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UGANDA

Technical report: Rehabilitation Study of Paper Machines No.1 and No. 2*

Prepared for the Government of Uganda
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of P. Rajasekhara, pulp and paper mill engineering consultant

Backstopping Officer: M. Farah, Industrial Management and Rehabilitation Branch

United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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A.1.01 OBJECT OF THE MISSION

The expert has been assigned by UNIDO, Vienna to assist PAPCO Industries in Uganda, to optimise the operation of the pope reeler purchased recently, and to train the mill personnel for its' operation.

The main object of the mission has been to assist the PAPCO (PULP AND PAPER COMPANY) and U.D.C. (UGANDA DEVELOPMENT CORPORATION) personnel to prepare a rehabilitation programme to increase the production of paper machine No. 1 which is in operation and a Feasibility study for the completion of erection and commission of paper machine No.2 for bank-loan purposes.

The duration of the mission has been one month for the completion of the above jobs including travelling time and report writing. However, since the work load was enormous and it was out of bounds to complete it with in a month, the Consultant had to stay an additional period of 16 days in the mill site after intimating the UNDP in Kampala and the mill management. The assignment started on April 17, 1988 and completed on June 1, 1988 including two weeks of extension.

Further 5 weeks have been utilised to collect and compile data to write the report on rehabilitation of PM1 and PM2 and their viability of operation.

A 2.01 SUMMARY OF THE MISSION

As assigned the expert completed the tight schedules of work despite the time barrier was a major concern. In addition, further jobs were carried out at the request of the mill management concerning several operating problems of PM1, like paper quality, reduction of fibre

losses. improvements on operational efficiency mill maintenance, reconfiguration of operational setup, positioning of stock consistency regulator, on line PH monitoring facility and so on.

Further to the completion of stipulated jobs a rational approach to set up an industry which can meet the countries requirement of paper, has been initiated and discussed in greater length with the authorities. Particular attention has been drawn during the discussion to use the most economical fibre for paper making in the initial stage and subsequently to explore the possibility of utilising indigenous raw material for pulp and paper making.

The consultant expresses his sincere gratitude to :

Dr. S. Tumwine, Minister of Industry & Technology.
Mr. A. Katumba, Permanent Secretary, Ministry of Industry & Technology.
Mr. T. Langoya, Commissioner of Industry.
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Mr. R. Nyakabwa-Atwoki, Ag. Chief Engineer, PAPCO, Jinja.
Mr. F. Rwegyema, Ag. Production Manager, PAPCO, Jinja.

and to all the staff members of PAPCO Industries Ltd., Jinja for extending their valuable assistance during the assignment and making the mission successful.

A.3.01 SYNOPSIS OF THE ESTABLISHMENT

The PAPCO industries is the only paper industry in

Uganda established in 1967 with one paper machine as a Joint venture between the Uganda Development Corporation (UDC) and an Asian Family. With the departure of the Asian Family in 1971 the UDC assumed responsibility to operate this mill as a Government enterprise. The second paper machine was bought in 1971 to diversify the quality of paper and to increase the production capacity of the mill.

Both paper machines were brought second hand and reported to have an annual installed capacity of 3600 tons each under optimum running conditions.

The machine No. 1 is designed to produce writing printing and wrapping grades of paper and machine No. 2 is supposed to produce kraft and M G grades of paper.

The operating facilities of the mill includes stock preparation, paper making, finishing equipment and a moderate work shop. The utilities includes direct supply of process water from the river Nile, low pressure steam generating unit, power supply from public grid through a step-down transformer and a mobile air compressor. The electrical characteristic for PM I is 415 Volts, 50 Hz 3 phase and for paper machine No.2 is 550 Volts, 50 Hz 3 phase.

The machine No. 1 is reported to be originally built in 1901 by K. M. W. Sweden and operated in the same country until purchased by PAPCO IND. in 1967. The machine No. 2 is said to be originally built in 1906 by Escher wyss West Germany and was installed and operated in Tenero paper mill Switzerland until purchased by PAPCO IND. in 1971. Since then, the half erected PM 2 is lying idle in the mill premises.

The details and the prospects of this machine is dealt separately in the later part of this report.

The mill has been reported to be looted thrice in the past years, during the period of war of liberation in 1979 and other civil disturbances in 1985 and 1986. Number of items have been found missing from their operating positions and from stores after these upheavals. As a result the mill has suffered a significant loss and operating set back.

Over the years few crucial parts of the paper machine, stock preparation and finishing equipment have been replaced with the financial assistance of UNIDO to make the plant operative. Number of laboratory equipment for quality control have also been provided.

A.3.02 **LIST OF MAJOR REPLACEMENT AND ADDITION OF EQUIPMENT IN THE PAST YEARS.**

1) Refiners (Disc & Conical).
2) Stock Consistency regulator.
3) On line PH metre and recorder.
4) Paper machine Head box.
5) Suction couch roll and vacuum pump set up.
6) Felt conditioning system.
7) One set of calender rolls.
8) Paper reel with thyristor drive and controls.
9) Simplex sheet cutter - Jogenberg.
10) Guillotine.
11) Few pumps and motors.
12) Steam flow metre.
13) Flat knife grinder.
14) Circular knife grinder.
15) Lathe machine.

SECTION 1

B.1.00 REHABILITATION STUDY OF PAPER MACHINE No. 1

Following are the existing operating facilities of paper machine No. 1

B.2.00 STOCK PREPARATION

B.2.01 HYDROPULPER : (Volume 5 M3)

This unit has not been in operation for years due to mechanical problems as reported. Excessive heat is being developed with its' drive pulley resulting failure of V-belts. Needed modification has been recommended to overcome this draw-back.

B.2.02 REFINING :

Originally there were five hollander beaters in operation, each connected with 75 KW motor for refining wood pulp and waste paper. One of the beaters has been recently replaced with a single disk refiner unit since the beaters are completely worn out to impart any refining effect on the pulp. However, the other four beaters are still in operation as pulp slushers in the absence of hydropulper.

The management has been recommended to put the hydropulper in to operation and to dismantle all the beaters to make space to install a second disk refiner and two conical refiners which are in stores. This will provide ample flexibility and stand-by capacity for pulp refining. A schematic diagram for the hook up of these units has been prepared and given to the management for execution.

Please refer Annex. DG. 4-1

B.2.03 SCREENING :

A conventional sand trap is the only screening system that is being used to arrest heavy materials from pulp stock before the machine head box. Since the performance of this system is inefficient and no material worth noting has been arrested after days of observation, it has been suggested to dismantle the sand trap and to resume operation of centricleaners which are abandoned for years. A detail diagram with new set up has been provided to help implementing this system.

Please refer Annex. DG. 4-3

B.2.04 CONSISTENCY CONTROLLER

Details for hooking up a new consistancy controller that existed in the stores has been provided. Proper operation of this set up will ensure to have a steady basis weight of paper.

A simple modification to the existing flat bottom flow box has been suggested to help regulating steady flow of stock to the machine.

Please refer Annex DG. 4-2

B.3.00 WIRE PART

B.3.01 BACK WATER PH METER

A detailed schematic diagram has been provided to install electrodes for continuous indication of machine back water PH. This set up will help to maintain a steady PH by controlled dosage of alum solution.

B.3.02 **MACHINE HEAD BOX :**

It is suggested to reinstall the rectifier roll in the machine head box after correcting the fault with its gearbox. Operation of this roll will help in achieving improved web formation and reduced breaks.

B.3.03 **WET END VACUUM SYSTEM :**

Increase of pipe line dia. of the vacuum connected between suction couch and vacuum pump has been suggested to improve the vacuum on suction boxes and suction couch.

Also it has been recommended to incorporate a vacuum separator tank complete with water discharge pump before the vacuum-pump. This set up will prevent the fibre and filler entering the rotor of the vacuum-pump and thereby grossly reducing the wear and tear of the pump.

B.3.04 **BACK WATER FILTER (THICKENER)**

The plant is being operated with open back water circuit loosing substantial quantity of fibre. The management has been urged to operate the back water filter which is idling in the mill for the last 16 years. A diagram has been prepared for a closed backwater system and given to the management for execution. Preparations are being made to put this filter into operation. Strict control on back water spillage and proper operation of back water filter will substantially reduce the fibre losses. From the available data it is clear that over 40% of the fibre is being lost in the drain during machine operation.

Please refer Annex. DG. 4-4

B.3.05 **FIBRE RECOVERY**

Random check up of material balance of the paper production reveals that the fibre losses through the system is enormous. It is suggested that the Company must take immediate action to construct and to operate the crucially needed fibre save all. The construction cost of the unit will soon be paid off if it is properly used during mill operation. A schematic diagram with design specifications has been prepared and given to the management for further action.

Please refer Annex. DG. 4-5a, 4-5b

B.4.00 **PRESS PART**

B.4.01 **FELT CONDITIONING**

It is suggested to hook up felt conditioning system to the 2nd plain press and 3rd reverse press felts. Installation of uhle boxes together with felt cleaning showers on the appropriate side of the felts and using them with adequate vacuum will help keeping the felts clean and dry which in-tern assist to obtain improved dryness of paper web. (Felt conditioning system prevails on the 1st plain press felt).

Further recommendation is made to independently connect the existing old vacuum-pump (presently idling) to the felt conditioning system allowing the new vacuum-pump to operate only for suction boxes and suction couch. The new set up should improve the overall performance of the machine wet end.

B.5.00 **DRYER PART**

B.5.01 **PAPER DRYING**

This section consists of 11 paper drying cylinders and 1 cooling cylinder of 1200 mm dia each, all set in one straight row. These dryers are split in to 7 drive groups of two cylinders each and are independently driven with an exception of last two cylinders which are driven separately. Each group is felted and incorporated with a felt dryer.

The last but one cylinder in the row is a cooling cylinder made out of copper body and the last one is a regular paper dryer. Both of them are reported to be not in operation for several years due to mechanical failure. However, the management has been suggested to interchange these two cylinders to locate the cooling cylinder at the last position of the row. Operating both these cylinders, one as a dryer and another as a cooling cylinder, will enhance the overall drying capacity of the group and to condition the paper web before the calender stack. Sheet cooling is essential for better calendering effect to produce smoother paper. The engineering staff of the company has been acquainted with the necessity to hook up pressurised air along with the water supply to the cooling cylinder. This will ensure for an effective and continuous evacuation of water from the cooling cylinder. The air pressure should be regulated to maintain approx. 0.5 Kg/cm^2 lower than the water pressure.

Further recommendation has been made to replace the present conventional dryer felts with synthetic dryscreen, by-passing all the felt dryers. This change should improve the overall drying capacity of this section. In other words it will be more economical in terms of steam consumption per ton of paper.

B.6.00 CALENDERING

B.6.01 CALENDER STACK

It is a six roll calender stack incorporated with manual loading mechanism. Presently the unit is operating with only four rolls without additional loading. The mill has a new set of calender rolls which can be used to replace the present worn out rolls. However, only four new rolls should be used since one of the new rolls has been damaged in the transportation. It is suggested to arrange regrinding the worn out rolls. It should be noted that not to use the new rolls in combination with the worn out rolls.

The fault with the calender loading mechanism and with the drive clutch system of the unit should be rectified to use them during operation. The management has been recommended to reinstall the calender cooling system which has been dismantled. Regulated operation of this system will help maintaining uniform smoothness across the width of the paper.

B.6.02 POPE REEL

This has been newly installed with its' independent thyristor drive to operate in conjunction with the line shaft. It is reported that excessive broke is being generated while passing the paper through this unit. After checking the installation, it is suggested to relocate its' pneumatic and electric panels by the side of the unit from the present for-off positions. A suitable place has been ear-marked for the new location, from where the operator can effectively control the feed, draw and tension of the paper web. This must prevent the undue generation of broke at this unit.

Additional recommendation has been made to provide 6-8 high pressure air nozzles along with the doctor blade of the pope reel for operational facility. Effective use of these air nozzles will greatly assist in quick winding of web to the paper spool during breaks and change over of paper jumbo reels.

B.7.00 DRIVE SYSTEM

B.7.01 MACHINE DRIVE

The machine drive is equipped with a Leonard converter unit and driven by a D.C. motor - line shaft combination. Power transmission to the groups is carried out through friction wheel system. This antique drive system cannot be improved unless the entire configuration is replaced. However, any drive system of present design is not worth installing on this machine at its' present status.

C.1.00 FINISHING EQUIPMENT

C.1.01 SLITTER REWINDER

This is a Voith manufactured unit designed to process paper rolls of 2420 mm trim width to produce a maximum 800 mm dia. rolls.

Similar to the paper machine, this unit is also very old with its' limited accessories to operate in the mill. The drive of the rewinder poses constant problem which cannot be rectified due to non-availability of spare parts. The overall performance of this unit is precariously low.

A new slitter rewinder of 2.6 metre wide and new paper spools are essential to cope with the full production of machine No. 1 and future machine No. 2.

C.1.02 **SHEET CUTTER**

The recently purchased "Jagenberg" simplex cutter with it's 8-roll back-stand assembly has a maximum capacity to process around 24 tons a day on a sustained operation. The machine is capable of cutting sheet web up to 300gr/m² under ideal operating conditions. The unit is equipped with expandable shafts for easy insertion of shafts into paper rolls.

However, additional mechanisation is necessary for quick loading of paper rolls to the back stand to achieve efficient through put. A monorail with half a ton electric hoist assembly is recommended to install along with the central axis of the cutter to improve its' performance.

Following are the Technical specifications of the sheet cutter.

Make	: Jagenberg W.Germany
Maximum trim width	: 1450 mm (2 lay boy)
Maximum speed	: 100 m/min (without overlapping)
Maximum load cut	: 500 grs. (300 grs normal)
Sheet length range	: 400 mm - 1600 mm
Maximum pile weight	: 1.6 M.T.
Connected power	: 20 KW

C.1.03 **GUILLOTINE :**

The recently purchased new guillotine in combination with one of the serviceable old guillotine are capable of meeting todays' market demand of small packets in standard sizes.

