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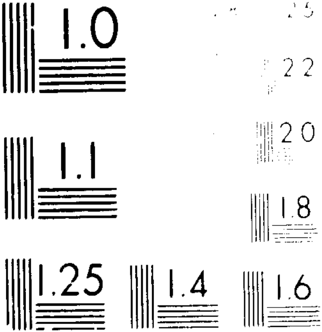
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P.T. Kertas Jatiluhur
Indonesia

PRE-INVESTMENT STUDY FOR A CIGARETTE PAPER MILL IN INDONESIA

PREPARED FOR THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION, VIENNA

Main Report and Annexes

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JAAKKO PÖYRY

K3918
Helsinki, December 1, 1981

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US/RAS/80/216

JAAKKO PÖYRY

Helsinki 1981-12-01

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MILL IN INDONESIA

Preface

The United Nations Industrial Development Organization (UNIDO), Vienna retained Jaakko Pöyry Consulting Oy of Helsinki, Finland (JAAKKO PÖYRY) to perform a pre-investment study of this project, a cigarette and light specialties paper mill in Indonesia, for P.T. Kertas Jatiluhur, Indonesia, using funds donated by the Ministry of Foreign Affairs of Finland.

Tervakoski Oy (TERVAKOSKI), a well-known cigarette and light specialty paper manufacturer in Finland, was retained to act as a technical adviser and to perform the preliminary evaluation of rosella, the tentatively selected main fibrous raw material for cigarette paper manufacture.

One field trip was made. The main purpose of this trip was to investigate cigarette paper markets, raw material, mill sites, costs and prices, and technical aspects of implementation.

The principal project team consisted of Mr. O Karjalainen, Team Leader and Pulp and Paper Specialist; Mr. L Kerkola, Expert in Special Light Papers; Mr. J Setälä, Financial Analyst; Mr. B Ström, Investment Estimates Expert; Mr. M Olkinuora, Market Analyst and Mr. P Niku, Indonesian Pulp and Paper Markets Specialist.

The results of JAAKKO PÖYRY's and TERVAKOSKI's work are presented in this report.

The kind cooperation of Development Bank of Indonesia (Bappindo), other Indonesian Government agencies, UNDP Jakarta, P.T. Kertas Jatiluhur, and all who assisted this study is gratefully acknowledged.

Jaakko Pöyry Consulting Oy

Sten von Troil
President

Olli Karjalainen
Project Manager

Tervakoski Oy

Lauri Kerkola
Technical Manager

LIST OF COMMON ABBREVIATIONS

Abbreviation	Definition
a	annum
ADt	air dry tonne (90 %)
ADt/a	air dry tonne per annum
bar	bar (absolute pressure; 1 bar = 0.1 MPa)
BDt	bone dry tonne
BDt/a	bone dry tonnes per annum
BL	bleached (pulp)
BOD	biological oxygen demand
^{o}C	degrees Celsius
CD	cross direction
COD	chemical oxygen demand
d	day
d/a	days per annum
dm^3/kg	pulp viscosity measured according to SCAN standard
FLI	fibre length index, grammes
FOB	free on board
g	gramme
g/l	grammes per litre
g/m^2	grammes per square metre
h	hour
ha	hectare
in.	inch (= 25.4 mm)
IRR	internal rate of return
J	joule
kg	kilogramme
kg/m^3	kilogrammes per cubic metre
kg/t	kilogrammes per ton
km	kilometre
kN/m	tensile strength, kilonewtons per metre
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
l	litre
l/s	litres per second
m	metre
min	minute
m/min	metres per minute
mm	millimetre
m^2	square metre
m^3	cubic metre
MD	machine (length) direction
mg	milligramme
mS/m	milli Siemens per metre
M	mega
MJ	megajoule
MVA	megavoltampere

Abbreviation	Definition
N	Newton
Pa	Pascal (= N/m^2)
pH	measure of alkalinity/acidity
Pt-Co	standard colour unit solution of platinum and cobalt
ROI	return on investment
Rp	rupies
s	second
S	Siemens
^oSR	freeness, degrees Schopper-Riegler
t	metric tonne - 1000 kg
t/a	metric tonnes per annum
t/d	metric tonnes per day
TSS	total suspended solids
UB	unbleached (pulp)
USD	United States dollar
μ	micro = 10^{-6}
μm/Pa x s	porosity, micrometres per Pascal second
V	volt
Ws/m	specific edge load as watt-seconds per metre
%	percent
% ISO	brightness measured according to ISO standard and expressed as percent

1 INTRODUCTION

1.1 General

P.T. Kertas Jatiluhur, Indonesia (hereafter the CLIENT) is planning to build a cigarette and light specialties paper mill in Indonesia.

Discussions with the CLIENT were held in Jakarta and in Helsinki, Finland, sponsored by the Ministry for Foreign Affairs of Finland and the United Nations Industrial Development Organization, Vienna (hereafter UNIDO). As a result of these discussions a memo of understanding was drawn up between the CLIENT and the Finnish companies Jaakko Pöyry International Oy and Tervakoski Oy (hereafter TERVAKOSKI), a well-known cigarette and specialty paper manufacturer. Terms of reference for a pre-investment study of the CLIENT's paper mill project were also drawn up in June, 1979. The executing agency for this study was determined in autumn 1979 to be UNIDO. Jaakko Pöyry Consulting Oy (hereafter JAAKKO PÖYRY) presented UNIDO with a proposal in December 1979, with TERVAKOSKI as a sub-consultant.

UNIDO awarded the contract for the study to JAAKKO PÖYRY de facto in January 1981.

In March and April, 1981 JAAKKO PÖYRY's team made a field trip to Indonesia to study the project, with the emphasis on markets, raw material, mill site, costs, prices and technical implementation aspects. The trip was successful, to a great extent thanks to the valuable assistance given by P.T. Kertas Jatiluhur.

A sample of the main fibrous raw material, rosella, was obtained in Finland in late June 1981.

Data from the field trip, raw material trials and other aspects of the study have been compiled into this report. The draft of this final report was delivered in October, 1981 and subsequently approved by UNIDO (telex of November 12, 1981).

1.2 Terms of Reference

1.2.1 Purpose

The purpose of this pre-investment study was to assess tentatively whether investment in an integrated pulp and light specialties paper (especially cigarette paper) mill in Indonesia would be feasible, and if it would, to recommend the alternative(s) that would be best for further development.

1.2.2
Objective

The objectives of the study were

- to develop two project concepts, one based on new equipment and one on reconditioned equipment; to compare their viability, to recommend one or both of them for a detailed study and to formulate the scope and programme for such a study
- to prepare a short project presentation for use in preliminary discussions with partners, financing institutions and the Investment Board

1.2.3
Scope

The scope was formulated to fulfil the objectives at a pre-investment study level. It contained all the normal elements of such a study; i.e. studies on

- markets
- raw materials
- mill concept
- mill site with considerations, such as infrastructure and the environment
- project economics
- implementation aspects such as target timetable

2 SUMMARY

2.1 General Approach

One of the terms of reference was changed during the study: the main fibrous raw material is now rosella instead of rami. The reasons for this are mainly that rosella appears to be a technically suitable and more commercially established and cheaper raw material than rami.

Cigarette paper is a high-value product. This means that a small mill can be profitable. A reasonable size was selected mainly with regard to markets, investment and profitability.

Product quality, the environment, local conditions and profitability were all important factors in selection of the technology.

The selected mill size is 3500 t/a. The reasons for selection of the size are explained.

A new mill entering established markets would inevitably face resistance to change. Producing some special paper qualities other than cigarette paper as part of the production is an obvious precaution. The plan for doing this (Alternative 2) is handled in parallel to the plan for producing only cigarette paper (Alternative 1).

The question of the mill site is handled to a depth necessary and possible in a pre-investment study; i.e. from all accounts there is a suitable site available but no committments could be made to firm this up.

Environmental aspects are also discussed.

2.2 Markets

2.2.1 Approach

The sales policy for this small mill is to get a reasonable market share of the higher quality end of thin special papers. This is a realistic approach provided that a capable technical management partner is selected to transfer the necessary know-how in production and sales during the first few years.

The paper qualities considered here are:

- cigarette paper
- tipping paper and plug wrap
- thin printing and writing papers

2.2.2
Cigarette Paper

Cigarette paper supply and demand figures for Indonesia, based on statistics and conservative projections, are given in Table 2-1.

Table 2-1
Cigarette Paper Supply and Demand in Indonesia 1975 - 1990

	1975	1980	1985	1990
		- 1000 tons -		
Demand	6.2	10.6	14.1	17.3
Supply	0.2	3.3	8.3	8.3
NET TRADE	-6.0	-7.3	-5.8	-9.0

The supply projection includes the planned expansion of PN Kertas Padalarang.

According to the net trade, a cigarette paper mill of the size planned by P.T. Kertas Jatiluhur, i.e. 2500 to 3500 t/a, would be very welcome to the Indonesian market any time.

It is likely, however, that the cigarette paper market is conservative. Adequate preparation, advance information and customer contacts at a very early stage are therefore emphasized as an absolute requirement for successful sales.

If the sales efforts meet high resistance, an alternative production programme including other thin special papers should be considered. The markets for these are summarized below.

2.2.3
Tipping Paper and Plug Wrap

The total consumption of tipping paper and plug wrap are preliminarily estimated at 800 tons in the mid 1980s. They are not manufactured in Indonesia.

2.2.4
Thin Printing and Writing Papers

According to the present relatively low usage, and demand growth estimates based on the usage pattern changing slowly, Indonesia would seem to be relatively self-sufficient in thin printing and writing papers for the next few years up to 1985.

Taking into account that the plan is to supply the higher quality thin special papers, it would not seem too difficult for P.T. Kertas Jatiluhur to place a small quantity, say 1000 t/a, on the Indonesian markets in the mid and late 1980s.

2.2.5
Mill Net Prices

The mill net prices for cigarette paper, tipping paper and plug wrap used in this study are based on prices of cigarette paper imported into Jakarta. The present effective import duty of 30 percent has been taken into account.

For thin printing and writing paper the domestic delivered price in Jakarta has been used.

Transport and handling, as well as sales cost and sales taxes, have been taken into account. Note that for imported papers the domestic sales tax has been ignored because it would have had to be first added and then subtracted in calculating a price comparable to imports.

The mill net prices used are as follows:

	USD/ton
Cigarette paper	3 368
Tipping paper	1 781
Plug wrap	2 543
Thin printing and writing paper	1 477

2.2.6
Marketing

The marketing organization and distribution are discussed.

It is again emphasized that thorough preparation and experienced help during the first few years would be an absolute prerequisite for successful sales of the planned special products.

2.3
Raw Materials

The raw materials for cigarette paper manufacture consist of the fibrous portion, filler, starch and impregnants. The fibrous portion in this case would be mainly bleached rosella pulp, with the rest being purchased bleached short-fibre wood pulp. Chalk (calcium carbonate) manufactured at the mill from quicklime (CaO) would be used as filler. Starch and impregnants would be applied according to the technical management partner's know-how.

Rosella is a commercially established fibre in Indonesia. Grade B quality raw fibre is foreseen as the raw material for pulp manufacture at the mill. The price is quoted as Rp 200/kg or about USD 320/ton air-dry fibre. The availability at the time of the mill start-up must be further investigated.

Further testing and trials at commercial scale are recommended to firm up process details and establish the optimum composition for the cigarette paper furnish.

2.4 Proposed Mill

2.4.1 General

The effect of size on mill economics was examined after the preliminary design had been made. It was found that the 3000 t/a production of cigarette paper was too small for the mill to be commercially profitable. A small, acceptable change in the paper furnish and an increase of production to 3500 t/a gave positive results. The preliminary design was therefore adjusted to conform to this production.

The mill was designed so that if the cigarette paper market proved to be more difficult to penetrate than reasonably expected, the mill could produce special paper qualities like tipping base and plug wrap for cigarette manufacture, and also thin printing grades, air mail and manifold paper, etc.

2.4.2 Some Design Features

The mill would produce its own rosella pulp by the soda method (with a small sulphur addition) batch cooking, pre-refining, washing and bleaching. Continuous or partly continuous processing was judged to be too complicated and expensive.

Rosella would be received as rosella fibre (grade B) in bale form. Its storage and handling would therefore be simple and inexpensive. Reservation could be made in the mill site for eventual rosella storage in stalk form and for decortication of the stalks.

The other main fibrous raw material, bleached short-fibre wood pulp, would be purchased and repulped for papermaking.

The main non-fibrous raw material, chalk, would be manufactured to the desired quality from quicklime in the mill.

The solids in the black liquor dissolved in cooking would be recovered in washing the unbleached pulp, and the black liquor evaporated to 55 % solids concentration ready to be taken to a kraft mill for burning and chemical recovery.

In stock preparation purchased pulp and bleached rosella pulp would be handled separately for making cigarette paper (Alternative 1). If other lightweight papers were manufactured (Alternative 2), the rosella stock preparation line could be used for processing one of the possibly two kinds of purchased pulp.

The paper machine would be of a type normally used for making mainly cigarette paper.

Additive systems would be designed so that they could supply the additives required for all the paper grades foreseen.

The finishing department would be designed so that it could handle about one third of the production in sheet form, the rest being in roll form; in the case of cigarette paper these rolls would be rather small, and called bobbins.

The mill would include all the necessary subsystems for the supply of

- water
- steam
- electricity
- compressed air

Steam would be made by burning oil only. Electricity would be purchased.

The mill would also include the following services:

- fire and security control
- office and laboratory
- personnel services
- maintenance
- emergency power
- communications
- some vehicles for transport

Maintenance would be of particular interest. It is rather expensive. The feasibility of providing part of the maintenance by outside contracting, combining the facilities with those of other factories nearby, etc. should be investigated.

2.5 Mill Site and Environmental Aspects

2.5.1 Site Selection

Several areas and sites were preliminarily considered: Jatiluhur, Tangerang near Jakarta, Lampung in south Sumatra and Manado in south Sulawesi. For the purposes of this pre-investment study, Jatiluhur, or to be precise the Cilangkap

Industrial Estate, was selected as the mill site since it seems to possess all the prerequisites for an acceptable mill site to a satisfactory degree.

2.5.2
Jatiluhur, Cilangkap Industrial Estate

There is still enough area available for the mill site, i.e. 11 to 13 ha next the river Citarum.

Soil surveys in the area indicate good soil, which means that the cost of the mill site works and foundations would be moderate.

Land is also likely to be available for the proposed plantations for part of the mill's raw rosella fibre supply, i.e. 600 to 800 hectares.

There is plenty of water in the Citarum river, the largest river in West Java.

Electricity is in principle available because the Jatiluhur dam hydroelectric power station is nearby.

Labour is available, although the availability depends on the season. Most of the personnel must be permanent, trained people. The nearby town, Purwakarta, could provide some of the personnel and accommodate them.

Accessibility to markets and transport connections are good; Jakarta is only 100 - 130 km away. A new toll road from Jakarta to Cicampek would probably be ready before the mill start-up. The railway from Jakarta to Bandung goes th Purwakarta.

The possibility of combining the required maintenance facilities with those for other factories in the area should be investigated.

All these points should be firmed up in discussions mainly with the Jatiluhur Authority as soon as a favourable preliminary investment decision has been made.

2.5.3
Environmental Aspects

Regarding the impact on the social environment, the mill could make only a beneficial contribution because the area is planned for industry.

The proposed process would not create significant air emissions. However, since chlorine would be used as a bleaching chemical, adequate training should be provided for the personnel and normal safety precautions observed to avoid accidental discharges.

The mill is now designed to rather stringent liquid effluent standards, taking into account the small size of the mill and the large size of the recipient, the river Citarum. Whether these standards can be relaxed is a subject to study and discuss with authorities in the next phase.

2.6 Capital Requirements

Estimates of the capital requirements are given in Section 7.1, and the mill investment estimate is given in more detail in Annex IV.

The estimates are constant money estimates (no inflation has been considered) at the third quarter 1981 price level.

The total capital requirement if all the machinery and equipment were new is summarized in Table 2-2.

Table 2-2
Total Capital Requirement

	USD 1000
Fixed investment	33 300
Preoperating expenses	1 000
Working capital	1 900
Interest during construction (interest rate 12 %)	3 555
TOTAL	39 755

The following items are not included

- any land for rosella plantations
- any housing for employees
- a power substation with transformer

because it is not clear that any investment would be required in these items, and if any were required, then the corresponding manufacturing costs would probably be so much lowered that the increased investment would probably be compensated.

The investment in the mill could be reduced, possibly by USD 2.7 to 3.7 million, if suitable secondhand machinery could be located. The possible effect of the use of old machinery on the manufacturing cost can be assessed only when further details of the machinery are known.

The investment in maintenance facilities could also be reduced, possibly by USD 0.7 to 1.5 million, by contracting part of the maintenance outside of the mill. Whether this is possible cannot be said without a fairly detailed investigation, including contract negotiations. How this would affect the total maintenance cost cannot be assessed either now.

2.7 Project Economics

2.7.1 Re-investments, Sales Revenues, Manufacturing Costs and Cash Flows

In addition to the fixed investment and working capital, necessary re-investments, sales revenues and manufacturing costs have been used as a basis for the cash flows, which are presented in Annex V for both Alternatives 1 and 2. Cash flow figures are given for three preoperating years and 15 years of operation.

2.7.2 Commercial Profitability

Only commercial profitability before taxes has been calculated.

Alternative 1

The calculated financial indicators for Alternative 1, in which only cigarette paper would be produced, are as follows:

- internal rate of return (= IRR)	%	14.2
- return on investment (=ROI)	%	17.1
- break-even point production		
- costs covered	t/a	700
- average capital charges covered	t/a	2 910

Alternative 2

Production of paper grades other than cigarette paper in the beginning according to the programme outlined would reduce the internal rate of return, IRR, to 11.2 %.

2.7.3
Sensitivity Analysis

The sensitivity of the internal rate of return to possible changes in sales income and in cost factors has been examined for both Alternatives 1 and 2. The detailed tables are given in Annex V together with the cash flows. The sensitivities are also shown graphically in Section 7.5, Figures 7/2 and 7/3.

The main conclusions are discussed in Section 7.5.

The curves give a convenient way of examining, for example, the effect of secondhand machinery (reduced investment) on the IRR. Care has to be taken that the effect of a possible increase in costs, such as manufacturing costs, is not forgotten.

2.8
Conclusions and Recommendations

2.8.1
Conclusions

A rosella pulp and cigarette paper mill producing 3500 tons of cigarette paper per annum would be profitable; a 3000 t/a mill would not necessarily be profitable.

3500 t/a cigarette paper would find markets in Indonesia. If customers were slow in accepting a new supplier, an alternative production programme (Alternative 2) producing light special papers as part of the product range could be considered for the first few years. These papers would also find markets provided they were at the upper end of quality.

The alternative production programme would give markedly lower profitability than producing cigarette paper alone. Proper planning, preparation and execution of sales is therefore very important.

Rosella is a suitable raw material for cigarette paper. Firming up of process details, finding the optimum furnish and producing advance samples would require a commercial-scale trial.

Although rosella is commercially established in Indonesia, it is by no means clear that its availability would be assured at the time the mill started up. On the other hand, there would be enough time to consider this problem.

Cilangkap Industrial Estate near Jatiluhur dam appears to be a suitable mill site. There are, however, several details concerning it that need looking into and firming up. The Jatiluhur Authority would be the first agency to contact, maybe even before a preliminary investment decision, and certainly after that.

To make a small integrated mill profitable, the pulping side has to be designed as simple as possible. It would not be essentially different even if secondhand machinery were used.

The investment could be reduced somewhat by using secondhand machinery, and also by contracting some maintenance outside the mill, or forming a cooperative maintenance unit with adjacent factories.

The next steps would require the expenditure of increasing amounts of money. P.T. Kertas Jatiluhur should make certain that it has an adequate organization to deal with the necessary decisions, contacts and other tasks, so that the project is not delayed and the money ill spent.

It is clear that P.T. Kertas Jatiluhur needs know-how and technical management assistance from abroad.

It is evident from various meetings that the present Indonesian capability in detailed civil engineering is fully adequate for this size of pulp and paper mill, but that support from abroad would be needed in pulp and paper mill basic civil engineering and in other engineering disciplines (process, mechanical, electrical and instrumentation engineering).

2.8.2 Recommendation

It is recommended that this promising project be considered for implementation.

The Investment Board should be contacted to get clearance that the temporary licence applies to a 3500 t/a mill.

The various activities required next are discussed in Section 5.4, Tentative Time Schedules and presented graphically in drawing K3918-HS-4001.

First an appraisal should be made of the pre-investment report. The appraisal should involve, besides P.T. Kertas Jatiluhur, Bapindo, UNIDO and the Board of Investment. It would also be advisable to contact the Jatiluhur Authority and maybe other Indonesian Government agencies such as the Directorate General for Basic Chemical Industries, the agency responsible for the environment and the Directorate for Horticulture.

Terms of reference for the subsequent events where help is required, for example in studies, should be drawn up and proposals obtained.

The various calculation bases (i.e. rosella, mill site, technical concept, etc.) have been checked only to the extent necessary and possible for a pre-investment study and subsequent preliminary investment decision. It is therefore recommended that a full feasibility study be performed. Such a study is briefly outlined in Annex VI.

Such a study would cover the following study subjects:

- rosella supply
- commercial-scale trials with rosella
- marketing
- mill site and environmental aspects
- preliminary design engineering
- capital requirement
- financial analysis

It is recommended that the following events should proceed during the feasibility study as far as possible:

- clearance with authorities
- clearance of financing
- commercial and legal matters

The feasibility study, combined with the outcome of the above events, would provide sufficient material for a rational go-ahead decision.

2.9 Tentative Time Schedule

It is not possible to give a fixed time schedule for the appraisal which follows the issuance of this report.

A possible time schedule for the recommended feasibility study is discussed in Annex VI.

The target time schedule for the implementation phase is given in drawing K3918-HS-4001. From the final investment decision, also called the go-ahead decision, to the start-up of commercial production, the schedule spans 28 months.

3 MARKETS

3.1 General

The purpose of this market study is to analyse the markets for cigarette paper in Indonesia. The study also includes a brief analysis of thin printing and writing papers, which can be considered as complementary products to fill the capacity, if necessary.

In this market study the following main items have been studied:

- supply and demand trends
- competition
- mill net prices
- a marketing plan

The study is based on official statistics and the results of field surveys in Indonesia.

3.2 Cigarette Paper Supply and Demand

3.2.1 Demand Trends

There are 276 cigarette factories in Indonesia: 263 factories produce kretek (clove) cigarettes and 13 white cigarettes. Their 1980 consumption of cigarette paper is estimated to be 10 600 tons, divided as follows:

	Consumption of cigarette paper in 1980	
	Tons	Percent
Kretek cigarettes	6 900	65
White cigarettes	3 700	[illegible]
TOTAL	10 600	[illegible]
	======	===

In the last five years the consumption of cigarette paper in Indonesia has grown very rapidly, by 11.4 percent a year. Despite anti-smoking campaigns, the demand for cigarette paper is expected to grow by at least 5.0 percent in the 1980s, reaching 17 300 tons in 1990 (Table 3-1).

Table 3-1
Demand for Cigarette Paper in Indonesia 1975 - 1990

Year	Demand, tons	Growth Years	%/year
1975	6 170		
1976	8 110		
1977	8 720	1975 - 80	11.4
1978	9 490		
1979	10 140		
1980	10 600		
1985	14 100	1980 - 90	5.0
1990	17 300		

3.2.2
Supply Trends and Net Trade

In 1980 the production of cigarette paper in Indonesia was 3300 tons. All of it was produced by PN Kertas Padalarang. Imports were about 7300 tons.

PN Kertas Padalarang has plans to expand its production of cigarette paper by 5000 tons in the next few years. However, no decision on this project has been taken. Even if this expansion is realized, there will be a deficit of 5800 tons in 1985, which will grow to 9000 tons in 1990 (Table 3-2, Fig. 3/1).

Table 3-2
Cigarette Paper Supply and Demand in Indonesia
1975 - 1990[1]

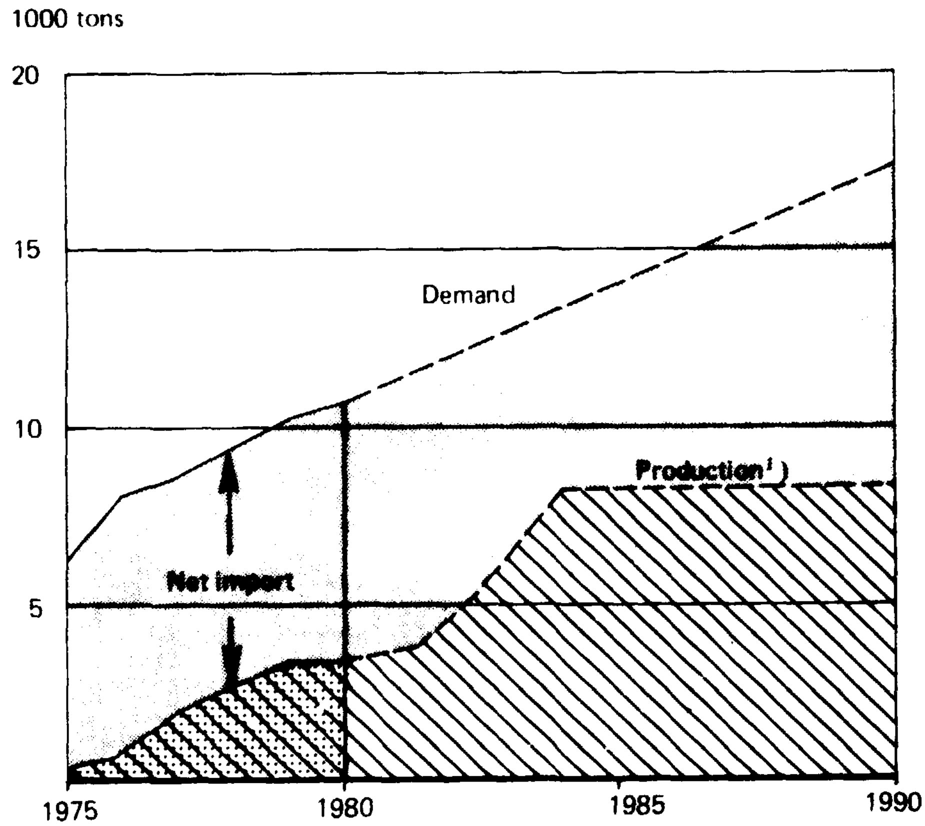
	1975	1980	1985	1990
		- 1000 tons -		
Demand	6.2	10.6	14.1	17.3
Supply	0.2	3.3	8.3[2]	8.3[2]
NET TRADE	-6.0	-7.3	-5.8	-9.0

This net trade development indicates that the cigarette paper mill planned by P.T. Kertas Jatiluhur would be very welcome to the Indonesian market.

1) Based on Directorate General for Basic Chemical Industries (IKD) statistics, import statistics and export statistics of the main countries supplying Indonesia.
2) Including planned expansion by PN Kertas Padalarang only.

Fig. 3/1

DEMAND FOR AND SUPPLY OF CIGARETTE PAPER IN INDONESIA IN 1975–1990



[1]) *Including expansion of Padalarang (5000 t/a, not decided)*

3.3 Competition in Cigarette Paper

There is only one producer of cigarette paper in Indonesia, PN Kertas Padalarang. PT Delitua Delta Paper in Medan used to produce cigarette paper, but for quality reasons it has changed over to making thin printing and writing papers.

PN Kertas Padalarang's mill is integrated with a pulp mill and can produce cigarette paper with three paper machines. Printing and writing papers are produced on the same machines. Paper machine 3 is relatively modern, but the other machines are obsolete (over 50 years old, Table 3-3).

Table 3-3
PN Kertas Padalarang Production Capacity

PM No.	Start-up	Capacity, t/year	Grades	Pulp mill
1	1925	)	) cigarette paper,	Start-up
		) 5 000	) printing and	in 1923,
2	1931	)	) writing paper	capacity 8 000
3	1974/75	2 600	cigarette paper, thin printing and writing papers, manifold	t/year, bl. soda

PN Kertas Padalarang supplies cigarette paper mainly to kretek cigarette factories. Import competition is hardest in cigarette paper for white cigarette factories.

Imports account for about 70 percent of cigarette paper consumption in Indonesia. Major exporters of cigarette paper to Indonesia are France, Japan and Spain. Major companies exporting to Indonesia are Mauduit in France and Miguel y Costas & Miguel in Spain.

