APPENDICIES

Appendix 1.

GENERAL

Appendix 1-1. ITINERARY

October 1982

2	(Sat.)	–	Lv. Tokyo – Av. Los Angeles Lv. Los Angeles for Quito
3	(Sun.)	–	Av. Quito
4	(Mon.)	–	Visit to Embassy of Japan and I.F.C
5	(Tue.)	–	Meeting with I.F.C
6	(Wed.)	–	Meeting with I.F.C
7	(Thu.)	–	Lv. Quito for San Lorenzo (Mr. Kano, Mr. Takeshita, Mr. Hayashi, Mr. Wakuta and Mr. Doisako)
		–	Observation of wood samples for pulping tests (Mr. Tonoya, Mr. Osada and Mr. Yamashita)
8	(Fri.)	–	Survey of logging process at Cayapas Forest Concession
		–	Lv. Quito for San Lorenzo (Mr. Osada and Mr. Yamashita)
9	(Sat.)	–	Survey of water resources at San Lorenzo and Recaurte
10	(Sun.)	–	Lv. San Lorenzo for Quito (Mr. Kano and Mr. Yamashita)
		–	Team internal meeting
11	(Mon.)	–	Visit to CONADE
		–	Visit to MICEI
		–	Visit to San Lorenzo Municipal Office
		–	Site Investigation at San Lorenzo area
		–	Lv. Quito for Guayaquil (Mr. Kano and Mr. Yamashita)
		–	Visit to PANASA head office, Guayaquil
		–	Visit to PRCASA, Guayaquil

12	(Tue.)	–	Investigation of waterway for access platform at San Lorenzo Bay
		–	Forest survey at Cayapas Forest Concession Lot 2
		–	Visit to PANASA Sancarlos factory, Guayaquil
13	(Wed.)	–	Visit to CENDES
		–	Lv. San Lorenzo for Esmeraldas (Mr. Osada, Mr. Takeshita, Mr. Hayashi, Mr. Wakuta and Mr. Doisako)
		–	Visit to Cámara de Industrias de Guayaquil
		–	Visit to INCAESA, Guayaquil
14	(Thu.)	–	Visit to A.P.E
		–	Visit to local civil, building and engineering contractors at Esmeraldas
		–	Visit to REFORMA, Guayaquil
		–	Visit to HEC, Guayaquil
15	(Fri.)	–	Lv. Esmeraldas for Quito (Mr. Osada, Mr. Takeshita, Mr. Hayashi, Mr. Wakuta and Mr. Doisako)
		–	Team internal meeting
		–	Visit to Ministerio de Agricultura y Canadería, Programa Nacional del Bananano, Guayaquil
		–	Visit to B.C.E, Guayaquil
16	(Sat.)	–	Lv. Guayaquil for Quito (Mr. Kano and Mr. Yamashita)
		–	Meeting with local civil, building and engineering contractor, Quito
		–	Team internal meeting
		–	Lv. Tokyo – Av. Los Angeles (Mr. Yoshida)
		–	Lv. Los Angeles for Quito (Mr. Yoshida)
17	(Sun.)	–	Lv. Quito for Guayaquil (Mr. Takeshita, Mr. Wakuta and Mr. Doisako)
		–	Av. Quito (Mr. Yoshida)
18	(Mon.)	–	Visit to local civil, building and engineering contractors at Guayaquil
19	(Tue.)	–	Visit to A.P.G
		–	Visit to A.E.D.D at Guayaquil
		–	Visit to B.C.E, Quito

20	(Wed.)	–	Visit to INCASA, Quito
		–	Visit to A.E.I.O at Guayaquil
		–	Lv. Guayaquil for Quito (Mr. Takeshita, Mr. Wakuta and Mr. Doisako)
21	(Thu.)	–	Meeting with I.F.C
		–	Lv. Quito – Av. New York (Mr. Osada)
22	(Fri.)	–	Team internal meeting for basic concept of Interim Report
		–	Lv. New York for Tokyo (Mr. Osada)
23	(Sat.)	–	Drafting of Interim Report
		–	Av. Tokyo (Mr. Osada)
24	(Sun.)	–	Drafting of Interim Report
25	(Mon.)	–	Drafting of Interim Report
26	(Tue.)	–	Drafting and Typing of Interim Report
27	(Wed.)	–	Typing of Interim Report
28	(Thu.)	–	Typing and binding of Interim Report
		–	Visit to C.F.N
		–	Lv. Quito – Av. New York (Mr. Yoshida)
29	(Fri.)	–	Presentation and explanation of Interim Report to I.F.C and C.F.N
		–	Lv. New York for Tokyo (Mr. Yoshida)
30	(Sat.)	–	Discussion Interim Report with I.F.C and C.F.N
		–	Av. Tokyo (Mr. Yoshida)
31	(Sun.)	–	Off

November 1982

1	(Mon.)	–	Visit to Embassy of Japan and I.F.C

2	(Tue.)	–	National Holiday – Off
3	(Wed.)	–	Lv. Quito – Av. New York
4	(Thu.)	–	Lv. New York for Tokyo
5	(Fri.)	–	Av. Tokyo

Appendix 1-2. MEMBERS OF JAPANESE STUDY TEAM

Name	Field
Mr. Tadao Kano	Team Leader
Mr. Seiichi Tonoya	Project Engineer
Mr. Yoshinao Osada	Forest Engineer
Mr. Masao Yoshida	Economic Analysist
Mr. Atsushi Yamashita	Process Engineer
Mr. Eiichi Takeshita	Industrial Economist
Mr. Masahiko Hayashi	Industrial Engineer
Mr. Kohji Wakuta	Industrial Engineer
Mr. Ushio Doisako	Interpreter

Appendix 1-3. MEMBERS OF THE ECUADOR TEAM REPRESENTATIVES

Mr. José Iturralde Arteága	President	I.F.C
Mr. Edmundo Estupiñan Maldonado	Administration Manager	I.F.C
Mr. Luís S. Valverde C	Professor	I.F.C
Mr. Antonino Saenz Fernandez	General Manager	I.F.C
Mr. Carlos E. Page Y.	Manager	I.F.C
Mr. Gianni Garibaldi	General Manager	C.F.N
Mr. Alberto Kury	Vice General Manager	C.F.N
Mr. Efrain Andrade	Manager	C.F.N
Mr. Gustavo Cevallos	Manager	C.F.N
Mr. Alfonso Cordovez	Manager	C.F.N

Appendix 2.

PULPING TEST

Appendix 2. PULPING TEST REPORT

Subjects of Examination

Suitability for pulping shown by mixed tropical hardwood species occurring in Ecuador:

- Pulping tests on hardwood species sampled in vicinity of San Lorenzo, Esmeraldas Province, northwest Ecuador

- Suitability for pulping shown by UKP for base liner, KSC and by NSSC pulp for corrugating medium and BKP for printing/writing paper.

2.1 Outline of Test and Results

10 species of hardwood occurring in the San Lorenzo area of Ecuador were tested to verify their suitability for pulping, in the forms of UKP for base liner, KSC and NSSC pulp for corrugating medium and BKP for printing/writing paper.

The specimens of wood were measured to determine their bone dry basic density; the blending ratio between the various species was determined from the forest volumes represented by each species in their source forests in Ecuador; the species were blended to this ratio for pulping tests.

The results were compared with those obtained from similar blends of hardwood species occurring in Hokkaido, Japan.

The basic densities shown by the Ecuadorian species proved to be relatively low as hardwood.

The alcohol-benzene extract in the chemical composition was roughly 1%, which is shown relatively low for tropical wood.

2.1.1 UKP as Material for Base Liner

Compared with the Japanese samples, the Ecuadorian blended specimens showed properties of:

–	Cooking speed	Equal
–	Cooking yield	3 to 3.5% higher for equal Kappa value
–	Pulp strength	Generally lower, except for tearing and folding resistance which are higher
–	Ring crush resistance	Equal.

The foregoing observations indicate that the Ecuadorian blended hardwood is equally suitable to the Japanese material for manufacturing base liner.

For producing kraft liner, it requires to be mixed with 30 to 40% of N. UKP.

2.1.2 KSC and NSSC Pulp as Material for Corrugating Medium

Whether the KSC or NSSC process is used for cooking, the Ecuadorian blend is susceptible to

- Higher cooking yield
- Equal or higher pulp strength

compared with the Japanese material.

Whichever process is adopted, the Ecuadorian blend should not be processed in short cooking time, such as adopted for continuous cooking, as this will result in significant lowering of pulp strength and energy consumed for disintegration.

Between KSC and NSSC processes, the KSC provides cooking yield about 10% lower, with correspondingly higher pulp strength, but for equal cooking yield the NSSC pulp provides higher strength, so that this process is judged more suitable in overall evaluation for the present instance.

The energy required for disintegration and beating estimated to be 30 to 40% higher

for the Ecuadorian blend for equal cooking yield.

It is indicated from the foregoing that the Ecuadorian blended material is amply utilizable for manufacturing corrugating medium.

2.1.3 BKP as Material for Printing/Writng Paper

UKP of 20 to 25 Kappa value was test bleached in five stage of C-E-H-E-H bleaching.

The results indicated the Ecuadorian blend to be, as compared with the Japanese sample:

- Equal in bleachability
- Equal in bleaching yield
- Somewhat lower in pulp viscosity after bleaching
- Brightness attaining 84
- Somewhat difficult to beat, with Kappa value around 20
- Superior in general pulp strength, bursting, tensile and tearing
- Equal in opacity and picking strength
- More subject to vessel picking.

As overall evaluation, it is indicated that the Ecuadorian blend is amply usable for producing BKP intended for the manufacture of printing/writing paper.

2.2 Examination of Raw Pulpwood

Of the more than 200 species of mixed tropical hardwood occurring naturally in the San Lorenzo area, 16 representative species were sampled, of which 6 were eliminated for their high basic density and 1 species for its containing corky material (listed in Table 2-1) to leave 10 species which were subjected to the present pulping tests.

The basic density constitutes an important criterion for judging the suitability of a wood species for the production of pulp.

It is noted in this connection that wood of high basic density has been judged unsuitable for pulping in studies undertaken since 1974 on the tropical hardwood occurring in this

Table 2-1. Species Eliminated from Pulping Tests

Species	Color		Bone Dry Basic Density
	Periphery	Core	
Chanul	Light gray	Dull red; turns into coffee color upon exposure to atomsphere	0.82
Caimitillo	Hardly existent	Rose	0.97
Tachuelo	Thick; light yellow	Coffee color	n.a
Guayacan	Grayish yellow	Coffee color	0.98
Mascarey	White	Dark purple	0.74
Peine de mono	Whitish	Yellow	0.26

region, conducted with the view of developing the forest resources.

The 10 species thus selected for testing are listed in Table 2-2. These species of wood are covered with 8 to 20 mm of bark, which was removed at site, and sliced into discs for shipment by air to Japan as specimens.

The average basic density of the blended chip was determined from calculation to amount to 455 kg/m^3 bone dry. When piled up, the apparent density was as follows.

- When piled without compression 140 kg/m^3
- When compressed to 4 kg/cm^2 171 kg/m^3

The chipped specimens presented a size distribution of

- 25 mm$^+$ 4.3%
- 20–25 mm 73.2%
- 7–20 mm 22.3%
- 7 mm$^-$ 0.2%

Table 2-2. Species Selected for Pulping Tests

Species	Water Content (%)	Alcohol-Benzene Extract (%)	Basic Density Measure (kg/m^3)	Basic Density in Reference Literature (kg/m^3)	Average of Two Values (kg/m^3)	Unit Forest Volume (m^3/ha)	Blending Ratio (%)
Sande	20.5	1.6	527	348	438	13.89	23
Cuangare	20.4	2.2	409	360	385	8.52	13
Anime	22.0	1.0	408	452	430	10.83	18
Jigua	23.3	1.1	443	423	433	8.45	14
Guabo	20.2	0.7	524	590	557	6.07	13
Chalviande	27.7	0.9	420	369	395	3.86	6
Uva	45.7	2.7	360	306	333	2.21	3
Carra	29.8	1.2	517	567	542	1.23	2
Chillalde	28.6	1.1	347	270	309	–	*4
Galza	24.3	2.5	391	–	391	–	*4

Notes: 1. *) Unit forest volume unknown, blending ratio of 4% arbitrarily adopted.

2. The 10 species listed above were hand-chipped for testing.

The hand-chipped size distribution given above is far more uniform than normally obtained with machine chipping at plant, an example of which is given below.

–	24 mm^+	7.8%
–	12–24 mm	43.5%
–	6–12 mm	38.3%
–	6 mm^-	10.4%

The reference blend of the Japanese hardwood species consisted of the following:

–	Species occurring commonly	Elm, Japanese oak, and Alder
–	Species occurring more rarely	Willow

2.3 Method of Pulping Test

2.3.1 UKP for Liner; BKP for Printing/Writing Paper

(1) Cooking

The pulp was cooked to 3 Kappa values around 20, 40 to 50, and 70 to 80.

Pulp of 40 to 80 Kappa was used for producing liner, and 20 to 25 Kappa for bleached pulp to manufacture printing/writing paper.

Cooking was applied at 5 lit/kg liquor ratio, 16 to 17% active alkali as Na_2O in reference to bone dry chip, 25% sulfidity, 150 to 170°C cooking temperature and 90 min holding time.

(2) Refining, Screening and Beating

The cooked chip was roughly refined in a Kumagai 12 inch test refiner, passed through 8/1,000 inch flat screen.

For liner it was further passed through PFI mill, and for printing/writing paper it was sent to bleaching.

With the PFI mill, the pulp was beaten to a freeness of 600, 500, and 400 m.l C.S.F; for bleaching the unbeaten pulp was processed directly after screening.

(3) Bleaching

The bleaching test was performed in five stages of C-E-H-E-H, the conditions of bleaching being as presented in Table 2-7. After bleaching the pulp was beaten to the prescribed freeness values of 500, and 400 m.l C.S.F.

(4) Papermaking by Hand

Papermaking was undertaken to produce:

- Pulp for liner of 150 g/m^2
- Pulp for printing/writing paper of 60 g/m^2

by TAPPI Standard.

(5) Tests on Paper Properties

Paper strength was measured by J.I.S-prescribed method.

Tests for printability were conducted with RI Tester.

2.3.2 KSC and NSSC Pulp for Corrugating Medium

(1) Cooking

Cooking tests were conducted with KSC and by NSSC processes.

Maximum temperature holding time was changed between 20 and 90 minutes for mutual comparison.

The conditions of cooking test were as follows:

– KSC process

Cooking liquor composition:	KP white liquor, 25% sulfidity
Cooking liquor quantity:	10% active alkali as Na_2O
Cooking temperature:	145 to 160°C
Duration of heating, holding:	45 : 20 and 45 : 90 minutes
Liquor ratio (lit/kg):	5

– NSSC process

Cooking liquor composition:	Na_2SO_3 : Na_2CO_3 = 4 : 1
Cooking liquor quantity:	12% Na_2SO_3 * and 3% Na_2CO_3
Cooking temperature:	165 to 180°C
Duration of heating, holding:	45 : 20 and 45 : 90 minutes
Liquor ratio (lit/kg):	5

(2) Refining, Screening

The cooked chip was roughly in a Kumagai 12 inch test refiner, passed through 8/1,000 inch flat screen, then beaten to a freeness of 450 m.l, C.S.F.

Rough refining was applied with the material passed 3 time through plate clearance of 4, 2, and 0.3 mm.

(3) Papermaking by Hand; Test of Paper Quality

Papermaking was undertaken to produce pulp with a basis weight of 145 g/m^2.

The resulting paper was tested by J.I.S-prescribed method.

Water absorption degree was tested by drop method, in which:

– Paper surface temperature was adjusted to 55°C
– A drop of water at 20°C was placed on the paper surface using a syringe
– The time taken for the water drop to be absorbed in the paper was measured for both top and bottom sides and the mean value derived.

2.4 Test Results

2.4.1 KP Cooking, Suitability of Pulp for Producing Liner

(1) Digestability

The Ecuadorian samples showed Kappa values differing little from the Japanese material for the same cooking conditions: The cooking speed was roughly equal between the 2 kinds of specimen.

For the same Kappa value, the cooking yield was 3 to 3.5% higher with Ecuadorian specimen.

The cooking and screening yield shown by the Ecuadorian blended specimen for various Kappa values are as given below.

Kappa value	20	40	60
Cooking yield (%)	50.2	53.5	56.5
Screening yield (%)	50	53.4	56.3

(2) Beating Speed

With Kappa values above 55, the Ecuadorian pulp was beaten more easily, whereas below 55 Kappa, the Japanese material become quicker to beat.

The Ecuadorian specimen was found devoid of the behavior shown by the Japanese material of showing a low unbeaten freeness at low Kappa, resulting in a small number of PFI cycles to attain the prescribed freeness, with correspondingly insufficient fiberization of the pulp and low pulp strength.

(3) Drainage Factor

In the range of 45 to 80 Kappa value, the drainage time was 9.5 to 9 seconds for the Ecuadorian specimen, as compared with 10.5 to 10 seconds for the Japanese material.

(4) Paper Density

Pulp from the Ecuadorian material gave densities 0.01 to 0.015 lower than the corresponding Japanese pulp, indicating that the Ecuadorian chip produced are relatively bulky pulp.

(5) Pulp Strength

Pulp strength, as material for liner, was compared at 40 to 80 Kappa value.

The results, as shown in the accompanying Table 2-3, indicated that the Ecuadorian pulp was slightly inferior to the Japanese material in respect of tearing strength and folding resistance.

It can be concluded from the foregoing that the Ecuadorian tropical hardwood specimen composed of a blend of 10 species, can be used for producing base liner pulp on equal standing with corresponding hardwood material occurring in Japan.

For producing kraft liner, lamination with 30 to 40% of N. UKP as top liner will be required.

Table 2-3. Ecuadorian vs. Japanese Pulp Strength Test Results

Item	Absolute Difference	Percentage	Overall Evaluation
Burst ratio	(-) 0–0.3	94.5–100	Japanese pulp found slightly stronger
Breaking length	(-) 0.35–0.45	93.6–94.8	
Elongation	(-) 0.9	81	Greater elongation with Japanese pulp
Tear ratio	(-) 20–30	116.7–122.9	Ecuadorian material found stronger
Folding endurance	(+) 55–100	107.2–118.5	
Ring crush ratio	(-) 0.7–1.3	94.5–97.0	Japanese material found somewhat stronger

Further details of test results are given in Tables 2-4, 5, and Figs. 2-1, 2, 3, 4.

2.4.2 Suitability of KSC and NSSC Pulp for Producing Corrugating Medium

(1) Digestability

- KSC Process:
  For the same cooking conditions, the Ecuadorian specimen provided for 2 to 3% higher cooking yield compared with the Japanese material.

- NSSC Process:
  For the same cooking conditions, the Ecuadorian specimen provided for 5 to 8% higher yield compared with the Japanese material.

(2) Refining

- KSC Process:
  To a freeness of 450 m.l, the energy required by the Ecuadorian material would be higher by the following percentages:

90 minutes cooking:	10%
20 minutes cooking:	70%.

- NSSC Process:
  As with the KSC pulp, the Ecuadorian material will require more energy to the following extent:

90 minutes cooking:	70%

Table 2-4. Ecuadorian vs. Japanese Pulp Test Results KP Cooking Applications for Liner

	Species		Ecuadorian Blend									Hokkaido (Japan) Hardwood								
Cooking Condition	Active Alkali Addition	%	16			16			27			16			16			17		
	Sulfidity	%	25			25			25			25			25			25		
	Liquor Ratio	–	5			5			5			5			5			5		
	Cooking Temperature	°C	150			160			170			150			160			175		
	Cooking Time/Heat-up	min.	75			75			75			75			75			75		
	Cooking Time/Hold	min.	90			90			90			90			90			90		
	Yield	%	60.2			55.1			50.2			55.4			50.8			46.4		
	Kappa Value	–	83.8			46.3			23.2			74.0			43.5			21.0		
	Unbleached Pulp Freeness	m.l	746			688			632			737			673			600		
	Rejects Ratio/8-cut Flat Screen 8/1,000	%	0.33			0.06			0.01			0.94			0.12			0.03		
Strength	PFI Mill Revolution	revol.	1,950	2,900	3,600	930	2,080	3,080	880	1,800	2,900	1,750	2,700	3,800	780	1,950	2,850	0	1,150	2,130
	Freeness	m.l	565	461	386	600	488	432	579	513	444	591	538	431	605	499	430	600	495	409
	Drainage Rate	sec.	7.3	10.4	14.5	7.2	9.9	12.9	8.1	10.7	14.8	6.9	8.6	13.3	7.0	10.5	13.7	6.8	11.0	17.6
	Basic Weight	g/m^2	154	153	152	149	149	149	148	148	146	151	149	151	150	150	149	151	150	149
	Density	g/cm^3	0.67	0.74	0.76	0.63	0.72	0.75	0.69	0.74	0.77	0.66	0.70	0.75	0.64	0.74	0.79	0.67	0.73	0.79
	Bursting Factor	–	4.67	5.62	6.18	4.16	5.23	5.74	4.39	5.13	5.52	4.39	5.03	5.72	4.42	5.45	6.08	4.12	5.33	5.93
	Breaking Length	km	5.76	6.52	7.42	5.65	6.72	7.06	6.10	6.77	7.08	5.93	6.38	7.30	6.08	7.01	7.62	5.94	6.71	7.71
	Elongation	%	3.8	4.4	5.0	3.1	3.9	4.2	2.9	3.7	3.9	4.3	4.8	5.4	3.8	4.5	5.2	4.0	4.5	5.4
	Ring Crush Factor	–	20.3	22.2	22.4	20.0	22.4	23.2	21.4	24.0	24.3	21.0	21.9	23.0	21.4	23.8	23.9	20.2	22.6	23.0
	Tear Factor	–	135	126	117	162	159	152	146	138	136	122	118	114	133	128	124	135	130	125
	Folding Endurance (1.5 kg)	–	162	429	897	44	350	590	144	368	652	65	133	460	34	251	571	11	133	393

Table 2-5. Ecuadorian vs. Japanese Pulp Test Results Characteristics of Both Pulps at Freenesses

PFI mill speed required for beating to the freenesses: 600 m.l, 500 m.l,
and 400 m.l and characteristics of each pulp in respective freenesses are as follows:

Species		Ecuadorian Blend									Hokkaido (Japan) Hardwood								
Active Alkali Addition	%	16			16			17			16			16			17		
Cooking Temperature	°C	150			160			170			150			160			175		
Kappa Value	–	83.8			46.3			23.2			74.0			43.5			21.0		
Freeness	m.l	600	500	400	600	500	400	600	500	400	600	500	400	600	500	400	600	500	400
PFI Mill Revolution	–	1,400	2,600	3,800	1,000	2,200	3,400	800	2,000	3,200	1,800	3,000	4,200	800	2,000	3,200	0	1,100	2,200
Drainage Rate	sec.	6.5	9.1	13.7	7.2	9.5	14.6	7.8	11.7	15.6	6.6	10.0	15.2	6.9	10.5	15.6	7.1	10.9	17.6
Density	g/cm^3	0.64	0.71	0.76	0.64	0.72	0.76	0.68	0.75	0.79	0.64	0.72	0.76	0.66	0.74	0.78	0.67	0.75	0.79
Bursting Factor	–	4.24	5.19	6.14	4.16	5.10	6.04	4.20	5.15	6.11	4.29	5.23	6.21	4.47	5.41	6.36	4.27	5.21	6.16
Breaking Length	km	5.44	6.31	7.19	5.65	6.53	7.41	5.88	6.75	7.63	5.86	6.71	7.57	6.13	7.00	7.89	5.94	6.81	7.70
Elongation	%	3.5	4.2	4.9	3.2	3.8	4.4	2.9	3.6	4.2	4.3	5.0	5.6	4.1	4.7	5.3	4.0	4.6	5.2
Ring Crush Factor	–	19.4	21.6	22.5	20.0	22.2	23.2	21.3	23.8	24.7	20.3	22.5	23.6	21.1	23.5	24.4	20.2	22.4	23.5
Tear Factor	–	137	132	117	162	160	144	146	143	127	123	120	110	133	131	120	135	134	123
Folding Endurance (1.5 kg)	–	70	340	755	50	320	740	80	400	895	30	230	610	35	270	690	10	120	440

