3.1.2 Grinding Process

Since the current GP requirement of 194 BDT/D remains unchanged if output is raised to 130,000 tons/year in Case 2, no improvement in equipment is needed for production increase. A GP requirement of 144 BDT/D in Case 1 (100,000 tons/year) corresponds to 75% of equipment capacity. The most important is shives improvement, which will later be described in detail.

Most of the equipment and technological improvements mentioned below pertain to shives improvement.

Improvement in equipment is outlined as follows.

1) Slabs and slivers, after being ground, are further ground to fine pieces with shredders appropriate for them.

2) The pressure type screen (1.6 mmø) is replaced by a low differential pressure type screen (0.12 mm slits).

3) The quantity of tails is increased and another refiner system is installed. A low differential pressure type screen is introduced also here, and a reject screen is installed for tail treatment.

4) A centri-cleaner is installed in the main stream. The polydisk filters need to be increased in number in Case 2, as a result.

5) The existing flow sheet is revised regarding the order of the screen and the cleaner of the tail system as well as destinations of accepts.

(1) Major equipment remodeling

1) Grinder stone material

For average logs	A 60 3 M 7 V	
For thick logs	A 46 7 O 7 V	Aksu mill

In Japan, stones of a kind are generally used at a mill both for average and thick logs. Stones of 60 mesh N are used in some mills (for red pines), but 70 mesh stones are used at most mills.

As current stone quality tends to cause rough stock, it is difficult to maintain fine stock. Stones of 70 meshes should be used, based on a talk with the stone maker. Use of 46 mesh stones should be discontinued by all means.

2) Shredder system

The existing shredder of re-chipper type seems suitable for big chip treatment. Only slabs discharged from the bar screen will therefore be fed to the shredder that is going to be relocated.

The bull screen plate is changed from 8 mmø to 5 mmø to increase the quantity of slivers as well as to mitigate load on the primary screen and to raise its efficiency. Rejects from it are fed to a newly installed hammer mill type shredder (one unit in Case 1 and two units in Case 2), together with stock to be treated by a shredder, and evenly ground, to raise efficiency of refiner treatment. Stock is conveyed on a belt conveyor and a screw conveyor.

3) Primary pressure screen

Two of the existing pressure type screens are replaced by two low differential pressure type screens having 0.12 mm slits.

Since these slits are of special type, these screens excel in large fiber separation.

4) Reject treatment system

Increase in the quantity of tails is considerable as a result of strengthening of the shredder system, improvement in the primary screens, and revision of the flow of the reject treatment system.

A. Installation of another refiner system

It is estimated that one Sprout-Waldron disk refiner of 500 kW treats about 25 BDT/D, 635 -- 340 CSF.

As the extent that shives are ground by the refiner is important, it is desirable that the amount to be treated be lowered down to 150 cc. The following is planned in each Case.

Case 1 disk refiner	2,200 kW, an increase of ca. 45 BDT/D
Case 2 disk refiner	3,300 kW, an increase of ca. 60 BDT/D

In either case, the existing refiner and drainer manufactured by Mitsubishi are replaced by a new screw press and another refiner.

B. Secondary pressure screen

The existing pressure screen is replaced by a low differential pressure type screen having 0.13 mm slits, exclusively for the refiners. The type of slit is the same as that of the primary screen.

C. Reject screen

Tails from the refiner screen are fed to the reject screen with a view to rejecting and discarding large fibers and shives that are difficult to refine. This apparatus has shown good results in selection with a two tab timer batch system. Stock that has passed 0.15 mm slits of the reject screen is returned to the refiner inlet.

D. Centri-cleaner

In Case 1, the Mitsubishi cleaner whose operation is now suspended is used in addition to the existing ALBIA cleaner, and a tertiary cleaner is installed.

A newly installed cleaner should have three stages for heightened selectivity and reject reduction.

5) Main stream centri-cleaner

A centri-cleaner is indispensable for shive removal. Both in Case 1 and Case 2, the apparatus should have five stages, though different in scale, to heighten selectivity and reduce rejects.

The existing office room on the second floor is relocated, and a new unit of cleaner equipment is installed in the eastern part.

6) Polydisk filter

New installation of a centri-cleaner lowers consistency and thereby lowers treatment capacity of the filter.

In Case 1, no new polydisk filter is installed. In Case 2, one additional filter of the same scale as the existing one is installed next to it.

In either case, capacity is raised by increased revolutions of the filters. If it is still insufficient, capacity is raised by medium addition of DIP or BKP.

7) Screw presses

Raw materials fed from the polydisk filter with the screw conveyer are dewatered to a higher density with the screw press, are mixed with H_2O_2 with the mixer and then are mixed with water glass NaOH and vapor at a high temperature.

8) Bleaching tower

Made of concrete; raw material density: 18% at 60°C; retention time: 24 hours

9) Construction of additional buildings

A glass water dissolving device and a bleaching tower are constructed on the first floor, and a screw press, a mixer and a chemical adding device are installed on the second and third floors.

A three-story reinforced concrete building (15.5 meters x 13 meters) is added to the eastern side of the polydisk filter room (its third floor being of steel-frame construction).

10) Major apparatuses to be improved in the grinding process are as shown on the following page.

11) The layout of newly installed GP bleaching apparatuses is as shown in Fig. IV-3-1 and VI-3-2.

Table of Major Apparatuses to be Improved in Grinding Process

	Equipment	Case 1	Case 2
(1)	Sliver hammer mill, new installation	610ø x 700 lit 15mmø Motor 55kW 1 unit	Ditto 2 units
(2)	Primary screen Renewal	Plate 0.12mm slits Motor 90kW 2 units	Plate 0.12mm slits Motor 110kW 2 units
(3)	Centri-cleaner New installation	Primary 34 pieces Secondary 14 pieces Tertiary 5 pieces Fourth 2 pieces Fifth 1 piece	Primary 44 pieces Secondary 18 pieces Tertiary 6 pieces Fourth 2 pieces Fifth 1 piece
(4)	Polydisk filter Increase	None	3,800mmø x 9 disks 5.5kW x 2 1 unit
(5)	Screw press Increase	VS motor 22kW 1 unit	VS motor 30kW 1 unit

(6)	Refiner Increase	45" single disk Motor 2,200kW 1 unit	Ditto Motor 3,300kW 1 unit
(7)	Refiner screen Renewal	Plate 0.13mm slits Motor 55kW 1 unit	Plate 0.13mm slits Motor 90kW 1 unit
(8)	Refiner reject screen, new installation	Plate 0.15mm slits Motor 11kW x 2 1 unit	Plate 0.15mm slits Motor 15kW x 2 1 unit
(9)	Centri- cleaner for refiner Increase	Mitsubishi cleaner whose operation is suspended 1 set Tertiary cleaner 1 piece	Primary 6 pieces Secondary 2 pieces Tertiary 1 piece

List (2) of Major Apparatuses to Be Newly Installed

	Equipment	Case 1	Case 2
(10)	Screw presses	8000 x 5,000 Motor 75kW 2 units	Ditto 3 units
(11)	Mixer	Double-shaft type Steam chemical motor 22kW x 2 1 unit	Ditto 1 unit
(12)	Bleaching tower	Made of concrete Internal diameter 4.8 mo x 8.6 mH 1 unit	Made of concrete Internal diameter 5.4 mo x 9.0 mH 1 unit

(2) Improvements pertaining to quality and operations

1) Instrumentation and material balance management

A. Management of measuring instruments

The manometers of the screen are left damaged and the grinder pit thermometer is not used. The meters of the grinder motor are so dirty that their indications cannot be read. Many of useful meters are not utilized. It is necessary to review necessity of these meters and improve their management to make them fulfill their functions.

B. Material balance sheet

Equipment underwent remodeling and the flow was revised several times in the past. However, it is only old drawings that exist, and there are no revised ones. It must be possible to make a material balance sheet by measuring consistency and the amount of discharge at important points and by utilizing flow meters. This constitutes the basis of subsequent improvements.

2) Burring of the grinders

As Fig. IV-3-1 shows, the cycle of burring is 7.1 days on the average, 3.7 days at the minimum, and 11.7 days at the maximum, in terms of continuous operation of the grinders. The cycle seems to be sometimes longer. At most Japanese mills burring is implemented once every two or three days. Freeness is SR 70 to 75 (reference: CF 80 to 50) just before burring and SR 45 to 50 (reference: CF 260 to 220) immediately after burring. Freeness should be around SR 58 (CF 150) immediately after burring. The reality is that the

grinder is too coarse.

SR 59 to 74 (CF 140 to 50) at the bull screen in Table IV-3-2 is too large in dispersion. Dispersion should be halved in the finer direction. The coarse and the fine should not be mixed to be averaged. It is important for each grinder to produce even stock. Using the grinders that have undergone strong burring causes large dispersion in freeness, as a natural consequence, because they are used until fine stock is obtained.

As the cycle of burring nears its end, unit power requirement increases. It is desirable to judge the timing of burring by change in freeness and unit power requirement of the two grinders combined.

In summary, the grinders should be equipped with fine-grain-size stones, which undergo light burring repeatedly in a short cycle.

Note: Though correlation with SR is not known accurately in the case of CF 110 and below, it is mentioned here for the reader's reference.

3) Unit power requirement for the grinders

Stronger cylinder pressure immediately after burring raises output, lowering unit power requirement to a large extent, but freeness becomes very coarse. Both output and unit power requirement are lowered at the end of a burring cycle and freeness becomes fine. Generally, stronger cylinder pressure does not change this situation.

As burring has a close relation with both productivity and unit power requirement, the primary importance consists in raising their efficiency within the range of quality to be maintained.

The 1989 result was 1,287 kWH/BDT, 20% to 30% larger than in Japan. A presumption: firstly, pressure cannot be made stronger, in order to avoid stock becoming coarse, in connection with burring, and this results in low productivity and high unit power requirement. A close review is needed in this respect. Secondly, non-continuous operation of the pocket type grinder due to its mechanical structure causes power loss from idling. Thirdly, power loss is caused by a racing of 30 minutes/day for stone shower cleaning and racing of one of the grinders (100 kW) when they are operated in odd numbers.

4) Grinder operations

A. Grinder shower cleaning

Piston pressurization of pocket stock is stopped and the surface of stones are cleaned with water pressurized to 5 kilograms/square centimeter, three times every day, each time for ten minutes.

It is desirable that high-temperature recycle water in the system be continuously sprinkled at a high pressure of 7 or 8 kilograms/square centimeter. Grinding becomes easy, as a result, fluctuation in power becomes smaller, and thereby unit power requirement is favorably affected. This means an increase in output without any need to stop production.

B. Heating of grinder shower water

The 1989 unit steam requirement was 0.81 T/GPBDT, which was considerably large in quantity. Filtrate from the polydisk filter is used for grinder shower, but filtrate temperature is lowered by raw water used for filter shower. Steam seems to be used for heating to prevent adverse effects, which is seemingly the reason that steam consumption is so large.

It is said that as recycle water temperature becomes higher, more energy can be saved. However, consumption of a large quantity of steam cannot pay. It is better to use high-temperature clear white water from the paper machine and limit the use of raw water to the minimum.

GP recycle water should be used as much as possible. Making a closed system by preventing GP recycle water from flowing out will help raise recycle water temperature and prevent stock loss. Incidentally there is no GP mill in Japan that uses steam for other than bleaching.

They say they have begun using paper machine white water as filter shower. But raw water was used during the Team's survey. If there are clogging, use of clear water from the gravity filter planned for processing is recommended.

C. Grinder pit stock consistency

Consistency has a very large dispersion of 1.4% to 4.2%. Dispersion may be inevitable in view of non-continuous operation of two pocket pressurization type. Since consistency, temperature and freeness in the pit are related with each other, fluctuation needs to be made as small as possible.

If consistency is too high, raw material could overflow the screen when the slits of the bull screen plate is made smaller to 5 mmø. Special attention needs to be paid in this respect.

5) Refiner operations

Chest stock after refiner treatment has a very large dispersion of 4.7% to 10.3%, SR 28 to 59 (CF 450 to 220). In treating shives, appropriate operation of the refiner treatment system is important. The refiner's function of making stock finer is most important, as a matter of course.

Freeness after treatment does not become stable nor shives are not reduced until adequate consistency and a proper amount of stock flow are maintained.

Another important matter is management of wear in the refiner. Replacement of parts should be implemented before it is too late, under close checking of freeness, power consumption, and service period.

6) GP finishing stock freeness

Freeness has a large dispersion of SR 64 to 74 (CF 110 to 50). We recommend, from our experience, that it be controlled at CF 70 to 90.

7) GP hydrogen peroxide bleaching

To attain 55 to 56 brightness for newsprint, the following values of brightness are required for GP.

Case 1	GP brightness	50 to 55
Case 2	GP brightness	50 to 53

The differences between Case 1 and Case 2 are caused because there are differences in blending proportion between BKP and GP given the same output of DIP for both cases.

As the chemicals facility is to be situated at some distance form DIP, its equipment is considered separately from the other equipment.

Although details of the equipment is basically the same as in the cases of DIP, an H_2SO_4 adding device is included for use in pH adjustment after bleaching.

As the brightness of unbleached GP varies widely with the type, place of production, timing of felling and freshness of the tree, the findings of a basic study like this should be grasped accurately.

It is also necessary to study the relation between the addition rate and brightness of the bleaching chemical for the pulp through a table test.

(3) GP bleaching chemicals

The chemicals used for bleaching GP include:

Chemical	Properties
Hydrogen peroxide	740g/l liquid
Caustic potash	750g/l liquid
Sodium silicate	Solid
Sulfuric acid	Liquid
DTPA	Liquid

Optimal conditions should be decided on the basis of the results of experiments on the addition rate, temperature, density and reaction time.

(4) Grinding Process Flow-sheet

Grinding process flow-sheets for current and both alternatives are shown in Fig. IV-3-3 and IV-3-5.