3.4 Markets for Thin Printing and Writing Papers

3.4.1 Product Description

The potentially interesting thin printing and writing papers (less than 50 g/m^2) for P.T. Kertas Jatiluhur as complementary products to cigarette paper include the following grades:

1 Thin printing papers
   - bible paper
   - other thin printing papers

2 Thin writing papers
   - manifold
   - air mail, etc.

3 Base papers for copy papers
   - carbon copy paper
   - carbonless copy paper

The end uses and main characteristics of the above grades are listed in Table 3-4.

3.4.2 Demand Trends

In 1980 the consumption of thin printing and writing papers in Indonesia was estimated to be 5420 tons, which is about 5 percent of the total consumption of printing and writing papers in the country.

The main reasons for the relatively low usage of thin printing and writing papers in Indonesia are:

- Most Indonesian printers are not used to printing on thin printing paper. They have also had problems with humidity in these grades.

- There is very little converting of carbon or carbonless copy papers in Indonesia, so they are imported as converted products.

In the 1980s the demand for carbonless copy paper is expected to grow very rapidly in Indonesia. It will be increasingly used as a substitute for carbon copy papers in continuous forms and form sets. The demand for other printing and writing papers is expected to grow quite steadily (Table 3-5).

Table 3-5
Estimated Demand for Thin Printing and Writing Papers in Indonesia 1980 - 1990

Grade	1980	1985	1990	Growth 1980 - 90
		- tons -		- %/year -
Thin printing papers	1 800	2 600	3 700	7.5
Thin writing papers[1]	2 200	3 100	4 000	6.2
Carbon copy papers	800	1 050	1 300	5.0
Carbonless copy papers[1]	620	1 100	2 010	12.5
TOTAL	5 420	7 850	11 010	7.3

1) Including imports of converted products.

Table 3-4
Main Characteristics of Thin Printing and Writing Papers

Grade	Grammage, g/m^2	End uses
Thin Printing Papers		
Bible paper	20...50	Used in printing books with many pages like bibles and dictionaries
Other thin printing papers	20...60	Used in printing books (dictionaries, directories, etc.) and air mail editions of certain magazines/newspapers
Thin Writing Papers	20...40	Used for air mail letters, copies, order books, computer print-outs, generally interleaved with carbon paper
Base Papers for Copy Papers		
Carbon copy base	15...30	Used for manufacturing carbon copy papers (one-time or multiple-use), which are used in copy sets etc.
Carbonless copy base	40...60	Used for manufacturing carbonless copy papers, which are used in continuous stationary, form sets, etc.

1) sa = sulphate (kraft) pulp
2) si = sulphite pulp

Main characteristics	Furnish
Small thickness, good opacity and formation, good runnability	Furnish sometimes contains rag pulp, but can be bleached wood pulp only. Filler content 10...30 %, TiO_2 often added
As above, not to same extent	As above, but generally only bleached wood pulp is used
Good writing surface, usually written on one side only and thus opacity requirements are not as high as in thin printing papers	Bleached chemical pulp. Filler content 0...10 %, TiO_2 often added
One-time carbon: thin, non-porous, uniform and quite strong Multiple-use carbon: same as above, but very resilient	One-time carbon: unbleached sa[1)] or si[2)] Multiple-use carbon: rag pulp, unbleached sa or si
Good opacity and formation, uniform, quite strong, certain special requirements depending on converting method	Bleached wood pulp, filler content 20...30 %

3.4.3
Supply Trends and Net Trade

The demand for thin printing and writing papers is mainly covered by domestic production. Only copy papers and certain special grades are currently imported.

Major producers of thin printing and writing papers in Indonesia are:

Company	Total capacity, t/year	Grades
P.T. Pindo Deli Pulp & Paper Mills, Krawang, West Java	7 800	Thin printing and writing papers, manifold, also heavier substances
P.N. Kertas Padalarang, West Java	7 600	Cigarette paper, thin papers, manifold
P.T. Delitua Delta Paper Mill, Medan, North Sumatra	1 500	Thin printing and writing papers

No radical changes are expected in the thin printing and writing paper supply situation in Indonesia in the next few years. Perum Kertas Basuki Rachmat in Banjuwangi has plans for a new paper machine for thin papers (7000 tons/year, mainly glassine, pergamine, etc.). However, no decision on this project has yet been taken.

Indonesia is expected to be relatively self-sufficient in thin printing and writing papers in the next few years. However, it would not be very difficult for P.T. Kertas Jatiluhur to place some thin printing and writing paper on the Indonesian markets in the mid and late 1980s.

3.5
Mill Net Prices

The mill net prices for cigarette paper to be used in this study are based on prices of cigarette paper imported into Jakarta. For thin printing and writing paper, the domestic delivered price in Jakarta has been used.

The following specifications have been used in the calculation of the mill net prices:

Grade	Substance, g/m^2	Dimensions
Cigarette paper	22	bobbins 27 mm x 6000 m
"	24	sheets 20" x 30"
Tipping paper	27	bobbins 40 mm x 3000 m
Plug wrap	23	bobbins 27 mm x 6000 m
Thin printing	20...40	average for sheets

The mill net prices for the alternative products are shown in Table 3-6.

Table 3-6
Mill Net Prices for P.T. Kertas Jatiluhur
(September 1981)

	Cigarette paper	Tipping paper	Plug wrap	Thin printing & writing
		- USD/ton -		
C & F Jakarta	2 650	1 400	2 000	
Transport/handling	13	13	13	
Import duty (30 %)	795	420	600	
Delivered	3 458	1 833	2 613	1 650
Sales costs (3 %)	-80	-42	-60	-50
Transport	-10	-10	-10	-10
Subtotal	3 368	1 781	2 543	1 590
Taxes (7 %)				-113
MILL NET	3 368	1 781	2 543	1 477

3.6 Marketing Plan

3.6.1 Basic Assumptions

This preliminary marketing plan is based on the following basic assumptions:

- The production of P.T. Kertas Jatiluhur is expected to be sold on the domestic market in both alternatives, which is realistic considering the supply and demand situation in Indonesia.

- P.T. Kertas Jatiluhur is expected to be competitive in both quality and price compared with both P.N. Kertas Padalarang and imports.

3.6.2 Product Mix

The following production programmes are planned for P.T. Kertas Jatiluhur:

Grade	Alternative 1			Alternative 2			
	Years after start-up			Years after start-up			
	1	2	3 etc.	1	2	3	7 etc.
	- tons/year -						
Cigarette paper	2 450	3 150	3 500	1 225	1 575	2 100 [1]	3 500
Tipping paper				245	315	280 [2]	
Plug wrap				245	315	280 [2]	
Thin printing				367	472	420 [2]	
Thin writing				368	473	420 [2]	
TOTAL	2 450	3 150	3 500	2 450	3 150	3 500	3 500

In Alternative 1 only cigarette paper would be produced. In Alternative 2 both cigarette paper and complementary products would be produced during the first 6 years of operation.

The company should concentrate on the higher quality end in all paper grades, especially in the white cigarette sector, so as to be competitive against the domestic and import competition.

3.6.3 Market Structure

Most of the 276 cigarette factories in Indonesia are in Java. About 90 % of the kretek cigarettes are produced in Kudus, Surabaya/Kediri and Malang. The biggest kretek cigarette factories are:

- P.T. Gudang Garam, Kediri
- P.T. Djarum, Kudus
- P.T. Bentoel, Malang

Most of the white cigarettes are produced in Jakarta. The biggest white cigarette producers are:

- British American Tobacco (BAT)
- STTC
- Faroka
- AIT

Most of thin printing and writing papers are consumed in Jakarta, Surabaya, Semarang and Bandung.

---

1) Years 4 to 6: gradual growth towards 3500 t/a.
2) Years 4 to 6: gradual decline towards zero.

3.6.4 Marketing Organization and Distribution

The combined main and sales office should be established in Jakarta, where most white cigarettes are produced. The white and kretek cigarette associations are in Jakarta.

To ensure uninterrupted and flexible supplies to kretek cigarette factories, most of which are in Central and East Java, the possibility of establishing a combined warehouse and sales office in Central/East Java should be studied.

Trucks should be used for most distribution, as they are cheaper and more flexible than rail transport.

3.6.5 Launching Stage

The potential customers of P.T. Kertas Jatiluhur should be informed of the project as soon as an investment decision has been taken, and all possible details of the mill's product range, capacity and timing should be distributed.

The marketing organization should be established as soon as possible after the investment decision. Preliminary customer negotiations should be started about two years before the scheduled start-up. These should be continued and intensified nearer start-up to reach agreements on annual sales volumes.

It would be a definite asset if cigarette paper samples were available in both roll (bobbin) and sheet form to back up the negotiations. The samples should be made at commercial scale from the intended raw materials, mainly rosella pulp as the main fibrous raw material, and they should conform to the normal quality specifications (i.e. Tercig H4).

A cigarette paper sales expert should be employed. This could conveniently be done within a technical management partner agreement, which would cover the first few years.

Depending on the competitive situation and prevailing supply and demand balance at the time of the start-up, an introductory discount might have to be given during the first few months of production.

4 PAPER RAW MATERIALS

4.1 General

The furnish components for cigarette paper and for other light specialty papers are described in detail in Section 5.2, Main Design Data. The raw materials for cigarette paper

- rosella fibre,
- purchased pulp,
- chalk and
- additives

are discussed below.

4.2 Rosella Fibre

4.2.1 Tentative Selection of Rosella

In normal cigarette paper furnishes the major fibre portion is from plants like flax, hemp, etc.

For the P.T. Kertas Jatiluhur mill rami was suggested as a source of fibre. Tests with a small sample showed promise. During the field trip it was soon established that the raw rami fibre was too expensive; it was quoted at USD 1/kg or Rp 630/kg.

Rami is a demanding plant with regard to quality of soil, elevation of the plantation and amount of fertilizing. There are no mills using rami where fibres not suitable for the primary production but still maybe suitable for pulp manufacture would have been available. There is no significant local cultivation of rami now, only 3 trial plantations with a total area of 100 ha only. The conclusion was that rami was not a feasible raw material.

Bapindo suggested rosella (Hibiscus sabdariffa var. altissima LIN). Rosella is commercially established in Java. There are 20 000 ha of plantations in Central and East Java for rosella, kenaf and jute. The exact share of the rosella plantations is not clear, but there are close to 4000 ha of rosella plantations alone for the government-owned sack factory in Semarang (Perkebunan Tanaman).

Rosella is a tall, vigorous, practically unbranched plant, 3 to 5 metres high, grown for fibre. In Indonesia there are 52 varieties of rosella, Hibiscus sabdariffa var. altissima LIN. The best today is designated as HS 40. The yield of raw fibre is up to 3 t/ha in a year, calculated as air-dry (approx. 90 %) raw fibre.

Rosella is not as demanding as rami (or flax) with regard to soil, elevation or fertilizing. It is normally planted in August or September and harvested for fibre in April or May.

The harvesting is done by hand. The stalks are steeped in water for 15 days. This phase, also called retting, allows the bark which contains the fibres to be subsequently separated by hand from the rest of the stalk.

Instead of retting the bark fibre could be separated mechanically by what is called decortication. Decortication is a dry process.

Three qualities of hand-harvested, retted and hand-separated raw rosella fibre are sold:

Grade	Price, Rp/kg air dry
A (best)	220
B	200
C (least good)	165

From the appearance of the fibres, it was judged that the grade "B" would suffice as a raw material for rosella pulp.

Samples of rosella stalks and all the three grades, concentrating on grade B (90 kg), were sent to Finland for analysis and preliminary pilot-type trials.

4.2.2 Trials and Results

The analysis and pilot-type trials were conducted at the Tervakoski Oy laboratories and pilot paper machine in Finland. The work and results are explained in Annex II, "Pulping and Papermaking Properties of Indonesian Rosella (Hibiscus sab..riffa) for Cigarette Paper Manufacture". The summary is as follows:

> The suitability of rosella (Hibiscus sabdariffa, var. altissima) fibre for pulping, bleaching and papermaking was studied at laboratory and pilot-plant scale. The tests were carried out at the Tervakoski Oy mill, a well-known cigarette paper manufacturer.
>
> Chemical analysis revealed that the rosella grade B fibre would be a suitable raw material for pulping. The high Kappa number, a measure of lignin content, and fairly high ash content indicated that an adequate alkali charge in cooking and sufficient refining before bleaching would be required for successful pulping.
>
> It is probable that the manufacture of grade B rosella fibre has included retting and manual stripping. If, instead, the

fibre were separated from the stalks mechanically (i.e. decorticated, without retting the stalks first), the resultant fibre would have a much higher hot water solubility and ash content. This would result in a higher alkali demand in cooking and could also cause difficulties in black liquor evaporation.

Laboratory-scale pulping tests of grade B rosella fibre indicated that an alkali charge of 17.5 % NaOH on raw fibre would be sufficient in combination with a maximum temperature of 160 °C and a 2 hours reaction time at the maximum temperature. The unbleached pulp viscosity was above 1000 dm^3/kg and the Kappa number 10 to 15. These are good figures for successful bleaching. The pulping yield in laboratory cooks indicates that the yield of commercial-scale bleached pulp would be 50 to 55 %.

Pulp bleaching was carried out in three stages: chlorination, alkaline extraction and hypochlorite. The results show that the target brightness of 70...75 % ISO can be obtained with an active chlorine charge of 3 % of pulp in chlorination and 1 % in the hypochlorite stage. The viscosity can be maintained at the desired level. It is necessary to reduce the ash content of the cooked pulp before bleaching to reach the desired brightness.

Refining of rosella pulp the desired way, with the equipment available at Tervakoski, can be done only at commercial scale. The pilot-plant beater with its low edge load typically results in inadequate formation on the paper machine. Therefore the results of the pilot-plant tests must be compared with previous pilot-plant tests and corresponding trials at commercial scale.

In this case, the fibre furnish, 80 % rosella fibre plus 20 % bleached birch pulp with chalk as a filler, gave a quality of paper on the pilot paper machine from which it can be predicted with fair confidence that the target quality of Tercig H4 can be obtained at commercial scale.

This prediction is based on experience from previous pilot-plant and corresponding commercial-scale trials at Tervakoski Oy's mill with flax (Linum usitatissimum), hemp (Cannabis sativa) and kenaf (Hibiscus cannabinus).

Porosity and sheet formation could be improved by adding more short-fibre pulp in the furnish. Without commercial-scale trials it is difficult to predict the maximum amount of short fibre that it would still be safe to use from the point of view of strength. What can be said with confidence is that up to 30...35 % could be added as short fibre.

4.2.3 Application of the Trial Results to This Study

The rosella would be received at the mill in bales made of "hands" consisting of grade B rosella fibre, after hand harvesting, retting by steeping in water, hand separation of fibrous bark and subsequent handling. This was judged to be appropriate technology for the region. Later on mechanical decortication might be considered if required.

It was tentatively assumed that 1350 air-dry tons per annum, half of the required fibre, would be available from the markets and that the other half, 1350 air-dry tons, could be obtained from plantations around the Jatiluhur reservoir, in the vicinity of the proposed mill site.

The average price at the mill was assumed to be Rp 200/kg.

The processing at the mill would be done according to the conclusions from the trials.

The portion of bleached rosella pulp in the cigarette paper fibre furnish would be 70 %, the rest would be purchased bleached short-fibre sulphate (kraft) pulp.

4.2.4 Recommendation for Further Investigation

Although the rosella fibre has a market price, the actual availability should be established t r the time when the mill would start up. This would necessitate discussions with the authorities concerned and with the present users and planters, especially the Directorate General of Horticulture and Perkebunan Tanaman, the sack paper factory in Semarang. The Jatiluhur Authority and private land owners around the Jatiluhur reservoir should also be contacted to explore the possibilities of growing rosella there, whether by the mill or by the farmers or both.

Trials in making bleached pulp and cigarette paper from rosella at commercial scale should also be made. These trials would be required to firm up some processing details and to establish the optimum composition of the cigarette paper furnish.

4.3 Purchased Pulp

Some 20 to 40 % of the cigarette paper fibre furnish would be bleached short-fibre sulphate wood pulp made from eucalyptus, birch, etc.

In the case of light specialty papers for printing and writing, no rosella pulp would be used. All pulp would be purchased bleached pulp, either from long-fibre or short-fibre wood.

All these pulps must be imported into Indonesia. They are, however, readily available. Prices used in this study conform to pricing in Indonesia today.

4.4 Chalk

The cigarette paper furnish contains 20 to 35 % of filler chalk, calcium carbonate. It is best made at the mill in order to obtain the desired quality, which is very important. Commercial quicklime, calcium oxide (CaO), which is readily available in Indonesia, is the raw material. Know-how for making the chalk at the mill is available.

4.5 Additives

Starch and various impregnants are used in sizing and impregnation of the cigarette paper to obtain the desired burning and other characteristics.

The exact composition and application of the additives are part of the know-how that the mill must acquire, preferably through a technical management partner contract.

The pricing of the additives in this study has a realistic basis from other applications.

5 MILL DESCRIPTION

5.1 General

The mill would basically be designed to produce cigarette paper conforming to the quality designation Tercig H4. To assess the effect of possible market limitations on profitability, a technically feasible alternative production programme has also been considered. The annual productions would be as follows:

Alternative 1 = Main Alternative		
- cigarette paper, 22...23 g/m^2	3 500 t/a	
Alternative 2		
- cigarette paper, 22...23 g/m^2	)	
- tipping base, 27...40 g/m^2	)	varying
- plug wrap, 23...27 g/m^2	)	proportions
- thin printing, 20...50 g/m^2	)	
- manifold, air mail, etc., 20...30 g/m^2	)	
Total	3 500 t/a	

The mill would be designed so that it could achieve both of these programmes.

The amount of cigarette paper in Alternative 2 would in the beginning be only 50 % of the total production. It would rise gradually and be 100 % in the seventh operating year. The rest of the production during the first 6 years would be divided between tipping base, plug wrap, thin printing and manifold paper, etc. in the ratio of 2 : 2 : 3 : 3 respectively.

This chapter contains:

- main design data with lists of areas, main subsystems, design criteria and design capacities

- energy balances

- tentative time schedules

The mill is outlined in drawing K3918-HM-1002, Function Diagram.

A brief discussion of environmental aspects is given in Section 6.6.

Manning and the consumptions of raw materials, chemicals and energy are summarized in Section 7.3, Manufacturing Costs.

5.2
Main Design Data

5.2.1
Mill Areas and Common Design

Mill Areas

- rosella storage and handling
- rosella pulping
- bleaching
- purchased pulp handling
- paper mill
- evaporation
- chemicals and additives preparation
- other mill areas

Common Design Criteria, Alternative 1

Cigarette paper	t/a	3 500

The main furnish components used in cigarette paper manufacture are to be bleached rosella pulp and bleached hardwood kraft pulp. The proportions in the finished product and the consumptions per net ton of paper are listed in Table 5-1.

Table 5-1
Cigarette Paper Furnish Components

		Paper	Calculated from total furnish		Calculated from fibre component	
			Filler $CaCO_3$ (= chalk)	Fibre	Rosella pulp	Wood pulp
Proportions						
- maximum	%		35	75	80	40
- average	%		30	70	70	30
Bone-dry content[1]	%	96	90	90	90	90
Losses	%		5	0.5	0.5	0.5
Consumptions[2]						
- maximum	kg/t		393	804	643	322
- average	kg/t	1000[3]	336	750	525	225

1) For calculation purposes
2) Taking into account proportion, losses and bone-dry content
3) Net without packing

Average annual consumptions of major furnish components (including raw material losses) would be:

- filler $CaCO_3$ (chalk)	t/a	1 180
- bleached rosella pulp	ADt/a	1 840
"	BDt/a	1 650
Note: this corresponds to unbleached rosella pulp	BDt/a	1 700
- bleached hardwood pulp	ADt/a	790

Several chemicals in addition to the main furnish components would be used for size press impregnation and surface sizing, and as furnish additives. Their consumptions can be summarized as follows:

	kg per t of paper	t/a
Starch	90	315
Impregnants	70	245

Common Design Criteria, Alternative 2

Total annual production	t/a	3 500

The main furnish components and additives for average compositions are summarized in Table 5-2.

Table 5-2
Major Furnish Components and Additives for Alternative 2

	Bone-dry content, %	Specific consumptions in average conditions for				
		Cigarette paper	Tipping base	Plug wrap	Thin printing	Manifold etc.
		- kg/net ton of paper -				
Bleached rosella pulp	90	525	-	-	-	-
Bleached softwood kraft pulp	90	-	460	430	640	800
Bleached hardwood kraft pulp	90	225	460	430	160	210
Chalk, $CaCO_3$	90	336	150	215	220	60
Titanium dioxide, TiO_2		-	8	-	50	-
Starch		90	75	-	-	-
Surface sizing		-	-	37	30	20
Impregnants		70	-	-	-	-
Colouring		-	37	-	-	-

Time	- annual days	d/a	365
	- public holidays (5 out of 10; in three periods)	d/a	-5
	- annual holidays	d/a	-15
	- scheduled repairs	d/a	-5
	- unscheduled shutdowns	d/a	-10
	Available operating time	d/a	330

5.2.2
Rosella Storage and Handling Design Data

Rosella storage and handling would consists of

- rosella bark fibre reception, including weighing
- storage
- cutting
- feeding to digester

Design Criteria

Annual amount of Grade B rosella bark fibre as received	ADt/a	3 700
Moisture content	%	10
Basic density of rosella in storage	kg AD/m^3	80
Storage losses	%	3
Net rosella to digester	BDt/a	3 230
Operating time		
- rosella reception		
- weekly	d/week	5
- daily, net	h/d	12
- annual	weeks/a	47
- cutting and feed to digester		
- annual	d/a	330
- weekly	d/week	7
- daily, gross	h/d	24
- daily net	h/d	18
Cutting length	mm	10...30

Design Figures

Reception, weighing and conveyance to storage		
- rosella received		
- daily average	ADt/d	15.7
- hourly design	.Dt/h	4
- bale scales	number	2
- pallet truck		
- pallets		

Rosella storage		
- storage capacity		
- time	months	2
- amount	ADt	600
- packing (with pallets)	kg AD/m^3	60
- storage shed		
- volume, net	m^3	10 000
- average height	m	5
- area	m^2	2 500
Rosella retrieval from storage, and feed to cutting		
- rosella retrieved (before losses)		
- daily average	ADt/d	11.2
- hourly design	ADt/h	2.2
- pallet truck		
- electric hoist		
- scales	number	2
Rosella cutting and feed to digester		
- rosella to digester (net of losses)		
- daily average	ADt/d	10.9
"	BDt/d	9.8
- hourly design	BDt/h	1.8
- feed conveyor from scales to cutters		
- number		2
- cutters	number	2
- feed chutes	number	2
- reversible conveyor		

5.2.3
Rosella F. .g Design Data

The rosella pulping system would consist of

- the rosella feed described in the previous section
- rotating batch digesters with auxiliaries
- a liquor feed arrangement for caustic soda and filling liquor
- a pressure relief arrangement with spray condenser
- a digester washing arrangement
- a feed conveyor
- hollanders for defibration, pre-refining and final washing
- an unbleached pulp storage chest

Design Criteria

Rosella to digester	BDt/a	3 230
Cooking yield (on Grade B)	%	54

Washing losses (sand etc.) on pulp	%	2
Annual production as unbleached pulp	BDt/a	1 710
Available operating time	d/a	330
Daily averages		
- rosella to digester	BDt/d	9.80
- pulp from final washing	BDt/d	5.17
Unbleached pulp needed for maximum proportion of rosella pulp in paper	BDt/d	6.3
Degree of rosella filling	kg BD/m^3	105
Alkali charge on rosella fibre		
- total as 100 % NaOH	%	17.5
- supplied by filling black liquor	%	2.5
- caustic soda	%	15.0
Sulphur charge on rosella fibre	%	1.0
Liquor-to-rosella ratio before cooking		5 : 1
Maximum temperature	^oC	160
Steam demand on unbleached pulp	t/BDt	1.7

Cooking and Digester Washing Sequence

Filling		
- rosella		
- liquor		
- packing by rotation		
- filling		
- pre-heating 70°C to 160°C		
- cooking at 160°C		
- pressure relief and drainage		
- washing with hot water		
- discharge		
Total time	h	14...15
Water used in digester washing, on unbleached pulp	m^3/BDt	8
Water used in hollander washing, on unbleached pulp	m^3/ADt	300

Design Figures

Steam pressure	bar (abs.)	8.0
Rotating spherical batch digesters		
- number		2
- volume of each, net	m^3	40
- digester discharge, as unbleached pulp	BDt	2.23
Measuring and feeding tanks for caustic soda and filling liquor		
- caustic soda measuring tank		
- filling liquor tank		
Pressure relief arrangement		
- blow liquor tank		
- spray condenser		
- hot water tank		
Digester washing arrangement		
- wash liquor tank		
- supply of compressed air		
Feed conveyor		
Hollanders for defibration, pre-refining and final washing equipped with washing drums and sand traps		
- number		2
- charge at 3...3.5 % cons.	BDt	0.45
- total available time pe charge	h	2.8
Unbleached pulp storage chest	m^3	75

5.2.4 Bleaching

The bleaching system would consist of:

- a batch bleaching plant with 3 stages: chlorination, neutralization and hypochlorite (C, E - H -)

- bleached rosella pulp storage

Design Criteria

Annual amount of unbleached rosella pulp	BDt/a	1 700
Bleaching losses	%	3
Annual production of bleached rosella pulp	BDt/a	1 650

Available operating time	d/a	330
Daily average bleached pulp	BDt/d	5.0
Unbleached Kappa number 10 to 15; assume		12
Brightness target	ISO %	70

Chemicals consumption on bleached pulp

- chlorine, Cl_2, in chlorination stage	kg/BDt	30
- caustic, NaOH, in neutralizing	kg/BDt	15
- chlorine for hypochlorite	kg/BDt	10
- caustic, NaOH, for hypochlorite	kg/BDt	12

Conditions in bleaching stages:

Stage	Time, h	Consistency, %	Temperature, °C
Chlorination	1	3...3.5	25...30
Neutralization	0.5	3...3.5	25...30
Hypochlorite	3	5...7	40

One digester batch bleached at one time

Washing after both neutralization and hypochlorite stages done in the same filter

Bleached rosella pulp storage

- consistency	%	12
- time	h	24

Design C, E - H -

Design capacity of bleach plant, bleached pulp	BDt/d	7.4

Chlorination and neutralization tower
- volume m^3 75
- equipped with
  - chlorine feed
  - caustic feed
  - circulation pump

Belt washer with vacuum pump

Hypochlorite tower
- volume m^3 50
- equipped with
  - hypochlorite feed
  - circulation pump
  - dilution arrangement

Bleached rosella pulp storage tower		
- volume	m^3	100
- equipped with dilution arrangement		

5.2.5
Purchased Pulp Storage and Handling Design Data

Purchased pulp storage and handling would consist of:

- pulp reception in bale form
- bale storage
- repulping

Design Criteria

Normal conditions with own pulp mill in operation		
- purchased wood pulp	ADt/a	790
- feed, on average	ADt/d	2.4
- feed, maximum	ADt/d	3.4

Storage and repulping are designed so that if need be all pulp could be purchased and handled.

Design Figures

Storage		
- normal conditions		
- storage time	months	3
- storage factor used	ADt/m^2	2.0
- storage area	m^2	108
Repulping		
- batch volume	m^3	7.5
- filling	ADt	0.3

5.2.6
Paper Mill Design Data

The paper mill would consist of:

- separate stock preparation for rosella pulp and purchased pulp
- a paper machine with auxiliaries including broke and white water systems
- finishing and packing
- paper storage

Design Criteria

Alternative 1 (Dominant)

Cigarette paper	t/a	3 500
- basis weight range	g/m^2	22...23
- average basis weight	g/m^2	22.5
- bobbin width	mm	27
- probable sheet size	in. x in.	20 x 30
"	mm x mm	508 x 762
- production of rolls/sheets	%/%	67/33

Alternative 2 (Less Important)

Cigarette paper	)
Tipping base paper	) varying
Plug wrap	) proportions
Thin printing	)
Manifold, air mail, etc.	)

Total	t/a	3 500
- basis weight range	g/m^2	20...50
- average basis weight for papers other than cigarette paper	g/m^2	30
- production of rolls/sheets	%/%	70/30

Design Figures

		Alt. 1	Alt. 2 (other than cigarette paper)
Trim at pope reel	mm	2 600	
Winder, maximum trim	mm	2 540	
Bobbin cutters, maximum trim	mm	1 250	
Speed range of paper machine	m/min	50...250	
Construction speed	m/min	300	
Average basis weight	g/m^2	22.5	30
Maximum speed at the above basis weight	m/min	165	134
Instantaneous design production at reel	t/d	14.0	15.0

		Alt. 1	Alt. 2 (other than cigarette paper)
Total available time	d/a	330	
Efficiencies			
- time efficiency		0.90	0.86
- yield (broke)		0.84	0.82
- total average efficiency		0.76	0.71
Average production, finished, net, unpacked	t/d	10.6	
Stock preparation for wood pulp			
- refiner			
- pumping and storage tanks		number	3
Stock preparation for rosella pulp (in case of Alt. 2 also used for wood pulp)			
- refiners		number	2
- broke deflaker			
- broke filter			
- calender pulper			
- disk filter for fibre recovery			
- pumping, storage, mixing, machine and warm water tanks		number	8
Paper machine equipment			
- general			
- crane			
- sealing water system			
- steam supply			
- sprinkler system			
- ventilation			
- heat exchanger			
- short circulation			
- refiners		number	2
- cleaner system, 2 stages			
- pressure screen			
- deflaker			
- wire pit			
- white water system			
- screen for shower water			
- tanks		number	2
- couch pit			
- paper machine with			
- head box			
- wire section including dandy roll			
- press section including pick-up, two presses and marking press			

- pre-dryer section with 8 cylinders
- impregnation press
- after-dryer section with 4 cylinders
- machine calender
- reel
- auxiliary systems
- open hood
- air heating and pocket ventilation system

Filler and additives design is discussed under "Chemicals and Additives Preparation".

