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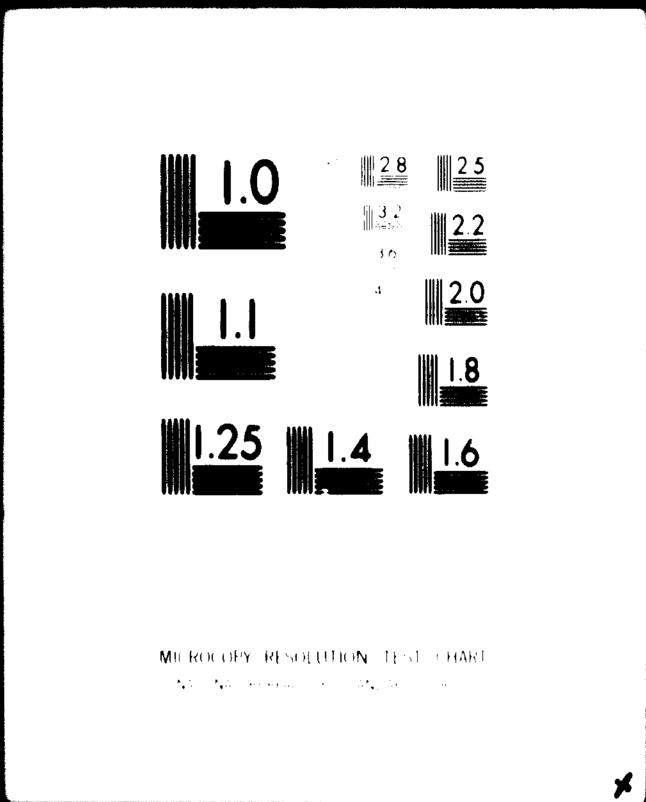
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SURVEY
OF
THE PETROCHEMICAL INDUSTRY
IN
INDONESIA

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UNIDO CONTRACT NO.72/30
PROJECT No. IS/INS/71/814

SURVEY OF THE PETROCHEMICAL INDUSTRY IN INDONESIA

VOLUME I

Report prepared for the United Nations Industrial Development Organization acting as Participating and Executing Agency for the United Nations Development Program (Special Industrial Services)

APRIL 1973
JAPAN GASOLINE CO., LTD.
Tokyo, Japan

CONTENTS

VOLUME I

VOLUME II

ABBREVIATION

ABS	Alkylbenzene Sulfonate
DOP	Di-octyl Phthalate
EG	Ethylene Glycol
EO	Ethylene Oxide
HDPE	High Density Polyethylene
LAS	Linear Alkylbenzene Sulfonate
LDPE	Low Density Polyethylene
n. a.	not available
neg.	negligible
N. G.	Natural Gas
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl Chloride
TPA	Terephthalic Acid
VCM	Vinyl Chloride Monomer

Tons in this report is meant metric tons unless particularly remarked.

The mark of $ refers in this report to the U.S. dollar, unless noted otherwise. The dollar prices stand on the rate of 1 SDR unit = US$0.921053 i.e., the rate which had been used until downard revaluation of the dollar on Feb. 12, 1973.

I. PREFACE

1. General

The 5-year development plan is now under way in Indonesia for the period 1967-1973. This plan is a "5-year plan for construction" which is aimed at providing strong foundation for the effective development to be achieved in the next developmental stage.

In this plan, emphasis is laid on the development of the agricultural sector as well as on the development of the infrastructure.

As for the mining and manufacturing industries, the plan regards them as the sectors which should be emphasized for the preparation of their future development. Such emphasis is the expression of a strong desire of the Indonesian Government, which wants to attain Indonesia's industrialization and set forward its natural resources development programs, not from short-term, but from long-term point of view on the comprehensive basis.

The present industrial development plan attaches priority to the following industries:

(1) Those industries which help the agricultural sector develop and also process agricultural products;

(2) Those industries which gain or save foreign currency;

(3) Those industries which make use of domestic raw materials;

(4) Those industries which offer more opportunities of employment; and

(5) Those industries which give incentive to regional development.

The petrochemical industry is one of the key industries, which supplies large amounts of materials of stable quality to light industries, textile industry, and the like, at low costs, and thus it should take one of major positions in the long-term industrialization plan. Particularly in Indonesia with its abundant domestic raw materials such as petroleum and natural gas, the petrochemical industry is of great importance as an "industry which makes use of domestic raw materials." At the same time, it is by itself an "industry which gains or saves foreign currency." Furthermore, the industry should be highly rated for its spreading effects to other "industries which gain or save foreign currency" and "industries which offer more opportunities of employment" such as light industries and textile industry.

Under these circumstances, the Indonesian Government asked UNIDO for a feasibility study on the petrochemical industrialization of Indonesia. UNIDO in turn entrusted Japan Gasoline Co., Ltd. to conduct this study under the UNIDO Contract No. 72/30 Project No. IS/INS/71/814.

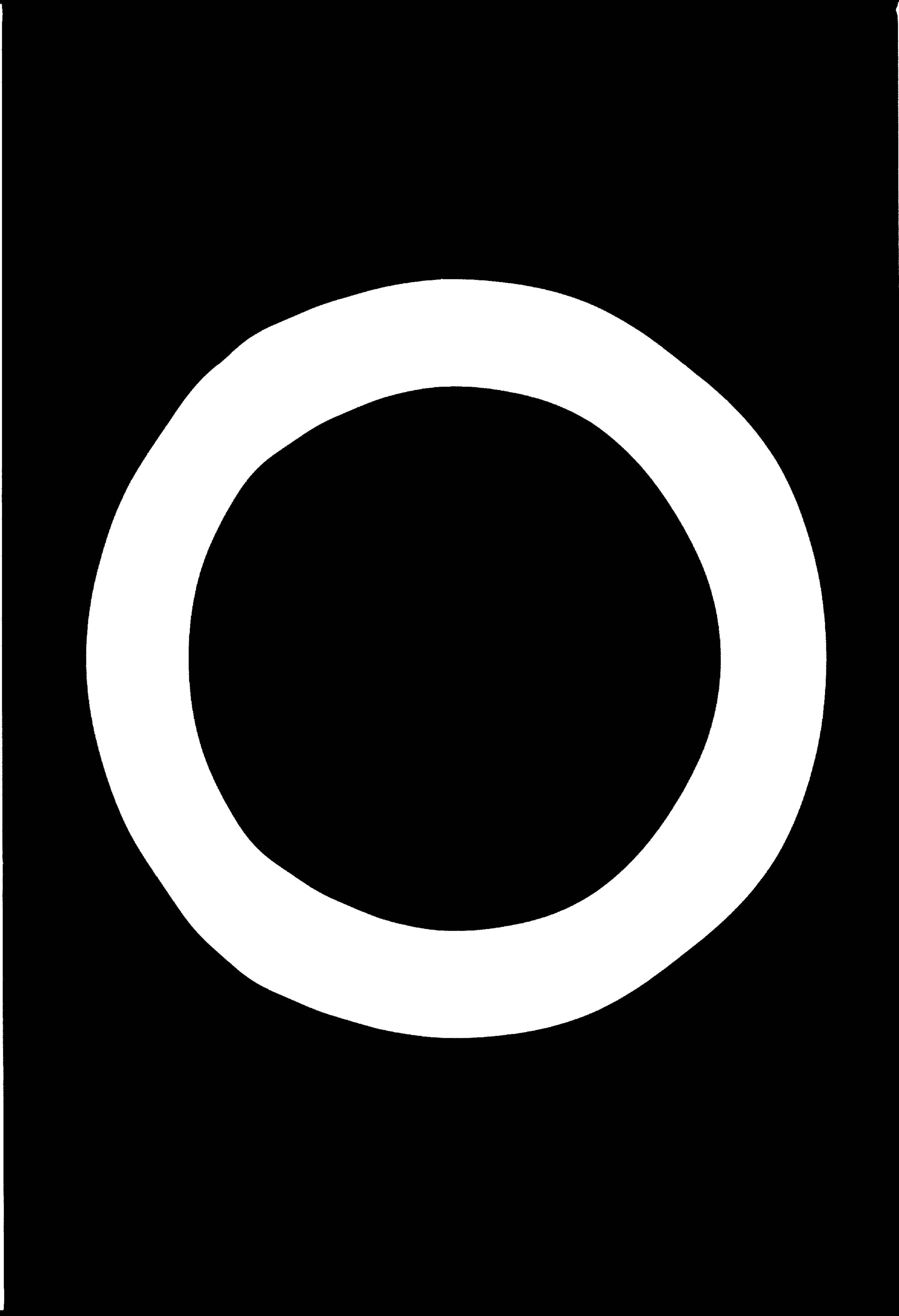
2. Objective

The objective of the Project is to conduct a survey of the petrochemical industry for the purpose of obtaining preliminary technical, economic, and market information for the Government of Indonesia.

The present study, Phase I, is to form an integral part of the study for the establishment of an overall development plan for the petrochemical industry in Indonesia.

The present survey shall contribute to the Government which may decide to explore the following-on studies, Phase II and III, after the completion of Phase I.

To attain this objective the survey has been implemented according to the paragraph 2.01 Statement of Work specified in UNIDO Contract No. 72/30, Project No. IS/INS/71/814.



II. SYNOPSIS

1. General Conclusions of Market Study and Petrochemical Complex Study

The long-term forecast (for the range of from 1975 to 1985) was made for Indonesian domestic demands and the possibility of export to ECAFE region markets which may come by when the petrochemical industry is raised in Indonesia with commodities selected from among various types of petrochemicals contained in a) to e) described below:

a. Synthetic resins (thermoplastics and thermosetting resins);

b. Synthetic fibers (polyesters, nylon-6, polypropylene, acrylonitrile);

c. Detergents (linear and non-linear alkylbenzene sulfonate);

d. Auxiliary chemicals (solvents, softeners, etc.);

e. Pesticides.

The following ten commodities were selected as promising products from the view point of marketability in Indonesia and in export market to afford their production in Indonesia.

Commodities & Estimated Demands for 1980

(Unit: tons)

1)	Low Density Polyethylene	111,000
2)	High Density Polyethylene	28,000
3)	Vinyl Chloride Monomer	93,000
4)	Polyvinyl Chloride	75,000
5)	Dioctyl Phthalate	40,000
6)	Polystyrene	35,000

7)	Polypropylene	44,000
8)	Caprolactam (for nylon 6)	26,500
9)	Terephthalic Acid (for polyester fiber)	77,100
10)	Ethylene Glycol (for polyester fiber)	32,500

Indonesia produces abundant petroleum and natural gas to be useable as raw materials in petrochemical industry, and is now actively proceeding further their development. Since the prospects of natural resource development is hopeful, the Indonesian Government expects for a petrochemical complex to be planned based on the estimated petrochemical market demands and on the premise that all the raw material requirements would be satisfactorily supplied.

We studied the feasibilities of a 300,000 ton ethylene petrochemical complex based on naphtha, as a raw material, derived from Indonesian indigenous crude oil and of a 200,000 ton ethylene complex based on Indonesian indigenous natural gas (and naphtha for aromatics production).

The following petrochemical complex have been found feasible from techno-economic points of view.

(Case I)

(Unit: ton per year)

Plant Name	Capacity
Naphtha cracker:	302,000 (in terms of ethylene)
1) LDPE	160,000
2) HDPE	35,000
3) VCM	129,000

4)	PVC	110,000
5)	DOP	60,000
6)	Polystyrene	50,000
7)	Polypropylene	60,000
8)	Caprolactam	33,000
9)	Terephthalic Acid	35,000
10)	Ethylene Glycol	15,000
11)	Butadiene	57,500

Total Investment (including working capital):	$416 million
Operation start-up year:	1980
Rate of return on investment as the whole complex:	13.4%

Furthermore the complex based on natural gas cracking and naphtha reforming have been found also feasible as follows:

(Case II)

(Unit: ton per year)

Plant Name	Capacity
Natural gas cracker	216,000 (in terms of ethylene)
Naphtha reformer	50,400 (in terms of p-xylene)
	or 50,000 (in terms of benzene)
1) LDPE	100,000
2) HDPE	26,000
3) VCM	15,500
4) PVC	60,000
5) Polystyrene	30,000
6) Polypropylene	30,000
7) Caprolactam	24,000

8) Terephthalic Acid	71,000
9) Ethylene Glycol	30,000

Total Investment Cost (including working capital):	$291.2 million
Operation start-up year:	1977
Rate of return on investment as the whole complex:	13.1%

Besides, an example of the petrochemical complex of minimum economic size based on only natural gas was shown as a reference for planning a complex when there is restriction or limitation in fund raising and raw material availability, etc.

(Complex of Minimum Economic Size)

(Unit: ton per year)

Plant Name	Capacity
Natural Gas Cracker	104,800 (in terms of ethylene)
1) VCM-PVC	20,000
2) LDPE	90,000
3) PP	23,700

Total Investment Cost (including working capital):	$122.65 million
Operation start-up year:	1977
Rate of return on investment as the whole complex:	10.0%

Foreign Currency Saving

Table II-1 and II-2 show the amount of foreign currency saving achieved by these projects. The foreign currency saving is a very important factor in evaluating a large project. A project should be evaluated with a board vision including rate of return on investment, foreign currency saving, and other view points of national interest. Especially the petrochemical complex project will have vital influence upon the growth of industries such as plastics processing industry, textile industry, etc., and increase in technological level and enhanced opportunity of employment.

In calculating foreign currency saving, the following premises were assumed:

1. Plant life would be set to 10 years.

Case I	1980 - 1989
Case II	1977 - 1986

2. Amounts of foreign loans, repayment method, money interests, domestic demand, volumes of export, product prices, etc., would be all based upon the data used in DCF calculation.

3. All foreign loans are used to procure abroad plants and equipment, catalysts and chemicals and payment for them is to be made in a lump at the time of start-up of the petrochemical complex, that is, in 1980 for Case I and in 1977 for Case II.

The foreign currency saving during 10 years of the project life is shown in Table II-1 and II-2.