3.1.3 Preparation Process

(1) Renovations

1) Separation of the DB and WB treatment systems

2) Installation of a WB receiving chest

3) Switching of white water recovery mediums from machine-finished stock to KP + DIP

4) Use of machine white water instead of diluting water for control water of the consistency controllers

5) Installation of equipment pertaining to new installation of DIP

6) Removal of the Jordan in front of the machine head box

7) The control system of the preparation room

8) Measures for raising temperature of BKP dissolved pulp

Temperature of BKP dissolved pulp is 31 degrees C. Stock inlet temperature needs to be maintained at 42 to 45 degrees C., by raising pulp temperature.

Stock inlet temperature can be raised through the following measures.

a) Currently clear water of the GP polydisk filter is shifted to the water storage and stored in the white water storage of the pulper room.

b) A measure to be taken is pumping up clear water directly into the white water storage of the pulper room.

c) Laying a pipe over several meters is sufficient for that purpose.

d) This improvement, together with effects from planned renovations in white water utilization, will maintain BKP pulp chest temperature at 50 to 55 degrees C., raising pulp temperature after refining to around 60 degrees C.

e) This measure contributes to raising stock inlet temperature by about 5 degrees C. Rise in stock temperature heightens dewatering effects

and contributes to energy conservation such as steam saving in the evaporation process.

(2) Details of renovations

1) A. In the existing broke recovery system, DB and WB are fed together to one stock thickener (2,000 ϕ x 7,000), which is located in a broke chest. Moreover, DB blending is limited to only 10% at Aksu mill, they say.

In Aksu mill, which has only one machine, the whole quantity of produced broke has to be treated, and it is therefore necessary to set a ceiling to DB blending. However, only WB should be fed when necessary.

From this point of view, DB and WB should be separately treated. For new flow, refer to the attached chart.

B. Details of equipment

(A) Installation of a screen ... High consistency cleaner

(B) Installation of a filter ... Disk ext unit

3,460 ϕ x 4D x 15kW

(C) Renewal of the refiner ..... Top-finer 2 units

440V x 86A x 2P

(D) For the flow from the DB finishing chest to the blending chest, the unused equipment is utilized.

a. DB finishing chest ... Reuse of 165 cubic meters, 150 tons (E07025)

b. Pumps ... Reuse of E07027 (0.5 cubic meters/min x 30mH x 15W) and E07033 (capacity unknown). As capacity will be insufficient in Case 2, E07027 is exchanged for E07013 (2.5 x 20 x 15kW), which becomes unnecessary as described in 3) below.

2) Installation of a WB receiving chest

A. Currently broke sent from the couch pit is directly fed to the stock thickener, without any cushion. The couch pit, seemingly having a volume of 115 to 120 cubic meters, a couch pit overflow was recorded three times in the survey on machine stoppages during January and February this year at Aksu mill.

Installation of a WB receiving chest is recommended, with the view of preventing such trouble as much as possible as well as of stabilizing WB quality.

B. Details of equipment

(A) The equipment is installed alongside of the chest on the first floor of the preparation room.

5,300 mm x 5,000 mm x 6,500 mmH = 160 cubic meters (220 T)

However, since the equipment is enclosed by the existing chests and the floor of the second story, engineering work is needed only for the chest floor and the surfaces of two walls, with smaller installation expenses.

(B) The existing broke storage chest (E07029) 7,500ø x 15,000H, having a large volume of 530 cubic meters, is partitioned, and one portion is used for WB.

3) A. Finished stock is used, pumped up from the machine chest, for a medium of the white water recovery polydisk filter.

White water recovery medium pulp is more effective when it consists of long-fiber pulp. KP and DIP are more appropriate than finished stock, in this respect. In Case 2, another polydisk filter (ø3,800 x 7D x 55kW) needs to be installed because recovery capacity becomes insufficient.

B. Details of equipment

(A) Piping is extended to the PDF, branched from the KP and DIP piping. A set of FIRC (flow indicating and recording control device) is attached to the piping. A 4B valve is satisfactory for 4B branch piping from the DIP piping and 6B piping. A 4B valve is satisfactory for KP4B branch piping.

4B x 8,700

(B) The existing filter feed pump (E07013-2.5 cubic meters/min x 20 mH x 15 kW) is removed.

4) A. Pulp consistency is currently controlled at six points: one point in the broke system, one point in GP, one point in KP, one point at the blending chest outlet, one point at the machine chest outlet, and one point at the stock feed pump. For diluting water, feed water from the water storage tank is used, mixed with clear white water from the process water pump, machine water heating tank, condenser pit or vacuum pump seal water.

This diluting water seems to be one cause of a low inlet temperature of 34 degrees C at Aksu mill. It is more desirable that white water from the seal pit be used for consistency control.

B. Details of equipment

(A) Flow change (see the attached chart).

(B) Renewal of the six consistency controllers

5) A. Regarding equipment pertaining to new installation of DIP, a receiving chest is not installed in the preparation room, in view of short distance from the DIP room and installation expenses.

For instrumentation concerning DIP, indicators in the panel room and a Firc for receiving DIP are needed.

B. Details of equipment

(A) A set of Firc equipped with a 4B valve in 4B piping

6) A. The Jordan in front of the machine head box is used for fiber cutting only. It should be removed. However, GP quality needs to be satisfactorily good.

B. Details

The Jordan is removed at the time piping is changed around the machine inlet. A 300 kW (375 RPM) motor becomes unnecessary, and electric power is saved, as a result.

7) A. The control valve and the indication controller in the preparation room must be superannuated from 20 years' installation. Taking into consideration the situation of instrumentation in the world and the significance of renovations, we have planned to introduce the CRT system to the control system.

B. An outline of the instrumentation flow is shown in the attached chart.

3.1.4 Papermaking Process

(1) Outline of the plans

Case 1

In Case 1, where annual output is set at 100,000 tons, the existing apparatuses are utilized as much as possible, based on the present diagnosis on their mechanical strength. We have planned overall equip-

ment improvement that will not be old-fashioned in the future, by examining apparatuses that are too inferior in operability and performance to cope with increased speed or increased output and that are difficult to maintain, and then by heightening their performance through renewal of them.

In Case 1, the characteristics of the existing Fourdrinier machine are utilized. The plan is aimed at improving product quality, including that of top and back sides. A partial twin system is introduced, investment costs to which are low and which does not cause large loss from a shutdown for remodeling. And thus, the output goal is planned to be attained with super light weight paper of 45 grams/square meter, at an operation speed of 760 meters/minute.

Case 2

To produce 130,000 tons/year, set in the planned renovations to satisfy increasing demand for newspaper in Turkey, an operation speed of 1,000 meters/minute is needed for the existing apparatuses. With a few exceptions, however, they do not have sufficient mechanical strength on the whole. Therefore the drier cylinder, gear, and gear case are used as they are, and the others need to be replaced by new ones. The twin former system, the most widely spread system, is introduced as the basis of Case 2 to make super light weight paper at high speed.

As the time study of winder operations at current roll measurements has shown that one winder is insufficient in capacity, another winder is installed.

(2) Production plan

1) Design output at the time of installation:

82,500 T/Y = 250 x 330 D/Y

A. Machine design elements

(A)	Wire	7,520mm
(B)	Trim on reel	7,000mm
(C)	Trim on winder	6,900mm
(D)	Design speed	700m/min
(E)	Balancing speed	760m/min
(F)	Production	366T/D

51.8G/sq.meter x 7,000 x 1,440 x 100%EFF
= 365.5T/24

B. Balance sheet DWG No. 41-65037-d

		Consistency (%)	Flow (cub.m/min)	Output (B.D. T/D)
(A)	Qty. of inlet feeding	0.670	55,55	535,9
(B)	Qty. of inlet discharge	0.64	53.29	519.4
(C)	Qty. before W.S. box	1.5	15.65	338
(D)	Qty. behind W.S. box	15	1.4	304.1
(E)	Qty. behind couch	21	1.0	300
(F)	Wire trim	21	0.13	4.1
(G)	Qty. of sheet break at wire	21	1.0	304.1

2) Current standard of output

A. Operation days and output

(A)	Operation days	300 days
(B)	Output	74,700 T/Y = 249 T/D at Winder
(C)	Production standards	
a.	Trim on wire	6,900 mm
b.	Basis weight	49 grams/square meter
c.	Machine EFF	82%
d.	Output calculation	

	EFF. (%)	Output efficiency (%)	Reel efficiency (%)
	100	82	88
Production (T/D)	304	249	268

3) Planned production increase in Case 1

A. 100,000 T/Y

(A)	Operation days	330 days
(B)	Basis weight	45 grams/square meter
(C)	Output	100,000 T/Y = 303 T/D at winder
(D)	Machine efficiency (%)	88
(E)	Output calculation	

	Product efficiency	Theoret. efficiency	Reel eff. efficiency
	(%)	(%)	(%)
	88	100	93
Prod. (T/D)	303	344	326

B. Material balance

344 T/D at 100% efficiency, moisture content: 7%
344 T/D x 0.93 = 320 B.D.T/D

C. Specifications of machine remodeling

(A)	Machine type	On top wire
(B)	Driving volume	760 m/min
(C)	Driving speed	760 m/min

4) Planned production increase in Case 2

A. 130,000 T/Y

(A)	Operation days	330 days
(B)	Basis weight	45 grams/square meter
(C)	Output	A- 130,000 T/Y = 394 T/D at winder B- Max. operation speed 1,000 m/min = 408 T/D at winder
(D)	Machine efficiency (%)	90
(E)	Output calculation	

		Product efficiency (%)	Theoret. efficiency (%)	Reel eff. efficiency (%)
		90	100	95
Output (T/D)	A-	394	438	416
	B-	408	454	413

(F) Material balance

a. In the case of A Theoretical efficiency of 438 T/D, moisture content: 7%, papermaking speed: ca. 966 m/min
438 T/D x 0.93 = 407.3 B.D.T/D

b. In the case of B Theoretical efficiency of 454 T/D, moisture content: 7%
454 T/D x 0.93 = 422 B.D.T/D

B. Specifications of machine remodeling

(A)	Machine type	Twin wire
(B)	Arrangement	Right-handed
(C)	Product	Newspaper
(D)	Basis weight	45 grams/square meter
(E)	Wire width	7,700 mm
(F)	Paper width	Trim on reel max. 7,000 mm Trim max. winder 6,900 mm
(G)	Operation speed	1,000 m/min
(H)	Drying capacity	1,000 m/min
(I)	Volume of driving gear	1,100 m/min
(J)	Max. design speed (Mechanical strength)	1,100 m/min
(K)	Roll balanc'g speed	1,100 m/min
(L)	Max. design winder speed	2,500 m/min

5) Output goal and design speed of the paper machine

To attain the goal of 100,000 tons/year set in Case 1, papermaking speed is 758 m/min at an overall efficiency of 88%.

To attain the goal of 130,000 tons/year set in Case 2, papermaking speed is 966 m/min at an assumed overall efficiency of 90%.

As design speed of the machine has been set at 760 m/min and 1,000 m/min for Case 1 and Case 2, design output slightly exceeds 100,000 tons/year and 130,000 tons/year, respectively.

(3) Outline of the equipment Case 1

1) Stock preparing equipment

A. BKP-solving and beating equipment

The existing equipment including pulpers and refiners should be applied to the intended use.

B. Pulp-blending equipment

(A) Initial equipment flow

The three types of pulps, namely, (1) GP, (2) BKP, and (3) D.B. are fed at a specified mixing ratio by using a consistency regulation meter and a flow meter provided to each type of pulps. Both the material (4) W.B. and white water-collecting pulp are mixed in a process to feed a finished pulp fully mixed in the preceding mixing box to the

blending chest. The pulps are composed of the four base pulp systems. They are fed to the machine chest through a consistency regulator and then to the stuff box again through the consistency regulator meter.

(B) The flow recommended by the survey included the functions of the mixing box in that of the blending chest for the pulps (3) and (4), though nothing has been changed for the pulps (1) and (2).

(C) Renovation plan

* The renovation plan adopts a structure provided with a new blending tank in which the five pulps, (1) GP, (2) BKP, (3) DIP, (4) W.B., and (5) D.B. are fed through a respective consistency regulator and a flow meter for mixing them.

* A white water-collecting pulp channel is compounded after the blending tank.

* A consistency regulator and a flow meter are renewed or newly provided at each channel of (1), (2), (3), (4), and (5).

C. Separation of the broke processing system

The existing equipment for collecting and processing wet broke (W.B.) and dry broke (D.B.) employs a thickener (2,000 mm in diameter x 7,000 mm in surface length) to process them together and to feed them to the

chest.

The W.B. has the same broke properties as pulps and may be compounded totally. Since, however, the D.B. is defiberized from paper, it naturally differs from the W.B. as to the properties and is compounded to a limited degree. Since stable properties of the pulps are indispensable for making super-light paper, the plan is adopted to separate the processing system from others.

(A) Wet broke system

* W.B. receiving chest . Existing 165 m^3 is applied to.
* Thickener ..... Existing thickener is applied to.
* W.B.finish chest ..... Existing thickener pit is applied to.

(B) Dry broke system

* D.B. receiving chest . Existing 135 m^3 is applied to.
* High-concentration cleaner ..... Eliminates foreign matter including metal pieces and protects a defiberer blade.

* Thickener ..... To be newly installed.

* D.B. finishing chest . Existing 65 m^3 is applied to.

* Defiberer ..... To be newly installed. The existing refiner is a beating type, not a type currently employed exclusively for defibering D.B.

(C) White water-collecting system

A medium presently used for collecting microfibers contained in the white water is one branched from the machine chest of finished pulps after the compounding process of GP and BKP. Since long-fibered BKP pulps are more effective in assuring collection of microfibers and improving filter capability, both the medium pulps and the flow related thereto are modified.

* Mixing tank ..... To be installed before the filter to mix the white water and the BKP.

* Filter ..... The existing poly-disk filter is used (3,800 in dia meter x 15 disks)

D. Other preparing equipment

The following equipment and facilities are listed to meet the requirements of modification, renewal, and capability based on the above-mentioned Renovation Plan.