Following are the Technical Specifications of the guillotines :

	New	Old
Make	Wohlenberg W.G. type 115, programmatic T.	Sehneider-Senator W.G. type 106,
Cutting length maximum.	1550 mm	1060 mm
Height of pile maximum.	165 mm	120 mm

D.1.00 **ADDITIVE PREPARATION**

The mill is not properly equipped to prepare any of the additives needed for paper production. The essential chemicals and additives required to be used in the process are :

a. Filler
b. Rosin size
c. Alum solution
d. Starch solution
e. Dye stuffs
h. Brightener

The present practice of uncontrolled method used to prepare additives and their dosage system need to be standardised. Employing proper procedure for chemical

preparation and their regulated dosage will prevent enormous wastage of these expensive materials.

A schematic diagram indicating the ways and means to prepare and dose filler and alum solution has been drawn and given to the management for execution. Similar standardised system should be instituted for the preparation and dosing of starch, dye-stuffs and brightener.

Please refer Annex D.G. 4-6.

Referring to the rosin size, it is essential to procure equipment for its' preparation to replace the present practice of mixing melted raw rosin with the stock. The recommended equipment for size preparation is Bewoid system which is widely used in paper industry.

E.1.00 STATUS OF THE PAPER MACHINE No. 1

From the start up of this machine in 1967, it is reported to be running under severe stress due to many local problems. The production has been continuously hampered due to lack of raw material, chemicals and financial difficulties for all through the years.

Besides its' bad production status, the operating condition of the machine is very precarious. It is very sad to notice the poor maintenance or no maintenance for years on the machine. This could be attributed for lack of availability of maintenance material from the local market and inadequate initiative.

It is evident that substantial maintenance work is due for both electrical and mechanical sections of the plant. In the interest of the company, it is highly advisable to get the services of an engineer having good

experience in pulp and paper mill operations and their maintenance to plan out the jobs and to complete them within a scheduled period on a crash basis.

However, to ease the situation details of short and long term measures required to be carried out in the plant has been explained in Annex No. 1 and 2.

E.2.00 **PRODUCTION DATA OF PAPER MACHINE No.1**

Having a built in capacity to produce 3600 tons of paper per year, the Company has achieved only the following production levels in the past years.

Year	Finished Prodn. MT	% of the capacity	Remarks
1978	315	8.7	No raw material
1979	---	---	No raw material
1980	197	5.5	No raw material
1981	196	5.4	No raw material
1982	153	4.2	No raw material
1983	301	8.3	Poor sales
1984	275	7.6	Poor sales
1985	383	10.6	No chemicals
1986	134	3.7	No raw material
1987	34	0.9	No raw material
1988 (Till 30 May)	111	3.1	No raw material
Yearly Average	190.8	5.3	

It is evident from the data that the Company has to take serious measures concerning major improvement about the runnability of the machine equipping it with basic necessities. In addition particular attention should be given for significant improvement on the quality of product, since the present quality is not comparable to any standards.

E.3.00 Review of the paper machine No. 1

The basic design of this machine from its' head box to pope reel, the paper making technology incorporated, the economy and efficiency of operation with its' production capabilities are totally outdated. Any attempt to modernise this machine by improving its' operating efficiency or product output will involve large sums and it is clearly foreseen that such investments cannot be justified.

The number of basic changes needed, time required and work involved to rebuild this paper machine will be enormous and it is not a practical solution to put efforts on this concept. Therefore it is a sincere opinion of the consultant to operate this machine as such in it's original form with due care and required maintenance, without any additional capital investment.

It should be noted that a new paper machine of compatible technology could be the only viable alternative for higher production of acceptable quality and to meet the country's increasing demand of paper.

E.4.00 PROSPECTS OF THE PAPER MACHINE No. 1

The following points are considered as very crucial and important to be noted by the "PAPCO" management for the operation of the machine.

1. It is very much needed to grossly improve the runnability of the machine.

2. Particular attention is required for :
   a. Maintenance for all equipment that is over due.
   b. Availability of mechanical and electrical spare parts
   c. Operating tools.
   d. Intensive on spot training for operating personnel

3. The required raw material, chemicals and operating amenities should be regularly made available for a stream line plant operation.

4. Material losses during the operation should be grossly reduced.

5. Input of chemicals should be metered based on standard calculations instead of the present practice of un-controlled excessive dosage.

6. Many areas of improper operating set up should be reconfigurated as has been advised.

7. Having done the recommended maintenance and the modification jobs in stock preparation, drying and calendering set up, the speed of the machine could be increased by approx. 15% reaching a maximum of 80 m/min.
   In other words the machine should be able to produce approximately 650 kg per hour or 14.5 tons of paper per day in 22 hours of operation.

   Maintaining a steady operation, it is possible to reach an annual finished production of 4250 tons regularly.

8. Due action should be taken to prevent the machine vibration by strongly securing the machine frames to its' foundation. It is advisable to check the dynamic balance of the drying cylinders at an increased speed for the safe operation of the machine.

9. It is foreseen that the prevailing utility services should cope up with the additional production of paper.

10. It is highly advisable to use secondary fibre by processing selected waste paper through deinking plant instead of the present practice of using the mixture of soft and hard wood virgin pulp in the paper furnish.

    A mixture of 70% - 80% of secondary fibre mixed with 20% - 30% soft or hard wood pulp in the fibre furnish can produce economical and acceptable quality of paper.
    Please refer Annex 3 for a brief description of deinking process.

F.1.00 **EFFLUENT**

The mill effluent is being discharged into the river Nile without any treatment at present. No tests of any sort are conducted to check the quality of effluent before discharge. However, the insignificant quantity of the effluent mixed with enormous flow of water (said to be 17000 M^3 per sec.) in the river cannot create any stream pollution as it stands to day.

Nevertheless, it should be born in mind to divert the course of the effluent to join the river current at the down stream of the pump house instead of the present

location of allowing it to join at the up stream before the mill pump house.

G.1.00 **LABORATORY**

The mill laboratory consist of the following test equipment for a routine control of operation and quality of paper. Some of the equipment and their parts were reported to be looted in the past years. However, they need to be replaced to make the laboratory operative.

Items	Status
1) One quadrant scale with template 20x20 cm. range 0-250 gr/m²	Available
2) One porosity tester (440) and smoothness tester (100).	A set of weights missing
3) One tensile strength and stretch tester range 3.5 Kg.	Available
4) Two freeness testers with sampling equipment.	one unit need to be repaired.
5) One MULLEN bursting strength tester.	pr. gauge missing
6) One electric oven for moisture testing	Missing
7) One portable electric oven for determining ash content.	Missing
8) One portable Lab. PH metre with electrodes.	Missing

9)	One precision Lab. weighing balance.	Missing
10)	One Lab. sheet former and dryer	Missing
11)	One pulp disintegrator	Missing
12)	One sizing tester type "Cobb"	Missing
13)	One folding endurance tester	Missing
14)	One ELMENDORF Tearing Tester	pointer missing
15)	Various glass-ware measuring flasks thermometers, density meters and miscellaneous test equipment.	Missing

A detail list with full specification require to be prepared for placing order.

A complete set of literature for testing procedure "TAPPI standard test methods" has to be procured.

H.1.00 **WORKSHOP FACILITIES**

The mill workshop constitute with the following facilities :

	Equipment	Status
1)	Lathe machines	New. In operation
	a. "Ajax"(1987) with 8" centre	
	b. Another one with 8" centre.	Old. In operation
2)	Circular Knife grinder (1984)	New. In operation

3) Flat Knife grinder (1982) by Honsa grinding machine.	New. In operation
4) Shaper machine by Invicitor England	Motor is needed.
5) Hydraulic puller heavy duty up to 15 tons.	New. In service.
6) Power saw	Old. In service.
7) Vertical drilling machine	Old. In service.
8) Tool grinding machine	Old. In service.
9) Hand grinding machine	New. In service.
10) Hand drilling machine	New. In service.
11) Electric welding machine	New. In service.
12) Gas welding machine	New. In service.
13) Roll grinding machine	Old. Burnt in a fire hazard. Need replacement of two motors & few sets of grinding tools; overhaul and realignment.
14) 3 very old lathe machines	Not functionable. Discorded.

I.1.00 **MATERIAL HANDLING**

The mill is equipped with one diesel operated heavy duty fork lift truck of 5.0T lifting capacity. This lift

truck needs certain spare parts to repair and to put back into service.

There are two hand pallet trucks in the mill. Both need spare parts to put them back into operation.

If the mill has to operate continuously with designed production levels, it will be necessary to reinforce this area with similar material handling equipment for a synchronised operation.

I.2.00 TRANSPORTATION

One of the most neglected areas of the PAPCO establishment is the transportation facility for mill personnel. The mill's one tilting truck and a pick up van is regularly used for the transportation of key -staff of the mill. The services of these vehicles are very unpredictable which seriously hampers the mill operation. The consultant wishes to stress that the authorities must give utmost importance to provide a regular and suitable means of transportation to all the mill personnel to cover the distance of approximately 4 Km. between the mill and the Jinja town. This facility should greatly help in the punctuality of all personnel and in the overall operation of the mill.

The present transportation of PAPCO consists of the following :

a. one "ISUZU" tilting truck.
   Old and unpredictable service due to excessive use and poor maintenance.

b. One "Toyota Hilux" pick up van.
   Old and unpredictable service due to excessive use and poor maintenance.

c. One "Sunny" saloon car.
Used by the General Manager of the company.

J.1.00 MILL PERSONNEL

As it appears the manning of the mill is not proper. There are excessive personnel in the operation sections without specific work designations. Unskilled labour are being excessively used for routine material handling. Simple mechanisation to carry out regular transportation jobs and incentive based work programme in certain areas should help to get the jobs done promptly and efficiently, using less than a half of the present work force. It is worthwhile that the management should take a fresh look at this matter with new ideas to improve the working calibre of the mill's operating crew and staff members.

In the interest of the company, it is essential to provide an intensive training for few technical personnel of PAPCO in the factories operating with identical products, to create a career oriented nucleus staff.

SECTION 2

K.1.00 FEASIBILITY STUDY FOR THE COMPLETION OF PAPER MACHINE No. 2

K.1.01 BACK-GROUND HISTORY

This is a second hand Yankee machine imported by PAPCO in 1971 with an intention to operate in parallel with machine No. 1 to produce Kraft and M.G. grades of paper.

It is a narrow width machine of 1.6 m. wide designed to operate at speeds ranging from 20 m to 140 m per minute.

As reported the machine can produce 7-12 tons per day in the basis weight range of 40-180 gr/m².

This machine is said to be a right hand machine as originally built and being erected in PAPCO as left hand machine with due changes and modifications to suit the requirement of the location.

Identical to paper machine No. 1, the design of equipment and technology involved for paper making on this machine is an age old system which does not correspond to any practices of recent years. The machine has been partially erected during the years 1972 to 1977 and no further progress has been made since then, due to series of domestic problems. Some of the erected equipment and parts ready for erection were looted and infiltrated over the years leaving the machine with many missing items to complete the erection work

K.2.01 **BASIC OPERATING FACILITIES PROVIDED FOR PAPER MACHINE No.2**

The machine consists of the following equipment and it's related auxiliaries.

One hydropulper, three deflakers, three conical refiners, sand trap, one vibrating screen, centri - cleaners, conventional open type head box, Fourdrinier wet-end with plain couch press, two plain presses, eight pre-dryers, one Yankee cylinder, four after-dryers, five roll calender stack, and a set of paper winders (originally a combination of on-machine slitter and winding spools vertically installed for parallel operation).

The machine is driven by 3 D.C. motor units synchronised with flat-pulley belt drive combinations. The D.C.

drives are powered through a Leonard D.C. generator unit

Note : For detailed specifications of the machine equipment, please refer to the Annex No. 5. This Annex also indicates the inventory of equipment, missing parts and present status of this partially erected machine.

As it appears from the available drawings the present set up of the first and second group drive units (58 HP each) and their driven parts are identical to the original design and operation of the machine. But the third drive unit (32 HP) is hooked up with an additional 4 paper dryers and 2 felt dryers along with the original Yankee cylinder, calender stack and winding spools. However, the original slitter unit is withdrawn from the assembly of this group. Nevertheless, it is necessary to recalculate the power required to drive this group.

K.3.01 RECOMMENDATIONS FOR ADDITIONS AND REPLACEMENT OF EQUIPMENT.

Besides the replacement of missing parts to complete the erection of the machine, the following additions and replacement of existing equipment is suggested to improve the operational economy and quality of product.

a. <u>Replacements :</u>

1. 3 stage centricleaning system complete.
2. Suction couch roll.
3. Vacuum pump complete.
4. Pope reel complete unit.
5. Back water filter complete unit.
6. Slitter rewinder complete unit with two back stands.
7. 5 pumps with motors and starters.
8. Pressure screen.
9. Additive preparation for Alum, Rosin and Starch.

b. Additions :

1. Two conical refiners complete units.
2. Air compressor.
3. Boiler water softening plant.
4. Preparation and storage of china clay solution, dyestuffs and brightener.
5. Instrumentation.
6. Paper spools.
7. Few laboratory equipment for quality control.

In addition to the above equipment, the requirement of a complete range of erection and workshop tools, electrical and mechanical hard ware, fabrication and construction accessories, at least two sets of machine clothings are foreseen for the erection and start up of the machine.

K.4.01 REQUIREMENT OF ERECTION AND COMMISSIONING ENGINEERS :

A team of about eight persons for a period of six months consisting approximately twenty four man months working in different periods has been foreseen to complete the work involved. This covers the pre-engineering work require to be done for placing orders for equipment, machinery and other supplies, completion of balance erection work including replacement, additions, complete electrical and instrumentation work, start up of machine and training the local operating crew.

Time schedule of erection and commissioning engineers.

Description	Duration	Man months
- One Chief coordinater (split period of 2 months and 4 months)	6 months	6.0
- One erector	3 months	3.0
- Four assistant erectors	3 months	12.0
- One electrical/instrument engineer (split period of 0.5 month and 1.0 month)	1.5 months	1.5
- One paper maker	1.5 months	1.5
Eight persons	--	24.0

The above team of engineers should have vast experience with the modification, erection and installation of paper making machinery and its' related equipment. Also it is essential that they have good knowledge about the start up and operation of pulp and paper mill.

It should be noted that the company should procure adequate quantity of raw material (different grades of pulp), chemicals and various operating supplies for start up and running the machine for at least 2 months period after start up.