Table II-1 Foreign Currency Saving (Case I)

(Unit: $1,000)

	(a)	(b)	(c)	(d)	(e)
1980	133,434	19,367	21,300	19,206	112,005
1981	158,392	22,722	21,300	19,913	134,283
1982	186,175	25,956	21,300	19,457	158,376
1983	211,346	28,999	61,877	14,769	135,239
1984	222,109	29,087	60,380	8,025	140,667
1985	224,949	30,090	58,225	7,400	144,034
1986	225,729	31,093	56,398	6,740	144,978
1987	226,569	31,093	54,573	6,080	146,983
1988	226,899	32,096	52,736	5,750	147,817
1989	226,899	32,096	50,921	5,750	149,632
	2,042,501	282,562	459,010	113,090	1,414,019

Table II-2 Foreign Currency Saving (Case II)

(Unit: $1,000)

	(a)	(c)	(d)	(e)
1977	81,697	14,945	10,961	77,713
1978	100,071	14,945	12,351	97,477
1979	122,309	14,945	13,578	120,042
1980	139,320	43,363	6,030	102,017
1981	147,231	42,046	1,256	106,441
1982	149,825	40,727	636	109,734
1983	152,530	39,411	0	113,119
1984	154,445	38,093	0	116,352
1985	156,155	36,776	0	119,379
1986	156,155	35,460	0	120,695
	1,359,738	320,711	320,711	1,083,869

(a) Import value of petrochemicals to meet the domestic demand.

(b) Export value of naphtha.

(c) Repayment of foreign loan and interest on foreign loan.

(d) Export value of petrochemicals.

(e) Yearly foreign currency saving:

(e) = (a) - (b) - (c) + (d)

Judging from the above studies and taking the situation in the world petrochemical industry and especially the movement toward petrochemical industrialization in ECAFE region countries into consideration, it is concluded that the petrochemical industrialization could be safely implemented in Indonesia and it would contribute greatly to Indonesian economy through foreign currency saving and other pertinent spreading effects on national economy, technology and sociological development.

2. World Petrochemical Industry and Petrochemical Industrialization in Developing Countries

2.1 General Conception of World Petrochemical Industry

The petrochemical industries in developed countries grew at rates of 10 to 20% per annum in Western Europe and the U.S. and at a striking growth rate of 20 to 30% per annum in Japan during 1960s. After such rapid growth, the petrochemical industries in developed countries have been suffering from keen competition and over capacity these years.

On the other hand, the situation in which the world petroleum industry has been changing coincidently. Petroleum had long been supplied affluently at low prices from oil-producing countries through major international oil companies and the petrochemical industry had been enjoying its low-cost raw material. But since 1971 the price of petroleum has been increasing year by year by OPEC (Organization of Petroleum Exporting Countries) negotiation. Furthermore the demand for clean energy has been rapidly increased and the world is going into the high-priced energy era.

Nevertheless it is forecasted from long-term point of view that the world petrochemical industry will grow steadily. For example, the petrochemical industry is predicted to grow at a rate of 10 to 13% per annum in Europe, at 8 to 10% per annum in U.S. and at around 10% per annum in Japan.

In the meantime, since the latter half of 1960s many developing countries have been attempting to bring up their own petrochemical industry as an important measure for industrialization, especially in anticipation of its spreading effects on the national economy.

The world petrochemical industries are predicted for 1980 as follows:

The U.S. which had been taking an outstanding position until 1960 will gradually lose its leading position. Instead, Europe will outrun the U.S. in ethylene production in 1980, and developing countries will have the ethylene production capacity accounting for about 8% of the world total. Regarding the developing countries in Asia, they will have a production capacity of about 3 million tons of ethylene. When the capacity of one petrochemical complex is as-

Table II-3 Ethylene Production Capacity in the World

(Unti: x 10^6 tons/yr.)

	1965	1970	1975	1980
Developed Countries	8.69 (98.7%)	27.8 (92.7%)	46.8-55.2 (91.9-92%)	68.9-78.9 (91.7-91.9%)
Developing Countries	0.11 (1.3%)	2.2 (7.3%)	4.1-4.8 (8-8.1%)	6.1-7.1 (8.1-8.3%)
World Total:	8.8 (100%)	30.0 (100%)	50.9-60.0 (100%)	75.0-86.0 (100%)

Breakdown, Developing Countries

Latin America	0.10 (1.1%)	1.156 (3.9%)	2.40-2.60 (4.3 -4.7%)	3.20-3.75 (4.3 -4.4%)
Asia	0.01 (0.1%)	1.025 (3.4%)	1.60-2.05 (3.1 -3.4%)	2.70-3.10 (3.6 -3.6%)
Africa	- (-)	0.035 (0.1%)	0.10-0.15 (0.2 -0.3%)	0.20-0.25 (0.3 -0.3%)

sumed to be 300,000 ton per year in terms of ethylene production, then 10 complexes should be erected by Asian developing countries.

Namely the world petrochemical industry will become more diversified regionally, when such newcomers as developing countries make entry into this field successively.

Table II-4 World Demands for Plastics

(Unit: x 10^6 tons/yr.)

	1970	1975	1980
Total Plastics	30.0	53.5	92.0
Polyolefins	8.0	16.0	30.0
Low Density Polyethylene	5.0	9.7	17.0
High Density Polyethylene	1.7	3.5	6.5
Polypropylene	1.3	2.8	6.5

(Conference held by the European Chemical Marketing Research Association in Budapest, Hungary)

Table II-5 World Demands for Synthetic Fibers

(Unit: x 10^6 tons/yr.)

	All fibers	Synthetics	Polyesters	Nylons	Acrylics
1969	21.2	4.4	1.4	1.8	0.9
1980	30.7	12.0	4.6	4.1	2.3

(Hoechst A.G. estimation, Chemical Age, Jan. 30, 1970)

With respect to petrochemical demands, the worldwide 1980 demand for synthetic resins is estimated to reach 90 million tons, or more than 3 times as large as the 1970 figure. As for synthetic fibers, an increase of about 2.7 times, from 4.37 million tons in 1969 to 12 million tons in 1980, is predicted.

With the waves of technological innovation, the capacity of petrochemical plant become larger and larger, and now, scale of petrochemical complex has reached 200,000 to 500,000 ton per year in terms of ethylene production. However, the merit of large capacities is now highly valued only with a proviso that large amounts of by-produced fractions should be effectively utilized, while keeping a high operation efficiency.

In other words, it is necessary to secure large and steady markets for various petrochemical products derived from olefins, aromatics and other basic chemicals co-produced.

Therefore, co-operation on the international level for orderly marketing and orderly construction of petrochemical plant will be increasingly important.

Keen competition in construction of the larger plants in 1960s has given rise to large surplus in plant capacity and unreasonable reduction in prices of petrochemicals in early 1970s. Investment on plant is forecasted to resume from 1973 in the U.S. and from 1974 or 1975 in Europe and Japan. In those occasions, however, efforts for orderly investment on new plants will have to be made.

Generally speaking, petrochemical process will become more and more standardized internationally, and the quality of products will also become standardized, so as to be acceptable in international market.

Therefore the competition in this industry is focussed on how to produce the low-priced products. Accordingly oil-producing countries will become more and more advantageous since they can fix the raw material price by themselves.

2.2 Petrochemical Industrialization in Developing Countries

(Latin American Countries)

Mexico:

Mexico is running the petrochemical complexes managed by state-owned company, Petroleos Mexicanos. It will have a total ethylene capacity of 435,000 ton per year by 1974 or 1975.

Venezuela:

Institute Venezuelano de Petroquimica, a state-owned enterprise, is planning to build a complex of which ethylene capacity is announced to be 150,000 ton per year. It is reported that Venezuela is approaching the Andes group countries to secure an export market. The domestic market of Venezuela is not large enough to afford the existence of internationally competitive petrochemical complex. The Andes group is a kind of economic community composed of Peru, Ecuador, Bolivia, Colombia and Chile.

Peru:

Peru has petrochemical projects to be undertaken by a state-owned company, Induperu. The first stage of these projects is to produce 40,000 tons/yr. of ethylene, it is reported.

Bolivia:

A new project is under consideration for a site near Lake Titicaca.

Ecuador:

They have already a dodecylbenzene plant but there is no news about erection of a petrochemical complex.

Brazil:

There is a small ethylene plant (20,000-30,000 ton per year), and a petrochemical complex of about 200,000 ton per year in terms of ethylene production capacity is now proceeding toward its implementation.

Argentine:

Two petrochemical complex plans have come to be on schedule.

(North African Countries)

Algeria:

SONATRACH, a state-owned company, is proceeding with a petrochemical complex comprising a 120,000 ton per year ethylene plant using ethane as the raw material, a 35,000 ton per year PVC plant, and a 48,000 ton per year LDPE plant.

At present there is no other petrochemical industrialization plan in this region, but LNG projects and methanol projects for clean energy production will be realized.

(ECAFE Countries)

Australia:

There are two petrochemical complexes operated by Altona petrochemical Co., Ltd. and Shell Chemical Pty. Ltd. with ethylene capacities of 150,000 and 25,000 ton per year, respectively. Australian petrochemicals have not been so strong in international competitiveness that they are protected by high customs duties in the domestic market.

Burma:

Burma is now proceeding with a polyester fiber production plan.

China:

China has been already operating some petrochemical plants by utilizing naphtha for sand cracking and refinery off-gas and is proceeding with two new complexes of 100,000 and 300,000 ton per year ethylene capacities, respectively. The Chinese economy develops under the planned economy system and is trying to attain the self-sufficiency of petrochemicals. The Chinese authorities clarify that they have no intention of exporting their petrochemical products in principle because they consider it the foremost objective to meet the domestic demand.

India:

They have two small sized petrochemical complexes. One is the 20,000 ton per year (ethylene) complex operated by Union Carbide India, Ltd. the other is the National Organic Chemical Industries, Ltd. complex with a naphtha cracker of 60,000 ton per year in terms of ethylene production, and at present in addition to the above, Indian Petrochemical Corporation is pushing forward construction of a complex based upon a naphtha cracker having 180,000 ton per year in terms of ethylene production in the Koyali area. Hardia plan is also reported. India is now aiming at her self-sufficiency of petrochemical products.

Iran:

The state-owned enterprise named National Petrochemical Co. (NPC) is now proceeding with its petrochemical complex plan by getting a tie-up with a Japanese company group. The project is based on natural gas cracking for ethylene production and naphtha reforming for BTX production. Iran takes advantage of her domestic production of natural gas and is scheduling to start from the begining with a petrochemical complex of international scale, i.e., a 300,000 ton per year ethylene plant, which is export-oriented.

Table II-6 Petrochemical Complex in Iran

(Unit: 1,000 ton per year)

	Capacity		Capacity
LDPE	100	SBR	40
HDPE	50	Styrene Monomer	50*
Ethylene Dichloride	300	Cumene	150*
Ethylene Glycol	50	Chlorine	225*
2-Ethyl Hexanol	not decided	Caustic Soda	250

* Second Stage

Korea:

Korea has the Ulsan complex with a capacity of 100,000 ton per year in terms of ethylene production. It will be expanded to 150,000 ton per year.

Philippines:

There are four chemical fertilizer makers, five synthetic detergent makers and two synthetic textile makers (nylon and polyester fibers), and Mabhay Vinyl Corporation is producing

16, 500 ton per year of PVC using imported VCM. Polystyrene production will start in this year at 6, 600 ton per year, and next year it is expected that the capacity is doubled to 13, 000 ton per year. BOI of the Philippines has already conducted a feasibility study on a petrochemical complex, but a sign of the birth of a full scale petrochemical industry such as chemical complex type has not appeared at present.

Singapore:

The petrochemical complex plans have been some times announced by Japanese groups; Sumitomo Chemical group, C. Itoh & Co. group and Mitsubishi group. At the begining of this year Sumitomo group again announced their intention toward the establishment of petrochemical complex in Singapore but materialization of the complex will face difficulties because of quite small domestic demand.

Thailand:

As for Thailand petrochemical complex programme, a Japanese group is again negotiating with Thai Petrochemical Co. on the price of ethylene. This negotiation was once broken off and the Japanese group tried to obtain ethylene from Iran. It was reported that Iran agreed to supply ethylene to Thailand but Thailand objected to this idea and strongly expressed their intention to supply ethylene domestically, then the negotiation on the price of ethylene has started again on the cost plus fee basis. Judging from these, Thailand Petrochemical complex plan will not be materialized easily in near future. Some more ups and downs will be seen for realization of this project.

At present, the petrochemical industries in those ECAFE region countries are no better than domestic market-oriented ones, which are in operation with the aim of replacing imported petrochemicals by domestically produced counterparts. However, even if much cannot be expected for exports, and even if more foreign currency payments are required for those imported machinery and equipment for producing domestic petrochemicals, still a large amount of savings in the foreign exchange holdings are brought about by domestic production.

Furthermore, various spreading effects are achieved by developing the petrochemical industry. These two advantages are the chief motives of their entry into the petrochemical undertaking.

As their domestic markets become exploited and opened, those countries next intend to expand their petrochemical industries and market their own products in other ECAFE countries.

Thus the petrochemical projects for the ECAFE region countries would take a variety of ways, depending upon such conditions as to whether countries have natural resources of their own, whether they start from the beginning with an international-scale petrochemical industry or start with a small-scale plant mainly to meet the domestic market, or how to tie up with related industries or with foreign-capital companies. In any case, these countries are consistently trying to develop their own petrochemical industries as a future key industry.

In the course of industrialization, any of them will try to go ahead of the others in its entry into international markets, so that it can gain more foreign exchange holdings and develop its own economy. Existing petrochemical industries will further come close to an international scale. In the latter half of 1970s, when petrochemical industries will have been materialized in Iran and Thailand, export competition will become severer among countries including European countries, the U.S. and Japan.

Measures should be taken to develop the domestic market, particularly related industries such as plastics processing and textile industry, and to effectively exploit the market, so that plants with internationally competitive scales can be put into operation as soon as possible. While solving the above problems, developing countries will divert their petrochemical industries in 1980s from a passive industry working on substitution for imported products into active industries capable of gaining foreign currencies through exports. Thus forward steps of petrochemical industries will become huge strides as a key industry in those developing countries.

3. Market Study

3.1 General

As stated in the "General Conclusion" we selected ten petrochemicals as the promising products. The domestic demands and possible volumes of export to the ECAFE region countries, of those promising products, were estimated for the 1975 - 1985 period.

Results of the survey are summarized in Table II-7. As shown in the table, these petrochemicals can be expected to have large demands and mark high growth rates. The methodology of the market study and results obtained for the domestic and overseas markets will be outlined in the following sections.

3.2 Domestic Market

Plastics

Results of the Indonesian domestic market study for 1980 and 1985 are given for each type of resins and each type of uses in Table II-9, "Breakdown of Plastics Demands in Each End Uses."