(A) A set of pumping facilities
(B) Piping and modification work
(C) Two items of filtering equipment for shower
(D) One item of electric equipment
(E) A set of instrumentation

2) Paper machine

The paper-making process and technique aim at making products with enhanced printing properties at low costs. To enhance the printing properties, the products have to meet diversified requirements of printing techniques with different quality levels. As other section of the Report describes what paper quality is required for assuring the best results by means of such printing techniques, required paper quality design is first established. And then, the best method to manufacture paper is determined in the following stage.

How required quality is to be created requires analysis of equipment to improve surface structure of paper and paper-making techniques. What should be kept in mind as concept of the machine is that no defects should be found in any of the processes to finish pulps, to compose textures, and to press, dry, and calendar pulps in the whole paper process which affects paper structures and quality which in turn affect printing properties. This is

because they cannot be corrected in subsequent processes.

When referring to selection and treatment of pulps, long fibers increase paper strength, short ones improve printing finishes, and intermediate ones maintain excellent paper quality. These factors determine the basic characteristics of paper.

The process to compose textures for stock inlet and wire part must realize proper arrangement of fibers in terms of uniform distribution and thickness direction.

The pressing process has to dehydrate the full machine length of paper by pressing the paper sheet, without damaging its fiber structure. The drying process must dry it in a manner moisture may become uniform throughout the sheet. The calendaring process must smooth paper surface and press the paper into a required thickness.

Each of the processes must be implemented appropriately, because any of their functions can be compensated by subsequent processes.

Improvement of equipment and facilities to meet the objectives of the project is based on the concepts described above, while improvement of respective parts are based on the following: That is, improper materials do not produce quality paper while the pressing process cannot make up for defects in textures. Uneven moisture profile produced while using a press cannot always be corrected in the drying process, but an attempt to cause the drying process to play the role of the pressing process is not recommendable.

Most of the dryers dry sheets with uneven moisture profile as they are, and the calendaring process does not correct any defects given in the preceding processes.

Machines are frequently employed with an expectation that the final calendaring process will make up for any paper defects, in spite of the fact that it cannot improve defective textures and shortage of basis weight. Just like the past examples in Japan where machines were employed under such mistaken ideas, it seemed that similar ideas were prevailing in Aksu mill.

To improve the equipment and facilities, super-light paper making has been selected by attaching more importance to quality, while the functions of respective parts have been determined based on the above-mentioned concept.

A. Design criteria for modifying the machine

Type of paper :	Newsprint paper
Basis weight :	45 to 49 g/m^2
Wire width :	7,520 mm
Sheet width on a reel :	7,000 mm
Sheet width on a winder :	6,900 mm
Raw materials :	GP 60%, DIP 30%, and BKP 20% Ratio of calcium silicate to pulp 5%
Freeness :	100 cc C.S.F. in head box
pH :	6
Temperature :	42 to 45°C
Design speed of drive :	760 m/min., max.
Operating speed :	760 m/min., max.

Balancing speed :	760 m/min.
Machine direction :	Right-hand (drive is located on the right side when watching the dry end from the wet one)
Theoretical production :	345 T/D (45g/m^3 x 760m/min. x 7,000 mm x 100%)

B. Dirt removing and deaerating unit (approach)

An existing deculator/cleaner system is utilized to apply to both the cleaner and the screen to elimination of shives. To realize resources-saving designs, the numbers of the cleaner and the screen stages are four and three, respectively.

(A) Cleaners

Since the internal rubber of the existing cleaners has been obsolete, it seems that the cleaner should be replaced with a new one. The most excellent design for eliminating shives have been selected while the mounting and connecting dimensions agree with the present ones. Existing inlet and outlet headers are used while the following cleaners are replaced with new ones:

primary : 36, *secondary* : 8, tertiary 3, and quaternary 1

(B) Screen

The existing pressure screen plate is provided with 1.8 mm pores which are not suitable for eliminating the shives. So, a slit-type pressure screen has been selected since they have been popularly employed in recent years.

Primary :	4, electric motor 55 kW, V-belt driving
Secondary :	1, electric motor 45 kW, V-belt driving
Tertiary :	1, electric motor 45 kW Each basket is provided with 0.35 mm slits.

(C) Replacing electric motors for driving fan pumps

The existing AC motor is replaced with a DC motor which assures precise regulation when changing paper-making speeds and flow rates and saves energy.

* Fan pump No. 1 : The present specifications : 75 m^3/min. x 43 mH x 700 kW Required specifications to use the existing pump are : 65 m^3/min. x 34 mH with the DC motor of 450 kW

* Fan pump No. 2 : The present specifications : 66 m^3/min. x 23 mH x 320 kW Required specifications to use the existing pump are : 63 m^3/min. x 19 mH with the DC motor of 240 kW

(D) Cleaners and cleaner pumps

* Secondary cleaner pump : 13 m^3in. x 44 mH x 140 kW
* Tertiary cleaner pump : 4.5 m^3/min. x 37 mH x 45 kW
* Quaternary cleaner pump : 2.5 m^3/min. x 37 mH x 30 kW
* Secondary cleaner pump : 4.7 m^3/min. x 10 mH x 11 kW
* Tertiary cleaner pump : 0.5 m^3/min. x 10 mH x 2.2 kW

(E) Stuff box

The existing stuff box is installed at an excessively low position and both the flow meter and the measure are mounted at inappropriate positions. Since they do not ensure stable, precise regulation and supply with least dispersion in dry weight of super-light paper, the box is installed at a higher position and the flow meter and the BW control valve measure are renewed and installed at appropriate positions.

(F) Pulsation attenuator

This is a device to absorb pulsation of pressure and is in stalled in advance of the head box to stabilize liquid pressure of pulps to be supplied to the box. It substantially reduce pressure pulsation which is caused by the screen, the fan pump, and pulp pipes to enhance paper quality. The attenuator is provided with an air controller and an air pressure regulator.

C. Head box

The existing, enclosed air-cushion type is provided with the perforated rolls which displays limited functions in dispersing pulp floc and arranging their flows in order. This type involves many problems for producing uniform paper with good textures, for example, the fact that it is easily smeared, dirt is accumulated on and around the perforated rolls, and it lacks in precision when it is obsolete. So, it is replaced with a modern hydraulic head box.

(A) Main body

* Slice width : 7,370 mm

* Adjustment of opening of slice lips : Micro-jacks are arranged at an equal interval of 100 mm for assuring fine adjustment through a remote controlling. Manual operation is also available for adjusting the openings. By installing an automatic operation controller interlocked with a B/M

meter, B.D. profiles can be stabilized at an early stage, including making paper.

(B) Recirculation valve : V ball valve driven by the AC electric motor.

(C) Warm water supply unit : Stabilizes slices at an early stage by circulating warm water corresponding to the temperature of the pulp.

(D) Operating panel

D. Modifications of the wire part

Pulps ejected from the head box are appropriately dewatered by means of foils and are formed into a mat on the bottom wire. Then they are dewatered in the upward direction so that a pulp mat may be formed on the top wire, as well.

Pulsated pressure is applied to low-concentration pulp suspension left between the mats so that upward dewatering may be further effected to disperse again. This type is sometimes called hybrid former or top former.

* Since dehydration is effected on both sides of paper, the paper quality on both sides will be improved.

* The top former gives the material dandying effects to improve paper texture.

* Wire part is often modified by using a Fourdrinier machine.

(A) The existing Fourdrinier is to be equipped with a top former so as to satisfy requirements for making super-light paper by making full use of the Fourdrinier and the dehydrators already available.

* Items utilizing an existing dewatering device

Forming board :	1
Single-blade foil	4 (Among the existing six units, the remaining two are used as spares)
Multiple foil	3 (Existing three units)
Vacuum foil	1 (One of the three existing units, with the remaining two being spares)
Wire suction box	1 (One of the six existing units, with the remaining five being spares)

* Existing rolls : All the existing rolls, including breast rolls, suction couch rolls, and wire rolls, are utilized.

* Wire-exchanging method : The existing "machine-out" method which requires pulling wires out of the main body is modified into a "cantilever" method to facilitate exchange of top and bottom wires. This modification is effected at three sets of C-type cantilever beams but does not require any large-scaled modification of foundations.

C-type cantilever beam : Steel box beam lined with stainless steel on the surface.

(B) Specifications of the top former

* Wire-exchanging method : Aisle-stringing method using cantilevers and plastic wires

* Wire width : 7,520 mm x about 33,000 mm long

* Rolls : 1,070 mm (diam.) x 7,650 mm (surface length) x 5

  810 mm (diam.) x 7,650 mm (surface length) x 1

* Dewatering device: 3, blades made of ceramics or zirconia

This former is a compact, durable six-roll unit and is composed of an adjustable lead-in roll, a solid center roll, a lead-out roll, a wire roll, a stretch

roll, a guide roll, and dewatering devices. It is designed to be installed on the cantilever. Roll connections, tension units, guide and positioner, save-all, shower, and a part of the dewatering devices are supported by the main frame which is in turn supported by the two-storied base plates.

* Piping : All the pipes in the top former component interiors and peripheries are supplied in a prefabricated form.

* Data for top former shower

Application	Pressure x flow rate (kg/cm^2)	State in use (l/min.)	Type of water
Type of water			
Cleaning wires :	35 x 170	Continuous	Fresh water
Lubricating wire rolls :	2.8 x 1,224	Continuous	White water
Cleaning windows :	2.8 x 13	Continuous	Fresh water
Cleaning wires :	35 x 170	Continuous	Fresh water
Lubricating ceramics :	2.8 x 768	Intermittent	Warm water

* Others

Top former seal pit to be additionally installed.

Full set of the facility including control panel and scaffoldings.

(C) Other modifications of wire part

* Installation of shower filters for rolls : Diluted white water which is supplied from the white water collector is treated through a gravity filter which is to be newly installed so that it may become of the quality applicable to shower for rolls and other components. This will substantially reduce volumes of fresh water to be used for showering and help raise pulp temperature.

* Improvement of sheet knock-off shower and trim knock-off shower : Sufficient pressure and shower control are required to fully drop sheets onto the couch pit. A high-pressure pump is newly installed and the existing shower pipes and valves are replaced with new ones.

* Improvement of water used for trimming jet and nozzle cutter

- The water is branched from a drinking water system.

- Strainers are installed in series.

- Pumps are renewed with those for 8 liters/min. x 120 mH (two pumps to be installed, one of them being spare)

- Nozzle types are modified.

* Repositioning the nozzle cutter

The existing nozzle cutter is mounted on the suction pick- up roll. The roll is vibrated depending upon degrees of wear of felts, resulting in such production losses as discontinuous sheet cutting and troubles in the paper-feeding process. It should be repositioned on the suction couch roll while the operating board be placed at a location appropriate for the paper-threading process, thereby stabilizing the operation.

- Brackets, operating panel, scaffolding, etc.

Collection of white water from the suction couch roll dewatering process. In the existing system, water discharged from the vacuum pump is discharged into the plant waste water line due to disconnection of pipes from the pump, though it should have been delivered to the water storage tank according to the initial design. This may have been done due to high concentration of the white water. A separator and a drain pump are installed between the roll and the pump to collect the white water by delivering it to the seal pit, thereby reducing discharge load and saving more resources.

- Separator to be installed
- Drain pump to be installed

E. Modification of the press part

Generally speaking, the existing presses offer so low pressure that moisture of pulp sheets is kept high 62% or so at the end of the pressing process, precluding productivity. The press part is modified for attaining the following targets:

a. To improve dewatering in the presses.
b. To improve moisture profile.
c. To improve paper quality as to smoothness and thickness.
d. To reduce sheet breaks in the dryer section.
e. To save steam consumption.
f. To minimize maintenance work of rolls.

When the proposed modification displays intended effects, a dryness value of sheets is raised to improve productivity while increased fiber bondage improves mechanical strength and threading capability of the sheets, thereby the machine efficiency being enhanced.

To attain these goals, the number of felt suction boxes are changed into two per each felt, and the presses No.2 and No.3 are modified into a Venta-nip.

(A) Composition and modification of presses

* Design pressure :

Press No. 1
Present capacity : 53.6 kg/cm
No modification because this is a suction press roll.

Press No. 2
Present capacity : 58 kg/cm
After modification : 70 kg/cm

Press No. 3
Present capacity : 62.5 kg/cm
After modification :100 kg/cm

* Modification of main rolls

Top roll of Press No. 2

Diameter 1,160 mm, surface length 7,620 mm, made of cast iron wrapped with rubber, provided with a Venta groove and a doctor with water cooling unit in the interior.

Bottom roll of Press No. 3

Diameter 875 mm, pressuring surface length 7,620 mm, crown-variable roll, made of centrifugal cast iron wrapped with rubber, provided with a Venta groove, hydraulic unit, controller, and doctor.

Suction felt roll

Diameter 570 mm, drilled surface length 7,470 mm, 13-chrome stainless steel centrifugally cast, suction width 75 mm, and provided with a suction port for threading paper.
(Existing center roll and top roll of Press No. 3 with the diameters of 1,220 mm and the surface length of 7,620 are applied to as they are.)

* Felt roll : Existing rolls are used by newly arranging to meet modification of Presses No. 2 and 3.

* Paper roll : An existing roll after the center roll is used, with a minor design changed to adopt a swing support in the operation side. It is installed and driven after Press No. 3.

* Felt suction box (uhle-type box): Suction width 19 mm, lips are made of zirconia or ceramics and box of stainless steel, respectively. Max. operating degree of vacuum 380 mmHg to ensure effecting cleaning and dewatering of felts.

The existing box is applied for Press No. 1. One box is added to Presses No. 2 and 3 (thereby two boxes for each after the addition) to clean and dewater the felts. An anti-blowing box should be added to the inlet side of Press No. 3.

(B) Steam box

* To be installed at the low vacuum section of the suction press roll No. 1.

* Provided with stainless steel profile section capable of remote controlling.

* Computer interface for C.D. moisture profile control can be installed in the future. The box incorporates an air cylinder and is provided with a standard, electronically remote-controlled panel. However, both a steam flow integrating recorder and a pressure regulating valve are included in the drainage instrumentation.

