exhaustible mineral. Even querring of this quantity of coal shall require high expenses.

FARMERS INCOME ASPECTS

Installation of the chemical recovery plant shall save the existing units enabling them a pollution free operation. Hence, the farmers in the area shall continue to supply their agricultural wastes to these units. The total earning to farmers at the bottom line level emerges to be around Rs. 27.0 million.

As per National Income theory, the money earned by the farmers shall be spent in following way:

$Y=C+S+I$

where,

Y= Income earned

C = Expenses on Consumption

S = Saving after Consumption

I = Investment from amount saved.

The typical pattern prevailing in the area are:

$Y_{100} = C_{40} + S_{60} + I_{30}$

Translated to the total income pattern the consumption and saving criterian could be analysed as followed:

Y(27.5) million = C(11 Million) + S(16.5 Million) + I(8.25) Million.

Which means that out of Rs. 27.5 million earned, the farmers shall be spending about Rs. 11 million on day to day consumption, Rs. 16.5 million shall be saved by them. Out of the saved amount Rs. 8.25 million shall be invested in various activities related to development and the rest shall be kept in liquid form to meet the contingencies.

The consumption further attracts payments of sales tax, excise duty, octroi etc. going to the exchequers. This clubbed up together (on macro level) comes to about 25% of the total expenditure on consumption. Resultantly the farmers shall be paying about Rs. 2.75 million to the exchequers which could help the nation to undertake development activities which shall have further employment generation and multiplier effects.

Even the amount saved in liquid form shall remain with the banks. The deposits with banks shall further add to multiplier effects through distribution theories which is difficult to be estimated and requires a thorough modeling of economics theories.

The amount invested shall further enchance farmers income and contribute to the overall economy of the country as these will facilitate enhancement of production, distribution and consumption. Due to these efforts further employment will be generated, consequently income will rise and result in more demand for the goods and again production. The exercise shall form a circle of multiplier effect and contribute to the economy in manifold ways.

EMPLOYMENT ASPECTS

In addition to save the employment of about 4800 people in the existing units, the recovery plant shall further generate, direct employment opportunity of about 180 persons and about 540 man year of indirect employment. Considering an average remuneration of about Rs. 2500/- per month per person this in turn shall distribute about Rs.165.60 Million per annum to the people. This again shall get distributed to consumption, saving and investment as per distribution theory concepts out of which about Rs.41.40 Million are likely to go the exchequers in form of different taxes.

DEMOGRAPHY ASPECT

The chemical recovery plant shall not only result in pollution minimisation but also improve the areas demographic profile. Its contribution in enhancement of NNP shall result in improvement in standard of living, education and consequently overall development of the region. The multiplier effects of the economic gains shall provide further impetus to the infrastructural development and socio economic upliftment of the region.

INDICATIVE SUMMED UP GAINS

S. No.	Parameters	Gains
1.	Foreign exchange saving	Rs. 1584 million.
2.	Total employment saved	4800 Man years Works Rs. 144 million per annum).
3.	Additional employment to be generated	720 Man years (Both Direct & Indirect)
4.	Exchequer Income saved	Rs. 158.40 million per annum.
5.	Farmer's income saved	Rs. 27.00 million per annum..
6.	Fresh investment saved	Rs.5,000.00 million.
7.	Energy saved	2500 KW per ton of Caustic Soda. (About 35 million KWH)
	Equivalent Coal saved	6 Tons of Coal per ton of Caustic Soda (About 75,000 TPA)
8.	Excess power available from CRS	Rs.27.5 million
9.	Taxes generated out of farmers income	Rs. 2.75 million
10.	Saving generated by farmers	Rs. 16.5 million
11.	Investment generated by farmers.	Rs. 8.25 million
12.	Multiplier effects	Infinite.

SOCIAL RATE OF RETURN

The investment in such innovative projects shall result in manifold social returns. Qualitatively it will create employment, save unemployment, save foreign exchange and energy. The qualification of social rate of return is a colossal. However, from macro economic implication point of view, the project shall result in following equation.

$V = E_o, E_1, Y_1, Y_2, Y_3, E(C,I,S), I, F_1, F_2, F_3 M_1, M_2, M_3 \ldots\ldots\ldots\ldots N.$

Where,

V = Investment in Recovery plant.

E_o = Employment saved

E_1 = Employment generated

Y_1 = Income generated through employment.

Y_2 = Income generated through raw material.

Y_3 = Income generated through the saving and investment

E_c = Expenditure on consumption

E_i = Expenditure on saving.

E_s = Expenditure on investment.

I = Investment as multiplier effect.

F = Financial accruals through excise duty.

F_2 = Financial accruals through sales taxes.

F_3 = Financial accruals through other taxes.

M = Multiplier effect at first stage.

M_2 = Multiplier effect at second stage.

M_3 = Multiplier effect at later stage.

N = Infinity.

In light of the above interlinking multiplier effects, it is understood that the social rate of return is infinite and a measurement of it shall require a full fledged economic study. As per prevailing conceptual finding such investments result in a proportion of about 1:27, i.e one rupee invested in such projects yields a social return up to Rs. 27 within 10 years.

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CHAPTER - 10

CONCLUSIONS AND RECOMMENDATIONS

Although nonwood fibres can be used to produce all grades of paper, they attract little attention and interest from the majority of the pulp producing countries. Forest poor countries however find these raw materials as an obvious option to produce paper. Nonwood paper production is an important industrial sector in India and plays a key role in local and regional economics. Nonwood mills are labour intensive and many source their fibres from the local area, generating income for a large number of farmers.

There are two main advantages for farmers in growing crops rather than trees. Firstly, income is generated every year, avoiding the need for credit to support tree growing costs over many years. Secondly, crops can be changed every year depending on the relative benefits from the crop. Besides, the use of agro-residues for papermaking is most positive, as it generates income and reduces waste.

Because of the majority of the mills being very small and their dependence on comparatively old and cheaper technology, they can ill afford independently recovery plant. Common recovery plant for a number of pulp mill units could be an answer to the pollution associated problems.

The conventional soda recovery system , which is widely used in wood based mills is perhaps today the best available technology also for the non-wood pulp mills.

The exercise carried out in this report clearly indicates that the common recovery plant can be viable only if sufficient financial support in form of softer loan and grant are available. The social and employment benefits of non-wood fibre mills have to be set against commercial disadvantages.

In view of the long range benefits of utilising agro wastes for papermaking, it is recommended that common recovery plants for a cluster of mills should be encouraged in order to keep harmony with nature.

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ANNEXURE - I

CENTRALISED RECOVERY PLANT

BASIS FOR THE DESIGN & CAPACITY OF MAJOR EQUIPMENTS

1. Existing combined pulping capacity	:	200 TPD
2. Capacity considered for the design of centralised recovery plant (20% extra):	:	240 TPD
3. Black liquor volume per ton of pulp (After modifications in washing system)	:	15 M^3
4. Black liquor concentration (After modifications)	:	8%
5. Caustic consumption (O.D. Raw material)		
i. In Kraft paper unit	:	8.5%
ii. In Bleached paper unit	:	12.5%
6. Yield -		
i. In Kraft paper units	:	48%
ii. In Bleached paper units	:	39%
7. Black liquor solids per ton of pulp	:	1.2 T
8. Quantity of recovered Caustic.		
i. Consumption of Caustic	:	48.32 TPD
ii. 90% Recovery	:	43.48 TPD
(43 TPD, Caustic soda)	:	14,190 TPA
Say	:	14,200 TPD

GENERAL CALCULATION

1.	Raw material requirement (O.D)		
	i. In bleached paper unit (40 TPD, 39% yield)	:	103 TPD
	ii. In Kraft paper unit (200 TPD, 48% yield)	:	417 TPD
	iii. Total	:	520 TPD
2.	Caustic consumption		
	i. For bleached paper (12.5% of raw material)	:	12.88 TPD
	ii. For unbleached paper (8.5% of raw material)	:	35.44 TPD
	iii. Total	:	48.32 TPD
3.	Total volume of black liquor (15 x 240) per day	:	3600 M^3
4.	Black liquor solids per day	:	288 T
5.	Volume of while liquor (95 gpl) to be handled per day.	:	508 M^3
6.	Storage capacity -		
i.	For black liquor (3 days)	:	10,800 M^3
ii.	For white liquor (3 days)	:	1,500 M^3