In forecasting the demand for each resin in each end use, such demand growth rates as given in the following table were assumed for major end uses, including household articles & miscellaneous goods, footwear, films & sheets, construction & civil engineering, and industrial uses. The volume of demand for a resin in each end use was calculated by a growth rate, which was obtained from the growth rate of potential market of each end use and the ratio of plastics demand to potential market. Then the total demand for plastics was allocated to LDPE, HDPE, PVC, PP, and Polystyrene, taking into account demand percentages for each resin in each end use both in Indonesia and other ECAFE region countries.

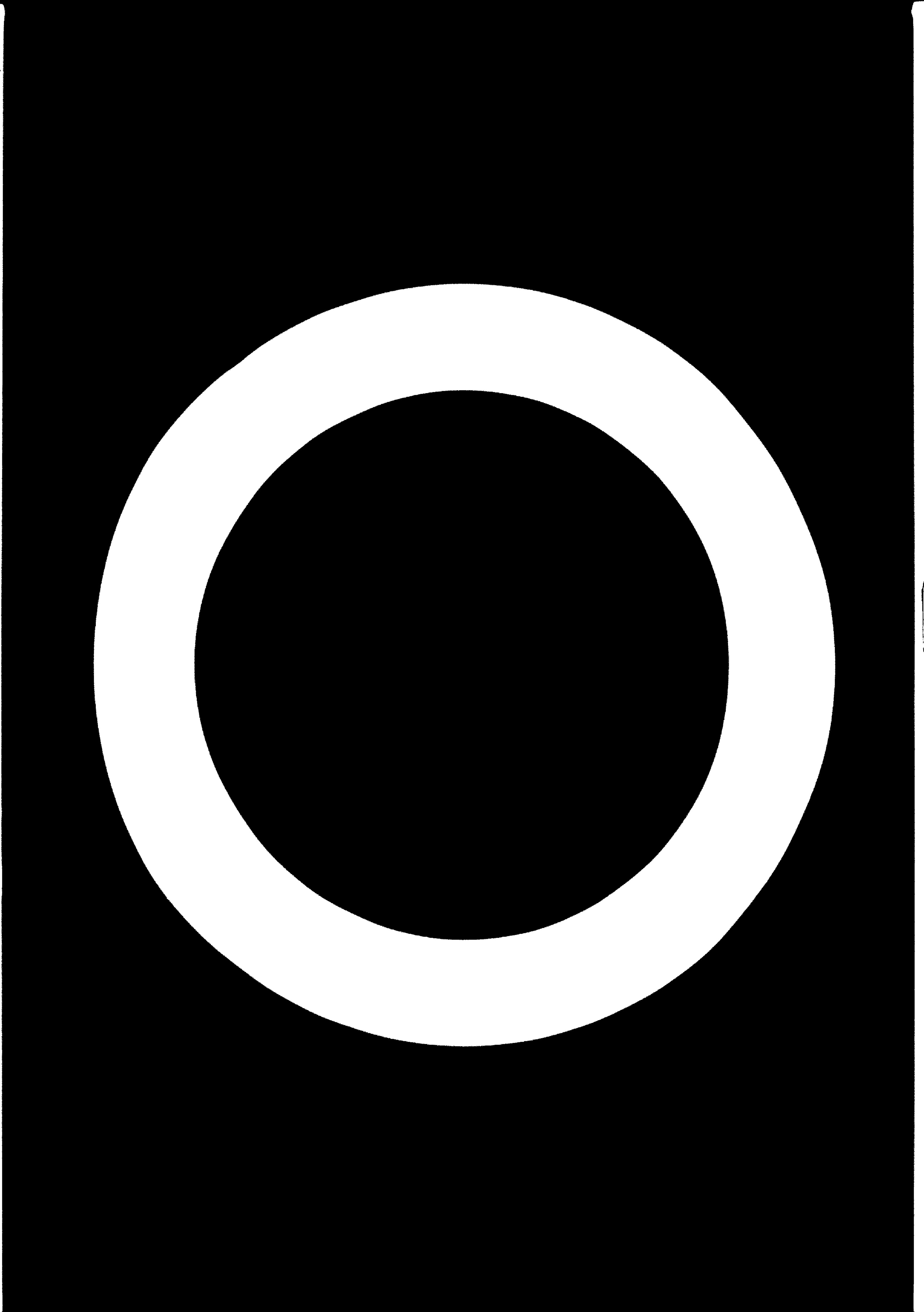


Table II- 7 Estimated Annual Demand for Indonesian P

		Products	Market	1975	1976	1977	1978	1979	19
Synthetic Resins		LDPE	Domestic	36,000	43,000	52,000	63,000	75,000	90,
			Overseas	15,000	15,400	18,400	20,000	22,000	21,
			Total	51,000	59,400	70,400	83,000	97,000	111,
		HDPE	Domestic	11,500	13,000	14,500	16,000	18,000	20,
			Overseas	4,900	5,700	6,600	7,300	8,000	8,
			Total	16,400	18,700	21,100	23,300	26,000	28
		VCM	Domestic	44,000	50,000	58,000	67,000	78,500	93,
			Overseas	0	0	0	0	0	
			Total	44,000	50,000	58,000	67,000	78,500	93,
		PVC	Domestic*1	23,000	29,000	36,000	44,000	54,000	65,
			Overseas	4,700	4,400	5,200	6,200	7,200	10,
			Total	27,700	33,400	41,200	50,200	61,200	75,
		DOP	Domestic	19,000	22,000	25,000	29,000	34,000	40,
			Overseas	0	0	0	0	0	
			Total	19,000	22,000	25,000	29,000	34,000	40,
		Polystyrene	Domestic	9,000	11,000	13,500	16,500	20,000	25,
			Overseas	6,500	7,200	7,800	8,500	9,200	10,
			Total	15,500	18,200	21,300	25,000	29,200	35,
		PP	Domestic*2	-	2,500	8,500	16,500	26,500	40,
			Overseas	-	2,800	3,000	3,200	3,400	4,
			Total	-	5,300	11,500	19,700	29,900	44,
Synthetic Fibers	Intermediates	Caprolactum*3	Domestic	15,100	16,200	19,900	22,300	24,600	26,
			Overseas	0	0	0	0	0	
			Total	15,100	16,200	19,900	22,300	23,600	26,
		TPA*4	Domestic	36,100	41,600	49,900	58,800	66,900	77,
			Overseas	0	0	0	0	0	
			Total	36,100	41,600	49,900	58,800	66,900	77,
		EG*4	Domestic	15,200	17,500	21,000	24,800	28,200	32,
			Overseas	0	0	0	0	0	
			Total	15,200	17,500	21,000	24,800	28,200	32,
	End Products	Nylon	Domestic	10,000	11,000	14,000	16,000	18,000	20,
			Overseas	4,400	4,500	5,000	5,300	5,500	5,
			Total	14,400	15,500	19,000	21,300	23,500	25,
		Polyester	Domestic	34,000	40,000	49,000	59,000	68,000	80,
			Overseas	8,300	8,700	9,400	9,900	10,300	10,
			Total	42,300	48,700	58,400	68,900	78,300	90,

Net Domestic Market = Total Domestic Demand - Planned Capacity already appro

*1 Total Domestic Demand - 15,000 T/Y (Planned by Eastern Polymer).

*2 Total Domestic Demand - 20,000 T/Y (Planned by Pertamina).

*3 Intermediate for nylon.

*4 Intermediate for polyester.

Note: The demand for caprolactum, TPA, and EG were estimated respectively from estin ratios of products/raw materials.

ed Annual Demand for Indonesian Petrochemical Products

(Unit: tons)

'77	1978	1979	1980	1981	1982	1983	1984	1985
,000	63,000	75,000	90,000	106,000	125,000	148,000	175,000	200,000
400	20,000	22,000	21,000	21,000	21,000	21,000	21,000	21,000
400	83,000	97,000	111,000	127,000	146,000	169,000	196,000	221,000
500	16,000	18,000	20,000	22,000	24,000	26,000	28,000	30,000
600	7,300	8,000	8,000	8,000	8,000	8,000	8,000	8,000
100	23,300	26,000	28,000	30,000	32,000	34,000	36,000	38,000
000	67,000	78,500	93,000	106,000	124,000	142,000	165,000	190,000
0	0	0	0	0	0	0	0	0
000	67,000	78,500	93,000	106,000	124,000	142,000	165,000	190,000
,000	44,000	54,000	65,000	78,000	95,000	113,000	135,000	160,000
,200	6,200	7,200	10,000	10,000	10,000	10,000	10,000	10,000
,200	50,200	61,200	75,000	88,000	105,000	123,000	145,000	170,000
,000	29,000	34,000	40,000	46,000	54,000	62,000	72,000	83,000
0	0	0	0	0	0	0	0	0
,000	29,000	34,000	40,000	46,000	54,000	62,000	72,000	83,000
,500	16,500	20,000	25,000	30,000	35,000	42,000	50,000	60 000
,800	8,500	9,200	10,000	10,000	10,000	10,000	10,000	10,000
,300	25,000	29,200	35,000	40,000	45,000	52,000	60,000	70,000
,500	16 500	26,500	40,000	51,500	65,000	81,000	100,000	120,000
,000	3,200	3,400	4,000	4,000	4,000	4,000	4,000	4,000
,500	19,700	29,900	44,000	55,500	69,000	85,000	104,000	214,000
,900	22,300	24,600	26,500	28,600	31,700	34,900	38,000	41,000
0	0	0	0	0	0	0	0	0
),900	22,300	23,600	26,500	28,600	31,700	34,900	38,000	41,000
,900	58,800	66,900	77,100	89,100	102,700	118,100	136,900	158,200
0	0	0	0	0	0	0	0	0
,900	58,800	66,900	77,100	89,100	102,700	118,100	136,900	158,200
,000	24,800	28,200	32,500	47,500	43,300	49,800	57,700	66,700
0	0	0	0	0	0	0	0	0
,000	24,800	28,200	32,500	47,500	43,300	49,800	57,700	66,700
,000	16,000	18,000	20,000	22,000	25,000	28,000	31,000	34,000
,000	5,300	5,500	5,300	5,300	5,300	5,300	5,300	5,300
,000	21,300	23,500	25,300	27,300	30,300	33,300	36,300	39,300
,000	59,000	68,000	80,000	94,000	110,000	128,000	150,000	175,000
,400	9,900	10,300	10,300	10,300	10,300	10,300	10,300	10,300
,400	68,900	78,300	90,300	104,300	120,300	138,300	160,300	185,300

(Source: JGC Estimates)

nd - Planned Capacity already approved by The Government.
ed by **Eastern Polymer**).
ed by **Pertamina**).

re estimated **respectively from estimated** Nylon and Polyester fiber demands, using

SECTION 2

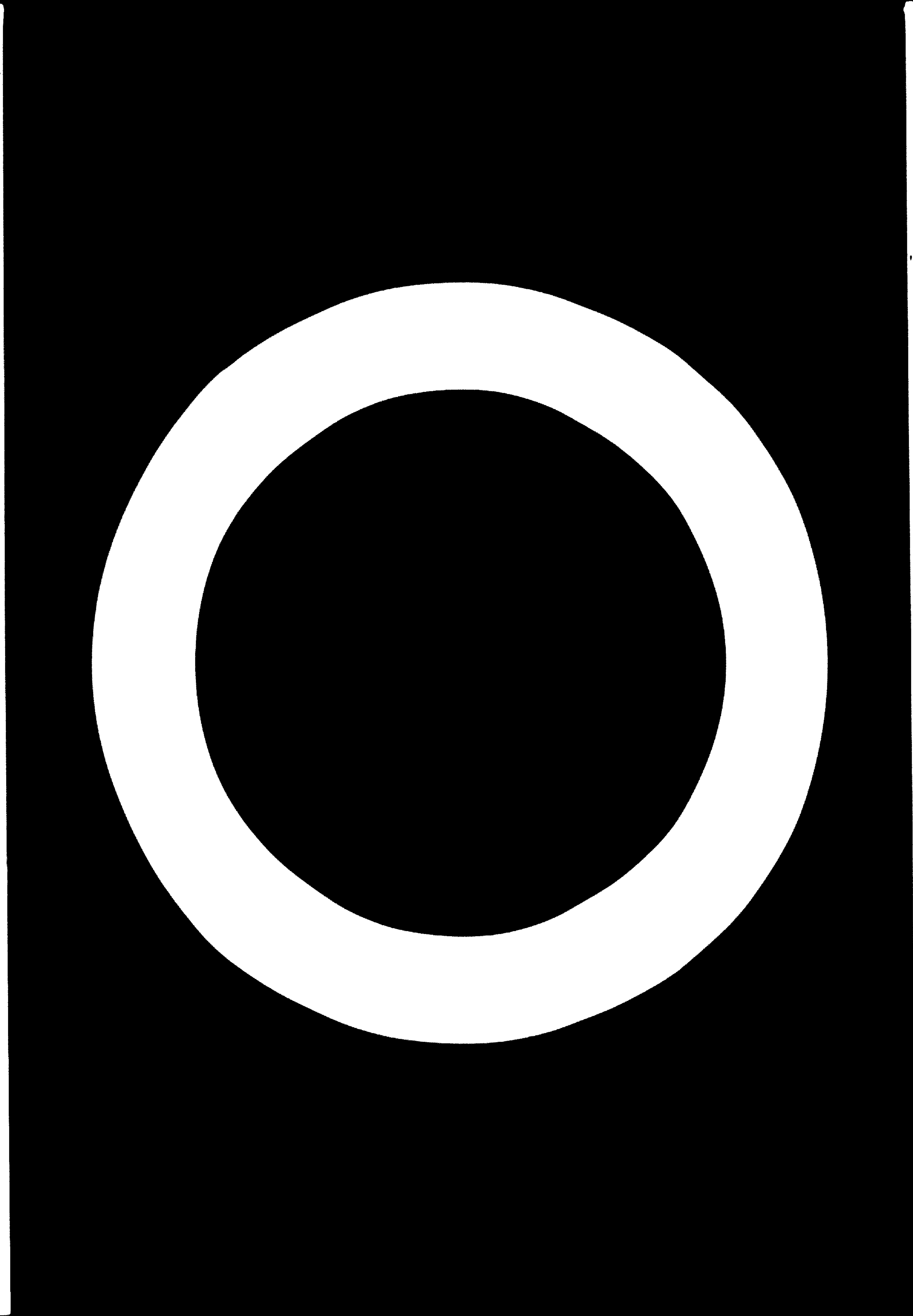


Table II-8 Demand Growth Rates in End Use

	'72 - '80	'80 - '85
Household articles & miscellaneous goods	17%	16%
Footwear	13%	10%
Film & Sheets	19%	18%
Construction & Civil Engineering	?6%	26%
Industrial use	18%	20%

Remarks of the demand forecasting will be described below separately for each resin.