Fig. 2-1. Ecuadorian vs. Japanese Pulp Test Results

Relationship between Cooking Yields and Kappa Values

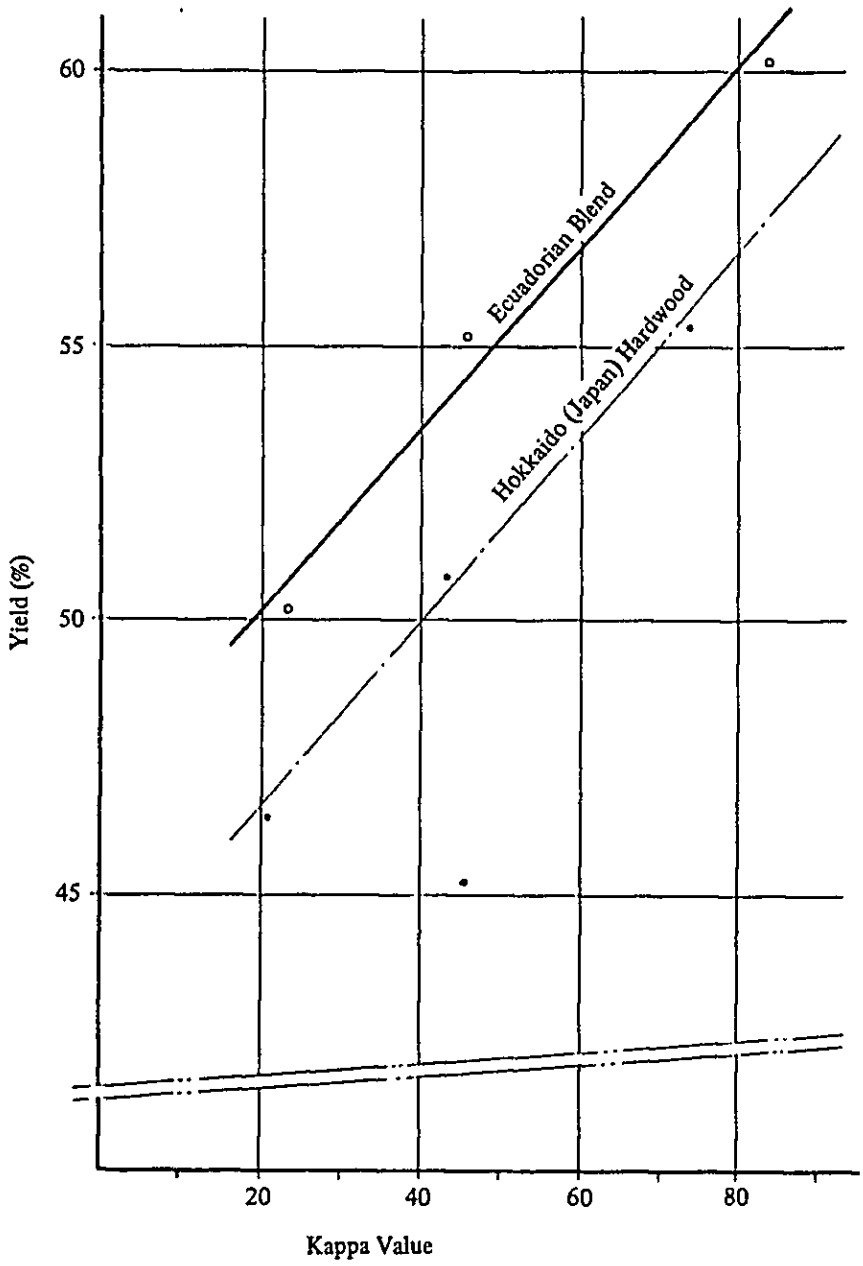


Fig. 2-2. Ecuadorian vs. Japanese Pulp Test Results

Relationship between Cooking Temperatures and Kappa Values

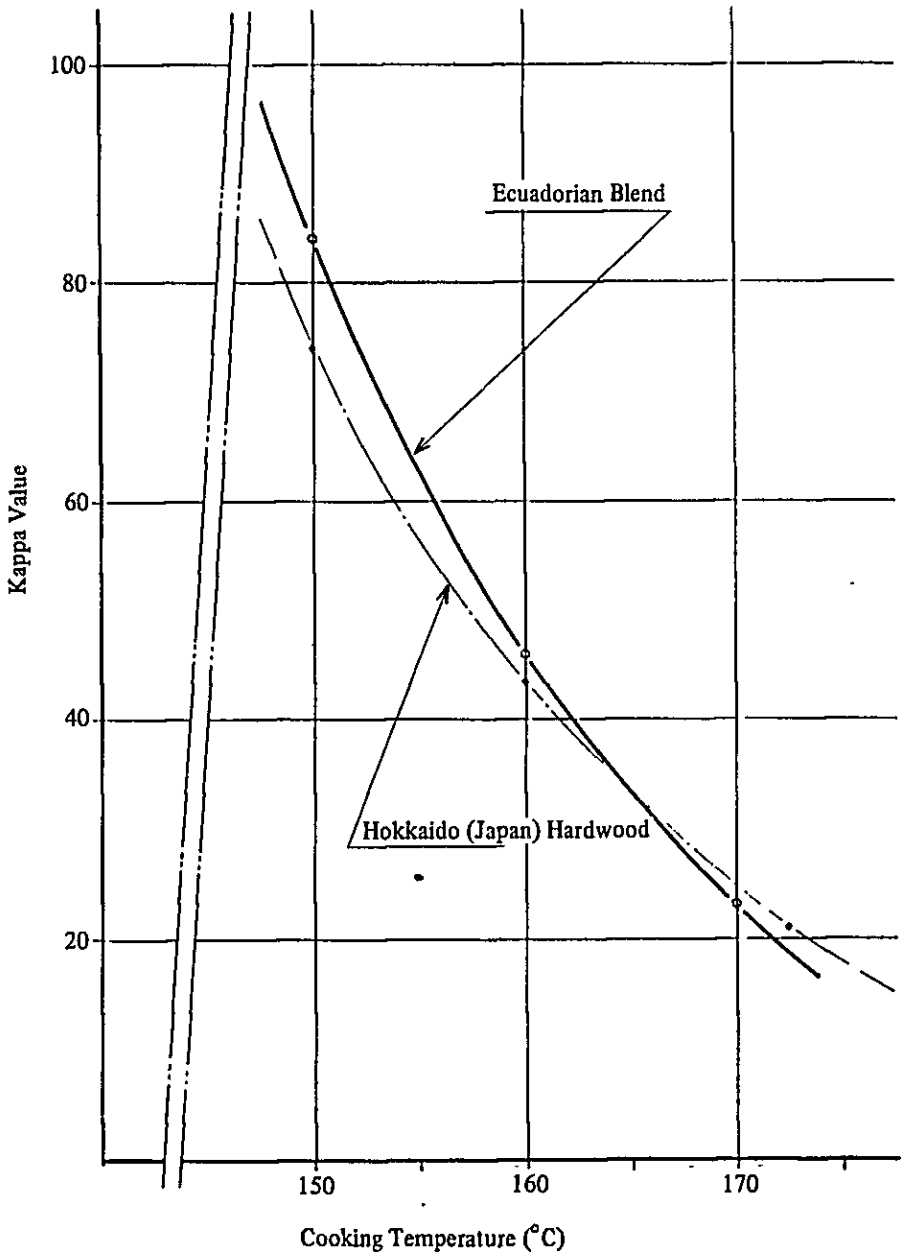


Fig. 2-3. Ecuadorian vs. Japanese Pulp Test Results

Relationship between Pulp Characteristics and Kappa Values, at 500 m.l Freeness

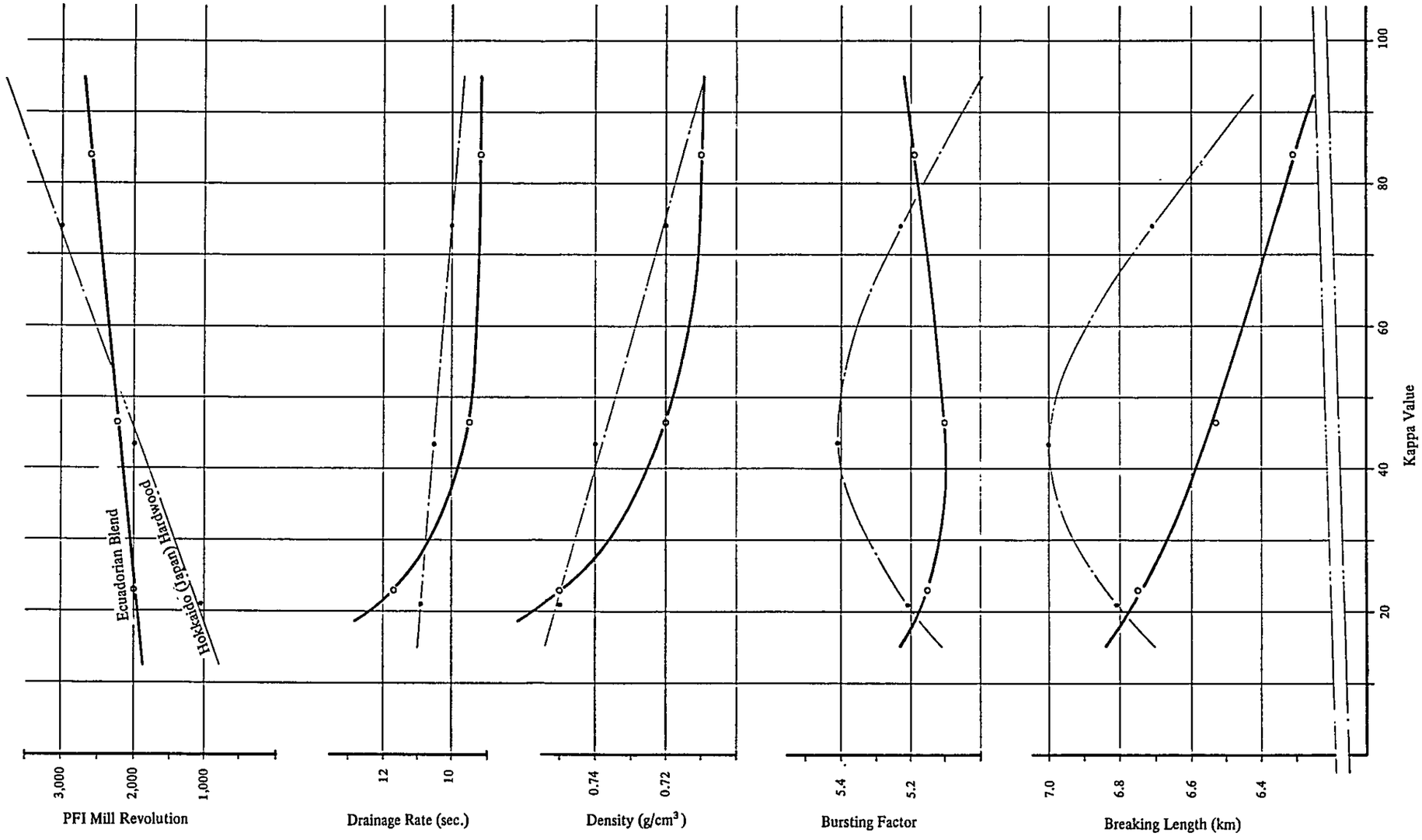
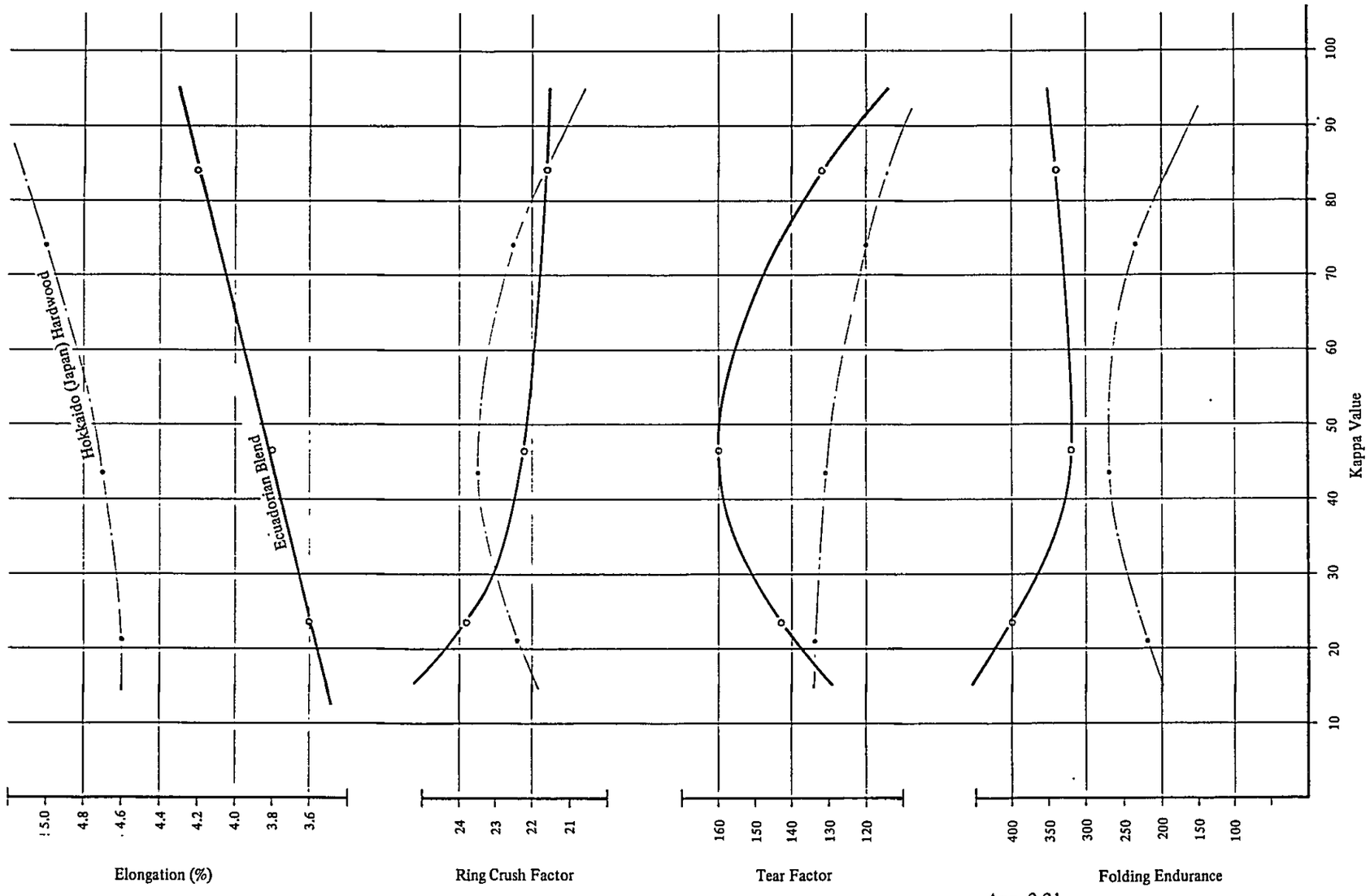


Fig. 2-4. Ecuadorian vs. Japanese Pulp Test Results

Relationship between Pulp Characteristics and Kappa Values, at 500 m.l Freeness



Elongation (%) | Ring Crush Factor | Tear Factor | Folding Endurance

20 minutes cooking: 140%.

(3) Pulp Properties

- Density

  - KSC Process:
    Despite the high yield ensured by the Ecuadorian specimen, a high density can be easily obtained, to produce high bursting strength.

    This quality of the Ecuadorian material, however, will be seriously impaired when cooked only for short duration at high temperature.

  - NSSC Process:

    - 90 minutes cooking:
      The Ecuadorian material, despite its 8% higher yield, shows a roughly equal bursting strength, for equal yield, the Ecuadorian material can be expected to show a higher bursting strength.

    - 20 minutes cooking:
      The Ecuadorian material shows a seriously impaired strength, significantly inferior to the Japanese material.

- Tearing Strength; Elongation

  - KSC Process:
    For the same cooking conditions, the Ecuadorian specimen yields tearing strength higher than the Japanese material, to percentages of:

    - 30% with 90 minutes cooking
    - 5% with 20 minutes cooking.

    Elongation is higher with the Japanese specimen.

  - NSSC Process:
    For the same cooking conditions, the Ecuadorian specimen yields

tearing strength lower than the Japanese material, to percentages of:

- 8% with 90 minutes cooking
- 15% with 20 minutes cooking

On the other hand, the Ecuadorian material ensures higher pulp yield and strength provided that suitable conditions of cooking are adopted.

Elongation is higher with the Japanese specimen.

With the NSSC process, the Ecuadorian specimen gives significantly poor values of tearing strength and elongation when subjected to short-duration cooking at high temperature.

- Ring Crush; Concora Crush

  - KSC Process:
    Specific values of both Ring and Concora crush are equally between the Ecuadorian and the Japanese specimens, except with 20-minute cooking, by which the Ecuadorian material shows a poorer performance.

  - NSSC Process:
    As with KSC process, expecting for the case of 20-minute cooking, by which the Ecuadorian material shows significantly poorer performance, both Ring and Concora crush values are only very slightly lower for the Ecuadorian material. However, considering the better yield provided by this material, the difference in strength can be judged negligible.

    It can be concluded that the Ecuadorian material, if cooked under severer conditions compared with the Japanese material, such as to result in comparative yield the resulting strength values can be well be expected to equal those of the Japanese specimens (see Table 2-6, Runs, Nos. 7 and 9).

– Folding Resistance: Tearing Strength

– KSC Process:
The Ecuadorian sample is superior both in folding resistance and tearing strength, though for the former property, poorer results are obtained with 20-minute cooking.

– NSSC Process:
For the same cooking conditions, the Ecuadorian specimen yields poorer results, but as it may be seen from the data Run No.9 of Table 2-6, the adoption of suitable cooking conditions will bring the performance of the Ecuadorian material to a level even higher than the Japanese material.

Remarks:
The foregoing test results would indicate that the KSC process provides better results for pulp quality obtainable with the Ecuadorian material, but considering the generally higher cooking yield provided by the Ecuadorian wood with NSSC process as compared with the Japanese specimen, adoption of the NSSC process with cooking extended to higher chemical addition should yield pulp of quality quite adequate for manufacturing corrugating medium.

– Water Absorption (by drop method)

Water absorption characteristics constitute an important criterion for judging the suitability of pulp for forming into corrugated board by pasting to liner with starch adhesive.

Whether with KSC or NSSC process, the Ecuadorian material produces pulp with faster water absorption, i.e. absorption in shorter time.

An excessively short absorption time can always be adjusted by adding size, so that the quality shown by the Ecuadorian pulp should present no problem.

(4) Concluding Remarks on the Suitability of the Ecuadorian Pulp for Producing Medium

Details of cooking test results are presented in Table 2-6 and Fig. 2-5.

- The foregoing cooking tests have proved the blend of 10 species of the Ecuadorian tropical hardwood to yield – both with KSC and NSSC processes – pulp with higher yield compared with corresponding the Japanese material, and showing strength at least equal to the Japanese pulp.

- Cooking for short duration at high temperature will result in significantly poor values of pulp strength, accompanied by increased energy required for disintegration and beating in the case of the Ecuadorian material, and such conditions of cooking should be avoided.

- Between the KSC and NSSC processes, the latter is judged more suitable considering all the factors involved.

- For the same pulp yield, 30 to 40% more energy is expected to be required for disintegration and beating in the case of the Ecuadorian as compared with the Japanese material.

The overall evaluation for the Ecuadorian blended pulpwood sample is that, it is quite suitable for producing pulp with which to manufacture corrugating medium.

Fig. 2-5. Pulp Properties on KSC and NSSC Pulping

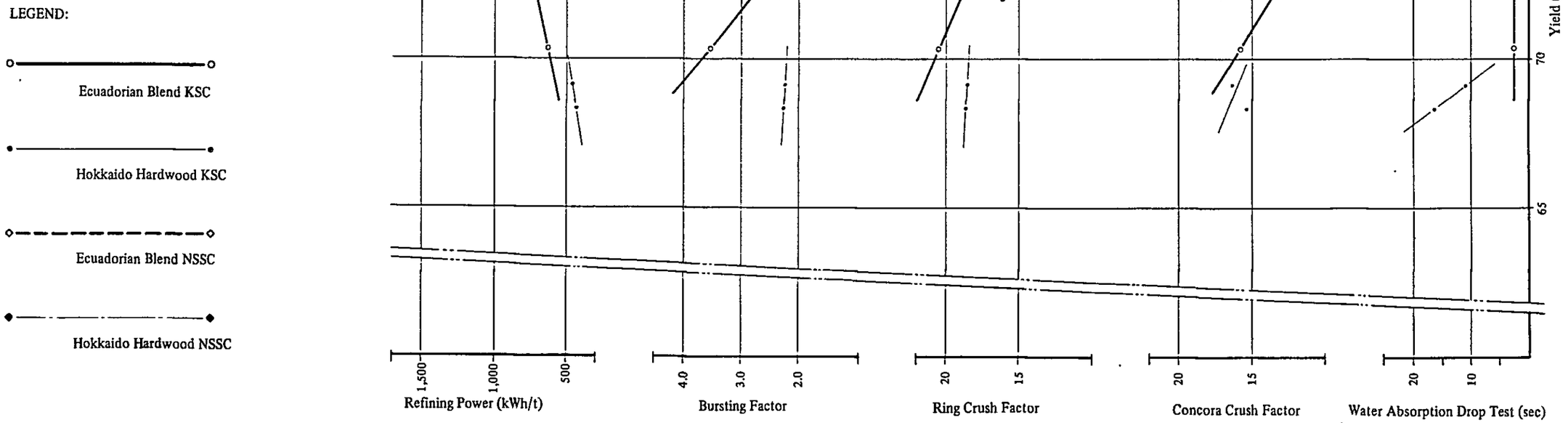


Table 2-6. Pulp Properties on KSC and NSSC Pulping

No.	1	2	3	4	5	6	7	8	9	10	11
Species	Ecuadorian Blend			Hokkaido (Japan) Hardwood		Ecuadorian Blend				Hokkaido (Japan) Hardwood	
Cooking Process	– KSC –					– NSSC –					
Cooking Chemicals Addition	Active Alkali: 10% Sulfidity: 25%					Na_2SO_3: 12% Na_2CO_3: 3%			Na_2SO_4: 14% Na_2CO_3: 3%	Na_2SO_3: 12% Na_2CO_3: 3%	
Liquor Ratio	– 5 –					– 5 –					
Cooking Time (heat up-hold; min)	40–90	45–90	45–20	45–90	45–20	45–90	45–90	45–20	45–90	45–90	45–20
Cooking Temperature (°C)	145	150	160	150	160	165	170	180	170	170	180
Yield (%)	72.7	70.3	72.3	68.3	69.1	82.5	81.3	81.0	80.7	72.9	76.0
1st Refining Power (kWh/t)	543	444	756	320	393	616	606	990	620	391	403
Final Refining Power (kWh/t)	211	176	231	117	81	249	250	273	234	117	120
Freeness (m.l)	435	441	430	430	448	442	430	440	430	454	447
Drainage Rate (sec.)	10.5	11.6	9.6	13.7	12.6	8.6	9.0	8.1	9.2	12.1	10.9
Basis Weight (g/m^2)	146	146	146	146	145	146	146	146	147	146	148
Thickeness (micron)	271	253	293	274	276	309	307	348	293	276	292
Density (g/cm^3)	0.54	0.58	0.50	0.53	0.53	0.48	0.48	0.42	0.50	0.53	0.51
Bursting Factor	2.55	3.56	2.30	2.24	2.28	2.15	2.09	1.51	2.38	2.30	2.17
Breaking Length (km)	4.52	5.11	4.20	3.87	4.00	3.84	3.60	3.05	4.41	3.92	3.57
Elongation (%)	2.6	2.8	2.5	3.0	3.3	1.8	1.7	1.8	2.3	2.7	2.5
Ring Crush Factor	18.4	20.5	16.1	18.6	18.6	16.4	16.2	13.3	17.6	18.6	18.3
Concora Crush Factor	12.5	15.9	12.7	15.3	16.5	15.8	15.3	12.0	16.2	17.1	16.5
Drop Water Absorption Test (sec.)	2.6	4.0	2.5	16.6	10.8	1.3	1.1	1.0	1.7	3.6	3.4
Folding Endurance (MIT 1kgf)	101	214	49	42	44	23	29	11	38	35	25
Tear Factor	63	68	55	42	37	44	45	34	54	36	38

2.4.3 Suitability of Ecaudorian L. BKP for Producing Printing/Writing Paper

As mentioned under Section 2.3.1, bleaching tests were conducted on pulp of 20 to 25 Kappa value applying a five stage C-E-H-E-H procedure.

(1) Bleachability

Table 2-7. Bleaching Conditions

Stage	Chemical	Percentage Added	Temperature (°C)	Pulp Consistency (%)	Bleaching Duration (Hours)
Chlorine	Cl_2	24% x Kappa value	Room Temp.	4	1
Caustic Extraction	NaOH	1.5	60	10	2
Sodium hypochlorite	NaClO + NaOH	2.0 + 0.7	40	10	2
Caustic Extraction	NaOH	0.5	60	10	2
Sodium hypochlorite	NaClO + NaOH	1.0 + 0.5	40	10	3

With identical conditions of bleaching, the Ecuadorian pulp was bleached to 84.5 brightness (23.2 Kappa value), and the Japanese pulp to 83.0 (21.0 Kappa value), that is, to equal brightness.

Bleaching yield was 95 to 96% in both cases.

The pulp viscosity after bleaching was 10.4 with the Ecuadorian pulp, a value that was found slightly low.

The value, however, can be considered quite normal taking account of the fact that sodium hypochlorite was used for bleaching.

(2) Beating Speed of Bleached Pulp

As already observed in Section 2.4.1 in connection with liner pulp, the Ecuadorian pulp at 20 to 25 Kappa value required a higher number of PFI revolutions to attain the prescribed freeness.

The reason for this is higher freeness of unbeaten bleached pulp possessed by the Ecuadorian material.

The drainage time was equal for freeness between the two kinds of pulp.

(3) Characteristics of the Bleached Pulp

The Ecuadorian bleached pulp, compared with corresponding Japanese specimen, proved to possess the following characteristics.

–	Mean fiber length	Longer (see Table 2-7)
–	Tearing, bursting, and tensile strength	About 15% higher
–	Folding resistance	Higher
–	Elongation	Lower
–	Opacity	Equal
–	Picking	Equal

(4) Vessel Pick

As shown in the accompanying photomicrographs, the proportion of vessels is actually lower with the Ecuadorian than with the Japanese pulp.

Even with a relatively small proportion of vessels, however, if they are of large size, they will tend to tear open with beating to adhere on the paper surface, and to break loose with the ink when printing (vessel picking).

This is a general characteristic of tropical hardwood, and was observed to some extent in the Ecuadorian blended specimen, as compared with the Japanese material.

An RI tester was used, with IPI No. 6 ink printed solid, and the results were compared between the Ecuadorian and the Japanese specimens through five category evaluation.

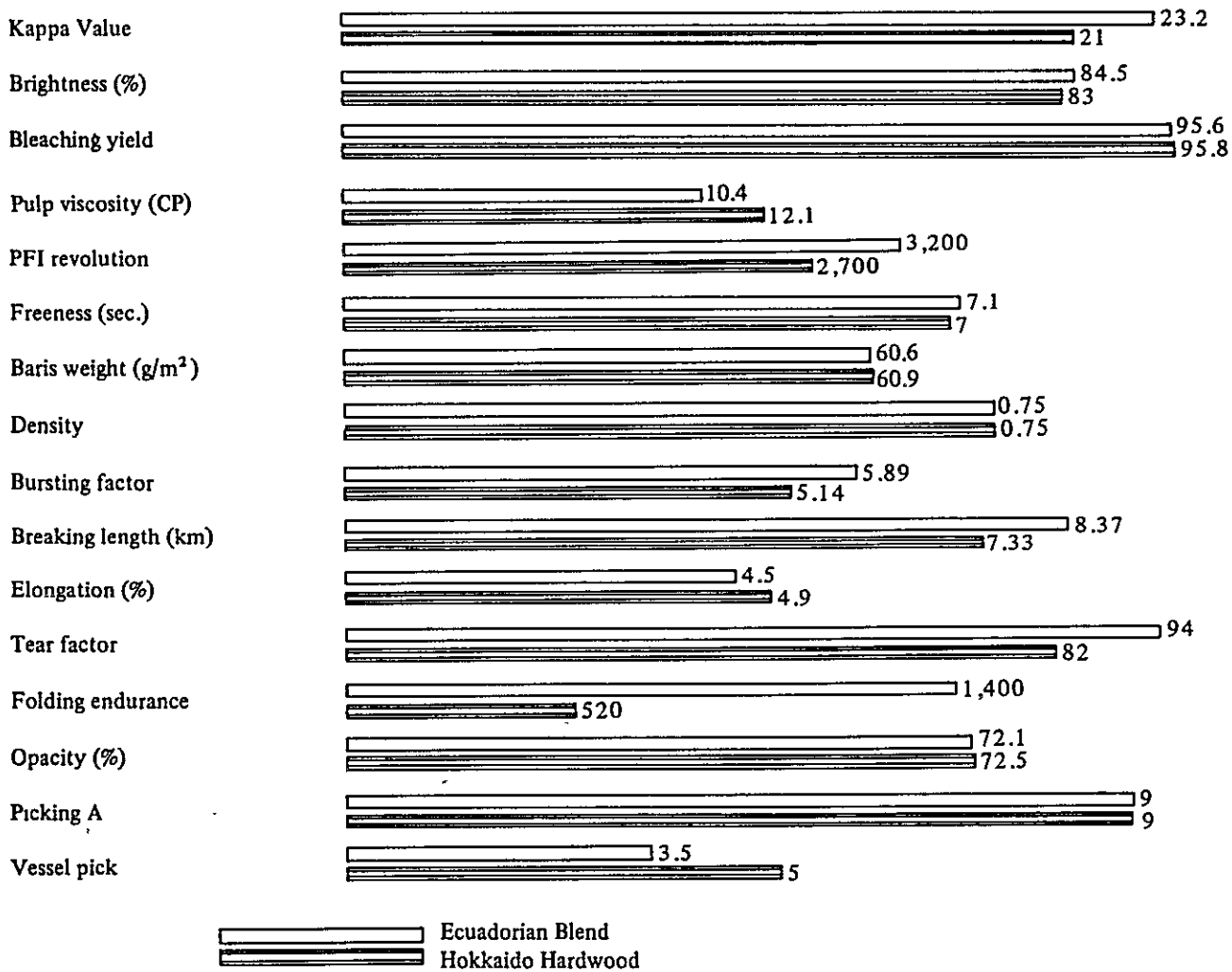
The results of vessel pick test are presented in Table 2-8 and Fig. 2-6.

Table 2-8. Ecuadorian vs. Japanese Bleached Pulp Properties

	Ecuadorian Blend		Hokkaido	
Kappa value	23.2		21.0	
Brightness (%)	84.5		83.0	
Bleaching Yield (%)	95.6		95.8	
Pulp Viscosity (CP)	10.4		12.1	
Freeness (m.l)	500	400	500	400
PFI Revolution	1,800	3,200	1,500	2,700
Dropping Rate (sec)	5.5	7.1	5.4	7.0
Basis Weight (g/m^2)	60.2	60.6	60.1	60.9
Density	0.70	0.75	0.69	0.75
Bursting Factor	4.87	5.89	4.18	5.14
Breaking Length (km)	7.35	8.37	6.35	7.33
Elongation (%)	4.2	4.5	4.3	4.9
Tear Factor (%)	104	94	84	82
Folding Endurance (1.5 kg)	290	1,400	200	520
Opacity (%)	73.4	72.1	74.3	72.5
Picking A	9	9	9	9
Vessel Pick Evaluation	3	3.5	4	5

Vessel pick test: By RI Test (5-point evaluation, 5 is the best)

Fig. 2-6. Ecuadorian vs. Japanese Bleached Pulp Preparation Properties at 400 m.l Freeness:



(5) Alcohol-Benzene Extract

Both Ecuadorian and Japanese pulp, whether bleached or unbleached, gave equal results for alcohol-benzene extract.

It must be noted, however, that some of the species blended in the chipped specimen showed alcohol-benzene extracts exceeding 2.0% (see Table 2-2), as compared with the corresponding value of 0.7 to 1.0% for Japanese wood.

This would mean that resin contained in the pulpwood could create problems if these high-resin species came to be blended in high proportion.

Table 2-9. Average Fiber Length, Alcohol-Benzene Extract of Bleached Pulp

Specimen	Unbleached Pulp Kappa Value	Average Fiber Length (mm)	Alcohol-benzene Extract (%)	
			Unbleached	Bleached
Ecuadorian Blend	23.2	1.19	0.4	0.3
Japanese Material	21.0	0.98	0.5	0.4

Note: The average fiber length was measured using universal projector.