Finishing design		
- winder		
- maximum width of the web	mm	2 600
- design speed, about	m/min	700
- bobbin slitters		
- trimmed width	mm	1 250
- number		2
- design speed, about	m/min	400
- sheeting with reel and guillotine		
- production, average	t/a	1 000
- design production	t/d	8
- basis weight range	g/m^2	20...50
- sheet size, dominant	mm x mm	508 x 762
" , maximum dimension	mm	1 105
- packing		
- machine for shrink film packing		
- scale for pallet weighing		
- average package unit	kg	500
- paper storage		
- storage time, max.	weeks	6
- storage capacity design	t	450
- storage factor	t/m^2	0.5
- storage area	m^2	860

5.2.7 Evaporation Design Data

The evaporation system would consist of:

- a two-effect vacuum evaporator plant with auxiliaries
- evaporated liquor storage

Design Criteria

Unbleached pulp production	BDt/a	1 700
Dissolved (dry) solids		
- total	t/BDt	1.17
- recovery in washing, 85 %	t/BDt	1.0

Solids concentration at vacuum evaporators		
- inlet, including spills	%	10
- outlet	%	55
Sodium content of evaporated liquor as Na_2SO_4		
- per unbleached pulp	kg/BDt	420
- per evaporated liquor	kg/t	230
Time lost on average in washing the evaporators	%	10

Design Figures

Capacity, evaporated water	t H_2O/h	3.0
Number of effects		2
Type of effects		
- effect I	forced circulation	
- effect II	natural circulation	
Live steam pressure	bar (abs.)	4
Elevation from sea level	m	70
Fresh water temperature	^oC	25
Warm water temperature	^oC	45

Storage tanks
- blow liquor tank in cooking plant would work as a feed tank
- strong black liquor tank
- warm water tank in the paper mill
- hot water tank in cooking plant would work as a condensate tank

5.2.8
Chemicals and Additives Preparation

Chemicals and additives preparation would include receiving, storage, handling and/or preparation for

- caustic soda, NaOH
- sulphur, S
- chlorine, Cl_2
- sodium hypochlorite (made on site)
- quicklime, CaO
- chalk for paper filler (made on site)
- alum, $Al_2(SO_4)_3 \times 15\ H_2O$
- starch and impregnants
- miscellaneous paper additives
- miscellanous water treatment chemicals

Design Criteria

Caustic soda as 100 % NaOH		
- for cooking	t/a	483
- for bleaching		
- as such	t/a	26
- for sodium hypochlorite	t/a	21
Total	t/a	530
Sulphur for cooking	t/a	33
Chlorine		
- for bleaching	t/a	75
- for water treatment	t/a	1
Total	t/a	76
Quicklime as 80 % CaO		
- for chalk = paper filler	t/a	747
- for water treatment	t/a	23
Total	t/a	770
Starch and impregnants		
- starch	t/a	315
- impregnants	t/a	245
Alum, $Al_2(SO_4)_3 \times 15\ H_2O$ for water treatment	t/a	80

For Alternative 2 production programme, there is the capability to handle miscellaneous paper additives like

- titanium dioxide, TiO_2
- surface sizing

Design Figures

Common
- truck scales

Caustic soda handling
- received as 50 % NaOH solution
- storage tank
- diluted, 5 % NaOH tanks

Chlorine handling
- received in drums
- roofed drum storage area
- scales
- chlorine vapourizing

Sulphur handling
- received in bulk
- roofed storage area

Sodium hypochlorite making
- hypochlorite making tank
- hypochlorite storage tank

Quicklime, CaO, handling
- received in bulk
- storage silo
- lime slaker
- mixer
- pumping tank
- centricleaner
- storage tank for $Ca(OH)_2$ slurry

Chalk, $CaCO_3$, making
- tower for acidifying
  $Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$
- wet separator for chimney gas
- chalk, $CaCO_3$, storage tank

Starch and impregnants
- received in sacks
- roofed storage area
- mixer and cooker
- storage tanks number 2

5.2.9
Other Mill Areas

Other mill areas not described above would be required to provide

- water
- effluent treatment
- steam
- electricity
- services
- infrastructure

Design Criteria and Design Figures

Water

- raw process water intake from Citarum river	1/s	60
- chemical treatment	1/s	35
- distribution Note: See raw water analysis of Citarum river, Annex III		
- fire protection water pumping and distribution	1/s	35

Effluent

- average discharges		
- process water to settling ponds	l/s	32
- BOD_5 in process water	t/d	0.4
- clean cooling etc. water	l/s	7
- effluent collection		
- settling ponds	m^2	2 x 100
- discharge pipe		
- design	l/s	60
- length	km	2

Steam

- make-up water softening		
- feedwater tank		
- feedwater treatment		
- power boiler fired with oil only		
- pressure	bar (abs.)	16
- design capacity	t/h	10
- steam distribution		
- condensate collection		
- condensate tank		
- heavy fuel oil tank		

Electricity would be supplied by the utility company, PLN. Tentative ideas before further discussions with PLN:

- power connection Note: Not included in investment	MVA	2.5
- supply voltage should be between	kV	(6)11...33
- distribution voltage	V	400

Services

- fire and security control
- operating office
- laboratory
- personnel
  - recruitment
  - first aid
  - canteen
  - lockers and washrooms
- maintenance
  - mechanical
  - electrical
  - instrument
  - civil
  - garage
- other
  - compressed air
  - emergency power
  - telephones etc.
- infrastructure
  - road improvement — km — 1
  - housing
    Note: Not included in investment

5.3 Energy Balances

5.3.1 Heat Balance, Alternative 1

		Heat from steam		
		8 bar	4 bar	Total
Consumption		1)	- MJ/BDt BL -	
	Pulping			
	- cooking	5 000	-	5 000
	- washing, bleaching[2)]	-	-	nil
	- evaporation	400	12 200	12 600
	- miscellaneous	300	250	550
	Total	5 700	12 450	18 150
	Paper machine		- MJ/t net paper -	
	- drying[3)]	-	11 000	11 000
	- miscellaneous	200	800	1 000
	Total	200	11 800	12 000
	Combined		- MJ/t net paper -	
	- pulping (0.473 BDt BL)	2 700	5 900	8 600
	- paper machine	200	11 800	12 000
	Total	2 900	17 700	20 600
Supply	Heat to steam from oil		MJ/t net paper	20 600
	Oil, heavy fuel oil		MJ/kg	40.6
	Boiler efficiency		%	85
	Specific oil consumption		kg/t net paper	600
	Annual oil consumption		t/a	2 100

1) Includes pro-rata the losses in the powerhouse.
2) No heat used in washing and bleaching other than hot water and warm water produced by secondary heat from cooking and evaporation.
3) Paper mill would use warm water from evaporator surface condenser.

5.3.2
Electricity Balance, Alternative 1

Consumption

	kWh/BDt BL	BDt BL/d	kW
Rosella preparation and pulping			
- rosella preparation	50	5.0	10
- cooking, washing, bleaching	840	5.0	175
- evaporation	20	5.0	5
- share of water, effluent, boiler, social premises, misc.	200	5.0	40
Total pulping	1 110		230

	kWh/t net paper	t paper/d	kW
Papermaking			
- stock preparation incl. all refining	1 090	10.6	480
- paper machine	1 100	10.6	485
- finishing	50	10.6	20
- share of water, effluent, boiler, social premises, misc.	130	10.6	60
Total papermaking	2 370		1 045

	kWh/t net paper	t paper/d	kW
Pulp and paper with auxiliaries combined			
- pulp (0.473 BDt BL)	530	10.6	235
- paper	2 370	10.6	1 045
Total	2 900		1 280
Annual consumption		MWh/a	10 100

Supply: All in principle supplied from outside (PLN) network.

5.3.3
Heat Balance, Alternative 2; Average for Papers Other than Cigarette Paper

Consumption		Heat from steam 8 bar	4 bar	Total
	Pulping		- none -	
			- MJ/t net paper -	
	Paper machine = combined			
	- drying	-	11 000	11 000
	- miscellaneous	-	5 800	5 800
	Total	-	16 800	16 800
Supply	Heat to steam from oil		MJ/t net paper	16 800
	Oil, heavy fuel oil		MJ/kg	40.6
	Boiler efficiency		%	85
	Specific oil consumption		kg/t net paper	490

5.3.4
Electricity Balance, Alternative 2; Average for Papers Other than Cigarette Paper

Consumption

Rosella preparation and pulping: none

	kWh/t net paper	t paper/d	kW
Papermaking = combined			
- stock preparation incl. all refining	650	10.6	285
- paper machine	1 100	10.6	485
- finishing	50	10.6	25
- share of water, effluent, boiler, social premises, misc.	150	10.6	65
Total	1 950		860

Supply All in principle supplied from outside (PLN) network.

5.4 Tentative Time Schedules

5.4.1 General

The sequence of events that starts with the issuance of the pre-investment report and ends with full commercial paper production can be roughly divided into three parts:

- activities required before the final investment or go-ahead decision
- implementation
- start-up

Each one of these parts will now be briefly outlined.

The activities before the go-ahead decision and the target time schedule are shown graphically in drawing K3918-HS-4001, Target Time Schedule.

5.4.2 Activities Before a Go-ahead Decision

The first stage can be called appraisal. The appraisal results in a preliminary investment decision, either for or against. This decision is actually an answer to the question whether the project merits spending the further fairly substantial amount of money needed even before the final investment decision or go-ahead decision. Most of this money would be spent on a full feasibility study, which would give firm grounds for the go-ahead decision.

This project seems promising. The appraisal should therefore involve several parties, among them P.T. Kertas Jatiluhur itself, Bapindo, Unido, whoever is going to finance the feasibility study, and the Board of Investment. It would be advisable also to contact the Jatiluhur Authority and maybe other Indonesian Government agencies such as the Directorate General of Basic Chemical Industries and the agency responsible for the environment.

The time spent on the appraisal would depend on so many things that it is not possible to estimate it here. Naturally, the interest and activity of P.T. Kertas Jatiluhur are the key to speeding up the proceedings.

The second stage of events before the go-ahead decision involves

- a full feasibility study, which is briefly outlined in Annex VI

and events which should preferably proceed during the feasibility study, like

- clearance with authorities
- clearance of financing
- commercial and legal matters

A tentative timetable is given in Annex VI for the feasibility study. The other events could, however, determine the overall time before the go-ahead decision could be made.

One of the commercial matters is the decision on how to implement the project: as a component purchase, package purchase or complete turnkey package. The tentative timetable for the feasibility study assumes that enquiries and tenders be made based on a component or package purchase. Satisfactory total turnkey specifications and the inevitable negotiations during the tendering would probably require a longer time.

5.4.3 Implementation

The target time schedule includes only the events that would probably be in the critical path. It spans 28 months, starting with the go-ahead decision and ending with the start-up of paper production.

It assumes that a new paper machine would be purchased. It is, therefore, the delivery, shipping and erection of the paper machine that is on the critical path and would determine the timetable for the whole mill.

The timetable for the other parts of the mill and for site works etc. may become critical in the case of purchasing an old reconditioned paper machine because the overall timetable may be considerably shorter.

5.4.4 Start-up Schedule

It is assumed that P.T. Kertas Jatiluhur would employ a technical management partner who would

- guide the engineering consultant in the design of the mill
- assist in management of the implementation phase, mainly in purchasing machinery and supplies
- arrange the training of key personnel abroad
- provide a crew for the start-up and oversee the running of the mill for the first 3 years
- assist in sales (part of which assistance would be the advance samples produced during commercial-scale trials)

It is also assumed that the mill would be properly designed, purchased and built.

On these assumptions the start-up (which in the target time schedule follows the normal testing period) would ;an the start of commercial production.

The production following start-up would be limited partly by the trimming and stoppages inevitable in a new mill and partly by the normal limitations in establishing sales for a new mill.

It is estimated that the start-up schedule, represented by the saleable production, would be:

Operating year	Saleable production	
	% of full commercial production	t/a
First	70	2 450
Second	90	3 150
Third and onwards	100	3 500

Please note that not all of the production during the first few years might be cigarette paper. The effect of this possibility on the economics of the mill has been considered in a model called "Alternative 2".

6 MILL SITE

6.1 Proposed Site: Jatiluhur

Several sites were preliminarily considered during the field trip. These were

- Jatiluhur, about 100 km southeast of Jakarta; more precisely the Cilangkap Industrial Estate

- Tangerang, the suggested location being about 35 km west of Jakarta

- Lampung, south Sumatra

- Manado, north Sulawesi

A preliminary rating according to availability of water, electricity, infrastructure, land for the mill site and access to markets led to visits to Jatiluhur and Tangerang.

Consideration of these factors plus the probable requirement of availability of some of the rosella near the mill led to the selection of Jatiluhur, or to be more exact the Cilangkap Industrial Estate, as a mill site for this pre-investment study. After a favourable investment decision, P.T. Kertas Jatiluhur would have the necessary more definite facts and backing (e.g. from Bapindo and the Board of Investment, BKPM) to start negotiations with the Jatiluhur Authority (POJ), which is under the Ministry of Public Works and Directorate of Power.

The following discussion is based on the visit to the area, and discussions with two companies, P.T. Allied Facific Dyechem and P.T. Indobharat Rayo in the Cilangkap Industrial Estate, and with POJ.

6.2 Location, Elevation, Climate

The location of the Cilangkap Industrial Estate is shown as an insert in drawing K3918-HM-1001, Mill Site Layout.

The Cilangkap and Curuk villages (kampong) are within Purwakarta district (kecamatan) in the Purwakarta administration area (kabupaten) in the West Java province.

The nearest town to the southeast is Purwakarta, about 10 km away. The Estate, 5 to 7 km long, is between the river Citarum and the road from Purwakarta. Jatiluhur dam on the river Citarum is approximately 4 km south. The distance to Jakarta varies from 100 to 130 km according to the road taken.

The elevation is close to 100 metres.

The climate is generally tropical. No precise data were obtained, but the following should apply roughly:

- temperature	^oC	20 to 32
- relative humidity	%	75 to 97
- winds (moderate)	m/s	1 to 6
- annual rainfall	mm	2000 to 4000

6.3 Area Available, Soil, Earthquakes

The Industrial Estate extends for several km along the Citarum river. The area required for the mill site, about 11 ha plus a reserve area of, say, 2 ha, for possible additional raw material storage is most probably still available. The land could be sold or leased against annual payment for 30 years (renewable). Rp 2000/m^2 (= USD 3.20/m^2) was given as a "safe" purchase price for the mill site.

If half of the required 3700 air-dry tons of rosella fibre per annum were to be grown near to the mill, it would require 600 to 800 ha for one rotation per annum harvesting. There could be enough area around the Jatiluhur reservoir. Most of the land belongs to POJ, some is private. Erosion should be controlled by either planting in cycles, if this is possible, or else alternating with other plants, etc.

The ground and soil in the mill site would not be a problem. In those places where soil surveys have been made, there has been found first organic soil to 2 to 3 m depth, and then claystone with a bearing capacity of 100 t/m^2 increasing to 200 t/m^2 at 5 m depth. Mostly a 2 m excavation or spread footing foundation has sufficed. No deep foundations have been required.

There was no mention of any special construction method to protect against earthquakes. Note that the 100 m high Jatiluhur dam is located a few kilometres upriver, therefore sufficient data would be available to consider special constructions, such as for the paper machine foundation.

6.4 Water

The river Citarum flows by the proposed mill site. It is the largest river in West Java, with an annual flow of 5.5 x 10^9 m^3 of water, which is an average flow (MQ) of 175 m^3/s (175 000 l/s). The maximum flow is about 3000 m^3/s. Floods are controlled by the Jatiluhur dam already mentioned. The reservoir above the dam covers 3300 ha, and can hold 3 x 10^9 m^3 of water, which is approximately a half a year's flow. The water is used to generate power, for irrigation and as a community water supply. The installed power generating capacity, 125 MW, and the annual generation, 700 GWh, are sufficient to be sure that enough water will flow in the Citarum river downwards from the dam. Moreover, much of the irrigation water is taken from the dam built in Curuk, downriver from the proposed mill site.

- average flow of the river (above dam)	m^3/s	175
- average water for the mill	m^3/s	0.04

A water sample was taken adjacent to the Indo Bharat mill site on March 28, 1981. An analysis was also obtained from POJ. The results are given as Annex III. The water is suitable for the mill. Some of it must be chemically treated.

6.5 Power

As mentioned earlier, the generating capacity of the Jatiluhur dam hydroelectric power station is 125 MW. Primary transmission is at either 160 kW or 70 kW. The 70 kV line capacity is fully contracted but not yet utilized. The distribution voltage for industrial estates, smallish consumers, etc. would normally be 11 to 33 kV, often 13.8 kV. Whether this will remain the case in the future must still be confirmed.

The mill would have

- an average consumption of	MW	1.3
- an hourly peak of about	MW	1.8
- a connection of about	MW	2.5
- a distribution voltage of (motors up to 300 kW would suit this)	V	400

The arrangements concerning the substation and transformer would be an important subject for discussion with POJ.

POJ applies now a flat rate of	Rp/kwh	18
which is about	USD/MWh	30

Preliminary discussions indicated that the mill might have to prefinance the power connection and transformer which would then be allowed for in the billing.

6.6
General Infrastructure and Transport

Some important distances from the Cilangkap Industrial Estate are

- Jakarta, depending on route	km	100...130
- Purwakarta, capital of the district	km	7...10
- Bandung, capital of West Java province	km	70
- Jatiluhur dam	km	20

Road connections are fair. A new Jakarta - Cicampek road is scheduled to be ready by the mid 1980s. It would be 15 to 30 km away, depending on the route.

The Jakarta - Bandung railway runs through Purwakarta.

Purwakarta has all normal facilities: medical centre, schools, garages, contractors and accommodation.

The Jatiluhur dam area has Hotel Pesanggrahan and bungalows with a total of 225 bedroosm. There are also tennis courts and a swimming pool. The hotel was almost empty during the field trip.

Local workshops would not be adequate for the mill's needs.

Outside contractors would probably have to be used.

The availability of labour at helper etc. level is generally good but seasonal. The construction period would therefore probably present no problems. The mill when running would, however, have to depend on an essentially permanent workforce. The discussions with POJ should include fairly detailed assessment of the local availability of personnel which could be trained, any help from the authorities in training, and the availability of housing etc. before making a final assessment of the preoperating and possible infrastructure costs.

6.7
Environmental Aspects

6.7.1
Impact on Social Environment

The proposed mill site is in the Cilangkap Industrial Estate. The existence of the estate itself shows that the authorities approve of industrial development and even encourage it. Therefore this point about the impact on the social environment need not be discussed here. It should be sufficient to mention that the mill would employ 340 people and the total annual personnel cost is estimated at USD 880 000, or Rp 550 million.

6.7.2 Air Emissions

The cooking medium is soda with a small addition of sulphur. The malodorous emissions would therefore be minimal.

Bleaching would be done with chlorine and hypochlorite. Adequate training would have to be provided and normal safety precautions observed in the handling of chlorine to avoid accidental discharges to the atmosphere. The small dosage for bleaching and the low chlorine concentrations in aqueous solution would ensure that no harmful emissions to the atmosphere occurred from the process itself.

6.7.3 Effluent Control

Total paper production	t/a	3 500

Alternative 1, in which only cigarette paper would be produced, is the dominant alternative from the point of view of effluent control because it involves producing more pulp than alternatives including other paper grades.

The relevant figures for Alternative 1 are as follows:

Cooking and washing		
- unbleached pulp	BDt/a	1 700
- dissolved solids		
- originating from the cooking chemicals plus organics dissolved in cooking	t/a	1 990
- recovered in washing, 85 %	t/a	1 690
- discharged to effluent	t/a	300
- biological oxygen demand (BOD_5) of the discharged dissolved solids		
- annual total	t O_2/a	102
- daily average	t O_2/a	0.31
- fibre loss	BDt/d	0.042
- sand etc. (partially recovered)	t/d	0.07
Bleaching		
- bleached pulp	BDt/a	1 650
- bleaching loss (dissolved plus fibres)		
- relative	%	3
- annual total	t/a	50
- biological oxygen demand (BOD_5) of the dissolved losses		
- annual total	t O_2/a	7
- daily average	t O_2/d	0.02
- fibre loss	BDt/d	0.018

Paper mill		
- starch		
- total usage	t/a	315
- losses estimated at 8 %	t/a	25
- biological oxygen demand (BOD_5) mainly from starch losses		
- annual total	t O_2/a	15
- daily average	t O_2/d	0.05
- fibre losses	BDt/d	0.036
- filler ($CaCO_3$) losses		
- total usage (90 %)	t/a	1 180
- annual losses at 5 %	t/a	59
- daily losses on average	t/a	0.18
- losses in filler making		
- annual total (mostly recovered)	t/a	150
- daily average	t/d	0.45
Total mill		
- amount of effluent, average	m^3/d	3 400
- biological oxygen demand (BOD_5) of effluent		
- daily average	t O_2/d	0.38
- concentration	mg O_2/l	120
- annual average minimum flow (MNQ) of the river Citarum estimated at	m^3/s	17
- biological oxygen demand (BOD_5) increment in the river Citarum at minimum flow conditions	mg O_2/l	0.26
- total fibre loss	BDt/d	0.10
- sand and other inorganic solids		
- total losses	t/d	0.70
- to effluent for certain	t/d	0.18
- difference	t/d	0.52
- probably recovered	t/d	0.40
- probably lost	t/d	0.12
- probable total to effluent	t/d	0.30

It is concluded that the very small increment in the river Citarum's biological oxygen demand, 0.25 mg/l at the minimum flow, would not cause any problems. Aeration of the effluent is therefore not included.

Two small settling ponds, 100 m^2 each, are planned for the removal of solids. Solids would be removed from these ponds periodically.

It is emphasized that the plan to recover 85 % of the dissolved solids from cooking would be a very advanced control method considering the small size of the mill and the large flow of the recipient, the river Citarum, provided the estimated minimum flow applied to the river at the mill site. It is also an expensive control method. After initial dilution with simple dispersion the resultant water should still be usable for almost any purpose downriver, even taking into account the compounds discharged from bleaching. It is to be noted that people, as a rule, do not drink water from the river except with chemical treatment or cooking.

If no recovery of the dissolved solids were practised, the biological oxygen demand increment in the river water after initial dilution, less than 2 mg O_2/l, might still be acceptable. The discharged sodium and the small amounts of sulphur, chlorides and chlorinated compounds would mean that the water should be more carefully dispersed to avoid harming fish or changing the taste of water. It is not quite clear whether dispersing alone would be enough to fulfill the most stringent requirements.

The 85 % of the solids from cooking would be recovered in washing, evaporated to 55 % concentration and trucked to a larger kraft pulp mill for burning in a recovery boiler. The planned mill in Cilacap, on the southern coast of Central Java is foreseen as a likely recipient. The small additional amount of dissolved solids should not create any difficulties to that mill. The question is, when will the mill be built. Discussions with the Directorate General of Basic Chemical Industries should clear this up.

If there are any difficulties about the relative timing of Jatiluhur and Cilacap mills, or the Cilacap mill would not take the liquor, then the following alternatives are available:

- burning the evaporated liquor in as simple a device as possible to avoid excessive investment costs

- no dissoved solids recovery; good dispersing of effluent in the river Citarum

- a change of cooking method, e.g. to ammonium sulphite, recovery by washing, evaporation and burning

All of these methods would need further investigation. Preliminary tests concerning the change in cooking method have been made. They look promising, but more work is necessary to determine further process details and economics.

The impact of the discharge without recovery should be evaluated in relation to the river flow duration curves and resulting concentrations, and the present and future water usage downstream.

7 PROJECT ECONOMICS

7.1 Capital Requirement

7.1.1 General

This chapter contains:

- an investment estimate for new machinery
- notes on old machinery and maintenance
- an estimate of working capital
- an estimate of re-investments

7.1.2 Investment Estimate for New Machinery

The capital cost estimate is based on the technical scope described in this report. The estimate covers all the mill departments and facilities such as roads, piping and sewers within the mill site, and an effluent discharge pipe.

The price level of the estimate is that of the third quarter of 1981. Cost escalation during the construction is not included.

The costs are based on JAAKKO PÖYRY's file information. No commercial tenders were requested specially for this project. Machines and materials have been assumed to be purchased FOB supplier's export harbour. Piping, electrical equipment and process control equipment have all been assumed to be purchased as separate packages, except for some equipment normally included in the machine supplier's delivery. Installation has been assumed to be contracted to specialized installation firms. Equipment costs do not include any customs duties or taxes.

Building costs have been estimated on the basis of quantities for similar projects. Current unit prices adjusted to relevant local conditions have been used.

Indirect cost items, such as project engineering, construction management, site supervision, project administration, start-up, temporary facilities and services have been estimated on the basis of experience from projects of the same type. The basic and detailed engineering of process departments have been assumed to be carried out by foreign engineers. The detailed civil engineering has been assumed to be carried out by Indonesian engineers. The costs of mill personnel and training before start-up have been estimated for a normal recruiting programme.

The costs are specified in US dollars.

The following rates of exchange have been used:

1 USD = 630 Rp
1 USD = 2.35 DEM
1 USD = 4.50 FIM

To compensate for minor changes and possible inaccuracies in the techical descriptions, a contingency of 10 percent has been added.

Summary

The investment cost estimate totals USD 34.3 million. The estimated division between Indonesian and foreign costs is as follows:

	Indo-nesian	Foreign	Total
		- USD 1000 -	
Machinery and equipment	800	14 477	15 277
Freight	400	1 250	1 650
Equipment erection	1 720	700	2 420
Civil works	5 025	-	5 025
Temporary works and facilities	1 000	-	1 000
Studies and project engineering services	300	3 200	3 500
Construction management, site supervision	150	850	1 000
Project administration, pre-operating and start-up expenses	700	300	1 000
Land	350		350
Subtotal	10 445	20 777	31 222
Contingencies	1 055	2 023	3 078
TOTAL	11 500	22 800	34 300

Working capital is not included in this summary.

The estimate is specified in more detail in Annex IV.

7.1.3 Notes on Old Machinery and Maintenance

Secondhand Machinery

The investment estimate is based on the purchase of new machinery throughout. Because the machinery needed for a cigarette paper mill is relatively small, it would perhaps not be very difficult to find some appropriate secondhand machines for the purpose. It is thought possible to replace the following machinery with secondhand machinery:

- paper machine with auxiliaries
- winder and bobbin slitters
- hollanders, refiners
- power boilers

The FOB value of these machines in the investment estimate is about USD 5.7 million (18 % of the total mill investment). The cost of the same as secondhand machinery, including dismantling, reconditioning and packing, could be within the range of USD 2 to 3 million. The savings in the investment would thus be some USD 2.7 to 3.7 million.

Maintenance

Although the maintenance department has been made as small as possible for normal operation of the mill without help from outside, the investment cost is disproportionately high for a small paper mill like this (USD 2.8 million, which is 9 % of the total mill investment).

If special maintenance services, such as roll grinding, could be provided by other paper mills within a distance of 100 km, the investment could be reduced by USD 0.7 to 1.0 million.

If it were also possible to agree on using the general workshop machines of other mills and private workshops in the vicinity of the Industrial Estate, the investment cost could possibly be further reduced by USD 0.3 to 0.5 million.