TENTATIVE DESIGN

A. STORAGE

i. **Black liquor**

Total volume required	:	11000 M^3
Open storage with Polythene lining	:	60 x 60 x 3m.

ii. **White liquor**

Total volume required	:	1500 M^3
Volume of one tank (Dia - 5.6 m, Height - 5.0)	:	500 M^3
Nos. of tanks	:	3

iii. **Furnace oil**

Consumption / T of pulp (Only for Design)	:	0.5 M^3
Consumption/day	:	120 M^3
Storage capacity	:	360 M^3
Nos. of tanks	:	4
Capacity of each tank	:	100 M^3

iv. **Lime**

Quantity require (400 Kg./T of pulp)	:	96 TPD
Storage capacity	:	7 days
Space requirement for (675 T lime)	:	85 M^3
(24 m x 12 m x 3 m)		

v. **Consumption of furnace oil**

50 Lit/T of Caustic
50 x 39 x 330 = 643.5
(About 8.2 Lit/T of Pulp)
SAY = 650M³

B. **EVAPORATORS**

i. Black liquor to be handled per day	:	3600 M³
ii. Inlet concentration	:	8%
iii. Outlet concentration	:	45%
iv. Water evaporated	:	2960 TPD
v. If 22 working Hrs / day	:	135 TPH
vi. Steam economy (may be consider for design)	:	6.2
vii. Steam requirement for evaporation.	:	21.77 TPH
viii. Semi concentrated black liquor per day	:	640 M³

C. **RECOVERY BOILER**

i. Black liquor solids to be handled per day.	:	288 TPD
ii. Steam pressure & temperature	:	46 Ata & 427 +/- 5°C
iii. Quantity of steam (2.8 T/ Tof B/L Solids)	:	34 TPH

D. **RECAUSTICIZING PLANT**

i. Production of white liquor per day	:	500 M³
ii. If 22 working Hrs./day	:	23 M³
iii. Concentration white liquor	:	95 gpl
iv. Green liquor to be handled per day	:	665 M³

ANNEXURE-II

ESTIMATION OF COST OF TRANSPORTATION

BASIS - 30 TPD PULP PRODUCTION

- 450m³ BLACK LIQUOR PER DAY

1.	Quantity of Black Liquor/Tanker	:	10M³
2.	No. of Trips/Day (450/10)	:	45
3.	Time Consumed in One Trip		
	a. Traveling Time	:	2.0 Hrs.
	b. Time for Loading, Unloading etc.	:	1.0 Hrs.
	Total Time	:	3.0 Hrs.
	Trips/Day	:	8.0
	Trips/Day, Considered for Calculation	:	7.0
4.	Tankers required for 450M³ Black Liquor (45/7)	:	6.4
	Say (one extra)	:	8.0
5.	Manpower requirement	:	One Driver
	Per Tanker/shift	:	One Helper
6.	Manpower requirement	:	24 Drivers
	Per day (8 Tanker, 3 Shift)	:	24 Helpers

7. Salaries & wages (Rs. in Million)

Drivers - 24 x 2500 x 12	:	0.72
Helpers - 24 x 1500 x 12	:	0.43
		1.15
50% other benefits		0.57
Annual Bill of Salaries & Wages		1.72

8. Consumption of fuel

- Avg. Distance/Trip	:	80 KM
- Fuel Consumption	:	8 Lit./Trip
	:	Rs.80/Trip
Annual Amount (Rs.in Million) (80 x 45 x 330)	:	1.18

9. Repairs & Maintenance(Rs.in Million)	:	8.0 x 8.0 x 0.10
(10% of Cost of Tankers)	:	0.64

10. Total annual cost of transportation (Rs. in Million)

- Initial Investment	:	6.40
Operating Cost (1.72 + 1.18+ 0.64)	:	3.55

(For comparison, only operating cost is considered with 20% interest on initial investment)

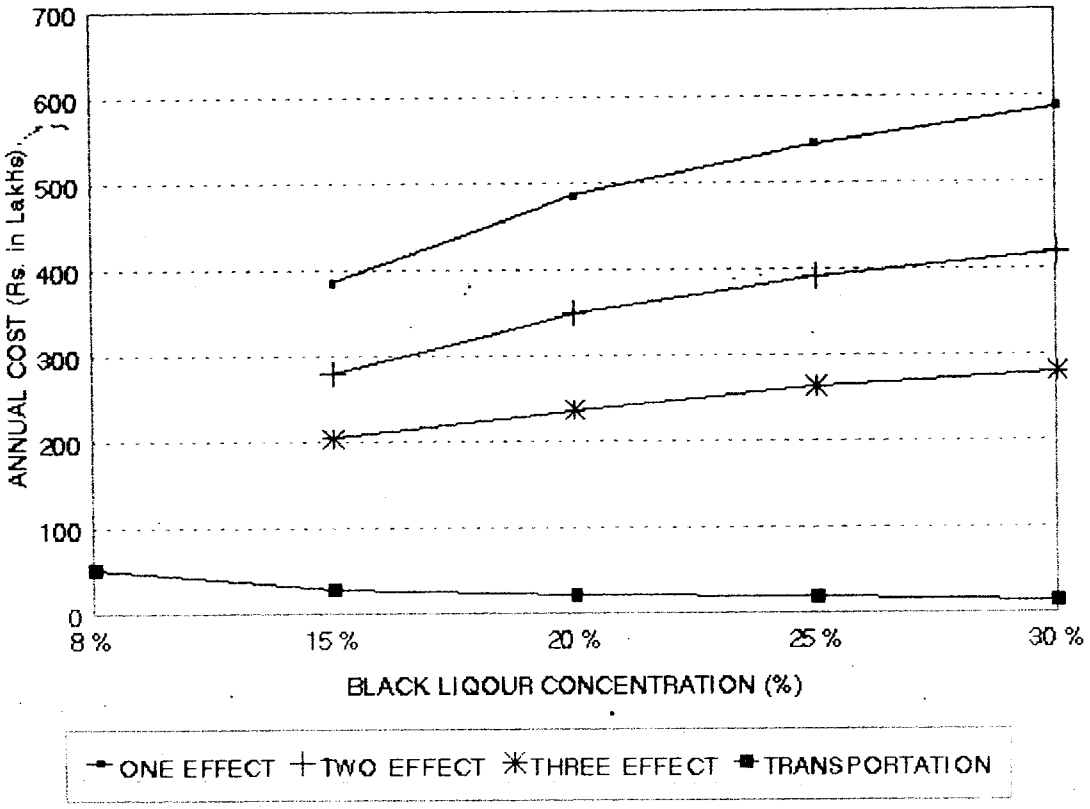
11. Cost of transportation of 240 TPD Pulp production

(3.55 x 8) (Rs. in Million)	:	28.44
Say	:	28.50

12. Cost of transportation/T of pulp

Initial investment	:	6.4x 8	= Rs. 51.20 Million
Operating cost	:	28.5	= Rs. 28.50 Million
Total	:		Rs.79.70 Million
On the basis of total cost	:	$\frac{797 \times 10^5}{330 \times 240}$	= Rs. 1,006/-
On the basis of operating cost (including 20% of initial investment)	:	$\frac{387.4 \times 10^5}{330 \times 240}$	= Rs. 489/-
Cost of transportation of dilute Black Liquor (Rs./Ton of pulp/k.m.)	:	$\frac{489}{40}$	= Rs. 12/-