(6) Concluding Remarks on the Suitability of Ecuadorian Pulp for Printing/Writing Paper

The blended Ecuadorian sample:

- Cooked for 90 minutes at 170 to 175°C with addition of 17% active alkali as Na_2O in reference to bone dry chip, and 25% sulfidity to produce unbleached pulp at 20 Kappa value, was bleached.

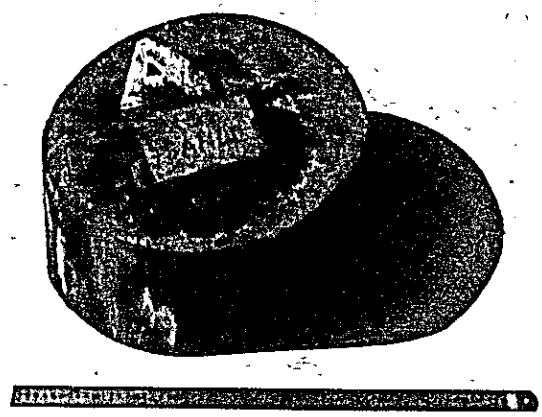
- In five stage of C-E-H-E-H

with resulting brightness of 84 for the bleached pulp.

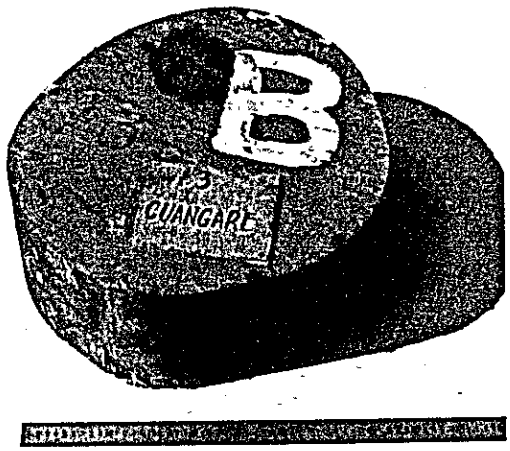
The above results indicated that the Ecuadorian blended material can produce bleached pulp of quality amply sufficient for manufacturing printing/writing paper.

In actually manufacturing the printing/writing paper, about 10% of bleached soft-wood kraft pulp would require to be blended.

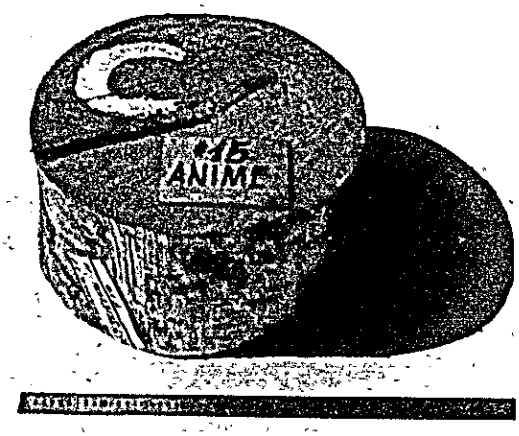
PULP WOOD



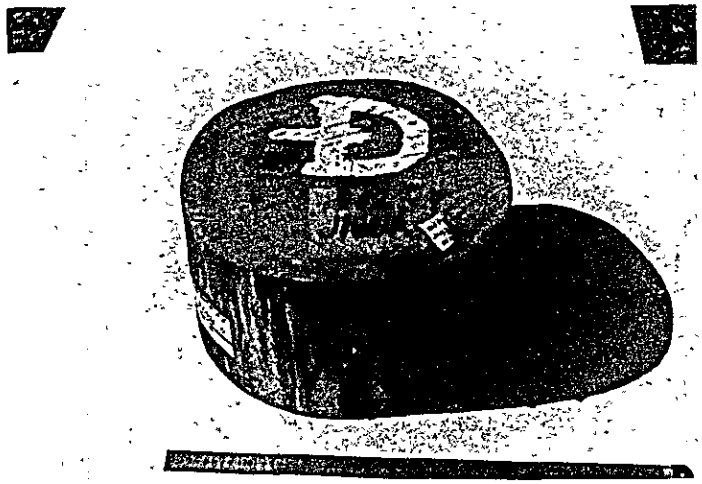
A: SANDE



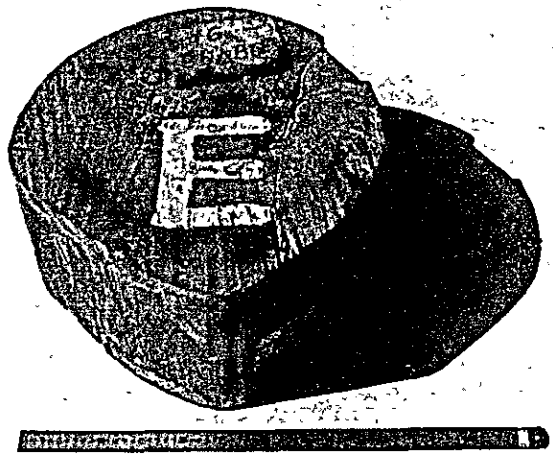
B: CUANGARE



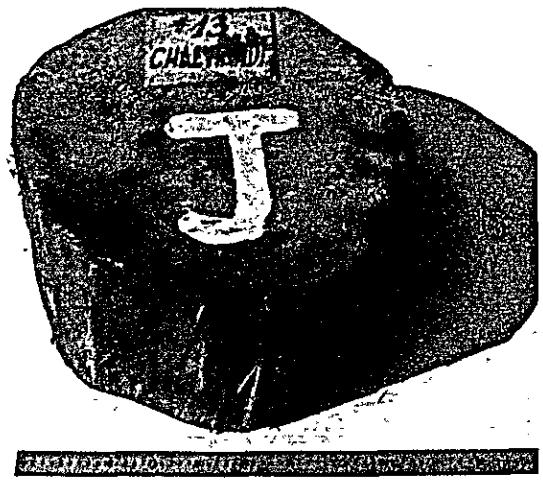
C: ANIME



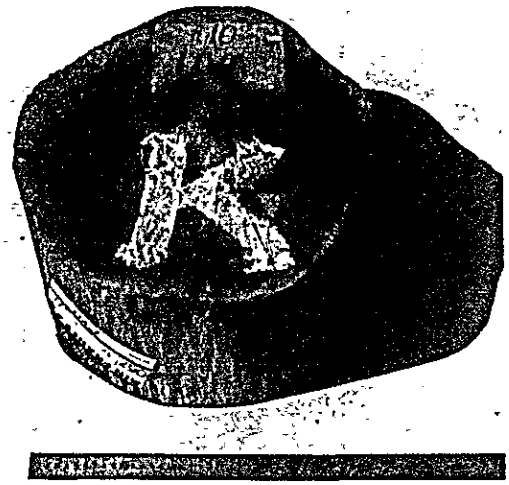
D: JIGUA



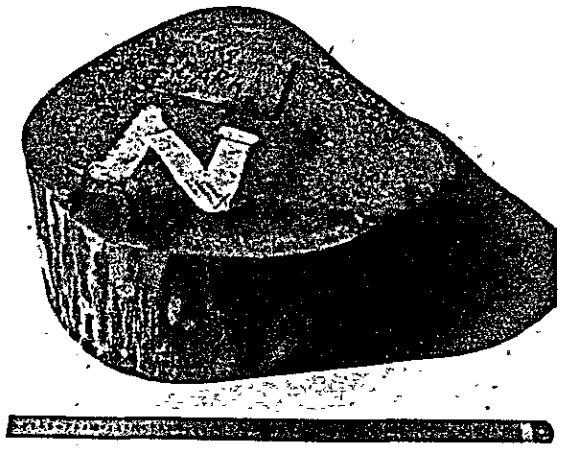
E: GUABO



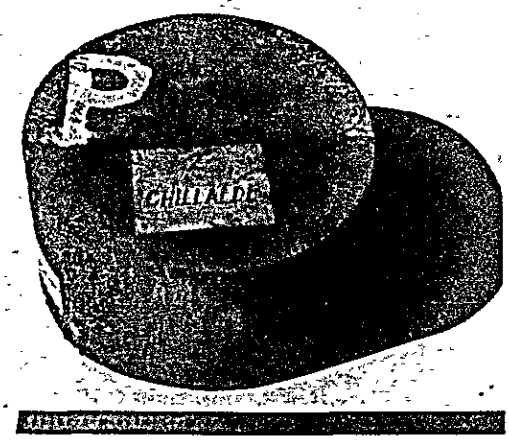
J: CHALVIANDE



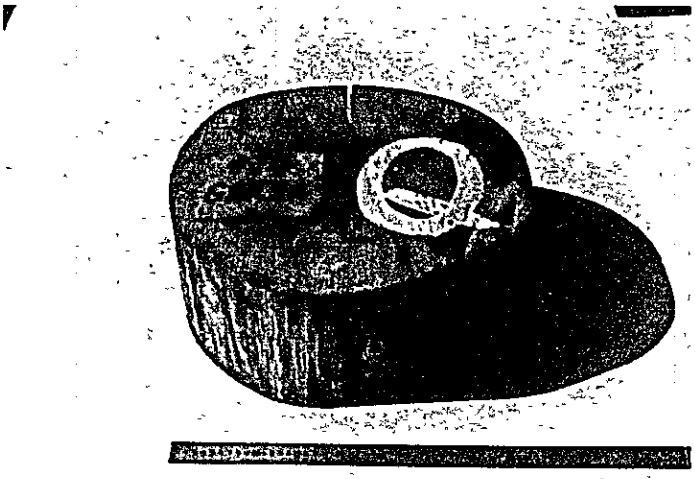
K: UVA



N: CARRA

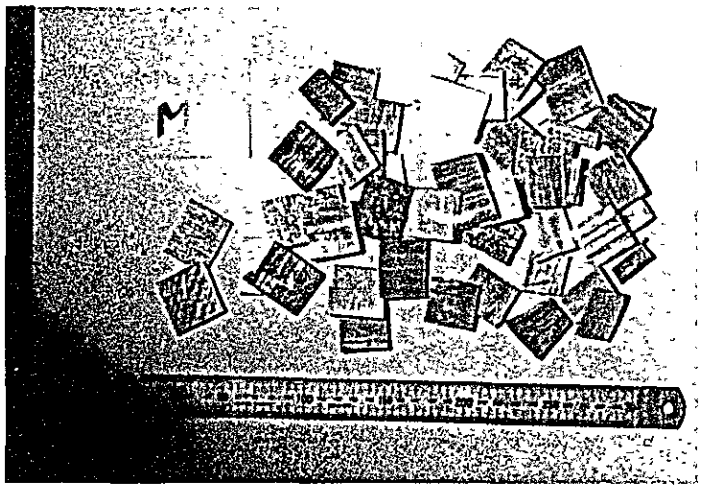


P: CHILLALDE

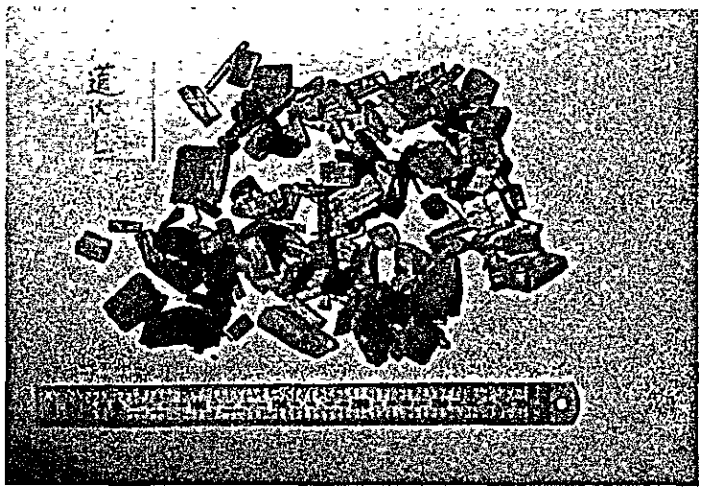


Q: GALZA

WOOD CHIP

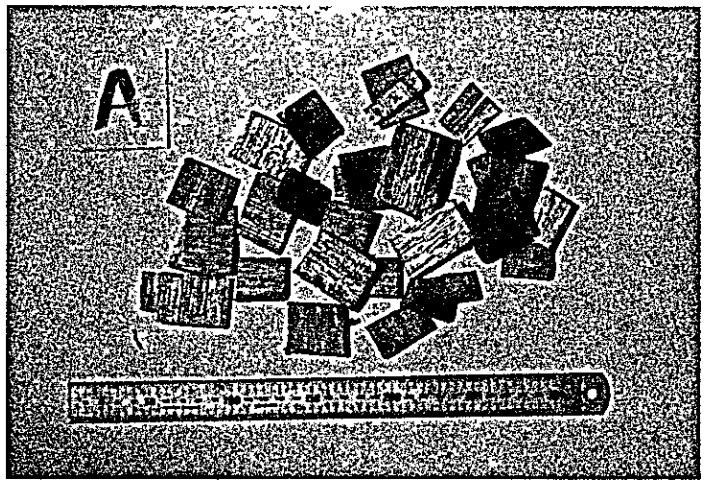


Mixed Ecuadorian wood chip (by Hand chipping)



Japanese wood chip (by Chipper)

Ecuadorian wood chip (by Hand chipping)



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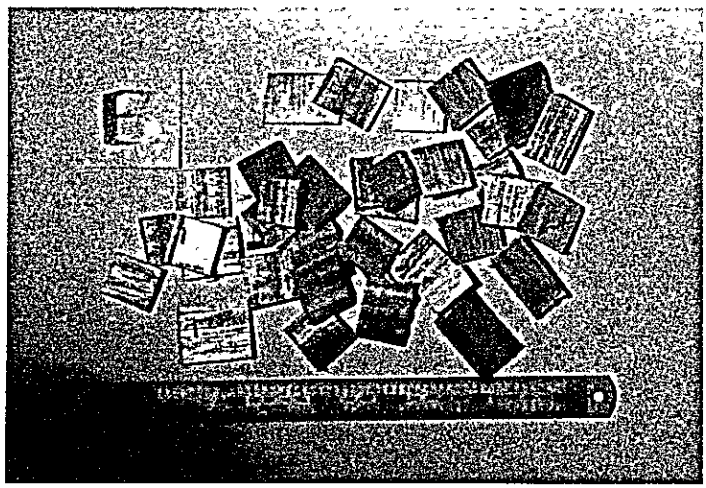
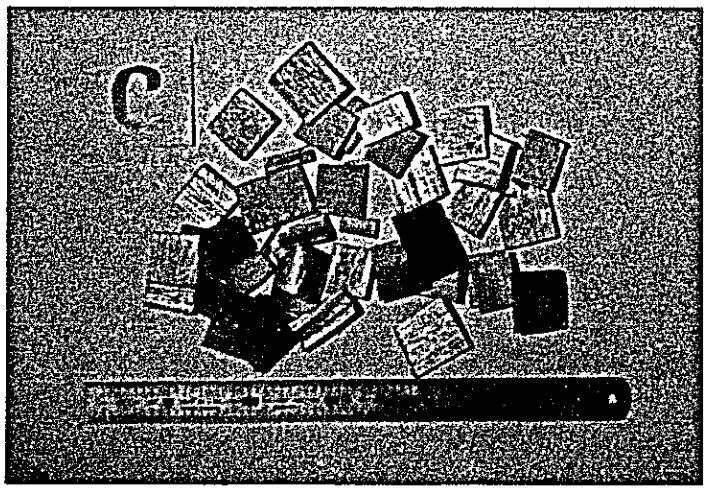
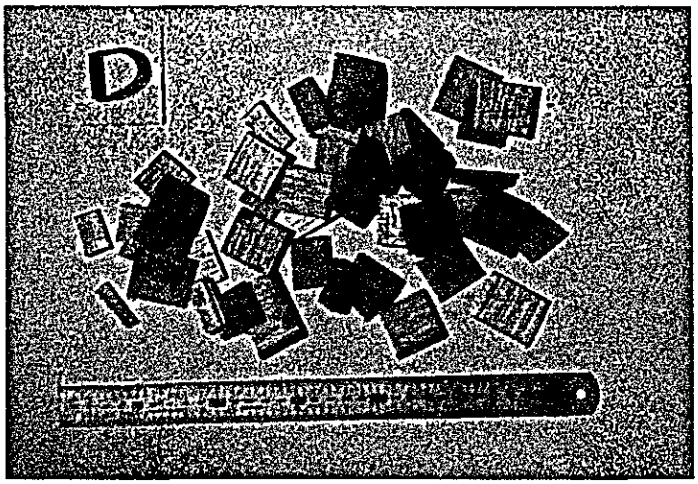


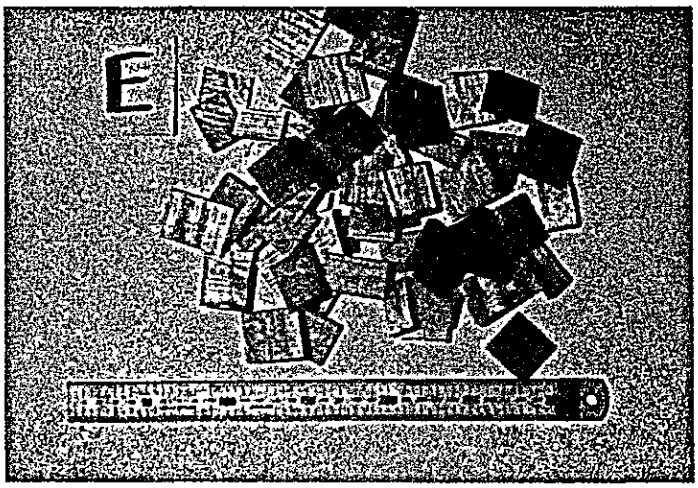
B: CUANGARE



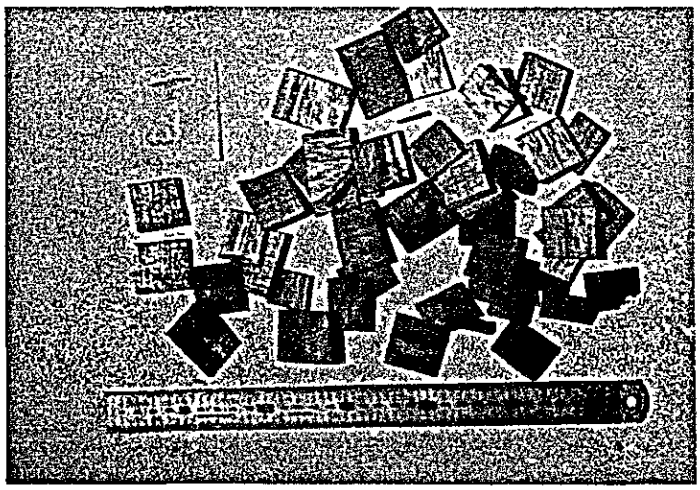
C: ANIME



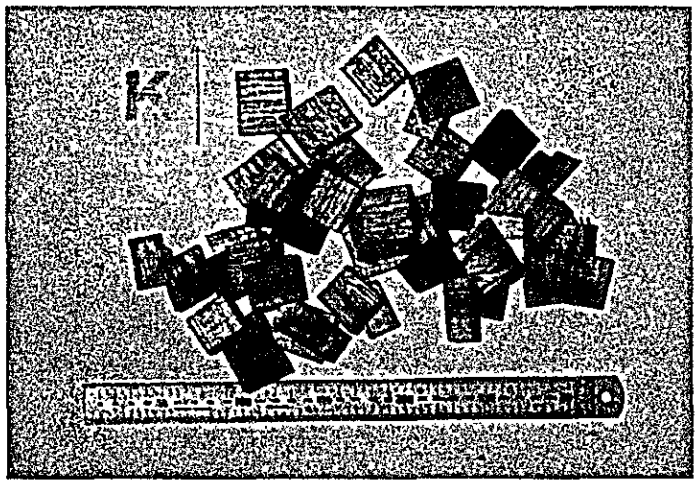
D: JIGUA



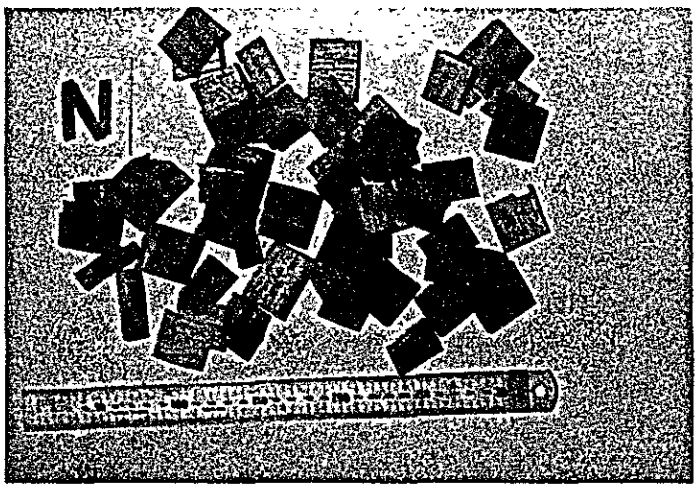
E: GUABO



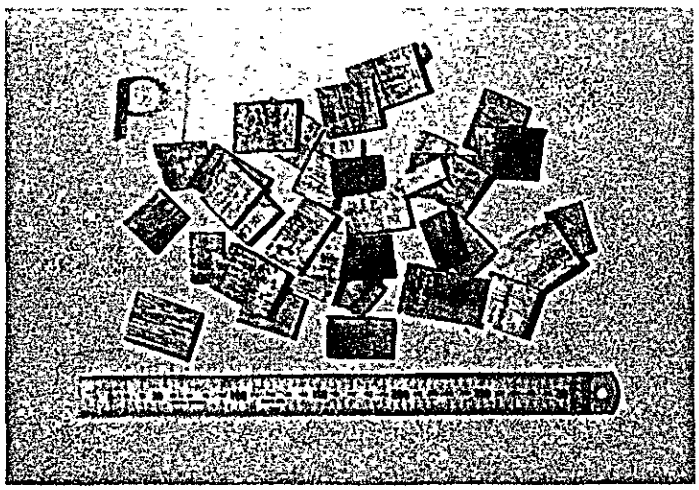
J: CHALVIANDE



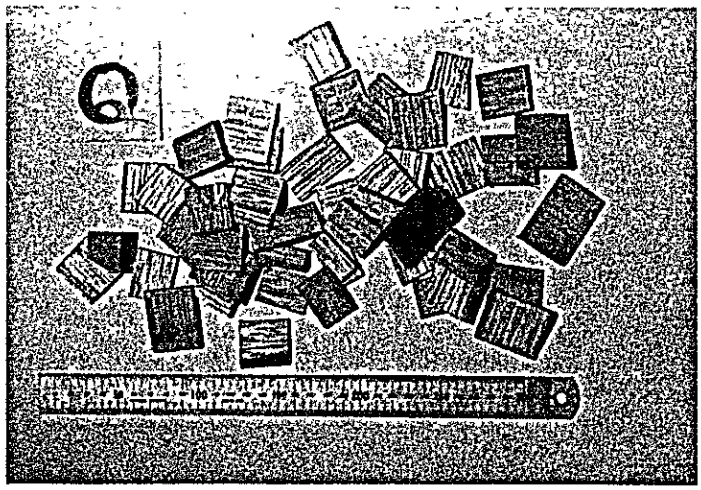
K: UVA



N: CARRA

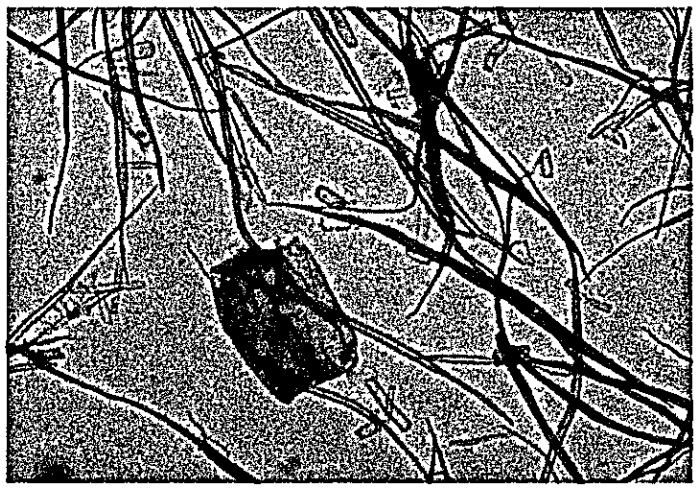


P: CHILLALDE



Q: GALZA

PROPORTION OF VESSELS: Ecuadorian wood pulp



Bleached pulp (LBKP) x50

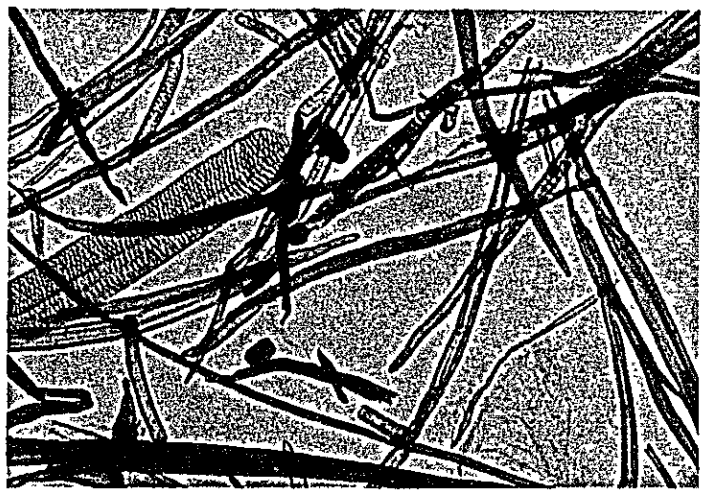
Bleached pulp (LBKP) x120

Unbleached pulp (LUKP) x50

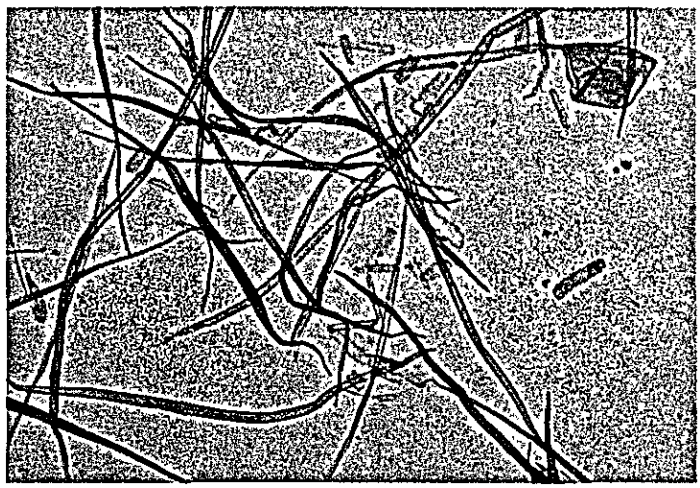
Unbleached pulp (LUKP) x120

PROPORTION OF VESSELS: Japanese wood pulp

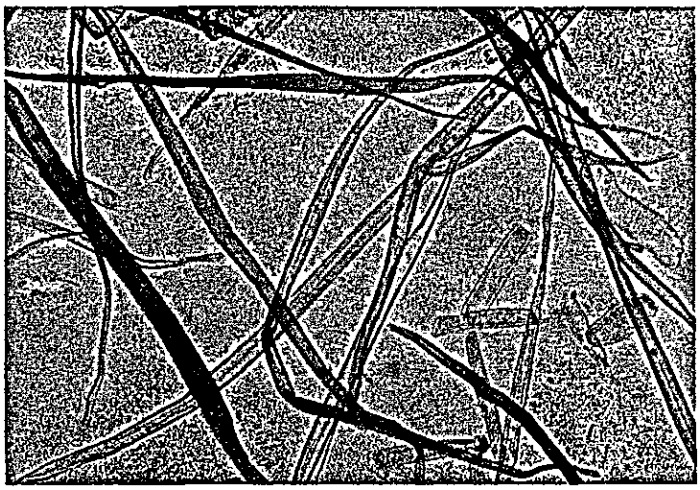
Bleached pulp (LBKP) x50



Bleached pulp (LBKP) x120



Unbleached pulp (LUKP) x50



Unbleached pulp (LUKP) x120

Appendix 3.

RECOMMENDATION ON REFORESTATION

Appendix 3. RECOMMENDATION ON REFORESTATION

3.1 Utilization of Deforested Clearings

Once the envisaged Plant enters full operation, 1,467 ha of forest will be felled every year.