(C) Additional items related to the modification of Presses No. 2 and 3

* Frame : The framework includes a rotary swing arm, stand, brackets, and cross-ties.

* Pressurizing unit : An air spring-type pressurizing unit is used for regulating nip pressure and for attaching/detaching rolls.

* Save-all : Made of stainless steel. To be supplied for two rolls. No need of detaching when exchanging felts. Rolls are exchanged for Press No. 3 by using a cross rail provided on the save-all. An existing save-all between the uhle box and the shower is replaced with a new one.

* Others : Scaffolding, piping, and operating board are included.

(D) Modification of other presses

* Data of shower after the presses are modified as proposed above (shower

pipes are to be installed at required locations)

Application	Quantity (kg/cm^2)		Pressure x flow (l/min.)	Operation,	Type of water
Cleaning felts	3	35	x 537	Continuous	Fresh water
Lubricating uhle box	3	2.8	x 219	Continuous	Fresh water
Cleaning grooved rolls	2	8.8	x 1,194	Continuous	Fresh water

* Improvement of broke chute shower

Showering has been effected even while no brokes are fed due to delayed broke treatment in the press center rolls, thereby reducing the concentration of wet brokes.

- Shower pipe is replaced in position and substituted with a new one. Filtrated white water is used.

- Showering is suspended while no brokes are fed.

* Installation of a doctor shower at the center roll and the 3P top roll

A doctor shower is installed to protect stone roll and doctor blades from being worn.

Water used for shower : 0.7 kg/cm^2 x 90 l/min. Fresh water

* Improvement of a doctor slider for the center roll and the 3P top roll

If the slider is not sufficiently maintained, the surface of the stone roll will be scratched in stripes and often lead to paper break. So, the slider including the doctor is improved.

F. Addition of vacuum pumps

The present air volume of the existing eight vacuum pumps is changed to values shown below as a result of surveying air volume balance after the wire part and press part are modified.

(A) Required air volume for vacuum

Nomenclature	Air volume (m^3/min.)	Degree of vacuum (mmHg)
Wire part		
Top former		
Box A	170	50
Box B	67	85
Box C	53	250
Box D	69	250
Suction box	29	250
Suction couch roll		
Low vacuum	124	250
High vacuum	272	500
Press part		
Suction pick		
Up roll	289	500
Suction press roll		
Low vacuum	233	
High vacuum	272	500
Uhle box	880	380
Suction felt roll	74	250

(B) Addition and modification of vacuum pumps

A vacuum pump is added to make up for a balance between the existing capacity and the required air volume as stated above, and internal cones of two pumps are modified to meet required degrees of vacuum.

* Addition : 280 m^3/min. x 380 mmHg x 285 kW x 1

* Modifications : Cones are exchanged in two vacuum pumps of 295 m^3/min. x 500 mmHg so they may display the capacity of about 295 m^3/min. x 380 mmHg.

(C) A blower, 151 m^3/min. x 10 mmHg, for generating humidity is included in the design of a hood unit.

(D) Other modifications

* Piping : To be newly added and modified as required.

* Air vent of pumps : Pump discharge ports from which waste gas is emitted indoors are sealed and be substituted with a device to discharge the whole waste gas outdoors so as to ensure improved environment.

- Modification of pits and installation of discharge flue

* Foundation and power supply works

G. Modification of the dryer part

The following items are modified to improve moisture pro file, to stabilize sheet traveling, and reduce power load.

a. Pocket ventilation roll
b. Drain diffusing bar to be installed in a dryer cylinder interior
c. Felt dryer cylinder to be removed
d. Steam blower to be exchanged
e. Dryer Group 1 to be modified so as to possess a single canvas, with a sheet transfer box being mounted in the inlet port
f. Tail cutter to be renewed

(A) Pocket ventilation

Twenty-one (21) pocket ventilation rolls with 512 mm in diameter and 7,030 mm in blowing face are installed to establish canvas conditioning (whose effects will allow the felt dryer cylinder to be removed) and to assure uniform humidity with low steam partial pressure in the dryer pocket interior.

* Hot air supplier : A full set of a 120^{o}C hot air supplier including a fan, a filter, a heater, dampers, and ducts.

(B) Drain diffusing bar

A magnet-type bar is mounted onto 16 dryer cylinders.

A coefficient of evaporating ratio (EV) is said to be improved by about 20%, if a large number of bars are mounted in an axial direction in the cylinder to reduce heat transfer resistance of steam condensate by causing turbulence in drain interior. These bars also play a role to unify thermal distribution in the direction of the cylinder width and to improve moisture profile.

(C) Steam blower

Apart from partial damages found in the existing rotary blower, it may increase both differential pressure required to discharge drain and blow-through steam as the paper-making speed is increased.

Such phenomena makes it impossible to apply three-stage cascade operation in the drainage system, compelling to use two-stage operation or causing similar problems. If a poorly maintained siphon prevents smooth discharge of drain, the dryer driving load will be increased so much that a stable drying operation cannot be expected at all. So, the existing steam blower is replaced with the following one:

* Simplex steam blower

* Fixed-type siphon for discharging drain ... 43 all paper dryers

* Pressure-sealed spherical carbon-type rotary joints for both steam-supplying and drain-discharging sides

(D) Single-canvas type for First Group

Six paper dryers contained in 1st Group are exchanged with single-canvas type by attaching more importance to stable traveling of wet sheets.

* Addition of doctors : A doctor is mounted onto the upper-stage paper dryers to protect sheets from winding about them.

(E) Sheet transfer box

A sheet transfer box is mounted to ensure smooth sheet transfer from the press to the dryer.

Hot air is supplied from the hot-air line of the pocket ventilation unit and is controlled by using a control damper.

(F) Renewal of a tail cutter

An existing knife which is used to pass paper tails from the dryer to the calendar is replaced with a rotary knife driven by a pneumatic motor so that it may travel along the width with an air motor remote-controlled.

(G) Changes in piping for supplying oil to dryers

Piping for supplying oil to dryers is changed, since the canvas dryers are removed while pocket ventilation rolls are newly installed. Pipes connecting from an oil supplier to oiled points form a few block of pipes, crossing over the dryers. Such cross-over portions allow paper pieces and dusts to be accumulated therein, causing problems from view points of prevention of casualty. The piping blocks are covered to minimize hazards.

(H) Improvement of drainage

Since 1st Dryer Group is changed into a single-canvas type, the section #4 for existing canvas dryers is used for the lower dryers, and instruments and pumps are added. Existing control instruments have been generally damaged so much that the whole set is exchanged with an electronic type so that the drainage system may be controlled through the D.C.S. of the instrumentation.

* Instruments : Full set
* Condensate pump : 1

(I) Modification of the calendar

Existing caliper profile controls include both cold and hot-air types. Although the hot-air type is subjected to automatic control interlocked with

the B/M meter, it has not displayed sufficient effects.

A modern dielectric generation unit is adopted, because it shows better response in caliper control and is most suitable for securing more uniform caliper profile of sheets.

The unit is modified to enable automatic control inter locked with the existing B/M meter.

* Dielectric generation unit : Full set, to be installed on the bottom roll

H. Dryer hood and waste heat collectors

When using dryers to dry paper, a large amount of steam is consumed, and moisture in the paper is evaporated in a form of steam. The paper cannot be fully dried until the steam is taken away by means of air current.

The dryer hood is modified into an air-tight design so that dry air in the hood interior may be effectively used to assure uniform drying of paper sheet. In case of a wider machine, the central part of a paper sheet is less dried than the edges due to reduction in air flow. The pocket ventilation is utilized to improve such uneven drying. The effects of the enclosed dryer hood are listed as follows:

a. To increase dew point of air discharged from the hood for reducing discharged air flow, thereby reducing steam consumption.

b. To recover heat from discharge air by means of heat exchangers.

c. To improve dryer capacity and paper quality through uniform drying.

d. To improve indoor working environment.

The system is composed of the following items:

a. Enclosed hood
b. Waste heat recovering unit
c. Air discharging unit
d. Air supplying unit
e. Pocket ventilator

The existing hood and the waste heat recovering unit have displayed extreme reduction in functions due to aging and lack of periodic maintenance. They have not fully discharged waste air, and a large amount of steam produced by drying paper sheets is blown from the hood into the room interior. Since the waste heat recovering unit has not functioned at all, no partial modification will produce any satisfactory results. So, the full set should be renewed.

(A) Design requirements of the unit

Production volume :	345 T/D
Moisture at dryer inlet:	59%
at dryer outlet	7%
Dew point	58°C
Discharged air temperature	80°C
Pocket ventilation air temperature	100°C

(B) Full set of enclosed hood

The hood possesses a heat-insulated structure which endures a high dew point. Air to be discharged from the hood is collected through a suction port via a regulating damper in the plenum at the top end of the hood. In addition to the doors listed below, the hood is provided with doors for transporting canvas dryers, for driving side, at hood end, and for inspection and treatment of waste paper (which is installed at the second floor). An opening through which sheets come in and out is provided with a blow pipe to prevent air leakage and dew concentration.

* External dimensions : 52m (L) x 11m (W) x 8m (H)
Made of aluminum

* Second floor, operation side : Lifting door, 2m (H) x 6m (L)
3.7 kW x 3, made of aluminum

* Second floor, driving side : Slide door, made of aluminum

* A set of illumination lights in the hood

(C) Heat exchanger x 2

The heat exchanger recovers heat from waste high-temperature wet air discharged through the hood and use the recovered heat to heat dry air to be

supplied to the hood. It is made of smooth plates so that dust in the waste air may not adhere to the exchanger surface and is provided with a cleaning spray.

* Plate type, 3.2m (D) x 2.325m (W) x 2.2m (H), made of stainless steel

(D) Air heater x 2

* Fine-tube heat exchanger

(E) Hood air discharger

This is a unit to discharge waste air in the hood into the atmosphere through the heat recovering unit. Discharged air volume is controlled by means of a discharging damper based on an automatic control system.

* Discharging fan : 2 units, centrifugal turbo type, made of stainless steel. 1,800 m^3/min. x 120 mmAq x 110 kW

* Duct : Made of aluminum and stainless steel.

* Damper : Multi-vane automatic type

(F) Hood air supplier

This is a unit covering from the air suction port of the chamber to the hood air supplying port and the pocket ventilation unit through the heat exchangers and the air heaters. The air

suction port sucks air above the hood so as to make effective use of heat discharged from the hood and to assure better ventilation of the paper-making room.

Heated air is supplied to the pocket ventilation unit, the blow-out pipe, blow pipes at the hood opening, and sheet transfer box.

* Air supplying fan : 2, centrifugal turbo type, made of stainless steel, 1,300 m^3/min. x 350 mmAq x 160 kW

* Air filter : Wire mesh, made of stainless steel, with a multi-vane automatic damper

* Damper : Multi-vane automatic type

(G) Wet part air-discharging fan (x 2)

This is a fan to discharge wet air coming from the wire part and the press part into the atmosphere.

* Fan for the wire part : 1,600 m^3/min. x 120 mmAq x 75 kW, made of stainless steel Mist separator and enclosure also made of stainless steel

* Fan for the press part : 500 m^3/min. x 80 mmAq x 15 kW, made of stainless steel

(H) Air system control

* Control devices : TIC x 2, TI x 3, TWI x 2, PIC x 2, and HC (for remote operation) x 4

Detecting ends, regulating valves, oscillators, and converters are all electronic. After modifying the existing B/M meter, it is incorporated in a distributed control system (DCS) so that operation may be controlled through a CRT.

* Control panel x 1

(I) A power panel

* 110 kW x 2, 160 kW x 2, 75 kW x 1, and 3.7 kW x 3

(J) Others

* A full set of foundation, duct and piping, heat insulating, and painting works

I. Reuse of breaker stack

As is found from the control records by the B/M meter and product quality inspection data in Japan, the density of the paper in issue is low (or the paper is thick). Indeed, this tendency is partly attributable to types of raw materials, but it is mainly due to low pressing pressure and lack of effects of a breaker stack.

Though a breaker stack has been originally installed, it has not been employed, because it was regarded as sources of sheet break and troubles in paper-threading operation. Such troubles seem to have occurred by unstable sheet movement at this point due to great dispersion in weight (or a paper sheet is thick in some times and thin in others) and moisture profile.

Since the recommended Renovation Plan ensures quality improvement, the sheet movement will be stabilized and the breaker stack may be applied once again to improve the paper density.

* An angle of 1.5 to 2^{o} to the bottom roll is set up at the sheet outlet port to ensure stable sheet running.

* Moisture of the breaker stack is regulated to 17 to 18% at the inlet port.

J. Modification of the calendar

Existing caliper profile controls include both cold and hot-air types. Although the hot-air type is subjected to automatic control interlocked with the B/M meter, it has not displayed sufficient effects.

A modern dielectric generation unit should be adopted, because it shows better response in caliper control and is most suitable for securing more uniform caliper profile of sheets.

The unit is modified to enable automatic control interlocked with the existing B/M meter.

K. Improvement of broke processing in the calendar pit

Broken paper pieces which are produced when paper sheets are cut at the final dryer, calendar, and reel sections are processed in a pulper installed in the calendar pit. In this process, a shower is used to introduce and dilute brokes so that they may be processed while they are circulated. In actuality, however, sheets are not always circulated but are left floated continuously on the surface. This phenomenon has easily filled the pit capacity and sent low-concentration stock to the preparing facilities, affecting broke-processing efficiency and paper quality.

The best way to improve such a state is to inject a large volume of pulps from the upper pit to quickly circulate and sediment the floating brokes into the lower circulating layer.

* Circulating pump x 1, 3 m^3/min. x 15 mH x 15 kW
* Shower pipe to be replaced
* Conveyer to be removed
* Pit to be modified

L. Modification of the winder

The existing winder has left nothing to be desired in terms of mechanical structure and strength (design speed of operation : 2,130 m/min.). However, it displays reduced performance in paper tension control and rolling tightness control. These two controls are replaced with modern ones to stabilize

high-speed operation and improve quality of roll paper.