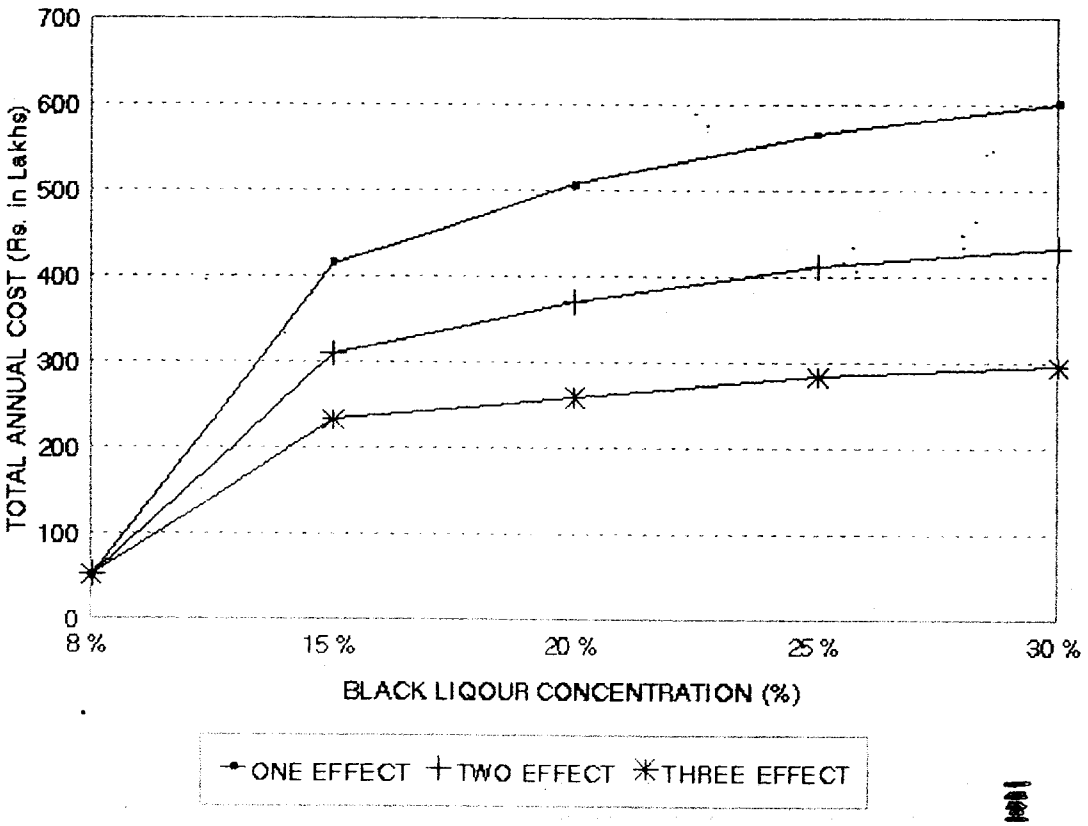
B/L CONCENTRATION V/S COST



BASIS

1. Cost is estimated for 30 TPD Pulping unit.
2. Volume of black liquor is considered $15 m^3/T$ of pulp at 8% concentration.
3. Total evaporation cost = Steam cost + Power cost + Manpower cost + 20% interest on Capital cost.

TOTAL ANNUAL COST V/S B/L CONCENTRATION



Notes

1. Cost is estimated for 30 TPD Pulping unit.
2. Volume of Black liquor is 15m^3/T of pulp at 8% concentration.
3. Cost of evaporation = Steam cost + Power cost + Man power cost + 20% interest on equipment cost.
4. Total cost = Cost of evaporation + Cost of transportation.

ANNEXURE - III

REPORT ON THE VISIT OF VARIOUS MILLS IN IDENTIFIED CLUSTERS (FROM 10.12.96 TO 17.12.96)

THE APPROACH

For a sample study, following units are selected and it may be assume that characteristics of raw material, and black liquor of these mills will represent the characteristics of raw material and black liquor of all the pulp producing units, situated in the area -

1. Shiva Paper Mills Ltd., Rampur.
2. Cheema Paper Mills Ltd., Bazpur.
3. Banwari Paper Mills Ltd., Kashipur.
4. Chadha Paper Mills Ltd., Rudrapur.
5. Multiwal Paper Mills Ltd., Kashipur.
6. Shree Shyam Paper Mills Ltd., Kashipur.
7. Vishvkarma Paper & Boards Ltd., Kashipur.

Among the above paper mills, all are running except Shree Shyam Paper Mills Ltd. which was in the final stage of erection at the time of visit. During the visit every mill was visited and data & information were collected about the process and raw material handling. Study was done in general and in particular about the cooking process & effluent treatment methods.

THE MILLS

All the mills which are visited, are based on the agriculture residues (Bagasse, wheat straw & rice straw). Except Shiva Paper Mills Ltd. all are producting unbleached kraft paper. Shiva Paper Mills Ltd. is producing bleached writing & printing paper. All mills are collecting bagasse from the sugar mills situated in the near by areas. Cooking process is almost same in all the mills, except chemical consumption which is about 12.5% in Shiva Paper Mills and 8.5% in other mills.

As far as washing of pulp is concerned, only Shiva Paper Mills is using brown stock washers and all other mills are using potcher type washing, single stage or double stage. Therefore, there is some scope of improvements in all the mills. At the time of digester feeding most of the mills are using fresh water for dilution of Caustic soda. There is no regular measurement of quantity of black liquor and concentration of black liquor are observed from the records of mills and are mentioned in the profile of every individual mill.

MODERNISATION & UPGRADATION

The region, under consideration is a bagasse rich region, therefore, bagasse will be the main raw material for these mills in future. In the development of technologies for paper making from non wood, most of developments have been for bagasse. These efforts have greatly improved methods of classification, storage, preservation, depithing & pulping of bagasse to produce different varieties of paper, boards & newsprint.

For the modernisation & upgradation of process, these mills are started to adopt new developed equipments & methods. M/s Shiva paper mills, Banwari paper Mills & Cheema Paper Mills are already using dry depithing for bagasse. Shiva Paper Mills is also using duster for wheat straw & rice straw and lye mixer with feeder for digester feeding. Cheema Paper Mill is also thinking for feeder & lye mixer.

In most of the mills , blowing is being done in potcher but now they are planning for blow tank. Shiva Paper Mills and Cheema Paper Mills are using blow tank and it is under construction in Banwari paper Mills. Shiva Paper Mills is also using blow heat recovery system.

For the storage of raw material, all mill have started to consider the scientific & systematic methods of storage. Effluent treatment, is the other area, in which all these small mills adopt developed methods.

Although, the process of modernisation and upgradation is not much fast in these mills, particularly because of financial limitations, but it has been started. As this is a well accepted fact that use of agricultural based raw materials will rise in the future, and so contribution of these mills will also increase. In the above background, there are many reasons to believe, that these units will continue the process of modernisation and upgradation.

OBSERVATIONS AND SCOPE OF IMPROVEMENTS

Mills are using fresh water to maintain bath ratio in the digesters. This, increased fresh water consumption, if the black liquor is added instead of fresh water it will reduce dilute black liquor production, fresh water consumption and it would increased black liquor concentration.

Except Shiva Paper Mills, all mills are using potcher type washing. In this type of washing water consumption is more, solid concentration of black liquor is less, and chemical loss with the pulp is more. In the view of chemical recovery plant, concentration of black liquor should be about 8-9%, therefore following methods may be considered for the improvement

i. Replacement of potchers by brown stock washers.
ii. Screw press, before the washing of pulp, to extract concentrated black liquor.
iii. Mechanical press, for the extraction of concentrated black liquor after the blow tank.

Among the above options first one is well proven and well adopted in paper industry. Installation of three stage brown stock washing system would increase black liquor concentration up to 8-10%, and reduce fresh water consumption.

LEVEL OF INVESTMENT IN EACH UNIT

This level of investment is estimated on the basis of replacement of potchers by brown stock washers and some open storage capacity of dilute black liquor. Three stage brown stock washing system is considered. As Shiva Paper Mills Ltd., already using brown stock washing system, they would have to invest only on storage capacity for dilute black liquor. Break up of estimated investment, for 30 TPD pulp production is given below:

1.	Three stage brown stock washing system.	: Rs. 2.50 Million
2.	Building & Civil works	: Rs. 1.00 Million
3.	Open Storage for dilute black liquor (3 days storage capacity 450M^3 per day)	: Rs. 0.50 Million
4.	Tanker's cost (8 Nos)	Rs .6.40 Million
	Total	: Rs 10.40 Million

A profile of the datas & informations collected during the visit is being given here with flow diagrames of process & effluent treatment.