The deal with the clearings thus deforested, one method would be to reforest the whole of this cleared area, but another approach, from a higher viewpoint of national economy, would be to utilize the cleared land for multiple purposes, based on a long-term program for land utilization.

For the present Project, which is being promoted as a contribution to forest resources development, a number of possible manners to which the deforested clearings might be utilized can be considered:

- Reforestation as pulpwood source
- Reforestation as plywood and saw log source
- Utilization as land for sedentary agriculture
- Utilization as land for stockraising
- Left to natural reforestation.

It should be noted in this connection that there is small risk of deteriorating the natural environment through wholesale logging, particularly in the case of Lot 2, on account of its being almost wholly situated on a flat land, and in consideration of the climatic conditions, granted that due consideration is given to ecological impact, with adequate countermeasures effectively adopted.

Even the last-mentioned method of leaving the clearings to natural reforestation can be expected to succeed, in view of the effective generation of secondary forest of Chillalde, Guarumo and other species that are observed to have qained a footing around existing clearings along logging roads.

3.2 Procedure for Reforestation

Successful reforestation will depend on the solution of technical difficulties as

they arise, and for this, it should be essential to start experimentally on a small scale, and to gradually extend the operations as experience is gained.

The following 3 steps of development should be envisaged:

(a) Step 1: **Trial plantation of small plots by species - "Species elimination test"**

A number of species are selected, which are considered to show fast growth; these species are systematically tested in trial plantations for comparative study of their growth, for further selection through sucessive elimination.

(2) Step 2: Pilot plantation for systematic study and economic evaluation

These species finally selected in Step 1 are planted in larger plots in pilot plantations created successively through a number of years, to further narrow down the selection of most suitable series.

(3) Step 3: Economic evaluation in industrial exploitation

Based on the results obtained in Step 1 and 2, an organized system will be established for large-scale reforestation operations, with proper measures studied and tested for dealing with vermin and blight, and aimed at realizing the two basic principles of maximizing the utilization of forest resources for mutiple purposes, and ensuring sustained yield of forest products.

3.3 Mode of Reforestation (Form of Plantation, Use of Product, Felling Age)

The form of plantation - tree spacing, thinning out, trimming, felling age, as determined for each species - is a very difficult but essential question that requires to be answered in proceeding with industrial forestation.

In practice, a good notion of the basic principles underlying such factors as tree spacing and nursing should contibute greatly to quickly succeeding in the trial and error procedure that requires to be followed in such studies.

Optimum tree spacing, for instance, will vary depending on the targets held in view concerning the quantity (log diameter) and quality (knottiness, straightness, non-taperness) of the lumber to be logged, and also on the available labor and economic conditions of the region.

The 2 principal factors affecting the establishment of an industrial forest are (1) envisaged utilization of the product wood (pulpwood or saw log) and (2) felling age (early or late), as discussed in what follows.

3.4 Envisaged Utilization of Product – Pulpwood or Saw Log

3.4.1 Pulpwood

Price paid for pulpwood is relatively low: this calls for minimizing the outlay for forest operations, and this end:

(1) Fast-growing species are chosen; expenses for removing undergrowth are minimized; early felling is practiced
(2) Straight-trunked species are chosen to facilitate logging operations
(3) High yield (high basic density) species are chosen
(4) Species of wood containing long fiber are chosen, whenever possible
(5) Tree spacing is maximized to the extent compatible with the preceding criteria.

3.4.2 Saw Log

For saw log, felling age would be extended and the trees left to grow during a period required for ensuring high wood quality.

This will inevitably increase the forestry operation outlay, but it will be recovered on the high price yielded by the wood product.

3.4.3 Felling Age

(1) Examples of late felling age

- Teak (Thailand) 60 – 70 years
- Mahogany (Fiji) 55 year

(2) Early felling age

Trees felled early are generally grown to 16 to 25 years, and sometimes to only 8 to 10 to 12 years (8 years in the case of Albizzia, Philippines).

3.5 Plan of Reforestation

The factors to be considered in planning for reforestation are the envisaged use of product and scale of operation.

In the present instance, pulpwood will be taken up as the product of principal interest.

The scale of operation is calculated from the volume of pulpwood requriement for the present Project.

Felling after 10 years of a fast-growing species is envisaged.

The pulpwood requirement in the present instance is estimated to be roughly 114,000 m^3/year (see Chapter 8, "Pulpwood Supply").

The forest volume that could be expected to be generated in 10 years with a selected species of wood is estimated to amount to 200 m^3/ha.

This means that

$$114{,}000/200 = 570 \text{ ha}$$

of forest will require to be felled every year to supply the required pulpwood for the envisaged Plant.

Taking a figure of 600 ha/year to provide some margin, the following program of plantation is envisaged in order to attain this rate of reforestation in due time.

- Step 1: Trial plantation - 4 years

1st. year	50 ha
2nd. year	100 ha
3rd. year	150 ha
4th. year	200 ha
Total	500 ha

- Step 2: Pilot plantation - 5 years

1st. year	300 ha
2nd. year	400 ha
3rd. – 5th. year	500 ha
Total	2,200 ha

- Step 3: Industrial plantation

10th. year onwards	600 ha every year

3.6 Species to be Tested

3.6.1 Criteria for Selection

With pulpwood chips held in view as final wood product, the criteria for selecting the species of wood for planting are determined with the following points borne in mind.

(1) Fast-growing (felling age about 10 years); Wood quality suitable for chipping

(2) Species already tested in other humid tropical lowland, and showing promise of being suited to growing in the San Lorenzo region climate and soil

(3) Species for which planting and nursing conditions have already been established; seed or seedlings obtainable or gatherable in quantity

(4) Species considered resistant to vermin and blight.

While not many species can be expected to satisfy simulataneously all the foregoing criteria, 13 species are tentatively listed in the following Section 3.6.2 as eligible for trial plantation.

3.6.2 Eligible Species for Trial Plantation

(1) Species already widely planted in tropical regions
- Leucaena glauca (Ipil Ipil)
- Gmelina arborea
- Albizzia falcata
- Eucalyptus deglupta

(2) Species currently being trially planted in tropical regions
- Terminalita brassi
- T. ivorensis
- T. superba
- Acacia auriculiformis

(3) Locally occurring species
- Cecoropia sp (Guarumo)
- Trichospermum mexicanum (Chillalde)
- Schizolobium parahybum (Pachaco)

(4) Softwood species
- Pinus caribaea
- P. merkussi

3.6.3 Characteristics Shown by Individual Species

(1) Leucaena glauca
- Most popularly planted for its fast-growing, highyield qualities
- Demands fertile soil and at least 1,000 mm of annual rainfall. Unsuitable for dry or infertile soil
- Heliophytic, but will grow also in the shade of other trees
- Many varieties grown.

(2) Gmelina arborea

- Grows preferably on fertile humid soil under at least 1,000 mm annual rainfall, but possesses considerable adaptability to any well-drained soil
- Semi-heliophytic
- Deciduous, generally short-lived
- Spreading branches, poor tree form
- Pleasing grain, yellow color
- Air-dry basic density: 0.40 to 0.54
- Utilizable also as raw log and as plywood source - relatively good durability

(3) Albizzia falcata

This species is coming to draw attention in Southeast Asia (Philippines and Indonesia) as promising fast-growing trees.

- High adaptability to various environmental conditions, but grows best in deep, medium humid soil
- Particularly suited for chipping
- Conditions for planting and nursing are already established to some extent

(4) Eucalyptus deglupta

This is a tropical eucalyptus species occurring in the Philippines, Indonesia and Papua-New Guinea.

- Straight trunk, suitable for chipping but also utilizable as thick log
- Grows preferably in deep, fertile, well drained soil; will not grow in humid ground carrying stagnant water
- Seed obtainable from second year; little variation in fertility, so that seed supply will create no problem
- No particular vulnerability to vermin or blight noted so far

(5) Terminalia brassi

This species occurs in a region extending from New Britain and Bougainville Islands to the Solomon Islands

- Promising for plantation in poorly drained humid tropical lowland
- A staraight-grained, good tree form

- Suitable as pulpwood, also as source for paneling and plywood when fully grown
- Drawback of large alterations in fertility of seed, and of short duration of seed germinability (problems foreseen in seed supply)

(6) Terminalia ivorensis; T. superba

These species are still under trial plantation in various tropical regions.

Ecological data are still scarce.

(7) Acacia auriculiformis or Acasia mangium

This is a species that is attracting attention for its extremely fast-growth in infertile tropical lowland.

Suitable also for soil stabilization on barren sloping ground.

- Supports well spells of dryness
- Suitable only as pulpwood on account of branches issuing from low height, and tortuous trunk form
- Can be either transplanted or directly planted from seed

(8) Trichospermum mexicanum (Chillalde); Cecropia sp. (Guarumo); Schizolobium parahybum (Pachaco)

These species occur as precursor vegetation in clearings and on logging road sides.

- Extremely heliophytic
- Said to be fast growing

(9) Pinus caribaea

Of the three varieties said to exist, the P. caribaea mor. var. hondurensis is the most widely planted.

It is seen to occur mostly in sandy loam and sometimes in gravelly well-drained soil.

- Does not grow well in argillaceous, poorly aerated soil
- Fast-growing

(10) Pinus merkusii

This species occurs widely Southeast Asia; several varieties are known, differing region to region.

- Persists under infertile soil and dry climate

3.7 Specifications on Reforestation Operations

Reforestation operation is envisaged based on the conditions of:

– Annual quantities of seedlings	800 seedlings/ha
– Annual forestation area	600 ha
– Total annual quantities of reforestation	480,000 seedlings

3.7.1 Nursery Facilities

– Nursery area	2 ha
– Buildings, installations	
Office	70 m^2
Warehouse	150 m^2
Store shed	50 m^2
Pumping installation	1 unit
Water reservoirs	2 units
– Road vehicles	
Trucks	2
Patrolling cars	2
– Personnel (temporary labor)	
July to December	10
January to March	8
April to June	6

3.7.2 Standard Cycle of Planting Operations (Average Felling Age, 11 Years)

Item	Man-day/ha	Substance of Work
Seeding		
Jan. to June	40	Prepare ground, furrow, bring in seeds, dig seedholes, seed.
Tending		
1st. year	35	Weeding (9 months vegetation)
2nd. year	20	Weeding
3rd. year	10	Weeding, bindweeding
4th. year	5	Bindweeding
Total Nursing	70	
Grand Total	110	

Note:
1. The above values have been derived from records of similar operation on plantations in other regions aimed at producing pulpwood.
2. The table is presented as a model case and should not be considered directly applicable to the present Project, for which pertinent information is not yet available.
3. The amount of labor required will vary widely with the species of planted wood, soil fertility and ground vegetation.

2.7.3 Supervisory Personnel

- Superintendent 1
- Silviculturist 1
- Assistant Silviculturist 1
- Assistant Hand 2

Total 5 supervisors in all.

Table 3-1. Nursery Cost (Fixed Cost)

(Unit: US.$)

Nursery Bed	
Nursery bed preparation (2 ha)	263,000
Piping works	
Buildings and Installations	35,500
Office	
Warehouse	
Store shed	
Pumping installation	
Water resouvoirs	
Road Vehicles	43,500
2–Trucks	
2-Patrolling cars	
Others	2,000
Total Nursery Cost	344,000

Note: Number of seedlings;
800 seedlings/ha x 600 ha = 480,000 seedlings

Table 3-2. Nursery Cost (Variable Cost)

(Unit: US.$)

Temporary Labor Cost	8,900
Nursery Facilities Cost Nursery pots Nursery bed maintenance Piping maintenance Chemicals Fertilizers Gasoline for pumps Other expenses	4,600
Total Nursery Cost (Variable Cost)	13,500

Note: Yearly number of seedlings;
480,000 seedlings

Table 3-3. Standard Cycle of Planting Operations (Average Felling Age 11 Years)

Item	Man-Day/ha	Substance of Work
Seeding (Jan. to June)	40	Prepare ground, furrow, bring in seeds, dig seedholes and seed
Nursing		
1st. year	35	Weeding (9 months vegetation)
2nd. year	20	Weeding
3rd. year	10	Weeding and bindweeding
4th. year	5	Bindweeding
Total Man-Day/ha	110	

Note:
1. The above values have been derived from records of similar operation on plantations in other regions aimed at producing pulpwood.
2. The Table is presented as a model case and should not be considered directly applicable to the present Project, for which pertinent information is not yet available.
3. The amount of labor required will vary widely with the species of planted wood, soil fertility and ground vegetation.

Table 3-4. Yearly Seeding and Nursery Costs

year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
STEP	1. Trial Plantation				2. Pilot Plantation					3. Industrial Plantation					
AREA (ha)	50	100	150	200	300	400	500	500	500	600	600	600	600	600	600
PLANTING (40 man-days/ha)	2,000	4,000	6,000	8,000	12,000	16,000	20,000	20,000	20,000	24,000	24,000	24,000	24,000	24,000	24,000
NURSERY: 1st year (35 man-days/ha)	1,750	3,500	5,250	7,000	10,500	14,000	17,500	17,500	17,500	21,000	21,000	21,000	21,000	21,000	21,000
2nd year (20 man-days/ha)		1,000	2,000	3,000	4,000	6,000	8,000	10,000	10,000	10,000	12,000	12,000	12,000	12,000	12,000
3rd year (10 man-days/ha)			500	1,000	1,500	2,000	3,000	4,000	5,000	5,000	5,000	6,000	6,000	6,000	6,000
4th year (5 man-days/ha)				250	500	750	1,000	1,500	2,000	2,500	2,500	2,500	3,000	3,000	3,000
TOTAL MANPOWER (man-days)	3,750	8,500	13,750	19,250	28,500	38,750	49,500	53,000	54,500	62,500	64,500	65,500	66,000	66,000	66,000

Table 3-5. Auxiliary Cost for Seeding and Nursery Operations

(Unit: US.$)

Camping Facilities	6,500
Knives and others	8,700
Chain Saws	7,000
Gasoline and Lubricants	9,800
Maintenance Costs	8,700
Welfares, Insurance	23,000
Other Expenses	4,300
Total Auxiliary Cost	68,000

Appendix 4.

COMPARISON BETWEEN PLATFORM-MOUNTED AND CONVENTIONAL PIECE-MEAL SYSTEMS OF CONSTRUCTION

Appendix 4. COMPARISON BETWEEN PLATFORM-MOUNTED AND CONVENTIONAL PIECE-MEAL SYSTEMS OF CONSTRUCTION

4.1 Introductory Remarks

The 2 alternative systems considered for the present Project are:

- Conventional system of installing the plant components piece-meal at site
- Platform-mounted system of towing to site for setting at site in one block are completely installed floating platform towed to site.

The first-mentioned conventional system is that currently practiced hitherto for constructing industrial plant, consisting of shipping to site the plant components piece-meal, to be there assembled and installed to constitute the plant through a complete series of operations involving civil, building assembly and installation, all to be performed at site, with the construction equipment and labor force brought to the site for this purpose.

The second, platform-mounted system of construction is a newly-developed method of plant installation particularly adapted to sites remote from industrial centers. The system consists of mounting into a large floating platform designed for this specific purpose the complete installation constituting the industrial plant, which is thus realized in its finally installed form already before shipment from works; the platform thus incorporating the complete plant is then towed to the site of installation, where the platform is set in its final position by suitable means, to permit its startup and commissioning, with the least amount of work requiring to be done at site.

In what follows, a comparison is made between the conventional and the platform-mounted systems, in respect of the following items:

(1) Plat Construction Cost
(2) Schedule of Plant Construction
(3) Commissioning and Productivity
(4) Quality of Completed Plant.

4.2 Overall Results of Comparison and Recommendations

It will be seen, from the detailed comparisons made in the Sections that follow, that the platform-mounted system possesses advantages over the conventional system in respect of the following major points:

(1) Smaller Overall Capital Investment
(2) Shorter Overall Construction Period
(3) Higher Quality of Completed Plant
(4) Higher Productivity of Completed Plant.

The above overall comparison, together with considerations of concordance with national policy, indicates that the platform-mounted system presents decisive advantages over the conventional system of construction for adoption in the present Project.

4.3 Cost of Plant Construction

The most obvious advantages of the platform-mounted system are:

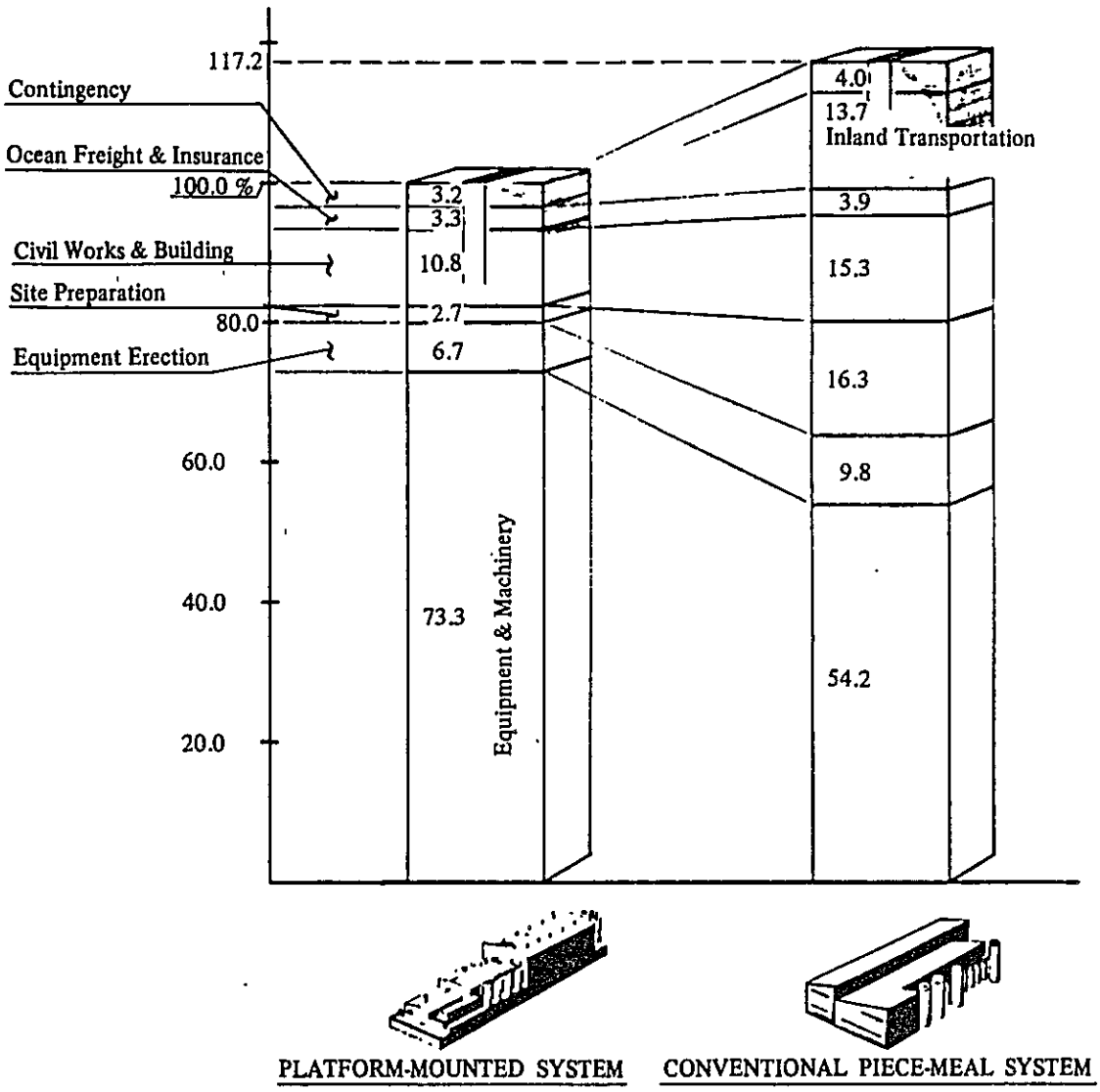
- Dispensing with heavy expenditures that would be required for providing the infrastructure that would be necessary for conventional piece-meal construction.

- Shortening of construction period, with resulting economies in personnel and other expenses that increase more or less proportionately with duration of construction period.

- Reduction of surface area occupied by plant on account of the compact arrangement of plant, with resulting economies in site preparation and other expenses for civil work.

Other less obvious but even more effective advantages of the platform-mounted system derive from the higher quality of completed plant ensured by its being completely installed in operating condition by skilled workers available in the supplier country, with resulting economies in expenses for installation at site, in early attainment of full scale production to permit quickly reaching profitability.

Fig. 4-1. Comparison of Plant Construction Costs between Platform-mounted and Conventional Piece-meal Construction Systems



The quantities indicated in the above values represent percentages in reference to the cost of plant construction by the platform-mounted system, and include only the net plant construction cost.

It is seen that the conventional piece-meal construction system will result in an increase of about 17 percent in total plant construction cost.

4.4 Period of Plant Construction

As described in Chapter 11, "Project Implementation", the platform-mounted system of construction will shorten the period of plant construction by 12 months over the conventional piece-meal system. This shortening of construction period results from the following principal factors:

(1) Despite the fact that the equipment has to be installed in final form in the platform before shipment, the timing of final shipment is actually earlier than in the case of the conventional system. This difference is attributable to the advantage of the platform-mounted system in permitting transportation (towage) to site without requiring considerations governing individual shipments in respect of such factors as ship schedules, customs clearance, reception at site, seasonal conditions at site.

(2) The duration of installation work at site is markedly shorter that with the conventional system, with all the equipment reaching the site already installed, and requiring only some readjustments to put it in operational condition, together with the work of piping, cabling and other work for linking the plant to corresponding land installations.

(3) The work at site is markedly less affected by climatic and other conditions, so that, as compared with the conventional system, control of work progress is vastly simplified and involves far less unforeseeable factors that constitute elements of contingency. Thus, climatic conditions at site, customs clearance procedures, inland transportation and other considerations required for the conventional piece-meal system hardly affect the platform-mounted construction.

4.5 Quality of Completed Plant

With the platform-mounted system of construction, the plant is completely installed in the platform by skilled workers available in the supplying country, and with well-organized inspection system to ensure highest quality of the installed equipment. The plant thus installed is shipped out in this completely installed condition, to be towed to site, where it is set in its final position with the plant quality completely preserved.

It is therefore obvious that this system will ensure a much higher quality of completed plant as compared with the conventional system of installing the equipment piece-meal at site under conditions that are not necessarily ideal for such work.

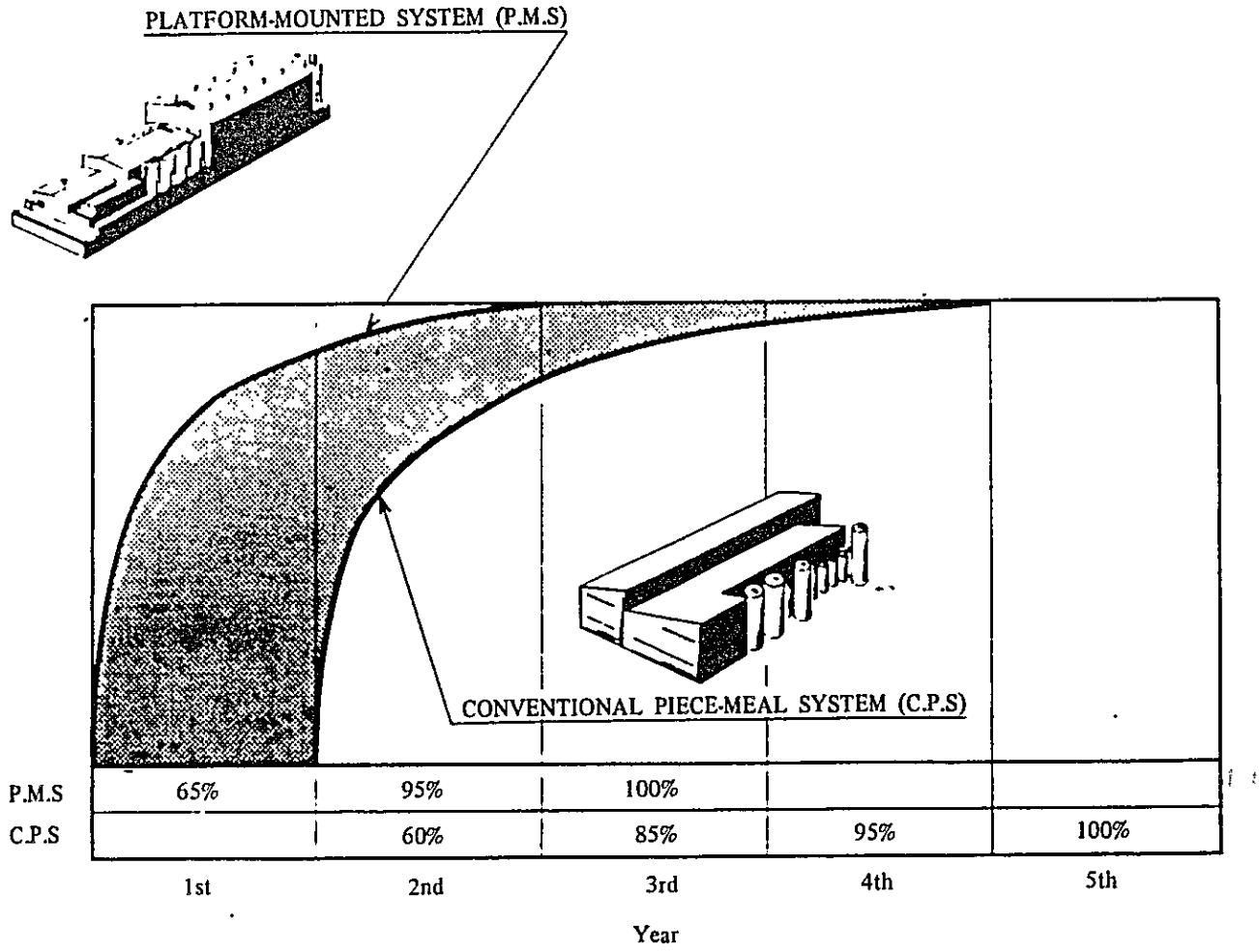
This applies particularly to such operations as welding, painting, lining, electrical and instrumentation installation, all of which call for skilled qualified labor which is usually scarce in remote installation sites.

4.6 Productivity of Completed Plant

The high quality of completed plant ensured with the platform-mounted system provides for much earlier attainment of full commercial production by the plant, to permit its contributing to early earning by the plant.

This rapid attainment of full operation will correspondingly simplify the operations of readjustments and other maintenance work after commissioning, personnel organization and sales plans both already keyed to full production.

Fig. 4-2. Comparison of Production Rate Programs at Startup between Platform-mounted and Conventional Construction Systems



Appendix 5.