(A) Paper tension control

* Segment roll : An existing guard board after the slitter is replaced with a new one, while one before it is used as it is.

* Electric load cell and control unit

(B) Winding tightness control

* A control unit for nip pressure of a rider roll and drum load

(C) Winding length indicator

* A rotation meter is provided onto the drum to indicate length on the control panel in a digital mode.

M. Modification of a driving unit

The existing line-shaft mechanical driving unit, including differential gears, have been aged so much that it will take much time and money in maintenance and give many influences upon attempts to increase speeds and production volume. The full set of the driving unit is renewed with a sectional electric type.

(A) Driving motor capacity

Section	Quantity	Motor capacity (kW)
Main		
Helper couch roll	1	370
Wire turning roll	1	370
Top former	1	150
Suction pick-up roll	1	55
Suction press roll	1	280
2P press roll	1	315
3P press roll	1	370
Press paper roll	2	5.5
1st dryer group	1	132
2nd dryer group	1	250
3rd dryer group	1	185
4th dryer group	1	185
Dryer paper roll	1	5.5
Breaker bottom roll	1	45
Breaker top roll	1	45
Spreader roll	1	5.5
Paper roll	1	5.5
Calendar roll	1	220
Spreader roll	1	5.5
Paper roll	1	5.5
Reel	1	75
Spreader roll	1	5.5
Reel spool starter	1	30

(B) Mechanical equipment

* Speed reduction gear	24
* Intermediate shaft	1 set
* Frame and safety cover	

(C) Electric equipment

* Paper-making machine	
- Electric motor	24 (total capacity : 3,121 kW)
- Controls	1 set
- Operating panel	1 set
* Fan pump	
- electric motor	2 (total capacity : 690 kW)
- Controls	1 set
* Power unit	
- Transformer, capacitors, and high-voltage CBS	
* Blower for cooling electric motors	1

N. Installation of a trim edge pulper

Trims or trim edges which are produced by cutting both ends of paper sheets during a roll-finishing process using a winder are pneumatically conveyed to the calendar pit by means of an exclusive blower so that they may be disposed of as dry brokes there.

There are no special problems in those facilities which are included in this trim-disposing process, and trims are separated from air in the calendar pit interior so that they may be disposed of by the pulper. However, the air is blown up through openings of the final dryer, the calendar and the reel, hindering smooth paper transfer and aggravating working environment around the process.

To solve this problem, a pulper to be exclusively used for disposing trims should be installed. Since the air blown through the opening of the final dryer has affected the process in the worst way, the opening has been sealed. So, this seal should be removed to cause brokes to smoothly drop into the pit.

(A) Pulper : Capacity 8.5 m^3, 90 kW

(B) Pump : 1.8 m^3/min. x 45 mH x 30 kW

(C) Change in layout of the pneumatic trim-conveying duct

O. Installation of broke pulpers in the first floor

In the present process, brokes produced in the first floor after the dryer part are transported to the calendar pit by means of a conveyer, while defective paper sheets found in the second floor are torn into pieces and transported into the calendar pit for further treatment.

It is desirable that a pulper already installed under the calendar should be fully capable of disposing of the brokes which may be produced as a result of cut in paper sheets. An additional pulper is installed to separate the broke treatment mentioned in this paragraph from that mentioned in the above paragraph.

The pulper in the calendar pit is started only when it receives a signal indicating a cut in sheets while it be kept out of use otherwise, to ensure energy saving.

(A) Pulper : Capacity 15 m^3, 150 kW
(B) Conveyer : 2m (W) x 30m (L), 11 kW
(C) Pump : 3 m^3/min. x 15 mH x 15 kW
(D) Piping and others

P. Pumps

Quantitative balance based on the Renovation Plan varies in accordance with operating conditions. Since it is influenced mainly by the former in the paper machine wire part and pulp concentration, pumps related to devices to remove dust and air from pulps (approach) have been recommended in consideration of this fact. Pumps except those listed in the sections of the preparation and the paper machine are listed in this section as follows:

(A) Pumps related to the preparation : 12
(B) Pumps related to the paper machine : 16

Q. Renewal of an automatic roll wrapping machine

The existing automatic roll wrapping machine is now unable to conduct a series of automated operation due to its structural defects and aging, thereby requiring manual operation in some processes. The wrapping capacity has been exceeded by the present production volume.

So, it is replaced with a wrapping machine which possesses a capacity meeting intended production volumes under the Renovation Plan,

and the existing winding and carrying facilities are renewed since they have been deteriorated.

(A) Renewal of pusher and slat conveyer : full set

(B) Roll wrapping machine : An overhead type to automatically wrap a roll in the order of centering, core-inserting, internal paper-inserting, trimming, external paper-pasting, pressurizing, and label-fixing processes. Wrapping capacity : 60 rolls per hr.

(C) Rolling lifter : Full set to be renewed
(D) Installation of a hoist
(E) Construction work, including foundation
(F) Electric and instrumentation work

R. Instrumentation

Since the time when we once developed the B/M (Basis weight/Moisture) System which was to be used exclusively for measuring and controlling basis weight and moisture, the paper-making industry has made a remarkable progress and has undergone many changes, and users' demands for the B/M system have been greatly diversified. In the whole industrial world, more importance has been attached to information, high technology, and addition of values, and process automation (PA) has displayed growth accordingly.

In the PA field, component techniques such as control techniques and computer technology have been utilized to make progress aiming at distributed control systems (D.C.S.) whose

basic concept is "distribution of functions and concentration of information."

The recent trend is toward "integrated control" in which control data and functions are integrated to meet needs for total factory automation. The renovation plan has been set up by taking these changes in the environment and future development of comprehensive control of paper-making machines.

(A) Preparation

Introduction of a computerized system to monitor, operate, and collect information on paper-making machines, covering controls of concentrations, flow rates, prescription rates, and liquid levels of pulps and controls of approaches of the paper machine will eliminate mistakes to be caused by human beings and contribute to stabilization of quality, maintenance of production volume even in case of sheet break, and reduction of production costs.

* Operation station	2
* Control station	1
* Printer	2
* Hard copying machine	1
* Engineering station	1
* Other ancillary items	1 set
* Control instruments	1 set

(B) Paper-making machine

The existing B/M meter is the Measures 2002ET introduced in June 1989. The product quality should be improved and stabilized by modifying it to use CRT for displaying absolute dry weight (by installing an actuator in the BD-head box), caliper controls, drainage, drives, heat recovery, and pulpers.

* Existing B/M meter, V-2002ET (CPU: 16 bits) to be modified into S.V-2002ET (CPU 32 bits)

S. Principal spares for the paper-making machine

(A) Ceramic blades	
A : Lead-in blade	1 row
B : Slide	2 rows
C : Top shoe	4 rows
(B) Box cover, made of ceramics	1 set
(C) Wire return roll	1 set
(D) Wire guide roll	1 set
(E) Press top roll No. 2	1 set
(F) Press bottom crown variable roll cell	1 set

(4) Outline of the equipment Case 2

1) Stock preparing facilities

A. BKP-solving and beating equipment

A full set of the existing facilities including pulpers and refiners should can be applied to the intended use as described below:

(A) BKP-solving equipment

The present production process is based on a batch feeding system, and the maximum capacity of the batch feeding system is 93 AD T/D. If a continuous feeding process is adopted, it is increased to 117 AD T/D.

(B) Refining equipment

* The capacity of the Double Disk Refinery (DDR), Model 3126 ranges from 50 to 100 T/D.

* Freeness (CSF) of the BKP wrap ranges from 750 to 800 cc. A refining power unit required to reduce this value to 650 cc, which is an objective value for assuring BKP quality (namely, by 120 cc = 750 to 800 - 650), amounts to 100 kWh/B.D.P.T (per ton of pulp). Supposing motor load is 90%, the facility capacity of the two refiners should be 105.88 D T/D.

B. Pulp-blending equipment

(A) Initial equipment flow

The three types of pulps, namely, (1) GP, (2) BKP, and (3) D.B. are fed at a specified mixing ratio by using a consistency regulator and a flow meter provided to each type of pulps. Both the material (4) W.B. and white water-collecting pulp are mixed in a process to feed a finished pulp fully mixed in

the preceding mixing box to the blending chest. The pulps are composed of the four base pulp systems. They are fed to the machine chest through a consistency regulator and then to the stuff box again through the consistency regulator.

(B) The flow recommended by the survey included the functions of the mixing box in that of the blending chest for the pulps (3) and (4), though nothing has been changed for the pulps (1) and (2).

(C) Renovation plan

* The Renovation Plan adopts a structure provided with a new blending tank in which the five pulps, (1) GP, (2) BKP, (3) DIP, (4) W.B., and (5) D.B. are fed through a respective consistency regulator and a flow meter for mixing them.

* A white water-collecting pulp channel is compounded after the blending tank.

* A consistency regulator and a flow meter are renewed or newly provided at each channel of (1), (2), (3), (4), and (5).

C. Separation of the broke processing system

The existing facility to collect and process wet broke (W.B.) and dry broke (D.B.) employs a thickener (2,000 mm in diameter x 7,000 mm in surface length) to process them together and to feed them to the chest.

The W.B. has the same broke properties as pulps and may be compounded totally. Since, however, the D.B. is defiberized from paper, it naturally differs from the W.B. as to the properties and is compounded to a limited degree. Since stable properties of the pulps are indispensable for making super-light paper, the plan is adopted to separate the processing system from others.

(A) Wet broke system

* W.B. receiving chest ... The existing two facilities of 165 m^3 and 135 m^3 are applied to.

* Thickener ..... The existing thickener is removed and replaced with a triple type of 3,000 mm in diameter and 5,000 mm in surface length.

* W.B.finish chest ..... The existing thickener pit is applied to.

(B) Dry broke system

* D.B. receiving chest ... Existing 135 m^3 is applied to.

* High-concentration cleaner ... Eliminates foreign matter including metal pieces and protects a defiberer blade.

* Thickener ..... A thickener of 3,000 mm in diameter and 6,000 mm in surface length to be newly installed.

* D.B. finishing chest ... Existing 65 m^3 is applied to.

* Defiberer ..... A unit currently employed exclusively for defibering D.B. is to be newly installed, by removing the existing refiner which is a beating type.

(C) White water-collecting system

A medium presently used for collecting microfibers contained in the white water is one branched from the machine chest of finished pulps after the compounding process of GP and BKP. Since long-fibered BKP pulps are more effective in assuring collection of microfibers and improving filter capability, both the medium pulps and the flow related thereto are modified.

* Mixing tank ... To be installed before the filter to mix the white water and the BKP.

* Filter ... The existing polydisk filter is used while one is to be added to.

Existing filter : 3,800 in diameter x 1[illegible] disks x 1

New one : 3,800 in diameter x 1[illegible] disks x 1

D. Other preparing equipment

The following items of equipment are listed to meet the requirements of modification, renewal, and capability based on the above-mentioned Renovation Plan.

(A) Pumping equipment
(B) Piping and modification work
(C) Two pieces of filtering equipment for shower
(D) Electric equipment
(E) Instrumentation

2) Paper machine

If a production plan of 130,000 tons a year is implemented with the basis weight of 45 g/m^2, the maximum speed of the existing paper-making machine should be increased to 1,000 m/min.

The existing Fourdrinier machine possesses mechanical strength of about 800 m/min. When making super-light paper sheets by using this machine, such negative factors are forecast as reduction in paper strength, opacity, and contents of waste paper and increase in fluctuation in paper quality in the cross direction. Moreover, there is another factor that the speed may be limited by pneumatic resistance at the pulp suspension surface on the wire which often causes fluctuation in the basis weight as the speed is increased. Problems which may be caused by these unfavorable factors have to be solved.

Selection of a twin-wire machine based on required production capacity and quality of finished paper will reduce differences between front and rear

sides, improve texture, and unify cross profile. Since the same degree of fluctuation results in a larger changing ratio at a smaller basis weight, it is important to select a machine model by giving importance to uniform profile.

In this Plan, a gap former is recommended as a machine to be used exclusively for making newsprint paper since it has been employed most widely in the industry. Existing dryer cylinders, gears, and frames which leave no problems in term of mechanical strength are transferred for use together with the new machine, while other parts are eliminated or discarded and exchanged with new ones, due to insufficient mechanical strength.

All the 44 dryer cylinders are subjected to balance adjustment using a dynamic balancing unit.

The existing building continues to be used while spaces for housing both vacuum pumps and winders are to be expanded. The foundation, pits, and related items are modified and rein forced in accordance with the proposed modification of the paper machine.

As previously stated, more uniform profiles are required as a lighter weight is chosen. If the paper-making speed is in creased to 950 to 1,000 m/min., limits of manual regulation become apparent. So, techniques to automatically control basis weights, moisture, and paper thicknesses as factors determining luster have been developed and commercialized one after another as sensors of required performances have been developed. Thickness has been automatically controlled by interlocking a B/M meter with a caliper sensor and changing calendar nip pressure in the cross direc-

tion by means of magnetic waves or similar media. Moisture has been controlled by dewatering at a press part and drying through dryers, while the weight has been controlled by automatically regulating openings of slice lips. Therefore, the Plan has adopted an instrumentation system based on these advanced techniques to increase system operability, and to improve and stabilize the paper quality.

A. Design criteria for modifying the machine

Type of paper :	Newsprint paper
Basis weight :	45 to 49 g/m^2
Wire width :	7,700 mm
Sheet width on a reel :	7,000 mm
Sheet width on a winder :	6,900 mm
Raw materials :	GP 52%, DIP 23%, and BKP 25%
Ratio of calcium silicate to pulp	5%
Freeness :	100 cc C.S.F. in head box
pH :	6
Temperature :	42 to 45°C
Design speed of drive :	1,100 m/min., max.
Operating speed :	1,000 m/min., max.
Balancing speed :	1,100 m/min.
Max. winder speed :	2,500 m/min.
Machine direction :	Right-hand (drive is located on the right side when watching the dry end from wet one)
Theoretical production :	454 T/D ($45g/m^3$ x 1,000m/min. x 7,000 mm x 100%)

B. Dirt removing and deaerating unit (approach)

The existing deculator/cleaner system is utilized to apply to both the cleaner and the screen to elimination of shives. To realize resources-saving designs, the numbers of the cleaner and the screen stages are four and three, respectively.