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SHIVA PAPER MILLS LIMITED
RAMPUR

MEETING WITH :

MR. D.B. SHARMA	-	DY. GEN. MANAGER
MR. S. PATEL	-	PROJECT & PLANNING
MR. H.K. ARYA	-	PULP MILL
MR. VINOD KUMAR	-	LAB
MR. BANSAL	-	PAPER MACHINE

1. Location of the industry	:	Vill. Dhamora (15 Km. from Rampur on Rampur - Bareilly Road) Distt. Rampur.
2. Product	:	Bleached paper (Writing & Printing Poster paper)
3. Capacity	:	50 TPD
4. Raw materials	:	Bagasse, Sarkanda, Rice straw, white cutting & imported pulp. (Main, bagasse - 75 - 85%, Ratio of Sarkanda & Rice straw is depend upon availability).
5. Pulp Mill Capacity	:	35 TPD
6. Pulping process	:	Soda process.
7. Raw material handling	:	Bagasse - Dry - depithing. Sarkanda, Rice straw - Dusting.
		2 Nos. of depithers.
		2 Nos. of dusters.
8. Digester's House	:	8 Nos., 40m^3, Rotary digesters.
		3 Nos. Rotary feeder, with lye mixer.
9. Cooking conditions	:	
i. Cooking Chemicals	:	12-13% (10% for Rice straw)
ii. Temperature	:	165-170°C.
iii. Pressure	:	6.0 - 6.5 Kg/Cm^2

iv. Time to temp.	:	1.3 Hrs.
v. Time at temp.	:	3 - 4 Hrs.
vi. Total cooking cycle (From charging to blowing)	:	8.45 - 9.00 Hrs.
vii. Blowing	:	In Potcher.
viii.Pulp yield	:	41-43% (Unbleached)
		37-39% (Bleached)
ix. K. No.	:	12-17 (14 Avg.)
10. Flow Sequence	:	Block diagramme for process is enclosed.
11. Washing, Screening & Cleaning.	:	3 Stage Brown stock washers.
		Warm water fromblow Heat r ecovery is being used in counter current washing system.
		B/L from Ist stage washing is being sent to lagoon.
		No. Knotter screen before BSW.
		Vibrating screen & Centricleaner (3-stage) are after B S W.
12. Black liquor volume	:	$30M^3$ / T of Pulp.
13. Concentration of Black Liquor	:	16,600 - 24,236 ppm
14. Bleaching sequence	:	C-E (P) - H

15. Bleaching conditions :

	Chlorination stage	Extraction/ Peroxide stage	Hypo stage
i. Cl_2 Addition	7-9%	-	5-7%
ii. NaOH/Peroxide	-	3.0%/0.5-0.8%	-
iii. Temp.	Ambient	65°C	40°C
iv. Retention time	30 min.	90 min.	120 min.
v. Consistency	2.5-3.0%	8-10%	8-10%
vi. PH.	4.0-4.5	9.0-10	7.5-8.0

16. Effluent load at different points :

	Lagoon inlet	Lagoon outlet	Primary clarifier inlet-outlet		Secondary clarifier (outlet)
i. B.O.D (ppm)	6000	2000	600	300	26
ii. C.O.D (ppm)	18000	9000	1700	1000	250
iii. T.D.S (ppm)	20000	2000	600	250	90
iv. P.H	11-12	9-10	7-8	7-7.5	7-7.5
v. Flow (cu.m/Hr.)	60	40	-	-	180-225

17. Freeness of pulp :

Blow tank : 14-16°SR

Washed pulp : 19°SR

Bleached pulp : 26-28°SR

S.R. Box : 38°SR

Head Box : 58-65°SR

18. Finished product properties :

	M.G. Poster 44 gsm	M.G. 100 gsm	M.F. 58 gsm
i. Breaking length (MD /CD)	3800/2300	4000/2500	4700/2500
ii. Burst factor	12-14	12-13	16-17
iii. Tear factor	40-48	39-41	40-41
iv. Brightness	70-71	70-71	69-72
v. Opacity	81-82	96-98	82-84
vi. Ash	8-10%	12-12.5%	11.5-12.5%
vii. Bulk	1.53	1.30-1.33	1.37-1.39

20. Remarks & General observations:

i. Dilution in digesters is being done by fresh water.

ii. Fresh water is being used for bleached pulp washing, because of shortage of warm water.

iii. LRP, Method is not being used in general.

iv. Retention time of B/L in lagoon is approx. 45 days.

v. Average consumption norms -

a. Power - 1250 KWH / T of Paper

b. Water - 180-200m^3 / T of Paper

c. Steam - 6.0-6.5 T / T of Paper

vi. There are four boiler. Brief details are as follows:

I LIPI	II LIPI	III Thermax	IV Thermax
6 TPH	6 TPH	7 TPH	7 TPH
Bagasse/Pith	Husk/Pith	Husk/Coal	Husk/Coal
17.58 Kg/Cm^2	17.58 Kg/Cm^2	11.04 Kg/Cm^2	17.58 Kg/Cm^2
6-7 Kg/Cm^2	6-7 Kg/Cm^2	6-7 Kg/Cm^2	6-7 Kg/Cm^2

vii. General process flow diagramme, Effluent treatment flow diagramme and a water balance are enclosed.

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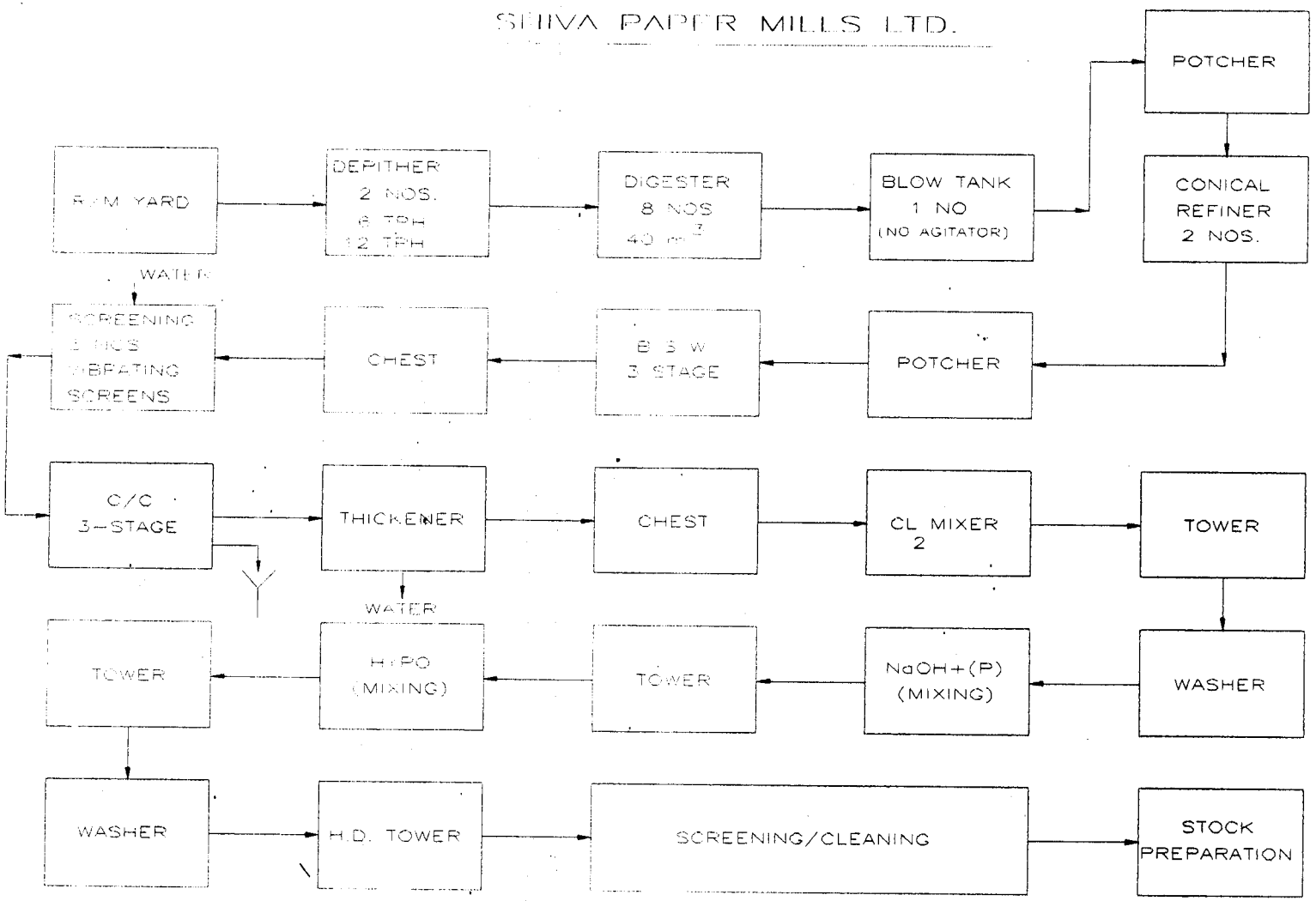
FLOW DIAGRAM

SHIVA PAPER MILLS LTD.