Assistance of the local technical crew (including for civil jobs) will be needed to work with the foreign team to supplement the required labour force.

Additional expenditure for some local purchases of miscellaneous items, civil work, labour and the local living expenses for the foreign technical team should be paid in local currency. This total expenditure is estimated to be equivalent to around 250,000 US dollars at the present cost structure.

SECTION 3

L.1.00 RATIONAL APPROACH FOR A PAPER INDUSTRY TO MEET THE COUNTRY'S DEMAND.

Besides the ardent desire of PAPCO industries to put the paper machine No. 2 into stream line operation, the consultant wishes to express his opinion about the prospects of this machine.

Identical to paper machine No. 1, this is also almost a century old machine incorporated with an equipment design of out-dated paper making technology.

The cost intensive low output of the machine, through it's narrow deckle width can not contribute even 15% of the countries annual requirement of paper. Having put this machine into operation, the quality of the paper produced may turn out to be substandard similar PM-I product.

Unless, there is a sentimental attachment because of the existence of this half erected machine, it is not a viable programme for any additional investment to put this machine into operation.

Therefore it is a sincere opinion of the consultant that the management and the Government of Uganda should take a firm stand to put up a new paper machine having compatible technology to produce required quality and quantity of paper for their domestic use. It is highly desirable that the new paper machine should be capable of producing most of the commonly needed grades of paper estimated to be around 15000 tons per year. Certain qualities of products which are not very crucial to produce immediately could be introduced gradually at a later stage.

Considerable number of existing equipment of paper machine No. 2 can be solvaged out to use them else where.

Once the proposed new machine gets into stream line operation, the present staggering machine No. 1 can be shut down for good.

In the move towards a practical approach with an ultimate objective to establish an efficient industry, it may be reasonable to give a thought about procuring an used but reconditioned paper machine as a second alternative. This should be considered only in case raising funds for a new paper machine becomes a serious issue. The concept of second hand machine could work out at around 65% of the investment of a new machine.

L.2.01 **ESTIMATED INVESTMENT**

It is estimated that a complete new paper machine capable of producing approximately 15000 tons of finished paper per year will be costing in the range of 16 to 17 million US dollars based on today's cost structure. This cost includes all equipment from pulper to rewinder with housing, erected and ready for commission.

An used and reconditioned paper machine having similar production capabilities is estimated to be costing in the range of 10 to 11 million US dollar at the stage it is delivered, erected and ready for start up.

A deinking plant to process 30 tons of waste paper a day for recycled fibre will be costing in the range of 3.5-4.0 million US dollars including housing by the time it is ready for commission.

It is very interesting to note that the total investment on a new paper machine and the deinking plant for a secondary fibre will be paid-off within 4 years period after start up.

In any case, it is high time that the government should adapt a national policy to encourage this vital commodity on a priority basis. A positive conclusion and action on this subject matter does strengthen the industrial growth while boosting the country's economy and self reliance.

Note : For estimated product cost calculations please refer Annex CC 6-1 to CC 6-4. They indicate the running cost figures of PM 1 and the estimated cost figures of PM 2 and the new paper machine.

L.3.01 **PRINCIPLE BENEFITS OF THE PROPOSED NEW PAPER MACHINE.**

There will be a net annual savings of foreign exchange drain up-to the extent of 10.0 million US dollars, by not importing the writing and printing grades of paper.

Besides, the company will be paying approximately 10.0 million US dollars equivalent in local currency to the Government in the form of taxes and revenues. The payment of revenues is from the estimated yearly turn over of 31.0 million US dollars worth of product produced at the current level of price structure.

A constant employment opportunity will be an another bright feature as the mill will be needing around 400 people to work on a sustained basis around the year.

L.4.01 HIGH LIGHTS OF THE PROPOSAL

* Revival of paper industry.
* Economical productivity.
* Growth of Country's economy.
* Self reliance.
* Pay-off of the total investment with in 4 years.
* Reduction of yearly foreign exchange drainage up to 10.0 million US dollars net.
* Yearly contribution of over 10.0 million US dollars equivalent, to Government coffer as various taxes and revenues.
* Sustained employment opportunities for the local community.
* Growth of social structure.

M.1.00 INTEGRATED PULP AND PAPER MILL

It is imperative that the Government must hold firm line to promote pulp and paper making facilities exploring the possibilities of utilizing indigenous raw material. A decisive action on this policy will be a great leap in terms of industrial and economical growth in the country.

The immediate approach could be to use bagasse which should be plenty available from the huge neighbouring sugar mills for pulp production. The next viable raw material could be Kenaf as an alternative to Bagasse. Suitable species of Kenaf can be economically grown on commercial scale for the production of pulp and paper. Kenaf is a promising raw material gradually dominating as a prosperous substitute for wood and to many other fibrous material in pulp and paper industry. It is heartening to note that Uganda has already acquired adequate experience in growing Kenaf in certain regions

of the country for various applications. This becomes more easy to promote and expand its cultivation on a regular commercial scale for pulp and paper industry.

A techno-economic feasibility study in this connection is strongly recommended to be undertaken in the immediate future. This study will serve as a basis for all future decision and action in promoting the paper industry.

Establishing an integrated pulp and paper industry in the country will act as a land mark in the growth of one of the most vital commodity needed for the cultural development across the country, besides its' impressive economical impact and industrial revival.

Annex 1

PAPER MACHINE No. 1
RECOMMENDED SHORT TERM MEASURES

A. STOCK PREPARATION :

1. a. Mechanical fault with the drive of the hydropulper is to be rectified on a priority basis.

   b. It appears that the V-belt grooves of the drive pulley do not correspond to the size of the belts.

   c. Recommended to change drive pulley suitable to the existing belts. Alternatively to buy suitable V-belts.

   d. Check the cause of water leakage through rotor bearing and rectify. It seems (from the explanation given) the gland cooling water leaks, through the external part of the sealing ring.

   e. In any event the pulper must be put into operation and the use of beaters (as slushers) should be terminated.

      With this change-over, a substantial saving on electricity consumption can be realised.

2. To erect the disc refiner and two conical refiners (all new) available in the mill stores in place of beaters No.3 and No.5 as per the layout diagram provided.

   The new set-up will provide flexibility of operation to cope with the quality of paper produced

3. Eventually all the beaters should be dismantled to make space for buffer storage of pulp, broke and to set up an exclusive additive preparation section.

4. To provide recirculation line for refining. This will enhance the flexibility of stock refining operation. All stock lines must be flushed with water before shut-down.

5. Pulp sample lines are to be provided at the outlet of each refiners.

B. APPROACH SYSTEM :

1. a. To install the stock consistency regulator and back water p.H. meter as per the layout diagram provided.

   b. To dismantle and remove the sand trap unit.

2. Suggestions to minimise fluctuation of basis weight :

   a. To maintain stock consistency in the flow box not exceeding 2%.

   b. To modify the flat bottom flowbox compartment into conical bottom for a steady stock flow.

   c. To increase the sides of the flow box by approx, 40 cm to provide additional static head in the box. (note : This modification should be done if the improvement achieved with the change recommended under 2 (b), is not satisfactory.

   d. To incorporate a "V" - notch valve for stock flow regulation instead of the present gate valve.

3. a. Centricleaners are to be set-up as per schematic diagram provided.

   b. 1st. stage-to check for it's performance with it's reject line submerged in the trough.

c. To install floater valve controlled dilution to maintain trough levels of 1st and 2nd stage cleaners.

d. Pressure gauges to be installed at the inlet and outlet of the primary centricleaners. (see the diagram). Approx. 0.5 Kg/cm² differential pressure should be maintained in each stage.

4. a. The wood filling of the shell and plug bars of the Jordan is to be chipped, to uniformly expose the bars to around 5 mm depth.

b. The loading mechanism of the unit is to be repaired for an effective function.

The complete system should always be flushed with water before shut-down.

C. <u>MACHINE WET END (Wire and Press parts)</u>

1. a. To locate the dismantled rectifier roll with it's drive and to re-install in the head box.

b. To provide proper water spray nozzles in the head box compartments to prevent formation of foam and fibre lumps.

2. To grind both slice lips and overhaul the top regulating valves (slice lips appears very uneven at present).

3. To re-align all table rolls and to replace the worn-out bearings enabling the rolls to rotate with the wire.

4. To repair the slackened brackets/bearing housings of the wire stretch rolls, and fasten them firmly to their positions.

5. Overhaul the automatic wire guide system and to put it into operation using air from the independent compressor provided or from the main compressor.

6. To regrind suction box covers.

7. a. To incorporate a vacuum separator tank to the existing vacuum pump installation.

   b. To replace the present 150 dia. suction pipe running across in front of the suction couch roll with 200 dia. pipe.

   c. To replace the present 200 dia. pipe running from the junction point of suction couch and suction box vacuums with 250 dia. pipe for all the length till the vacuum pump.

8. a. To open and check the suction couch roll for :
   - The alignment of its' internal vacuum box.
   - Sealing and water lubrication systems.
   - Other internal components against their wear and tear.

   b. To locate a position to install vacuum gauge on the suction couch header.

9. a. To incorporate trim knock-off showers on both edges of the wire.

   b. To increase water pressure to the knock-off showers of the wire to have 8 kg/cm^2 as minimum.

10. To install and use a caustic spray pipe line across the wire for uniform application of chemical during wire cleaning against the present practice of manual pouring.

11. To install high pressure showers from the felt side on all the three press felts.

12. To reduce slot opening of all uhle boxes (vacuum boxes for felt cleaning) to 5-6 mm width from the present 10 mm. width.

13. a. To incorporate uhle boxes on the paper sides of the second and third press felts (Two new uhle boxes are in stores) Note : To install on 3rd press while changing the present felt since the prevailing hard crease of this felt may damage the vacuum slot.

    b. To use both uhle boxes located on each side of the first press felt.

14. To align all uhle boxes to have positive and even contact with the respective felts.

15. a. To install permanent caustic spray pipes on all the felts for felt cleaning purposes. (The present method of manual pouring is totally not satisfactory).

    b. The caustic dissolving tank is to be permanently located in a convenient place and the necessary distribution pipe lines with valves to be provided for each position.

    Felt washing procedure has to be followed for better washing effect as has been explained to the operating crew.

16. Prevent mixing of bearing lubrication oil with 1st and 2nd press tray water, and to direct this water into couch pit.

17. To install vacuum gauges to suction boxes and suction couch roll.

18. a. To lead a 50 mm dia. pipe line from the delivery line of the couch pit pump towards the stock suction of the pump inside couch pit. At times of partial blockage of suction line and/or massive accumulation of wet sheet in the couch pit, this line can be used for creating turbulence to disintegrate the dense stock.

b. A similar line at the opposite side of the couch pit does assist to use periodically in the absence of a mechanical agitator.
All these lines are to be connected with required shut off valves for independent operation.

c. Injecting machine tray water at the suction side of the couch pit pump impeller using one inch dia. pipe will assist at times to release the dense pulp blockage at the suction line. Such relief prevent the over flow of couch pit and thus minimise fibre losses. The tray water inject line should be incorporated with a shut off and non return valves.

d. To cope up with the pumping of couch pit stock and wire pit water, an increase of r.p.m of the couch pit pump to 1200 from the present 1000 is recommended. The connected 5.5 KW motor can take the additional load. (actual load during operation is reported as 3.5 Amps equivalent to 2 KW approximately).

e. All press rolls need to be regrinded with proper camber.

D. DRYERS :

1. All the 12 headers of the machine drying cylinders (including one cooling cylinder) require complete repair with change of carbon sleeves, rings and diaphragms, where necessary.

2. All the syphons are to be checked against breakages and twisting within the drying cylinders. The condensate evacuation clearance in the cylinders, to be regulated to 2 mm. or below.

3. a. All the worn out flange gaskets of steam and condensate lines are to be replaced.

   b. All worn out gland packing of the steam control valves and condensate valves are to be replaced.

4. All steam traps connected to each drying cylinder are to be overhauled to ensure for proper function.

5. The condensate discharge unit (OGDAM PUMP) to be checked for its' positive function. In case of its' unsatisfactory operation a closed tank hooked up with a pump operating on level switch control to pump condensate to boiler is recommended.

6. Condensate vapour from the main header to be directly connected to the boiler economiser (boiler water storage tank).

7. Lagging of all steam and condensate lines are essential.

8. Doctor blades for drying cylinders are to be replaced.

9. To realign the doctor blade to pope reel drum.

10. Use of a 1/4" dia. high pressure air hose pipe connected with a quick open/shut valve located next to pope reel will assist for easy leading of paper tail to take off spool during breaks or change over of paper jumbo reel.

11. It is recommended to relocate the pneumatic control panel and the speed regulating panel of the pope reel drum, to its' tending side for operational convenience. Operating from the new position will completely eliminate the said problem of generating broke during change - over of paper reels.

12. a. Replace the calender rolls with new one's which are in stores (except the broken one) and arrange to regrind the used rolls.

    b. To repair the loading mechanism of the calender stack and the clutch (engage / disengage) of its' drive unit.

E. <u>DRIVE</u> :

1. a. To repair the driven pulleys of the calender stack and wire part by filling the cavity of the spot wear on their contact surface. This repair will prevent the eventual damage to the bearings, calender rolls and prevent sheet vibration.

    b. To re-groove the drive and the driven pulleys of the calender stack to prevent slippage and loss of speed at increased calender loading. The groove specification can be taken from the non-worn part of the pulleys.

2. For a steady operation, re-grooving might be necessary for drive groups which are relatively loaded more.

These groups are in the sequence of :

a. Wire drive
b. Calender stack
c. I press
d. III press
e. II press

3. To fasten the line shaft supports firmly to their foundation to stop them vibrating.

4. To cover all 13 positions of opened line shaft bearings to protect them from dust and other undesirable materials.

5. To use just adequate quantity of lubricants to prevent spillage and overflow on to the floor.

F. FIBRE RECOVERY AND CLOSED WHITE WATER CIRCUIT :

1. The pulp thickener which has not been working since 1973 must be put into operation at the earliest. This unit will assist to thicken the couch pit stock and to recover part of the fibre which is being lost with the over flow of excess machine white water. The fibre losses and the reuse of white water can be well controlled after the fibre save all is constructed and put into operation. There will also be savings of chemicals and conservation of fresh water when the entire system is in operation.