More detailed investment estimates and calculations about effects on mill operating expenses have to be left to the next phases of the study.

7.1.4
Working Capital Estimate

A breakdown of the estimated working capital is as follows:

Item	Size of inventory, weeks	Corresponding value, USD 1000
Inventories		
- rosella fibre	8	190
- other pulps	8	50
- chemicals	8	120
- fuel	4	15
- miscellaneous (packaging etc.)	8	50

(cont'd)

Item	Size of inventory, weeks	Corresponding value, USD 1000
- operating supplies	12	25
- maintenance materials	12	90
- finished products in store (at cost)	6	575
Total inventories		1 115
Accounts receivable	4	840
Accounts payable	2	145
Cash		90
NET WORKING CAPITAL		1 900

7.1.5
Re-investments

Re-investments have been considered only in the cash-flow calculations, not in the investment estimate. The purpose of the re-investments is to keep the mill in good condition during the whole calculation period. The re-investments have been estimated as follows:

- years 1 - 2:	0.25 % of the original fixed investment	USD 80 000/a
- years 3 - 9:	-	
- years 10 - 15:	1.5 % of the original fixed investment	USD 500 000/a

7.2 Production and Market Data

7.2.1 General

The production and sales plan for the Jatiluhur mill are based on the following assumptions:

- the whole production of the mill could be sold in the domestic market
- the main grade would be cigarette paper. In Alternative 1 the only product would be cigarette paper. In Alternative 2 a gradually diminishing fraction of the production volume would be paper grades other than cigarette paper, including thin printing and writing papers. The amount of these other papers would decrease from 50 % of the total production to 0 % in six operation years
- the price and cost level used in the calculations is that of the 3rd quarter 1981

7.2.2 Product Mix

The product mix of each alternative is shown in Table 7-1.

Table 7-1
Product Mix of Jatiluhur Mill

Alternative 1

Year of operation	Cigarette paper - t/a -	Capacity utilization rate, %
1	2 450	70
2	3 150	90
3 etc.	3 500	100

Alternative 2

Year of operation	Cigarette paper	Tipping paper	Plug wrap	Thin printing	Manifold etc.	Total	Capacity utilization rate, %
	- t/a -						
1	1 225	245	245	367	368	2 450	70
2	1 575	315	315	472	473	3 150	90
3	2 100	280	280	420	420	3 500	100
4	2 450	210	210	315	315	3 500	100
5	2 800	140	140	210	210	3 500	100
6	3 150	70	70	105	105	3 500	100
7 etc.	3 500	0	0	0	0	3 500	100

7.2.3 Sales Revenues

The mill net prices of the products are calculated in the market part of this report (Chapter 3), so they are only summarized here. The average mill net prices are shown in Table 1-2.

Table 1-2
Average Mill Net Prices

Quality	Mill net price, USD/t
Cigarette paper	3 368
Tipping paper	1 781
Plug wrap	2 543
Thin printing	1 477
Manifold etc.	1 477

The expected annual sales revenues of the mill are shown in Table 1-3.

Table 1-3
Annual Sales Revenues

Year of operation	Alternative 1	Alternative 2
	- 1000 USD/a -	
1	8 252	6 271
2	10 609	8 062
3	11 788	9 524
4	11 788	10 090
5	11 788	10 656
6	11 788	11 222
7 etc.	11 788	11 788

7.3 Manufacturing Costs

7.3.1 Calculation Basis

All the unit costs have been adjusted to correspond to the cost level prevailing the 3rd quarter 1981. The manufacturing cost estimates for the mill alternatives have been divided into two parts:

A Variable costs (which depend directly on the output; so they are expressed per production unit)
- A1 Rosella fibre
- A2 Pulp
- A3 Chemicals
- A4 Energy
- A5 Packaging materials
- A6 Other variable costs

B Fixed costs (which depend on time, not output; so they are expressed as annual costs)
- B1 Personnel (salaries and wages, including fringe benefits)
- B2 Operating supplies
- B3 Maintenance and repair materials
- B4 General overheads

The calculation procedure and coverage of each item are described later.

7.3.2 Unit Costs and Prices of Main Cost Items

The prices and costs are specified in US dollars. The exchange rate used is:

1 USD = 630 Rp

Rosella Fibre

The rosella fibre would be obtained partly from the plantations near the mill and partly from plantations near Sukarta (about 600 km from the mill). The average cost of the rosella fibre at the mill site would be USD 320/t air dry fibre (90 %). About 1840 ADt/a of rosella pulp would be made from the rosella fibre. The variable costs of rosella pulp per ton are shown in in Annex V/1.

Purchased Pulp

Bleached hardwood kraft pulp would also be used for the production of cigarette paper. In Alternative 2 the other paper grades would also need bleached softwood kraft pulp. The price of purchased pulp at the mill site is determined as follows:

	Bleached hardwood pulp	Bleached softwood pulp
	- USD/ADt -	
C & F Jakarta	540	565
Transport & handling	20	20
Taxes	81	85
Delivered	641	670

Main Chemicals

The following list shows the mill net cost of each chemical. The chalk would be prepared at the mill site from quicklime.

Chemical	Unit price, USD
Caustic soda (NaOH)	445/t
Sulphur (S)	190/t
Chlorine (Cl_2)	450/t
Quicklime (CaO)	75/t
Titanium dioxide (TiO_2)	2 035/t
Starch	520/t
Surface size	3 245/t
Impregnants	1 210/t
Colouring	1 575/t
Water treatment chemicals	4.1/t paper

Energy

The mill would have to purchase the following energy:

- electricity
- fuel oil
- diesel oil

The cost of purchased electricity is based on the local tariffs. It is estimated at USD 30/MWh. The cost of domestic fuel oil was reported to be about USD 90/ton, including transport costs. This price, although clearly less than the world market price, has been used in the financial calculations.

The consumption of diesel oil in locomotives, trucks, loaders, etc. in mill operations has been estimated at 2.5 kg/t of paper, with a unit price of USD 150/t of diesel oil.

Packaging Materials

The packaging material costs for cigarette paper are estimated as follows:

	USD/t paper
Pallet	14.0
Particleboard	12.0
Wires	1.0
Shrink film	4.2
Coverage paper	0.8
Cores	36.0
Labels etc.	2.0
TOTAL	70.0

For the other paper grades the wrapping material consumption would be 10 kg/t of paper, and unit price USD 1100/t of material.

Other Variable Costs

Other variable costs include the costs of minor items such as water etc.

7.3.3
Cost Calculations

Variable Costs

The variable costs of each paper grade are estimated separately (see Annexes V/2...V/6)

Fixed Costs

Personnel

The mill manning would be as follows:

Pulp mill department	70
Paper mill department	50
Steam, water and power supply department	30
Laboratory and quality control department	15
Maintenance and workshop department	75
Raw material supply department	5
Planning and personnel department	5
Purchasing department	10
Transportation and mill stores	15
Personnel services, catering, safety and general services	50
Total	322
Administrative and professional personnel	18
GRAND TOTAL (excluding head office and sales)	340

The annual personnel cost would be USD 884 000, which gives an average wage of USD 2600/a per person.

The numbers of expatriates would be as follows:

- sales (and special purchase)
  - 1 man 3 years
- technical
  - 1 man 3 years
  - 1 man 1 year

The annual personnel costs for expatriates would be:

Year of operation	Annual cost, 1000 USD/a
1	300
2	200
3	200
4 etc.	0

Operating Supplies

The costs of operating supplies have been estimated on the basis of records from other similar mills. The costs have been estimated at USD 5 per ton rosella pulp and USD 30 per ton paper, which gives and annual amount of USD 115 000.

Maintenance Materials

The cost of maintenance materials has been estimated to be:

- normal repair and maintenance materials, about 1.1 % of the fixed investment USD 350 000/a

General Overheads

General overhead costs include office expenses, insurance, travel costs, taxes, telex and telephone costs. They are calculated at 1.1 % of the fixed investment. They are assumed to remain the same for each year of operation. The total annual amount of general overhead expenses would be USD 350 000.

Total Manufacturing Costs

The total manufacturing costs are summarized for Alternative 1 in Table 7-4.

Table 7-4
Manufacturing Costs of Alternative 1
(normal year of full production)

		USD/t paper	1000 USD/a
A1	Rosella fibre	336	1 176
A2	Pulp	144	505
A3	Chemicals	244	854
A4	Energy	142	498
A5	Packaging materials	70	245
A6	Other variable costs	2	7
Variable costs		938	3 284

Table 7-4 (cont'd)

	USD/t paper	1000 USD/a
B1 Personnel	253	884
B2 Operating supplies	33	115
B3 Maintenance and repair materials	100	350
B4 General overheads	100	350
Fixed costs	486	1 699
MANUFACTURING COSTS	1 424	4 983

7.4 Profitability Calculation

7.4.1 General

The profitabilities of the two alternatives have been estimated by the internal rate of return (IRR) and return on investment (ROI) methods. Break-even points have also been calculated. All calculations are on a before-tax basis.

Cash Flow Estimate

The IRR calculations are based on annual cash flows. The annual cash flows have been calculated for the period up to mill start-up, and for the first 15 years of production. Costs and prices have been fixed at the level of the 3rd quarter 1981 for the calculation period (no inflation has been considered). Interest during construction and escalation of investment have been excluded. The annual cash flows have been calculated in the following way:

Annual sales revenues
less manufacturing costs
= Annual operating profit
less capital expenditure
= Annual cash flow

Internal Rate of Return (IRR)

The IRR method calculates the interest rate that would make the present value of the cumulative cash flow equal to zero according to the discounted cash flow method.

Return on Investment (ROI)

In the ROI method the operating profit in a normal operating year (full production) is divided by the total investment and expressed in percent.

The total investment includes the fixed investment, preoperating expenses, working capital and interest during construction. Escalation is not included in the investment or in the costs and incomes.

$$ROI = \frac{\text{Sales revenue - Manufacturing costs}}{\text{Fixed investment + Preoperating expenses + Working capital + Interest during construction}}$$

Break-Even Point

The break-even point is the point (the capacity utilization rate) at which sales revenue equals operating costs plus capital charges.

7.4.2 Profitability

The annual cash flows for both alternatives are presented in Annexes V/7 and V/8. The main results are as follows:

Alternative 1

Production	t/a	3 500
Sales income	1000 USD/a	11 788
Manufacturing costs	"	4 983
Operating profit	"	6 805
Investments		
- fixed investment	1000 USD	33 300
- preoperating expenses	"	1 000
- working capital	"	1 900
- interest during construction (interest rate 12 %)	"	3 555
Total	"	39 755
ROI		17.1 %
IRR (Annex V/7)		14.2 %
Break-even point (see Figure 7/1)		
- costs covered		700 t/a
- average capital charges covered		2 910 t/a

The production of paper grades other than cigarette paper in the beginning would reduce the IRR to 11.2 % (see Alternative 2, Annex V/8).

7.5 Sensitivity Analysis

Sensitivity analyses have been carried out for both Alternative 1 and Alternative 2. The sensitivities to the following factors have been analysed:

- sales price (sales income)
- cost of rosella fibre
- price of electricity
- total variable costs
- personnel costs
- fixed investment

The basic estimates in the cash flow calculations have been varied from -50 % to +50 %, and the IRR rates calculated. The results are shown in Annexes V/7 and V/8 and Figures 7/2 and 7/3.

Both alternatives are most sensitive to changes in sales price. A decrease of 10 % in the price of cigarette paper would bring the profitability down about 3.5 percentage points to 10.8 % (IRR). An increase of 10 % in the price would give an IRR rate of 17.4 %.

Another important factor is the investment cost. As seen earlier in the break-even calculations, capital charges increase the break-even point from 600 t/a (only manufacturing costs) to 2910 t/a. In Alternative 1 a 10 % increase in the fixed investment would decrease the IRR rate by 1.5 percentage points to 12.7 %. A combined effect of several factors might give a bigger change in the IRR rate. For example, if the sales price of cigarette paper decreased by 10 % and the investment cost at the same time increased by 10 %, the combined effect on the IRR rate would be a change of 5 percentage points, the new IRR being 9.3 %.

Figure 7/1
Break – Even Diagram of Alternative 1

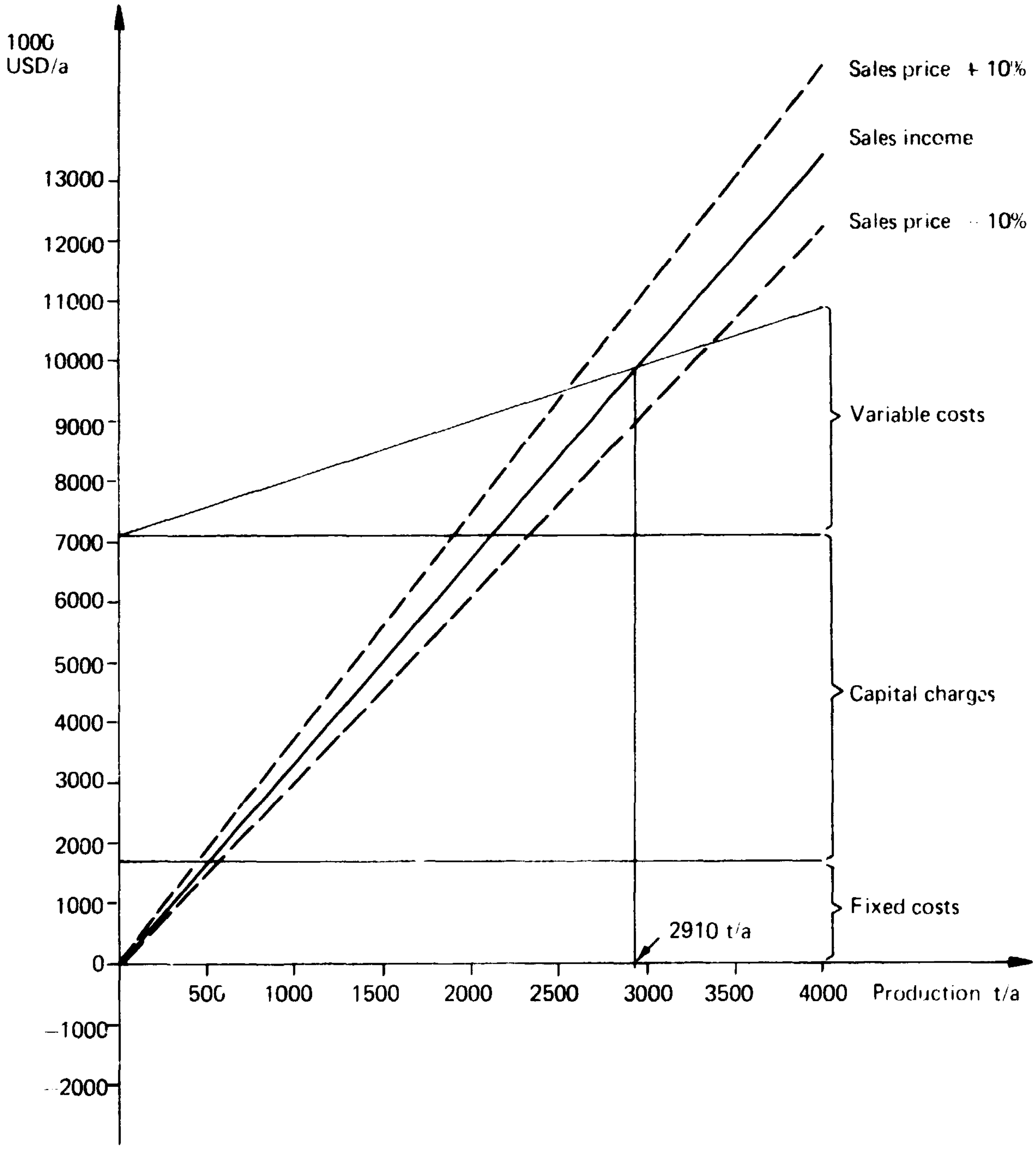
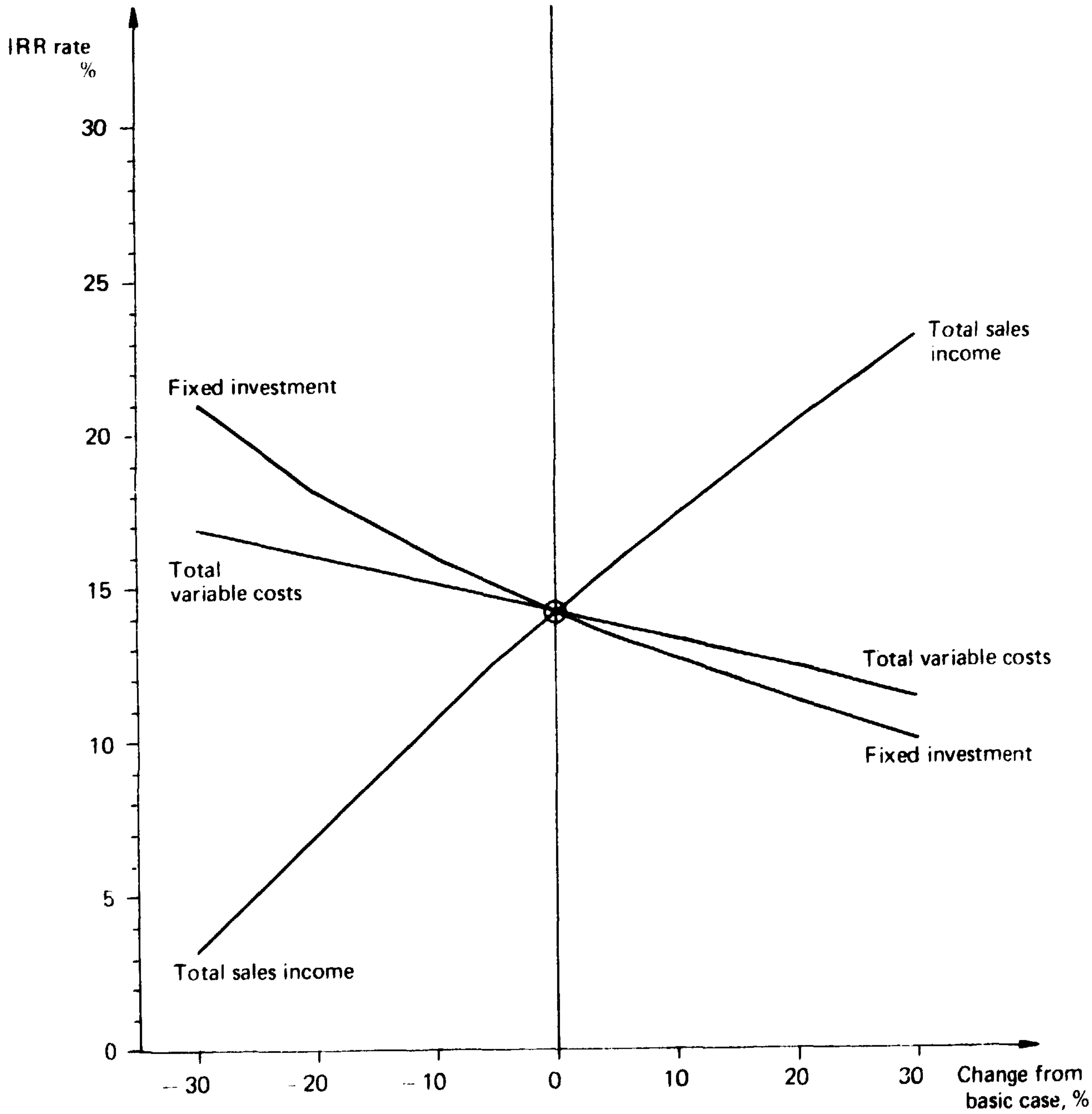
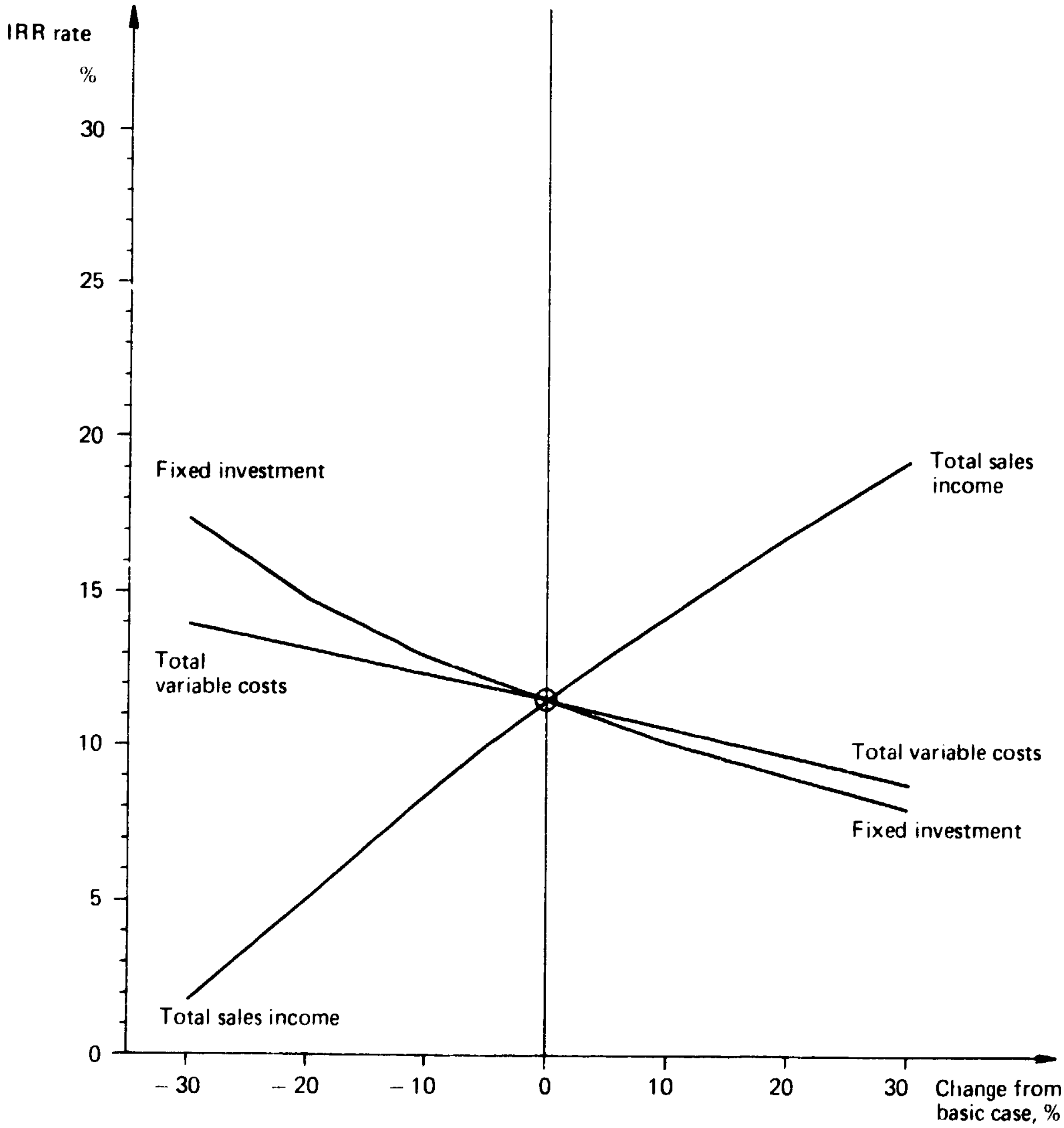


Figure 7/2
Sensitivity of the IRR
Alternative 1



Basic rate: 14.2%

Figure 7/3
Sensitivity of the IRR
Alternative 2



Basic rate: 11.5%

LIST OF PRINCIPAL CONTACTS DURING FIELD TRIP

JAAKKO PÖYRY

1 GENERAL

A field trip was made to Indonesia 1981-03-21...04-12 by

- Mr. Olli Karjalainen, Jaakko Pöyry Consulting Oy, Project Manager and

- Mr. Lauri Kerkola, Tervakoski Oy

in connection with the Pre-investment Study for a Cigarette Paper Mill in Indonesia for P.T. Kertas Jatiluhur.

The main purpose of the field trip was to investigate:

- cigarette paper markets
- raw material
- mill sites
- costs and prices
- technical aspects of implementation

After the field trip a debriefing was held in the UNIDO, Vienna headquarters attended by:

- Mr. Olli Karjalainen
- Dr. Manfred Judt, the Substantive Officer for this project

Contacts in Indonesia before this field trip, connected with either this project or other projects, provided necessary background for this investigation, as well as a substantial amount of comparative data. These contacts included, but were not limited to:

- Investment Board, BKPM
- P.T. Kertas Padalarang (cigarette paper mill)
- Other paper mills
- Indonesian Pulp and Paper Association
- Paper agents and users of various printing qualities

2 LIST OF PRINCIPAL CONTACTS IN INDONESIA

2.1 P.T. Kertas Jatiluhur

Jl. P. Tubagus Angke No. 22 A
Jelambar Ilir, Jakarta - Barat
Phones 610 508 and 610 991

- Mr. Wim T. Joseph, President Director
- Mr. Oentoeng, S.

2.2
UNDP

Jl. Thamrin 14, Jakarta
UNDP P.O. Box 2338
Phone 321 308

- Mr. F.M. Iqbal, Senior Industrial Development Field Adviser
- Mr. Pirkka Aula, Field Officer

2.3
Bapindo

Bank Pembangunan Indonesia
Development Bank of Indonesia
Jl. Gondangdia Lama 2-4, Jakarta
P.O. Box 140, Jakarta
Telex 01.44214 and 01.44335
Phone 321 908

- Mr. Soetedjo K, Deputy Manager, Project Promotion Department
- Mr. J.F. Tumbuan, Agricultural Expert, Project Promotion Department

2.4
The Embassy of Finland

15 A Jl. Kusumah Atmaja, Jakarta
Telex 44294 finamb jkt
Phones 346 686, 345 871

- Mr. Heikki Lappi-Seppälä, Commercial Counsellor

2.5
The Embassy of Finland

Commercial Section
14 Jl. Borobudur, Jakarta
Telex 48280 kaindo ia
Phones 881 824 and 883 689

- Mr. Harri Uusivirta, Commercial Attaché

2.6
P.T. Buhmeria (Rami) Industries Ltd.

Jl. Mangunsarkoro 8
Jakarta, Pusat

- Mr. Faruk Abdulkadir, President Director
- Mr. Soebagjo

2.7
Department of Agriculture

Directorate General of Horticulture
Research and Development Centre for Industrial Plants
Departemen Pertanian
Directorat Jenderal Perkebunan
Pusat Pengembangan Penelitian
Tanaman Industri
Jl. Cimanggu No. 1, Bogor

- Mrs. Emmy

2.8
Mill Using rosella

Perkebunan Tanaman
P.T.P. XVII Semarang (Persero)
Jl. MPU Tantular 27 (ATAS)
Telex 22218
Cables Tujuhbelas
Phone (024)21451

(Mr. Wim T. Joseph only)

- Ir. Purwadi, Director

2.9
GAPPRI

Jakarta Office
As. Gap. Persikatan Pabrik Rokok
Kretek Cigarette Manufacturer's Association
Jl. Kebon Kacang 30/1B, Jakarta

- Mr. Santoso

2.10
Gaprindo

(White Cigarette Association)
Jl. H.O.S. Cokroaminoto No. 60
P.O. Box 239
Jakarta, Pusat
Telex 44135
Phone 341 784, 596 151

- Mr. H.S. Joyosupeno, General Manager
- Mr. Soetedjo, Board Member
- Mr. Anton Simon, Board Member
- Mr. Asmaun Tjahjadi, Board Member

2.11
P.T. Asia Indonesia Tobacco (AIT)

Factory:
Jl. Raya Jakarta - Bogor Km 24
P.O. Box 2451
Cijantung
Cable address "ASIATOB" Jakarta
Phone 849 726

- Mr. Asmaun Tjahjadi, Director

Office:
Jl. Hayam Wuruk No. 4 QX
Telex 45877 Jakarta
Phone 357 464

2.12
P.T. Allied Facific Dyechem

Cilangkap Industrial Estate (Jatiluhur)

- Mr. Cheppy Sudharyono

2.13
Indo-Bharat Rayon

Staple Fibre Plant Construction Site
Cilangkap Industrial Estate (Jatiluhur)

- Mr. P.L. Panchal, Civil Engineer

Office:
Indo-Bharat Rayon
43 Jl. Taman Pahalwan
Purwokerto

2.14
Jatiluhur Authority

Directorate of Power (POJ)
Jl. H. Agus Salim 69, Jakarta Puwat
Phones 341 506, 343 807, 345 239

- Mr. Donardi, Director
- Mr. Walujo, Chief Executive Civil Engineer

Also office in Jatiluhur
Phone (0264)21525

2.15
P.T. Pembangunan Jaya

Gedung Jaya 4th Floor
Jl. M.H. Thamrin - Jakarta
Telex 46244 ptjaya jkt
Phone 327 508

- Mr. I.T. Sarriola, Construction Manager

2.16
Directorate General for Basic Chemical Industries

Jl. Kebon Sirih 31, Jakarta, Pusat
Phones 323 235, 350 756, 327 430

- Mr. Hartarto, Director General
- Mr. Agil Dahlan, Director for Existing Industrial Development
- Mr. Erwin N.A., Director for Project Implementation

2.17
Wiratman and Associates

Consulting Engineers
Jl. Bendungan Hilir Raya
Kav. 36 a - Blok B No. 14-18
Phones 583 407, 583 769

- Mr. Wiratman Wangsadinata, President (Also Chairman of INKINDO, National Association of Indonesian Consultants)
- Mr. N. Rahardjo Muljono, Marketing Manager

2.18
P.T. Encona Engineering Inc.

Jl. Angkasa 32 Blok B 5.6.7
Jakarta
Phone 414 808

- Mr. Soufyan N. Noerbambang, Vice President

Branch office in Bandung (not far from Jatiluhur)

PULPING AND PAPERMAKING PROPERTIES OF INDONESIAN ROSELLE (HIBISCUS SABDARIFFA) FOR CIGARETTE PAPER MANUFACTURE

CONTENTS

SUMMARY

The suitability of rosella (Hibiscus sabdariffa, var. altissima) fibre for pulping, bleaching and papermaking was studied at laboratory and pilot-plant scale. The tests were carried out at the Tervakoski Oy mill, a well-known cigarette paper manufacturer.