(A) Cleaners

Since the internal rubber of the existing cleaners has been obsolete, it seems that the cleaner should be replaced with a new one. The most excellent design for eliminating shives have been selected while the mounting and connecting dimensions agree with the present ones. Existing inlet and outlet headers are used while the following cleaners are replaced with new ones:

Primary : 36, secondary : 8, tertiary 3, and quaternary 1

(B) Screen

The existing pressure screen plate is provided with 1.8 mm pores which are not suitable for eliminating the shives. So, a slit-type pressure screen has been selected since they have been popularly employed in recent years.

Primary : 4, electric motor 55 kW, V-belt driving

Secondary : 1, electric motor 55 kW, V-belt driving

Tertiary : 1, electric motor 30 kW

Each basket is provided with 0.35 mm slits.

(C) Replacing electric motors for driving fan pumps

The existing AC motor is replaced with a DC motor which assures precise regulation when changing paper-making speeds and flow rates and saves energy.

* Fan pump No. 1 : The present specifications : 75 m^3/min. x 43 mH x 700 kW
  Required specifications to use the existing pump are : 65 m^3/min. x 34 mH with the DC motor of 450 kW

* Fan pump No. 2 : The present specifications : 66 m^3/min. x 23 mH x 320 kW
  Required specifications to use the existing pump are : 63 m^3/min. x 19 mH with the DC motor of 240 kW

(D) Cleaners and cleaner pumps

* Secondary cleaner pump: 13 m^3in. x 44 mH x 140 kW

* Tertiary cleaner pump : 4.5 m^3/min. x 37 mH x 45 kW

* Quaternary cleaner pump : 2.5 m^3/min. x 37 mH x 30 kW

* Secondary cleaner pump : 4.7 m^3/min. x 10 mH x 11 kW

* Tertiary cleaner pump : 0.5 m^3/min. x 10 mH x 2.2 kW

(E) Stuff box

The existing stuff box is installed at an excessively low position and both the flow meter and the measure are mounted at inappropriate positions. Since they do not ensure stable, precise regulation and supply with least dispersion in dry weight of super-light paper, the box is installed at a higher position and the flow meter and the BW control valve are renewed and installed at appropriate positions.

(F) Pulsation attenuator

This is a device to absorb pulsation of pressure and is in stalled in advance of the head box to stabilize liquid pressure of pulps to be supplied to the box. It substantially reduce pressure pulsation which is caused by the screen, the fan pump, and pulp pipes to enhance paper quality. The attenuator is provided with an air controller and an air pressure regulator.

C. Head box

The existing, enclosed air-cushion type is provided with a the perforated rolls which displays limited functions in dispersing pulp floc and arranging their flows in order. This type involves many problems for producing uniform paper with good textures, for example, the fact that it is easily smeared, dirt is accumulated on and around the perforated rolls, and it lacks in precision when it is obsolete. So, it is replaced with a modern hydraulic head box suitable for the gap former.

(A) Main body

* Slice width : 7,550 mm

* Adjustment of opening of slice lips : Micro-jacks are arranged at an equal interval of 100 mm for assuring fine adjustment through a remote controlling. Manual operation is also available for adjusting the openings. By installing an automatic operation controller interlocked with a B/M meter, B.D. profiles can be stabilized at an early stage, including making paper.

(B) Recirculation valve : V ball valve driven by the AC electric motor.

(C) Warm water supply unit : Stabilizes slices at an early stage by circulating warm water corresponding to the temperature of the pulp.

(D) Operating panel

D. Wire part

The Plan selects a gap former type which has been most popularly adopted, judging from the excellence in monitoring capability, operability, and maintainability as well as availability of high-speed production at 1,000 m/min.

One of the reasons why the wire is wider than in Plan 1 above is that pulp is placed between two wires at the start point of the wire part to enable continuous dewatering, thereby paper sheets being formed earlier than in Plan 1. The other is that edges are apt to be more disturbed and more contracted by the dryer than the central part, thereby keeping the pond width and wire width wider to make up for these possible reduction.

(A) Type : Gap former

Width of wire No. 1:	7,700 mm, plastic wire
Width of wire No. 2:	7,700 mm, plastic wire

(B) Rolls and dewatering device

* Breast forming roll:	810 mm (diam.) x 7,800 mm (surface length) x 2

* Suction rolls :

No. 1 1,525 mm (diam.) x 7,750 mm (drilled surface length) x 1

No. 2 1,170 mm (diam.) x 7,750 mm (drilled surface length) x 1

Material: M-alloy 2000, drilled with gun drill

* Wire rolls :
1,070 mm (diam.) x 7,800 mm (surface length) x 3

810 mm (diam.) x 7,800 mm (surface length) x 4

628 mm (diam.) x 7,800 mm (surface length) x 2

270 mm (diam.) x 7,910 mm (surface length) x 2

* Dewatering devices :

A 18-blade type	1
B Suction box type, 500 wide	2
C Single type	1
D Vacuum type	1
Material of blades	Zirconia

(C) Wire components

* Doctor : 13 for rolls, 11 out of them are air spring-sliding type

* Wire tension indicator : Load cell type x 2

* Wire guider and stretcher : Guider : Automatic air spring type

Stretcher : Remote-controlled air motor-driven type

* Wire exchanger : Since plastic wires are employed, no wire stringers are required. An oil jack which presses up a cantilever beam is included to pull in wires by means of five aluminum wire poles.

(D) Others

* Ventilator : Air is discharged through a discharging fan, with a plenum installed in the driving side and a mist shield panel mounted in the wet end of the driving side and the press side, respectively.

* Scaffolding : Step boards, ladders, and rails are made of aluminum or stainless steel.

* Operating panel : Made of stainless steel

* Piping : Prefabricated piping provided around the main body

(E) Shower : Shower pipes are installed on the main body.

* Wire roll shower	7
* Expander roll shower	2
* Wire-cleaning shower	3
* Sheet knock-off shower	1
* Sheet knock-off wetting shower	1
* Trim knock-off shower	1
* Trim knock-off wetting shower	1
* Edge-cutting jet	6
* Wire-cleaning chemical shower	2
* Suction roll-cleaning shower	2
* Suction box shower	2
* Ceramics-protective shower	4
* Suction box edge shower	4

(F) Other modifications of wire part

* Installation of shower filters for rolls :

Diluted white water which is supplied from the white water collector is treated through a gravity filter which is to be newly installed so that it may become of the quality applicable to shower for rolls and other components. This will substantially reduce volumes of fresh water to be used for showering and help raise pulp temperature.

* Improvement of water used for trimming jet and nozzle cutter

- The water is branched from a drinking water system.

- Strainers are installed in series.

- Pumps are renewed with those for 8 liters/min. x 120 mH (two pumps to be installed, one of them being spare)

- Nozzle types are modified.

E. Modification of the press part

Generally speaking, the existing presses provide so low pressure that moisture of pulp sheets is kept high 62% or so at the end of the pressing process, decreasing productivity and quality. The press part is modified for attaining the following targets:

a. To improve dewatering in the presses.
b. To improve moisture profile.
c. To improve paper quality as to smoothness and thickness.
d. To reduce sheet breaks in the dryer section.
e. To save steam consumption.
f. To minimize maintenance work of rolls.

When the proposed modification displays intended effects, a dryness value of sheets is raised to improve productivity while increased fiber bondage improves mechanical strength and threading capability of the sheets, thereby the machine efficiency being enhanced.

To attain this goal, a four-press system (1P to 4P) is adopted by installing the 4P so that reducing paper dust, improving differences between surface and back sides, and decreasing moisture.

By installing a steam box at the outlet of the 1P and changing the presses 1P to 4P with a crown-variable roll, moisture profile can be better controlled. The number of felt suction boxes is increased to two per felt to attain a target of 57% moisture at the outlet of the 4P.

Since components are often exchanged in this part, a cantilever type is adopted to facilitate exchange of felts.

(A) Composition of presses

* Design pressure :

Press No. 1
Present capacity : 53.6 kg/cm
New press : 80 kg/cm
Suction roll and grouped roll

Press No. 2
Present capacity : 58 kg/cm
New press : 90 kg/cm

Press No. 3
Present capacity : 62.5 kg/cm
New press : 125 kg/cm

Press No. 4

New press : 125 kg/cm

(B) Rolls

* Suction pick-up roll : 915 mm in diameter, 7,600 mm in drilled surface length. Material : M-alloy 2000, drilled by using a gun drill

* Suction roll : 1,120 mm in diameter, 7,600 mm in drilled surface length. Material : M-alloy 2000, drilled by using a gun drill

* Press bottom roll No. 1 : 895 mm in diameter, 7,500 mm in pressurizing surface length. Crown-variable penta-grouped roll

* Press bottom roll No. 2 : 895 mm in diameter, 7,500 mm in pressurizing surface length. Crown-variable penta-grouped roll

* Press bottom roll No. 3 : 895 mm in diameter, 7,500 mm in pressurizing surface length. Crown-variable penta-grouped roll

* Press bottom roll No. 4 : 895 mm in diameter, 7,500 mm in pressurizing surface length. Crown-variable penta-grouped roll

* Center roll and 4P top roll : 1,370 mm in diameter, 7,750 mm in pressurizing surface length. Granite roll (Existing center roll and 3P top roll: 1,220 mm in diameter and 7,620 mm in surface length)

* Felt plane roll : 528 mm in diameter, 7,910 mm in surface length x 22

* Felt worm roll : 528 mm in diameter, 7,910 mm in surface length x 4

* Paper roll : 528 mm in diameter, 7,600 mm in surface length x 2

* Expander roll : 270 mm in diameter, 7,910 mm in surface length x 4

* Suction felt roll : 610 mm in diameter, 7,600 mm in drilled surface length x 2

(C) Press components

* Roll pressurizing unit : Nip pressure is applied from a hydraulic unit by using a hydraulic cylinder-type pressurizing unit. Press No. 4 is provided with a snapper to prevent bouncing.

* Felt suction box (uhle box) : Single-slot type with suction width of 19 mm x 8 units. Lip is made of zirconia ceramics. The box is made of stainless steel, with the maximum degree of vacuum for operation set to a value of -380 mmHg for effective cleaning and dewatering of the felts.

* Hydraulic unit : Cascade type in which hydraulic pressure follows changes of a press nip pressure, designed for crown- controllable rolls. It is provided with an oil tank, a cooler, a heater, a duplex pump, and controls.

* Broke conveyer : A broke conveyer is installed to cover the full width of the 4P top roll.

* Felt tension : Each of the four felt sets is provided with a load cell-type felt tension indicator coupled with a limit alarm and a lamp.

* Frame : A module-type framework to allow the cantilever to freely move when exchanging the felts.

* Felt-exchanging belt : The belt drives four felt rolls to facilitate exchange of the felts.

* Felt guider and stretcher

Grider : Pneumatically operated automatic guide and positioner

Stretcher : Air motor-driven stretcher

* Exchange of rolls : The frame has a structure arranged to facilitate exchange of rolls, with requirements to handle the upper units set to minimum.

* Nozzle cutter : A nozzle cutter for threading paper is installed below the pick-up felt.

(D) Others

* Scaffolding : Drain board-type step boards, ladders, and rails are made of stainless steel and are arranged to

facilitate exchange of rolls and threading of paper sheets.

* Control panel : Made of stainless steel

* Piping : Made of stainless steel and prefabricated pipes are provided around the main body.

(E) Steam box : To be installed at a low vacuum section of the suction press roll No. 1.

The box is made of stainless steel and has a profile-sectioned structure suitable for remote controlling.

Computer interface for C.D. moisture profile control can be installed in the future. The box incorporates an air cylinder and is provided with a standard, electronically remote-controlled panel. However, both a steam flow integrating recorder and a pressure regulating valve are included in the drainage instrumentation.

(F) Showers : Shower pipes are provided on the main body.

* Felt roll doctor shower	3
* Felt circulation shower	5
* 4P top roll doctor shower	1
* Center roll doctor shower	1
* Felt-cleaning shower (high sliding pressure)	4
* Grouped roll shower	4

* Broke chute shower 1
* Suction roll-cleaning shower 2
* Paper-cutting jet shower 1

F. Lubricating unit

A centralized lubricating system is adopted for lubricating main roll bearings at wet ends of the wire and press parts.

(A) Construction

The unit is composed of an oil pump, an oil tank, oil filters, a gravity lubricator, a dust-sealing fan, an oil-collecting tank, and a control panel.

(B) Lubricating unit

* Duplex oil pump
* Drum filter
* Oil tank : Provided with a steam heater.

Tank capacity 2,250 liters

(C) Control panel

G. Addition of vacuum pumps

The present air volume of the existing eight vacuum pumps is changed to values shown below as a result of surveying air volume balanced supposing the wire part and press part are modified.

(A) Required air volume for vacuum

Nomenclature	Air volume (m^3/min.)	Degree of vacuum (mmHg)
Wire part		
Box A	30	75
Box B	52	75
Box D	26	250
Suction couch roll No. 1		
Low vacuum	360	250
High vacuum	170	380
Suction couch roll No. 2		710
Press part		
Suction pick-up roll	194	500
Suction press roll		
Low vacuum	94	250
High vacuum	256	500
Suction felt roll	310	250
Uhle box	1,030	380

(B) Addition and modification of vacuum pumps

A vacuum pump is added to make up for a balance between the existing capacity and the required air volume as stated above. * Addition :

A : 260 m^3/min. x -380 mmHg x 4
B : 260 m^3/min. x -250 mmHg x 1
Both A and B are directly driven by a 1,300 kW motor. C : 170 m^3/min. x -380 mmHg x 1
Belt-driven by a 185 kW motor.