TECHNICAL SPECIFICATIONS AND FLOW SHEETS

Appendix 5-1. SPECIFICATIONS

Major Equipment, Civil and Building Specification for Corrugating Medium Plant

FOREST WORKS

Department	11	Logging Equipment

LOG HANDLING

Department	21	Log Handling and Chipping

PULP MAKING

Department	31	Cooking and Refining
Department	32	Brown Stock Washing and Screening

PAPER MAKING

Department	41	Stock Preparation
Department	42	Paper Machine
Department	43	Finishing
Department	44	Auxiliary Equipment for Paper Machine

CHEMICAL RECOVERY

Department	51	Black Liquor Evaporation
Department	52	Chemical Recovery Boiler
Department	53	Chemical Recovery

UTILITIES

Department	61	Fuel Supply
Department	62	Power Boiler
Department	63	Electrical Power Generation

Department	64	Substation and Electrical Power Distribution
Department	65	Electrical Equipment
Department	66	Instrumentation
Department	67	Water Supply
Department	68	Compressed Air Supply
Department	69	Mill Inter-connecting Piping

MILL SERVICE

Department	71	Maintenance Shop
Department	72	Laboratory
Department	73	Fire Protection System
Department	74	Vehicles
Department	75	Communication Equipment
Department	76	Mill Effluent Treatment

PLANT CONSTRUCTION

Department	90	Platform
Department	91	Civil Works
Department	92	Buildings and Structures

Department 11. Logging Equipment – On Shore

Item No.	Quantity	Equipment	Specification
Logging and Log Transportation Equipment			
11101	22	Chain Saws	24 inch
11102	14	Angledozers	Equipped with towing winch
11103	4	Skid Loaders	
11104	26	Road Trucks	Capacity; 13 – 14 m^3
Road Construction Equipment			
11105	3	Angledozers	
11106	1	Angledozer	
11107	1	Bucket Loader	
11108	1	Back Hoe Shovel	
11109	1	Mobile Crane	Capacity; 16 tons
11110	1	Chain Saw	24 inch
11111	1	Tire Roller	Capacity; 8.5 tons
11112	1	Road Roller	McAdam-type, Capacity; 16 tons
11113	1	Motorized Piledriver	
11114	6	Dump Trucks	Capacity; 5 m^3
11115	1	Truck	Capacity; 8 tons
Maintenance and Repair Equipment			
11116	2	Trucks	

Item No.	Quantity	Equipment	Specification
11117	1 set	Machine Tools	
11118	1	Generating Set	
11119	1	Air Compressor	
Construction Material Transportation Equipment			
11120	3	Trucks	Capacity; 8 tons
Fuel Distribution Equipment			
11121	2	Tank Trucks	Capacity; 10 tons
Lighting Equipment at Logging Camp Site			
11122	22	Generating Sets	
Administrative Equipment			
11123	2	Passenger Buses	Capacity; 40 passengers
11124	5	Patrolling Cars	
11125	2	Generating Sets	

Department 21. Log Handling and Chipping -- On Shore

Item No.	Quantity	Equipment	Specification
Pulpwood Handling and Chipping			
21101	1	Truck Scale	
21102	1	No. 1 Log Deck	Chain live deck
21103	1	No. 2 Log Deck	Chain live deck with log kicker
21104	1	No. 1 Log Conveyors	Chain conveyor
21105	1	No. 2 Log Conveyors	Chain conveyor
21106	1	Chipper	Gravity Feed, top discharge chipper
Large Pulpwood Handling			
21107	1	Splitter	
Chip Handling			
21108	1	Chip Cyclone	Centrifugal cyclone
21109	1	Chip Feeder	Star type with chip bin
21110	1	Chip Screen	Rotary type
21111	1 set	Fines Conveyors	Belt conveyor
21112	1 set	Overs Conveyors	Belt conveyor
21113	1	Rechipper	Knife type rechipper with cyclone
21114	1 set	Chip Screen Outlet Conveyors	Belt conveyor
21115	1	Chip Stacker	Belt conveyor. for outside chip storage use

Item No.	Quantity	Equipment	Specification
21116	1	Chip Reclaimer	Chain conveyor
Refuse Handling			
21117	1 set	Bark and Dust Conveyors	Belt conveyor
Auxiliary Equipment			
21201	1 set	Pumps for Log Handling and Chipping Department	
21510	1 set	Electric Equipment	
21600	1 set	Scaffolding	
21700	1 set	Piping and Valves	

Department 31. Cooking and Refining -- On Platform

Item No.	Quantity	Equipment	Specification
31101	1	Chip Washer	Horizontal type chip washer
31102	1	Chip Feeding Conveyor	Inclined trough belt conveyor
31103	1	Chip Weighing Conveyor	Horizontal trough belt conveyor with weight meter and magnetic separator
31104	1 set	Chip Distribution Conveyors	Trough belt conveyors
31105	3	Chip Bins	Vertical cylindrical type chip bin
31106	3	Digesters	Rotary globe type batch digester, 4,800 mm diameter
31107	3	Blow Pulp Drainers	Blow pit
31108	1 set	Blow Pulp Conveyors	Screw conveyor
31109	1 set	Refiner Feed and Return Conveyors	Inclined belt conveyor
31110	3	Refiner Infeed Conveyor	Screw conveyor
31111	3	Refiners	Double disc refiner
31201	1 set	Pumps	
31301	1 set	Agitators	
31401	1 set	Tanks	
31510	1 set	Electric Equipment	
31520	1 set	Instrument	

Item No.	Quantity	Equipment	Specification
31700	1 set	Piping and Valves	
31600	1 set	Scaffolding	
31800	1 set	Insulation	

Department 32. Brown Stock Washing and Screening -- On Platform

Item No.	Quantity	Equipment	Specification
32101	1	Brown Stock Washer	Two-stage drum washer
32102	1	Pulp Screen	Presure type
32103	1	Thickener	Valveless type, 4,500 mm length and 3,000 mm diameter
32104	1	Rejects Thickener	Extractor type
32105	1	Rejects Conveyor	Screw conveyor
32106	1	Rejects Refiner	Disc refiner
32107	1	Black Liquor Screen	Inclined type
32201	1 set	Pumps	
32301	1 set	Agitators	
32402	1 set	Chests and Tanks	
32510	1 set	Electric Equipment	
32520	1 set	Instrument	
32700	1 set	Piping and Valves	
32600	1 set	Scaffolding	
32800	1 set	Insulation	

Department 41. **Stock Preparation -- On Platform**

Item No.	Quantity	Equipment	Specification
41101	1	Pulp Refiner	Disc refiner
41102	1	Stock Mixer	Vertical cylinddrical mixing tank with agitator
41103	1	Machine Refiner	Conical refiner
41104	1	Stuff Box	
41105	1	Machine Screen	Pressure type
41106	1	Tail Screen	Vibrating type
41107	1 set	Additive Chemicals Preparation Equipment	
41201	1 set	Pumps	
41301	1 set	Agitators	
41402	1 set	Chests and Tanks	
41510	1 set	Electric Equipment	
41520	1 set	Instrument	
41700	1 set	Piping and Valves	
41600	1 set	Scaffolding	
41800	1 set	Insulation	

Department 42. Paper Machine – On Platform

Item No.	Quantity	Equipment	Specification
42101	1	Head Box	Multi-tube flow distributor
42102	1	Fourdrinier	Cantilever quick wire changing type, no shaking. Wire width: Approx. 4,880 mm
42103	1 set	Press Part	Primary and secondary press. – comprising one grooved press roll and one fixed center roll installed between these two press rolls. Tertiary press. – straight-through grooved rool. Wringer press.
42104	1 set	Dryer Part	Double deck multi-cylinder type with vapour removal roll system. Gearing – clossed gearing. Paper dryers – Approx. 1,520 mm diameter, 61 rolls.
42105	1 set	Reel	Horizontal surface reel, autoflyte type
42106	1 set	Dryer Hood Exhaust Fans	Centrifugal fan
42107	1	Size Preparation Screen	
42401	1	Machine Pit	
42402	1	Couch Pit	
42403	1	White Water Pit	
42404	1	Calender Broke Pit	

Department 43. Finishing – On Platform

Item No.	Quantity	Equipment	Specification
43101	1	Rewinder	
43102	1	Roll Weight Meter	
43103	1	Roll Packing Machine	
43104	1 set	Pneumatic Conveying System for Sheets Cutter	
43105	1 set	Pneumatic Conveying System for Rewinder	
43106	1 set	Core Making Machine	
43107	1 set	Core Cutter	

Department 44. Auxiliary Equipment for Paper Machine – On Platform

Item No.	Quantity	Equipment	Specification
44101	1 set	Paper Machine Drive	Sectional driving system by DC motors
44102	1 set	Hood and Air System	Total enclosed type with motorized sliding doors
44103	1 set	Hot Air Supply System for Vapour Removal Rolls	
44104	1 set	Fourdrinier Air Exhaust System	
44105	1 set	Machine Room Ventilation System	
44106	1 set	Steam and Condensate System	Cascade flush-blow through type
44107	1 set	Vacuum System	NASH type
44108	1 set	Lubrication System	Forced circulation central oil supply type
44109	1	Save-all	
44110	1	Over-head Crane	Load capacity-25 tons. Two crabs three Hooks with operating console
44111	1	Reel Crane	Load capacity-20 tons. Low speed two-hooks with pendant push button switch box
44201	1 set	Pumps	
44301	1 set	Agitators	

Item No.	Quantity	Equipment	Specification
44402	1 set	Chests and Tanks	
44510	1 set	Electric Equipment	
44520	1 set	Instrument	
44700	1 set	Piping and Valves	
44600	1 set	Scaffolding	
44800	1 set	Insulation	

Department 51. Black Liquor Evaporation – On Platform

Item No.	Quantity	Equipment	Specification
51101	1	First Effect Evaporator	Falling film type
51102	1	Second Effect Evaporator	Falling film type
51103	1	Third Effect Evaporator	Falling film type
51104	1	Fourth Effect Evaporator	Falling film type
51105	1	Surface Condenser	Shell and tube type
51106	1	Pre-cooler	Barometric type
51107	1	Steam Ejector	Two stage ejector
51201	1 set	Pumps	
51301	1 set	Agitators	
51401	1 set	Tanks and Towers	
51510	1 set	Electric Equipment	
51520	1 set	Instrument	
51600	1 set	Scaffolding	
51700	1 set	Piping and Valves	
51800	1 set	Insulation	

Department 52. Chemical Recovery Boiler – On Platform

Item No.	Quantity	Equipment	Specification
52101	1 set	Recovery Boiler Proper	Steam evaporation; 8 t/hr Pressure; 12 kg/cm^{2}G Outside installation
52102	1 set	Boiler Furnace	Water cooled membrane wall construction
52103	1 set	Superheater	Pendant platen type
52104	1 set	Attemperature	Spray type
52105	1 set	Economizer	Bare tube vertical type
52106	1	Steam Air heater	
52107	1 set	Steel Framework for Boiler Support	
52108	1 set	Steel Casing for Boiler enclose	
52109	1 set	Soot Blower	Long retracting rack soot blower, steam blowing type
52110	1 set	Black Liquor Spray Apparatus	Hoseless type
52111	1	Cascade Evaporator	
52112	1 set	Electrostatic Precipitator	Horizontal flow, dry bottom
52113	1 set	Oil Burner	Y-jet steam atomizer with innitor
52114	1	Smelt Spout	Water cooled
52115	1	Forced Draft Fan	Backward bladed fan

Item No.	Quantity	Equipment	Specification
52116	1	Induced Draft Fan	Radial bladed fan
52118	1	Sampling Apparatus	Sampling for water and steam
52119	1	Boiler Stack	
52201	1 set	Pumps	
52301	1 set	Agitators	
52401	1 set	Tanks and Towers	
52510	1 set	Electric Equipment	
52520	1 set	Instrument	
52600	1 set	Scaffolding	
52700	1 set	Piping and Valves	
52800	1 set	Insulation	

Department 53. Chemical Recovery — On Platform

Item No.	Quantity	Equipment	Specification
53101	1	Smelt Screen	Drum screen
53102	1	Smelt Screen	Vibration screen
53103	1	Main Separator	Centrifugal separator
53104	1	Main Reactor	
53105	1	Reactor	
53106	1	SO_2 Gas Absorber	
53107	1	Gas Washer	
53108	1	Sludge Filter	
53109	1	Gas Scrubber	
53201	1 set	Pumps	
53301	1 set	Agitators	
53401	1 set	Tanks	
53510	1 set	Electric Equipment	
53520	1 set	Instrument	
53600	1 set	Scaffolding	
53700	1 set	Piping and Valves	
53800	1 set	Insulation	

Department 61 Fuel Supply – On Shore

Item No.	Quantity	Equipment	Specification
61202	1 set	Heavy Oil Receiving Pumps	
61202	1 set	Diesel Oil Receiving Pumps	
61203	1 set	Gasoline Receiving Pumps	
61204	1 set	Heavy Oil Feed Pumps	
61205	1 set	Diesel Oil Feed Pumps	
61206	1 set	Gasoline Feed Pumps	
61401	1	Heavy Oil Storage Tank	
61402	1	Diesel Oil Storage Tank	
61403	1	Gasoline Storage Tank	
61510	1 set	Electric Equipment and Controls	
61600	1 set	Scaffolding	
61700	1 set	Piping and Valves	

Department 62. Power Boiler – On Platform

Item No.	Quantity	Equipment	Specification
62101	1 set	Boiler Proper	Steam evaporation; 50 t/hr Steam pressure; 42 kg/cm^2 Steam temperature; 420°C Fuel; oil and hog Outdoor installation type comprises; Boiler furnace Water tube Headers, downcommers, feeders Drums Boiler bank tube Boiler bank skin casing
62102	1	Superheater	Pendant convection type
62103	1	Economizer	Bare tube convection type
62104	1	Air Heater	Tublar type
62105	1	Steam Air Heater	
62106	1	Boiler Casing	Ribbed aluminum cald sheet
62107	1 set	Steel Framework	
62108	1 set	Soot Blower	Long retractable or rotary type blower, steam blowing type
62109	1	Forced Draught Fan	Turbo fan
62110	1	Induced Draught Fan	Turbo fan
62111	1	Secondary Air Fan	Turbo fan

Item No.	Quantity	Equipment	Specification
62112	1 set	Chemical Dosing Equipment	Comprises: tanks, pumps and agitator for dosing chemicals of ammonia, hydrazine, disodium phosphate and trisodium phosphate.
62113	1 set	Sampling Equipment	
62114	1 set	Boiler Feed Pump	Multi-staged turbine pump
62115	1	Fuel Oil Heater	
62116	1 set	Fuel Oil Burner	Steam atomizing type
62117	1 set	Pilot Oil Burner	Air atomizing type
62118	1 set	Make-up Water Treatment Equipment	Mixed bed, polisher type
62119	1	Ion Exchanger	
62120	1 set	Process Return Water Treatment Equipment	
62121	1	Stack	
62122	1	Main Condenser	Divided water box type surface condenser
62123	1	Main Steam Jet Air Ejector	Twin element two stage steam jet ejector
62124	1	Starting Air Ejector	Single stage steam jet type
62125	1 set	Feed Water Heater	Shell and tube type heater
62126	1	Deaerator	Spray type
62201	1 set	Pumps for Water Make-up	

Item No.	Quantity	Equipment	Specification
62401	1 set	Tanks for Water, Chemicals and Fuels	
62510	1 set	Electric Equipment and Controls	
82520	1 set	Instrument	
62600	1 set	Scaffolding and Support	
62700	1 set	Piping and Valves	
62800	1 set	Insulation	

Department 63. Electrical Power Generation – On Platform

Item No.	Quantity	Equipment	Specification
63101	1	Steam Turbine	9,000 kVA. Single cylinder, Impules type double extraction condensing turbine
63102	1	Generator	9,000 kVA. Three phase synchronuous generator, open type forced air cooled, horizontal and gear coupled to steam turbine
63103	1 set	Protective Device	
63104	1 set	Lubrication System	
63105	1 set	Steam Seal System	
63106	1 set	Turning Gear Device	
63107	1 set	Air Cooler for Generator	
63108	1	Power Generator for Emergency	500 kVA. Diesel engine driven power generator
63201	1 set	Pumps	
63401	1 set	Tanks	
63510	1 set	Control System	Speed and pressure control
	1 set	Excitation System	Three phase full-wave bridge, self cooled rectifier utilizing silicon diodes
63520	1 set	Instrument	

Item No.	Quantity	Equipment	Specification
63700	1 set	Piping and Valves	
63800	1 set	Insulation	

Department 64. Substation and Electric Power Distribution – On Platform

Classification of Electric Power Distribution System

	Voltage	Frequency	Phases	Wires	Grounding system
High Voltage	3,300 V	60	3	3	Resister neutral
Low Voltage	440 V	60	3	3	Non-grounded
90 kW and above AC motor	3,300 V	60	3	3	Non-grounded
75 kW and below AC motor	440 V	60	3	3	Non-grounded
DC motor	440 V	–	–	2	Non-grounded
Control Circuit and Instrument	110 V	60	1	2	Non-grounded
Lighting	220 V	60	1	2	Non-grounded
Battery Lighting (D.C)	110 V	–	–	2	Non-grounded

Item No.	Quantity	Equipment	Specification
64501	1 set	3.3 kV High Voltage Sheet-steel Cubicle Switchgear	
64502	1 set	Electrical Cable	
		3.3 kV Class Power Cable	Cross-linked polyethylene insulated, polyvyniyle chloride sheated cable
		600 V Class Power Cable	Cross-linked polyethylene insulated, polyvinyle chloride sheated cable

Item No.	Quantity	Equipment	Specification
		600 V Class Control Cable	Polyvinyle chlorided insulated and sheathed control cable
		600 V Class Control Shield Cable	Polyvinyle chloride insulated and sheathed control cable with copper tape shield

Department 65. Electrical Equipment -- On Platform

Item No.	Quantity	Equipment	Specification
65501	1 set	High Voltage sheet-steel Cubicle Switchgear	Draw-out type
65502	1 set	High Voltage Motor Control Center	Draw-out type
65503	1 set	Low Voltage Load Center	Fixed type
65504	1 set	Low Voltage Motor Control Center	Draw-out type
65505	1 set	Operation Panel for Motors	
65506	1 set	Local Push Button Switch Box	
65507	1 set	Electrical Motor	

Department 66. Instrumentation – On Platform

Supply Characteristics

Electric power for instrument operation will be made available at 110 V, 60 Hz, single phase.

General Specification

1) Control system type.
Control system will be mainly pneumatic and to be generally insulated on locally.

2) Transmission and control signal.
Electronic transmission and control signal range will be 4 to 20 mA. Pneumatic signal will be of 0.2 to 1.0 kg.f/cm^{2}G.

3) Transmitter.
Transmitter will be of the force-balance type or, where specified, of the mortion balance indicating type, except in case of electrical measurement or control signal.

4) Recorder.
Recorder will be of the standard transmitted signal range and contain multiple recording pens. Miniature recorder with folding strip chart will be used for general mill service.

5) Control Station.
Controller will be mounted on panel with vertical scale for set point and process varible indication.

6) Indicator.
Indicator will be of the vertical scale type and the standard transmission signal.

7) Chart Drive.
Recorder chart drive will be of 110 V, 60 Hz, single phase.

8) Pen.
All pen will be of the capillary type with reservoirs in generally.

9) Local Mount Type Controller.
Displacement type level, capillary type pressure and temperature, etc. will be included.

10) Annunciator.
Annunciator will be suitable for 110 V, 60 Hz, single phase service and to be supplied with an acknowledge and test pushbutton.

11) Air Supply Regulator (Air Set).
All such regulator will be of the reducing-relief type with integral filter.

Process Control Panel

1) Panel Type.
Control panel will generally by of the free-standing type located in locally.

2) Panel Design.
Instrument arrangement on panel will be in accordance with department planning drawings.

3) Piping and Ducting.
Air supply header mounted within panel will be of copper tubing. Necessary air regulating system consisting of filter, reducing valve and pressure gauge with stop valve should be included.

4) Electric Equipment.
All electric equipment including materials, wiring and panel-itself.

Process Control Valve

1) Globe and Angle Valve.
Double-seated valve will be top and bottom guided.
Single-seated valve will be top and bottom or cage guide.

2) Batterfly Valve.
All batterfly valve will be of "Wafer" type.

3) Ball Valve.
Ball valve will be suitable for the throttling of pulp flow from full open to shut-off and such valve will have flow characteristics closely approximately that of "equal percentage".

4) Valve Positioner and Transducer.
Pneumatic valve positioner will be considdered.

5) Air Supply Regulator (Air Set).
All such regulator will be of the reducing-relied type with integral filter.

6) Accessories, Piping and Tubing.
All accessories normally mounted on valve will be included.
All tubing connection will be made using copper tubing and tube fittings.

Instrument Piping

The major materials for instrument piping will be as follows:

1) Vinyle covered multi-control copper tube.
2) Copper tube.
3) SGP (W) pipe.
4) Half-union.
5) Nipple.
6) Miniature stop valve.

Department 67. Water Supply – On Shore

Item No.	Quantity	Equipment	Specification
67101	1	Clarifier	Slurry circulation type
67102	1 set	Chemical Addition Unit	
67103	1 set	Filter	
67104	1 set	Demineralizing System	
67105	1 set	Potable Water System	
67201	1 set	Pumps	
67301	1 set	Agitator	
67401	1 set	Tanks and Towers	
67510	1 set	Electric Equipment	
67520	1 set	Instrument	
67600	1 set	Scaffolding	
67700	1 set	Piping and Valves	

Department 68. Compressed Air Supply – On Platform

Item No.	Quantity	Equipment	Specification
68101	2	Instrument Air Compressor	Oil free, water cooling double acting type
68102	1	Air Dryer	Automatic, electric heating
68103	1	Prefilter	
68104	1	After-filter	
68105	2	Mill Air Compressor	Water cooling, double acting lubricated tyep
68510	1 set	Electric Equipment	
68520	1 set	Instrument	
68600	1 set	Scaffolding	
68700	1 set	Piping	

Department 69. Mill Inter-connecting Piping

One complete set of mill inter-connecting piping system, i.e., process lines, chemicals lines, steam lines, water lines, potable water lines, fuel lines, all waste and effluent lines, etc., should be included for mill operation.

Department 71. Maintenance Shop – On Shore

Item No.	Quantity	Equipment	Specification
71101	2	Center Lathe	
71102	1	Universal type Milling Machine	
71103	1	Cutter Knife Grinder	
71104	1	Sliter Knife Grinder	
71105	1	Roll Grinder	
71106	1	Double Column type Plane and Milling Machine	
71107	1	Upright Drilling Machine	
71108	1	Floor type Bench Drill Machine	
71109	1	Overhead Crane	
71110	1	Trolly type Hoist with Beam	
71111	1	Marking Off Tools	
71112	1	Electric Hydraulical type Pipe Bender	
71113	5	Disc type Tube Cutter	
71114	2	Pipe Threading Machine	
71115	10	AC Arc Welder with Remote Control	
71116	1	Auto Single Surface Planer	
71117	1	Circular Saw on Frame	

Item No.	Quantity	Equipment	Specification
71118	1	Double Column type Hydraulic Press for Shop	
71119	1	Shaper	
71120	5	Acetylene Cutting and Welding Outfil	
71121	5 sets	Miscellaneous Hand Tool Kits	

Department 72. Laboratory – On Platform

Item No.	Quantity	Equipment	Specification
72101	1	Wood Chip Classification Unit	
72102	1	Laboratory Digester	
72103	1	Laboratory Flat Screen	
72104	1	Laboratory Disintegrator	
72105	1	Laboratory Beater	Niagara type
72106	1	Sheet Forming Machine	TAPPI standard type
72107	4	Freeness Tester	Canadian type
72108	1	Brightness Tester	
72109	1	Tensile Strength Tester	Schopper type
72110	1	Folding Endulance Tester	
72111	1	Bursting Strength Tester	Mullen type
72112	1	Treating Tester	Elemendorf type
721113	1	Stiffness Tester	
72114	1	Ring-crush Tester	
72115	2	Sample Cutter	
72116	2	Thickeness Gauge	
72117	1	Gurley Tester for Smoothness, Porosity and Softness	
72118	1	Centrifuge	

Item No.	Quantity	Equipment	Specification
72119	2	Microscope	
72120	1	Projector	
72121	1	Drying Oven	
72122	1	Water Batch	
72123	2	Stopwatch	
72124	1	Electric Muffle Furnace	
72125	3	Basis Weight Balance	
72126	2	Direct Reading Balance	
72127	1	Platform Scale	
72128	2	Analytical Balance	
72129	2	ph Meter	
72130	8	Baume Scale	
72131	2	Turbidometer	
72132	2	Color Comparator	
72133	2	Hand Tachometer	
72134	1	Surface Pyrometer	
72135	10	Thermometer	
72136	1	Psychrometer	
72137	2	Stone Ware Sink Unit	
72138	2	Center Table	
72139	2	Balance Table	
72140	2	Water Still	

Item No.	Quantity	Equipment	Specification
72141	5	Jar Tester for Water	
72142	10 sets	Glass Wear	

Department 73. Fire Protection System – On Platform

One complete set of water hydrant system consisting automatic water sprinkler system and automatic water fog spray system, and set of portable chemical powder fire extinguishers for Platform and On-shore buildings should be included for the mill.

Complete sets of necessary piping, and electrical equipment and controls also should be considered.

Department 74. Vehicles

Item No.	Quantity	Equipment	Specification
74101	5	Front-end Loader	Tire skidder, 250 hp Logs offloading use
74102	5	Front-end Loader	Tire skidder, 280 hp Logs sorting in wood yard use
74103	2	Crawler Dozer	200 hp Wood yard use
74104	4	Fork-lift Truck	
74105	4	Shop Truck	3/4 ton
74106	2	4 x 4 Vehicle	
74107	10	Power-saw	Wood yard use

Department 75. Communication Equipment – On Shore

Item No.	Quantity	Equipment	Specification
75220	1 set	Telephone equipment	
75221	1 set	Telex Equipment	
75222	1 set	Office equipment	

Department 76. Mill Effluent Treatment – On Shore

Item No.	Quantity	Equipment	Specification
76101	1	Neutralization Mixer	Vertical type with bar screen
76102	1 set	Chemical Addition Unit	
76103	1	Clarifier	Slurry circulation type
76104	1	Sludge Thickener	
76105	1	Sludge Vacuum Filter	
76106	1 set	Lagoon with Mechanical Aerator	
76201	1 set	Pumps	
76301	1 set	Agitators	
76401	1 set	Tanks and Towers	
76510	1 set	Electric Equipment	
76520	1 set	Instrument	
76600	1 set	Scaffolding	
76700	1 set	Piping	

Department 90. Platform

General Particulars

The platforms will be designed, constructed, equipped, inspected, tested and delivered to the Plant site, and will be operated immediately after the installation by the Builder in accordance with these Specifications.

Dimensions of Platform

Length	Approx. 100 m
Breadth	Approx. 30 m
Depth	Approx. 12.5 m

Platform and House Structure

1) General

The platform will be designed to suit installation and operation of plant equipment and will be of all welded construction. The platofrm will be strengthened locally for the foundation of equipment where necessary.

2) Bottom Construction

Cellular double bottom will be constructed under the first floor. Bottom frame and inner bottom stiffeners will be arranged longitudinally. Transverse floors and longitudinal girders under double bottom tank top will be also arranged.

Carling or girder will be provided under machinery of other concentrated load wherever necessary. Vibratory characteristics of machinery, operating loads, equipment and fittings will be considered.

3) Framing

Framing system of main structure will be generally longitudinal.

4) Floors

All floors will be of steel fabrication and beams of main floor will be of logitudinal system, supported by deck transverses.

Beams on other floors will be either transverse or longitudinal system, whichever

suits the construction of the structure and operating requirement of the equipment. Carling, girder or suitable stiffening will be provided under the concentrated load wherever necessary.

5) Walls

Transverse walls will be plane type with vertical stiffeners. Boundart walls of the rooms such as operation room, laboratories, control rooms, transformer rooms, disconnection panel rooms, switch gear rooms, turbo generator room, etc. will be of steel fabrication.

6) Foundations

All welded foundation will be fitted for the equipment arranged on floors and walls. Suitable reinforcement by means of pillars, krackets and stays will be provided to prevent excessive concentrated load.

7) Construction of Houses

The side wall and roof of the house will be generally constructed of weathertight asbesto sheet supported with steel framing.

Laddars, Handrails and Elevators

1) Ladders and Steps

Access ladders to machinery and equipment will be of 800 mm wide and 45° to 60° inclined. Step interval will be 220 mm for inclined ladders and 300 mm for vertical ladders.

2) Handrails for Weather Exposed Part

Steel handrails will be fitted on decks except where breakwater will be provided. Handrail will be 1,050 mm high from deck.

3) Gratings

Gratings will be provided around equipment, pipes etc. for proper access and operation.

4) Elevators

Electric elevators for cargo use will be provided. Safety device for overloading, over speed trip, etc. will be also provided.

Ventilation and Air Conditioning System

1) Air Conditioning

Air conditioning system will be installed in dry end test room, operation room and laboratories, and central control room and kiln & recausticizer control room. The system will consist of refrigerating compressor(s), chilled water circulating pump(s) and fan unit(s). Provisions also will be made for supplying cooled air to disconnection panel rooms and switch gear rooms to maintain the inside temperature at 38°C.

Cooler(s) for men will be installed on the floors personnel use.

2) Mechanical Ventilation System

Main compartments of the platform will be served by mechanical supply and/or exhaust ventilation system.

Turbo generator room, air compressor room and refrigerating compressor room will be mechanically ventilated with supply of outside air.

The mechanical ventilation will utilize electric motor driven fans of low pressure type.

3) Natural Ventilation

The side walls of the platform will be opened at site, but insect screen will be supplied for every 5 m of side walls of paper machine area and products finishing area. The insect screen to have stainless steel screen, frame and fittings.

Hull Piping

1) General

Piping system required for fuel oil, fresh water, compressed air, drainage, etc. will be provided.

2) Firefighting System

Water hydrant system will be served for fire extinguishing the platform main compartments. Water will be supplied from shore side. Automatic water sprinkler system will be provided for products finishing areas, and turbo generator bearings and fuel oil pump area. Automatic water fog spray system will be provided for transformer rooms.