Chemical analysis revealed that the rosella grade B fibre would be a suitable raw material for pulping. The high Kappa number, a measure of lignin content, and fairly high ash content indicated that an adequate alkali charge in cooking and sufficient refining before bleaching would be required for successful pulping.

It is probable that the manufacture of grade B rosella fibre has included retting and manual stripping. If, instead, the fibre were separated from the stalks mechanically (i.e. decorticated, without retting the stalks first), the resultant fibre would have a much higher hot water solubility and ash content. This would result in a higher alkali demand in cooking and could also cause difficulties in black liquor evaporation.

Laboratory-scale pulping tests of grade B rosella fibre indicated that an alkali charge of 17.5 % NaOH on raw fibre would be sufficient in combination with a maximum temperature of 160°C and a 2 hours reaction time at the maximum temperature. The unbleached pulp viscosity was above 1000 dm^3/kg and the Kappa number 10 to 15. These are good figures for successful bleaching. The pulping yield in laboratory cooks indicates that the yield of commercial-scale bleached pulp would be 50 to 55 %.

Pulp bleaching was carried out in three stages: chlorination, alkaline extraction and hypochlorite. The results show that the target brightness of 70...75 % ISO can be obtained with an active chlorine charge of 3 % of pulp in chlorination and 1 % in the hypochlorite stage. The viscosity can be maintained at the desired level. It is necessary to reduce the ash content of the cooked pulp before bleaching to reach the desired brightness.

Refining of rosella pulp the desired way, with the equipment available at Tervakoski, can be done only at commercial scale. The pilot-plant beater with its low edge load typically results in inadequate formation on the paper machine. Therefore the results of the pilot-plant tests must be compared with previous pilot-plant tests and corresponding trials at commercial scale.

In this case, the fibre furnish, 80 % rosella fibre plus 20 % bleached birch pulp with chalk as a filler, gave a quality of

paper on the pilot paper machine from which it can be predicted with fair confidence that the target quality of Tercig H4 can be obtained at commercial scale.

This prediction is based on experience from previous pilot-plant and corresponding commercial-scale trials at Tervakoski Oy's mill with flax (Linum usitatissimum), hemp (Cannabis sativa) and kenaf (Hibiscus cannabinus).

Porosity and sheet formation could be improved by adding more short-fibre pulp in the furnish. Without commercial-scale trials it is difficult to predict the maximum amount of short fibre that it would still be safe to use from the point of view of strength. What can be said with confidence is that up to 30...35 % could be added as short fibre.

2 OBJECTIVE AND SCOPE

The objective of the study was to investigate the pulping, bleaching and papermaking properties of rosella fibre in laboratory and pilot plant scale tests to verify its potential as a raw material for cigarette paper making.

The usability of rosella raw material in the manufacture of cigarette paper was compared with Tervakoski Oy's experience of flax, hemp, kenaf, etc. The international cigarette paper quality Tercig H4 was considered the target level.

Fibre length and fibre composition analyses were performed by the Finnish Pulp and Paper Research Institute. All other tests were carried out by Tervakoski Oy.

3 RAW MATERIAL AND EXPERIMENTAL WORK

3.1 Raw Material

3.1.1 General

Rosella, Hibiscus sabdariffa, var. altissima, is a tall, vigorous, practically unbranched plant, 3...5 m high, with fibrous, spiny, inedible calyces, grown for fibre.

It is a dicotyledon in the order Malvales included in the family Malvaceae, which contains about 50 genera and 1000 species of herbs and shrubs.

The economic genera of Malvaceae are Urena, Hibiscus and Gossypium (cotton). In the Hibiscus genera are three economic species, Hibiscus cannabinus (kenaf), Hibiscus esculentus (okra) and Hibiscus sabdariffa, which has two variations, i.e. var. sabdariffa and var. altissima.

In Indonesia the best rosella variety is designated as HS 40.

3.1.2
Sample

Four types of rosella material were received:

1 rosella stalks (lower, middle and upper part with seed capsules of stalk)
2 grade B (commercial raw fibre)
3 " A (" ")
4 " C (" ")

The amount of grade B fibre was 90 kg and the amounts of grades A and C fibre 10 kg each.

3.1.3
Decortication of Rosella Stalks

The stalks (Picture 4.2) were broken with a breaker machine which had six pairs of breaking rolls. Scutching was done by hand to reach adequate fibre quality (Picture 4.3).

Note that this treatment was purely mechanical and did not include any steeping in water (retting) or other biological or chemical treatment.

The fibre yield was 35 %.

This method is called decortication.

3.1.4
Further Treatment of Raw Fibre

The decorticated fibre sample and the grades A, B and C raw fibre samples (Picture 4.1) were cut to 10...30 mm lengths with a guillotine-type cutter (Picture 4.4) and each mixed carefully to get a representative sample for analysis and further experiments.

3.1.5
Raw Material Analysis

The raw fibre samples were analysed for fibre length, distribution, percentage of various fibres, solubility in hot water, extractives content, ash content, Kappa number and pentosans content.

3.2
Cooking and Washing

The cooking method employed can be described as a soda cook with small amount of sulphur added.

To find suitable cooking conditions for larger laboratory cooks, the raw material was cooked at microscale using different alkali charges and cooking times. The rising time was 2 hours, maximum temperature was a constant 160 °C, the amount of alkali, NaOH, varied, the amount of sulphur was constant at 1 % on bone dry (BD) raw fibre, and the liquor-to-fibre ratio was 7 : 1.

The amount of raw fibre in micro-scale cooking was 100 g.

The larger laboratory cooks were carried out with 1.5 kg raw fibre.

Cooked pulps were washed several times with hot water using alternate soaking and thickening.

The washed fibre was defibrized in a Valley hollander to a degree of beating of 30^{o}SR for easier bleaching.

3.3 Bleaching

The target brightness was 70...75 % ISO and the bleaching sequence used was chlorine - alkali - hypochlorite. The conditions in the laboratory scale studies were as follows.

Item	Bleaching stage		
	Chlorination = C	Alkaline extraction = E	Hypochlorite stage = H
Chemical dosage, % on BD fibre			
- active chlorine	1, 2 & 3		1
- NaOH		2	
Consistency, %	3	10	6
Temperature, ^{o}C	25	50	40
Reaction time, min	45, 60 & 90	60	60

The chemical in the C stage was chlorine water and in the H stage sodium hypochlorite.

The larger laboratory cooks were combined after washing and defibrized and bleached in one batch.

3.4 Pilot Paper Machine Trial

In the pilot paper machine trial the cigarette paper quality Tercig H4 was aimed at. Typical features of this quality are a porosity of 4 um/Pa x s and a tensile strength of 0.95 kN/m and opacity (Ro) of 71.

The bleached pulp was beaten in a hollander.

4 RESULTS AND DISCUSSION

4.1 Properties of Raw Material

4.1.1 General Appearance

Picture 4.1 cl ·rly shows the differences between the samples.

A stalk sample is lower left, a grade A sample upper left has light, soft fibre bundles, grade C (upper right) has dark, hard bundles, and grade B (lower right) has quite light, soft bundles.

Picture 4.3 shows the fibre obtained in (dry) decortication.

4.1.2 Raw Material Analysis

The analysis results for the four rosella fibre samples are given in Table 4-1.

Table 4-1
Analysis Results of Rosella Fibre Samples

	Grade B	Grade A	Grade C	Decorticated fibre (not retted)
Hot water solubility, %	1.39	1.20	1.58	7.42
Dichlormethane, CH_2Cl_2, extractives, %	0.49	0.47	0.66	0.65
Ash, %	3.26	0.88	11.34	4.49
Kappa number	44	48	46	57
Pentosans, %	16.1	16.1	13.2	15.7

Rosella grade B fibre has a medium ash content, a high pentosans content, a low extractives content and a surprisingly high Kappa number (lignin content).

The composition of rosella grades A and C differ from grade B, as can be expected. The fibre that was separated from the stalks with (dry) decortication has a high solubility in hot water, and such a high ash content that it may result in difficulties in evaporation of the black liquor.

The composition of the grade B rosella fibre, the intended raw material, is given in Table 4-2, and the fibre length distribution in Figure 4/1.

The fibre length of rosella grade B can be characterized as follows:

- range	mm	0.9...5.7
- arithmetic average	mm	2.78
- average length by length	mm	2.97

The results of the analysis of the grade B rosella fibre can be summarized by stating that it seems to be a suitable raw material for pulping. The high ash content is probably the only characteristic which could result in difficulties if it is not controlled before bleaching.

4.2 Cooking Tests

4.2.1 Experiments at Small Laboratory Scale

To find suitable cooking conditions for rosella fibre, cooking was performed with various alkali charges and various cooking times. The results are summarized in Table 4-4 and Figures 4/2 to 4/5.

The results show that at 160°C cooking temperature 2 h cooking time is sufficient. Delignification does not proceed significantly after this. It must be emphasized that the rising time of a cook as as long as 2 h and the reaction naturally proceeded fairly far during this period. The results indicate that alkali charge is the main command variable. The amount of residual alkali indicates that 17.5 % alkali charge is suitable.

The pulping yield in the small-scale cooking was fairly high, about 70 %. However, this could not be reproduced in larger scale cooks. The high yield of the small scale cooks is due to incomplete washing of pulp (no refining, ash content 1...3 %) and minimum fibre loss. In large-scale operations the expected cooking yield could be seom 51...57 %.

Viscosity of the pulp was good for further processing. For successful bleaching, an initial viscosity above 1000 dm^3/kg is a good starting point.

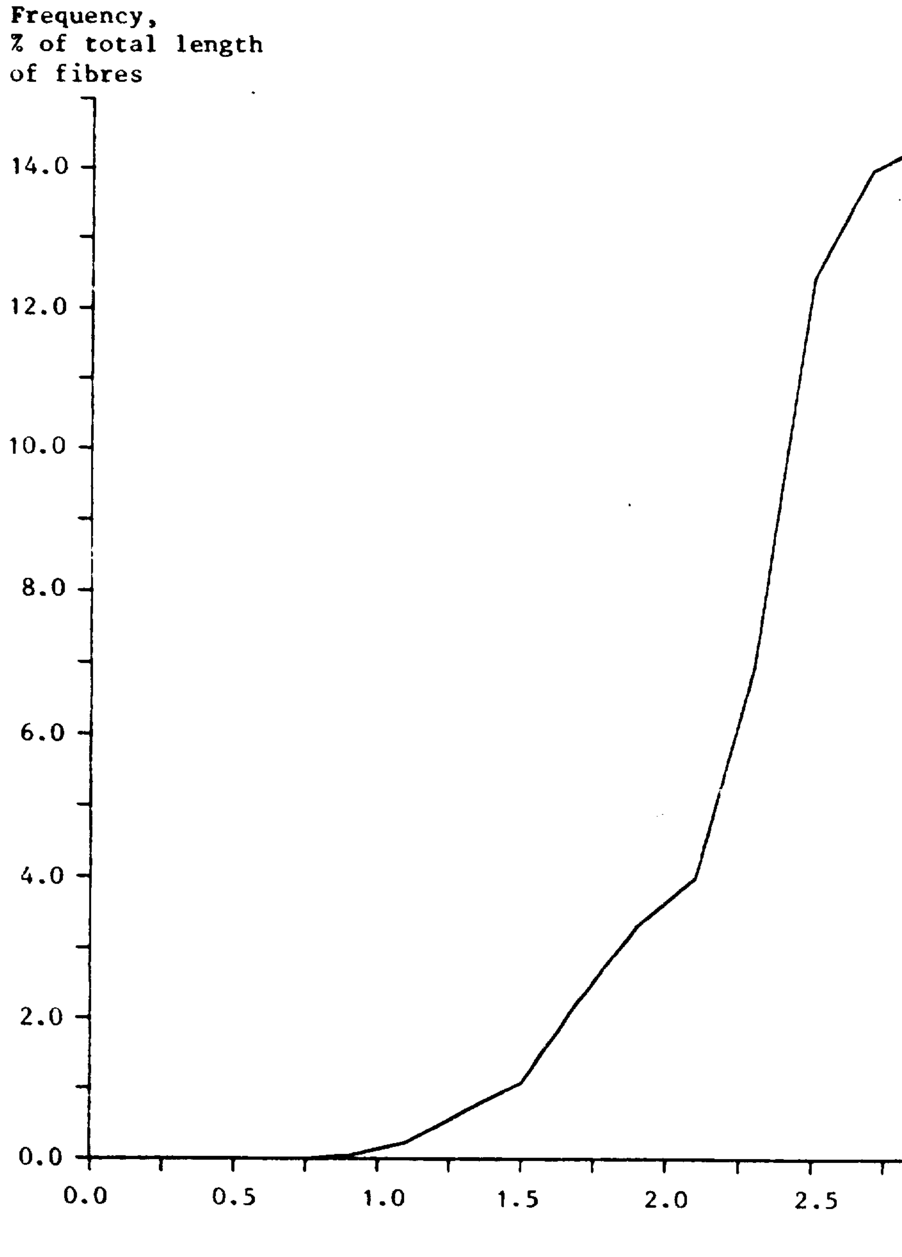
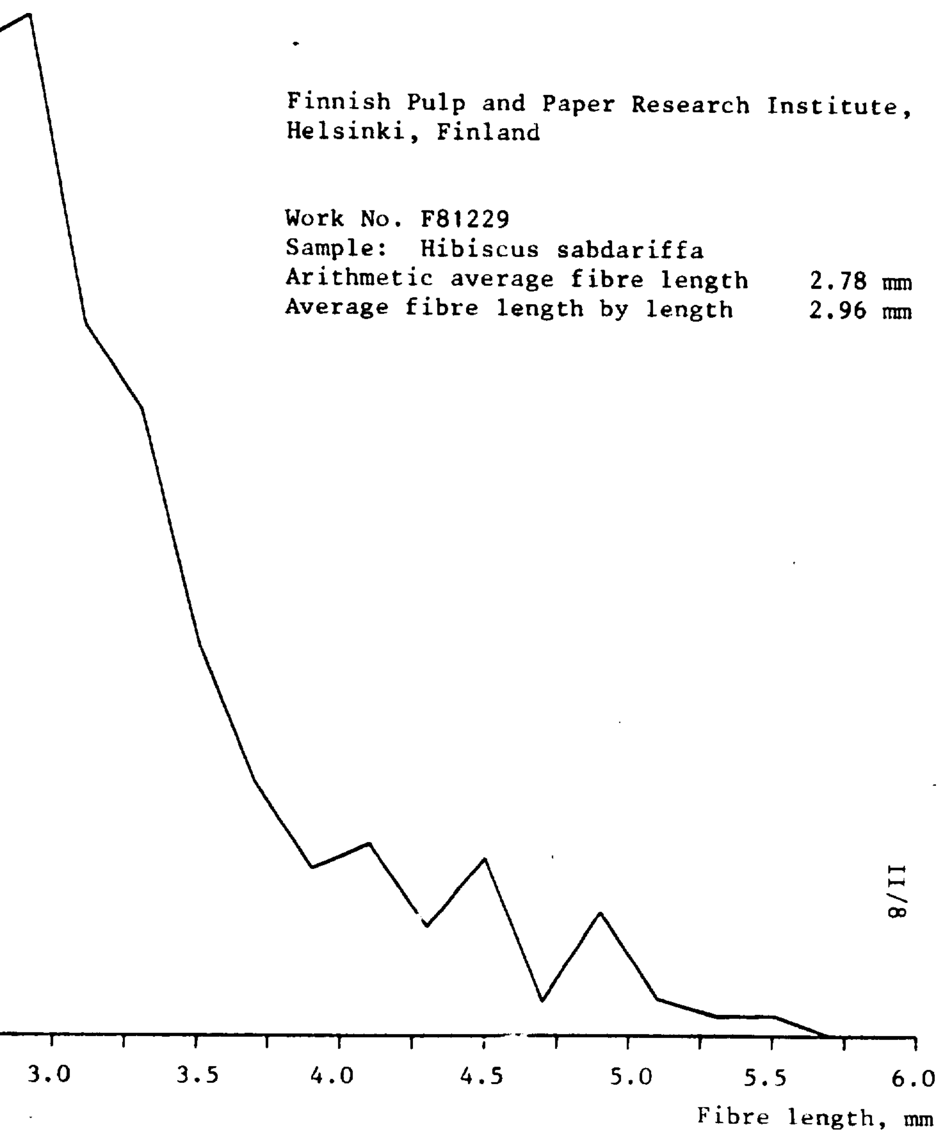
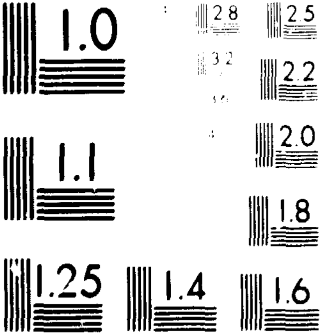

Frequency,
% of total length
of fibres
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5

Figure 4/1
Fibre Length Distribution

Finnish Pulp and Paper Research Institute,
Helsinki, Finland

Work No. F81229
Sample: Hibiscus sabdariffa
Arithmetic average fibre length 2.78 mm
Average fibre length by length 2.96 mm





MICROCOPY RESOLUTION TEST CHART

Table 4-4
Small-scale Laboratory Cooking of Rosella Grade B Fibre

Cooking conditions:

Fixed
- raw fibre, 100 g BD
- elemental sulphur charge, 1 % on BD raw fibre
- liquor-to-fibre ratio, 7 : 1
- rising time to 160°C, 2 h

Variable
- NaOH charge, % on BD raw fibre
- time at 160°C, h

Results:

Alkali, % NaOH	Kappa number			Viscosity, SCAN dm^3/kg			Yield, %			Ash, %			Residual alkali, g/l		
	1 h	2 h	3 h	1 h	2 h	3 h	1 h	2 h	3 h	1 h	2 h	3 h	1 h	2 h	3 h
7.5	74			1 085			90			1.1			-		
10.0	59	58	60	1 090	1 140	1 190	92	82	80	1.1	1.4	1.5	0.2	-	0.3
12.5	49	54	52	1 065	1 110	1 040	82	80	76	1.4	1.6	3.1	0.8	0.2	0.5
15.0	32	20	19	1 130	1 200	1 320	74	74	68	1.3	1.2	2.3	2.1	2.1	3.2
17.5	23	14	11	1 030	1 050	950	74	71	67	1.3	1.0	1.4	4.8	4.3	6.1
20.0	19	15	9	900	1 025	1 005	69	70	65	0.9	1.2	1.8	7.2	7.0	9.1
22.5		12	12		965	1 040		70	67		1.0	0.8		9.1	11.8

TERVAKOSKI OSAKEYHTIÖ

LABORATORY COOKS OF ROSELLA

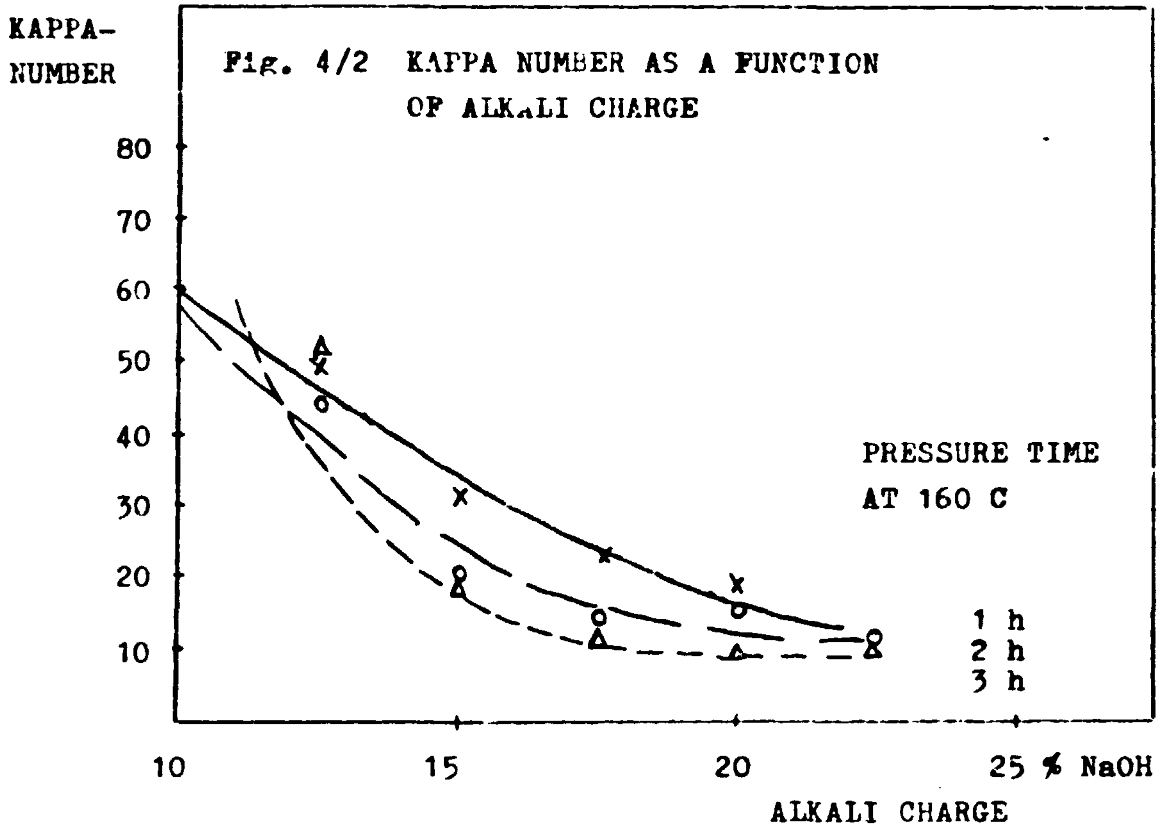


Fig. 4/2 KAPPA NUMBER AS A FUNCTION OF ALKALI CHARGE

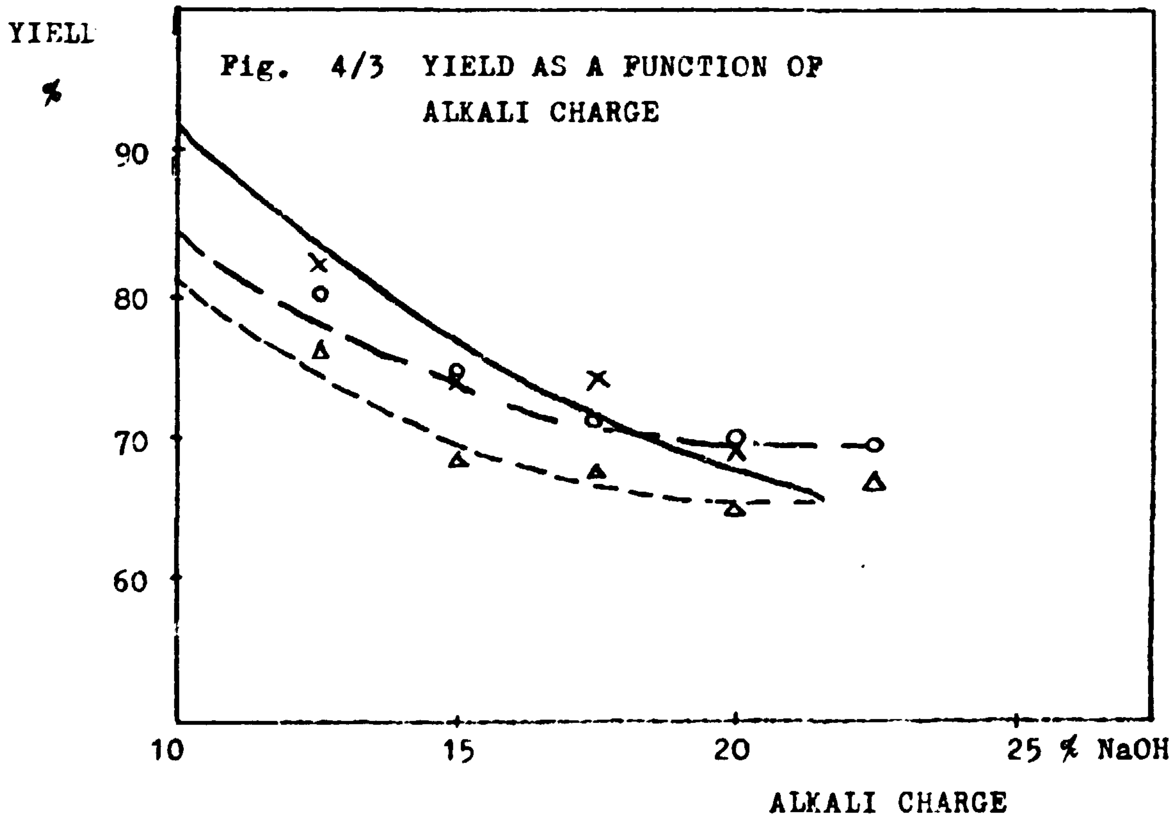
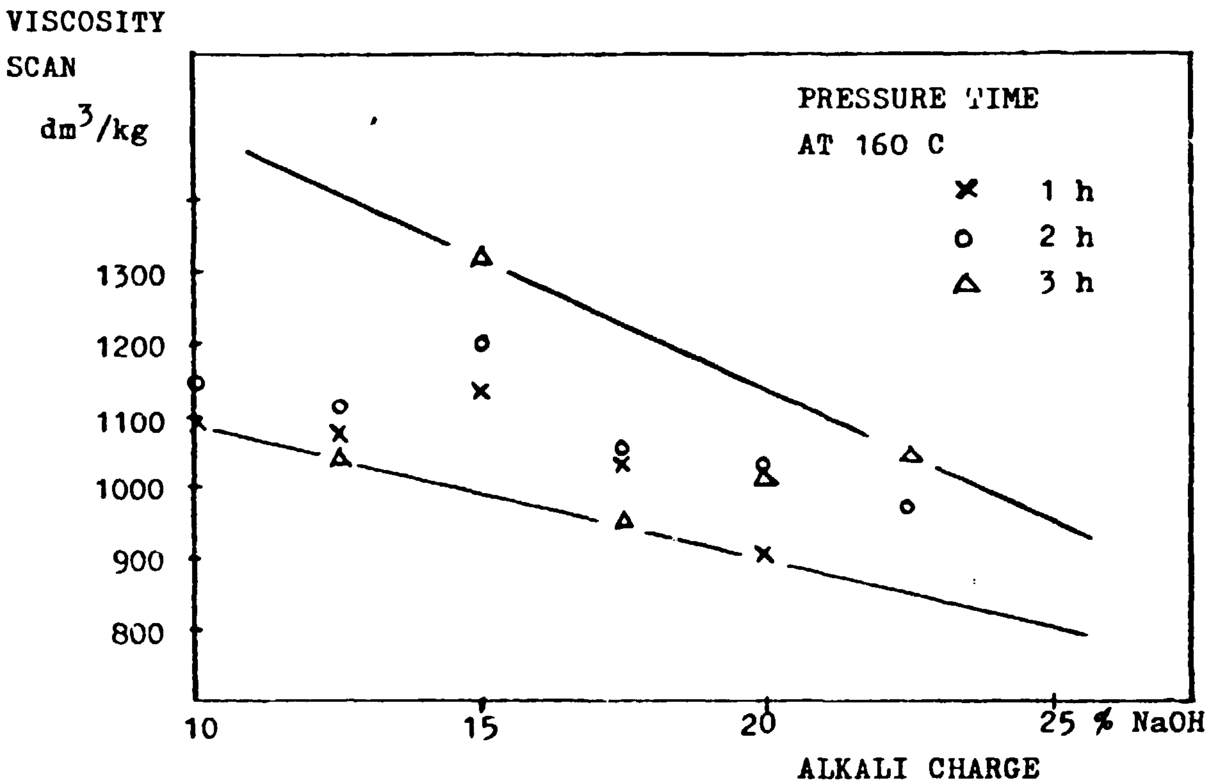