BANWARI PAPER MILLS
KASHIPUR

MEETING WITH : MR. JASVIR SINGH - M.D
MR. GUPTA - G.M. (FINANCE)
MR. MURLI YADAV - W.M.
MR. O.D. TYAGI - PULP MILL.

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1. Location of the industry	:	Kashipur - Ramnagar Road Kashipur. (About 4 Km. from Kashipur)
2. Product	:	Unbleached kraft paper. gsm - 80 to 180
3. Capacity	:	30 TPD
4. Raw materials	:	Bagasse, Hessian & Waste paper. Bagasse pulp is about 85% of furnish.
5. Pulp Mill Capacity	:	30-32 TPD
6. Pulping process	:	Soda process.
7. Raw material handling	:	Bagasse, Dry depithing.
8. Digester's House	:	$40m^3$, 5 Nos. No lye mixer. Feeding by conveyor.
9. Cooking conditions	:	
i. Cooking Chemicals	:	8.5 - 9.0% on O.D. raw material.
ii. Time to temp.	:	1.0 Hrs.
iii. Temperature	:	155-160°C.
iv. Pressure	:	6.0 - 6.5 Kg/Cm^2
v. Time at temp.	:	4.0 Hrs.

vi. Blowing	:	0.15 - 0.20 Hr.
vii. Yield	:	47-48%
viii. K.No.	:	17.5 - 18.0
ix. Blowing system (Blow tank is under construction)	:	In Potcher
10. Washing, Screening & Cleaning.	:	Two stage washing in potcher. Machine back water is being used for washing. Vibrating screen & three stage Centricleaning.
11. Black liquor volume	:	Not measured. Only, inlet flow to ETP is estimated as 55-60 lit/sec. (4750 m^3/day.)
12. Concentration of Black Liquor	:	1 - 2% (Estimated).
13. Finished product	:	
Burst factor	-	20+
Cobb	-	30-32

14. Remarks & General Observations:

i. There are two nos of boilers. But old boiler is remained shut. Only new boiler is operating. Pith may be burn in old boiler. At present, they are not burning pith.

ii. Chemical consumption on the basis of finished paper:

Rosin - 0.1%

Alum - 4.5%

iii. Fresh water or machine back water is being used for dilution in digesters.

iv. Mr. Gupta informed that management of Banwari Paper Mills Ltd., have done some work on the concept of centralised recovery plant. They included one more paper mill, to achieve 50 TPD pulping capacity.

v. One blank questionnaire left with Mr. Tyagi and Mr. Yadav. They required some time to complete it.

vi. No estimation about general consumption norms of power & steam.

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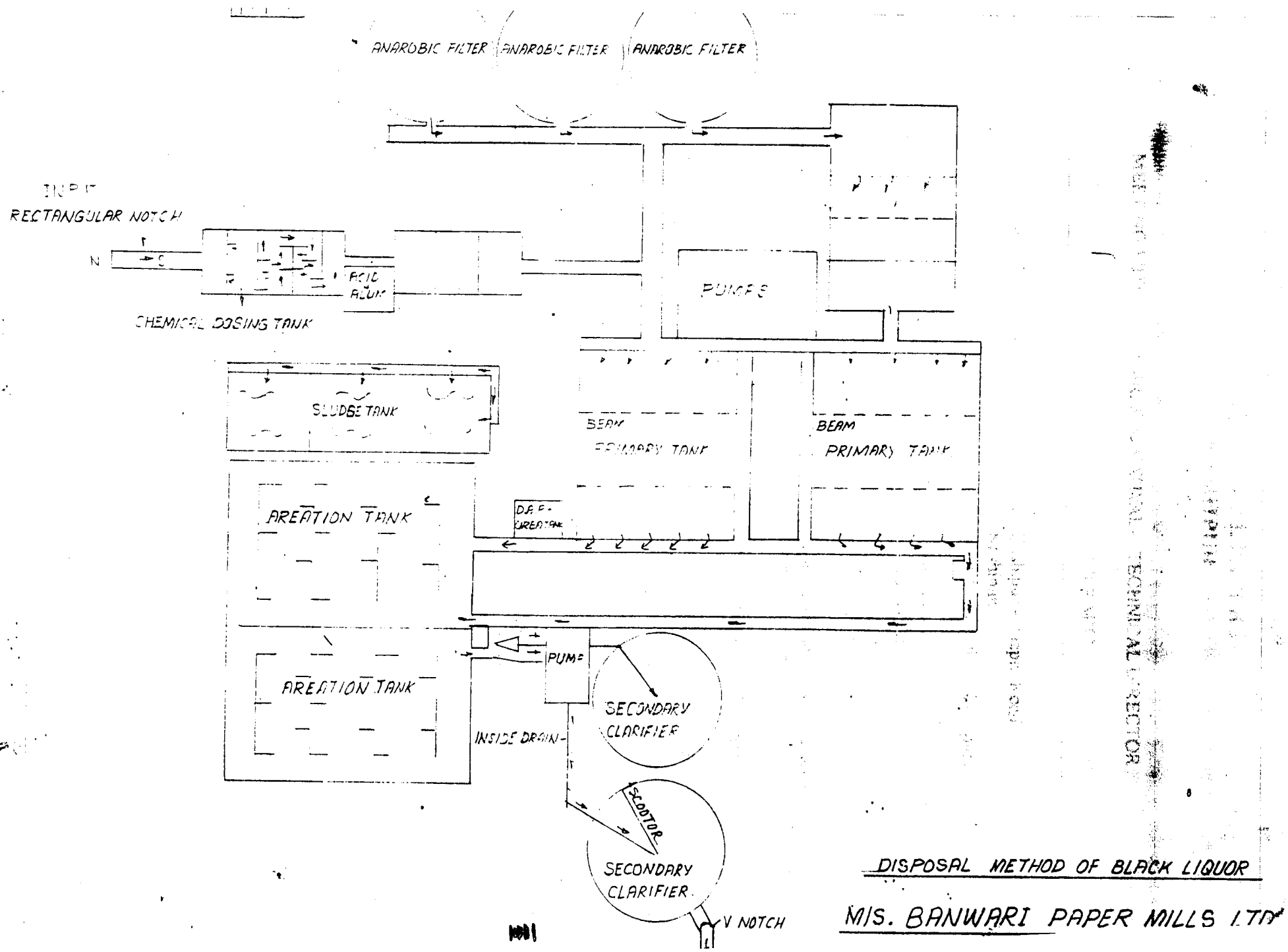

DISPOSAL METHOD OF BLACK LIQUOR

M/S. BANWARI PAPER MILLS LTD

MULTIWAL PAPERS
KASHIPUR

MEETING WITH : MR. K.K. KATIYAL - TECHNICAL DIRECTOR
MR. KUNDU - G.M.
MR. SHARMA - PULP MILL

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1. Location of the industry	:	Kashipur - Bazpur Road Kashipur. (About 9 Km. from Kashipur)
2. Product	:	Kraft paper 80 - 180 GSM
3. Capacity	:	30 TPD
4. Raw materials	:	Bagasse, Wheat straw, Old hessian bags, Imported waste paper. Total agriculture residue pulp - 85%. Waste paper / Hessian bags pulp - 15%.
5. Pulp Mill Capacity	:	30 TPD (Production - 800 T/month)
6. Pulping process	:	Soda process
7. Raw material handling	:	No depithing. Straight feeding to digester from raw material yard by belt conveyor. No lye mixer.
8. Digester's House	:	$40m^3$, Rotary type digesters.
9. Cooking conditions	:	
i. Cooking Chemicals	:	10-12% on OD. Raw material.
ii. Temperature	:	160-165°C.