Portable chemical extinguishers will be provided where necessary in accordance with Japanese regulation.

3) Fresh Water System

Fresh water line will be piped for cold water fountains, laboratories, emergency showers and eye washers and toilets.

4) Scupper and Drainage System

Scupper and drain pipes will be provided for the main floors, roof of houses, sanitary spaces and other enclosed spaces wherever necessary.

Joiner Works, Deck covering, Insulation, etc.

1) Joiner Work

Asbestos cement board Joiner lining will be fitted on inside steel walls of operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

Asbestos cement board ceiling will be fitted in operation rooms, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

2) Deck Covering

Synthetic rubber composite deck will be furnished in operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room. Floor in other rooms will be furnished only with paint.

3) Insulation

Glass wool insulation will be provided for interior surface of operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

Glass wool insulation will be also provided for interior surface of weather exposed ceilings and walls of disconnection panel rooms, switch gear rooms, turbo-generator rooms, air compressor rooms, machine room, elevator machine rooms and battery rooms.

Electric Installation

1) General

This Section explains the following features of the overall electrical installation:

1) Electric lighting throughout the areas within the platform.

2) Communication system
3) Fire alarm system
4) Warning lights for airplane
5) Lighting conductors

2) Electric Lighting

Lighting fixtures will be applied to obtain adquate illumination to levels prevailing in corresponding spaces in the pulp industry.

3) Telephone System

To communicate with the platform and shore facilities, telephone system will be applied.

4) Communication System

To communicate with the platform and shore facilities, transceiver system will be applied as well as telephone system.

5) Calling Horn System

Motor horns and push buttons will be installed to call work-men within the platform.

6) Fire Alarm System

One (1) set of fire alarm system with detectors will be installed.

7) Obstruction Warning Light for Airplane

Sets of obstruction light on the platform will be installed.

8) Lighting Conductor

Sets of lightning conductor will be installed on the platform.

Department 91. Civil Works

Item No.	Quantity	Equipment	Specification
91101	1	Topographic survey work	
91102	1	Soil testing work	
91103	1	Clearing and grubbing work	
91104	1	Grading and ditching work	
91105	1	Graveling work	
91106	1	Revetment work	
91107	1	Road work	
91108	1	Process effluent disposal work	
91109	1	Sanitary effluent disposal work	
91110	1	Water supply work	
91111	1	Underground fire protection work	
91112	1	Foundation work for equipment	
91113	1	Dedging and piling work for platform	

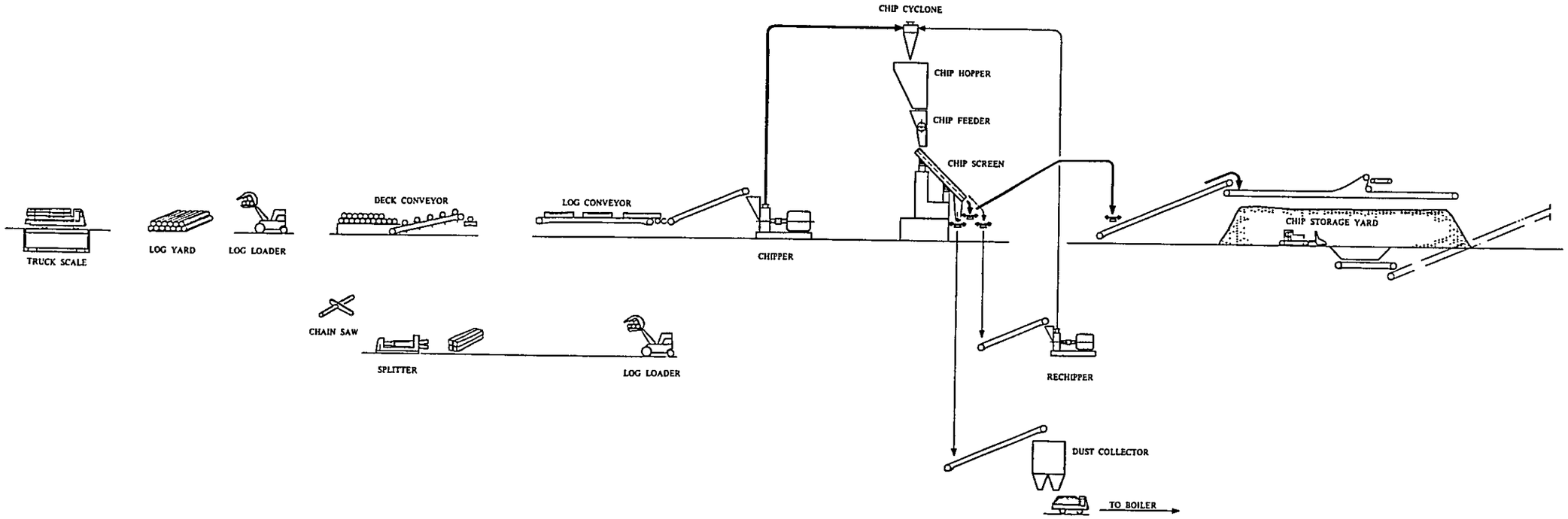
Department 92. Buildings and Structures

Item No.	Quantity	Equipment	Specification
92201	1	Administration building including laboratory	One story-building 20 x 50 m Structure: Block and brick structure with steel reinforcements Wall: Brick Roof: Asbesto slate
92202	1	Gate house and fire station	One story 5 x 5 m Structure: Block and structure with steel reinforcements Wall: Asbesto slate and brick Roof: Asbesto slate
92203	1	Maintenance shop and Locker house	One story 20 x 30 m Structure: Block and structure with steel reinforcements Wall: Asbesto slate and brick Roof: Asbesto slate
92204	1	Chipper and chip screen	One story 6 x 12 m Structure: Pipe truss structure Roof: Asbesto slate
92205	1	Warehouse	One story 30 x 170 m Structure: Pipe truss structure Wall: Asbesto slate and brick Roof: Asbesto slate

Appendix 5-2. FLOW SHEETS

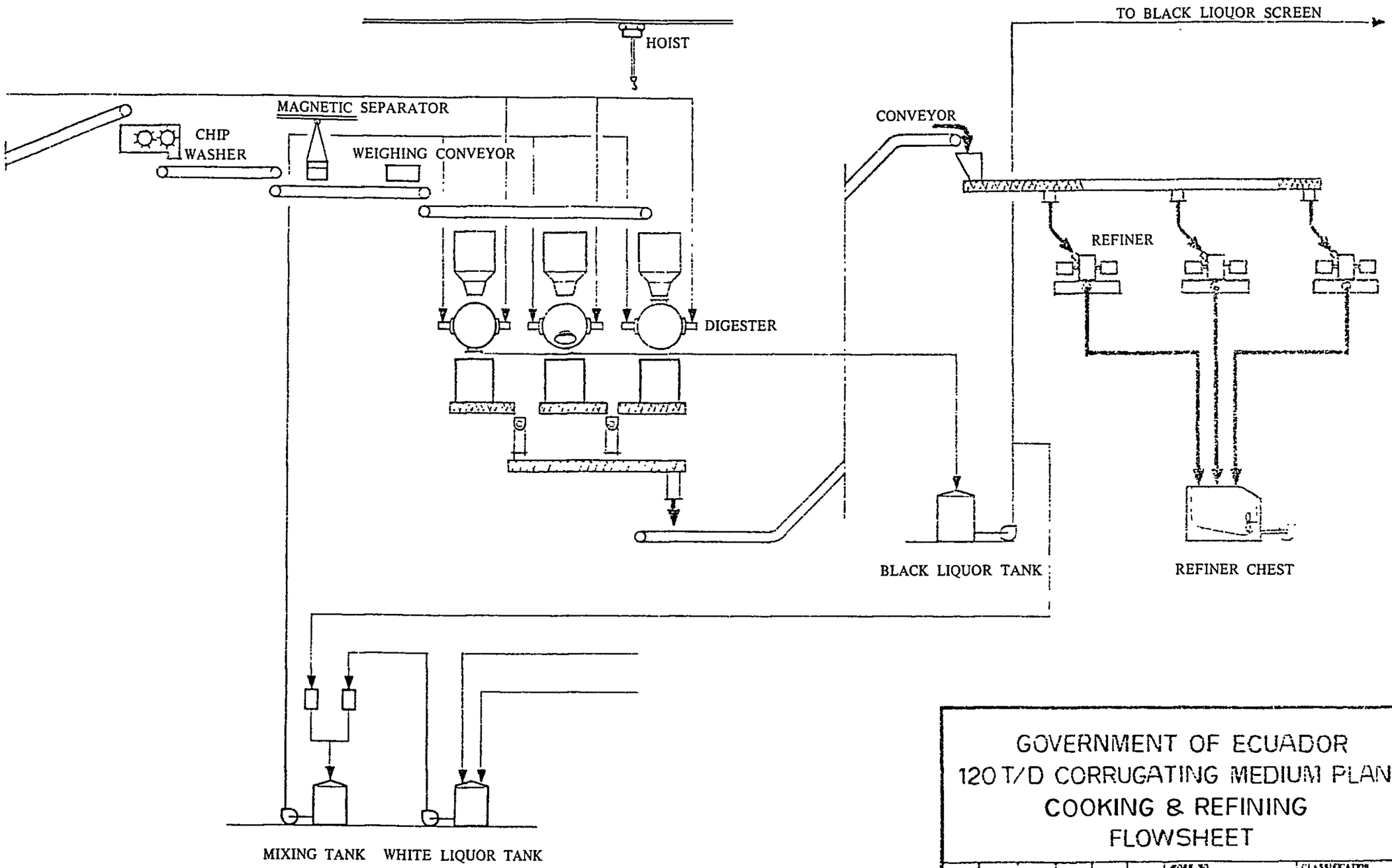
Flow Sheets for Corrugating Medium Plant

Department	21	Log Handling and Chipping
Department	31	Cooking and Refining
Department	32	Brown Stock Washing and Screening
Department	41	Stock Preparation
Department	42	Paper Machine and Finishing
Department	50	Auxiliary Plants for Corrugating Medium Plant



GOVERNMENT OF ECUADOR
PULP & PAPER PLANT
LOG HANDLING & CHIPPING
FLOWSHEET

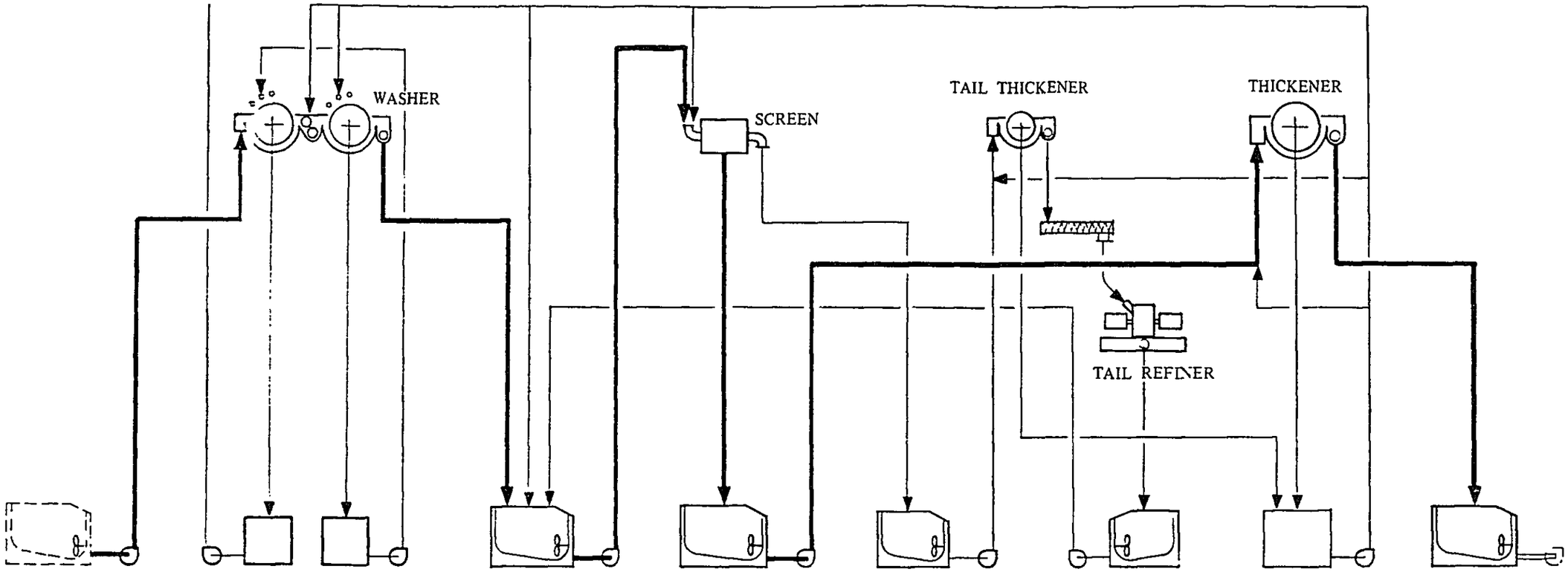
JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR
120 T/D CORRUGATING MEDIUM PLANT
COOKING & REFINING
FLOWSHEET

						WORK NO	CLASSIFICATION
						DRAWING NO	
DATE	DRAWN BY	ENG. CHAR	CHIEF	DEPT. MANAG	MANAG.		

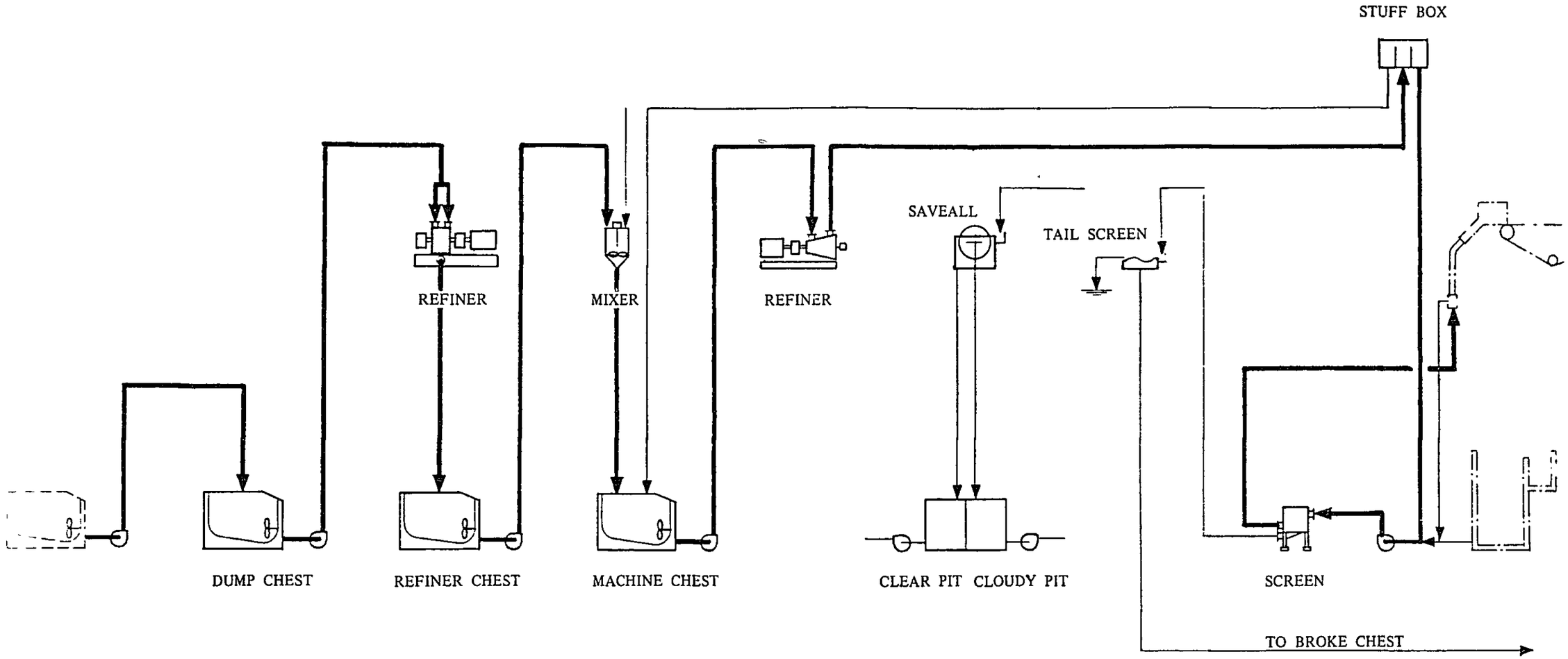
JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR
120 T/D CORRUGATING MEDIUM PLANT
BROWN STOCK WASHING & SCREENING
FLOWSHEET

						WORK NO	CLASSIFICATION
						DRAWING NO	
DATE	DRAWN BY	ENG. CHAR.	CHIEF	DEPT. MANAG.	MANAG.		

JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR
120 T/D CORRUGATING MEDIUM PLANT
STOCK PREPARATION
FLOWSHEET

						WORK NO	CLASSIFICATION
						DRAWING NO	
DATE	DRAWN BY	ENG CHAR	CHIEF	DEPT. MANAG	MANAG.		

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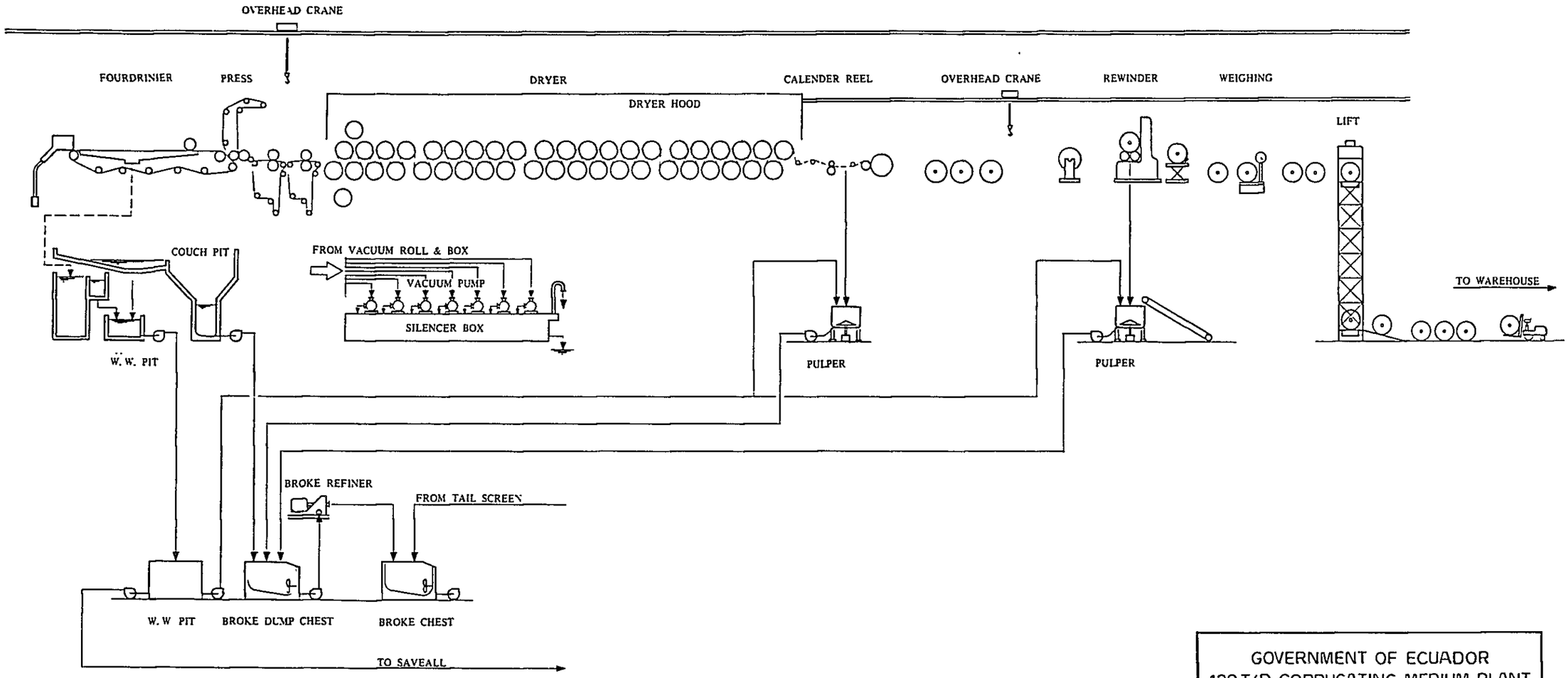

GOVERNMENT OF ECUADOR
120 T/D CORRUGATING MEDIUM PLANT
PAPER MACHINE
FLOWSHEET

						WORK NO	CLASSIFICATION
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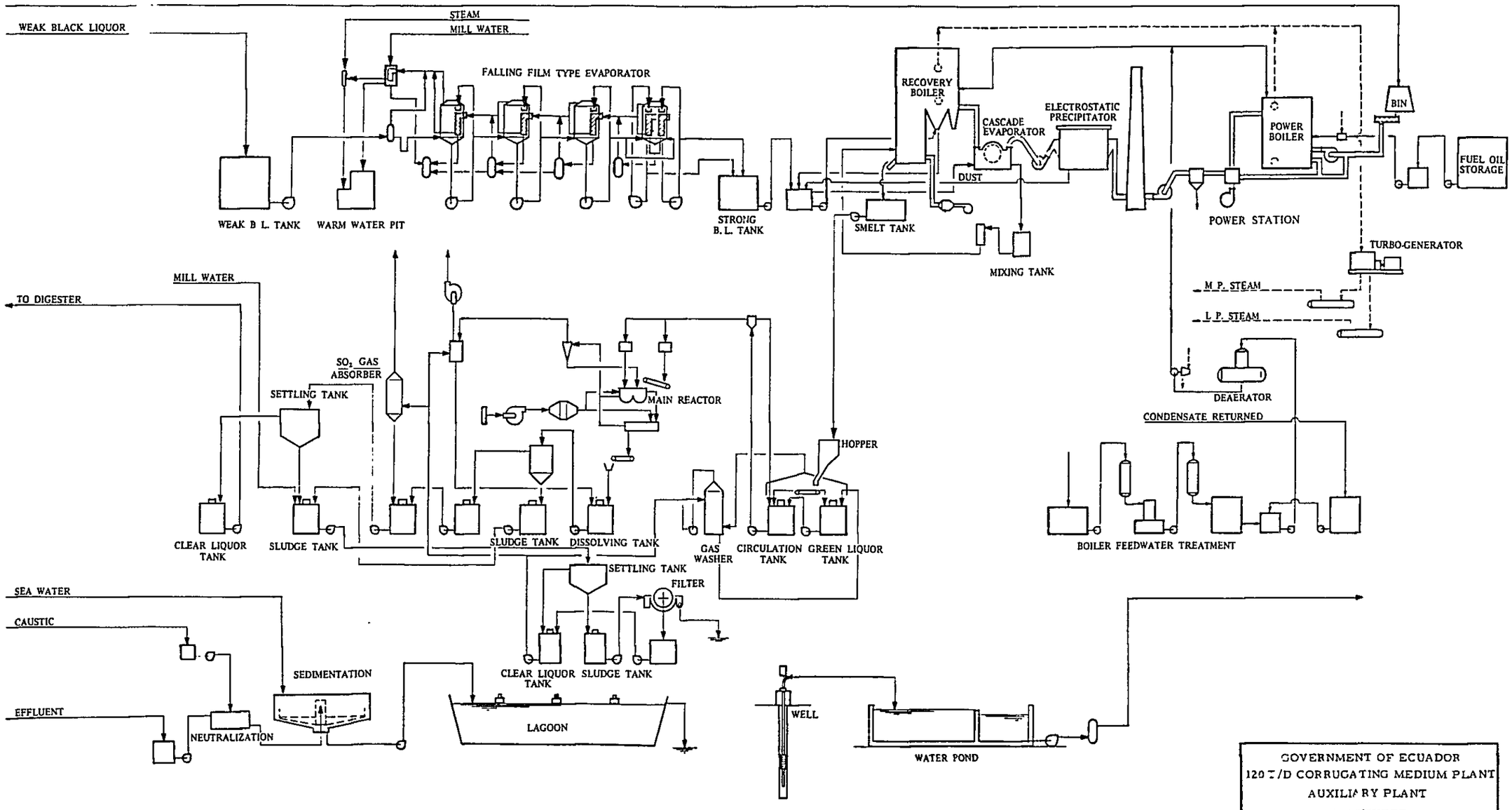


GOVERNMENT OF ECUADOR
120 T/D CORRUGATING MEDIUM PLANT
AUXILIARY PLANT
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY

Appendix 5-3. SPECIFICATIONS

Major Equipment, Civil and Building Specification for Printing/Writing Paper Plant

FOREST WORKS

Department	11	Logging Equipment

LOG HANDLING

Department	21	Log Handling and Chipping

PULP MAKING

Department	31	Cooking
Department	32	Brown Stock Washing and Screening
Department	33	Bleaching
Department	34	Auxiliary Equipment for Pulp Making

PAPER MAKING

Department	41	Stock Preparation
Department	42	Paper Machine
Department	43	Finishing
Department	44	Auxiliary Equipment for Paper Machine

CHEMICAL RECOVERY AND MAKING

Department	51	Black Liquor Evaporation
Department	52	Chemical Recovery Boiler
Department	53	Recausticizing
Department	54	Lime Recovery
Department	56	Bleach Chemical Preparation

UTILITIES

Department	61	Fuel Supply
Department	62	Power Boiler
Department	63	Electrical Power generation
Department	64	Substation and Electrical power Distribution
Department	65	Electrical Equipment
Department	66	Instrumentation
Department	67	Water Supply
Department	68	Compressed Air Supply
Department	69	Mill Inter-connecting Piping

MILL SERVICE

Department	71	Maintenance Shop
Department	72	Laboratory
Department	73	Fire Protection System
Department	74	Vehicles
Department	75	Communication Equipment
Department	76	Mill Effluent Treatment

PLANT CONSTRUCTION

Department	90	Platform
Department	91	Civil Works
Department	92	Buildings and Structures

Department 11. Logging Equipment – On Shore

Item No.	Quantity	Equipment	Specification
Logging and Log Transportation Equipment			
11101	22	Chain Saws	24 inch
11102	14	Angledozers	Equipped with towing winch
11103	4	Skid Loaders	
11104	26	Road Trucks	Capacity; 13 – 14 m^3
Road Construction Equipment			
11105	3	Angledozers	
11106	1	Angledozer	
11107	1	Bucket Loader	
11108	1	Back Hoe Shovel	
11109	1	Mobile Crane	Capacity; 16 tons
11110	1	Chain Saw	24 inch
11111	1	Tire Roller	Capacity; 8.5 tons
11112	1	Road Roller	McAdam-type, Capacity; 16 tons
11113	1	Motorized Piledriver	
11114	6	Dump Trucks	Capacity; 5 m^3
11115	1	Truck	Capacity; 8 tons
Maintenance and Repair Equipment			
11116	2	Trucks	

Item No.	Quantity	Equipment	Specification
11117	1 set	Machine Tools	
11118	1	Generating Set	
11119	1	Air Compressor	
Construction Material Transportation Equipment			
11120	3	Trucks	Capacity; 8 tons
Fuel Distribution Equipment			
11121	2	Tank Trucks	Capacity; 10 tons
Lighting Equipment at Logging Camp Site			
11122	2	Generating Sets	
Administrative Equipment			
11123	2	Passenger Buses	Capacity; 40 passengers
11124	5	Patrolling Cars	
11125	2	Generating Sets	

Department 21. Log Handling and Chipping – On Shore

Item No.	Quantity	Equipment	Specification
Pulpwood Handling and Chipping			
21101	1	Truck Scale	
21102	1	No. 1 Log Deck	Chain live deck
21103	1	No. 2 Log Deck	Chain live deck with log kicker
21104	1	No. 1 Log Conveyors	Chain conveyor
21105	1	No. 2 Log Conveyors	Chain conveyor
21106	1	Chipper	Gravity Feed, top discharge chipper
Large Pulpwood Handling			
21107	1	Splitter	
Chip Handling			
21108	1	Chip Cyclone	Centrifugal cyclone
21109	1	Chip Feeder	Star type with chip bin
21110	1	Chip Screen	Rotary type
21111	1 set	Fines Conveyors	Belt conveyor
21112	1 set	Overs Conveyors	Belt conveyor
21113	1	Rechipper	Knife type rechipper with cyclone
21114	1 set	Chip Screen Outlet Conveyors	Belt conveyor
21115	1	Chip Stacker	Belt conveyor. for outside chip storage use