Annex 2

PAPER MACHINE No. 1
RECOMMENDED LONG TERM MEASURES

A. PRODUCTION :

1. A consolidated additive preparation section should be set-up in one area for a better control and synchronised operation.

   This section principally consists of :

   a. Alum preparation and storage (see diagram).
   b. Rosin size preparation and storage.
   c. Starch cooking and storage.
   d. China clay dissolving, screening and storage (see diagram).
   e. Dyestuff / Brightener preparation and storage.

2. To regrind all table rolls of the machine and to incorporate deflectors if the machine has to regularly operate at around 60 meters/min and above.

3. To install the old vacuum pump out-side the building, to operate parallel with the existing one and to connect it's vacuum to all uhle boxes for an independent operation.

4. To reinstall calender cooling system with its' air flow regulators to obtain uniform calendering effect on writing and printing grades of paper.

5. To provide high pressure air nozzles along side the pope reel doctor to help blow sheet web to reel-spool.

6. To interchange the last two cylinders preceding calender stack to relocate the cooling cylinder immediately before the calender and to put them for service.

This will enhance the drying capacity of the machine and further assists in conditioning the paper web before calendering.

The existing independent cylinder felt is preferred to run with the cooling cylinder.

In addition to the water input into the cooling cylinder, an air inlet through a 1/4" dia. line is essential to keep continuous evacuation of water from the cylinder. Air pressure should be maintained at approximately 0.3 - 0.5 Kg/cm² lower than the supplied water pressure in the cylinder.

Pressure gauges to indicate air and water pressure will be helpful.

7. In the absence of automatic felt guide control system for all press and dryer felts, it is advisable to incorporate sound and light alarm signal for all these sections to warn when felts start moving out of their positions.

   This system will significantly help in avoiding felt creases and damages, if attended promptly.

8. To replace all the present dryer felts with synthetic dry screens by-passing all the felt drying cylinders. This change should considerably improve the drying capacity of the machine.

B. <u>FIBRE RECOVERY UNIT</u> :

1. To construct a fibre save all and to operate it to prevent the record high fibre losses during plant operation. A civil engineering work is essential to obtain construction details and cost estimates for this

unit (schematic diagrams with design details are provided).

C. FINISHING EQUIPMENT :

To install an overhead mono-rail to run along with the centre line of the back stands of Jagenberg Sheet Cutter and to hook up an electrical overhead hoister having a lifting capacity of 500 Kg. This facility will assist in the gross reduction of loading time of paper rolls to the back stand. This addition will be required if the sheet cuter need to process increased tonnage of paper on a sustained basis.

D. UTILITY SERVICES :

1. To obtain all relevant information about the missing parts of the second package boiler from its' manufacturer, Siller and Jamart Barmen, West-Germany. This information including its' cost and delivery time will enable the company to take timely action when the necessity arises.

2. When the 10 T/Hr. capacity second boiler is to be started it is essential to install a simple water softening plant of a suitable size. A single stage Zeolite or two stage cold lime Zeolite process could be economically employed to produce "ZERO" hardness water. The softened water ensures for an efficient and safe operation of the boiler.

3. A steam flow indicator and recording unit is to be incorporated to monitor the steam consumption and the performance of the boiler.

E. AUXILIARY SERVICES :

1. It is very essential to institute maintenance log sheets

for each unit operating in the mill and to programme and adapt preventive maintenance system regularly.

2. To clean and overhaul the roll grinding machine, re-wind or replace the burnt-out two motors, replace worn-out parts and arrange to get the unit aligned and recommissioned through an expert.

To have a roll regrinding facility in the mill is a great asset for the mill operation.

Annex 3

UTILIZATION OF SECONDARY FIBRE

From the early 70's utilization of secondary fibre is gaining much importance in the paper industry due to its' economical advantage on the cost of final product. Almost all grades of paper for common use are being successfully produced using secondary fibre as a main fibre furnish in the process. Certain grades of paper like news print and magazine paper are produced using 100% recycled fibre.

All secondary fibre or recycled fibre is processed through deinking system to remove the ink from the waste paper and bleached to obtain higher brightness. The deinking and bleaching process differs from mill to mill according to the type of waste paper being processed and the desired quality of fibre for paper making.

There are two systems of deinking process in practice.

a. Washing system
b. Flotation system

Each of these systems are selected according to the independent convenience and specific requirement of the mill.

Deinking by Washing system is commonly employed in USA where as the Flotation system is widely used in Europe and the rest of the world.

The equipment cost and process used varies according to the system employed. However, deinking by washing system is equipment intensive and the operating costs could be slightly favourable compared with the flotation system.

The washing system require a very high quantity of water (25 m^3 - 130 m^3 per ton of fibre) where as flotation system needs (7 m^3 - 25 m^3 per ton of fibre) far less.

Normal chemicals used in deinking process are caustic soda, sodium silicate and detergents. PH level, stock temperature and residence time are carefully controlled according to chemical concentration and system employed during the process.

Sodium peroxide or Hydrogen peroxide is used to improve the brightness of fibre or regular bleaching sequence is sometime employed to reach higher brightness levels.

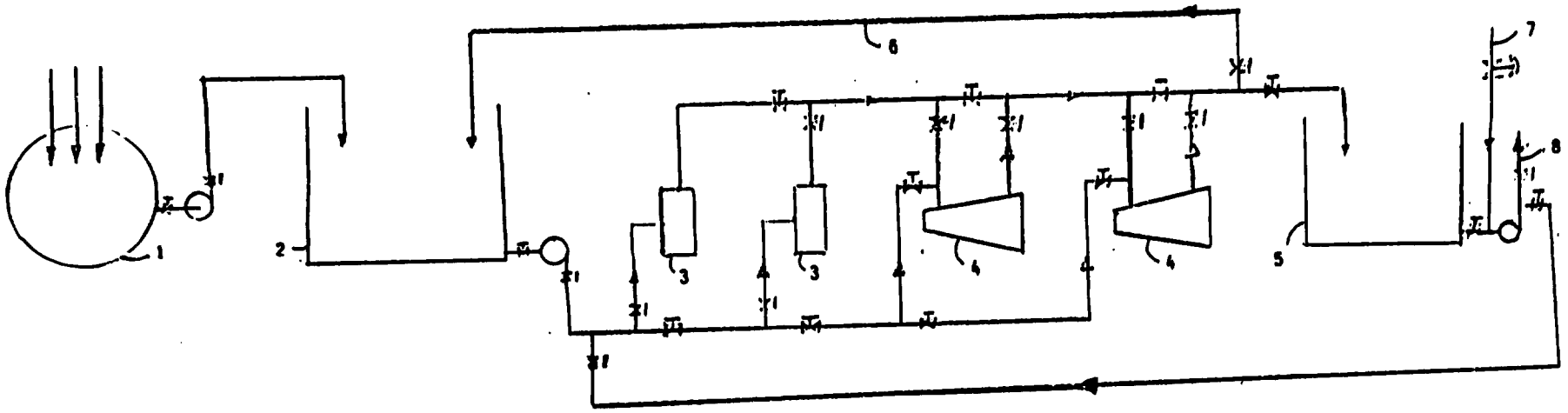
The yield figures of the recycled pulp ranges from 65% to 95% which factor is mainly governed by the type of waste paper used and the degree of brightness required.

The overall cost figures of the recycled pulp could be around 50% of a given grade of virgin pulp. Using recycled fibre as a major furnish for paper making has proved ideal and highly economical for countries which depends upon 100% imported virgin pulp for paper making.

Following are some of the known equipment manufacturers for deinking process employing flotation system.

- Voith, West - Germany
- Escher Wyss, West - Germany
- Sunds, Sweeden

USA stands as a major exporter of assorted waste paper, baled and hauled in bulk quantity through containers to all parts of the world. Assured supply of waste paper can be ensured through long term agreements with the suppliers.



1. HYDROPULPER. 2. DUMP CHEST. 3. DISK REFINERS. 4. CONICAL REFINERS. 5. REFINED STOCK CHEST. 6. STOCK RECERCULATION LINE. 7. BACK WATER DILUTION FOR CONSISTENCY CONTROL. 8. PULP TO FLOW BOX.

MODIFIED STOCK PREPARATION LAY OUT PM.1

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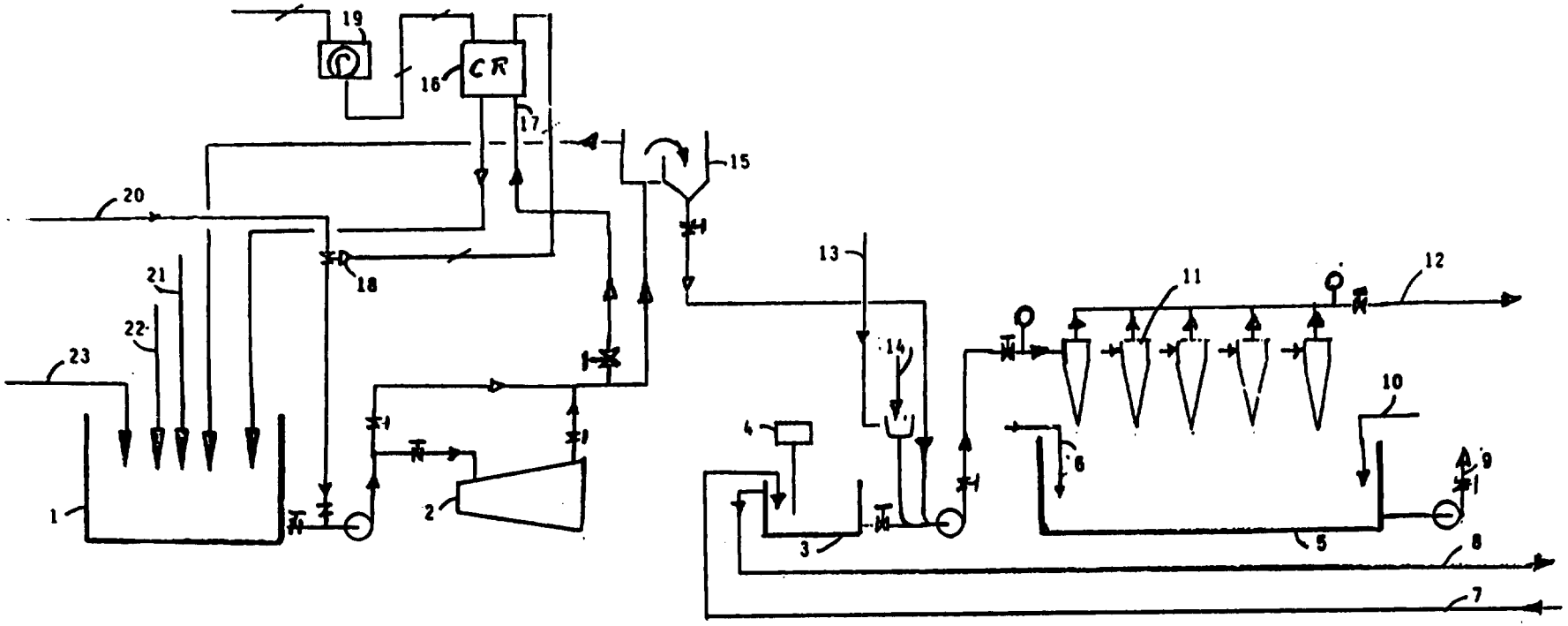

1. REFINED STOCK CHEST. 2. JORDAN. 3. MACHINE WHITE WATER. 4. PH METER. 5. 1st. STAGE CENTRICLEANER REJECT TROUGH. 6. WHITE WATER DILUTION. 7. MACHINE TRAY WATER INLET.8. WHITE WATER OVER FLOW. 9. TO 2nd. STAGE CENTRICLEANER INLET. 10. ACCEPTS FROM 3rd. STAGE CENTRICLEANER. 11. 1st. STAGE CENTRICLEANERS. 12. ACCEPTS 1st. STAGE CENTRICLEANERS TO MACHINE HEAD BOX. 13. ACCEPTS FRO. 2nd. STAGE CENTRICLEANERS. 14 ALUM DOSAGE. 15. FLOW BOX . 16. CONSISTENCY REGULATOR. 17. PULP SAMPLING LINE TO CONSISTENCY REGULATOR. 18. STOCK DILUTION CONTROL VALVE. 19. STOCK CONSISTENCY RECORDER. 20. MACHINE TRAY WATER INLET. 21. FILLER DOSAGE. 22.ROSIN SIZE DOSAGE. 23. PULP FROM REFINERS.