iii. Pressure	:	6.5 Kg/Cm^2
iv. Time to temp.	:	2.30 Hrs.
v. Time at temp.	:	3.0 Hrs.
vi. Blowing	:	In Potcher.
vii. Yield	:	48 to 50%
viii. K.No.	:	18-20
10. Flow Sequence	:	Enclosed as block diagramme.
11. Washing, Screening & Cleaning	:	Single stage. potcher washing system. Machine back water is used for washing. Vibrating screens.
12. Black liquor volume	:	25-30M^3 / T of Pulp. (Estimated)
13. Concentration of Black Liquor	:	4-5% (Estimated)
14. Freeness of pulp	:	
Washed pulp	:	15°SR
After DDR	:	32-33°SR
S.R. Box	:	36-38°SR
Head Box	:	50-53°SR
15. Finished Product	:	
Burst factor	:	20-22
Tear factor	:	48-52
Double fold	:	4-5
Cobb	:	32-45
gsm range	:	80-180

16. Remarks & General Observations:

i. There are two husk fired boiler. One is 6 TPH & other is 10 TPH. Only 6 TPH boiler is in operation.

ii. In digesters, steaming time is more because of shortage of steam.

iii. General consumption norms :

Power - 750 Unit / T of Paper

Steam - 4.5-5.0 T / T of Paper

Water - 120-130m^3 / T of Paper

iv. Hessian is cooked mildly, & then mixed with Bagasse pulp after sufficient beating. No refining of Hessian pulp.

v. General flow for effluent treatment plant -

Pond - Primary clarifier - Aeration tank - Sec. clarifier - Discharge.

vi. No fibre recovery from machine back water.

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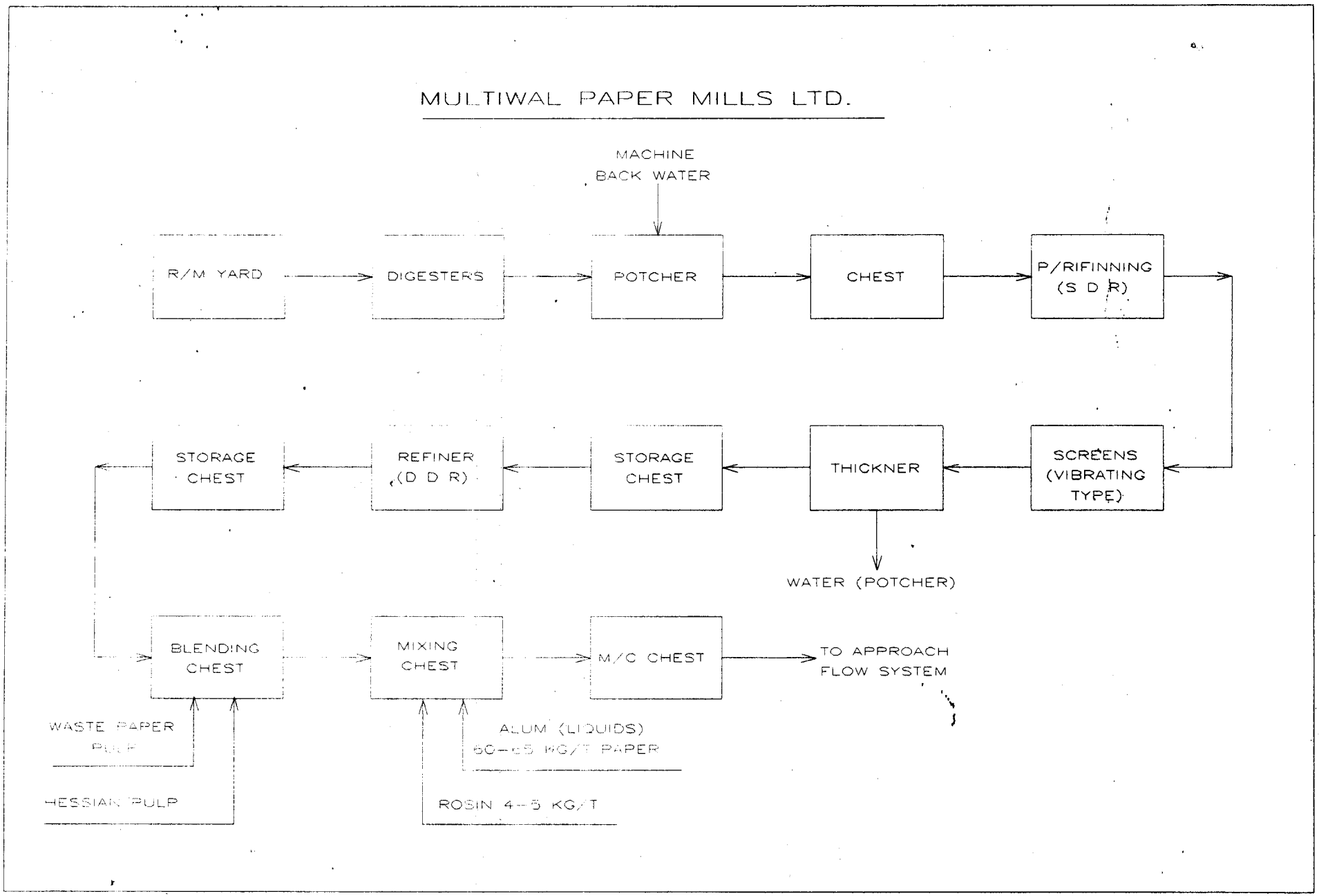
MULTIWAL PAPER MILLS LTD.



VISHVAKARMA PAPER & BOARDS LTD.
KASHIPUR

MEETING WITH : MR. ARVIND GOEL - DIRECTOR
MR. R.K. TYAGI - PRODUCTION MANAGER

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1. Location of the industry	:	Kashipur - Ramnagar Road (About 4.5 Km. from Kashipur)
2. Product	:	Unbleached, kraft paper.
3. Capacity	:	15 to 20 TPD
4. Raw materials	:	Bagasse, Wheat straw, O.C.C.
		Agri. residues pulp - 75%.
		Hessian & O.C.C. - 25%.
5. Pulp Mill Capacity	:	10-12 TPD
6. Pulping process	:	Soda process
7. Raw material handling	:	Straight from raw material yard to d igesters by belt conveyor.
		No depithing.
8. Digester's House	:	$40m^3$, 3 Nos.
		No feeder.
		No lye mixer.
9. Cooking conditions	:	
i. Cooking Chemicals	:	8.5%
ii. Temperature	:	150-160°C.
iii. Pressure	:	6.0 - 6.5 Kg/Cm^2
iv. Time to temp.	:	1.3 - 2.0 Hrs.

v. Time at temp. : 4.0 Hrs.

vi. Yield : 40%

vii. K.No. : 16 -17

10. Flow sequence : Block diagramme of process is enclosed.

11. Washing, Screening & Cleaning. : Single stage potcher washing.

Drum size - 6 feet.

Machine back water and water from Decker thickener is used for washing.

Beater is used for Hessian pulp.

Vibrating screen and centri- cleaners are used for pulp cleaning.

12. Black liquor volume : No estimation.
(They have informed on the basis of material balance in digester).

13. Concentration of Black Liquor : 1% (Estimated)

14. Finished product :

Burst factor - 20-24

Cobb - 35-45

G.S.M range - 80-140

15. Remarks & General Observations :

i. One husk fired boiler.

ii. Flow sequence of effluent treatment :

Setling tank - Primary clarifier - Airation tank - Sec. clarifier - O/F (Discharge)

U/F

Send filter - sludge

Filtrate to setting tank.

iii. One depither of 12 TPH is under consideration.

iv. Management is very interested to find out any economic method for black liquor treatment.

v. Black liquor from potcher washer is being used for dilution in digesters.