Item No.	Quantity	Equipment	Specification
21116	1	Chip Reclaimer	Chain conveyor
Refuse Handling			
21117	1 set	Bark and Dust Conveyors	Belt conveyor
Auxiliary Equipment			
21201	1 set	Pumps for Log Handling and Chipping Department	
21510	1 set	Electric Equipment	
21600	1 set	Scaffolding	
21700	1 set	Piping and Valves	

Department 31. Cooking – On Platform

Item No.	Quantity	Equipment	Specification
31101	1	Chip Washer	Horizontal type chip washer
31102	1	Chip Feeding Conveyor	Inclined trough belt conveyor
31103	1	Chip Weighing Conveyor	Horizontal trough belt conveyor with weight meter and magnetic separator
31104	1 set	Chip Distribution Conveyors	Trough belt conveyors
31105	3	Chip Bins	Vertical cylindrical type chip bin
31106	3	Digesters	Vertical stationary type batch digester, 65 m^3
31107	3	Liquor Heaters	
31108	1	Blow Tank	Vertical cylindrical tank
31109	1	Direct Contact Condenser	
31110	1	Accumulator	
31111	1	Heat Exchanger	
31201	1 set	Pumps	
31301	1 set	Agitators	
31402	1 set	Tanks	
31510	1 set	Electric Equipment	
31520	1 set	Instrument	

Item No.	Quantity	Equipment	Specification
31600	1 set	Scaffolding	
31700	1 set	Piping and Valves	
31800	1 set	Insulation	

Department 32. Brown Stock Washing and Screening – On Platform

Item No.	Quantity	Equipment	Specification
32101	1	Metal Trap	
32102	1	Knotter	
32103	1	Three-stage Brown Stock Washer	Drum washer · 2,500 mm diameter, 2,000 mm length
32104	1	Pulp Conveyor	Screw conveyor
32105	1	Black Liquor Screen	Inclined type
32106	1	Pulp Screen	Cowan type or equivalent
32107	1	Thickener	Valveless type
32108	1	Pulp Conveyor	Horizontal screw conveyor
32109	1	Rejects Screen	Cowan type or equivalent
32110	1	Rejects Screen	Vibrating screen
32111	1	Rejects Cleaner	Centrifugal screen
32401	1	H.D. Chest	High density chest for pulp storage
32201	1 set	Pumps	
32301	1 set	Agitators	
32402	1 set	Chests and Tanks	
32510	1 set	Electric Equipment	
32520	1 set	Instrument	
32600	1 set	Scaffolding	

Item No.	Quantity	Equipment	Specification
32700	1 set	Piping and Valves	
32800	1 set	Insulation	

Department 33. Bleaching – On Platform

Item No.	Quantity	Equipment	Specification
33101	1	Chlorine Mixer	Inline type
33102	1	Chlorine Washer	Vacuum type
33103	1	No. 1 Caustic Mixer	Screw type
33104	1	No. 1 Caustic Washer	Vacuum type
33105	1	No. 1 Hypo Mixer	Screw type
33106	1	No. 1 Hypo Washer	Vacuum type
33107	1	No. 2 Caustic Mixer	Screw type
33108	1	No. 2 Caustic Washer	Vacuum type
33109	1	No. 2 Hypo Mixer	Screw type
33110	1	No. 2 Hypo Washer	Vacuum type
33111	1	Pulp Cleaner	Centrifugal type
33112	1	Two-stage Pulp Thickener	Extractor and vacuum type
33401	1	Chlorination Tower	Vertical cylindrical type, 62 m^3
33402	1	No. 1 Caustic Extraction Tower	Vertical cylindrical type, 40 m^3
33403	1	No. 1 Hypo Tower	Vertical cylindrical type, 65 m^3
33404	1	No. 2 Caustic Extraction Tower	Vertical cylindrical type, 40 m^3
33405	1	No. 2 Hypo Tower	Vertical cylindrical type, 65 m^3
33406	1	H.D. chest	High density chest for pulp storage

Item No.	Quantity	Equipment	Specification
33201	1 set	Pumps	
33301	1 set	Agitators	
33407	1 set	Chests and Tanks	
33510	1 set	Electric Equipment	
33520	1 set	Instrument	
33700	1 set	Piping and Valves	
33600	1 set	Scaffolding	
33800	1 set	Insulation	

Department 41. Stock Preparation – On Platform

Item No.	Quantity	Equipment	Specification
41101	1	Pulp Refiner	Disc refiner
41102	1	Pulper Feed Converyor	Steel slat conveyor
41103	1	Hydrapulper	Continuous pulper
41104	1	No. 1 Stock Refiner	Disc refiner
41105	1	No. 2 Stock Refiner	Disc refiner
41106	1	No. 1 Stock Mixer	Vertical cylindrical mixing tank with agitator
41107	1	No. 2 Stock Mixer	Vertical cylindrical mixing tank with agitator
41108	1	Machine Refiner	Conical refiner
41109	1	Stuff Box	
41110	1	Machine Screen	Pressure type
41111	1	Machine Cleaner	Centrifugal cleaner
41112	1	Tail Screen	Vibrating type
41113	1 set	Additive Chemicals Preparation Equipment	
41201	1 set	Pumps	
41301	1 set	Agitators	
41402	1 set	Chests and Tanks	
41510	1 set	Electric Equipment	
41520	1 set	Instrument	
41700	1 set	Piping and Valves	

Item No.	Quantity	Equipment	Specification
41600	1 set	Scaffolding	
41800	1 set	Insulation	

Department 42. Paper Machine – On Platform

Item No.	Quantity	Equipment	Specification
42101	1	Head Box	Totally enclosed air cushion type with multi-tube flow distributor
42102	1	Fourdrinier	Cantilever quick wire changing type, no shaking. Wire width: Approx. 2,980 mm
42103	1 set	Press Part	Primary and secondary press. – comprising one suction pick up press roll, one grooved press roll and one fixed center roll installed between these two press rolls. Tertiary press. – straight-through grooved roll. Wringer press.
42104	1 set	Pre-dryer Part	Double deck multi-cylinder type with vapour removal roll system. Gearing - clossed gearing. Paper dryers - Approx. 1,520 mm diameter. Cooling cylinder - Approx. 1,520 mm diameter.
42105	1 set	Size Press	
42106	1 set	After-dryer Part	Double deck multi-cylinder type with vapour removal roll system. Gearing - clossed gearing. Paper dryers - Approx. 1,520 mm diameter.

Item No.	Quantity	Equipment	Specification
			Cooling cylinder - Approx. 1,520 mm diameter.
42107	1 set	Calender	Six rolls, two stacks with open type frame
42108	1 set	Reel	Horizontal surface reel, autoflyte type
42109	1 set	Dryer Hood Exhaust Fans	Centrifugal fan
42110	1	Size Preparation Screen	
42401	1	Machine Pit	
42402	1	Couch Pit	
42403	1	White Water Pit	
42404	1	Calender Broke Pit	

Department 43. Finishing – On Platform

Item No.	Quantity	Equipment	Specification
43101	1	Sheets Cutter	
43102	1	Sheets Wrapper	
43103	1	Rewinder	
43104	1	Roll Weight Meter	
43105	1	Roll Packing Machine	
43106	1 set	Pneumatic Conveying System for Sheets Cutter	
43107	1 set	Pneumatic Conveying System for Rewinder	

Department 44. Auxiliary Equipment for Paper Machine – On Platform

Item No.	Quantity	Equipment	Specification
44101	1 set	Paper Machine Drive	Sectional driving system by DC motors
44102	1 set	Hood and Air System	Total enclosed type with motorized sliding doors
44103	1 set	Hot Air Supply System for Vapour Removal Rolls	
44104	1 set	Fourdrinier Air Exhaust System	
44105	1 set	Machine Room Ventilation System	
44106	1 set	Steam and Condensate System	Cascade flush-blow through type
44107	1 set	Vacuum System	NASH type
44108	1 set	Calender Cooling System	
44109	1 set	Lubrication System	Forced circulation central oil supply type
44110	1	Pulper Feed Conveyor	Steel slat conveyor
44111	1	Dry Broke Pulper for Reel and Cutter	Continuous pulper
44112	1	Save-all	
44113	1	Broke Thickener	Drum filter
44114	1	Broke Breaker	
44115	1	Over-head Crane	Load capacity-25 tons. Two crabs three Hooks with operating console

Item No.	Quantity	Equipment	Specification
44116	1	Reel Crane	Load capacity-20 tons. Low speed two-hooks with pendant push button switch box
44201	1 set	Pumps	
44301	1 set	Agitators	
44402	1 set	Chests and Tanks	
44510	1 set	Electric Equipment	
44520	1 set	Instrument	
44600	1 set	Scaffolding	
44700	1 set	Piping and Valves	
44800	1 set	Insulation	

Department 51. Black Liquor Evaporation – On Platform

Item No.	Quantity	Equipment	Specification
51101	1	First Effect Evaporator	Falling film type
51102	1	Second Effect Evaporator	Falling film type
51103	1	Third Effect Evaporator	Falling film type
51104	1	Fourth Effect Evaporator	Falling film type
51105	1	Surface Condenser	Shell and tube type
51106	1	Pre-cooler	Barometric type
51107	1	Steam Ejector	Two stage ejector
51201	1 set	Pumps	
51301	1 set	Agitators	
51401	1 set	Tanks and Towers	
51510	1 set	Electric Equipment	
51520	1 set	Instrument	
51600	1 set	Scaffolding	
51700	1 set	Piping and Valves	
51800	1 set	Insulation	

Department 52. Chemical Recovery Boiler – On Platform

Item No.	Quantity	Equipment	Specification
52101	1 set	Recovery Boiler Proper	Outside installation
52102	1 set	Boiler Furnace	Water cooled membrane wall construction
52103	1 set	Superheater	Pendant platen type
52104	1 set	Attemperature	Spray type
52105	1 set	Economizer	Bare tube vertical type
52106	1	Steam Airheater	
52107	1 set	Steel Framework for Boiler Support	
52108	1 set	Steel Casing for Boiler enclose	
52109	1 set	Soot Blower	Long retracting rack soot blower, steam blowing type
52110	1 set	Black Liquor Spray Apparatus	Hoseless type
52111	1	Cascade Evaporator	
52112	1 set	Electrostatic Precipitator	Horizontal flow, dry bottom
52113	1 set	Oil Burner	Y-jet steam atomizer with ignitor
52114	1	Smelt Spout	Water cooled
52115	1	Saltcake Screw Feedre	
52116	1	Saltcake Rotary Feeder	
52117	1	Saltcake Conveyor	Bucket conveyor

Item No.	Quantity	Equipment	Specification
52118	1	Forced Draft Fan	Backward bladed fan
52119	1	Induced Draft Fan	Radial bladed fan
52120	1	Sampling Apparatus	Sampling for water and steam
52121	1	Boiler Stack	
52201	1 set	Pumps	
52301	1 set	Agitators	
52401	1 set	Tanks and Towers	
52510	1 set	Electric Equipment	
52520	1 set	Instrument	
52600	1 set	Scaffolding	
52700	1 set	Piping and Valves	
52800	1 set	Insulation	

Department 53. Recausticizing – On Platform

Item No.	Quantity	Equipment	Specification
53101	1	Green Liquor Clarifier	Unit type thickener
53102	1	Green Liquor Heater	Inline type steam direct injection
53103	1	Lime Slaker	Combined type with mixer tank and classifier
53104	1 set	Causticizer	Turbine mixer
53105	1 set	White Liquor Classifier	
53106	1	Dregs Mixer	Turbine type
53107	1	Dregs Washer	Unit type thickener
53108	1	Dregs Filter	Drum filter
53109	1	Lime Mud Washer	Unit type thickener
53110	1	Lime Mud Filter	Drum filter
53111	1	Slaker Discharge Conveyor	Belt conveyor
53201	1 set	Pumps	
53301	1 set	Agitators	
53401	1 set	Tanks	
53510	1 set	Electric Equipment	
53520	1 set	Instrument	
53600	1 set	Scaffolding	
53700	1 set	Piping and Valves	
53800	1 set	Insulation	

Department 54. Lime Recovery – On Platform

Item No.	Quantity	Equipment	Specification
54101	1	Feed End Hood	
54102	1	Lime Kiln	Short type
54103	1 set	Satellite Cooler	
54104	1	Firing Hood	
54105	1	Discharge Housing	
54106	1 set	Driving Unit	
54107	1 set	Supporting Unit	Three tires one thrust roller
54108	1	Rotary Valve	
54109	1	Cyclone	
54110	1	Discharge Divider	
54111	1	Venturi-scrubber	
54112	1	Table Feeder	
54113	1	Lime Stone Crusher	Hammer type
54114	1	Lime Stone Crusher	Roll type
54115	1	Cage Mill	
54116	2	Belt Conveyor	
54117	1	Paddle Mixer	
54118	3	Screw Conveyor	
54120	1	Bucket Elevator	
54121	1	Bucket Elevator	

Item No.	Quantity	Equipment	Specification
54122	1	Feed Hopper	
54123	1 set	Oil Pump Unit	
54124	1 set	Oil Burner	
54125	1 set	Diesel Oil Pump Unit	
54126	1	Exhaust Fan	
54127	1	Primary Fan	
53201	1 set	Pumps	
53301	1 set	Agitators	
53401	1 set	Tanks	
54510	1 set	Electric Equipment	
54520	1 set	Instrument	
54600	1 set	Scaffolding	
54700	1 set	Piping and Valves	
54800	1 set	Bricks and Insulation	

Department 56. Bleach Chemical Preparation – On Platform

Item No.	Quantity	Equipment	Specification
56101	1 set	Salt Handling	Comprising: 3-Salt conveyors 1-Salt dissolving tank 1-Slurry receiver
56102	1 set	Brine Purification	Comprising: 1-Raw brine receiver 1-Reactor 1-Settler 1-Brine receiver 1-Filter 1-Chemical dossing equipment 1-Filter press 1-Filtrate liquor receiver 1-Mud conveyor 1-Mud receiver
56103	1 set	Electlysis and NaOH Line	Comprising: 3-Cells of membrane apparatus 1-Rectifier
56104	1 set	Cl_2 Line	Comprising: 2-Cl_2 gas washing and cooling towers 1-Cooling water tank 4-Cooling water pumps 2-Water coolers 3-Cl_2 gas drying towers: 3-H_2SO_4 Coolers 1-Cl_2 Gas cooler 2-Cl_2 Gas Liquefiers 1-Refriator 2-Cl_2 Gasifiers 1-Cl_2 Gas receiver 1-Air compressor 1-Air dryer 1-Air receiver

Item No.	Quantity	Equipment	Specification
56105	1 set	Brine Recovery	Comprising: 1-Weak brine receiver 1-Dechlorination tower 1-Air blower 1-Weak brine receiver 1-Desulphated tank 3-Brine pumps 1-$CaCl_2$ Dissolving tank 1-$CaCl_2$ Pump
56106	1 set	Na-Hypo Preparation	Comprising: 1-NaOH Cooler 2-Absorption towers
56107	1 set	Exhaust Cl_2 Absorption	Comprising: 1-Mixer 2-NaOH Circulation tank 2-NaOH Circulation pumps 1-Na-hypo Cooler 1-Exhaust Cl_2 gas absorption tower 3-No. 1 Exhaust Cl_2 gas blowers
56108	1 set	Na-Hypo Preparation	Comprising: 1-Reaction tube 1-Cooler
56201	1 set	Pumps	
56301	1 set	Agitators	
56401	1 set	Tanks and Towers	
56510	1 set	Electrical Equipment and Controls	
56520	1 set	Instrumentation	
56600	1 set	Scaffolding	
56700	1 set	Piping and Valves	

Department 61. Fuel Supply -- On Shore

Item No.	Quantity	Equipment	Specification
61202	1 set	Heavy Oil Receiving Pumps	
61202	1 set	Diesel Oil Receiving Pumps	
61203	1 set	Gasoline Receiving Pumps	
61204	1 set	Heavy Oil Feed Pumps	
61205	1 set	Diesel Oil Feed Pumps	
61206	1 set	Gasoline Feed Pumps	
61401	1	Heavy Oil Storage Tank	
61402	1	Diesel Oil Storage Tank	
61403	1	Gasoline Storage Tank	
61510	1 set	Electric Equipment and Controls	
61600	1 set	Scaffolding	
61700	1 set	Piping and Valves	

Department 62. Power Boiler – On Platform

Item No.	Quantity	Equipment	Specification
62101	1 set	Boiler Proper	Outdoor installation type comprises: Boiler furnace Water tube Headers, Downcommers, Feeders Drums Boiler bank tube Boiler bank skin casing
62102	1	Superheater	Pendant convection type
62103	1	Economizer	Bare tube convection type
62104	1	Air Heater	Tublar type
62105	1	Steam Air Heater	
62106	1	Boiler Casing	Ribbed aluminum cald sheet
62107	1 set	Steel Framework	
62108	1 set	Soot Blower	Long retractable or rotary type blower, steam blowing type
62109	1	Forced Draught Fan	Turbo fan
62110	1	Induced Draught Fan	Turbo fan
62111	1	Secondary Air Fan	Turbo fan
62112	1 set	Chemical Dosing Equipment	Comprises: tanks, pumps and agitator for dosing chemicals of ammonia, hydrazine, disodium phosphate and trisodium phosphate.

Item No.	Quantity	Equipment	Specification
62113	1 set	Sampling Equipment	
62114	1 set	Boiler Feed Pump	Multi-staged turbine pump
62115	1	Fuel Oil Heater	
62116	1 set	Fuel Oil Burner	Steam atomizing type
62117	1 set	Pilot Oil Burner	Air atomizing type
62118	1 set	Make-up Water Treatment Equipment	Mixed bed, pilisher type
62119	1	Ion Exchanger	
62120	1 set	Process Return Water Treatment Equipment	
62121	1	Stack	
62122	1	Main Condenser	Divided water box type surface condenser
62123	1	Main Steam Jet Air Ejector	Twin element two stage steam jet ejector
62124	1	Starting Air Ejector	Single stage steam jet type
62520	1 set	Instrument	
62600	1 set	Scaffolding and Support	
62700	1 set	Piping and Valves	
62800	1 set	Insulation	
Boiler Feed Water System			
62125	1 set	Feed Water Heater	Shell and tube type heater
62126	1	Deaerator	Spray type
62202	1 set	Pumps	

Item No.	Quantity	Equipment	Specification
62402	1 set	Tanks	
62510	1 set	Electric Equipment	
62520	1 set	Instrument	
62600	1 set	Scaffolding	
62700	1 set	Piping and Valves	
62800	1 set	Insulation	

Department 63. Electrical Power Generation – On Platform

Item No.	Quantity	Equipment	Specification
63101	1	Steam Turbine	9,000 kVA. Single cylinder, Impules type double extraction condensing turbine
63102	1	Generator	9,000 kVA. Three phase synchronuous generator, open type forced air cooled, horizontal and gear coupled to steam turbine
63103	1 set	Protective Device	
63104	1 set	Lubrication System	
63105	1 set	Steam Seal System	
63106	1 set	Turning Gear Device	
63107	1 set	Air Cooler for Generator	
63108	1	Power Generator for Emergency	500 kVA. Diesel engine driven power generator
63401	1 set	Tanks	
63510	1 set	Control System	Speed and pressure control
	1 set	Excitation System	Three phase full-wave bridge, self cooled rectifier utilizing silicon diodes
63520	1 set	Instrument	
63700	1 set	Piping and Valves	
63800	1 set	Insulation	

Department 64. Substation and Electric Power Distribution – On Platform

Classification of Electric power Distribution System

	Voltage	Frequency	Phases	Wires	Grounding system
High Voltage	3,300 V	60	3	3	Resister neutral
Low Voltage	440 V	60	3	3	Non-grounded
90 kW and above AC motor	3,300 V	60	3	3	Non-grounded
75 kW and below AC motor	440 V	60	3	3	Non-grounded
DC motor	440 V	–	–	2	Non-grounded
Control Circuit and Instrument	110 V	60	1	2	Non-grounded
Lighting	220 V	60	1	2	Non-grounded
Battery Lighting (D.C)	110 V	–	–	2	Non-grounded

Item No.	Quantity	Equipment	Specification
64501	1 set	3.3 kV High Voltage Sheet-steel Cubicle Switchgear	
64502	1 set	Electrical Cable	
		3.3 kV Class Power Cable	Cross-linked polyethylene insulated, polyvyniyle chloride sheated cable
		600 V Class Power Cable	Cross-linked polyethylene insulated, polyvinyle chloride sheated cable

Item No.	Quantity	Equipment	Specification
	600 V Class Control Cable		Polyvinyle chlorided insulated and sheathed control cable
		600 V Class Control Shield Cable	Polyvinyle chloride insulated and sheathed control cable with copper tape shield

Department 65. Electrical Equipment – On Platform

Item No.	Quantity	Equipment	Specification
65501	1 set	High Voltage sheet-steel Cubicle Switchgear	Draw-out type
65502	1 set	High Voltage Motor Control Center	Draw-out type
65503	1 set	Low Voltage Load Center	Fixed type
65504	1 set	Low Voltage Motor Control Center	Draw-out type
65505	1 set	Operation Panel for Motors	
65506	1 set	Local Push Button Switch Box	
65507	1 set	Electrical Motor	

Department 66. Instrumentation – On Platform

Supply Characteristics

Electric power for instrument operation will be made available at 110 V, 60 Hz, single phase.

General Specification

1) Control System Type
Control system will be mainly pneumatic and to be generally insulated on locally.

2) Transmission and Control Signal
Electronic transmission and control signal range will be 4 to 20 mA. Pneumatic signal will be of 0.2 to 1.0 kg.f/cm^{2}G.

3) Transmitter
Transmitter will be of the force-balance type or, where specified, of the mortion balance indicating type, except in case of electrical measurement or control signal.

4) Recorder
Recorder will be of the standard transmitted signal range and contain multiple recording pens. Miniature recorder with folding strip chart will be used for general mill service.

5) Control Station
Controller will be mounted on panel with vertical scale for set point and process varible indication.

6) Indicator
Indicator will be of the vertical scale type and the standard transmission signal.

7) Chart Drive
Recorder chart drive will be of 110 V, 60 Hz, single phase.

8) Pen
All pen will be of the capillary type with reservoirs in generally.

9) Local Mount Type Controller
Displacement type level, capillary type pressure and temperature, etc. will be included.

10) Annunciator.
Annunciator will be suitable for 110 V, 60 Hz, single phase service and to be supplied with an acknowledge and test pushbutton.

11) Air Supply Regulator (Air Set)
All such regulator will be of the reducing-relief type with integral filter.

Process Control Panel

1) Panel Type
Control panel will generally by of the free-standing type located in locally.

2) Panel Design
Instrument arrangement on panel will be in accordance with department planning drawings.

3) Piping and Ducting
Air supply header mounted within panel will be of copper tubing. Necessary air regulating system consisting of filter, reducing valve and pressure gauge with stop valve should be included.

4) Electric Equipment
All electric equipment including materials, wiring and panel-itself.

Process Control Valve

1) Globe and Angle Valve
Double-seated valve will be top and bottom guided.
Single-seated valve will be top and bottom or cage guide.

2) Batterfly Valve
All batterfly valve will be of "Wafer" type.

3) Ball Valve

Ball valve will be suitable for the throttling of pulp flow from full open to shut-off and such valve will have flow characteristics closely approximately that of "equal percentage".

4) Valve Positioner and Transducer

Pneumatic valve positioner will be considdered.

5) Air Supply Regulator (Air Set)

All such regulator will be of the reducing-relied type with integral filter.

6) Accessories, Piping and Tubing

All accessories normally mounted on valve will be included.

All tubing connection will be made using copper tubing and tube fittings.

Instrument Piping

The major materials for instrument piping will be as follows:

1) Vinyle covered multi-control copper tube
2) Copper tube
3) SGP (W) pipe
4) Half-union
5) Nipple
6) Miniature stop valve

Department 67. Water Supply – On Shore

Item No.	Quantity	Equipment	Specification
67101	1	Clarifier	Slurry circulation type
67102	1 set	Chemical Addition Unit	
67103	1 set	Filter	
67104	1 set	Demineralizing System	
67105	1 set	Potable Water System	
67201	1 set	Pumps	
67301	1 set	Agitator	
67401	1 set	Tanks and Towers	
67510	1 set	Electric Equipment	
67520	1 set	Instrument	
67600	1 set	Scaffolding	
67700	1 set	Piping and Valves	

Department 68. Compressed Air Supply – On Platform

Item No.	Quantity	Equipment	Specification
68101	2	Instrument Air Compressor	Oil free, water cooling double acting type
68102	1	Air Dryer	Automatic, electric heating
68103	1	Prefilter	
68104	1	After-filter	
68105	2	Mill Air Compressor	Water cooling, double acting Iubricated tyep
68510	1 set	Electric Equipment	
68520	1 set	Instrument	
68600	1 set	Scaffolding	
68700	1 set	Piping	

Department 69. Mill Inter-connecting Piping

One complete set of mill inter-connecting piping system, i.e., process lines, chemicals lines, steam lines, water lines, potable water lines, fuel lines, all waste and effluent lines, etc., should be included for mill operation.

Department 71. Maintenance Shop – On Shore

Item No.	Quantity	Equipment	Specification
71101	2	Center Lathe	
71102	1	Universal type Milling Machine	
71103	1	Cutter Knife Grinder	
71104	1	Sliter Knife Grinder	
71105	1	Roll Grinder	
71106	1	Double Column type Plane and Milling Machine	
71107	1	Upright Drilling Machine	
71108	1	Floor type Bench Drill Machine	
71109	1	Overhead Crane	
71110	1	Trolly type Hoist with Beam	
71111	1	Marking Off Tools	
71112	1	Electric Hydraulical type Pipe Bender	
71113	5	Disc type Tube Cutter	
71114	2	Pipe Threading Machine	
71115	10	AC Arc Welder with Remote Control	
71116	1	Auto Single Surface Planer	
71117	1	Circular Saw on Frame	

Item No.	Quantity	Equipment	Specification
71118	1	Double Column type Hydraulic Press for Shop	
71119	1	Shaper	
71120	5	Acetylene Cutting and Welding Outfil	
71121	5 sets	Miscellaneous Hand Tool Kits	

Department 72. Laboratory – On Platform

Item No.	Quantity	Equipment	Specification
72101	1	Wood Chip Classification Unit	
72102	1	Laboratory Digester	
72103	1	Laboratory Flat Screen	
72104	1	Laboratory Disintegrator	
72105	1	Laboratory Beater	Niagara type
72106	1	Sheet Forming Machine	TAPPI standard tyep
72107	4	Freeness Tester	Canadian type
72108	1	Brightness Tester	
72109	1	Tensile Strength Tester	Schopper type
72110	1	Folding Endulance Tester	
72111	1	Bursting Strength Tester	Mullen type
72112	1	Treaing Tester	Elemendorf type
721113	1	Stiffness Tester	
72114	1	Ring-crush Tester	
72115	2	Sample Cutter	
72116	2	Thickeness Gauge	
72117	1	Gurley Tester for Smoothness, Porosity and Softness	
72118	1	Centrifuge	
72119	2	Microscope	

Item No.	Quantity	Equipment	Specification
72120	1	Projector	
72121	1	Drying Oven	
72122	1	Water Batch	
72123	2	Stopwatch	
72124	1	Electric Muffle Furnace	
72125	3	Basis Weight Balance	
72126	2	Direct Reading Balance	
72127	1	Platform Scale	
72128	2	Analytical Balance	
72129	2	ph Meter	
72130	8	Baume Scale	
72131	2	Turbidometer	
72132	2	Color Comparator	
72133	2	Hand Tachometer	
72134	1	Surface Pyrometer	
72135	10	Thermometer	
72136	1	Psychrometer	
72137	2	Stone Ware Sink Unit	
72138	2	Center Table	
72139	2	Balance Table	
72140	2	Water Still	

Item No.	Quantity	Equipment	Specification
72141	5	Jar Tester for Water	
72142	10 sets	Glass Wear	

Department 73. Fire Protection System – On Platform

One complete set of water hydrant system consisting automatic water sprinkler system and automatic water fog spray system, and set of portable chemical powder fire extinguishers for Platform and On-shore buildings should be included for the mill.

Complete sets of necessary piping, and electrical equipment and controls also should be considered.