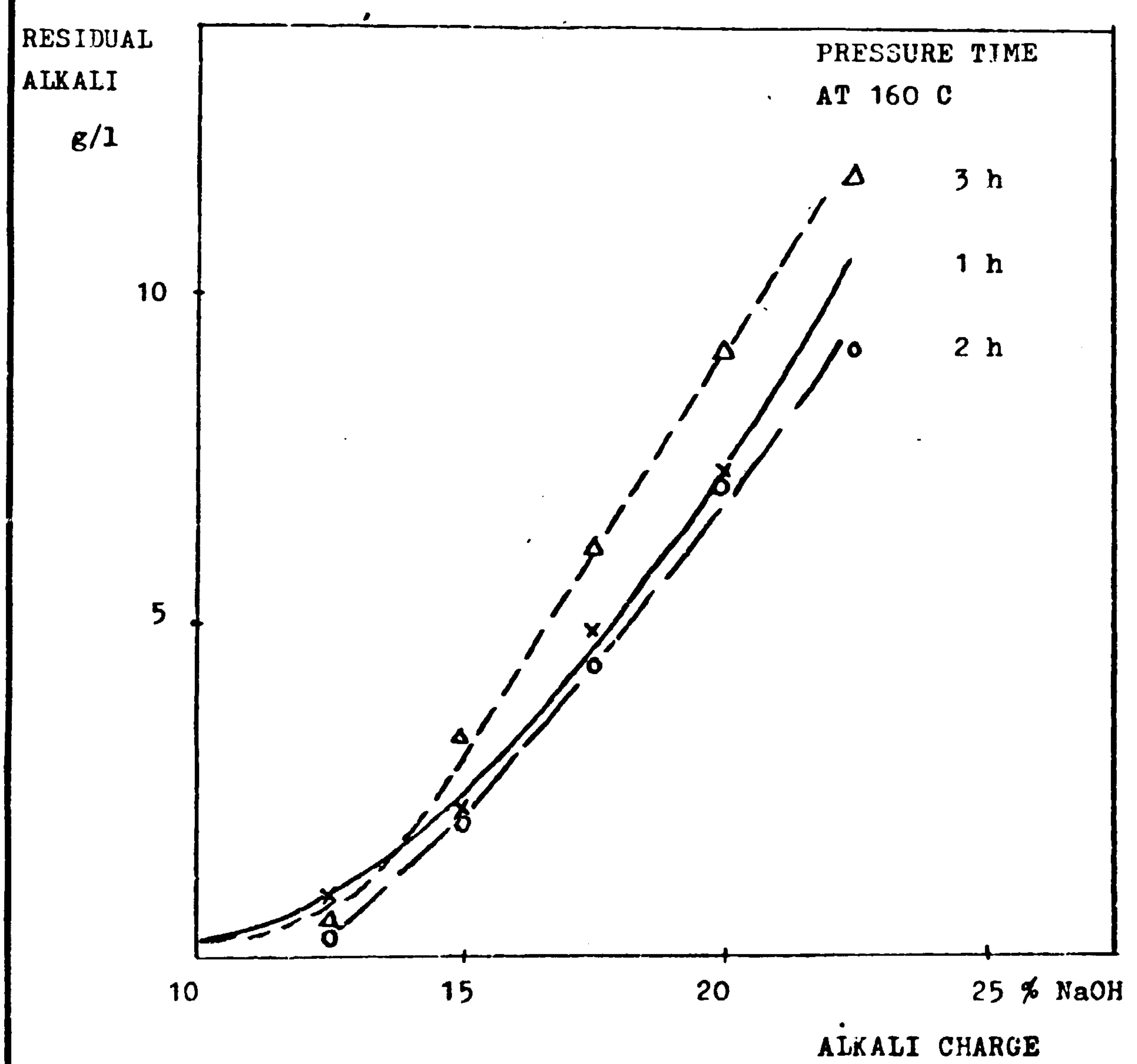
Fig. 4/3 YIELD AS A FUNCTION OF ALKALI CHARGE

Fig. 4/4 VISCOSITY AS A FUNCTION OF ALKALI CHARGE



LABORATORY COOKS OF ROSELLA

Fig. 4/5 RESIDUAL ALKALI AS A FUNCTION OF ALKALI CHARGE.



4.2.2
Larger Laboratory Cooks

On the basis of the results of the small laboratory cooks, 17.5 % NaOH charge and 2 h pressure time were selected for larger cooks.

To wash sand and mud from the pulp the washed pulp was beaten in a Valley hollander to 35 °SR freeness, and the pulp was then pumped through the pilot paper machine centrifugal cleaning line.

The unbleached pulp was analysed following this treatment. The results are given in Table 4-2.

Table 4-2
Results of Analysis of the Unbleached Pulp

Kappa number		10
Viscosity, SCAN	dm^3/kg	1 065
Ash	%	0.92
Brightness, ISO	%	35.5

4.3
Bleaching Tests

4.3.1
Experiments at Laboratory Scale

Laboratory bleaching was carried out to find correct bleaching conditions for pilot-scale bleaching.

Figures 4/6 and 4/7 show that 3 % chlorine dosage with 60 min reaction time and 1 % hypochlorite dosage with longer than 60 min reaction time give the target brightness with a high viscosity value.

4.3.2
Experiment at Pilot Scale

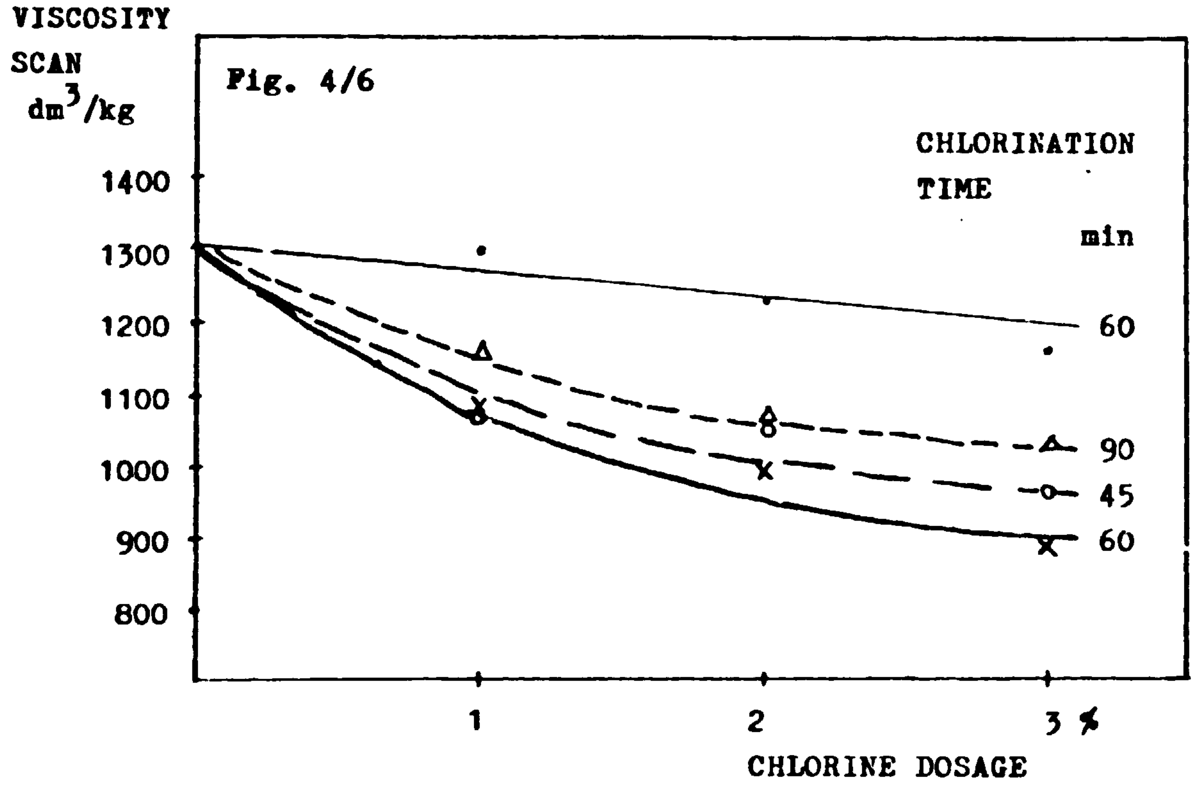
The pilot-scale bleaching was carried out as follows:

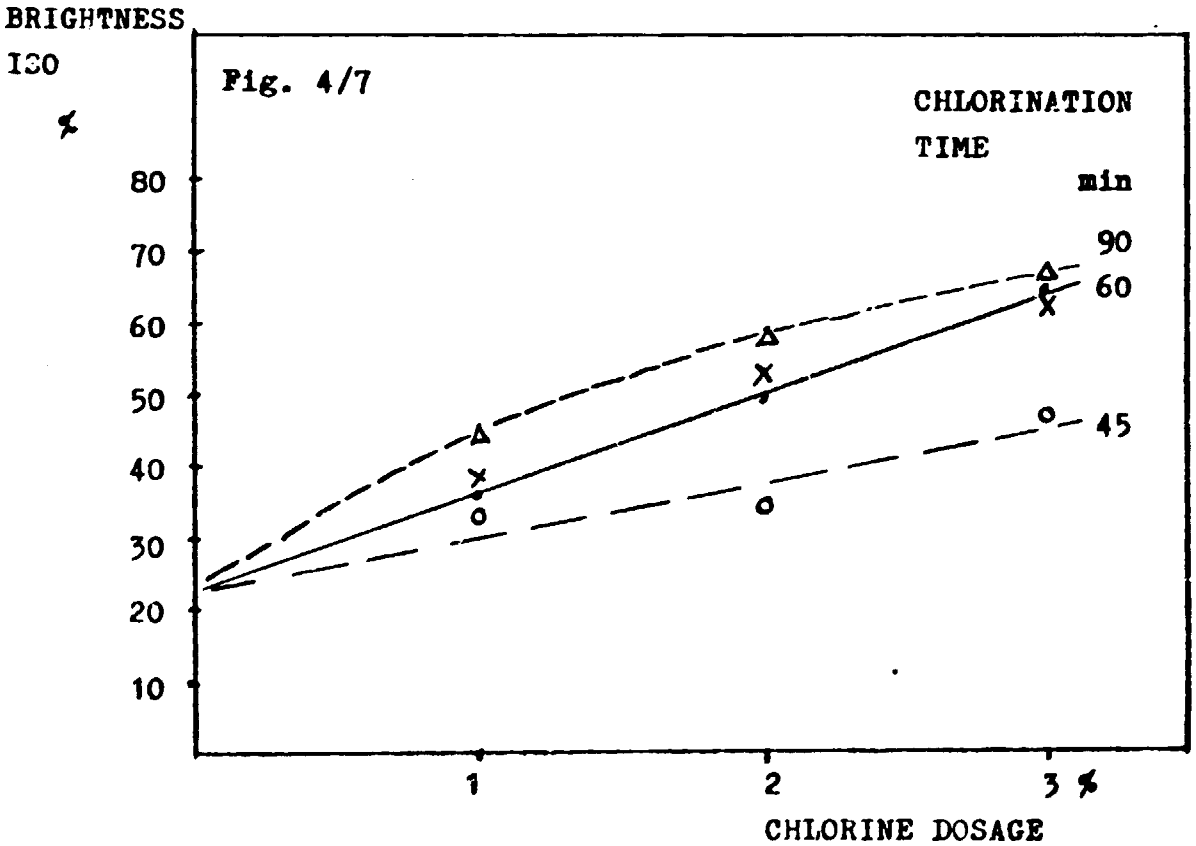
	Stage		
	C	E	H
Active chlorine dosage, %	3	2	1
Consistency, %	3.5	8	6
Temperature, °C	25	50	40
Time, min	60	60	180
pH	2.2	10.8	10.8

TERVAKOSKI OSAKEYHTIÖ

LABORATORY BLEACHING OF ROSELLA

II/14





Päiväys:	Laatinut:	Huomautuksia:	Sivu No	Piir. No

Table 4-3
Properties of the Bleached Pulp

Brightness, ISO	%	73.8
Viscosity, SCAN	dm^3/kg	610
Ash	%	0.76
Pentosans	%	12.9

The brightness was at the target level. Viscosity was lower than expected because of the 180 min reaction time in the hypo stage.

4.4 Beating in the Pilot Paper Machine Line

The pulp was beaten in the pilot paper machine hollander before and after bleaching. The results were as follows:

Time, min/kg	Freeness (degree of beating), $^{\circ}SR$	Fibre length index FLI, g	Consistency, %	Specific edge load, Ws/m
0	14	4.5	2.5	0
6.5	18.5	2.65	"	1.0...0.6
13	22.5	2.2	"	0.5
20	26	2.0	"	"
25	35	1.85	"	"
Removal of sand and bleaching				
40	87	0.80	2.1	0.5
47.5	92	0.55	"	"
55	95	0.31	"	"

Total beating energy	12 000 MJ/t
Pure beating energy	2 500 "

Because of the hollander's very low specific edge load (0.5 Ws/m) the fibre length index was left too high compared with the degree of beating. The preferred edge load value is 5...6 Ws/m. This high an edge load can be obtained with, for instance, a deep angle conical refiner.

After mixing with birch fibres and chalk, the freeness decreased to 61° and the FLI value increased to as high a value as 1.26 owing to flocking of rosella fibres. With machine beaters the freeness increased to the desired level of 84°SR, but the FLI value remained too high at 0.53 g. Good cigarette paper sheet formation needs 85°SR freeness and a 0.3 g FLI value.

Table 4-5
Properties of Pulp Suspension After Different Paper Machine Steps

	Consistency, %	Freeness, ^{o}SR	FLI, g
After rosella fibre beating	1.1	95	0.32
After mixing of 20 % bleached birch fibre	1.6	89.5	0.63
After mixing of 65 % chalk from fibre furnish	1.8	61	1.26
After machine beaters	1.2	84	0.53
In the head box	0.25	85	-

4.5
Papermaking Tests

Table 4-6 shows the properties of paper made in pilot paper machine trials and at commercial scale.

Table 4-6
Properties of Cigarette Paper in Pilot Paper Machine Trials Versus Properties at Commercial Scale

		Rosella trial in pilot paper machine	Flax trial in pilot paper machine	Flax at commercial scale	Target (Tercig H4)
Basis weight	g/m^2	24.1	24	24	24
Tensile MD	kN/m	0.80	0.76	0.98	0.95 (sized)
" CD	kN/m	0.37	0.42	0.44	
Stretch MD	%	1.1	1.1	1.9	
" CD	%	1.6	3.2	4.0	
Porosity	µm/Pa x s	5.2	6.4	4.0	4
Opacity	R_0	65.8	74.3	70.0	71
Ash	%	13.4	17.0	14.1	17...18
Brightness ISO	%	85.4	88.5	88.0	88

As mentioned before, the flocculation of fibres in the pilot paper machine line caused quite poor sheet formation, a lower ash content and therefore lower brightness and opacity values.

Experience from previous trials of annual plant fibre at Tervakoski Oy shows that the properties of cigarette paper in this particular trial are such that commercial-scale operation with harsher beating (specific edge load 5...6 Ws/m) of bleached rosella pulp would probably result in the target, Tercig H4, cigarette paper quality.

5 CONCLUSIONS

The following conclusions concerning the design data for . cigarette paper mill can be drawn from the present results:

- To ensure good processability of rosella grade B during pulp and paper making processes, the raw fibre has to be chopped to a particle length not exceeding 25...30 mm.

- In case rosella stalks were used as raw material, a tentative value for decortication yield of 30...35 % could be used for evaluations. Decorticated fibres have a high hot-water solubility, and high ash content. Cooking of this type of raw fibre would require more alkali, mainly owing to the higher lignin content.

- The total alkali charge in cooking would be 15...20 % NaOH on BD raw material, depending on the degree of retting. A part of the alkali would come with filling black liquor; the amount of make-up alkali would depend on the black liquor concentration.

- The yield of bleached pulp could be around 50...55 %.

- To improve ash removal, the pulp must be refined after cooking.

- When ash removal is efficient enough and the Kappa number of unbleached pulp is 10...15, about 3 % chlorine and a hypochlorite charge of 1 % is needed to obtain a brightness of 70...75 % ISO.

- The harshest possible beating (up to 6 Ws/m specific edge load) has to be applied in basis beating to obtain the right SR - FLI relationship. 85 °SR and 0.3 g FLI should be suitable values.

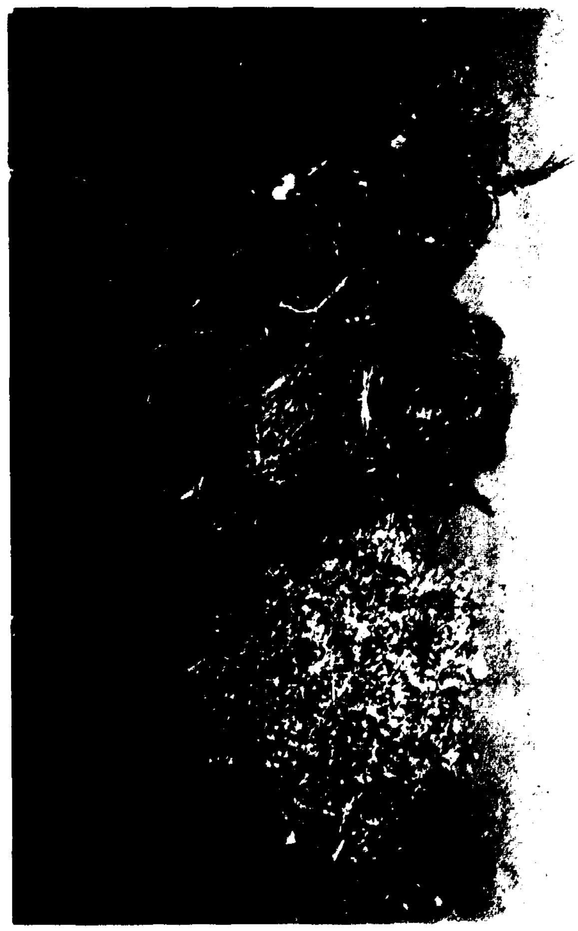
- Tercig H4 target paper quality was not reached in the pilot paper machine trial. It can be stated from previous experience that the target quality could be reached by using commercial-scale refiners, as parallel results, with flax pulp as an example, show.

Picture 4.1

Picture 4.4

Picture 4.2

Picture 4.3



UNBLEACHED ROSELLA

PULP

TERVAKOSKI OSAKEYHTIÖ SUOMI FINLAND

BLEACHED ROSELLA

PULP

TERVAKOSKI OSAKEYHTIÖ SUOMI FINLAND

PILOT PAPER MACHINE
TRIAL
UNSIZED CIGARETTE
PAPER

TERVAKOSKI OSAKEYHTIÖ SUOMI FINLAND

TERCIC H 4

TERVAKOSKI OSAKEYHTIÖ SUOMI FINLAND

WATER ANALYSES

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III/2

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Mr. Juhani Anhava
P.O.Box 16
00401 HELSINKI 40

Your ref. Our ref. Mrs. L. Tolvanen Date Helsinki, May 25, 1981

P.T. Jatiluhuv, K 3918

Water Research Laboratory
Research No 106/81/5600

Sample: River Citarum, Indo Bharat Construction site Between villages Cilangkap and Curuk after fairly substantial rainfall

Time of sampling: March 28, 1981

Water analysis:

pH-value		7,1
Conductivity at 25°C	m S/m	14,6
Turbidity	FTU	45
Suspended solids, 1 µm	mg/l	45
COD_{Mn}	"	53
Colour, Pt	"	140
Chlorides, Cl	"	5
Sulphates, SO_4	"	8
Silicates, SiO_2	"	16
Iron, Fe	"	2,3
Manganese, Mn	"	0,06
Calcium, Ca	"	15
Magnesium, Mg	"	3,7
Sodium, Na	"	7,4
Potassium, K	"	1,9

OY VESI-HYDRO AB

Mauri Pasanen

LABORATORIUM TEKNIK PENYEHATAN
LABORATORY OF SANITARY ENGINEERING
INSTITUT TEKNOLOGI BANDUNG
JALAN GANESHA 10 BANDUNG - TILP. 82647; 82051 - 82055, PES 432

PEMERIKSAAN / EXAMINATION

No. : KA.376E/80
Ag.No.: 393/TP/A.2/80.

Contoh / Sample : Air Sungai Citarum

Pengirim / Sender : Sdr. Sjamsudin H.
Forum Otorita Jatiluhur

Diterima tanggal / Date Received : 3 September 1980.

Warna / Colour	: 10 units Pt-Co	Lumpur Kasar / Settleable Solids	:	%-Vol. (: men/min)
Kekeruhan / Turbidity	: 4 mg/L SiO_2	Zat dalam Suspensi / Suspended Solids	:	mg/L
Daya Hantar Listrik / Electr. Conductance	: 238 μ-mhos/cM	Zat Terlarut / Dissolved Solids	:	mg/L
N - ammonia	: mg/L (NH_4)	Zat Padat Total / Total Solids	:	mg/L (Ev.: °C)
- proteid	: mg/L (NH_3)	Sisa Pemijaran / Residue on Ignition	:	mg/L (@ °C)
- nitrit	: mg/L (NO_2)	Zat Organik / Organic Matter	: 1,23	mg/L $KMnO_4$
- nitrat	: mg/L (NO_3)	C.O.D. (: $KMnO_4$)	:	mg/L
pH	: 7,1	B.O.D. (5 H ; 20°C)	:	mg/L
SiO_2	: mg/L			

Na	:	mg/L	me/L	HCO_3	: 67	mg/L	me/L
K	:	mg/L	me/L	CO_3	:	mg/L	me/L
Ca	: 14,0	mg/L	me/L	OH	:	mg/L	me/L
Mg	: 5,03	mg/L	me/L	SO_4	: 3,2	mg/L	me/L
Fe	: 0,15	mg/L	me/L	Cl	: 11,9	mg/L	me/L
Mn	: 0,0	mg/L	me/L	PO_4	:	mg/L	me/L
Al	:	mg/L	me/L	NO_3	:	mg/L	me/L
( )	:	mg/L	me/L	F	:	mg/L	me/L
			me/L				me/L

CO_2	: 8,8 mg/L	Alkalitet Total / Total Alkalinity	:	me/L	
CO_2-agresif / CO_2-agressive	: 7,8 mg/L	Kesadahan Total / Total Hardness	:	me/L	3,13 °G
Logam Berat / Heavy Metals	: negatip mg/L	Alkalitet Sisa / Residual Alkalinity	:	me/L	
Daya Pengikat Chlor / Chlorine Demand	: 0,89 mg/L	Silikat Sisa / Residual Silicate	:	me/L	
Sisa Chlor / Residual Chlorine	: mg/L				

Bandung, 10 September 1980

Ir. Ny. Teti K. Sumardi
An. Kepala Laboratorium
Chief of the Laboratory

INVESTMENT ESTIMATE

JAAKKO PÖYRY

INVESTMENT ESTIMATE

Reg. No.

Page No.

Project	Project No.	Cost area
P.T. Kertas Jatiluhur, Indonesia	K3918	Cigarette paper mill

COST OBJECT 1000 USD

AREA CODE	COST AREA SPECIFICATION	0 Unclassified	1 Civil Works	2 Machinery	3 Piping	4 Electrical	5 Process control	6 Painting & Insulation		9 Spare parts	0...9 TOTAL
	Rosella storage and handling		370	260	60	10	-	·		20	720
	Pulping		610	780	25	70	20	5		35	1 545
	Bleaching		-	380	20	25	30	5		10	470
	Purchased pulp storage & handling		-	70	5	20	-	-		5	100
	Paper mill		1 040	9 200	550	900	450	40		850	13 030
	Evaporation		5	180	40	5	40	10		5	285
	Chemicals & additives preparation		75	390	40	40	70	-		10	625
	Fresh water treatment		260	400	60	25	30	-		20	795
	Effluent treatment		150	10	80	7	-	-		-	247
	Steam boiler		95	390	60	30	70	30		15	690
	Power distribution (400 V)		-	-	-	130	-	-		-	130
	Maintenance		700	1 950	20	90	-	-		20	2 780
	Offices, laboratory, personnel rooms		1 100	600	20	90	-	-		-	1 810
	Mobile equipment			260	-	-	-	-		15	275
	Mill site		620	-	170	60	-	20		-	870
	Temporary works and services	1 000	-	-	-	-	-	-		-	1 000
	Studies and engineering services	3 500	-	-	-	-	-	-		-	3 500
	Construction management, site supervision	1 000	-	-	-	-	-	-		-	1 000
	Project administration, preoperating and start-up expenses	1 000	-	-	-	-	-	-		-	1 000
	Land	350	-	-	-	-	-	-		-	350
	Subtotal	6 850	5 025	14 870	1 150	1 502	710	110		1 005	31 222
	Contingencies										3 078
	TOTAL										34 300

SUPPORTING DATA FOR PROJECT ECONOMICS

VARIABLE COST

Pulp Grade: Bleached rosella pulp
Cost Level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per ADt	Cost USD/ADt
A1 Fibre				
- unbleached rosella	ADt	320	2.0	640.0
A3 Chemicals				
Cooking				
- NaOH	kg	.445	264	117.5
- Sulphur	kg	.190	18	3.4
- Other				-
				120.9
Bleaching				
- Cl_2	kg	.450	36	16.2
- NaOH	kg	.450	24	10.8
- Other				-
				27.0
Total chemicals				147.90
A4 Energy				
- electricity	kWh	0.03	1000	30.0
- fuel oil	kg	0.090	475	42.8
- diesel oil	kg	0.150	-	-
				72.8
A6 Other variable costs				-
A1-A6 TOTAL VARIABLE COSTS				860.7

VARIABLE COST

Pulp grade: Cigarette paper
Cost level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per t	Cost USD/t
A2 Fibre				
- bl. rosella pulp	ADt	860.7	.525	451.9
- bl. softwood kraft pulp	ADt	670.0	-	-
- bl. hardwood kraft pulp	ADt	641.0	.225	144.2
				596.1
A3 Chemicals				
- CaO	kg	0.075	235	17.6
- titanium dioxide	kg	2.035	-	-
- starch	kg	0.520	90	46.8
- surface sizing	kg	3.245	-	-
- impregnants	kg	1.210	70	84.7
- colouring	kg	1.575	-	-
- water treatment				4.1
- other				2.0
				155.2
A4 Energy				
- electricity	kWh	0.03	2400	72.0
- fuel oil	kg	.090	350	31.5
- diesel oil	kg	.150	2.5	0.4
				103.9
A5 Packaging				70.0
A6 Other variable costs				2.0
A1-A6 TOTAL VARIABLE COSTS				927.2

VARIABLE COST

Paper Grade: Tipping base
Cost Level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per t	Cost USD/t
A2 Fibre				
- bl. rosella pulp	ADt	860.7	-	-
- bl. softwood kraft pulp	ADt	670	.460	308.2
- bl. hardwood kraft pulp	ADt	641	.460	294.9
				603.1
A3 Chemicals				
- CaO	kg	0.075	105	7.9
- titanium dioxide	kg	2.035	8	16.3
- starch	kg	0.520	75	39.0
- surface sizing	kg	3.245	-	-
- impregnants	kg	1.210	-	-
- colouring	kg	1.575	37	58.3
- water treatment				2.8
- other				2.0
				126.3
A4 Energy				
- electricity	kWh	0.03	1950	58.5
- fuel oil	kg	.090	490	44.1
- diesel oil	kg	.150	2.5	0.4
				103.0
A5 Packaging	kg	1.100	10	11.0
A6 Other variable costs				2.0
A1-A6 TOTAL VARIABLE COSTS				845.4