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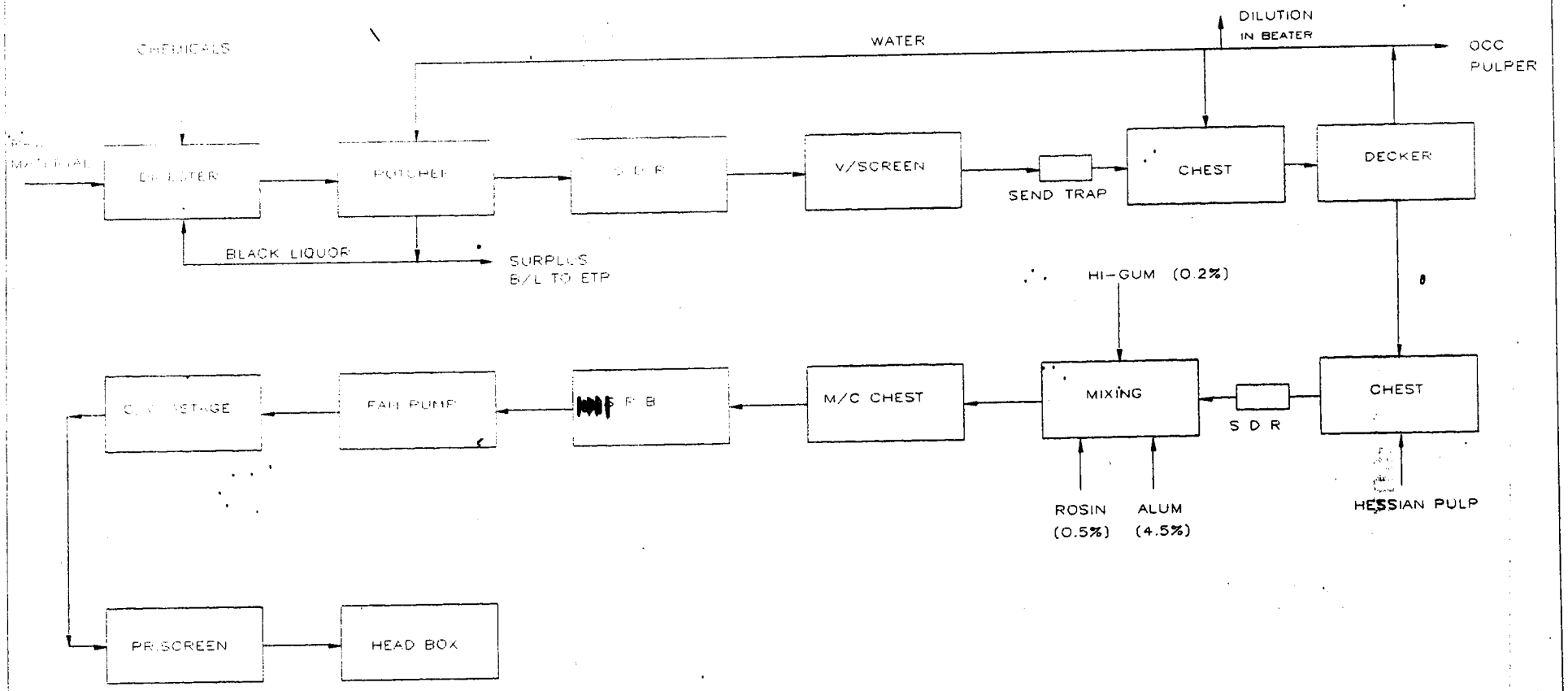
ISHWARNIA PAPER & BOARDS LTD.



CHADHA PAPER MILLS
BILASPUR

MEETING WITH : MR. M.S. KANWAR
VICE PRESIDENT (WORKS)

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1. Location of the : Chadha Estate
Nainital Road
Tehsil Bilaspur
Rampur.
(About 85 Km. from Kashipur)

Only general informations could collect. Mr. Kanwar was about to leave for Bombay, and he suggested to collect various process details, after analysing the informations given in questionnaire. A blank questionnaire left with him. At present they are making 60 TPD Kraft Paper using bagasse as main raw material with rotary type digesters,potcher type washing system.

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CHEEMA PAPER MILLS
BAZPUR

MEETING WITH : MR. DARSHAN SINGH
PRODUCTION MANAGER

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1. Location of the Industry	:	2 KM Stone, Bazpur Kashipur Road, (About 25 KM from Kashipur).
2. Product	:	Unbleached kraft paper. (GSM - 80 to 180)
3. Capacity	:	30 TPD
4. Raw Materials	:	Bagasse, Waste Paper, Rice Straw (Very Less)
5. Pulp Mill Capacity	:	30 TPD
6. Pulping process	:	Soda
7. Raw Material Handling	:	Dry depithing of Bagasse. Feeding by Conveyor. No Lye Mixer.
8. Digester's House	:	$40M^3$, 5 Nos. $30M^3$, 1 No. Caustic Mixing by separate line at the time of bagasse feeding in the digester. No rotary feeder.

9. Cooking Conditions

i. Cooking Chemicals	:	8.5% on O.D. Raw material.
ii. Time to Temp.	:	2 Hrs.
iii. Temperature	:	160°C
iv. Pressure	:	6.0 Kg/cm^2
v. Time at Temp.	:	3.30 Hrs.
vi. Blowing	:	0.15 Hrs.
vii. Yield	:	56%
viii. Blow Tank	:	Being used
ix. K.No.	:	16-18
x. Total Cooking Cycle	:	8.00 - 9.00 Hrs.
10. Flow Sequence	:	Pulp Mill Flow diagramme is enclosed.
11. Washing, Screening & Cleaning	:	Junk Box, after blow tank.
		Two stage washing in potcher but some time only single stage used (second stage by passed).
		Machine back water is used for washing, in second stage some quantity of fresh waster is used.
		Vibrating type screens are used after refiners.
		3-stage centricleaning after screening.
12. Black Liquor Volume	:	55-60M^3/T of pulp.(This is estimated on the basis of total volume of effluent).
13.Cone^n. of Black Liquor	:	1.5 - 2.0% (Not measured, only estimation)

14. Freeness of Pulp : Blow Tank - 18-20°SR
Washed Pulp - 22°SR
S.R.Box - 35-38°SR
Head Box - 40-45°SR

15. Finished Product : Breaking Length - No testing
Burst Factor - 23-24
Tear Factor - 55-60
Cobb - 30-35

16. Remark & General Observations

i. There is no regular measurement of water/black liquor properties. Water addition/ removal is being done only by observation.

ii. Two nos. of boiler, husk fired, 10% pith m ay be mixed. Total steam generation capacity is about 14 TPH.

iii. Paper breaks, due to sudden vacuum drop in suction box (2-3 times in a shift).

iv. Krofta is not working properly.

v. Approximate consumption norms.

Power consumption - 800 Unit/T of paper

Steam Consumption - 5-5.5T/T of paper

Water Consumption - No estimation.

vi. Block diagramme for process & effluent treatment plant is enclosed.