Department 74. Vehicles

Item No.	Quantity	Equipment	Specification
74101	5	Front-end Loader	Tire skidder, 250 hp Logs offloading use
74102	5	Front-end Loader	Tire skidder, 280 hp Logs sorting in wood yard use
74103	2	Crawler Dozer	200 hp Wood yard use
74104	4	Fork-lift Truck	
74105	4	Shop Truck	3/4 ton
74106	2	4 x 4 Vehicle	
74107	10	Power-saw	Wood yard use

Department 75. Communication Equipment -- On Shore

Item No.	Quantity	Equipment	Specification
75220	1 set .	Telephone equipment	
75221	1 set	Telex Equipment	
75222	1 set	Office equipment	

Department 76. Mill Effluent Treatment – On Shore

Item No.	Quantity	Equipment	Specification
76101	1	Neutralization Mixer	Vertical type with bar screen
76102	1 set	Chemical Addition Unit	
76103	1	Clarifier	Slurry circulation type
76104	1	Sludge Thickener	
76105	1	Sludge Filter	
76106	1	Lagoon with Mechanical aerator	
76201	1 set	Pumps	
76301	1 set	Agitators	
76401	1 set	Tanks and Towers	
76510	1 set	Electric Equipment	
76520	1 set	Instrument	
76600	1 set	Scaffolding	
76700	1 set	Piping	

Department 90. Platform

General Particulars

The platforms will be designed, constructed, equipped, inspected, tested and delivered to the Plant site, and will be operated immediately after the installation by the Builder in accordance with these Specifications.

Dimensions of Platform

Length	Approx. 100 m
Breadth	Approx. 30 m
Depth	Approx. 12.5 m

Platform and House Structure

1) General

The platform will be designed to suit installation and operation of plant equipment and will be of all welded construction. The platform will be strengthened locally for the foundation of equipment where necessary.

2) Bottom Construction

Cellular double bottom will be constructed under the first floor. Bottom frame and inner bottom stiffeners will be arranged longitudinally. Transverse floors and longitudinal girders under double bottom tank top will be also arranged.

Carling or girder will be provided under machinery of other concentrated load wherever necessary. Vibratory characteristics of machinery, operating loads, equipment and fittings will be considered.

3) Framing

Framing system of main structure will be generally longitudinal.

4) Floors

All floors will be of steel fabrication and beams of main floor will be of longitudinal system, supported by deck transverses.

Beams on other floors will be either transverse or longitudinal system, whichever

suits the construction of the structure and operating requriement of the equipment. Carling, girder or suitable stiffening will be provided under the concentrated load wherever necessary.

5) Walls

Transverse walls will be plane type with vertical stiffeners. Boundart walls of the rooms such as operation room, laboratories, control rooms, transformer rooms, disconnection panel rooms, switch gear rooms, turbo generator room, etc. will be of steel fabrication.

6) Foundations

All welded foundation will be fitted for the equipment arranged on floors and walls. Suitable reinforcement by means of pillars, krackets and stays will be provided to prevent excessive concentrated load.

7) Construction of Houses

The side wall and roof of the house will be generally constructed of weathertight asbesto sheet supported with steel framing.

Laddars, Handrails and Elevators

1) Ladders and Steps

Access ladders to machinery and equipment will be of 800 mm wide and 45° to 60° inclined. Step interval will be 220 mm for inclined ladders and 300 mm for vertical ladders.

2) Handrails for Weather Exposed Part

Steel handrails will be fitted on decks except where breakwater will be provided. Handrail will be 1,050 mm high from deck.

3) Gratings

Gratings will be provided around equipment, pipes etc. for proper access and operation.

4) Elevators

Electric elevators for cargo use will be provided. Safety device for overloading, over speed trip, etc. will be also provided.

Ventilation and Air Conditioning System

1) Air Conditioning

Air conditioning system will be installed in dry end test room, operation room and laboratories, and central control room and kiln & recausticizer control room. The system will consist of refrigerating compressor(s), chilled water circulating pump(s) and fan unit(s).

Provisions also will be made for supplying cooled air to disconnection panel rooms and switch gear rooms to maintain the inside temperature at 38°C.

Cooler(s) for men will be installed on the floors personnel use.

2) Mechanical Ventilation System

Main compartments of the platform will be served by mechanical supply and/or exhaust ventilation system.

Turbo generator room, air compressor room and refrigerating compressor room will be mechanically ventilated with supply of outside air.

The mechanical ventilation will utilize electric motor driven fans of low pressure type.

3) Natural Ventilation

The side walls of the platform will be opened at site, but insect screen will be supplied for every 5 m of side walls of paper machine area and products finishing area. The insect screen to have stainless steel screen, frame and fittings.

Hull Piping

1) General

Piping system required for fuel oil, fresh water, compressed air, drainage, etc. will be provided.

2) Firefighting System

Water hydrant system will be served for fire extinguishing the platform main compartments. Water will be supplied from shore side. Automatic water sprinkler system will be provided for products finishing areas, and turbo generator bearings and fuel oil pump area. Automatic water fog spray system will be provided for transformer rooms.

Portable chemical extinguishers will be provided where necessary in accordance with Japanese regulation.

3) Fresh Water System

Fresh water line will be piped for cold water fountains, laboratories, emergency showers and eye washers and toilets.

4) Scupper and Drainage System

Scupper and drain pipes will be provided for the main floors, roof of houses, sanitary spaces and other enclosed spaces wherever necessary.

Joiner Works, Deck Covering, Insulation, etc.

1) Joiner Work

Asbestos cement board Joiner lining will be fitted on inside steel walls of operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

Asbestos cement board ceiling will be fitted in operation rooms, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

2) Deck Covering

Synthetic rubber composite deck will be furnished in operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room. Floor in other rooms will be furnished only with paint.

3) Insulation

Glass wool insulation will be provided for interior surface of operation room, control rooms, kiln and recausticizer control room, laboratory and dry end test room.

Glass wool insulation will be also provided for interior surface of weather exposed ceilings and walls of disconnection panel rooms, switch gear rooms, turbo-generator rooms, air compressor rooms, machine room, elevator machine rooms and battery rooms.

Electric Installation

1) General

This Section explains the following features of the overall electrical installation:

1) Electric lighting throughout the areas within the platform.
2) Communication system
3) Fire alarm system
4) Warning lights for airplane
5) Lighting conductors

2) Electric Lighting

Lighting fixtures will be applied to obtain adequate illumination to levels prevailing in corresponding spaces in the pulp industry.

3) Telephone System

To communicate with the platform and shore faciliteis, telephone system will be applied.

4) Communication system

To communicate with the plateform and shore facilities, transceiver system will be applied as well as telephone system.

5) Calling Horn System

Motor horns and push buttons will be installed to call work-men within the platform.

6) Fire Alarm System

One (1) set of fire alarm system with detectors will be installed.

7) Obstruction Warning Light for Airplane

Sets of obstruction light on the platform will be installed.

8) Lighting Conductor

Sets of lighting conductor will be installed on the platform.

Deparment 91. Civil Works

Item No.	Quantity	Equipment	Specification
91101	1	Topographic Survey Work	
91102	1	Soil testing work	
91103	1	Clearing and grubbing work	
91104	1	Grading and ditching work	
91105	1	Graveling work	
91106	1	Revetment work	
91107	1	Road work	
91108	1	Process effluent disposal work	
91109	1	Sanitary effluent disposal work	
91110	1	Water supply work	
91111	1	Underground fire protection work	
91112	1	Foundation work for equipment	
91113	1	Dedging and piling work for platform	

Department 92. Buildings and Structures

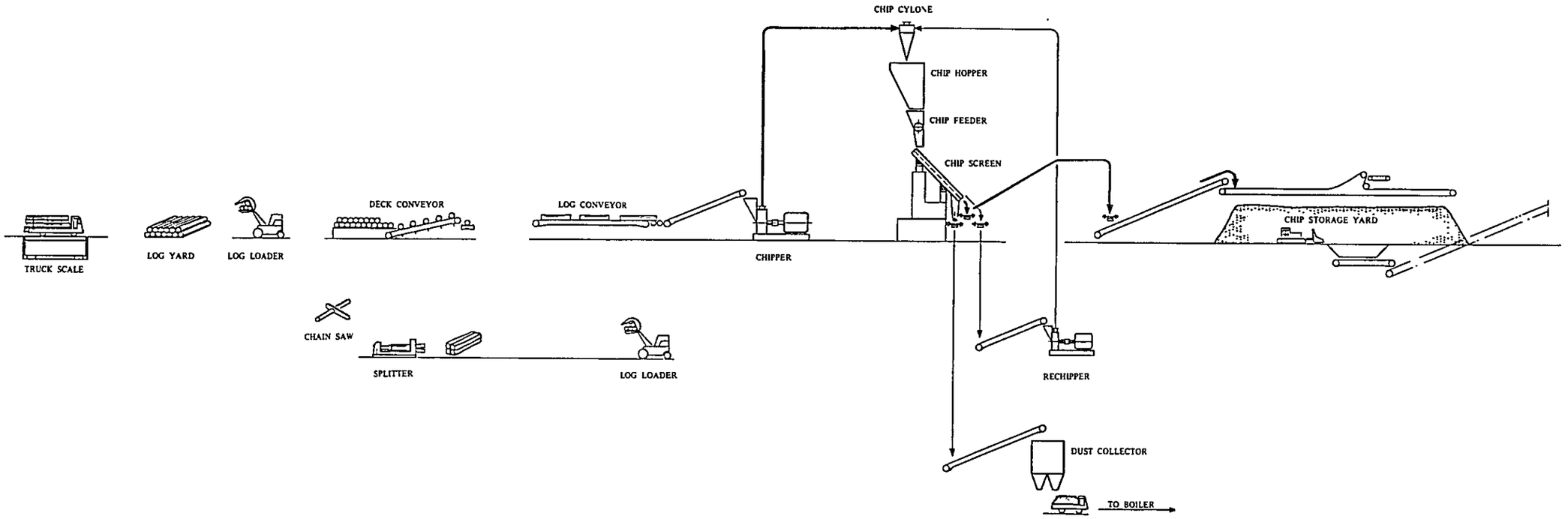
Item No.	Quantity	Equipment	Specification
92201	1	Administration building including laboratory	One story-building 20 x 50 m Structure: Block and brick structure with steel reinforcements Wall: Brick Roof: Asbesto slate
92202	1	Gate house and fire station	One story 5 x 5 m Structure: Block and structure with steel reinforcements Wall: Asbesto slate and brick Roof: Asbesto slate
92203	1	Maintenance shop and Locker house	One story 20 x 30 m Structure: Block and structure with steel reinforcements Wall: Asbesto slate and brick Roof: Asbesto slate
92204	1	Chipper and chip screen room	One story 6 x 12 m Structure: Pipe truss structure Roof: Asbesto slate

Item No.	Quantity	Equipment	Specification
92205	1	Warehouse	One story 30 x 170 m Structure: Pipe truss structure Wall: Asbesto slate and brick Roof: Asbesto slate

Appendix 5-4. FLOW SHEETS

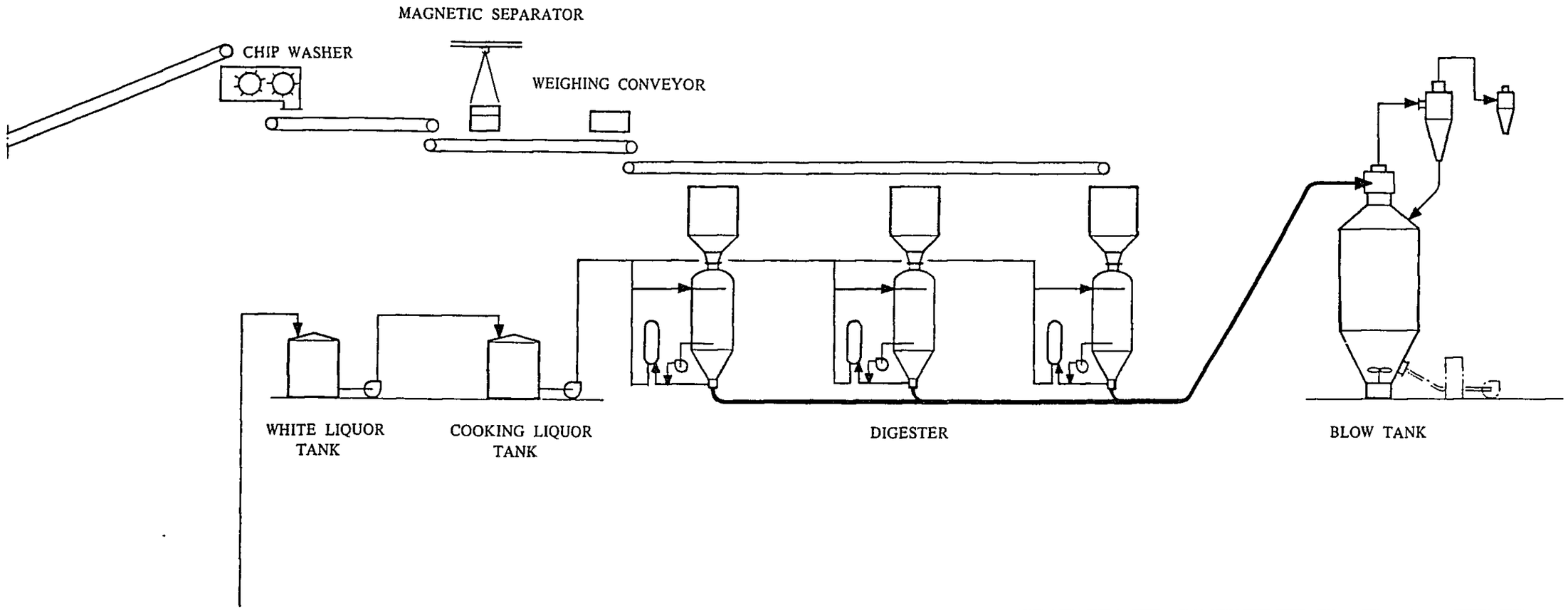
Flow Sheets for Printing/writing Paper Plant

Department	21	Log Handling and Chipping
Department	31	Cooking
Department	32	Brown Stock Washing and Screening
Department	33	Bleaching
Department	41	Stock Preparation
Department	42	Paper Machine and Finishing
Department	50	Auxiliary Plants for Printing/writing Paper Plant



GOVERNMENT OF ECUADOR
PULP & PAPER PLANT
LOG HANDLING & CHIPPING
FLOWSHEET

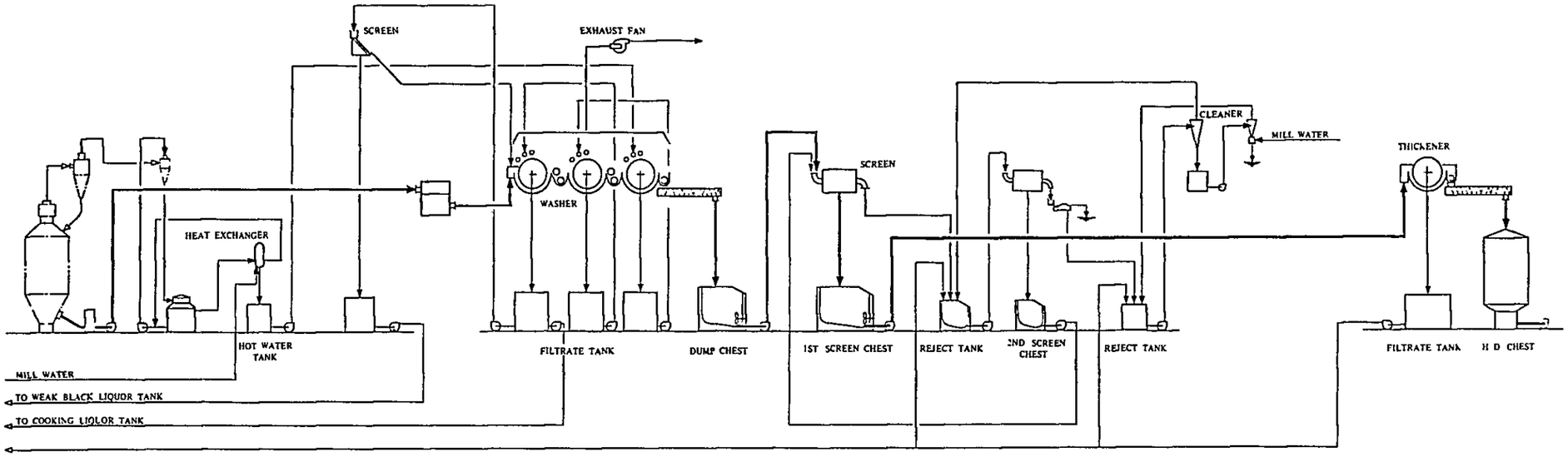
JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR
70T/D PRINTING/WRITING PAPER PLANT
COOKING
FLOWSHEET

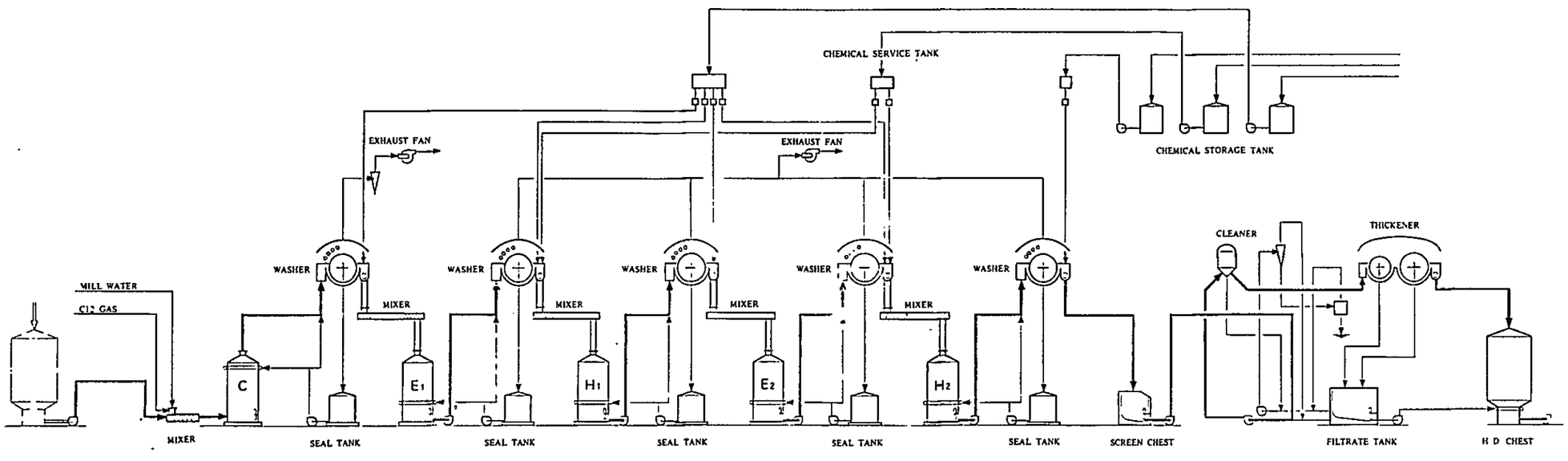
						WORK NO	CLASSIFICATION
						DRAWING NO	
DATE	DRAWN BY	ENG. CHAR	CHIEF	[illegible]	MANAG.		

JAPAN INTERNATIONAL COOPERATION AGENCY



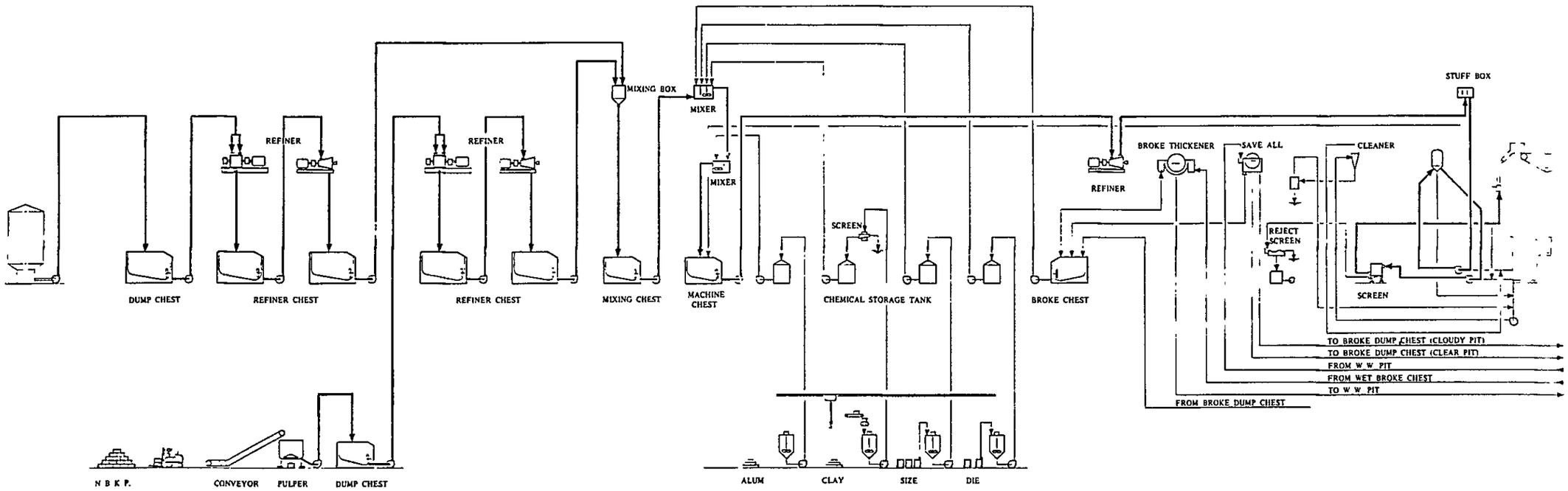
GOVERNMENT OF ECUADOR
70T/D PRINTING/WRITING PAPER PLANT
BROWN STOCK WASHING & SCREENING
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY



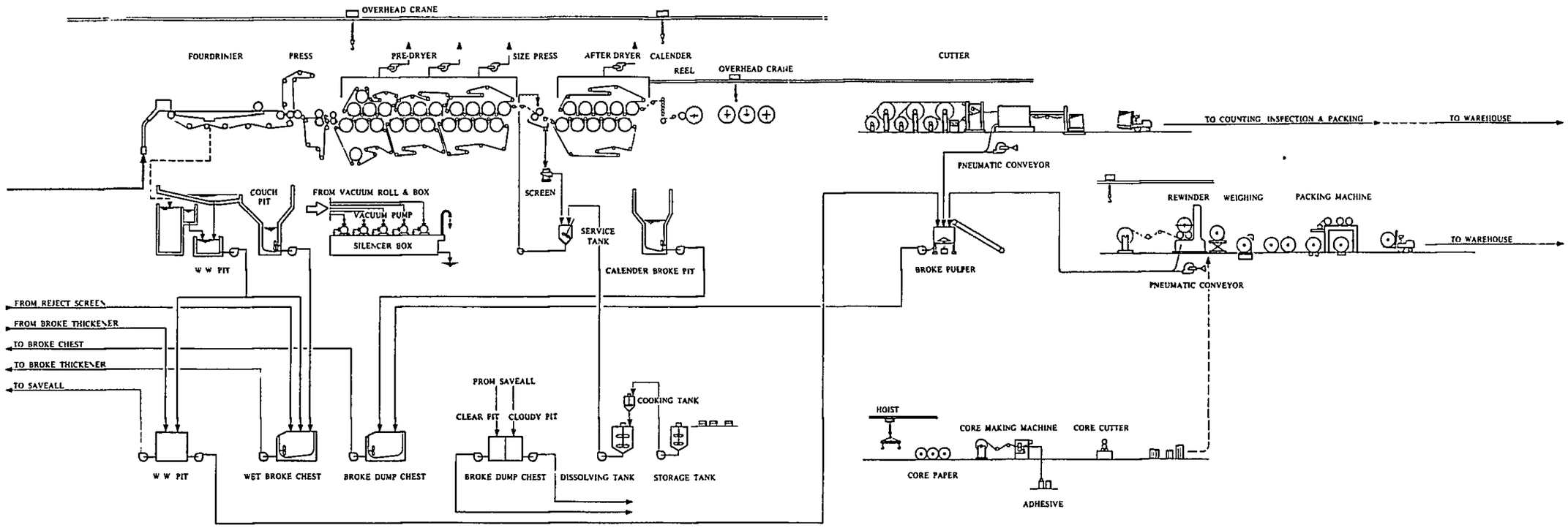
GOVERNMENT OF ECUADOR
70T/D PRINTING/WRITING PAPER PLANT
BLEACHING
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY



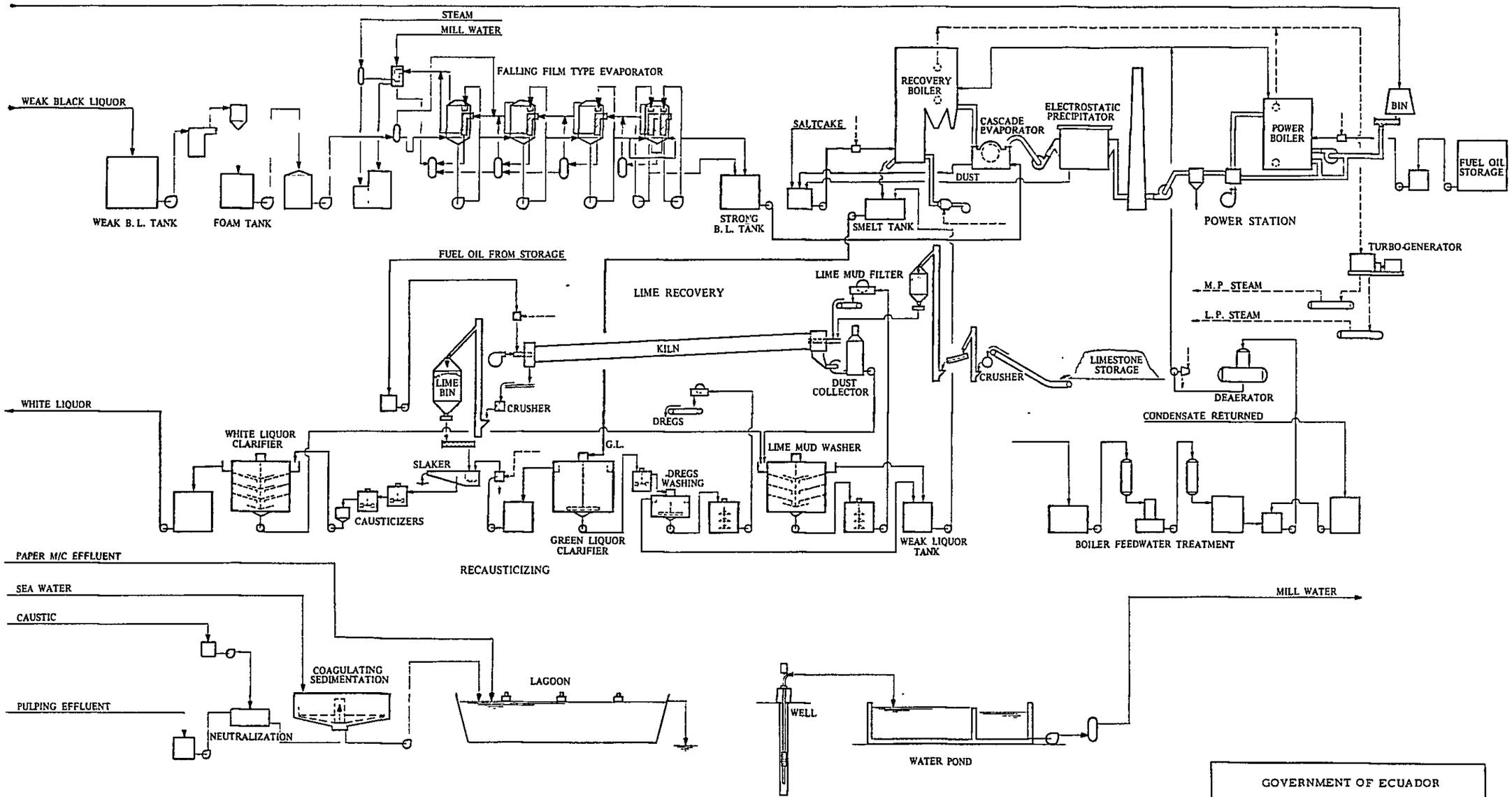
GOVERNMENT OF ECUADOR
70T/D PRINTING/WRITING PAPER PLANT
STOCK PREPARATION
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR
70T/D PRINTING/WRITING PAPER PLANT
PAPER MACHINE & FINISHING
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY



GOVERNMENT OF ECUADOR

70 T/D PRINTING/WRITING PAPER PLANT
AUXILIARY PLANT
FLOWSHEET

JAPAN INTERNATIONAL COOPERATION AGENCY