MODIFIED APPROACH SYSTEM PM.1

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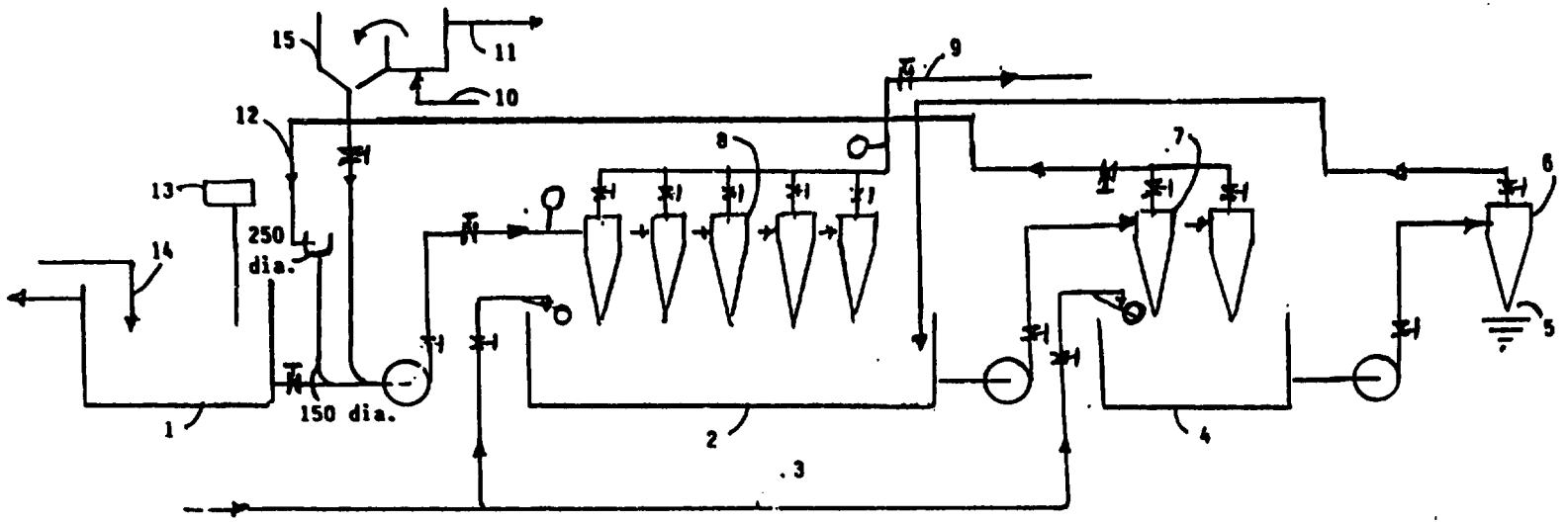

1. MACHINE TRAY WATER. 2. REJECTS 1st. STAGE CENTRICLEANERS. 3. MACHINE TRAY WATER INLET. 4. REJECTS 2nd. STAGE CENTRICLEANERS. 5. REJECTS 3rd. STAGE CENTRICLEANERS TO THE DRAIN. 6. 3rd. STAGE CENTRICLEANERS. 7. 2nd. STAGE CENTRICLEANERS, 8. 1st. STAGE CENTRICLEANERS. 9. ACCEPTS 1st. STAGE CENTRICLEANERS TO MACHINE HEAD BOX. 11. OVER FLOW TO MACHINE CHEST. 12. ACCEPTS FROM 2nd. STAGE CENTRICLEANERS. 13. PH METER. 14. WHITE WATER FROM MACHINE TRAY PIT. 15. FLOW BOX. (10. REFINED STOCK INLET)

CENTRICLEANING LAY OUT PM.1

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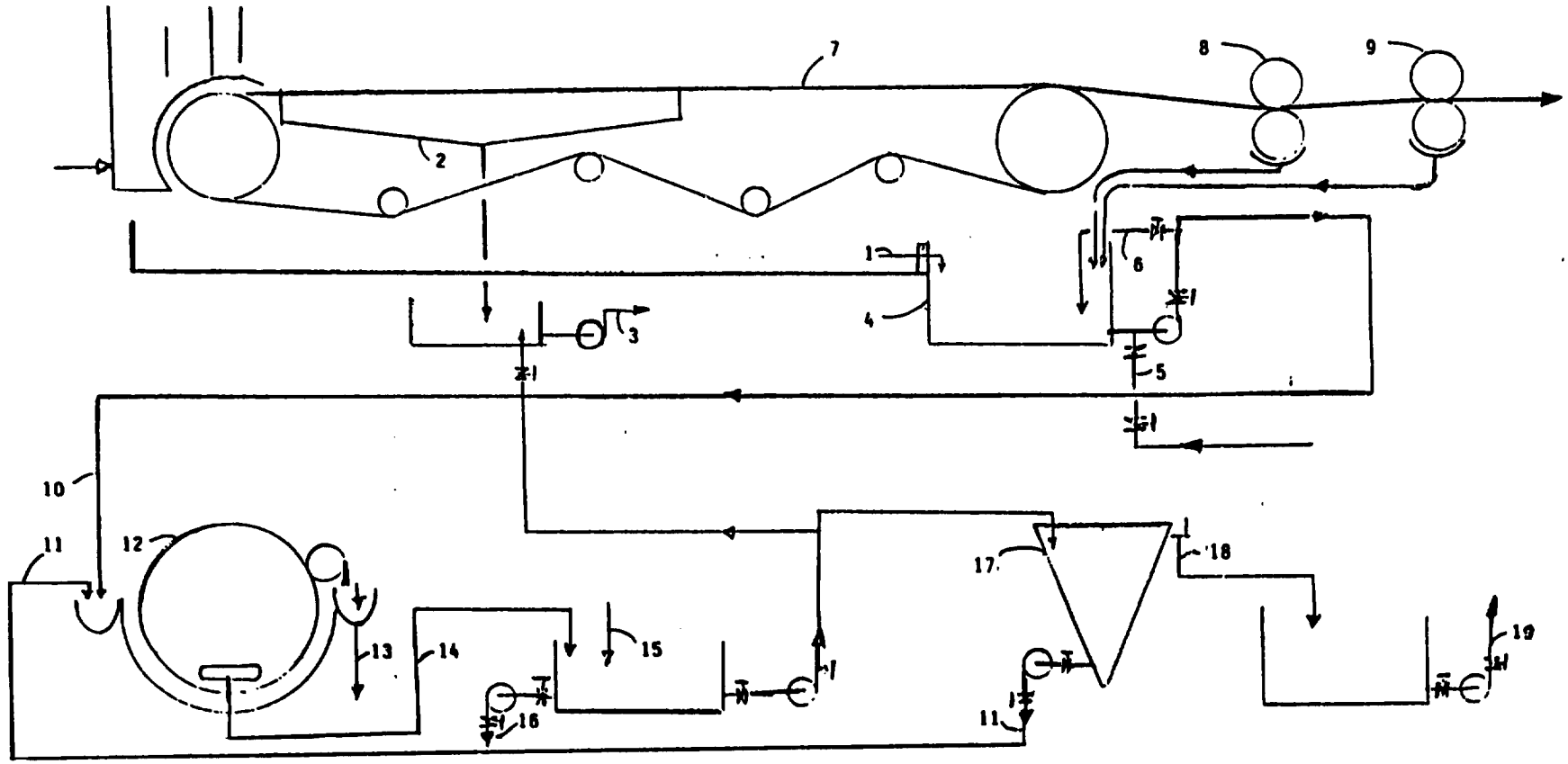

1. WIRE PIT WATER. 2. MACHINE TRAY WATER (RICH WHITE WATER). 3. WHITE WATER TO CONSISTENCY REGULATOR & CENTRICLEANER DILUTION. 4. COUCH PIT. 5. WHITE WATER INLET. 6. 50 mm. Dia. RECIRCULATION LINE. 7. WIRE PART. 8. 1st. PRESS. 9. 2nd. PRESS. 10. STOCK FROM COUCH PIT. 11. RECOVERED FIBRE. 12. THICKENER RECOVERED PULP TO DUMP CHEST. 14. THICKENER FILTRATE. 15. FROM VACUUM SEPARATOR. 16. TO HYDROPULPER DILUTION. 17. CONICAL FIBRE SAVE ALL. 18. CLARIFIED BACK WATER. 19. TO MACHINE WET END USE.

WHITE WATER & FIBER RECOVERY CIRCUIT PM. 1

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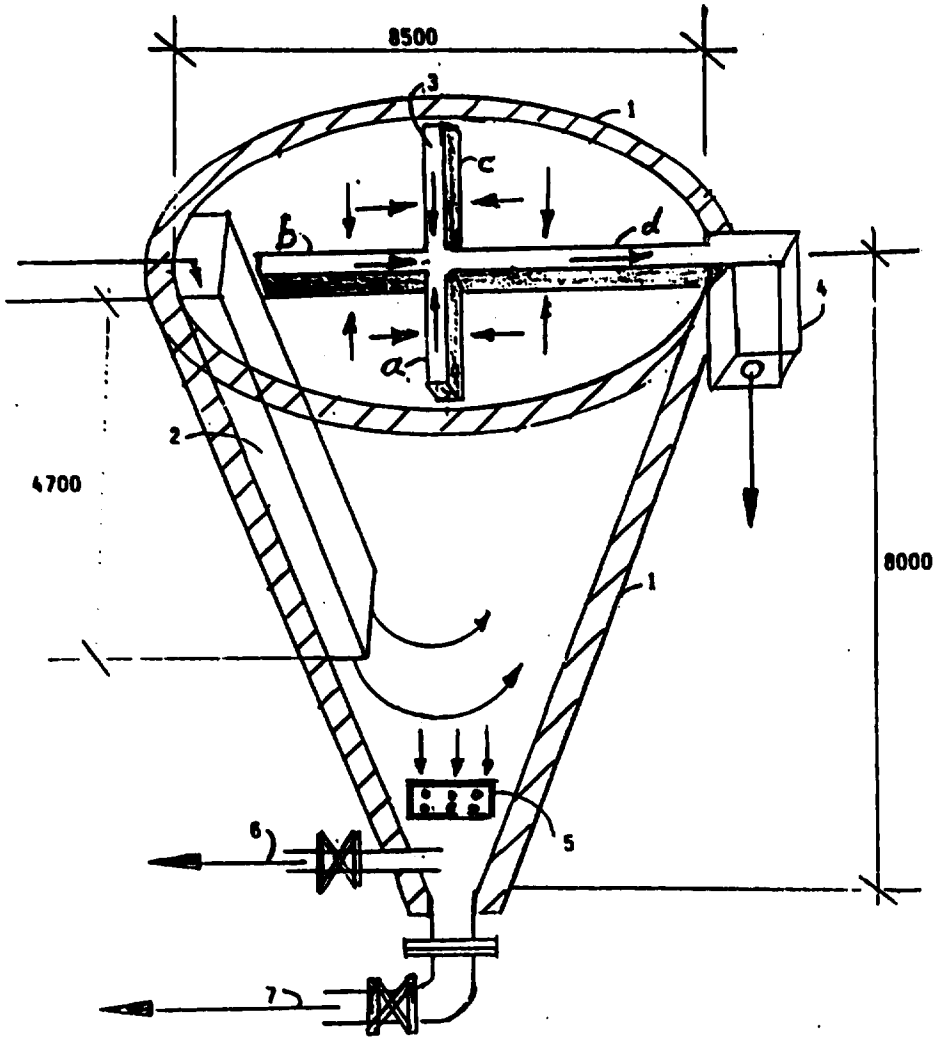

1. CONICAL FIBRE SAVE ALL OF RCC CONSTRUCTION.
   SIZE: 8500 mm. Dia. X 8000 mm. HEIGHT NET.
2. MACHINE WHITE WATER INLET CHANNEL.
   SIZE: 600 X 900 mm AND HEIGHT 4700mm. NET.
3. CLARIFIED WATER DISCHARGE CHANNELS.
4. CLARIFIED WATER OUTLET TROUGH.
5. INSPECTION HOLE. SIZE: 800 X 600 mm. APPROAX.
6. RECOVERED FIBRE OUTLET.
7. DRAIN LINE.

CONICAL FIBER SAVE ALL - a.

PAPCO INDUSTRIES LIMITED

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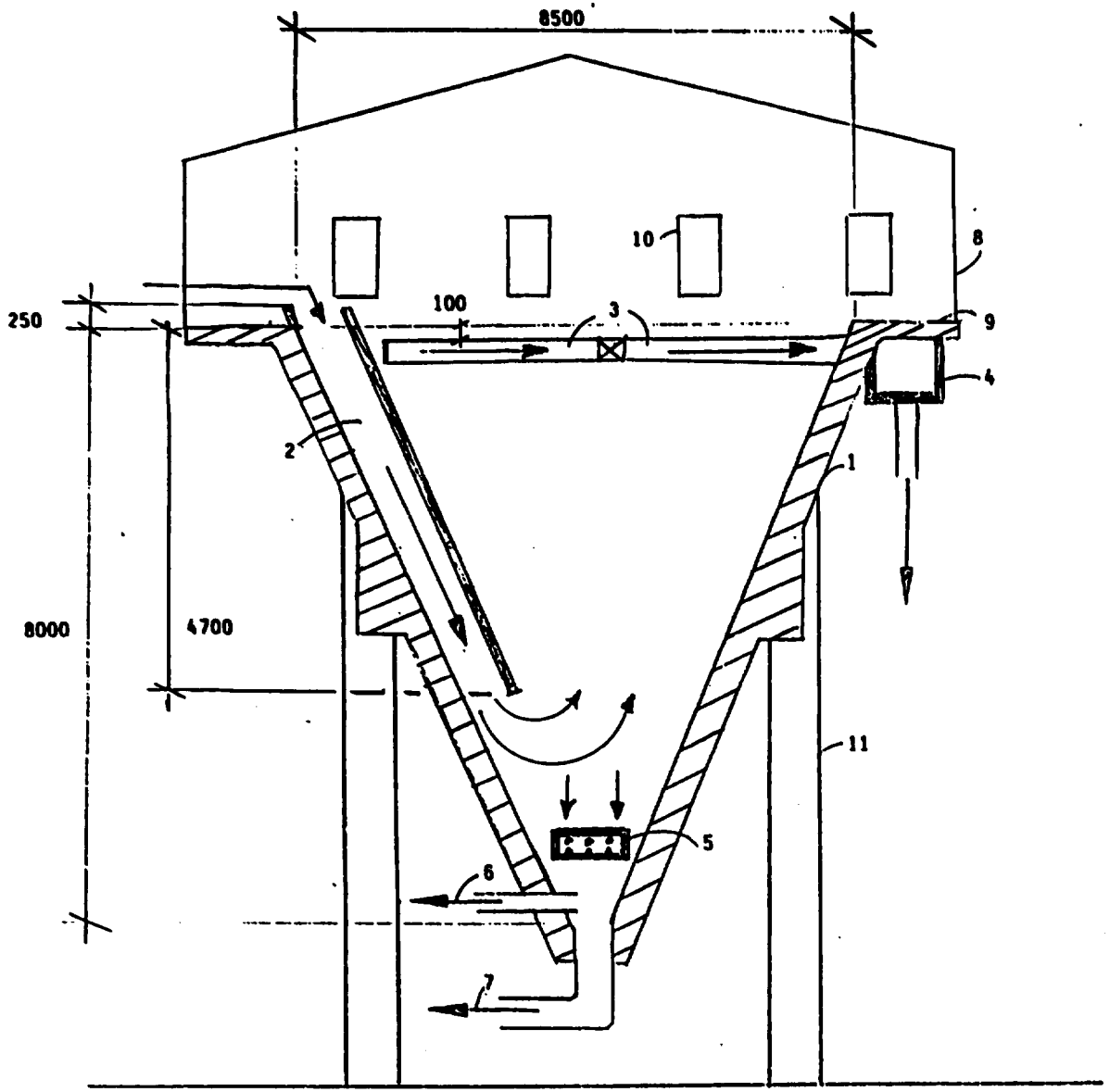


1. CONICAL FIBER SAVE ALL OF RCC CONSTRUCTION.
   SIZE: 8500 mm. Dia. X 8000 mm. HEIGHT NET.
2. MACHINE WHITE WATER INLET CHANNEL.
   SIZE: 600 X 900 mm. AND HEIGHT 4700 mm. NET.
3. CLARIFIED WATER DISCHARGE CHANNELS.
4. CLARIFIED WATER OUTLET TROUGH.
5. INSPECTION HOLE. SIZE: 800 X 600 mm. APPROAX.
6. RECOVERED FIBRE OUTLET.
7. DRAIN LINE.
8. DUST PROOF ENCLOSURE.
9. WALKING PLATFORM. 800 mm. WIDE.
10. WINDOWS.
11. SUPPORT PILLERS OF RCC CONSTRUCTION.