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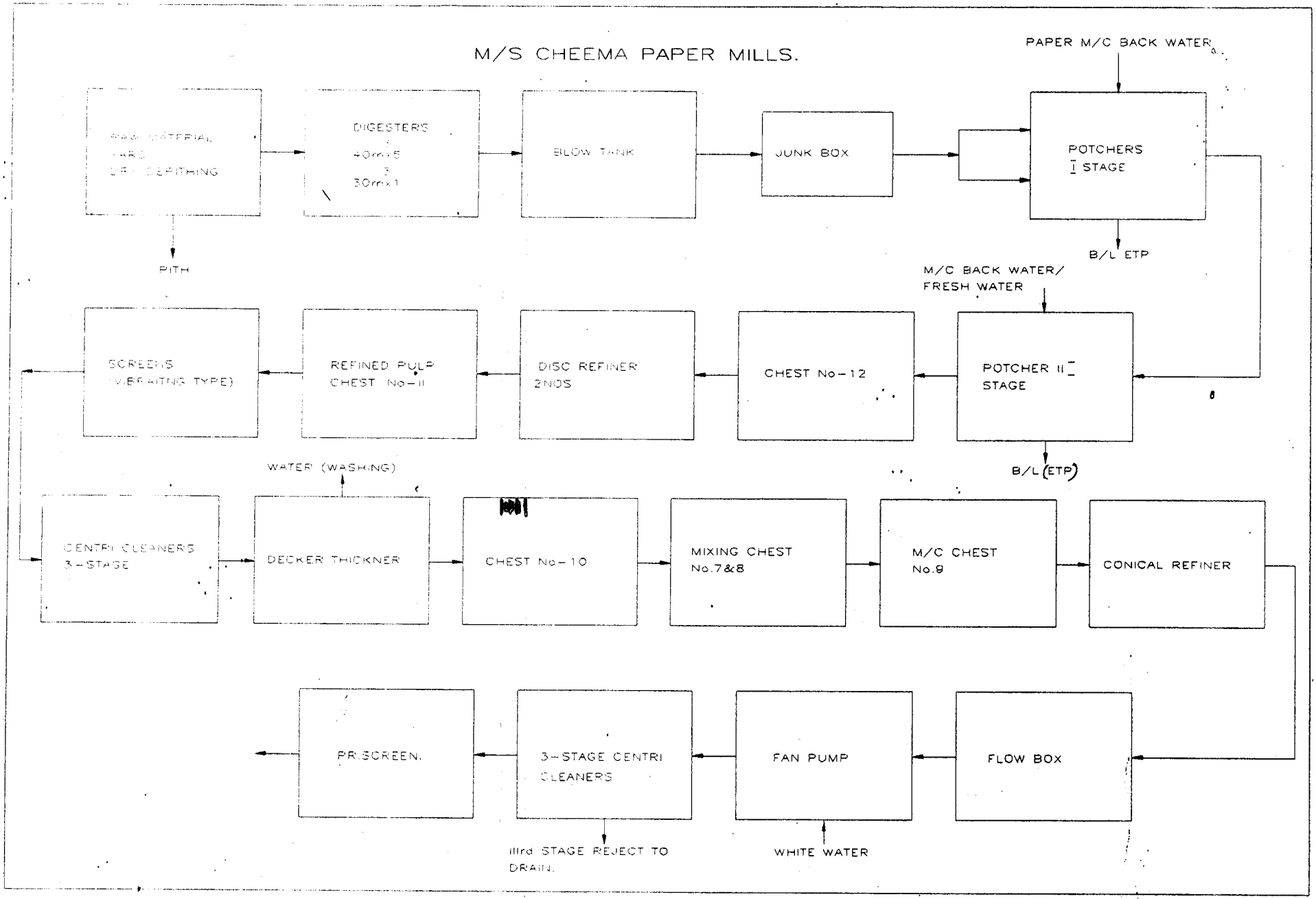
M/S CHEEMA PAPER MILLS.



SHREE SHYAM PAPER MILLS LTD.
KASHIPUR

MEETING WITH : MR. K.K. KATIYAL
TECHNICAL DIRECTOR

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1. Location of the Industry : Kashipur
(About 4.0 Km from Kashipur, on Station Road)

This plant is in final stage of erection. About 70% work of paper machine is completed. In first phase, they are planning to produce unbleached kraft paper, but for bleaching process, provisions are provided in building. Production is expected to start by the end of Jan. 97.

2. Capacity : 60 TPD

3. Raw material : Agriculture residue, Hessian & waste paper.

4. Digester House : 60M^3 Digesters.

5. Flow sequence : Flow diagramme for process & effluent treatment are enclosed.

6. Some details about Paper Machine :

Deckle	-	3.0m Finished
Designed Speed	-	225 MPM
GSM Range	-	80-180
Press	-	Two Straight Press with one reverse press.
Pre-dryer	-	11 Nos.
MG Cylinder	-	14 Feet dia
Post Dryer	-	7 Nos.

7. Remarks & General Observations

i. Mr. Katiyal informed that they are planning to install belt press after modification.

ii. Capacity of pulp mill is about 60-70 TPD, and therefore, it may include in the concept of centralised recovery plant.

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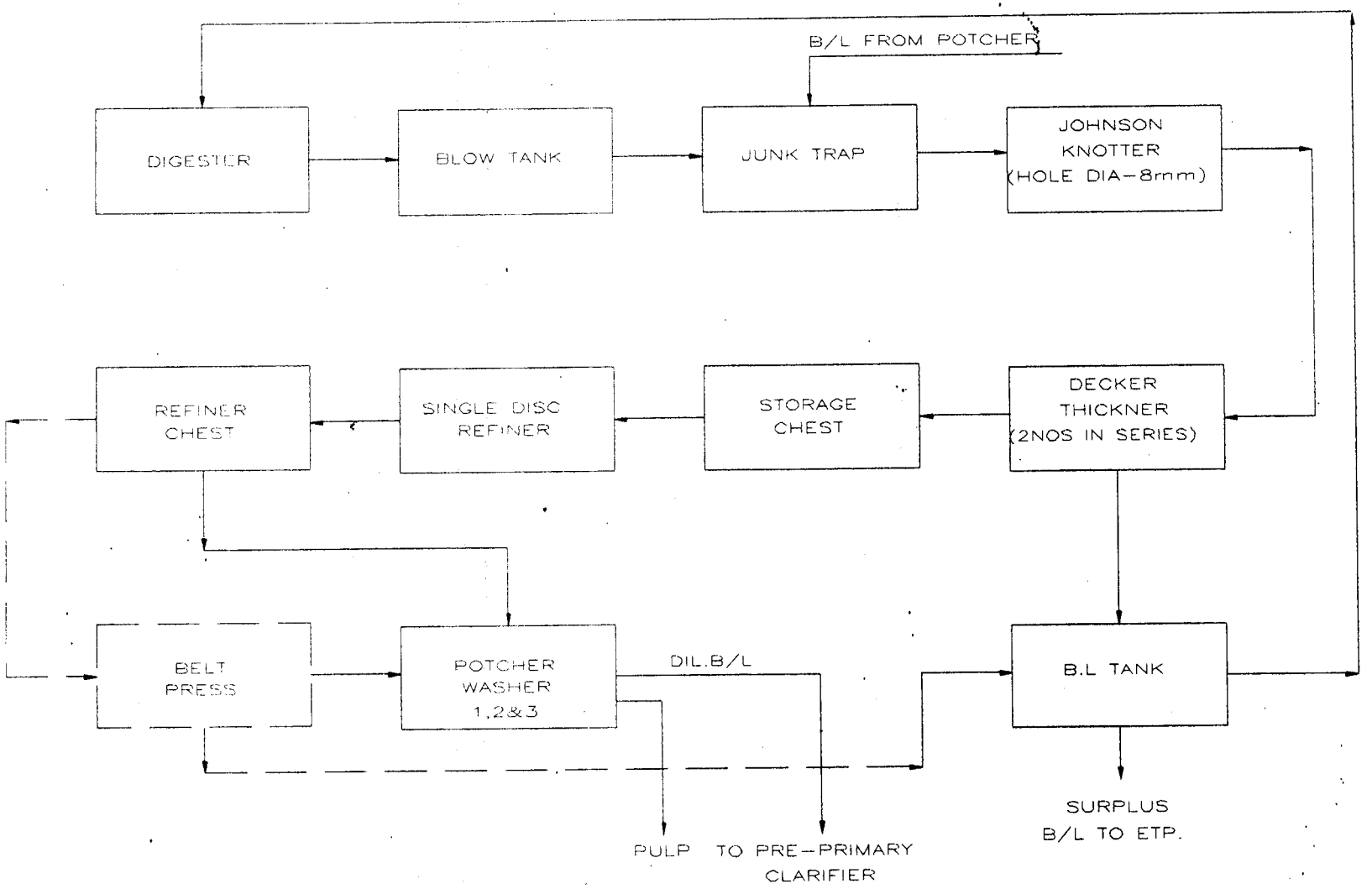
SHRI SHYAM PAPER MILLS LTD



SHRI SHYAM PAPER MILLS LTD.
(EFFLUENT TREATMENT PLANT)