VARIABLE COST

Paper Grade: Plug wrap
Cost Level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per t	Cost USD/t
A2 Fibre				
- bl. rosella pulp	ADt	850.7	-	-
- bl. softwood kraft pulp	ADt	670	.430	288.1
- bl. hardwood kraft pulp	ADt	641	.430	275.6
				563.7
A3 Chemicals				
- Cao	kg	0.075	151	11.3
- titanium dioxide	kg	2.035	-	-
- starch	kg	0.520	-	-
- surface sizing	kg	3.245	37	120.1
- impregnants	kg	1.210	-	-
- colouring	kg	1.575	-	-
- water treatment				2.8
- other				2.0
				136.2
A4 Energy				
- electricity	kWh	0.03	1950	58.5
- fuel oil	kg	.090	490	44.1
- diesel oil	kg	.150	2.5	0.4
				103.0
A5 Packaging	kg	1.100	10	11.0
A6 Other variable costs				2.0
A1-A6 TOTAL VARIABLE COSTS				815.9

VARIABLE COST

Paper Grade: Thin printing
Cost Level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per t	Cost USD/t
A2 Fibre				
- bl. rosella pulp	ADt	860.7	-	-
- bl. softwood kraft pulp	ADt	670	.640	428.8
- bl. hardwood kraft pulp	ADt	641	.160	102.6
				531.4
A3 Chemicals				
- CaO	kg	0.075	154	11.6
- titanium dioxide	kg	2.035	50	101.8
- starch	kg	.520	-	-
- surface sizing	kg	3.245	30	97.4
- impregnants	kg	1.210	-	-
- colouring	kg	1.575	-	-
- water treatment				2.8
- other				2.0
				215.6
A4 Energy				
- electricity	kWh	0.03	1950	58.5
- fuel oil	kg	.090	490	44.1
- diesel oil	kg	.150	2.5	0.4
				103.0
A5 Packaging	kg	1.100	10	11.0
A6 Other variable costs				2.0
A1-A6 TOTAL VARIABLE COSTS				863.0
				=====

VARIABLE COST

Paper Grade: Manifold etc.
Cost Level: Third quarter 1981

Item	Unit	Unit price USD	Unit consumption per t	Cost USD/t
A2 Fibre				
- bl. rosella pulp	ADt	860.7	-	-
- bl. softwood kraft pulp	ADt	670	.800	536.0
- bl. hardwood kraft pulp	ADt	641	.210	134.6
				670.6
A3 Chemicals				
- Cao	kg	0.075	42	3.2
- titanium dioxide	kg	2.035	-	-
- starch	kg	.520	-	-
- surface sizing	kg	3.245	20	64.9
- impregnants	kg	1.210	-	-
- colouring	kg	1.575	-	-
- water treatment				2.8
- other				2.0
				72.9
A4 Energy				
- electricity	kWh	0.03	1950	58.5
- fuel oil	kg	.090	490	44.1
- diesel oil	kg	.150	2.5	0.4
				103.0
A5 Packaging	kg	1.100	10	11.0
A6 Other variable costs				2.0
A1-A6 TOTAL VARIABLE COSTS				859.5
				=====

JAAKKO PÖYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 1

CASH FLOW STATEMENT (1000 USD)

	-3	-2	-1	1	2	3
PRODUCTION (T)						
-CIGARETTE PAPER	0	0	0	2450	3150	3500
TOTAL PRODUCTION	0	0	0	2450	3150	3500
TOTAL SALES INCOME	0	0	0	8252	10609	11788
VARIABLE COSTS						
-ROSELLA FIBRE	0	0	0	823	1058	1176
-PULP	0	0	0	353	454	505
-CHEMICALS	0	0	0	598	768	854
-ENERGY	0	0	0	348	448	498
-PACKING MATERIAL	0	0	0	171	220	245
-OTHER	0	0	0	5	6	7
TOTAL VARIABLE COSTS	0	0	0	2299	2956	3284
CONTRIBUTION MARGIN	0	0	0	5953	7654	8504
FIXED COSTS						
-PERSONNEL	0	0	0	1184	1084	1084
-OPERATING SUPPLIES	0	0	0	115	115	115
-MAINTENANCE MATERIAL	0	0	0	350	350	350
-GENERAL OVERHEAD	0	0	0	350	350	350
TOTAL FIXED COSTS	0	0	0	1999	1899	1899
TOTAL MANUFACTURING COSTS	0	0	0	4298	4855	5183
OPERATING PROFIT	0	0	0	3954	5755	6605
INVESTMENTS						
-FIXED INVESTMENT	800	10390	20790	1320	0	0
-PREOPER. EXPENSES	0	330	630	40	0	0
-REINVESTMENTS	0	0	0	80	80	0
-WORKING CAPITAL	0	0	0	1330	380	190
TOTAL INVESTMENTS	800	10720	21420	2770	460	190
CASH FLOW	-800	-10720	-21420	1184	5295	6415

REPORT PREPARED BY IIMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:19

JAAKKO PÖYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 1

C A S H   F L O W   S T A T E M E N T   (1000 USD)

	4	5	6	7	8	9
PRODUCTION (T)						
-CIGARETTE PAPER	3500	3500	3500	3500	3500	3500
TOTAL PRODUCTION	3500	3500	3500	3500	3500	3500
TOTAL SALES INCOME	11788	11788	11788	11788	11788	11788
VARIABLE COSTS						
-ROSELLA FIBRE	1176	1176	1176	1176	1176	1176
-PULP	505	505	505	505	505	505
-CHEMICALS	854	854	854	854	854	854
-ENERGY	498	498	498	498	498	498
-PACKING MATERIAL	245	245	245	245	245	245
-OTHER	7	7	7	7	7	7
TOTAL VARIABLE COSTS	3284	3284	3284	3284	3284	3284
CONTRIBUTION MARGIN	8504	8504	8504	8504	8504	8504
FIXED COSTS						
-PERSONNEL	884	884	884	884	884	884
-OPERATING SUPPLIES	115	115	115	115	115	115
-MAINTENANCE MATERIAL	350	350	350	350	350	350
-GENERAL OVERHEAD	350	350	350	350	350	350
TOTAL FIXED COSTS	1699	1699	1699	1699	1699	1699
TOTAL MANUFACTURING COSTS	4983	4983	4983	4983	4983	4983
OPERATING PROFIT	6805	6805	6805	6805	6805	6805
INVESTMENTS						
-FIXED INVESTMENT	0	0	0	0	0	0
-PREOPER. EXPENSES	0	0	0	0	0	0
-REINVESTMENTS	0	0	0	0	0	0
-WORKING CAPITAL	0	0	0	0	0	0
TOTAL INVESTMENTS	0	0	0	0	0	0
CASH FLOW	6805	6805	6805	6805	6805	6805

REPORT PREPARED BY HMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:19

JAAKKO PöYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 1

CASH FLOW STATEMENT (1000 USD)

	10	11	12	13	14	15
PRODUCTION (T)						
-CIGARETTE PAPER	3500	3500	3500	3500	3500	3500
TOTAL PRODUCTION	3500	3500	3500	3500	3500	3500
TOTAL SALES INCOME	11788	11788	11788	11788	11788	11788
VARIABLE COSTS						
-ROSELLA FIBRE	1176	1176	1176	1176	1176	1176
-PULP	505	505	505	505	505	505
-CHEMICALS	854	854	854	854	854	854
-ENERGY	498	498	498	498	498	498
-PACKING MATERIAL	245	245	245	245	245	245
-OTHER	7	7	7	7	7	7
TOTAL VARIABLE COSTS	3284	3284	3284	3284	3284	3284
CONTRIBUTION MARGIN	8504	8504	8504	8504	8504	8504
FIXED COSTS						
-PERSONNEL	884	884	884	884	884	884
-OPERATING SUPPLIES	115	115	115	115	115	115
-MAINTENANCE MATERIAL	350	350	350	350	350	350
-GENERAL OVERHEAD	350	350	350	350	350	350
TOTAL FIXED COSTS	1699	1699	1699	1699	1699	1699
TOTAL MANUFACTURING COSTS	4983	4983	4983	4983	4983	4983
OPERATING PROFIT	6805	6805	6805	6805	6805	6805
INVESTMENTS						
-FIXED INVESTMENT	0	0	0	0	0	0
-PREOPER. EXPENSES	0	0	0	0	0	0
-REINVESTMENTS	500	500	500	500	500	500
-WORKING CAPITAL	0	0	0	0	0	-1900
TOTAL INVESTMENTS	500	500	500	500	500	-1400
CASH FLOW	6305	6305	6305	6305	6305	8205

REPORT PREPARED BY HMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:19

JAAKKO PÖYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 1

CASH FLOW ANALYSIS 1000 USD

IRR 14.20%

	TOTAL INVEST-MENTS	OPER. PROFIT	CASH FLOW	DISC-COUNTED CASH FLOW	CUM. DISC. CASH FLOW
1	800.0	.0	-800.0	-800.0	-800.0
2	10720.0	.0	-10720.0	-9386.7	-10186.7
3	21420.0	.0	-21420.0	-16423.1	-26609.8
4	2770.0	3953.8	1183.8	794.7	-25815.1
5	460.0	5754.6	5294.6	3112.4	-22702.6
6	190.0	6605.0	6415.0	3302.0	-19400.6
7	.0	6805.0	6805.0	3067.1	-16333.5
8	.0	6805.0	6805.0	2685.7	-13647.8
9	.0	6805.0	6805.0	2351.6	-11296.2
10	.0	6805.0	6805.0	2059.1	-9237.1
11	.0	6805.0	6805.0	1803.0	-7434.0
12	.0	6805.0	6805.0	1578.8	-5855.3
13	500.0	6805.0	6305.0	1280.8	-4574.4
14	500.0	6805.0	6305.0	1121.5	-3452.9
15	500.0	6805.0	6305.0	982.0	-2470.8
16	500.0	6805.0	6305.0	859.9	-1610.9
17	500.0	6805.0	6305.0	753.0	-858.0
18	-1400.0	6805.0	8205.0	858.0	.0

PREPARED BY HMP USING IFPS MODEL CFLOWAN AND REPORT CFLOWET
TIME: 1981-9-30 14:21

JAAKKO PöYRY

PROJECT K391B CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 1

S E N S I T I V I T Y   A N A L Y S I S   F O R   I R R

VARIABLE TO BE CHANGED	-50%	-20%	-10%	-5%	0%
TOTAL SALES INCOME	-100	7.0%	10.8%	12.6%	14.2%
ROSELLA FIBRE	15.8%	14.7%	14.5%	14.4%	14.2%
ELECTRICITY	14.6%	14.4%	14.3%	14.3%	14.2%
TOTAL VARIABLE COSTS	18.5%	16.0%	15.1%	14.7%	14.2%
PERSONNEL	15.6%	14.8%	14.5%	14.4%	14.2%
FIXED INVESTMENT	27.8%	18.1%	16.0%	15.1%	14.2%

	0%	5%	10%	20%	50%
TOTAL SALES INCOME	14.2%	15.8%	17.4%	20.3%	28.3%
ROSELLA FIBRE	14.2%	14.0%	13.9%	13.6%	12.6%
ELECTRICITY	14.2%	14.2%	14.1%	14.0%	13.8%
TOTAL VARIABLE COSTS	14.2%	13.8%	13.3%	12.4%	9.4%
PERSONNEL	14.2%	14.1%	13.9%	13.6%	12.8%
FIXED INVESTMENT	14.2%	13.4%	12.7%	11.3%	8.0%

*** IRR COMPUTED ON TOTAL INVESTMENT ***

PREPARED BY HMP USING IFPS MODEL STDSEN2 AND DATA FILE SENSTEMI
TIME: 1981-9-30 14:22

JAAKKO PÖYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 2

CASH FLOW STATEMENT (1000 USD)

	-3	-2	-1	1	2	3
PRODUCTION (T)						
-CIGARETTE PAPER	0	0	0	1225	1575	2100
-TIPPING BASE	0	0	0	245	315	280
-PLUG WRAP	0	0	0	245	315	280
-THIN PRINTING	0	0	0	367	472	420
-MANIFOLD	0	0	0	368	473	420
TOTAL PRODUCTION	0	0	0	2450	3150	3500
TOTAL SALES INCOME	0	0	0	6271	8062	9524
VARIABLE COSTS						
-ROSELLA FIBRE	0	0	0	412	529	706
-PULP	0	0	0	904	1163	1134
-CHEMICALS	0	0	0	299	384	512
-ENERGY	0	0	0	300	386	443
-PACKING MATERIAL	0	0	0	99	128	162
-OTHER	0	0	0	5	6	7
TOTAL VARIABLE COSTS	0	0	0	2019	2596	2964
CONTRIBUTION MARGIN	0	0	0	4252	5466	6560
FIXED COSTS						
-PERSONNEL	0	0	0	1184	1084	1084
-OPERATING SUPPLIES	0	0	0	115	115	115
-MAINTENANCE MATERIAL	0	0	0	350	350	350
-GENERAL OVERHEAD	0	0	0	350	350	350
TOTAL FIXED COSTS	0	0	0	1999	1899	1899
TOTAL MANUFACTURING COSTS	0	0	0	4018	4495	4863
OPERATING PROFIT	0	0	0	2253	3567	4661
INVESTMENTS						
-FIXED INVESTMENT	800	10390	20790	1320	0	0
-PREOPER. EXPENSES	0	330	630	40	0	0
-REINVESTMENTS	0	0	0	80	80	0
-WORKING CAPITAL	0	0	0	1330	380	190
TOTAL INVESTMENTS	800	10720	21420	2770	460	190
CASH FLOW	-800	-10720	-21420	-517	3107	4471

REPORT PREPARED BY IIMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:24

JAAKKO PöYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 2

CASH FLOW STATEMENT (1000 USD)

	4	5	6	7	8	9
PRODUCTION (T)						
-CIGARETTE PAPER	2450	2800	3150	3500	3500	3500
-TIPPING BASE	210	140	70	0	0	0
-PLUG WRAP	210	140	70	0	0	0
-THIN PRINTING	315	210	105	0	0	0
-MANIFOLD	315	210	105	0	0	0
TOTAL PRODUCTION	3500	3500	3500	3500	3500	3500
TOTAL SALES INCOME	10090	10656	11222	11788	11788	11788
VARIABLE COSTS						
-ROSELLA FIBRE	823	941	1058	1176	1176	1176
-PULP	977	820	662	505	505	505
-CHEMICALS	598	683	768	854	854	854
-ENERGY	457	470	484	498	498	498
-PACKING MATERIAL	183	204	224	245	245	245
-OTHER	7	7	7	7	7	7
TOTAL VARIABLE COSTS	3044	3124	3204	3284	3284	3284
CONTRIBUTION MARGIN	7046	7532	8018	8504	8504	8504
FIXED COSTS						
-PERSONNEL	884	884	884	884	884	884
-OPERATING SUPPLIES	115	115	115	115	115	115
-MAINTENANCE MATERIAL	350	350	350	350	350	350
-GENERAL OVERHEAD	350	350	350	350	350	350
TOTAL FIXED COSTS	1699	1699	1699	1699	1699	1699
TOTAL MANUFACTURING COSTS	4743	4823	4903	4983	4983	4983
OPERATING PROFIT	5347	5833	6319	6805	6805	6805
INVESTMENTS						
-FIXED INVESTMENT	0	0	0	0	0	0
-PREOPER. EXPENSES	0	0	0	0	0	0
-REINVESTMENTS	0	0	0	0	0	0
-WORKING CAPITAL	0	0	0	0	0	0
TOTAL INVESTMENTS	0	0	0	0	0	0
CASH FLOW	5347	5833	6319	6805	6805	6805

REPORT PREPARED BY HMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:24

JAAKKO PöYRY

V/14

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 2

CASH FLOW STATEMENT (1000 USD)

	10	11	12	13	14	15
PRODUCTION (T)						
-CIGARETTE PAPER	3500	3500	3500	3500	3500	3500
-TIPPING BASE	0	0	0	0	0	0
-PLUG WRAP	0	0	0	0	0	0
-THIN PRINTING	0	0	0	0	0	0
-MANIFOLD	0	0	0	0	0	0
TOTAL PRODUCTION	3500	3500	3500	3500	3500	3500
TOTAL SALES INCOME	11788	11788	11788	11788	11788	11788
VARIABLE COSTS						
-ROSELLA FIBRE	1176	1176	1176	1176	1176	1176
-PULP	505	505	505	505	505	505
-CHEMICALS	854	854	854	854	854	854
-ENERGY	498	498	498	498	498	498
-PACKING MATERIAL	245	245	245	245	245	245
-OTHER	7	7	7	7	7	7
TOTAL VARIABLE COSTS	3284	3284	3284	3284	3284	3284
CONTRIBUTION MARGIN	8504	8504	8504	8504	8504	8504
FIXED COSTS						
-PERSONNEL	884	884	884	884	884	884
-OPERATING SUPPLIES	115	115	115	115	115	115
-MAINTENANCE MATERIAL	350	350	350	350	350	350
-GENERAL OVERHEAD	350	350	350	350	350	350
TOTAL FIXED COSTS	1699	1699	1699	1699	1699	1699
TOTAL MANUFACTURING COSTS	4983	4983	4983	4983	4983	4983
OPERATING PROFIT	6805	6805	6805	6805	6805	6805
INVESTMENTS						
-FIXED INVESTMENT	0	0	0	0	0	0
-PREOPER. EXPENSES	0	0	0	0	0	0
-REINVESTMENTS	500	500	500	500	500	500
-WORKING CAPITAL	0	0	0	0	0	-1900
TOTAL INVESTMENTS	500	500	500	500	500	-1400
CASH FLOW	6305	6305	6305	6305	6305	8205

REPORT PREPARED BY HMP USING IFPS MODEL INCOME AND REPORT INCOMEENG
TIME: 1981-9-30 14:24

JAAKKO PÖYRY

PROJECT KJ918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 2

CASH FLOW ANALYSIS 1000 USD

IRR 11.44%

	TOTAL INVEST-MENTS	OPER. PROFIT	CASH FLOW	DISC-COUNTED CASH FLOW	CUM. DISC. CASH FLOW
1	800.0	.0	-800.0	-800.0	-800.0
2	10720.0	.0	-10720.0	-9619.7	-10419.7
3	21420.0	.0	-21420.0	-17248.6	-27668.3
4	2770.0	2252.6	-517.4	-373.9	-28042.2
5	460.0	3567.4	3107.4	2014.9	-26027.3
6	190.0	4660.8	4470.8	2601.5	-23425.8
7	.0	5346.9	5346.9	2791.9	-20633.9
8	.0	5832.9	5832.9	2733.1	-17900.8
9	.0	6318.9	6318.9	2656.9	-15243.8
10	.0	6805.0	6805.0	2567.6	-12676.2
11	.0	6805.0	6805.0	2304.1	-10372.1
12	.0	6805.0	6805.0	2067.6	-8304.6
13	500.0	6805.0	6305.0	1719.0	-6585.5
14	500.0	6805.0	6305.0	1542.6	-5042.9
15	500.0	6805.0	6305.0	1384.3	-3658.6
16	500.0	6805.0	6305.0	1242.2	-2416.4
17	500.0	6805.0	6305.0	1114.7	-1301.7
18	-1400.0	6805.0	8205.0	1301.7	.0

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TIME: 1981-9-30 14:27

JAAKKO PöYRY

PROJECT K3918 CIGARETTE PAPER FOR CLIENT UNIDO/P.T. KERTAS JATILUHUR
CASE: ALTERNATIVE 2

S E N S I T I V I T Y   A N A L Y S I S   F O R   I R R

VARIABLE TO BE CHANGED	-50%	-20%	-10%	-5%	0%
TOTAL SALES INCOME	-100	5.0%	8.4%	10.0%	11.5%
ROSELLA FIBRE	12.7%	11.9%	11.7%	11.6%	11.5%
ELECTRICITY	11.8%	11.6%	11.5%	11.5%	11.5%
TOTAL VARIABLE COSTS	15.5%	13.1%	12.3%	11.9%	11.5%
PERSONNEL	12.8%	12.0%	11.7%	11.6%	11.5%
FIXED INVESTMENT	22.4%	14.7%	12.9%	12.2%	11.5%

	0%	5%	10%	20%	50%
TOTAL SALES INCOME	11.5%	12.9%	14.2%	16.8%	23.7%
ROSELLA FIBRE	11.5%	11.3%	11.2%	10.9%	10.1%
ELECTRICITY	11.5%	11.4%	11.4%	11.3%	11.0%
TOTAL VARIABLE COSTS	11.5%	11.0%	10.6%	9.7%	6.9%
PERSONNEL	11.5%	11.3%	11.2%	10.9%	10.0%
FIXED INVESTMENT	11.5%	10.8%	10.1%	9.0%	6.1%

*** IRR COMPUTED ON TOTAL INVESTMENT ***

PREPARED BY HMP USING IFPS MODEL STDSEN2 AND DATA FILE SENSTEMI
TIME: 1981-9-30 14:28

TENTATIVE PROGRAMME FOR FURTHER INVESTIGATION

CONTENTS

1 GENERAL

If a favourable preliminary investment decision is taken on the basis of the pre-investment work, then several activities are required before a go-ahead decision is made.

This annex does not consider the activities required after the issuance of the report and even before the preliminary investment decision can be made - i.e. the project appraisal.

The activities required after the preliminary investment decision include

- a full feasibility study and events which should preferably proceed as far as possible during the feasibility study, such as
  - clearance with authorities
  - clearance of financing
  - commerical and legal matters

This annex is mainly concerned with the full feasibility study, with notes on some matters which are optional, i.e.:

- looking for suitable secondhand machinery which could be purchased with or without reconditioning

- investigating the possibility of reducing the investment in maintenance facilities

- investigating environmental matters, depending on the outcome of discussions with authorities

The tentative thoughts concerning the timing of the study are based on the premise that tenders would be requested for new main machinery only plus other factors listed later.

The work proposed in the scope would be based on the mill proposal as conceived in this pre-investment study.

The work would be done partly abroad and partly in Indonesia. Some savings could be effected if part of the work in Indonesia were done by either P.T. Kertas Jatiluhur or some other party under the main consultant's guidance.

2 OJECTIVE OF THE STUDY

The main objective of the study would be to present sufficient material for a go-ahead decision.

Since there is reason to believe that the decision would be favourable, the objective is also to prepare sufficient material for the transition to implementation to proceed with all possible speed once the go-ahead decision has been taken.

Optional objectives, subject to discussion during the appraisal phase and resultant terms of reference, are to

- reduce the investment by using secondhand machinery where feasible

- reduce the investment in maintenance facilities

- determine the need for environmental control measures

3 SCOPE

3.1 GEneral

The scope of the study has been formulated to fulfil the objectives stated above. It would cover the following study subjects:

- Rosella Supply
- Commercial-Scale Trials with Rosella
- Marketing
- Mill Site and Environmental Aspects
- Preliminary Design Engineering
- Capital Requirement
- Financial Analysis

The sequence of events normally in a critical path are shown in drawing K3918-HS-4001, Target Time Schedule.

3.2 Rosella Supply

The availability of rosella at the probable time of mill start-up and beyond that, and its cost should be investigated.

The investigation should cover the following main items:

- present supply and consumption
- current plans for the future
- possibility of supplying the mill from existing or planned plantations
- possibility of supplying part of the mill's rosella requirements from the vicinity of the mill

In addition, the party doing this investigation would acquire a sample of rosella fibre for the commercial-scale trials, probably 11 tons of grade B, and manage the handling and shipping at Indonesian end.

3.3 Commercial-Scale Trials

3.3.1 General

The commercial-scale trials should include pulping, bleaching and a cigarette paper machine trial run at commercial scale.

3.3.2 Programme by Subconsultant, Tervakoski Oy

- The paper machine trial run should be of 24 hours, which would allow enough time to adjust the conditions.

- The raw material required is 11 tons of rosella grade B fibre. The fibre would be cut into 25 mm lengths before cooking.

- Five cooks would be made. The results of the first cook would be used to adjust the conditions for the others as required.

- Four batch bleachings (3 stages each) would be performed. The results of the first bleaching would be used to adjust the conditions for the following as required.

- Pre-refining trials would be performed with the bleached pulp. The results of these trials would be used to determine the conditions for pulp refining in the commercial-scale paper making trial.

- The commercial scale cigarette paper making trial run would be performed with the normal cigarette paper quality Tercig H4 as a target. Several fibre compositions would be used with bleached rosella fibre as the major component and bleached birch fibre as the minor component, plus normal filling with chalk and impregnation according to Tervakoski Oy's current practice.

- The trial would also include all the analysis work and recording of conditions normally performed on the raw material, the unbleached and bleached pulp, the various stages of refining, the ready-made paper, and the required samples in roll and sheet form.

3.4 Market Study

3.4.1 General

The markets and marketing of cigarette paper (dominant) and other lightweight special papers (less important), tipping base, plug wrap, thin printing and writing would be analysed.

3.4.2
Scope

The market study would include

- A review of the domestic demand. The projected growth would be taken into account.
- The states of competing projects would be reviewed.
- A tentative marketing and distribution plan would be formulated after visits to the most important customers.
- Samples from the commercial-scale trial run with rosella should be used to get a definite customer reaction.
- The effect of the markets would be taken into account in formulating the production programme.
- Mill net prices would be established for the proposed distribution plan and product mix.

3.5
Mill Site and Environmental Study

3.5.1
General

The mill site study would present sufficient data for selecting the site. Environmental considerations would be taken into account.

The Cilangkap Industrial Estate near the Jatiluhur dam seems a likely site. It is proposed that it be investigated first. The rest of the study is contingent upon the outcome of this investigation. The next likely site, if talks with the Jatiluhur Authority failed or for any other reason, would be Tangerang, 35 km west of Jakarta.

3.5.2
Scope

The following points would normally be investigated and firmed up as far as possible:

- availability, cost and terms of
  - land
  - water
  - electricity
  - accommodation
  - services: medical, educational, building contractors, general maintenance facilities (garages, etc.)

- connections, present and planned
  - roads
  - railway
  - power supply
  - telecommunications

- local conditions, if special
  - floods
  - earthquakes

- what help the authorities are willing to provide
  - data such as contour line maps, soil surveys (should be acquired in every case)
  - training

- construction cost data

- examination of the recipient water course including water uses downriver

- general or local regulations
  - environmental
  - other

The results of this work would form the basis not only for site selection, but also for the mill site layout, and estimates concerning mill site preparation, foundations and other civil construction work. They would also affect other cost factors: production costs, and investment costs such as design of liquor recovery, effluent treatment and disposal, personnel facilities and housing.

An optional point to investigate, as mentioned above, would be the possibility of contracting some maintenance from outside the mill and/or forming a cooperative maintenance unit with other mills in the vicinity.

If adequate soil surveys are not available, then one would have to be specified and made. This could also apply to contour maps. This should be done only after it is clear from other connections where the site could be. It is to be noted here that the soil in the Cilangkap Industrial Estate is thought to be good for construction.

3.6 Preliminary Design Engineering

3.6.1 Introduction

The study would, as an important element, include preliminary engineering.

The aim of this preliminary engineering would be to:

- provide data to be used with other documents in the study as a basis for the go-ahead decision and financing negotiations

- make final selection of the production processes

- specify main equipment. This is necessary for financing, for cost calculations, and to get a "flying" start

- determine how to build the mill in the shortest possible time

- prepare a first investment budget

- serve as a basis for further engineering work

The scope is briefly described in this section.

3.6.2
Items of Work

Preliminary engineering work would cover the following mill process and service departments:

Mill site
- buildings
- roads, yards
- connections between departments (pipe bridges etc.)

Rosella storage and handling
- reception
- storage
- cutting
- feeding to digester

Rosella pulping
- cooking based on batch digesting
- washing and pre-refining
- unbleached pulp storage

Bleaching
- batch bleaching plant
- bleached pulp storage

Purchased pulp storage and handling
- reception
- bale storage
- repulping

Paper mill
- stock preparation, two lines
- paper machine
- auxiliary equipment, including broke and white water systems
- finishing of rolls and sheets
- paper storage

Evaporation
- evaporation with auxiliaries
- evaporated liquor storage

Chemicals and additives handling and/or preparation for
- caustic soda
- sulphur
- chlorine
- sodium hypochlorite
- quicklime
- chalk for paper filler
- alum
- starch and impregnants
- miscellaneous paper additives
- miscellaneous water treatment chemicals

Common systems
- water distribution
- sewer system
- effluent treatment
- steam generation and distribution
- condensate system
- power connection and distribution
- emergency power system
- compressed air system
- telecommunications

Services
- fire and security control
- operating office
- laboratory
- personnel
  - recruitment
  - first aid
  - canteen
  - lockers and washrooms
- maintenance
  - mechanical
  - electrical
  - instrumentation
  - civil
  - garage
- infrastructure
  - road improvement
  - housing if any

3.6.3 Process Design

Preliminary process engineering would be carried out, and design criteria for the mill would be determined, including:

- capacities of main machinery
- consumption of rosella
- consumption of chemicals
- consumption of electricity
- consumption of steam
- consumption of fresh water
- effluent load

The following process documents would be prepared:

- flow diagrams with information on departmental capacities
- process descriptions and appropriate balances
- list of the main equipment

3.6.4
Environmental Impact Study

Special attention would be paid to environmental aspects. A description of the environmental measures to be taken, both internal effluent reduction measures and external treatment, would be provided and presented. Expected pollutant discharge levels would be stated, and their effect on the receiving water body assessed.