CONICAL FIBER SAVE ALL - b.

PAPCO INDUSTRIES LIMITED

JINJA-UGANDA

CONICAL FIBRE SAVEALL

Specifications :

1 Size of the saveall : dia. of the cone top 8500 mm net.
Height of the Cone 8000 mm net.

2. Material of construction : RCC

3. The levels of the clarified water discharge channels (No.3), a, b, c, and d, to be 100 mm below the top embankment of the main body of save all.

All the four channels should be perfectly horizontal.

The internal size of the channels a, b, c, and d to be 200 X 200 mm net and the channel marked as "d" to have approximately 5% downward gradient towards the collector trough from its' centre.

4. The size of water collector trough (No.4) to be 350 X 350 X 400 mm depth. A 200 mm diameter S.S pipe connected with a flange to be grouted at the bottom of the trough during construction for water outlet connection.

5. A Stainless Steel flange of 100 mm. dia. with bolts should be grouted on the side at 600 mm. above the bottom of the RCC cone for connecting a fibre discharge pump.

6. The bottom cone of the saveall to be grouted with 200 mm diameter S.S pipe with a flange during construction for drainage connection.

7. A stainless steel frame (size approx. 600 X 800 mm) ready with bolts to be grouted at the bottom of the saveall to fix a man-hole (No. 5).

8. The size of white water inlet trough (No. 2) to be 900 X 600 mm net and vertical height of the trough to be 4700 mm from the top of the cone.
The four rectangular embankments of the trough (2) to be raised by 250 mm above the level of the saveall brim.

9. All internal surfaces of the main RCC body which comes in contact with water should have a smooth finish. An internal coat with acid resistant cement is preferred.

10. An RCC walking platform of approximately 800 mm wide around the top embankment of the saveall body should be provided.

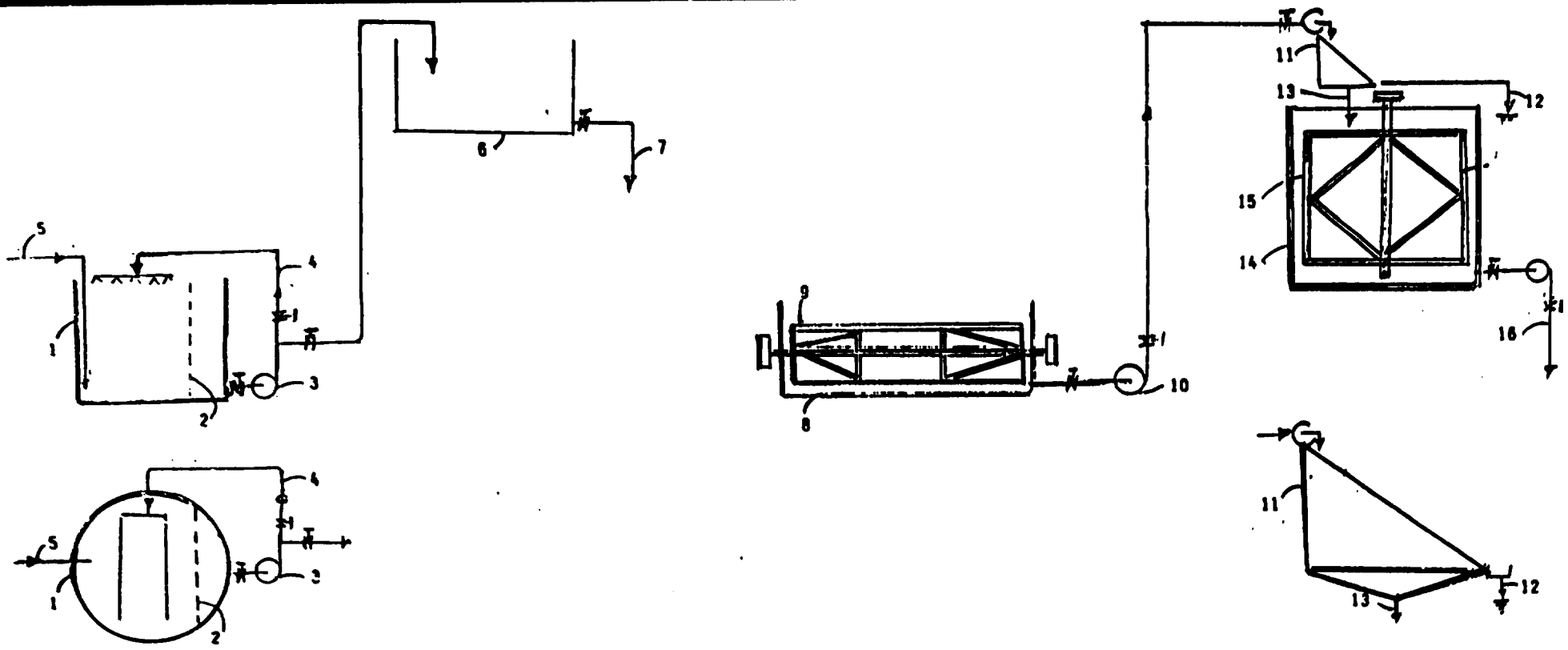
11. A strong dust proof enclosure (No. 8) should be provided to cover the saveall and its' platform around with an approach door.

12. Strong hand rails around the platform should be provided for the safety of working personnel.

13. A pump having a capacity of approx. 60 lit/min with 15 meters head should be adequate to pump the recovered fibre.

14. A by-pass line connection between the inlet and outlet lines of the pump may be useful for fibre discharge.

It is important to take adequate care during construction to the effect, not to allow air pockets in the RCC structure and to ensure non-exposure of Reinforcement bars to the atmosphere.



1. ALUM DISSOLVER, CAP. 1.5 M^3 STAINLESS STEEL TANK FOR 250 Kg. PER CHARGE. 2. 4mm. Dia. PERFORATED S.S. PLATE. 3. S.S. PUMP CAP. 150 Lit/Min. H. 15 Mt. 4. 50 mm. Dia. RECERCULATION LINE. 5. STEAM INLET. 6. S.S. or PVC ALUM STORAGE TANK. 7.DOSAGE TO MACHINE. 8. RCC TROUGH FOR CLAY DISSOLVING. CAP. 10 M^3. 2 TONS OF CLAY PER CHARGE. 9. PADDLE MIXER 10-15 RPM . 10. CLAY SLURRY DISCHARGE PUMP. CAP. 300 Lit/Min. H. 20 Mt. DELIVERY LINE 75 mm.Dia. 11. HILLSIDE SCREEN SIZE 1200 X 800 WITH 60 MESH S.S. WIRE. TWO UNITS. (ALTERNATIVELY VIBRATING JOHNSON SCREEN). 12. CLAY GRIT TO THE DRAIN. 13. SCREENED CLAY SLURRY FOR STORAGE. 14.RCC CLAY SLURRY STORAGE TANK. CAP. 20 M^3. 15. PADDLE MIXER. 16. DOSAGE TO MACHINE THROUGH ROTAMETER.

ADDITIVE— PREPARATION

PAPCO INDUSTRIES LIMITED

JINJA- UGANDA

Annex 5

PAPER MACHINE No. 2

INVENTORY OF EQUIPMENT AND STATUS OF ERECTION

Code Nos.	Description	Status
A. STOCK PREPARATION		
1.1.0	Hydropulper	
1.1.1	Hydropulper type Fibrella W2, complete with v-belt pulley. Technical data not available. By Leje and Thurne AB Stockholm Sweeden.	Main unit installed. Rotor assembly incomplete.
1.1.2	Electric motor for item 1.1.1 500V, 100KW, 1460 rpm. Fa no.104053. by Gebrüder Meier, Zurich, Switzerland. Complete with V-belt pulley, starter and isolator.	Installed. Wired. Not connected. Starter need replacement.
1.1.3	Set of v-belts for item 1.1.1 and 1.1.2 6 D. 204".	Missing.
1.1.4	Pipe line from Hydropulper to the magnetic trap.	Installed.
1.1.5	Magnetic trap.	Installed.
1.1.6	Pipe line from the magnetic trap to the deflakers.	Installed.
1.1.7	Operating platform around the hydro-pulper.	Missing.
1.1.8	Hood for the hydropulper.	Missing.
1.1.9	Proposed high density cleaner between the magnetic trap and the deflakers.	Not supplied.

1.2.0	<u>Fresh Water Supply from the overhead tank</u>	
1.2.1	100 mm dia. fresh water pipe line to hydropulper.	Installation incomplete.
1.2.2	Level indicator for main fresh water tank.	Not purchased.
1.2.3	Motorised 100 mm dia. valve, controlled by the level indicator,	Not delivered.
1.2.4	100 mm dia. back water supply line to the hydropulper.	Installation incomplete.
1.2.5	100 mm dia. valve to item 1.2.4	Missing.
1.3.0	<u>Deflakers</u>	
1.3.1	Two deflakers, Fa. No. 6090 and 6091 by Escher Wyss Ravensberg F.R.G. Technical data not available.	Installed.
1.3.2	Two Electric motors for the item No. 1.3.1 type Swk 11e-2, 500 V, 55 KW 2920 rpm. Fa No. S763740 and S763741, by Brown Boveri Switzerland, Complete with starters isolators and ammeters.	Installed and wired, not connected.
1.3.3	Two, three-way hand operated valves to item 1.3.1.	Installed.
1.3.4	Interconnecting 100 mm dia. pipes to item 1.3.1.	Installed.
1.3.5	Hand operated flow control unit for item 1.3.1.	Installed.

1.3.6	100 mm dia. pipe line to the dump chest.	Installation incomplete.
1.3.7	Two 100 mm dia. gate valves for item 1.3.6.	Missing.
1.4.0	<u>Dump chests</u>	
1.4.1	Block of two RCC dump chests of approximately 30 m^3 each.	Constructed.
1.4.2	Two agitators for item 1.4.1 type SCS-760-75-22-342 rpm, rotor dia. 760 mm, with one 900 mm dia. v-belt pulley each. By Fampa, cieplica Poland.	Installed.
1.4.3	Two electric motors for the item 1.4.2 500 V, 22 KW, 985 rpm with the relevant starters.	Not supplied including starters.
1.4.4	Two v-belt pulleys, 315 mm dia. for item 1.4.3.	Not supplied.
1.4.5	Two sets of v-belts for item 1.4.2 4 C 3550 each set.	Not supplied.
1.4.6	Two transmission guards for drive system, items 1.4.2 and 1.4.4,	New. Not installed.
1.4.7	1/4" sealing water piping with valves to item 1.4.2.	Not installed.
1.4.8	100 mm dia. discharge piping with two discharge gate valves and two drain gate valves.	Installation Incomplete. Both valves missing.

1.5.0	Refiners	
1.5.1	Stock pump (No.89) type 1409 C, Q 1000L/min, H 16 m WC, 1400 rpm, Fa No. 32923, by Hany and Cie pumpern fabrik, Meilen, FRG.	On site. Not installed. coupling missing.
1.5.2	Electric motor with starter for item 1.5.1, type MQUa 64, 500 V, 9 HP, 1430 rpm, Fa No. 101714, Brown Buveri, Switzerland.	Missing. Not wired. Starter need replacement.
1.5.3	Bell refiner, type 2 MK 12 K14, 55 KW, 950 rpm, Fa No. 42 (1955), Maschinen fabrik. Theodor Boll & Cie, Kriens - Luzen. Switzerland.	Installed. coupling parts missing.
1.5.4	Electric motor for item 1.5.3, 500 V, 85 HP, 970 rmp, Fa No. 302214, Maschinen fabrik oerlikon, Switzerland, Complete with starter, isolator and ammeter.	Installed. Wired. Not connected. Starter need replacement.
1.5.5	Two Refiners by Escher Wyss. Ravensburg FRG Technical data not available.	Installed. 1 flexible delivery hose missing.
1.5.6	Two Electric motors for item 1.5.5 :	
1.5.6.1	One electric motor type SWK 14, 500 V, 58 KW, 970 rpm, Fa No. 5659408. Brown Boveri, Switzerland. Complete with starter isolator and ammeter.	Installed. Wired. Not connected.
1.5.6.2	One electric motor type MQU 280 M6c. 500 V, 110 HP, 975 rpm, Fa No. 4828272 Brown Boveri, Switzerland. Complete with starter isolator and ammeter.	Installed. Wired. Not connected.