Table II-9 Breakdown of Plastics Demands in Each End Uses

(Unit: tons)

		LDPE	HDPE	PVC	PP	Polystyrene	Domestic Total
Household articles & miscellaneous good	70	3,000	3,500	500	500	2,500	10,000*
	72	3,500	8,000	500	2,000	4,000	18,000*
	80	9,000	15,000	1,000	20,000	20,000	65,000
	85	18,000	20,000	2,000	50,000	40,000	130,000
Footwear	70	500		5,000			6,000
	72	500		9,500			10,000
	80	1,000		25,000			26,000
	85	2,000		40,000			42,000
Film & Sheets	70	14,500	500	8,000	500		23,500
	72	22,000	1,000	11,500	6,000		40,500
	80	80,000	5,000	39,000	40,000		164,000
	85	180,000	10,000	98,000	90,000		378,000
Construction & Civil Engineering	70			1,800			1,800
	72			2,700			2,700
	80			10,000			10,000
	85			25,000			25,000
Industrial use	70			500		500	1,000
	72			800		700	1,500
	80			5,000		5,000	10,000
	85			10,000		20,000	30,000

(Source: JGC Estimates)

* Exclues 1,000 tons yr. of imported products which can not be classified into each plastics items.

LDPE

The LDPE demand is expected to show a large growth in the field of film and sheets, mainly for use in package. Demand percentage in this field will reach 89% in 1982 and 90% in 1985 as compared with 84% in 1972, as shown in Table II-10.

Table II-10 Breakdown of Domestic LDPE Demand in End Uses

(Unit: tons)

	1970	1972	1980	1985
Household articles & miscellaneous	3,000 (18%)	3,500 (14%)	9,000 (10%)	18,000 (9%)
Footwear	500 (3%)	500 (2%)	1,000 (1%)	2,000 (1%)
Film & Sheets	14,500 (69%)	22,500 (84%)	80,000 (89%)	180,000 (90%)
Construction & Civil Engineering	-	-	-	-
Industrial use	-	-	-	-
Total	18,000(100%)	26,000(100%)	90,000(100%)	200,000(100%)

Of the LDPE-demanding fields, "household articles & miscellaneous goods", the second largest user after "film & sheets," is expected to occupy 10% of the total LDPE demand. The LDPE demand in the "footwear" field is also considered to increase because of an inexpensive cost of LDPE, although a large demand growth cannot be expected due to competition with PVC. Besides, LDPE demands in the fields of "industrial use" and "construction & civil engineering" will continue to be negligible.

The above prospects for the LDPE demand are expected to show a trend given in Table II-11, as a whole, for the 1975-1985 period.

Table II-11 Indonesia's Estimated Domestic Demand for LDPE

(Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
26,000	36,000	43,000	52,000	63,000	75,000	90,000	106,000	125,000	148,000	175,000	200,000

HDPE

Large demand may be expected in the field of "household articles and miscellaneous goods", due to excellent thermal resistant property of HDPE. The HDPE demand in this field will account for

Table II-12 Breakdown of Domestic HDPE Demand

(Unit: tons)

	1970	1972	1980	1985
Household Articles & miscellaneous good	3,500 (87%)	8,000 (88%)	15,000 (75%)	20,000 (67%)
Footwear	-	-	-	-
Film & Sheets	500 (13%)	1,000 (12%)	5,000 (25%)	10,000 (33%)
Construction & Civil Engineering	-	-	-	-
Industrial use	-	-	-	-
Total	4,000(100%)	9,000(100%)	20,000(100%)	30,000(100%)

70% in 1980 and 67% in 1985. And in another field of heavy duty packaging (40 Kg or more) HDPE will find its growing market. In fact, however, much would not be expected in both fields, seeing that HDPE will have to compete with PP which is to be domestically produced in 1973.

Taking competition with PP into consideration, we summarized the demand records and estimates over 1972-1985, in Table II-13.

Table II-13 Estimated Domestic Demand for HDPE

(Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
9,000	11,500	13,000	14,000	16,000	18,000	20,000	22,000	24,000	26,000	28,000	30,000

PVC

Like LDPE, PVC will also find its major use in the field of film, particularly for packaging. The PVC demand in this field is likely to reach 39,000 tons or 49% of the total demand for PVC in 1980, and 98,000 tons or 56% of the total PVC demand in 1985. Use in sandals will have large demand, since this field can make effective use of PVC's characteristics of lightness, washability, and low price. There is a strong possibility that it will have increasing demand in the field of civil engineering and architecture, for use in pipes.

Taking the above points into consideration, we summarized the estimated PVC demand for each of end uses in Table II-14.

Table II-14 Breakdown of Domestic PVC Demand in Indonesia

(Unit: tons)

	1970	1972	1980	1985
Household articles & miscellaneous good	500 (3%)	500 (2%)	1,000 (1%)	2,000 (1%)
Footwear	5,500 (34%)	9,500 (38%)	25,000 (31%)	40,000 (23%)
Film & Sheets	8,000 (49%) *1	11,500 (46%) *3	39,000 (49%)	98,000 (56%)
Construction & Civil Engineering	1,800 (11%) *2	2,700 (11%) *4	10,000 (13%)	25,000 (15%)
Industrial use	500 (3%)	800 (3%)	5,000 (6%)	10,000 (5%)
Total	16,300(100%)	25,000(100%)	80,000(100%)	175,000(100%)

*1) Of this amount, 3,000 tons was imported in the form of product.

*2) Of this amount, 1,200 tons was imported in the form of product.

*3) Of this amount, 5,000 tons was imported in the form of product.

*4) Of this amount, 3,000 tons was imported in the form of product.

As a whole the PVC demand is expected to follow such a trend as given in Table II-15 for the 1972-1985 period.

Table II-15 Estimated Domestic Demand for PVC

(Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
25,000	38,000	44,000	51,000	59,000	69,000	80,000	93,000	110,000	128,000	150,000	175,000

As for PVC, Eastern Polymer Co. was granted approval of the Government for the construction of a 15,000 ton per year PVC plant. Therefore the PVC demand contemplated under this project are given in Table II-16 below.

Table II-16 Estimated Net Domestic Demand for PVC

(Unit: tons)

'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
23,000	29,000	36,000	44,000	54,000	65,000	78,000	95,000	113,000	135,000	160,000

Polystyrene

Polystyrene is expected to find its use in the field of industrial use, particularly in household electric appliances. In this field

Table II-17 Breakdown of Polystyrene Demands in Major End Uses in Indonesia

(Unit: tons)

	1970	1972	1980	1985
Household articles & miscellaneous goods	2,500 (83%)	4,000 (85%)	20,000 (80%)	40,000 (67%)
Footwear	-	-	-	-
Film & Sheets	-	-	-	-
Construction & Civil Engineering	-	-	-	-
Industrial use	500 (17%)	700 (15%)	5,000 (20%)	20,000 (33%)
Total	3,000(100%)	4,700(100%)	25,000(100%)	60,000(100%)

demand percentage of polystyrene will attain 80% or 20,000 tons/yr. in 1980 and 67% or 40,000 tons/yr. in 1985.

The polystyrene demand is expected to follow a trend given in Table II-18 for the 1972-1985 period.

Table II-18 Indonesia's Estimated Domestic Demand for Polystyrene

(Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
4,700	9,100	11,000	13,500	16,500	20,000	25,000	30,000	35,000	42,000	50,000	60,000

Polypropylene

PP is estimated to have the largest demand in Indonesia in the field

Table II-19 Breakdown of Domestic Demand for PP

(Unit: tons)

	1970	1972	1980	1985
Household articles & miscellaneous good	500 (50%)	2,000 (25%)	20,000 (33%)	50,000 (35%)
Footwear	-	-	-	-
Film & Sheets	500 (50%)	6,000 (75%)	40,000 (67%)	90,000 (65%)
Construction & Civil Engineering	-	-	-	-
Industrial use	-	-	-	-
Total	1,000(100%)	8,000(100%)	60,000(100%)	140,000(100%)

of film. If PP is used domestically for bags for rice, sugar, tapioca, copra and cement, in addition to fertilizer, then PP demand would be around 30,000 tons in 1980. In addition to the use as film, PP is also used in the household articles and miscellaneous goods as shown in Table II-19.

The polypropylene demand is estimated to follow a trend given in Table II-20 for the 1972-1985 period.

Table II-20 Indonesia's Estimated Domestic Demand for PP

(Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
8,000	17,500	22,500	28,500	36,500	46,500	60,000	71,500	85,000	101,000	120,000	124,000

Like PVC, Pertamina will start a 20,000 ton per year polypropylene plant in 1973. Therefore the polypropylene demands contemplated under this project are as given in Table II-21.

Table II-21 Estimated Net Domestic Demand for PP

(Unit: tons)

'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
-	2,500	8,500	16,500	26,500	40,000	51,500	65,000	81,000	100,000	120,000

In order to prove the accuracy of the above estimation based upon microscopic analyses of plastics markets, we also calculated the demands for all resins, using the demand growth rates of each resin estimated for the 1972-1980 period and the per-capita plastics consumption estimated for 1980, given in Table II-22.

Table II-22 Estimated Average Growth Rate and Estimated Consumption per capita for Each Resin

	Estimated Average growth rate	Consumption per-capita (Unit: Kg/yr.)	
	1972 - 1980	1972	1980
LDPE	17%	0. 21	0. 60
HDPE	11%	0. 06	0. 13
PVC	16%	0. 20	0. 53
Polystyrene	22%	0. 04	0. 16
PP	28%	0. 06	0. 40

Table II-23 Demand for Each Resin Estimated in Macroscopic and Microscopic Analyses - 1980

(Unit: tons)

	Macro	Micro
LDPE	100, 000 - 130, 000	90, 000
HDPE	25, 000 - 32, 000	20, 000
PVC	75, 000 - 90, 000	80, 000
Polystyrene	22, 000 - 27, 000	25, 000
PP	45, 000 - 60, 000	60, 000

We adopted the results of microscopic analyses as the more accurate data on the domestic demands for plastics.

Synthetic Fibers

The per-capita fiber consumption, which was 0. 8 Kg in 1970 in Indonesia, is estimated to reach 2. 4 Kg in 1980, which is almost identical with that of today's Hong Kong (2. 6 Kg) and Thailand

(2.4 Kg). The ratio of synthetic fiber to total fiber in demands will approach about 25% in 1975 and 30% in 1980.

Table II-24 Estimated Demand for Synthetic Fibers, Nylon and Polyester Fibers in Indonesia

(Unit: tons)

	1975	1976	1977	1978	1979	
Synthetic Fibers	49,000	57,000	71,000	84,000	9[illegible],000	
Nylon	10,000	11,000	14,000	16,000	18,000	
Growth rate			15%			
Polyester	34,000	40,000	49,000	59,000	68,000	
Growth rate			17%			
	1980	**1981**	**1982**	**1983**	**1984**	**1985**
Synthetic Fibers	113,000					
Nylon	20,000	22,000	25,000	28,000	31,000	34,000
Growth rate			10%			
Polyester	80,000	94,000	110,000	128,000	150,000	175,000
Growth rate			17%			

The proportions of nylon and polyester in the total synthetic fiber demand is estimated to be 20% and 70% respectively in 1975, and 18% and 70% in 1980. The demand for nylon and polyester fibers were estimated for 1981-1985 assuming that the average growth rates of nylon demand estimated 15% per annum for 1975-1980 will drop to 10% during 1981-1985, and the demand for polyester fibers would stay on the same level as 17% growth rate per annum during 1975-1980.

3.3 Export Markets

Potential demands, by types of products within the scope of this survey, were calculated for each of the ECAFE region countries, from estimated demand and production in these countries. Then possible volumes of export of Indonesian products were calculated based upon estimated shares of Indonesian products in those potential demands. Those countries which fall within a) to d), below, were excluded from the target export markets for Indonesian products, even if they have potential demands, because we could not rate them as constant markets for Indonesian petrochemicals.

a) Those countries of which the industrial level for petrochemical has already reached not only to satisfy whole domestic demands but also to have stable export markets; They can be spot markets to fill the demand-supply gap, but cannot be constant export markets for Indonesian petrochemicals from long-term point of view. Only Japan falls under this category.

b) Those countries which have petrochemical industries of their own; Judging from available petrochemical production information, Indonesia will have a possibility to export products to those countries in the future when the demand have outrun the supply. However, it is more likely that they will construct new plants or scale up existing ones, in order to attain their self-sufficiency. In addition, they are, and will be, taking such measures as import bans or high customs duties. In the light of these circumstances, they can be spot markets for Indonesian products, but can never be constant markets. Australia, India, and Korea fall under this category.

c) Those countries in which petrochemical industries are not yet commercialized, but will sure be established in the future (1975-1985); they will take protective measures for their petrochemical industries, and hence are no better than spot export markets for Indonesian products; Iran and Thailand fall under this category.

d) China is based upon planned economy, under which supply plans are so designed to meet the domestic demand that it cannot be considered as an export market for Indonesian products.

However, among the above countries to be eliminated, we predicted that the start-up of the Thai petrochemical complex would be postponed from initially scheduled date of 1976 to 1979. This is due to the problem of the percentage of interests in the joint venture secured by the Japanese group and Thailand, and the problem of ethylene price which has aroused disputes between the ethylene suppliers and the downstream industries. We considered that Thailand could continue to be an export market for the Indonesian petrochemicals until 1969. Then we obtain the 7 countries of the Philippines, Hong Kong, New Zealand, Singapore, Malaysia, Sri-Lanka, and Thailand as the possible export markets for Indonesian petrochemicals.

Possible volumes of export of Indonesian products to the above 7 countries are given in Table II-25 to II-33. While taking into consideration the competition with Japanese, European, U.S. and other makers, we calculated the minimum and the maximum volumes of export.

As for plastics, at present, Japan has the largest share in the ECAFE region. Taking advantage of its geographical location close to the ECAFE region countries, Japan has already established its sales networks through capital participation, technical services, and managerial guidance. It will thus be difficult for Indonesia to compete with

Japanese products in those countries, even when its products are lower-priced than the corresponding Japanese products.

Keeping these circumstances in mind, we calculated the possible volumes of export of Indonesian petrochemicals to each of the 7 target countries. Our calculation is based on an assumption that after the share of a Japanese product is subtracted from a potential market of the same product, the Indonesian product would secure 20% (min) to 30% (max) of the remaining share in each of the target countries. When we fixed the extent of the above percentages, we took into consideration the competition from products of European, U. S., and newcoming ECAFE region countries.