(C) A blower for generating humidity is included in the design of a dryer hood and a waste heat recovering unit.

(D) Other modifications

* Building for additional pumps : A building for housing additional pumps is to be constructed besides the existing one.

* Piping : To be newly added and modified as required.

* Air vent of pumps : Pump discharge ports from which waste gas is emitted indoors are sealed and be substituted with a device to discharge the whole waste gas outdoors so as to ensure improved environment.

- Modification of pits and installation of discharge flue

* Foundation and power supply works

H. Modification of the dryer part

The following items are modified to improve moisture pro file, to stabilize sheet traveling, and reduce power load.

a. Pocket ventilation roll
b. Drain diffusing bar to be installed in a dryer cylinder interior
c. Felt dryer cylinder to be removed
d. Steam blower to be exchanged

e. Dryer Group 1 to be modified so as to possess a single canvas, with a sheet transfer box being mounted in the inlet port
f. Tail cutter to be renewed

(A) Pocket ventilation

Twenty-one (21) pocket ventilation rolls with 512 mm in diameter and 7,030 mm in blowing face are installed to establish canvas conditioning (whose effects will allow the felt dryer cylinder to be removed) and to assure uniform humidity with low steam partial pressure in the dryer pocket interior.

* Hot air supplier : A full set of a 120°C hot air supplier including a fan, a filter, a heater, dampers, and ducts.

(B) Drain diffusing bar

A magnet-type bar is mounted onto 24 dryer cylinders.
The coefficient of evaporating ratio (EV) is said to be improved by about 20%, if a large number of bars are mounted in an axial direction in the cylinder to reduce heat transfer resistance of drain by causing turbulence in drain interior. These bars also play a role to unify thermal distribution in the direction of the cylinder width and to improve moisture profile.

(C) Canvas roll

All the existing rolls whose diameter is 456 mm are to be replaced with new ones, because they do not withstand high-speed operation.

* Rolls with 510 mm in diameter and 7,420 mm in length x 81

(D) Dryer cylinder balancing

All the existing dryer cylinders are removed and their dynamic balancing is adjusted at site by using measuring instruments.

(E) Steam blower

Apart from partial damages found in the existing rotary blower, it may increase both differential pressure required to discharge drain and blow-through steam as the paper-making speed is increased.

Such phenomena makes it impossible to apply three-stage cascade operation in the drainage system, compelling to use two-stage operation or causing similar problems. If a poorly maintained siphon prevents smooth discharge of drain, the dryer driving load will be increased so much that a stable drying operation cannot be expected at all. So, the existing steam blower is replaced with the following one:

* Simplex steam blower

* Fixed-type siphon for discharging drain ... 43 all paper dryers

* Pressure-sealed spherical carbon-type rotary joints for both steam-supplying and drain-discharging sides

(F) Single-canvas type for First Group

Six paper dryers contained in 1st Group are exchanged with single-canvas type by attaching more importance to stable traveling of wet sheets.

* Addition of doctors : Two (2)

A doctor is mounted onto the upper-stage paper dryers to protect sheets from winding about them.

(G) Sheet transfer box

A sheet transfer box is mounted to ensure smooth sheet transfer from the press to the dryer.

Hot air is supplied from the hot-air line of the pocket ventilation unit and is controlled by using a control damper.

(H) Renewal of a tail cutter

An existing knife is used to pass paper tails from the dryer to the calendar. Since the existing fixed-type knife is not so sharp, it is replaced with a rotary knife driven by a pneumatic motor

so that it may travel along the width with an air motor remote-controlled.

(I) Changes in piping for rubrication oil to dryers

Piping for rubricating oil to dryers is changed, since the canvas dryers are removed while pocket ventilation rolls are newly installed. Pipes connecting from an oil supplier to oiled points form a few block of pipes, crossing over the dryers. Such cross-over portions allow paper pieces and powder to be accumulated therein, causing problems from view points of prevention of casualty. The piping blocks are covered to minimize hazards.

(J) Improvement of drainage

Since 1st Dryer Group is changed into a single-canvas type, the section #4 for existing canvas dryers is used for the lower dryers, and instruments and pumps are added. Existing control instruments have been generally damaged so much that the whole set is exchanged with an electronic type so that the drainage system may be controlled through the D.C.S. of the instrumentation.

* Instruments :	Full set
* Condensate pump :	1

I. Dryer hood and waste heat collectors

When using dryers to dry paper, a large amount of steam is consumed, and moisture in the paper is evaporated in a form of steam. The paper cannot be fully dried until the steam is taken away by means of air current.

The dryer hood is modified into an air-tight design so that dry air in the hood interior may be effectively used to assure uniform drying of paper sheet. In case of a wider machine, the central part of a paper sheet is less dried than the edges due to reduction in air flow. The pocket ventilation is utilized to improve such uneven drying. The effects of the enclosed dryer hood are listed as follows:

a. To increase dew point temperature of air discharged from the hood for reducing discharged air flow, thereby reducing steam consumption.

b. To recover heat from discharge air by means of heat exchangers.

c. To improve dryer capacity and paper quality through uniform drying.

d. To improve indoor working environment.

The system is composed of the following items:

a. Enclosed hood
b. Waste heat recovering unit
c. Air discharging unit
d. Air supplying unit
e. Pocket ventilator

The existing hood and the waste heat recovering unit have displayed extreme reduction in functions due to aging and lack of periodic maintenance. They have not fully discharged waste air, and a large amount of steam produced by drying paper sheets is blown from the hood into the room interior. Since the waste heat recovering unit has not functioned at all, no partial modification will produce any satisfactory results. So, the full set should be renewed.

(A) Design requirements of the unit

Production volume :	454 T/D
Moisture at dryer inlet	59%
at dryer outlet	7%
Dew point	58°C
Discharged air temperature	80°C
Pocket ventilation air temperature	100°C

(B) Enclosed hood

The hood possesses a heat-insulated structure which endures a high dew point. Air to be discharged from the hood is collected through a suction port via a regulating damper in the plenum at the top end of the hood. In addition to the doors listed below, the hood is provided with doors for transporting canvas dryers, for driving side, at hood end, and for inspection and treatment of dry broke (which is installed at the second floor). An opening through which sheets come in and out is provided with a blow pipe to prevent air leakage and

dew concentration.

* External dimensions : 52m (L) x 11m (W) x 8m (H) Made of aluminum
* Second floor, operation side : Lifting door, 2m (H) x 6m (L)
  3.7 kW x 3, made of aluminum
* Second floor, driving side : Slide door, made of aluminum
* A set of illumination lights in the hood

(C) Heat exchanger x 2

The heat exchanger recovers heat from waste high-temperature wet air discharged through the hood and use the recovered heat to heat dry air to be supplied to the hood. It is made of smooth plates so that dust in the waste air may not adhere to the exchanger surface and is provided with a cleaning spray.

* Plate type, 3.2m (D) x 2.325m (W) x 2.2m (H), made of stainless steel

(D) Air heater x 2

* Fine-tube heat exchanger

(E) Hood air discharger

This is a unit to discharge waste air in the hood into the atmosphere through the heat recovering unit. Discharged air volume is controlled by means of a discharging damper based on an automatic

control system.

* Discharging fan : 2 units, centrifugal turbo type, made of stainless steel. 1,800 m^3/min. x 120 mmAq x 110 kW

* Duct : Made of aluminum and stainless steel.

* Damper : Multi-vane automatic type

(F) Hood air supplier

This is a unit covering from the air suction port of the chamber to the hood air supplying port and the pocket ventilation unit through the heat exchangers and the air heaters. The air suction port sucks air above the hood so as to make effective use of heat discharged from the hood and to assure better ventilation of the paper-making room.

Heated air is supplied to the pocket ventilation unit, the blow-out pipe, blow pipes at the hood opening, and sheet transfer box.

* Air supplying fan : 2, centrifugal turbo type, made of stainless steel, 1,300 m^3/min. x 350 mmAq x 160 kW

* Air filter : Wire mesh, made of stainless steel, with a multi-vane automatic damper

* Damper : Multi-vane automatic type

(G) Wet part air-discharging fan (x 2)

This is a fan to discharge wet air coming from the wire part and the press part into the atmosphere.

* Fan for the wire part : 1,600 m^3/min. x 120 mmAq x 75 kW, made of stainless steel Mist separator and enclosure also made of stainless steel

* Fan for the press part : 500 m^3/min. x 80 mmAq x 15 kW, made of stainless steel

(H) Air system control unit

* Control devices : TIC x 2, TI x 3, TWI x 2, PIC x 2, and HC (for remote operation) x 4

Detecting ends, regulating valves, oscillators, and converters are all electronic. After modifying the existing B/M meter, it is incorporated in a distributed control system (DCS) so that operation may be controlled through a CRT.

* Control panel x 1

(I) Power panel

* 110 kW x 2, 160 kW x 2, 75 kW x 1, 15 kW x 1, and 3.7 kW x 3

(J) Others

* A full set of foundation, duct and piping, heat insulating, and painting works

J. Reuse of breaker stack

As is found from the control records by the B/M meter and product quality inspection data in Japan, the density of the paper in issue is low (or the paper is thick). Indeed, this tendency is partly attributable to types of raw materials, but it is mainly due to low pressing pressure and lack of effects of a breaker stack.

Though a breaker stack has been originally installed, it has not been employed, because it was regarded as causes of sheet break and troubles in paper-threading operation. Such troubles seem to have occurred by unstable sheet movement at this point due to great dispersion in weight (or a paper sheet is thick in some times and thin in others) and moisture profile.

Since the recommended Renovation Plan ensures quality improvement, the sheet movement will be stabilized and the breaker stack may be applied once again to improve the paper density.

* An angle of 1.5 to 2^{o} to the bottom roll is set up at the sheet outlet port to ensure stable sheet running.

* Moisture of the breaker stack is regulated to 17 to 18% at the inlet port.

* Rolls and arms are replaced to increase mechanical strength.

(A) Rolls

* Bottom roll : An existing crown-controllable roll of 965 mm in diameter and 7,570 mm in length is applied to this Plan (2).

* Top roll : An existing roll of 456 mm in diameter and 7,420 mm in length is replaced with a roll of 510 mm in diameter and is used for supplying hot water from the hot water unit of the calendar to help thermal control.

* Spreader roll : An existing roll of 456 mm in diameter and 7,420 mm in length is replaced with a roll of 510 mm in diameter.

* Paper roll : An existing roll of 456 mm in diameter and 7,420 mm in length is replaced with a roll of 510 mm in diameter.

(B) Frames

* Main frame : The existing frame is applied to.

* Swing arm and pressuring unit : To be replaced with new ones.

K. Modification of the calendar

A full set of the existing calendar part, except the bottom roll, is renewed due to insufficient mechanical strength.

A new calendar is an open-type, six-stage calendar with multiple functions. It is composed of a bottom roll and three middle rolls of crown-variable type, while the upper two are hot-water rolls. Since nip pressure is regulated by means of the middle roll relieve unit and the crown-variable mechanism, operation can be effected at any nip pressure required. The maximum design nip pressure is set to 110 kg/cm.

(A) Rolls

* Bottom crown-controllable roll : 965 mm in diameter, 7,190 mm in surface length --- An existing one is to be applied.

* Middle crown-controllable roll : 660 mm in diameter, 7,370 mm in surface length --- three double chute-type rolls to be newly installed.

* Top and middle rolls : 660 mm in diameter, 7,370 mm in surface length --- two rolls to be newly installed for passing thermally controlled hot water.

* Spreader roll : 510 mm in diameter and 7,370 mm in surface length --- one to be newly installed

* Paper roll : 510 mm in diameter and 7,370 mm in surface length --- one to be newly installed

(B) Calendar components

* Hydraulic unit : For middle crown-controllable rolls

* Water heater : For supplying hot water to calendar middle rolls and breaker stack top rolls.

* Roll hoisting unit : For meshing the middle rolls and the top roll with a lifting bar and a worm jack.

* Nip-relieving unit : For regulating nip pressure by means of an air spring.

* Frame and doctor : Frame and doctor made of steel. The doctor is slid by an AC motor.

(C) Caliper control

Existing caliper profile controls include both cold and hot-air types. Although the hot-air type is subjected to automatic control interlocked with the B/M meter, it has not displayed sufficient effects.

A modern dielectric generation unit should be adopted, because it shows better response in caliper control and

is most suitable for securing more uniform caliper profile of sheets.

The unit is modified to enable automatic control interlocked with the existing B/M meter.

* Dielectric generation unit : One set to be installed on the bottom roll.

(D) Others

* Scaffolding, paper-feeding unit, operating panel, and piping

L. Reel

This is a surface reel provided with a fully automatic frame exchanger together with a spool storage unit and a transfer unit. The drum surface is grooved to meet requirements for high-speed operation.

(A) Rolls

* Reel drum : 1,220 mm in diameter, 7,370 mm in surface length x 1, Grooved drum surface. Cooling unit incorporated in the interior.

* Spreader roll : 510 mm in diameter and 7,370 mm in surface length x 1

* Reel spool : 784 mm in diameter, 7,620 mm in surface length x 12 Rubber-covered. For dynamic balancing at 2,500 mm/min.

(B) Reel components

* Spool storage : Capable of supporting three spools and transferring a primary arm by using a swing arm which is driven by a motor.

* Doctor : Made of soft steel and provided with an air jet. To be slid by an AC motor.

* Frame : Made of soft steel and cast iron.

* Primary arm : To be driven by a motor by means of a torque coupling and a speed reduction gear.

* Secondary arm : To be operated by an air cylinder which is connected to a link mounted on the cross shaft.

* Paper feeder : Air tube type

* Spool starter : A fixed rubber tire type driven by a DC motor.

* Others : Scaffolding, operating panel, and piping

M. Improvement of broke processing in the calendar pit

Broken paper pieces which are produced when paper sheets are cut at the final dryer, calendar, and reel sections are processed in a pulper installed in the calendar pit. In this process, a shower is used to introduce and

dilute broke so that they may be processed while they are circulated. In actuality, however, sheets are not always circulated but are left floated continuously on the surface. This phenomenon has easily filled the pit capacity and sent low-concentration water to the preparing facilities, affecting broke-processing efficiency and paper quality.