3.6.5
Personnel

Manning tables for the mill, indicating production, maintenance and administrative personnel would be prepared.

The availability of skilled production expertise would be assessed. The costs of external training and expatriate production personnel would be estimated.

3.6.6
Layout Engineering

The following documents would then be prepared:

- mill site layout (1 : 2000 or 1 : 1000)
- department layouts (1 : 200) showing the locations of the main machinery and main dimensions of buildings
- floor drawings and sections
- aerial perspective drawings

Provision for future expansion would be made in the layout.

3.6.7
Electrical Engineering

The electrical engineering would produce:

- a summary of electrical requirements including voltage selection
- a power distribution diagram
- space requirements for electrical rooms in department layouts
- specification of special electrical drives

3.6.8
Instrument Engineering

The instrument engineering would produce:

- a summary of process control requirements including clarification of the general level of automation in the mill
- space requirements of control rooms in the layout

3.6.9
Building Requirements

A general description of construction methods and materials used would be given, with allowance made for local conditions.

3.6.10
Project Time Schedule

An overall target time schedule would be prepared for the entire project, showing the main activities and target dates for

- engineering
- procurement
- civil construction
- erection
- start-up

3.7
Capital Requirement

3.7.1
Mill Investment Calucation

A calculation of the investment required would be worked out on the basis of the preliminary engineering documentation.

Tenders for main equipment would be obtained. The number of tenders would be limited to a practical minimum. For the balance of the equipment, file material would be used and costs updated to correspond to the present cost level. For site works, construction and erection cost data would be checked locally in order to achieve as realistic figures as possible.

The investment would be reported under the following headings:

- general and indirect
- civil and structural
- process and auxiliary machinery and equipment
- piping
- electrical installations
- process control

This investment calculation would serve as a budget for the mill, and it would be updated during the course of the basic engineering.

The presentation would include:

- base cost
- physical contintencies
- price (inflation) escalation contingencies

3.7.2 Combining Other Items in a Total Capital Requirement

The working capital requirements would be calculated on the basis of the production plan. Pre-operating expenses at the mill and the capitalized interest during construction would be estimated.

3.8 Financial Analysis

3.8.1 Sales Revenue

When the final production programme and the target markets had been agreed, the sales prices would be briefly reviewed and established in the market study.

After deduction of sales commissions, transport costs, taxes, etc., mill net prices would be calculated for the selected distribution plan and used in determining project revenues in the financial analysis.

3.8.2 Manufacturing Costs

Rosella cost would be established as a result of the special study part.

The mill manufacturing costs would be estimated and specified as follows:

Variable costs
- rosella
- purchased pulp
- chemicals
- purchased energy
- operating materials
- packaging materials

Fixed costs
- personnel costs (operating, maintenance, administration)
- operating and maintenance materials
- general costs

To facilitate discussions with authorities, the cost items would be split into local and foreign cost components.

3.8.3 Working Capital Estimate

The allowance for working capital would be estimated from the storage periods required for production inputs, the average duration of accounts receivable and accounts payable, and the minimum desirable cash position.

3.8.4
Capital Cost Estimate

The capital cost estimate for the planned project would be treated in different ways in the financial analysis. For calculating the project's profitability at today's prices and costs, no price escalation allowance would be included. All these items plus duties, taxes and fees would be incorporated when determining finance requirements of the project.

3.8.5
Profitability and Sensitivity Analysis

Project profitability would be determined primarily by calculating the discounted cash flow rate (DCF rate), also called the internal rate of return (IRR). In addition to the IRR, other profitability ratios, such as return on investment (ROI) and payback period, would be calculated.

A break-even analysis would also be given.

The effect on the calculated IRR of changes in product prices, operating costs, capital costs and capacity utilization would be determined in a sensitivity analysis. All analyses would be carried out before taxes.

3.8.6
Risk Analysis

In order to assist the decision maker, the sensitivity analysis would be supplemented with a qualitative analysis of the risks involved in implementing the project and operating the mill.

3.8.7
Project Financing

Tentative and theoretical financing plans would be worked out for the financial analysis.

3.8.8
Financial Projections

A set of financial forecasts (before taxes) based on the foregoint estimates and assumptions would be prepared for the whole project period until the debt had been paid.

4
TIMING

The timetable for the feasibility study depends mainly on

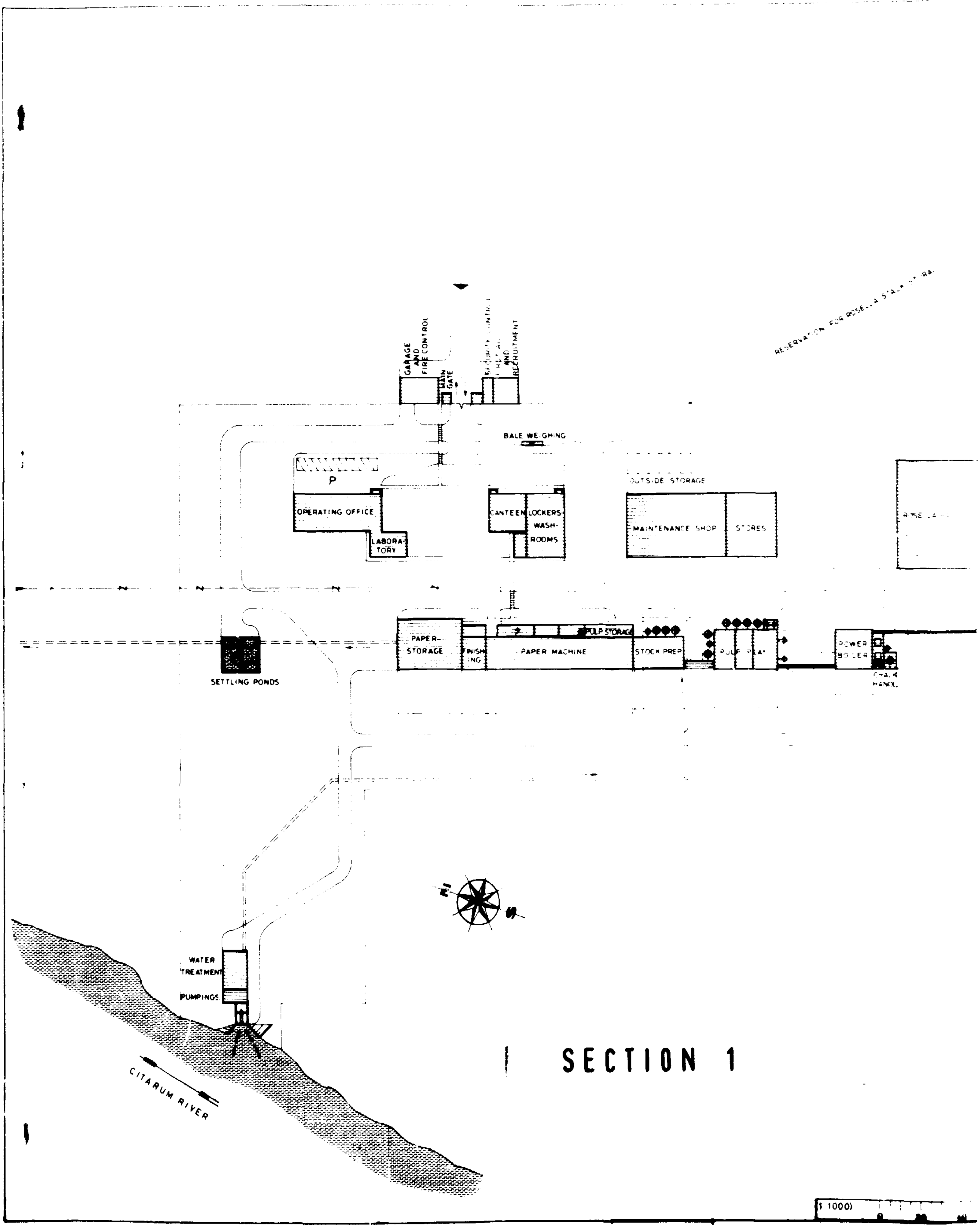
- outcome of the discussions concerning the mill site; i.e. whether other sites besides Jatiluhur must be considered

- how the work is arranged in Indonesia

- the time required to get the 11 tons of rosella to Finland for commercial-scale trials
- that the tenders would be asked for main machinery only and that the number of tendering companies would be limited to a practical minimum
- it is foreseen that the minimum possible active working time would be 8 months

DRAWINGS

Mill Site Layout	K3918-HM-1001
Function Diagram	K3918-HM-1002
Target Time Schedule	K3918-HS-4001



GARAGE AND FIRE CONTROL
MAIN GATE
RECRUITMENT
BALE WEIGHING
P
OPERATING OFFICE
LABORATORY
CANTEEN
LOCKERS-WASH-ROOMS
OUTSIDE STORAGE
MAINTENANCE SHOP
STORES
PULP STORAGE
PAPER STORAGE
FINISHING
PAPER MACHINE
STOCK PREP
POWER BOILER
SETTLING PONDS
WATER TREATMENT
PUMPINGS
CITARUM RIVER
SECTION 1
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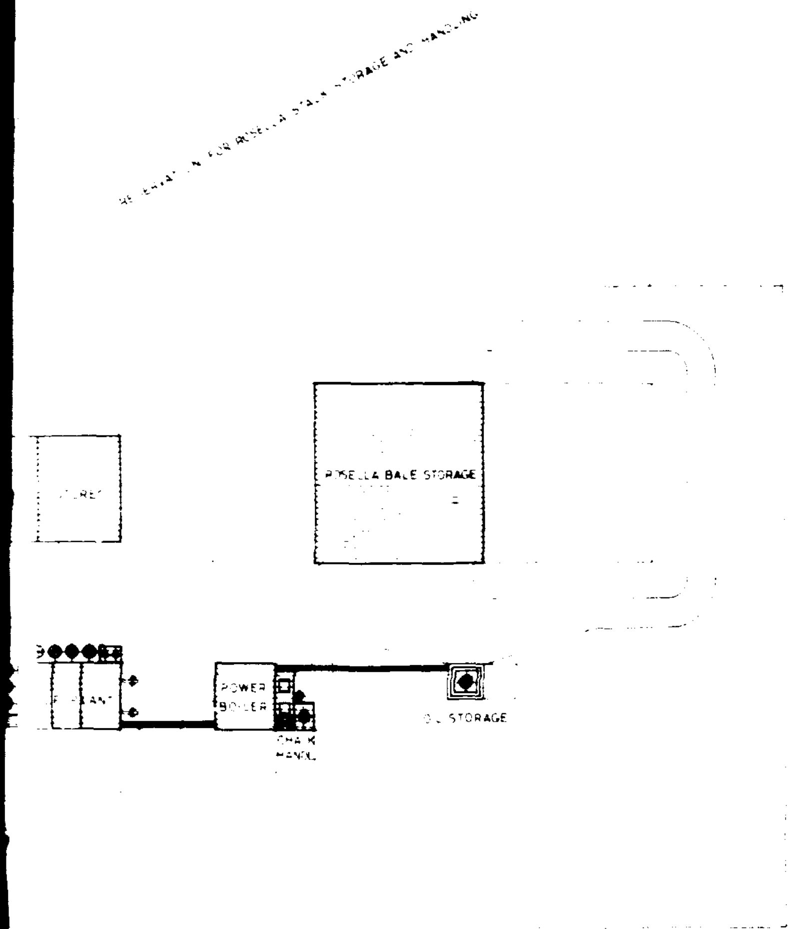
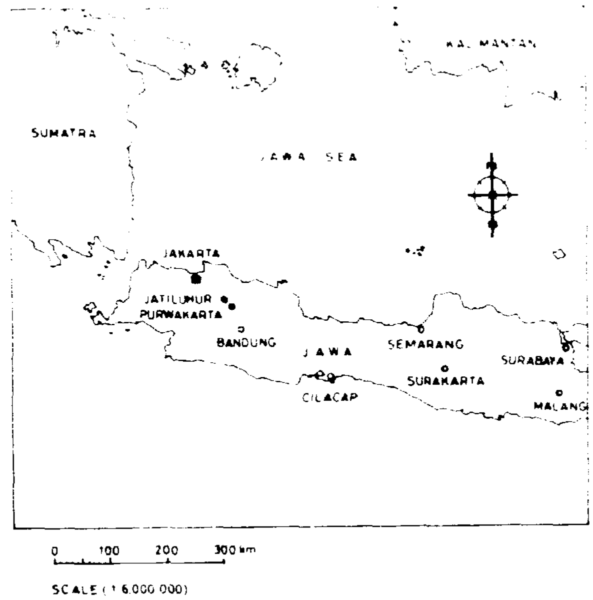
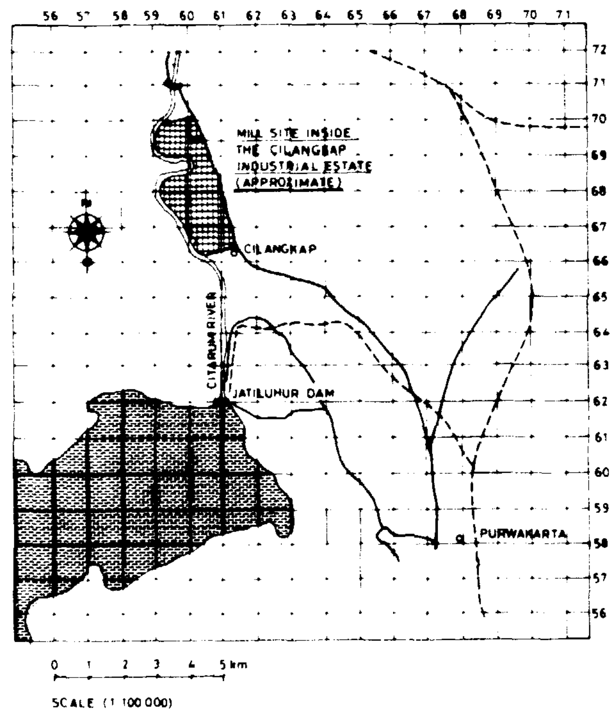


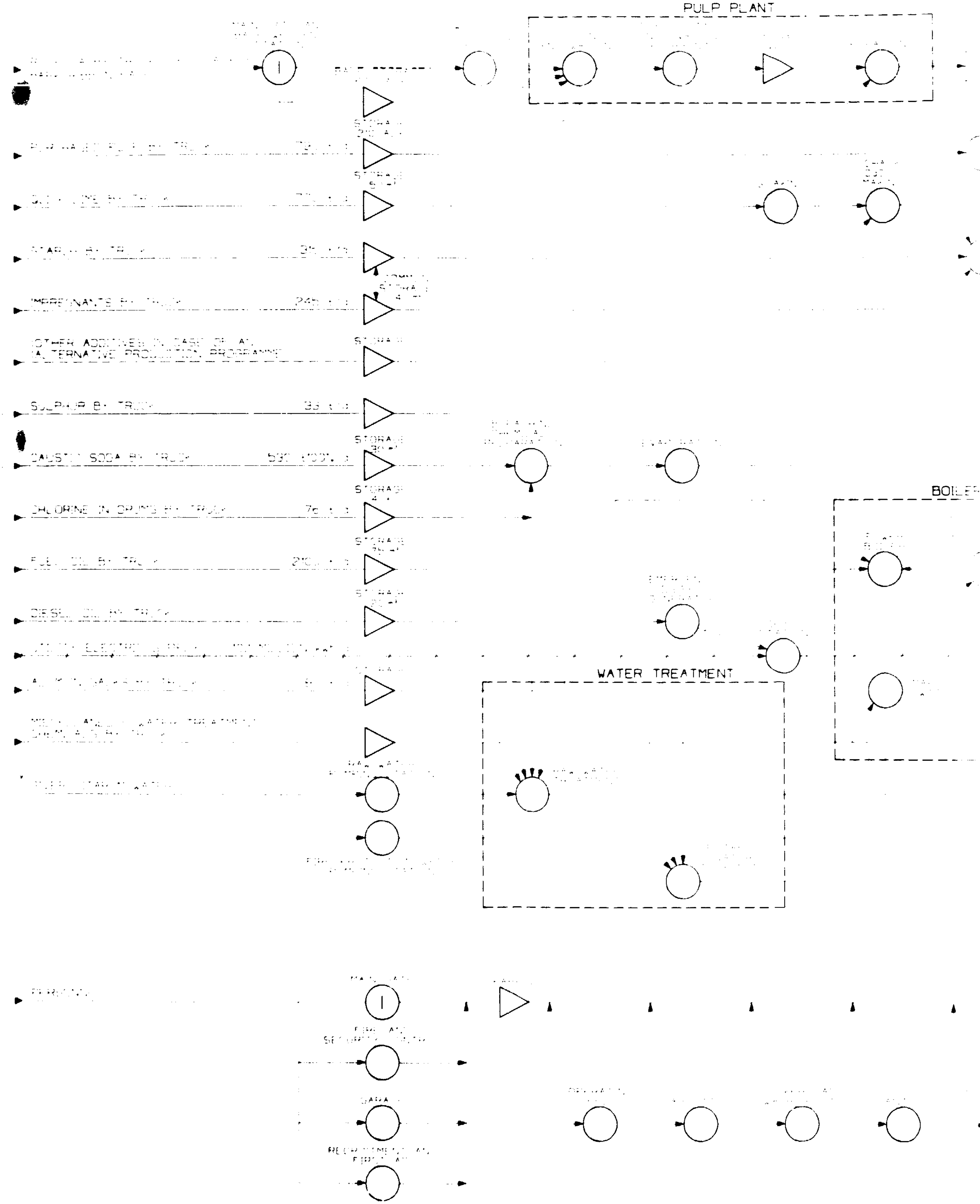




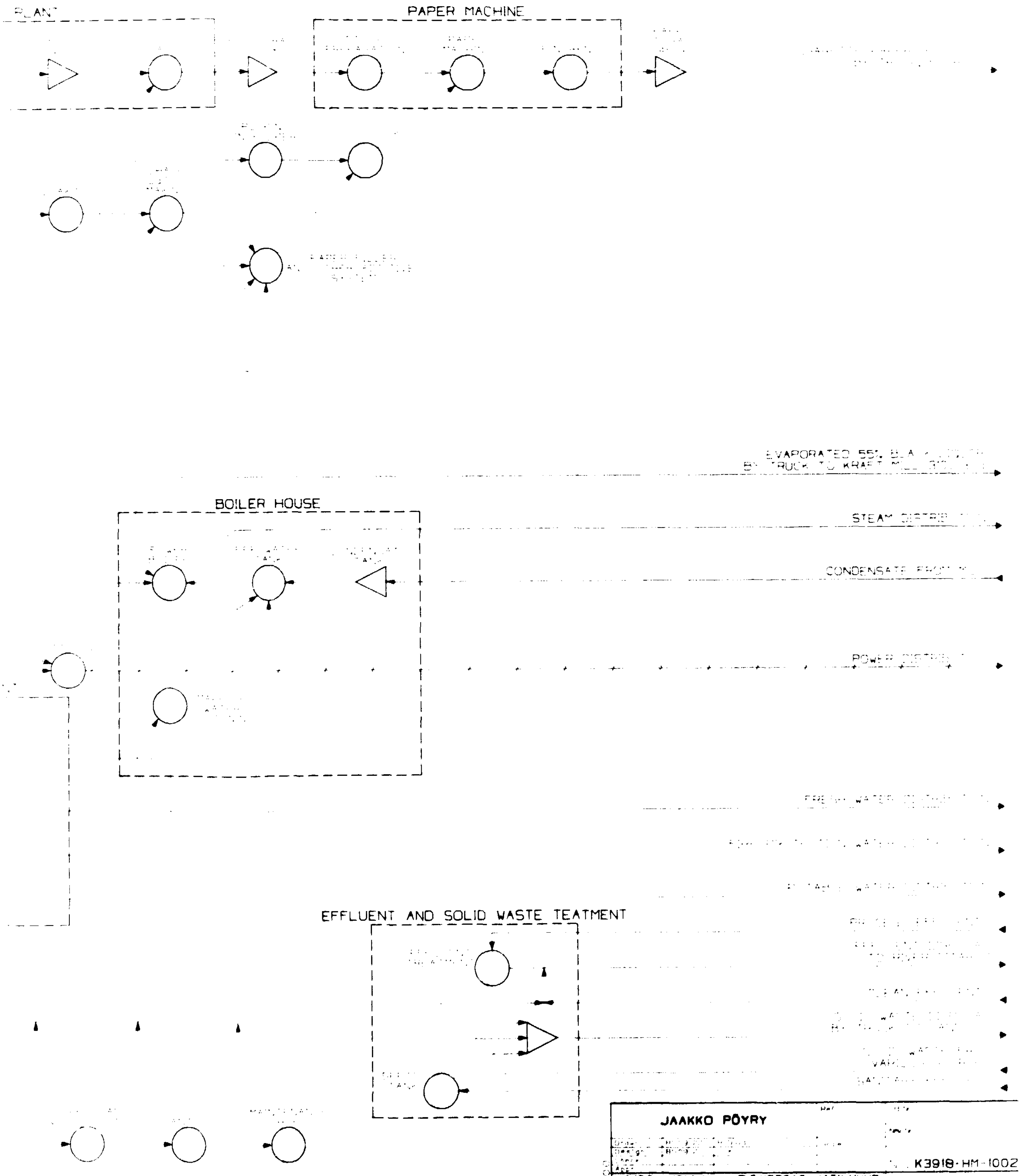
SECTION 2

JAAKKO PÖYRY	Ref	Old No / New No
Drawn 81.09.24 ANL; Checked; Approved	Scale	No. K3918-HM-1001
UNIDO, VIENNA P.T. KERTAS JATILUHUR		Old No / New No
CIGARETTE PAPER MILL MILL SITE LAY OUT		No.

1:1000 0 20 40 60 80 100 120 140 160 180 200 m


PULP PLANT
IMPREGNANTS BY TRUCK
(OTHER ADDITIVES IN CASE OF AN
ALTERNATIVE PRODUCTION PROGRAMME)
SULPHUR BY TRUCK
CAUSTIC SODA BY TRUCK
CHLORINE IN DRUMS BY TRUCK
DIESEL OIL BY TRUCK
STORAGE
WATER TREATMENT
GARAGE

SECTION 1

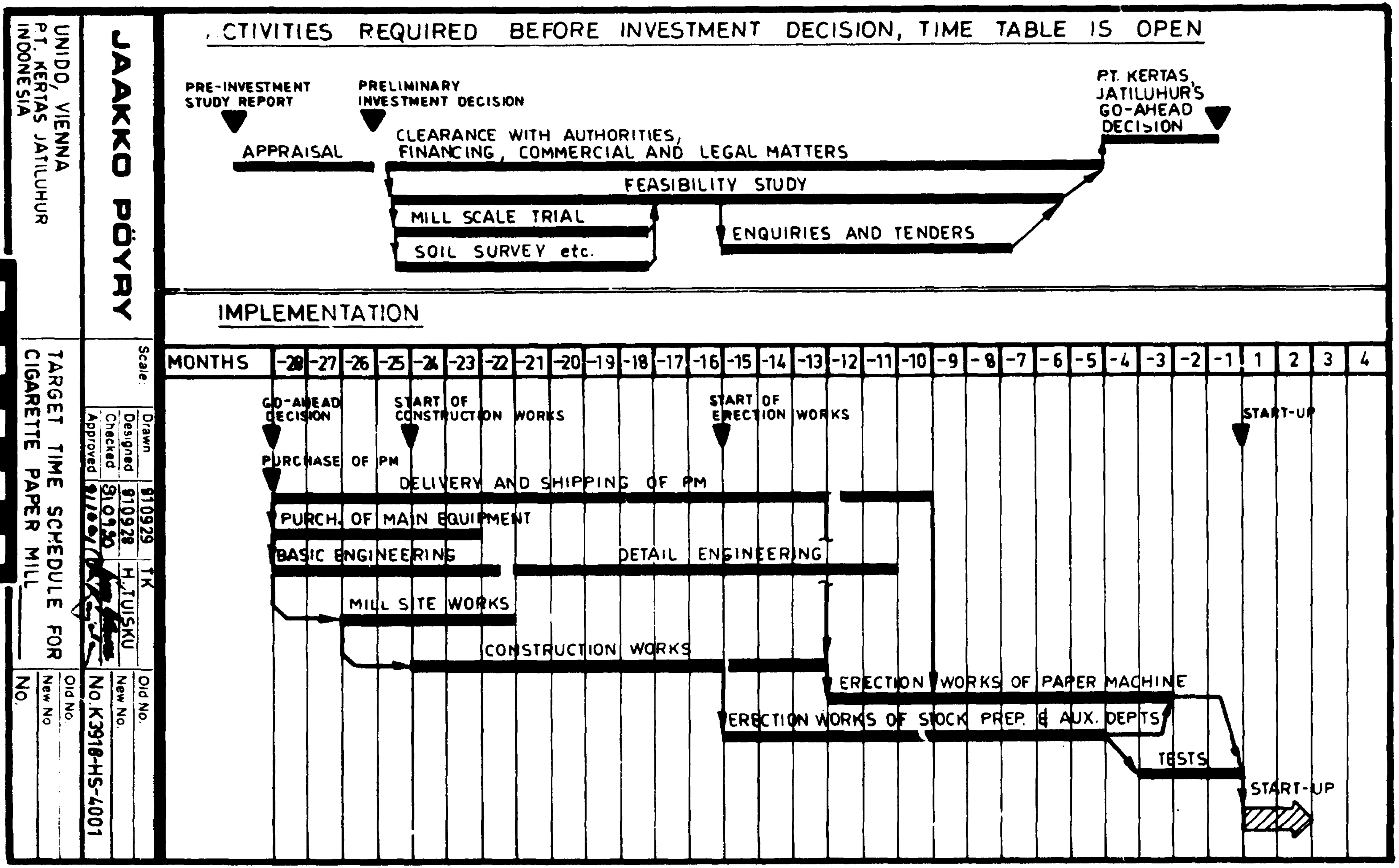


JAAKKO PÖYRY

K3918-HM-1002

UNIDO, VIENNA P.T.KERTAS JATILUHUR
CIGARETTE PAPER MILL

SECTION 2



UNIDO, VIENNA
P.T. KERTAS JATILUHUR
INDONESIA
JAAKKO PÖYRY
TARGET TIME SCHEDULE FOR
CIGARETTE PAPER MILL
Scale
Drawn 810929 TK
Designed 810928 H.TUISKU
Checked 810930
Approved
Old No.
New No.
No. K3918-HS-4001
.CTIVITIES REQUIRED BEFORE INVESTMENT DECISION, TIME TABLE IS OPEN
PRE-INVESTMENT STUDY REPORT
PRELIMINARY INVESTMENT DECISION
P.T. KERTAS JATILUHUR'S GO-AHEAD DECISION
APPRAISAL
CLEARANCE WITH AUTHORITIES, FINANCING, COMMERCIAL AND LEGAL MATTERS
FEASIBILITY STUDY
MILL SCALE TRIAL
SOIL SURVEY etc.
ENQUIRIES AND TENDERS
IMPLEMENTATION
MONTHS -28 -27 -26 -25 -24 -23 -22 -21 -20 -19 -18 -17 -16 -15 -14 -13 -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4
GO-AHEAD DECISION
START OF CONSTRUCTION WORKS
START OF ERECTION WORKS
START-UP
PURCHASE OF PM
DELIVERY AND SHIPPING OF PM
PURCH. OF MAIN EQUIPMENT
BASIC ENGINEERING
DETAIL ENGINEERING
MILL SITE WORKS
CONSTRUCTION WORKS
ERECTION WORKS OF PAPER MACHINE
ERECTION WORKS OF STOCK PREP. & AUX. DEPTS
TESTS
START-UP