Besides, though Japan will keep its predominant shares of plastics in the ECAFE region countries, we can give more optimistic possible volumes of export if Indonesia gets some Japanese share.

Only for reference, we would like to show in the same table the extent of Indonesian share gained on the assumption that an Indonesian product can successfully occupy 20% of the share of a corresponding Japanese product. We do not think it impossible for Indonesia to increase the sales if Indonesia takes some appropriate means, such as joint export with a big partner, in order to penetrate the Japanese market.

As for synthetic fibers, we calculated the possible volumes of exports, depending on information obtained from experts of each country and Japanese trade firms. We estimated that an Indonesian share would be 5 to 10% of the potential market of products.

Table II-25 **Estimated Volumes of Export from Indonesia LDPE (1975 - 1985)**

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981-1985
Hong Kong	Min	6,600	7,100	7,700	8,300	9,000	9,700	
	Max	9,900	10,700	11,500	12,400	13,400	14,500	
	*	21,900	23,700	25,600	27,600	29,900	32,300	
Malaysia	Min	1,300	1,400	1,600	1,700	1,900	2,100	
	Max	2,100	2,300	2,500	2,700	3,000	3,300	
	*	5,100	5,700	6,200	6,800	7,500	8,300	
New Zealand	Min	2,600	2,800	3,000	3,200	3,500	3,700	
	Max	4,000	4,200	4,500	4,900	5,200	5,600	
	*	4,400	4,700	5,000	5,400	5,700	6,200	
Philippines	Min	1,900	2,300	2,800	3,100	3,600	4,000	
	Max	2,800	3,400	4,100	4,700	5,400	6,000	
	*	15,000	18,300	21,800	25,200	28,600	32,000	
Singapore	Min	700	700	800	800	900	100	
	Max	900	1,000	1,100	1,300	1,400	1,500	
	*	6,200	6,800	7,600	8,400	9,300	10,000	
Sri-Lanka	Min	700	800	1,000	1,100	1,300	1,400	
	Max	1,100	1,200	1,400	1,600	1,900	2,200	
	*	2,400	2,800	3,200	3,700	4,200	4,800	
Thailand	Min	1,200	1,300	1,500	1,700	1,900	0	
	Max	1,800	2,000	2,300	2,600	2,900	0	
	*	11,600	13,200	15,000	17,200	19,200	0	
Total	Min	15,000	16,400	18,400	19,900	22,100	21,000	21,000
	Max	22,600	24,800	27,400	30,200	33,200	33,100	33,100
	*	66.000	56,900	84,400	94,300	104,400	93,600	93,600

* : Possible volume of export estimated on assumption that Indonesian products would occupy 20% of the Japanese share in export market.

Table II-26 **Estimated Volumes of Export from Indonesia HDPE (1975 - 1985)**

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	400	400	500	500	500	600	
	Max	600	600	700	700	800	900	
	*	3, 900	4, 200	4, 500	4, 900	5, 300	5, 700	
Malaysia	Max	300	300	300	300	400	400	
	Max	400	400	500	500	600	600	
	*	1, 300	1, 400	1, 600	1, 700	1, 900	2, 100	
New Zealand	Max	1, 200	1, 300	1, 500	1, 600	1, 800	2, 000	
	Max	1, 800	2, 000	2, 200	2, 400	2, 700	2, 900	
	*	2, 000	2, 200	2, 400	2, 700	3, 000	3, 300	
Philippines	Min	2, 300	2, 700	3, 100	3, 600	4, 100	4, 700	
	Max	3, 500	4, 100	4, 700	5, 400	6, 100	7, 100	
	*							
Singapore	Min	200	200	200	200	200	300	
	Max	200	300	300	300	400	400	
	*	1, 500	1, 700	1, 900	2, 100	2, 300	2, 600	
Sri-Lanka	Min	100	100	200	200	200	200	
	Max	200	200	200	300	300	400	
	*	400	500	500	600	700	800	
Thailand	Min	400	700	800	900	1, 000	0	
	Max	500	1, 000	1, 100	1, 300	1, 500	0	
	*							
Total	Min	4, 900	5, 700	6, 600	7, 300	8. 200	8, 200	8, 200
	Max	7. 200	8, 600	9, 700	10, 900	12, 400	12, 300	12, 300
	*	9, 100	10, 000	10, 900	12, 000	13, 200	14, 500	14, 500

Table II-27 Estimated Volumes of Export from Indonesia VCM (1975 - 1985)

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		0	0	0	0	0	0	
Malaysia	Min	0	0	0	0	0	00	
	Max	0	0	0	0	0	0	
		2,100	2,100	2,100	2,100	2,100	2,100	
New Zealand	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		0	0	0	0	0	0	
Philippines	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
			5,200	n.a.	n.a.	n.a.	22,000	
Singapore	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		2,200	2,200	2,200	2,200	2,200	2,200	
Sri-Lanka	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		0	0	0	0	0	0	
Thailand	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		0	8,800	8,800	8,800	8,800	8,800	
Total	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
		4,300	18,300	13,100	13,100	13,100	35,100	35,100

Table II-28 Estimated Volumes of Export from Indonesia PVC (1975 - 1985)

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	1,600	1,700	1,800	1,900	2,000	2,100	
	Max	2,400	2,500	2,700	2,800	3,000	3,200	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Malaysia	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
New Zealand	Min	600	600	600	700	700	700	
	Max	900	900	1,000	1,000	1,100	1,100	
	*	1,900	2,000	2,100	2,200	2,300	2,500	
Philippines	Min	1,100	n. a.	n. a.	n. a.	n. a.	4,200	
	Max	1,800	n. a.	n. a.	n. a.	n. a.	6,100	
	*	3,300	n. a.	n. a.	n. a.	n. a.	11,400	
Singapore	Min	700	900	1,200	1,400	1,700	2,000	
	Max	1,100	1,400	1,700	2,100	2,300	2,600	
	*	1.800	2,300	2,900	3,500	4,000	4,900	
Sri-Lanka	Min	300	400	400	500	600	600	
	Max	500	500	600	700	800	1,000	
	*	1,100	1,200	1,400	1,600	1,900	2,200	
Thailand	Min	400	800	1,200	1,700	2,200	0	
	Max	600	1,200	1,800	2,600	3,300	0	
	*	800	1,600	2,400	3,400	4,400	0	
Total	Min	4,700	4,400	5,200	6,200	7,200	9,600	9,600
	Max	7,300	6,500	7,800	9,200	10,500	14,000	14,000
	*	8,900	7,100	8,800	10,700	17,600	21,000	21,000

Table II-29 **Estimated Volumes of Export from Indonesia**
Styrene Monomer (1975 - 1985)

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
Malaysia	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
New Zealand	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
Philippines	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	2, 600	2, 600	2, 600	2, 600	2, 600	2, 600	
Singapore	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	2, 000	2, 000	2, 000	2, 000	2, 000	2, 000	
Sri-Lanka	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
Thailand	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
Total	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	4, 000	4, 600	4, 600	4, 600	4, 600	4, 600	4, 600

Table II-30 Estimated Volumes of Export from Indonesia Polystyrene (1975 - 1985)

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	4,800	5,100	5,500	5,900	6,300	6,700	
	Max	7,200	7,700	8,200	8,800	9,400	10,000	
	*	16,000	17,100	18,300	19,600	20,900	22,400	
Malaysia	Min	100	100	100	100	100	000	
	Max	100	100	100	100	200	200	
	*	700	800	800	900	1,000	1,100	
New Zealand	Min	1,100	1,200	1,200	1,300	1,400	1,500	
	Max	1,600	1,700	1,800	1,900	2,000	2,100	
	*							
Philippines	Min	200	400	500	700	800	1,000	
	Max	300	600	800	1,000	1,300	1,500	
	*	800	1,400	2,000	2,600	3,200	3,800	
Singapore	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	0	0	0	0	0	0	
Sri-Lanka	Min	100	100	200	200	200	200	
	Max	200	200	200	300	300	400	
	*	400	500	500	600	700	800	
Thailand	Min	200	300	300	300	400	500	
	Max	300	400	500	500	600	700	
	*	2,200	2,600	3,000	3,400	4,000	4,600	
Total	Min	6,500	7,200	7,800	8,500	9,200	10,000	10,000
	Max	9,700	10,700	11,600	12,600	13,800	14,900	14,900
	*	20,100	22,400	24,600	27,100	29,800	32,700	32,700

Table II-31 **Estimated Volumes of Export from Indonesia PP (1975 - 1985)**

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	400	500	500	500	600	600	
	Max	600	700	800	800	900	900	
	*	2,100	2,300	2,500	2,700	2,900	3,200	
Malaysia	Min	100	200	200	200	200	300	
	Max	200	200	300	300	400	500	
	*	1,400	1,600	1,800	2,200	2,400	2,800	
New Zealand	Min	300	300	300	300	300	400	
	Max	400	400	400	500	500	500	
	*	400	400	500	500	600	600	
Philippines	Min	1,500	1,600	1,800	1,900	2,000	2,200	
	Max	2,300	2,500	2,800	3,000	3,200	3,400	
	*	5,800	6,400	7,000	7,400	8,000	8,600	
Singapore	Min	200	200	200	300	300	400	
	Max	200	300	300	400	500	500	
	*	800	900	1,100	1,300	1,500	1,800	
Sri-Lanka	Min	-	-	-	-	-	-	
	Max	neg.	neg.	neg.	neg.	neg.	neg.	
	*							
Thailand	Min	0	0	0	0	0	0	
	Max	0	0	0	0	0	0	
	*	2,800	3,400	4,000	4,400	5,200	6,000	
Total	Min	2,400	2,800	3,000	3,200	3,400	3,900	3,900
	Max	3,700	4,100	4,600	5,000	5,500	5,800	5,800
	*	13,300	15,000	16,900	18,500	20,600	23,000	23,000

Table II-32 Estimated Volumes of Export from Indonesia
Nylon (1975 - 1985)

(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	300	300	400	400	500	500	
	Max	600	700	800	800	900	1,000	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Malaysia	Min	1,100	1,100	1,200	1,300	1,300	1,300	
	Max	2,200	2,300	2,400	2,500	2,600	2,600	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
New Zealand	Min							
	Max	800	800	900	1,000	1,100	1,200	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Philippines	Min	1,100	1,100	1,200	1,300	1,300	1,300	
	Max	2,200	2,300	2,400	2,500	2,600	2,600	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Singapore	Min	1,300	1,400	1,500	1,700	1,900	2,000	
	Max	2,500	2,800	3,100	3,400	3,700	4,100	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Sri-Lanka	Min	100	100	100	200	200	200	
	Max	200	200	300	400	400	400	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Thailand	Min	500	500	500	400	300	0	
	Max	1,100	1,100	1,000	800	500	0	
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Total	Min	4,400	4,500	5,000	5,300	5,500	5,300	5,300
	Max	9,600	10,200	10,900	11,400	11,800	11,900	11,900
	*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table II- 33 **Estimated Volumes of Export from Indonesia Polyester (1975 - 1985)**

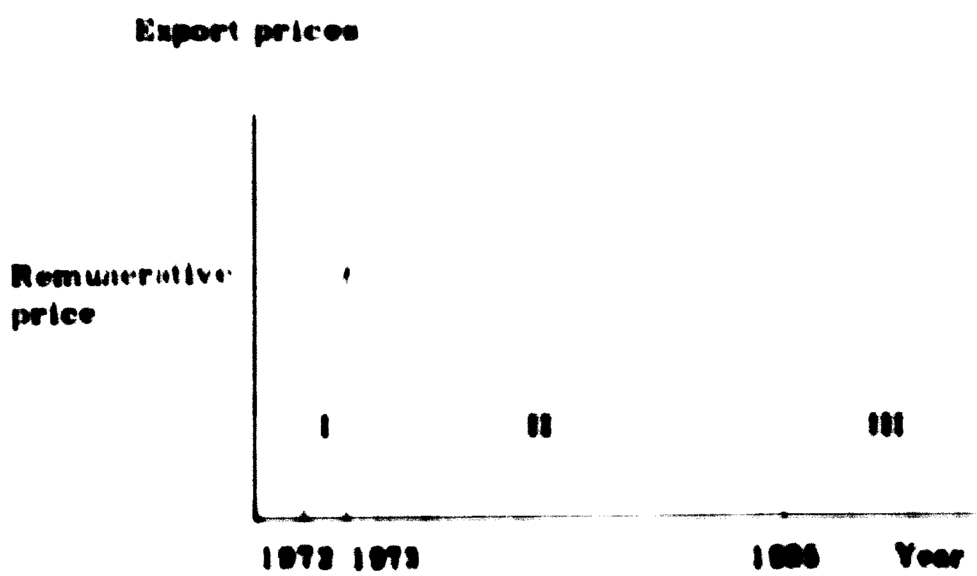
(Unit: tons)

Name of Countries		1975	1976	1977	1978	1979	1980	1981 - 1985
Hong Kong	Min	600	600	700	800	800	900	
	Max	1, 200	1, 300	1, 400	1, 500	1, 700	1, 800	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Malaysia	Min	1, 700	1, 800	1, 900	2, 000	2, 100	2, 100	
	Max	3, 400	3, 600	3, 800	4, 000	4, 100	4, 100	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
New Zealand	Min	500	500	600	600	700	700	
	Max	900	1, 000	1, 100	1, 200	1, 300	1, 400	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Philippines	Min	1, 700	1, 800	1, 900	2, 000	2, 100	2, 100	
	Max	3, 400	3, 600	3, 800	4, 000	4, 100	4, 100	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Singapore	Min	2, 700	3, 000	3, 300	3, 600	4, 000	4, 300	
	Max	5, 400	6, 000	6, 600	7, 200	7, 900	8, 700	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Sri-Lanka	Min	100	100	100	200	200	200	
	Max	200	300	300	400	400	500	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Thailand	Min	1, 000	900	900	700	400	0	
	Max	1, 900	1, 900	1, 700	1, 400	900	0	
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	
Total	Min	8, 300	8, 700	9, 400	9, 900	10, 300	10, 300	10, 300
	Max	16, 400	17, 700	18, 700	19, 700	20, 200	20, 600	21, 200
	*	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.

We adopted the minimum values in the final estimation of export volumes, and forecasted that exports of all products would remain on the same level from 1980 on. Indonesian products will have to compete with those produced at international-scale plants of Japanese, European, and the U.S. makers and with those products of newcomers in the ECAFE region. It is very risky to set a higher degree of dependence upon export from the beginning of the petrochemical industrialization in Indonesia in such severer international export situations.