The best way to improve such a state is to inject a large volume of pulps from the upper pit to quickly circulate and sediment the floating broke into the lower circulating layer.

* Circulating pump : 3 m^3/min. x 15 mH x 15 kW x 1
* Shower pipe to be replaced
* Conveyer to be removed
* Pit to be repaired

N. Modification of the winder

The maximum speed of the existing winder is 2,130 m/min. It is estimated, however, based upon a review of the present state that an average operating speed of the winder will be at most 1,500 to 1,750 m/min. even after the qualitative improvement is completed. So, the winder is not applicable with much reliance to the proposed speed of 966 m/min. of the paper-making machine to produce 130,000 tons a year.

When reviewing the capacity of the winder, it is found that it will not cause sheet break at an average operating speed of 1,500 m/min. but that time allowance for the winder to finish sheet breaks to be wound by a reel will become

negative. In addition, time allowance at the average speed of 1,750 m/min. will be limited only to a few minutes. If factors causing paper cuts are taken into consideration, it is concluded that the winder capacity is totally insufficient. As a result, this Plan recommends that one winder should be added.

(A) Specifications of the winder

* Model : Two-drum type
* Max. design speed : 2,500 m/min. (mechanical strength)
* Balancing speed : 2,500 m/min.
* Unwinding roll diameter : 2,240 mm, max.
* Finish winding diameter : 1,500 mm, max.
* Winding method : Shaftless
* Drum : 760 mm in diameter, 7,200 mm in surface length. Tungsten carbide to be flame-sprayed to the front side. Spiral grooves provided on the rear side.

(B) Winder components

* Unwinding stand : Is equipped with a hydraulic width and direction regulator, a spool-connecting clutch, an emergency stop disk brake, a regeneration brake motor, and an air cylinder-operated empty spool ejector.

* Tension control : An electric load cell mounted on a segment paper roll of 175 mm in diameter. Tension is controlled by an unwinding brake

motor.

* Lead-in roll : 710 mm in diameter and 7,200 in surface length. Driven by a 45 kW motor.

* Spreader roll : To be mounted in front of the slitter. The roll surface is treated with molybdenum coating. Grooved crown volume is regulated by using a jack screw.

* Slitter : Nine sets of top and bottom slitters. The top slitter of 203 mm in diameter pressurizes air and releases the springs, while the bottom slitter of 267 mm in diameter is driven by a motor.

* Slitter-positioning unit : The slitters are position fully automatically by a computer provided. Winding tightness is also controlled. * Sheet spreader : A segment-type spreader roll is mounted after the slitter, or immediately before the back drum, and sheets are adjusted by means of pneumatically operated adjusting rods.

* Core chuck : The core chuck is provided with a spindle which is operated by a hydraulic cylinder to hold both edges of a core. The upward and downward movement of the chuck is controlled by the hydraulic cylinder. Both the holding operation and the vertical movement are remote-controllable.

* Rider roll : A segment-type roll of 320 mm in diameter is driven by a motor installed at both ends. As a diameter of a wounded product is increased, the pressurizing force is automatically reduced.

* Paper threading unit : This is a unit to smooth paper threading from the unwinder to the winding drum.

* Automatic ejector : This is a unit to automatically eject a roll which has wound up full length of paper sheet by means of the hydraulic cylinder. A device to automatically apply an adhesive tape to cores is also included.

* Cradle : Is a unit to unload a wound roll onto the floor by means of the hydraulic cylinder.

* Trim eliminator : A set of trim guide and hopper

* Hydraulic unit : Hydraulic unit for the winder

* Trim blower : A set of a blower and ducts

* Piping and others

(C) Driving motors : A set of a DC motor and controls. The motor capacities are listed below:

Section	Quantity	Motor (kW)
Winder drum	2	200
Unwinder	1	290
Paper roll	1	45
Rider roll	2	11
Slitter	9	1.1

O. Modification of the winder

The existing winder has left nothing to be desired in terms of mechanical structure and strength (design speed of operation : 2,130 m/min.). However, it displays reduced performance in paper tension control and rolling tightness control. These two controls are replaced with modern ones to stabilize high-speed operation and improve quality of roll paper.

(A) Paper tension control

* Segment roll : An existing guard board after the slitter is replaced with a new one, while one before it is used as it is.

* Electric load cell and control unit

(B) Winding tightness control

* A control unit for nip pressure of a rider roll and drum load

(C) Winding length indicator

* A rotation meter is provided onto the drum to indicate length on the control panel in a digital mode.

P. Modification of a driving unit

The existing line-shaft mechanical driving unit, including differential gears, have been aged so much. Especially operation controls have been so insufficiently maintained that stable operation is not expected in the future. Since it greatly affects the policy to increase speeds and production volume, the full set of the driving unit is renewed with a sectional electric type.

(A) Driving motor capacity : Total capacity of the facility = 5,748 kW, 29 units

Section	Quantity	Motor capacity (kW)	
		Main	Helper
Suction couch roll, No. 1	1		450
Wire turning roll	1	450	
Suction couch roll, No. 2	1		55
Stretch roll	1		55
Suction pick-up roll	1		90
1P bottom roll	1		300
Suction press roll	1		300
2P press roll	1		400
3P press roll	1		400
Center roll	1	400	
4P top roll	1		300
4P bottom roll	1	400	
Press paper roll	2		11
1st dryer group	1	200	

2nd dryer group	1	355	
3rd dryer group	1	280	
4th dryer group	1	250	
Dryer paper roll	1		11
Breaker bottom roll	1	75	
Breaker top roll	1		75
Spreader roll	1		11
Paper roll	1		11
Calendar roll	1	670	
Spreader roll	1		11
Paper roll	1		11
Reel	1	110	
Spreader roll	1		11
Reel spool starter	1		45

(B) Mechanical equipment

* Speed reduction gear 29
* Intermediate shaft 1 set
* Frame and safety cover

(C) Electric equipment

* Paper-making machine
- Electric motor 29 (total capacity : 5,748 kW)
- Controls 1 set
- Operating panel 1 set

* Fan pump
- electric motor 2 (total capacity 960 kW)
- Controls 1 set

* Power unit
- Transformer, capacitors, and high-voltage CBS

* Blower for cooling electric motors
  1

Q. Installation of a trim edge pulper

Trims or trim edges which are produced by cutting both ends of paper sheets during a roll-finishing process using a winder are pneumatically conveyed to the calendar pit by means of an exclusive blower so that they may be disposed of as dry brokes there.

There are no special problems in those facilities which are included in this trim-disposing process, and trims are separated from air in the calendar pit interior so that they may be disposed of by the pulper. However, the air is blown up through openings of the final dryer, the calendar and the reel, hindering smooth paper transfer and aggravating working environment around the process.

To solve this problem, a pulper to be exclusively used for disposing trims should be installed. Since the air blown through the opening of the final dryer has affected the process in the worst way, the opening has been sealed. So, this seal should be removed to cause brokes to smoothly drop into the pit.

(A) Pulper : Capacity 8.5 m^3, 90 kW
(B) Pump : 1.8 m^3/min. x 45 mH x 30 kW
(C) Change in layout of the pneumatic trim-conveying duct
(D) Recipient of air-blow in trims from an additional winder

R. Installation of broke pulpers in the first floor

In the present process, brokes produced in the first floor after the dryer part are transported to the calendar pit by means of a conveyer, while defective paper sheets found in the second floor are torn into pieces and transported into the calendar pit for further treatment.

It is desirable that a pulper already installed under the calendar should be fully capable of disposing of the brokes which may be produced as a result of break in paper sheets. An additional pulper is installed to separate the broke treatment mentioned in this paragraph from that mentioned in the above paragraph.

The pulper in the calendar pit is started only when it receives a signal indicating a cut in sheets while it be kept out of use otherwise, to ensure energy saving.

(A)	Pulper :	Capacity 15 m^3, 150 kW
(B)	Conveyer :	2m (W) x 30m (L), 11 kW
(C)	Pump :	3 m^3/min. x 15 mH x 15 kW
(D)	Piping and others	

S. Pumps

Quantitative balance based on the Renovation Plan varies in accordance with operating conditions. Since it is influenced mainly by the former in the paper machine wire part and pulp concentration, pumps related to devices to remove dust and air from pulps (approach) have been recommended in consideration of this fact.

Pumps except those listed in the sections of the preparation and the paper machine are listed in this section as follows:

(A) Pumps related to the preparation : 15
(B) Pumps related to the paper machine : 20

T. Renewal of an automatic roll wrapping machine

The existing automatic roll wrapping machine is now unable to conduct a series of automated operation due to its structural defects and aging, thereby requiring manual operation in some processes. The wrapping capacity has been exceeded by the present production volume.

So, it is replaced with a wrapping machine which possesses a capacity meeting intended production volumes under the Renovation Plan, and the existing winding and carrying facilities are renewed since they have been deteriorated.

(A) Renewal of pusher and slat conveyer : full set

(B) Roll wrapping machine : An overhead type to automatically wrap a roll in the order of centering, core-inserting, internal paper-inserting, trimming, external paper-pasting, pressurizing, and label-fixing processes. Wrapping capacity : 80 rolls per hr.

(C) Rolling lifter : Full set to be renewed

(D) Installation of a hoist

(E) Construction work, including foundation

(F) Electric and instrumentation work

U. Instrumentation

Since the time when we once developed the B/M (Basis weight/Moisture) System which was to be used exclusively for measuring and controlling basis weight and moisture, the paper-making industry has made a remarkable progress and has undergone many changes, and users' demands for the B/M system have been greatly diversified. In the whole industrial world, more importance has been attached to information, high technology, and addition of values, and process automation (PA) has displayed growth accordingly.

In the PA field, component techniques such as control techniques and computer technology have been utilized to make progress aiming at distributed control systems (D.C.S.) whose basic concept is "distribution of functions and concentration of information."

A recent trend is toward "integrated control" in which control data and functions are integrated to meet needs for total factory automation. The Renovation Plan has been set up by taking these changes in the environment and future development of comprehensive control of paper-making machines.

(A) Stock preparation

Introduction of a computerized system to monitor, operate, and collect information on paper-making machines, covering

controls of concentrations, flow rates, prescription rates, and liquid levels of pulps and controls of approaches of the paper machine will eliminate mistakes to be caused by human beings and contribute to stabilization of quality, maintenance of production volume even in case of paper cut, and reduction of production costs.

* Operation station	2
* Control station	1
* Printer	2
* Hard copying machine	1
* Engineering station	1
* Other ancillary items	1 set
* Control instruments	1 set

(B) Paper-making machine

The existing B/M meter is the Measurex 2002ET introduced in June 1989. The product quality should be improved and stabilized by modifying it to use CRT for displaying absolute dry weight (by installing an actuator in the BD-head box), caliper controls, drainage, drives, heat recovery, and pulpers.

* Existing B/M meter, V-2002ET (CPU: 16 pits) to be modified into S.V-2002ET (CPU 32 pits)

V. Principal spares for the paper-making machine

(A) Wire roll : 1,070 mm in diameter, 7,800 mm in surface length: 1

(B) Wire roll : 810 mm in diameter, 7800 mm in surface length: 2

(C) Suction couch roll No. 1 : 1,525 mm in diameter and 7,750 mm in drilled surface length: 1

(D) Suction couch roll No. 2 : 1,170 mm in diameter and 7,750 mm in drilled surface length: 1

(E) Expander roll : 270 mm in diameter and 7,910 mm in surface length: 2

(F) Suction pick-up roll : 915 mm in diameter and 7,600 mm in drilled surface length: 1

(G) Suction press roll : 1,120 mm in diameter and 7,600 mm in drilled surface length: 1

(H) Suction felt roll : 610 mm in diameter and 7,600 mm in drilled surface length: 1

(I) Granite roll : 1,370 mm in diameter and 7,750 mm in surface length: 1

(J) Venta-grooved crown-controllable roll : 895 mm in diameter and 7,500 mm in pressurized surface length: 1

(K) Felt roll (plane) : 528 mm in diameter and 7,910 mm in surface length: 2

(L) Felt roll (worm) : 528 mm in diameter and 7,910 mm in surface length: 1

(M) Paper roll : 528 mm in diameter and 7,600 mm in surface length: 1

(N) Brace top roll : 660 mm in diameter and 7,370 mm in surface length: 1

(O) Calendar middle roll : 660 mm in diameter and 7,370 mm in surface length: 2

(P) Middle crown-controllable roll : 660 mm in diameter and 7,370 mm in surface length: 3

(Q) Canvas roll : 510 mm in diameter and 7,780 mm in surface length: 2

(R) Canvas roll : 510 mm in diameter and 7,665 mm in surface length: 1

W. Buildings and foundation

As the paper-making machines are modified and additionally installed, construction works for the following foundations, pits, and buildings are implemented. The following list does not include those items which have been listed in each part concerned:

(A) Repair and reinforcement of machine foundations from the head box to the press part.

(B) Elimination of the existing seal pit and construction of a new one.

(C) Modification of the existing silo.

(D) Elimination of the existing couch pit and construction of a structure in which both a couch pit and a press pit are combined.

(E) Addition of the calendar foundation and modification of the calendar pit.

(F) Preparation of foundation for increasing a winder.

(G) Expansion of the building as a result of the addition of the winder.

(H) Preparation and reinforcement of foundation for driving units.

(5) Paper-making Process Flow-sheet

Paper-making process flow-sheets for each alternatives and existing flow are shown in Fig. IV-3-7 and IV-3-9 for ease of comparison.

(6) Paper Machine Layout

Paper machine layouts are shown in Attachment IV-3-1(Case-1) and Attachment IV-3-2(Case-2).

(7) Paper Machine Approach Flow

Paper machine approach flow systems are shown in Attachment IV-3-3(Case-1) and Attachment IV-3-4(Case-2).