1.5.7	Three pieces of 3-way hand operated valves for items 1.5.4 and 1.5.5.	Installed.
1.5.8	Interconnecting 100 mm dia. pipes for items 1.5.4 and 1.5.5.	Installed.
1.5.9	Hand operated flow control unit.	Installed.
1.5.10	Proposed two stand by refiners cornected with approx. 55 KW motors each including starters.	Both units not purchased.
1.5.11	100 mm dia. delivery pipe line to the refined stock chest.	Partially installed.
1.6.0	Refined Stock chest	
1.6.1	An RCC stock chest of approx. 50 m^3 capacity.	Not constructed.
1.6.2	Agitator for the chest item 1.6.1 type SCS 900-75-30, 276 rpm, Rotor dia. 914 mm, with v-belt pulley 710 mm dia.	New. Not installed.
1.6.3.1	Electric motor for item 1.6.2 type SE 225 M6 V 30 KW, 985 rpm, Fa No. 875613 (1973) with v-belt pulley 200 mm dia. by Celma-Cieszyn, Poland.	New. In stores.
1.6.3.2	Starter and cables for item 1.6.3.1.	Missing.
1.6.4	Set of v-belts for item 1.6.2, 6C 3150	Missing.
1.6.5	Transmission guard for items 1.6.2 and 1.6.3.1.	New. In stores.
1.6.6	1/4" sealing water pipe with valve.	Missing.
1.6.7	Required 100 mm and 150 mm dia.gate	Missing.

	valves for stock inlet and chest drain lines and additional pipe lengths and fittings for item 1.6.1.	
1.7.0	Glue Size preparation	
1.7.1	Glue tank of required size made out of stainless steel sheets with steam jacket.	To be fabricated.
1.7.2	Support structure and operating platform with ladder.	To be fabricated.
1.7.3	Required pipes, valves and fittings for steam inlet, condensate outlet, steam trap, size discharge line.	Missing.
1.8.0	Egalising refiner.	
1.8.1	Stock pump type NDP-D Fa No. 537 by Egger pump enbaucressier, Switzerland. Technical data not available.	Not installed. Coupling missing.
1.8.2	Electric motor for item 1.8.1, starter and cables.	Missing. Not wired.
1.8.3	100 mm and 150 mm dia. gate valves for item 1.8.1, required pipe lengths and fittings between the pump and the refiner.	Missing.
1.8.4	One piece 3-way hand valve.	On site.
1.8.5	Egalising refiner, type SJ-40, Fa No. 188 (1973), Sr No. 2043. Capacity range 4-20 MTD (Bone dry), maximum flow at 500 L/min. stock Consistency 2% - 5%. by Fampa-Cieplice, Poland.	New. On site. Not installed.

1.8.6	Electric motor for item 1.8.5 type MBRF 25, 415 V, 45 KW, 975 rpm, ASEA, Sweeden.	New. Coupled with refiner. Starter missing. NOTE : Different voltage.
1.8.7	100 mm dia. pipe line, valves and fittings from the refiner to the machine chest.	Missing.

B. PAPER MACHINE

2.1.0 Machine Chest

2.1.1	Block of two RCC stock chests with a capacity of 20 m^3 each with operating platform and ladder.	Constructed.
2.1.2	Stock inlet box placed above the chest, made out of S.S sheets.	Missing.
2.1.3	Two horizontal paddle mixers hooked up with pulp discharge bucket wheels.	Installed.
2.1.3.1	Drive for one of the mixers item 2.1.3 consisting of : - Electric motor 500 V, 5.5 KW, 1450 rpm Fa No. 97307 by Gebruder Meier-Zurich, Switzerland. - Reduction gearbox. - Two open gears.	Installed. Wired. Not connected. Emergency Stop button Missing.
2.1.3.2	Drive for the second mixer item 2.1.3 consisting of : - Electric motor 500 V, 10 HP, 1440 rpm. - Reduction gear box. - Two open gears.	Installed. Wired. Connected.

Annex 5 (Contd.)

2.1.3.3	Two transmission guards for the above two open gears.	Missing.
2.1.4	Two pulp discharge control gates.	Installed.
2.1.5	Operating platform for item 2.1.4.	Missing.
2.1.6	100 mm dia. drain pipe with two gate valves.	Installed.
2.2.0	Sand trap.	
	Manufactured in S.S sheets.	New. Installed.
2.3.0	Preparation of Alum Solution.	
2.3.1	Standard operation system and storage of Alum solution (with acid resistant material).	Missing.
2.3.2	Relevant support structure and operating platform for item 2.3.1.	Missing.
2.3.3	Discharge pipe and stop valve with acid resistant material.	Missing.
2.3.4	Rotameter for flow indicator and control.	Missing.
2.4.0	Pulp screening.	
2.4.1	Johnson Lindgren vibrating screen, type L-2, Ekstroms, Stockholm, Sweeden, Complete with two vibration motors, type MKA 15, 500 V, 5.5 HP, 1450 rpm each Fa No. 2152396 and 2723487 ASEA Sweeden. One drive motor type MKE 11/UCA 140, 500 V, 0.95 KW. 925/9 rpm, Fa. No. 2099861, ASEA Sweeden, with gear box Switches and ammeters.	Installed. Wiring incomplete. Water spray not installed. Ammeters broken.

2.5.0	Vortrap Centricleaners.	
2.5.1	Stock inlet pump for item 2.5.0 by Egger, Switzerland. Fa No. 4593. Technical data not available.	Installed.
2.5.2	Electric motor for item 2.5.1, 500 V, 30 HP type MQUa 94a, Fa No. 283155 Brown Boveri, Switzerland.	Installed. Wiring incomplete.
2.5.3	125 mm dia. pipe line from the constant level box, through the pump item 2.5.1 to the Vortrap centricleaners with two gate valves.	Installation incomplete. Both gate valves and most pipe line missing.
2.5.4	Four Vortrap centricleaners, Bell-Krens, Switzerland, complete with transperant cylinder for reject accumulation, flushing system, and support structure.	Partially installed. One transperant cyl. & 150 mm dia. discharge control valve missing. Pr. gauges broken.
2.5.5	150 mm. dia. discharge pi line from cleaners to constant level box.	Incomplete.
2.6.0	Stock Consistency regulator.	
2.6.1	Consistency regulator and fresh water line for stock dilution.	Missing.
2.7.0	S.S Constant level box (for accepted stock from vibrating screen).	Installed.
2.7.1	Float valve and spray pipe.	Missing.

2.7.2	200 mm dia by-pass line from sand trap to the constant level box.	Missing.
2.7.3	250 mm dia. pipe line from the constant level box to the machine head box.	Installed.
2.7.4	Over head box for machine back water made out of S.S plates.	Installed on machine chest.
2.7.5	100 mm dia. pipe line from machine tray water sump to item 2.7.4.	Installed.
2.7.6	White water distribution lines from item 2.7.4 to stock dilutions and over flow line.	Not installed.
2.8.0	<u>Paper machine wet end</u>	
2.8.1	Fourdrinier wire :	
2.8.1.1	Conventional v-type open head box made out of stainless steel.	Installed. Worm gear for slice lip control missing.
2.8.1.2	Wire shaking unit. Fa No. 55/49, Escher Wyss, FRG Complete with : - Electric motor type DK 720, 500 V, 4 HP, 1440 rpm, Fa No. 137569, Elektromotorenbau AG. Birsfelden, Switzerland. - Gear box Fa No. 14764, L. Kissling and Cie Maschinenfabrik, Zurich - Seebach, Switzerland. - Speed indicator.	Installed. Wired. Speed indicator broken. Belt missing.

2.8.1.3	Breast roll, 23 table rolls, 4 suction boxes, forming roll, couch press, 4 wire stretcher rolls with 2 doctors, 1 wire guide roll, deckle strips with water spray, dandy roll brackets, cross bridge. Length of the wire part : 8550 mm, length of the shaking zone 3750 mm.	Installed. Table Rolls need regrinding. Over 16 table rolls are bent / damaged. Vacuum boxes to be repaired Missing parts: spray pipes & roll showers deckle & tail cutter systems vac. con/tions all missing.
2.8.1.4	Vacuum pump type turbair KRC 5 Scut No 30, Fa No. 466195 (1451), Sulzer, Switzerland.	Installed. Vac gauge missing. Piping incomplete.
	- Gearbox type K 10, 8 HP, 2900/560 rpm Fa No. 21/21202, Maag, Zurich, Swiss.	Installed.
	- Electric motor type MQUa 52, 500 V, 7 HP, 2800 rpm, Fa No. A841373, Brown Boveri, Swiss. Including coupling and starter.	Missing. Wired.
	- Main water separation tank catch drop, water droplets discharge pipe with water seal, water level indicator, vent pipe with valve.	Installed. Exhaust pipe missing.
2.8.1.5	Water evacuation pump from the water separation tank, type NCP 10200,	Installed. Wired.

	capacity 12 lit/sec, Head 12 m, 2.6 HP, 1450 rpm. Fa No. 33949 (1951) pumpenbou Brugg.	100 mm dia. pipe installed inlet valve missing.
	- Electric motor type MUe 44, 500 V, 4 HP, 1425 rpm. Fa No. A826438R, Brown Boveri, Swiss. and starter.	Missing. Wired.
2.8.1.6	White water sump of reinforced cement concrete.	Constructed.
	- White water pump, Fr. Bieri pumpenbou Munsingen, Tech. data not available.	Installed. with pipe line Foot valve missing.
	- Electric motor type MQUa 82, 500 V, 25 HP, 2920 rpm, Fa No. 925622, Brown Boveri, Switzerland.	In stores.
	- Delivery pipe line to the overhead SS white water tank.	Installed.
2.8.1.7	Spray water pump, type 3 up1 (1970) capacity 18 lit/sec. Head 13 m, 1450 rpm 3.6 - 5.5 KW. Fa No. 3170792, Kirloskar Bros. poona India, with 100 mm dia. valve and pipeline, with 70 mm dia. by-pass valve.	Installed. Motor, starter and water nozzles missing.
2.8.1.8	Couch pit pump, type SRP 17 1/2, capacity 50 lit/sec, H : 4.2 m, 5.5 HP, 1450 rpm, Fa No. 34413 (1951) pumpenbou Brugg.	Installed. Wired. Not connected. Pipe line incomplete.
	- Electric motor type MQMa 54, 500 V, 5.5 KW, 1430 rpm, Fa No. A853390, Brown Boveri, Switzerland.	Installed. Wired. To be connected.

2.8.2	Press section.	
2.8.2.1	Couch jacket with pick up felt assembly. Felt dimensions : width : 1.85 metres. length : 4.65 metres maximum. length : 4.26 metres minimum.	Installed. Repositioning of felt rolls required. One uhle box missing. No felts in stock
2.8.2.2	First press felt assembly with felt conditioning, stretch rolls, guide rolls and felt squeeze rolls. Felt dimensions : width : 1.85 metres. length : 12.60 metres maximum. length : 11.65 metres minimum.	Installed. repositioning of some rolls required. 3 new felts size 1.85X11.8 mtr. in stock.
2.8.2.3	Second reverse press assembly with felt stretch rolls and guide rolls. Felt dimensions : width : 1.85 metres. length : 7.78 metres maximum. length : 7.26 metres minimum. (NOTE : Final measurements are rec .mend - ed for correct felt dimensions after reconfiguration of felt rolls. All doctors require replacement).	Installed. Two new felts are in stock. a. 1.85x8.0 m. b. 1.85x8.4 m.
2.8.2.4	Pick up screen. Size of the screen : 1.85x4.45 metres.	Installed. Reshuffling of felt rolls incorporating drive system is needed. 4 new screens are in stock.

2.9.0 Dryer

2.9.1	Pre-dryer section consisting of eight paper dryers and four felt dryers split into two groups complete with the required paper rolls, felt rolls, stretcher and guide rolls in general.	Erected. Few felt rolls felt guide rolls missing. One doctor blade holder, one steam trap 2 cond. heads, and pressure gauges missing. No dry screens in stock.
	First top pre-dryer felt dimensions :	
	with felt dryer / without felt dryer	
	width : 1.850 mt. / 1.850 mt.	
	length : 16.18 mt. max. / 13.100 mt. max.	
	length : 15.18 mt. min. / 12.100 mt. min.	
	First bottom pre-dryer felt dimensions :	Felt dryers not required to use.
	width : 1.850 mt. / 1.850 mt.	
	length : 17.350 mt. max. / 13.150 mt. max.	
	length : 16.350 mt. min. / 12.15 mt. min.	
	Second top pre-dryer felt dimensions :	Felt dryers not required to use.
	width : 1.850 mt. / 1.850 mt.	
	length : 16.050 mt. max. / 14.000 mt. max.	
	length : 15.050 mt. min. / 13.000 mt. min.	
	Second bottom pre-dryer felt dimensions :	Felt dryers not required to use.
	width : 1.850 mt. / 1.850 mt.	
	length : 21.420 mt. max. / 13.250 mt. max.!!	
	length : 20.420 mt. min. / 12.250 mt. min.!!	
2.9.2	Yankee cylinder (MG) 2200 mm dia. complete with felt and paper rolls, MG press roll with loading mechanism, glazing felt system, oscillating doctor, felt spreader, tension and guide rolls.	Installed. 3 felt rolls to be installed. Doctor oscilation not connected. Cond. line not installed. Doctor blade

	Felt dimensions : First alternative. 1.850 x 16.240 mt. max.!! 1.850 x 15.800 mt. min.!! As dry screen.	to be replaced MG cyl. to be regrinded. No screens in stock.
	Second alternative. 1.850 x 5.450 mt. max. 1.850 x 4.750 mt. min. As glazing felt without felt dryer and felt tension roll.	Two pieces glazing felts in stock.
2.9.3	After dryer section. Consists of four 1500 mm dia. cylinders complete with doctors, felt guides, felt stretcher and steam traps. The bottom two dryers are equipped for dry screen installation whereas the top two dryers are not. Dry screen dimension without felt dryer width : 1.850 mt. length : 16.050 mt. max. length : 15.300 mt. min.	Not installed: Doctor holders for top and bot. cylinders I paper guide roll, part of cond. line its connections & cond. pump. Missing items: one felt roll & 1 felt guide roll, 2 steam headers & 2 steam traps. Doctor blades and fittings.
2.10.1	Cooling cylinder. 100 mm dia. with paper guide roll, doctor blade holder and water inlet and outlet valves.	Installed. Water pipe to be installed. 3 felt return rolls for the cyl. missing.
2.10.2	Machine calender stack with 5 rolls and doctors.	Partially installed.