3.4 Price

The domestic prices and export prices of those domestic petrochemicals produced in Indonesia are fixed in accordance with the trend in the export prices of Japanese products, because Japan is the largest supplier of petrochemicals to Southeast Asia and is keeping its position as the price leader. Future export prices of Japanese petrochemicals will show such a trend as depicted below.



Stage I in the above graphic illustration is the period during which present low-price levels are expected to be properly adjusted.

In Stage II, an orderly marketing principle is established so that reasonable export prices will be maintained. Therefore, export prices will continuously rise at a few percent per annum on an average, merely in order to offset the rise of production cost.

In Stage III, competition of petrochemical export will again become stiff due to continued construction of petrochemical complexes in the Southeast Asian region. This competition will unable export prices to absorb the rise of production costs, but will be obliged to maintain constant price levels.

The ex-factory prices for domestic sales of Indonesian petrochemicals will be set to those levels obtained by adding import charges to the CIF prices of Japanese products imported into Indonesia. The ex-factory prices for export of Indonesian petrochemicals will be set to such levels obtained by subtracting the cost of transportation between Indonesia and any destinations from the CIF prices of Japanese products imported into each overseas market.

Based upon the above rules of calculation, we estimated both the domestic prices and the export prices of the domestic petrochemicals produced in Indonesia for 197[illegible], 1980 and 1983. Results of calculation are given in the following list.

Table II-34 Estimated Price of Indonesian Petrochemicals

(Unit: $/ton)

	Price	1977	1980	1985
LDPE	Domestic	340	360	375
	Export	262	280	295
HDPE	Domestic	347	370	390
	Export	287	310	330
PP	Domestic	357	380	400
	Export	287	310	330
PVC	Domestic	322	340	355
	Export	252	270	285
VCM	Domestic	192	200	210
Polystyrene	Domestic	336	350	360
	Export	266	280	290
DOP	Domestic	367	390	410
EG	Domestic	257	270	280
Caprolactam	Domestic	565	600	660
TPA	Domestic	440	470	520

4. Resource Study

4.1 Petroleum - Naphtha

(1) Crude Oil Situation in Indonesia

Indonesia is the second largest oil-producing country after Iran in the ECAFE region. Production of Crude oil has begun to show a remarkable increase in 1968, amounting to 55.4 million Kl in 1971 and more than 70% of this production was exported.

Indonesian crude oils are particularly characterized by their low sulfur content as compared with Middle East crudes (e.g., average 0.1% sulfur content in contrast to average 2.3% in the Middle East crudes). This characteristic makes the Indonesian curde oils quite valuable for the control of environmental pollution, which is now arousing worldwide concerns.

Although it is predicted in Indonesia that crude oil production from existing oil wells will trend downward in the future, attempt to develop new oil fields is actively under way, so as to overcome such downward trend. The total oil production is estimate to increase in the years to come.

President Sutowo of Pertamina has stated that the oil production would reach 1.5 million BPCD (or 87 million Kl annually) in 1973, 2 million BPCD (or 116 million Kl annually) in 1975 and 3 million BPCD (or 174 million Kl annually) in 1980.

(2) Petroleum Product Market in Indonesia

All the refineries in Indonesia are operated by Pertamina excepting Jjepu refinery owned by LEMIGAS. Crude oil refining capacity is at present 396,000 BPSD. (20,778,120Kl annually). A half or more of the oil products produced in Indonesia was domestically consumed, and less than a half was exported in 1971.

It can be estimated, however, that the domestic consumption will be outrun by export from 1972 on. On the contary, kerosene, gas oil, and asphalt depend partly on import because their production cannot catch up with domestic demand.

Kerosene is the most important petroleum product for civilian requirements in Indonesia and its demand will grow steadily. With regard to asphalt, about 90% of 200,000 tons/yr. of present annual demand can be supplied domestically when the Pladju refinery is put into full operation. However it is stressed that infrastructure should be further expanded for Indonesian industrialization, and that asphalt demand is continuously growing larger.

For the production of asphalt it is more advantageous to use Middle East crude oil, high-sulfur, but inexpensive, such as, e.g., Khafji crude, than to use costly Minas crude. If about 560,000 tons are expected for the 1980 asphalt demand, necessary Khafji crude oil amounts to 40,000 BPSD (6,360 Kl/D), from which about 300,000 tons/yr. of naphtha is available. And if this amount of naphtha is allocated to the use as the Petrochemical raw material, about 100,000 tons/yr. of ethylene will be produced.

(3) Availability of Naphtha as Petrochemical Raw Material in Indonesia

According to the information given by Pertamina, the naphtha available for petrochemical use is at present 5,000 BPSD (795 Kl/day) of Minas naphtha and 5,000 BPSD (795 Kl/day) of Java Sea naphtha. These quantities correspond to a little over 100,000 tons per year in terms of ethylene production.

In anticipation of future success of the resources development now in active progress, the Indonesian Government expects for a petrochemical complex to be planned in such a way that the complex is not based upon present availability of natural resources, but should contribute to the future development of petroleum resource and the future programs for supplying oil products.

Such an object can be achieved in this preliminary study, by planning on a petrochemical industrialization project based upon market forecasting of petrochemical products and by clarifying the quality and quantity of the raw material naphtha required for that project.

Generally speaking, the yields of ehtylene and other co-products vary depending on the quality of naphtha and the operation conditions of cracking. The PONA* analysis values of feed naphtha relate to yields of olefins under the same operation condition, as follows:

Naphtha which contains a large amount of paraffins, in particular n-paraffins, gives higher ethylene yields. When cracked under the same conditions, i-paraffins produce less ethylene and more propylene than n-paraffins do. Therefore, naphtha which is high in i-paraffin content cannot be called a good feedstock in case maximum ethylene production is intended.

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* P: Paraffin O: Olefin N: Naphthene A: Aromatics

A feedstock which has a low n-paraffins/i-paraffins ratio is preferable in case emphasis is placed on high propylene yield. A feedstock which is high in naphthene content does not improve ethylene yield, but shows a trend towards heightening butadiene content in C_4 fraction and aromatics content in cracked gasoline. Aromatics in feed naphtha have extremely great thermal stability. Therefore, a feedstock high in aromatics is not preferable for olefin production.

It was assumed in our study that naphtha from Minas crude oil was used as a feed to naphtha cracking complex. Specifications of this feed naphtha are shown in the Table II-35.

Table II-35 Specifications of Minas Naphtha

TBP cut IBP	49°C (120°F)	
EP	180°C (355°F)	
Yield on Crude	12.6 vol %	11.3 wt %
Specific Gravity	0.733	
API (60/60°F)	61.5	
PONA Analysis (vol %)		
Paraffin	62	
Olefin	0	
Naphthene	37	
Aromatics	1	

Naphtha reforming is also an important measure for the production of aromatics. Since aromatics in feed naphtha are not affected in the reforming process and since naphthenes are converted to aromatics at a high conversion rate, naphtha with high contents of aromatics and naphthenes is suitable as the feed to reforming.

Java Sea Naphtha has such high contents of aromatics and naphthenes that it was selected as a reforming feed in our study.

Table II-36 Specifications of Java Sea Naphtha

Cut Range	82.2 - 149°C (180 - 300°F)
Specific Gravity	0.743
API (60/60°F)	59
PONA Analysis (vol %)	
Paraffin	39
Olefin	0
Naphthene	47
Aromatics	14

4.2 Natural Gas

(1) Natural Gas Situation in Indonesia

Indonesia's natural gas deposits and its production are registered as given in Table II-37. (These figures do not

Table II-37 Natural Gas Deposits and Production

(Unit: 10^6 Nm^3)

	Reserves (1969)	Production (1971)
North Sumatra	5,960	460
Central Sumatra	22,199	2,270 (Central and South Sumatra)
South Sumatra	21,104	
Java	6,188	28
Kalimantan	3,581	470
Total	58,132	3,228

(Source: Directorate General of Oil & Gas, The Indonesian Government) include recently discovered new gas fields, both onshore and offshore.)

Despite these abundant reserves, the situation in natural gas production and utilization is still on an unsatisfactory level. Present activities and future plans are as follows:

Pertamina Unit I — It supplied the LPG plant and the carbon black plant (channel black at 7,000 tons/yr.) with 116 million Nm^3/yr of natural gas in 1971. If these plants are in full operation, they are estimated to consume 154 million Nm^3/yr. of natural gas.

In other words, natural gas will not be available for the new project as long as present production level of 460 million Nm^3/yr is maintained.

According to the latest information, Mobil Oil has successfully found large scale natural gas fields in the Arun area in North Sumatra and has announced to erect a LNG plant (4 million tons per year at its initial stage). It may be possible to use condensate accompanied therewith as petrochemical raw materials.

Pertamina Unit II and Stanvac — As of 1971, the Pusri fertilizer plant received [illegible] million Nm^3/yr of natural gas from Stanvac to produce 100,000 tons/yr of urea. As a leading fertilizer plant in Indonesia, this plant is expected to scale up to reach production of [illegible] tons/yr of urea in the middle of 1974, and it has already made reservation for the supply of natural gas from Pertamina Unit II and Stanvac.

Pertamina Unit III: Pertamina is now making effort for oil field development in the Djatibarang area, and has discovered natural gas. However, the 1971 production of natural gas was as small as 21 million Nm^3/yr., and future prospects for production are unknown.

Pertamina Unit IV: The 1971 production in this area was 467 million Nm^3/yr. The natural gas from this area has the gas composition suitable as a petrochemical raw material. However from regional point of view, the infrastructure of this area is extremely undeveloped.

Even if consideration is given only to the problem of transportation to markets (mainly to Java Island as the Indonesian domestic market), it will be unappropriate to establish a petrochemical base in this area.

Caltex: The company produced 449 million Nm^3/yr. of natural gas in 1971, but has not made public the gas composition. In order to take the Caltex gas into consideration, special negotiations will be required with the company.

Pertamina Unit V and Lemigas: Production in negligible in both cases.

(2) Availability of Natural Gas as a Petrochemical Raw Material

According to the Ministry of Mining, present volume of natural gas available for the petrochemical raw material is simply such a volume as to permit production of 60,000 tons/yr. of ethylene. On the other hand, Indonesian Government is optimistic on the future production with a background of the present active development of petroleum and natural gas resources, although quantitative forecasting is not available.

Therefore, in respect to natural gas, the Indonesian Government has informed us of its intention that, by panning on petrochemical industrialization project based upon future prospecting of petrochemical markets, and by clarifying the quality and quantity of the raw material natural gas required for the project, the present study should serve as an aid in planning on future natural gas development project.

For the production of ethylene the quality of gas has to be satisfactory; in other words, the content of C_2+ is required to be at least 5 volume %. Since Indonesian natural gas is generally of a wet type, we took North Sumatra natural gas has having the following composition as the illustrative feed in our gas cracking study (Table II-38).

Table II-38 Specification of Natural Gas (North Sumatra)

(Unit: vol %)

Methane	66.5
Ethane	13
Propane	10
C_4 Fraction	7
C_5 Fraction	3
Hydrogen Sulfide	nil
Carbon Dioxide	0.5

5. Petrochemical Complex in Indonesia

5.1 General

The following ten products are selected as the promising petrochemical products with sufficient demands to afford their domestic production in Indonesia;

For plastics:	Vinyl Chloride Monomer-Polyvinyl Chloride, Low Density Polyethylene, High Density Polyethylene, Polystyrene, Polypropylene
For Synthetic fibers:	Caprolactam for Nylon 6, Ethylene Glycol and Terephthalic Acid for Polyester fiber
For Plasticizer:	Dioctyl Phthalate

We present examples of typical and reasonable petrochemical complexes using naphtha and natural gas available in Indonesia as the starting feedstocks and reflecting technical, economic, and other pertinent factors.

We set forward our preliminary feasibility study on the following premises:

(1) As a domestic market condition, there would not be taken strong protective measures for the domestic petrochemical industry, such as high tariffs barrier against import or import bans. In other words, a pre-requisite of our study is that the petrochemicals produced in the complex we are planning on will have to be of the internationally acceptable quality and be marketable at international prices.

(2) As a principal attitude toward a measure to cope with varying market demands, we would consider petrochemical complexes on such scale as to meet the estimated demands in market as fully as possible. This is mainly because it is rather advantageous to construct as large a plant as possible from a view point of scale merit only if there is a large demand.

(3) Natural resources development and long-term industrialization plan are now getting under way simultaneously in Indonesia. Especially the development of Indonesian petroleum and natural gas characterized by their low-sulfur content is actively proceeding in response to rapid increase in worldwide demand for clean energy. Accordingly the future availability of natural resources can hardly be predicted.

The Indonesian Government expected that the future petrochemical complex would be depicted from the market environment and the resource requirements of the complexes would be clarified.

Therefore, we would plan on petrochemical complexes on the assumption that all the requirements for raw materials would be satisfactorily supplied.

(4) Orientation of complex sites is not made.

Further it is requested to group a total of not less than eight production units in at least two alternatives by product or by process, as far as possible, into one or more integrated complexes in the Term of Reference, 2.01 D "Production Units".

The results of our market study have left the 10 commodities as the promising petrochemical products which are likely to have reasonable demands in the Indonesian market, and all of these commodities are not of special types, but very common types in petrochemical complexes.

Therefore it would not be so important to present alternative schemes of petrochemical complexes by selecting 8 constituent products from only 10 candidate commodities.

We planned on complexes organized with the above 10 commodities and will present the alternative schemes by process.

In Indonesia, naphtha and natural gas are conceivable as the petrochemical raw materials.

Naphtha cracking co-produces olefins and aromatics, both usable as the basic chemicals for petrochemical production (Mainly the former is used for plastics production, and the latter for synthetic fiber production).

Natural gas cracking produces only olefins and not aromatics.

Therefore, we planned a complex based upon naphtha cracking, and as the alternative scheme associated with processes, we planned another complex based upon natural gas cracking for olefins production and upon naphtha reforming for aromatics production.

In consideration of petrochemical complexes, it was supposed that a utility center to provide them with electric power, steam and water, as well as auxiliary plants to supply the complexes with such auxiliary raw materials as sulfuric acid, chlorine etc. would be erected and located at sites adjacent to the complex.

The outlines of the complexes and the results of economic feasibility study thereof will be described hereinafter.

5.2 Outlines of the Petrochemical Complexes

Case I: Petrochemical Complex based on Naphtha Cracking

Since the worldwide standard of internationally competitive petrochemical complex falls between 300,000 and 500,000 ton per year in terms of ethylene production, we fixed the scale of a complex with naphtha cracking at 400,000 ton per year, i.e. the mid-point level of international scale, also by paying attention to the market demands forecasted for Indonesian petrochemical industry. The year of operation start up is fixed at 1980 from the point of market size.