2.10.3	Spray damper.	Not installed.
2.10.4	Reel with friction brakes.	Not installed.
	NOTE : there are few paper and felt guide rolls lying under the machine and in the stock preparation section. Need sorting if they could fit in to use some where.	
2.11.0	<u>Machine drive</u>	
2.11.1	Leonard D.C. Converter unit.	Installed.
2.11.1.1	A.C. motor type MZK 144, 500 V, 142 amp, 100 KW, 1455 rpm, Fa No. 55585 Brown Boveri and Cie Baden. Swiss.	Installed.
2.11.1.2	Leonard D.C. generator type GJK. 146, 0-460 V, Excitation voltage 100 V, 92 KW, 1455 rpm, Fa No. 56174, Brown Boveri, Baden, Switzerland.	Installed.
2.11.1.3	Exciter type GCEa, 115V, 61 Amp, 7 KW, 1460 rpm, Fa No. A709771, Brown Boveri, Baden, Switzerland.	Installed.
2.11.1.4	Auxiliary Exciter, type CJ 100L - 2B, 0.24 KW, 1460 rpm, 20 V, excitation voltage 110V, rotor current 12 A, design B 3, Brown Boveri, Switzerland.	Missing.
2.11.2.	1st. Group drive with speed control (master drive).	
2.11.2.1	D.C. motor, type GCJTBa 114a, 440 V, 58 HP, 1350-1700 rpm, Fa No. A743067 Brown Boveri, Baden-Switzerland.	Installed.

2.11.2.2	Generator, type GSJa 64a, 0.15-1.3 KVA, 200-1500 rpm, Fa No. A77130 Brown Boveri, Baden-Switzerland.	Installed.
2.11.2.3	Generator, type GJa 44, 0.16 KW, 300-1500 rpm, Fa No. 762708 Brown Boveri, Baden-Switzerland.	Installed.
2.11.2.4	Generator, type GSJa 64a, 0.15-1.3 KW, 200-1500 rpm, Fa No. A 771304, Brown Boveri, Baden-Switzerland.	Installed.
2.11.2.5	Control gear box, Fa No. 6506, Drg No. 6954, BAN, Contraves A.G. - Zurich, Switzerland.	Missing.
2.11.2.6	Gearbox, type T2 VELOC, 35 HP, 1450/26.2/87 rpm, Fa No. 17931, V. Fechini-Milano, Italy.	Installed.
2.11.2.7	Flat belt pulleys and open gear transmissions for the drive group.	Installed, Belt guides not installed. Belts and transmission guards missing. Some electric components for speed regulation missing.
2.11.3	2nd. Group drive.	
2.11.3.1	D.C. motor, type GCJTBa, 114a, 440 V, 58 HP, 1350-1700 rpm, Fa No. A743068, Brown Boveri, Baden, Switzerland.	Installed.

Annex 5 (Contd.)

2.11.3.2	Gearbox, type T2 VELOC, 35 HP, 1450/26.2/87 rpm, Fa No. 17988, V. Fachini, Milano, Italy.	Installed.
2.11.3.3	Flat belt pulleys and open gear transmissions for the drive group.	Installed, belt guides & transmission guards missing.
2.11.3.4	Operating platforms.	Not installed.
2.11.4	3rd. Group drive.	
2.11.4.1	D.C. motor, type GCJTBa 104, 440 V, 32 HP, 1350-1700 rpm, Fa No. A764413, Brown Boveri, Baden, Switzerland.	Installed.
2.11.4.2	Gearbox, type T2 VELOC, 35 HP, 1450/26.2/87 rpm, Fa No. 17932, V. Fachini, Milano, Italy.	Installed.
2.11.4.3	Flat belt pulleys and open gear transmissions for the drive group.	Installed. belt, guides & transmission guards missing
2.11.4.4	Operating platforms.	Not installed.
2.11.5	Main distribution board, type 2119 (1974) 801-009-3-05-4, 3 X 500 V, 600 A, 500 KVA, APATOR, Torum, Poland.	New. Installed and Wired.
2.11.6	Main switch board.	Installed. Wired.
2.11.7	Machine control panel (MCC) NOTE : the complete MCC needs replacement with its' isolators and ammeters as it is severely damaged	Installed.

and many items are missing. The MCC should be incorporated with starters for the following motors.

1. For item 2.1.3.1 and 2.1.3.2 machine chest mixers.
   a) 5.5 KW, 500 V, 1 unit.
   b) 10.0 HP, 500 V, 1 unit.

2. For item 2.4.1 vibrating screen.
   a) 5.5 HP, 500 V, 2 units.
   b) 0.95 KW, 500 V, 1 unit.

3. For item 2.5.2 stock pump.
   a) 30.0 HP, 500 V, 1 unit.

4. For item 2.8.1.2 wire shaker.
   a) 4.0 HP, 500 V, 1 unit.

5. For item 2.8.1.4 vacuum pump.
   a) 7.0 HP, 500 V, 1 unit.

6. For item 2.8.1.5 water evacuation pump.
   a) 4.0 HP, 500 V, 1 unit.

7. For item 2.8.1.6 white water sump pump.
   a) 25.0 HP, 500V, 1 unit.

8. For item 2.8.1.7 spray water pump.
   a) 8.0 KW, 500 V, 1 unit.

9. For item 2.8.1.8 couch pit pump.
   a) 5.5 KW, 500 V, 1 unit.

10. Provision for additional 4 starters for future needs.

NOTE : Most of the terminal covers of motors are broken and connecting cables disrupted and cut. All motors need a thorough overhaul, repair and testing before service.

It may be necessary to review the entire machine drive control system and its' cubicles referring to their age old components and availability of replacement spares. A practical and viable action is suggested to be taken at the time of effecting rehabilitation programme for PM2.

3.0.0 UTILITY SERVICES :

3.1.0 Steam

3.1.1	One low pressure package boiler Fa No. 3215, type steam bloc 300 by Gotaverken - Wanson, (1962), Sweeden. Capacity 3000 Kg/Hr. Pr. 12.50 Kg/cm².	In operation. Very old. Low efficiency. No spares. Manually operated.
3.1.2	One low pressure package boiler type UN 73/100, Fa No. 17562 (1977), by SILLER and WUPPERTAL JAMART BARMEN. West-Germany. Capacity 10000 Kg/Hr. Pr. 15 Kg/cm², F. 219 m².	New. Installed.

Following items are missing for this boiler :

Rotary burner motor, 415 V, 4 KW, 1450 rpm with v-belt. pulley. Tension device combustion air fan motor and starter 415 V, 18.5 KW, 2900 rpm. 2 motors and starters for feed water pumps. 450 V, 15 KW, 2900 rpm, 2 oil heating cartridges 415 V, 50 watts each, audible alarm type Hp w 220 V, 50 Hz - 0.1 Amp. Funke and Huster,

	Exhaust chimney, water and steam line — connections and pressure gauges.	
3.1.3	Condensate tank capacity : 10 m^3 working pressure : 0.1-0.4 Kg/cm^2.	Installed.
3.1.4	Main fuel oil storage tank. Capacity : 56000 litres. Connected with pumps.	In service. Need high level alarm system to prevent over-flow of oil.
3.2.1	River bed pumps.	In operation.
	a. one old pump from kirloskar India. Designed capacity : 57.6 m^3 / hour. Head : 50 mt. direct coupled with motor 37 KW, 1450 rpm, 420 V.	Problem with bearings. Need replacement.
	b. One new multi-stage pump from Halberg Sweeden. Type : HEG 6503. Designed capacity 60 m^3 / hr. Head : 150 mt. direct coupled with motor 405 KW, 2900 rpm, 380 Volts.	Installed. Pump not suitable for this position. To be replaced Motor voltage improper.
	c. Delivery line from the river bed pumps to the overhead tank in the mill. Pipe line (galvanized) dia. 150 mm. Total length : 272 mt. Net level difference : 57.7 mt. No. of 90° bends in the line : 8.	In service.
3.2.2	Overhead tank for fresh water located at 11.85 mt. from the ground level in the mill site. Capacity : 177 m^3.	In service. Badly leaking. Need major repair.

3.3.1	Power supply for PM 2. Step-down transformer 11 KV/0.5 KV - 500 KVA. HV 2824 Amp. LV 575.4 Amp. at normal taping. 3 phase 50 Hz. induction level HV 75. LV 2.5. Impedance at normal taping 4.45. Core + winding 967 KG. Cooling. O.N	Installed. Not in service.
3.3.2	Additional step-down transformer for PM 1. to operate in parallel with the existing one for PM 1. 11 KV / 0.5 KV, 3 phase 50 Hz.	New. Not installed. Not wired.
3.4.1	Air supply : One portable air compressor mounted on a small reservoir. Capacity by vol. 350 lit./min. (twin pistons). Max. pressure 10.5 bar. motor 7.5 KW, 1430 rpm, 450 V from ASEA.	Installed. In service.
4.0.0.	<u>OVER HEAD CRANE FOR PM 2</u>.	
4.1.1	Type TIP from ASEA equipped with 2 cable telphers type TMF - E 3241 <u>380 Volts</u>. Lifting force : 2 x 2500 Kg. Span width : 9.75 mt. Lifting height : 10.00 mt. Lifting speed : 8.0-1.3 m/min. Cross travel speed : 19.0 mt./min. Longitudinal speed : 27.0 mt./min. Rated for 100 Amp. 415 V, 50 Hz. 3 phase.	New. Partially installed. 2 new telphers complete in stores. Longitudinal power supply bars of 77.5 mt. length and collector items missing.

Annex CC 6-1

COST CALCULATIONS

Following is a typical cost calculations of paper as presented by PAPCO for the month of April 1988.

Cost calculation of PM 1 producing approx. 3 tons of paper in one shift a day operation.

Total finished production : 30.0 MT.
(duplicating paper : substance 80 gr./m²)

Contents	Total Fixed Cost U.Sh.	Total vari. Cost U.Sh.	Total cost U.Sh.	Cost/Ton U.Sh.
Raw materials	---	1,875,000	1,875,000	62,500
Auxiliary material (chemicals)	-	210,000	210,000	7,000
Direct labour	30,000	----	30,000	1,000
Factory overhead	506,500	338,360	844,860	28,162
Cost of manufacture (variable)	536,500	2,423,360	2,959,860	98,662
Administration overhead	376,260	----	376,260	12,542
Cost of production	912.760	2,423,360	3,336,120	111,204
Selling Expenses	39,000	----	39,000	1,300
Total Cost Ex - Mill	951,760	2,423,360	3,375,120	112,504
Equivalent in U.S. $	15,863	40,389	56,252	1,875

Establishing selling price (As practiced)

	U.Sh.	U.S. $
Total Cost/Ton Ex - Mill :	112,504	1,875,0
Add profit 30 % :	33,751	562,5
Net mill realisation :	146,255	2,437,5
Add Govt. sales tax 40 % :	58,502	975,0
Selling price Ex - mill :	204,757	3,412,5

(NOTE : 1 U.S. dollar = 60 Ugandan Shillings).

As recorded, the monthly cost figures are inconsistent and therefore may not represent the actual production cost of paper. However, these figures may be accounted for an overall cost structure of the mill operation.

Annex CC 6-2

The following cost figures in U.S dollars are derived from manipulating the present non continuous one shift operation into three shift continuous operation on a sustained basis.

Estimated cost calculation of paper machine No.1 producing 10 Tons of paper per day in three shifts operation.

(Comparative study based on plant operation in April 1988)

Contents	1 shift opern. Cost/T. U.S. $	% of total Mfg. Cost	3 shifts opern. Cost/T. U.S. $	% of total Mfg. Cost
Raw material	1042	55.5	1042	72.8
Aux. materials	116	6.3	116	8.1
Direct labour	17	0.9	13	0.9
Factory overhead (Fix)	282	15.0	40	2.8
Factory overhead (vari)	187	10.0	187	13.1
Admin. overhead	209	11.2	30	2.1
Selling Expenses	22	1.1	3	0.2
Total Cost Ex - Mill	1875	100.0	1431	100.0

Annex CC 6-3

Estimated cost calculation of paper machine No. 2 producing 10 Tons of paper per day in three shifts, operating in parallel with PM 1.

Contents	3 shifts opern. Cost/T. U.S. $	% of total Mfg. Cost
Raw material	1042	67.8
Aux. material	116	7.6
Direct labour	13	0.8
Factory overhead (fixed)	20	1.3
Factory overhead (variable)	187	12.1
Administration overhead	15	1.0
Selling expenses	2	0.1
Sub Total	1395	90.7
* Depreciation on equipment	137	8.9
** Interest on loan	6	0.4
Cost Ex - Mill	1538	100.0

* Calculated only on 3.3 million U.S. dollars as investment on equipment to complete erection and commission of the PM 2.

** Interest calculated only on 3.3 million U.S. dollars as soft loan at 1 % interest payable in approximately 25 years period.

Annex CC 6-4

Estimated Cost Calculation of a new paper machine with an annual production capacity of 15,000 tons of paper using secondary fibre as a major paper furnish.

Contents	Quantity per ton Kgs	Unit Cost per ton U.S $	Total Cost per ton U.S. $	% of Mfg. Cost
Variable Cost :				
Virgin fibre	240	1050	252	22.5
Secondary fibre	560	525	294	26.2
Total Chemicals (Addit.)	---	---	200	17.8
Utilities (Elec, water, steam)	---	---	150	13.4
Repairs and maintenance	---	---	7	0.5
Machine clothings and operative supplies	---	---	17	1.5
Packing material	---	---	6	0.5
Sub Total :	---	---	926	82.5
Fixed Cost :				
Salaries and wages	---	---	14	1.4
Admin.Expen. & overhead	---	---	11	1.0
Sales expenses	---	---	2	0.2
* Depreciation of equipment and building	---	---	161	14.3
** Interest on long term loans	---	---	7	0.6
Sub Total :	---	---	195	17.5
Cost / T. Ex - Mill	---	---	1121	100.0

* Depreciation on equipment and buildings has been calculated at an annual rating of 12 1/2 % and 4% respectively.

** Interest has been calculated based on soft loan at an annual rating of 1% payable in approximately 25 years period.

Selling price :

Description	U.S. dollars
Cost / Ton Ex - Mill	1121
Profit 30 %	336
Mill net realisation	1457
Govt. Sales tax 40 %	583
Selling price / Ton Ex - mill	2040

Gross turn over per year	30.6 million U.S. dollars
Net profit per year	5.0 million U.S. dollars
Contribution towards Govt. revenue	8.7 million U.S. dollars

The above calculations are based on the following assumptions :

- Set up of a new paper machine with auxiliaries including housing.
- Set up of a new deinking plant to process approximately 70 % of the required fibre furnish.
- Utilisation of virgin wood pulp at approximately 30 % of the required fibre furnish.

NOTE : Some of the cost points are based on latest price structure of material and utilities obtained from the mill.