Case II: Petrochemical Complex based on Natural Gas Cracking and Naphtha Reforming

We also fixed the scale of a complex based upon natural gas cracking at 300,000 ton per year, with its operation start up scheduled for 1978. The year 1977 is also considered the earliest year of plant start up, when attention is paid to the period necessary for plant construction work. As described before, a naphtha reforming plant is added for aromatics production.

The simplified block flow diagrams for these two petrochemical complexes are shown in Figs. II-1 and II-2 respectively.

In Case I naphtha cracking co-produces [illegible] tons/yr of propylene and [illegible] tons/yr of C_4 fraction. Therefore the [illegible] of [illegible] phthalate (DOP) and [illegible] was decided on [illegible] these co-products [illegible]. Since the demands for synthetic fibers are very large in Indonesia, we adopted the p-xylene [illegible] process and [illegible] for DOP [illegible] would be [illegible]. It [illegible] of [illegible] xylene and [illegible] [illegible].

In Case II the amounts of co-produced propylene and C_4 fraction are not so large as to [illegible]. Therefore the production of DOP and [illegible] was decided. The investment costs, requirements of utilities and labor cost are shown in Tables [illegible] and [illegible].

[illegible] Economic Feasibility Studies on Petrochemical [illegible]

Economic feasibility was studied [illegible] using the [illegible] Flow Method and calculating the [illegible] of [illegible].

[illegible]

Furthermore [illegible] complex and [illegible] the [illegible] of [illegible].

criteria of rate of return on investment for basic chemicals sector is set to 7.5%.

On the other hand, the downstream sector to produce plastics and raw materials for synthetic fibers is usually operated by half private or wholely private companies, because this sector necessitates different sales networks for its various products, and requires elaborated sales techniques, such as, for example, technical services to users, managerial and capital assistance, etc. Therefore a necessary rate of return on investment is set preferably to 15% or at least 10% for the downstream products sector.

The rates of return on investment for Case I and II are shown in Table II-42.

Case I/II-1: No tax holiday applied.

Case I/II-2: 5 Years' tax holiday applied to those plants with asterisked figures

In the former cases, the rates of return on investment do not satisfy some plants, and then 5 years' tax holiday would be applied to these plants to give the latter cases. Although some plants do not yet give the rate of return on a satisfactory level even with this preferencial step, both of these two complexes are feasible as a whole. It has thus been concluded that the complex based upon production of [illegible] ton per year of ethylene by means of naphtha cracking can be put into operation in 19[illegible] and that the complex producing [illegible] ton per year of ethylene by means of natural gas cracking and aromatics by means of naphtha reforming can start operation in 1977.

Table II-39 Investment Cost

(Unit: $1,000)

Plant Name	Capacity Case (I)	Capacity Case (II)	Battery Limits Case (I)	Battery Limits Case (II)	Off-Site Case (I)	Off-Site Case (II)	Total Investment Case (I)	Total Investment Case (II)	Working Capital Case (I)	Working Capital Case (II)	Total Case (I)	Total Case (II)
[illegible]	[illegible]	[illegible]	56,100	45,000	16,400	13,200	72,500	58,200	12,500	10,000	85,000	68,200
[illegible]	[illegible]	[illegible]	12,800	9,000	3,300	2,400	16,100	11,800	2,800	1,800	18,900	13,600
[illegible]	[illegible]	[illegible]	12,700	8,300	3,800	2,500	16,500	10,800	2,900	1,900	19,400	12,700
[illegible]	[illegible]	[illegible]	50,800	36,000	15,200	10,800	66,000	46,800	11,600	8,200	77,600	55,000
[illegible]	[illegible]	[illegible]	11,100	8,800	3,300	2,600	14,400	11,400	2,500	2,000	16,900	13,400
[illegible]	[illegible]	[illegible]	4,000	5,800	1,100	1,600	5,100	7,400	800	1,200	5,900	8,600
[illegible]	[illegible]	[illegible]	15,700	11,500	4,500	3,300	20,200	14,800	3,600	2,500	23,800	17,300
[illegible]	[illegible]	[illegible]	24,100	14,900	7,200	4,500	31,300	19,400	5,500	3,400	36,800	22,800
[illegible]	[illegible]		30,000		7,700		37,700		5,900		43,600	
[illegible]	[illegible]		3,600		900		4,500		700		5,200	
[illegible]		[illegible]		5,000		1,400		6,400		1,100		7,500
[illegible]	[illegible] Benzene [illegible] p-Xylene		12,000		3,100		15,100		2,400		17,500	
		[illegible] Benzene [illegible] p-Xylene		11,200		2,800		14,000		2,100		16,100
[illegible]	[illegible]	[illegible]	1,100	1,000	300	200	1,400	1,200	204	200	1,600	1,400
[illegible]	[illegible]	[illegible]	30,800	20,200	9,200	6,100	40,000	26,300	7,000	4,600	47,000	30,900
[illegible]	[illegible]	[illegible]	11,000	15,500	3,300	4,700	14,300	20,200	2,500	3,500	16,800	23,700
Total			275,800	192,600	79,300	56,100	355,100	248,700	60,900	42,500	416,000	291,200

Table II-40 Utilities Requirement

Plant Name	Electricity (kW)		Steam (tons/hr.)		Cooling Water: Sea Water (tons/hr.)		Cooling Water: Industrial Water (tons/hr.)		Boiler Feed Water* (tons/hr.)		Fuel (x 10^6 Kcal/hr.)	
	Case		Case		Case		Case		Case		Case	
	(I)	(II)	(I)	(II)	(I)	(II)	(I)	(II)	(I)	(II)	(I)	(II)
[illegible]	[illegible]	[illegible]	-	-	21,800	4,120	1,100	220	178	90	180	100
[illegible]	[illegible]	[illegible],170	7	4	12,500	7,470	500	300	100	60	15	10
[illegible]	[illegible]	[illegible]	26	15	1,730	960	90	50	42	23	-	-
[illegible]	[illegible]	25,250	[illegible]	20	4,900	3,120	270	170	-	-	-	-
[illegible]	[illegible]	2,410	11	8	1,040	770	50	37	-	-	-	-
[illegible]	[illegible]	[illegible]	15	[illegible]	1,770	3,500	100	200	2	4	-	-
[illegible]	[illegible]	[illegible]	42	25	740	440	40	24	-	-	17	10
[illegible]	[illegible]	2,[illegible]	23	12	2,160	1,000	110	55	-	-	-	-
[illegible]	[illegible]		110		7,810		410		33		-	
[illegible]	[illegible]		25		100		6		-		-	
[illegible]		310		27		340		18		-		23
[illegible]	[illegible]	2,[illegible]	[illegible]	15	1,370	80	80	5	-	1	53	50
[illegible]	[illegible]	250	-	1	24	17	2	1	5	4	1	1
[illegible]	[illegible]	2,[illegible]	51	[illegible]	560	400	30	22	-	-	13	10
[illegible]	[illegible]	4,[illegible]	[illegible]	[illegible]	1,[illegible]	2,660	70	143	110	225	30	68
Total	[illegible]	[illegible]	[illegible]	254	57,892	24,937	2,854	1,245	470	407	309	272

* [illegible]

Note: [illegible] requirements of [illegible] gas are estimated at about 4,000 $Nm^3/hr.$ for Case I and about 3,000 $Nm^3/hr.$ for Case II.

Table 1.4 Labor Requirement

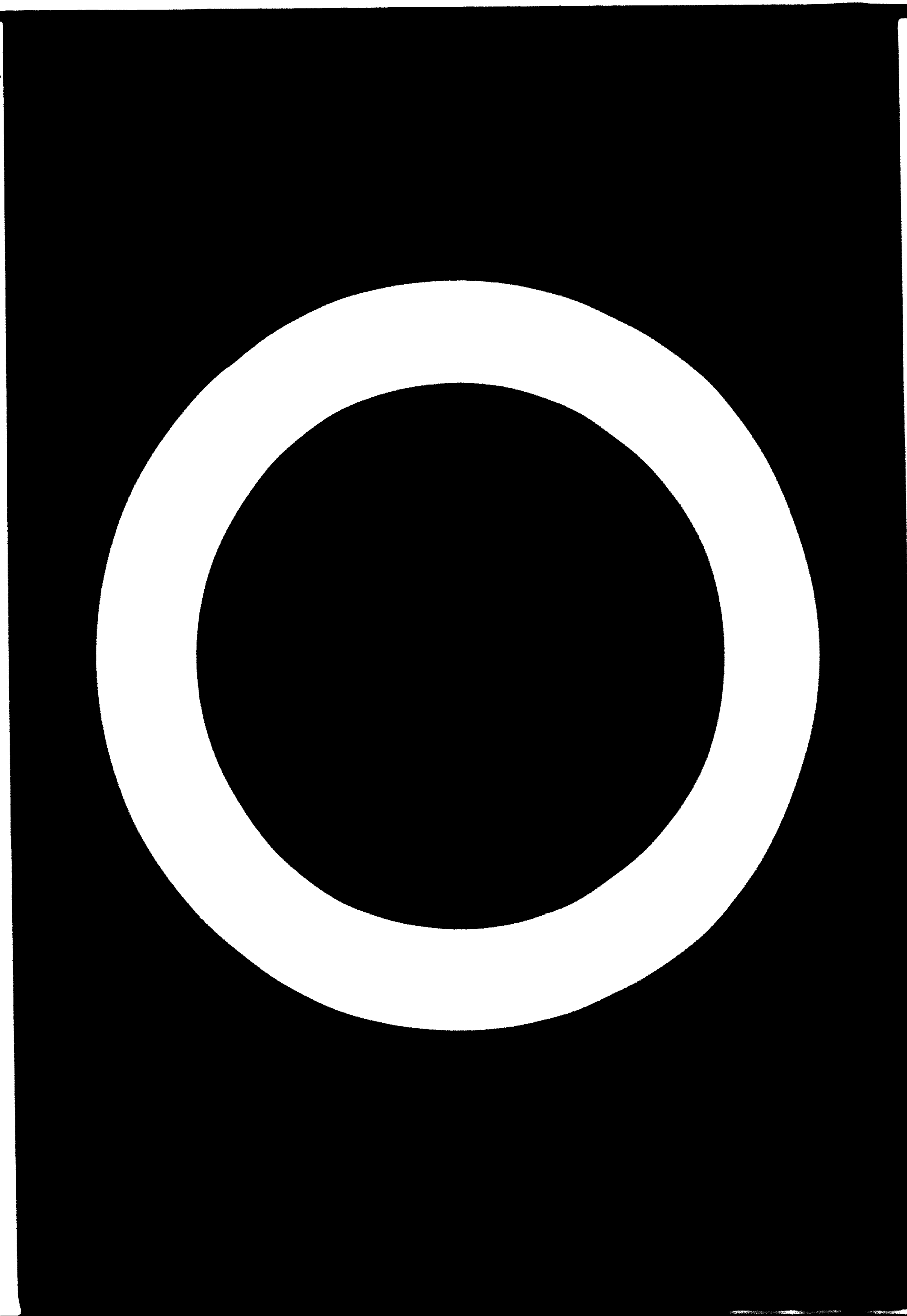
Plant	Total: Supervisor Case (I)	Total: Supervisor Case (II)	Total: Operator & Analyst Case (I)	Total: Operator & Analyst Case (II)	Total: Laborer Case (I)	Total: Laborer Case (II)
[illegible]	1	1	49	39	-	-
[illegible]	1	1	40	24	-	-
[illegible]	2	1	28	20	72	24
[illegible]	2	[illegible]	30	64	120	100
[illegible]	1	1	16	16	52	40
[illegible]	1	[illegible]	20	24	-	-
[illegible]	[illegible]	[illegible]	56	48	60	40
[illegible]	[illegible]		28	20	28	16
[illegible]	[illegible]		[illegible]		-	
[illegible]			[illegible]		-	
[illegible]		2		32		
[illegible]			36	28	-	-
[illegible]			[illegible]	12	-	-
[illegible]			[illegible]	28	46	40
[illegible]		[illegible]		20	20	32
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	260	292
[illegible]			[illegible]			
			679			

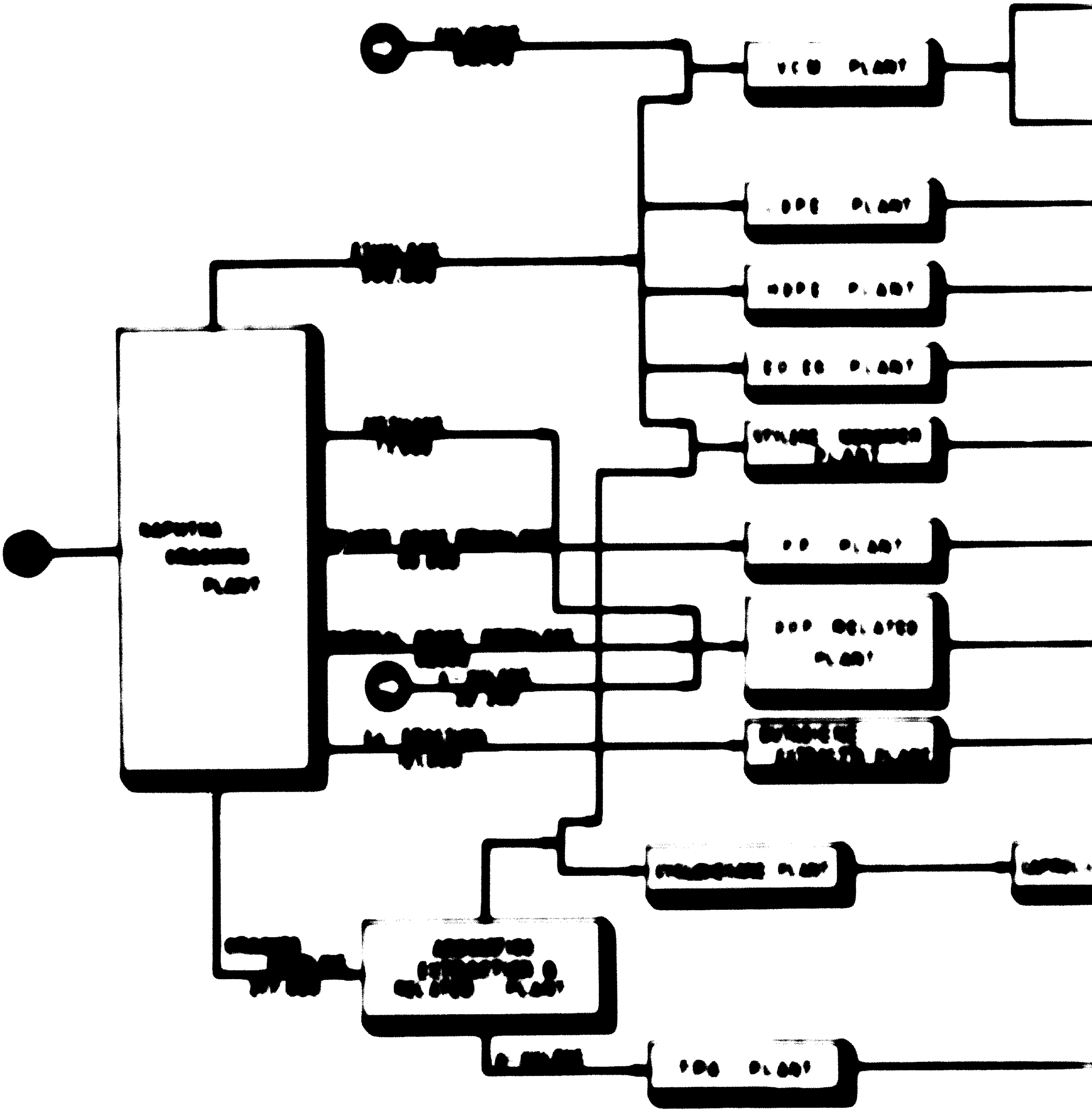
Table [illegible]-42 Rate of Return on Investment

Plant Name	Capacity Case I	Capacity Case II	Rate of Return on Investment (%) Case I - 1	I - 2	Case II - 1	II - 2
[illegible]	[illegible]	216,[illegible]	6.8	8.8	5.8	7.7*
[illegible]	[illegible]	[illegible]	23.3	23.3	18.5	18.5
[illegible]	[illegible]	[illegible]	24.4	24.4	18.4	18.4
[illegible]	[illegible]	[illegible]	12.4	16.9*	12.3	16.3*
[illegible]	[illegible]	26,[illegible]	15.4	15.4	15.2	15.2
[illegible]	[illegible]	[illegible]	[illegible]	4.1	14.2	14.2
[illegible]	[illegible]	[illegible]	19.0	19.0	9.0	11.7
[illegible]	[illegible]	[illegible]	12.8	17.9	5.8	7.9
[illegible]	[illegible]		4.3	5.6		
[illegible]	[illegible]		24.8	24.8		
[illegible]		209,000			8.0	8.0
[illegible]	[illegible]	[illegible],000 Benzene	[illegible]	[illegible]	8.3	8.3
[illegible]	[illegible]	26,400	7.6	9.0	7.6	9.6*
[illegible]	[illegible]	24,000	5.4	6.6	7.9	9.8
TPA	[illegible]	[illegible],000	12.[illegible]	16.4	25.4	25.4
Total [illegible]			11.2	13.4	11.3	13.1*

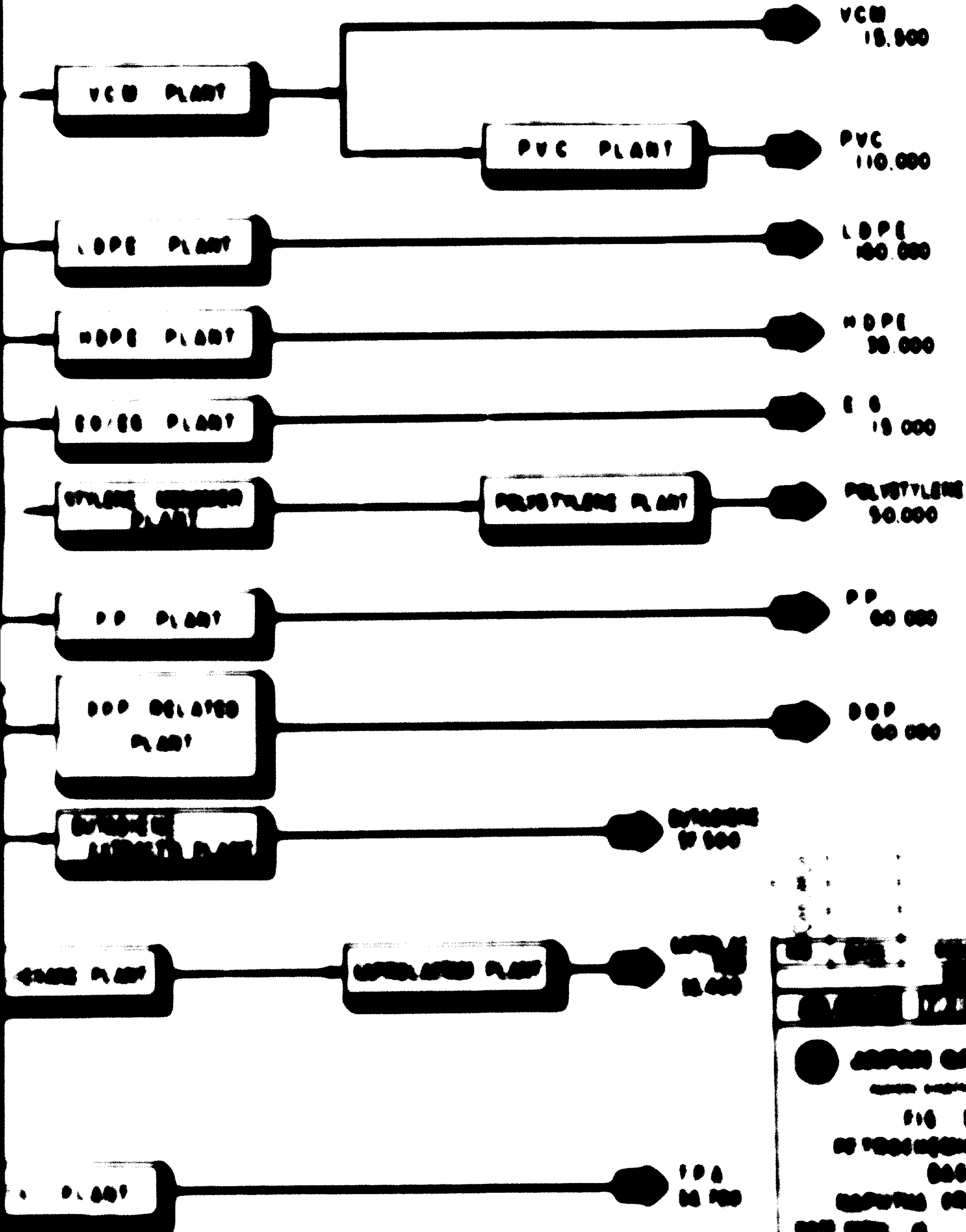
Case [illegible] tax holiday applied

Case [illegible] years' tax holiday applied to these plants with asterisked figures.



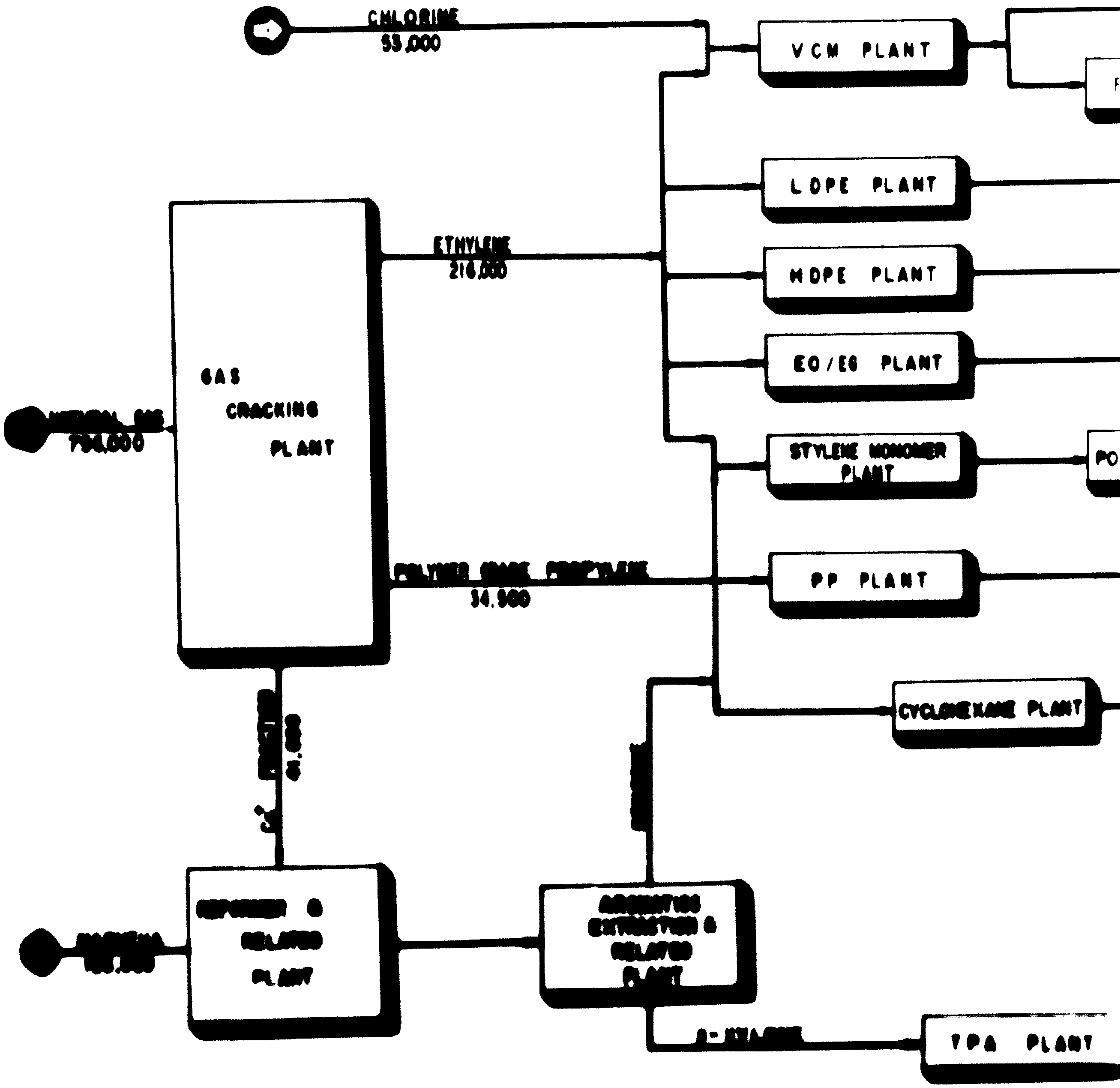


SECTION 1

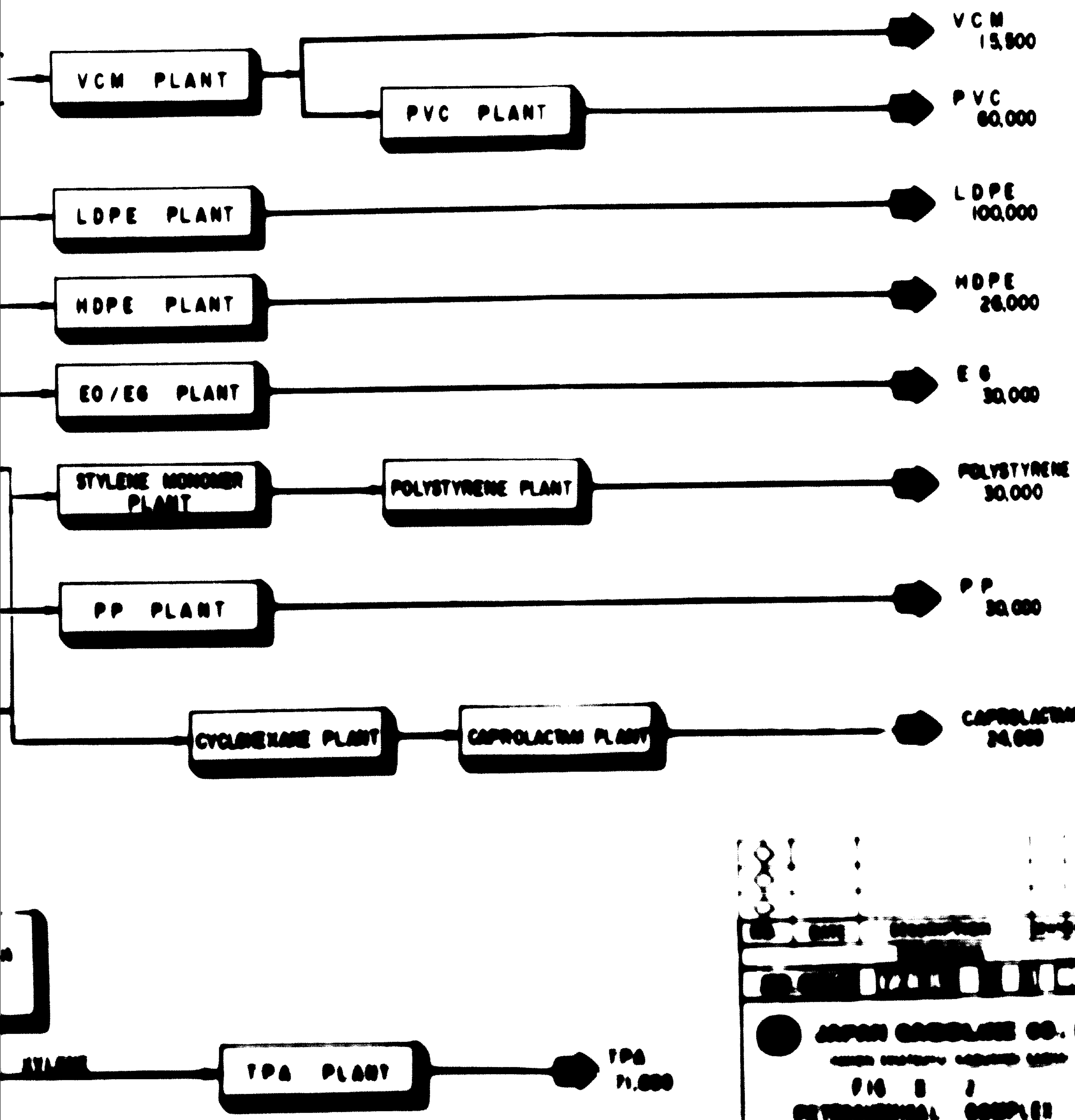


PETROCHEMICAL COMPLEX
BASED ON

SECTION 2

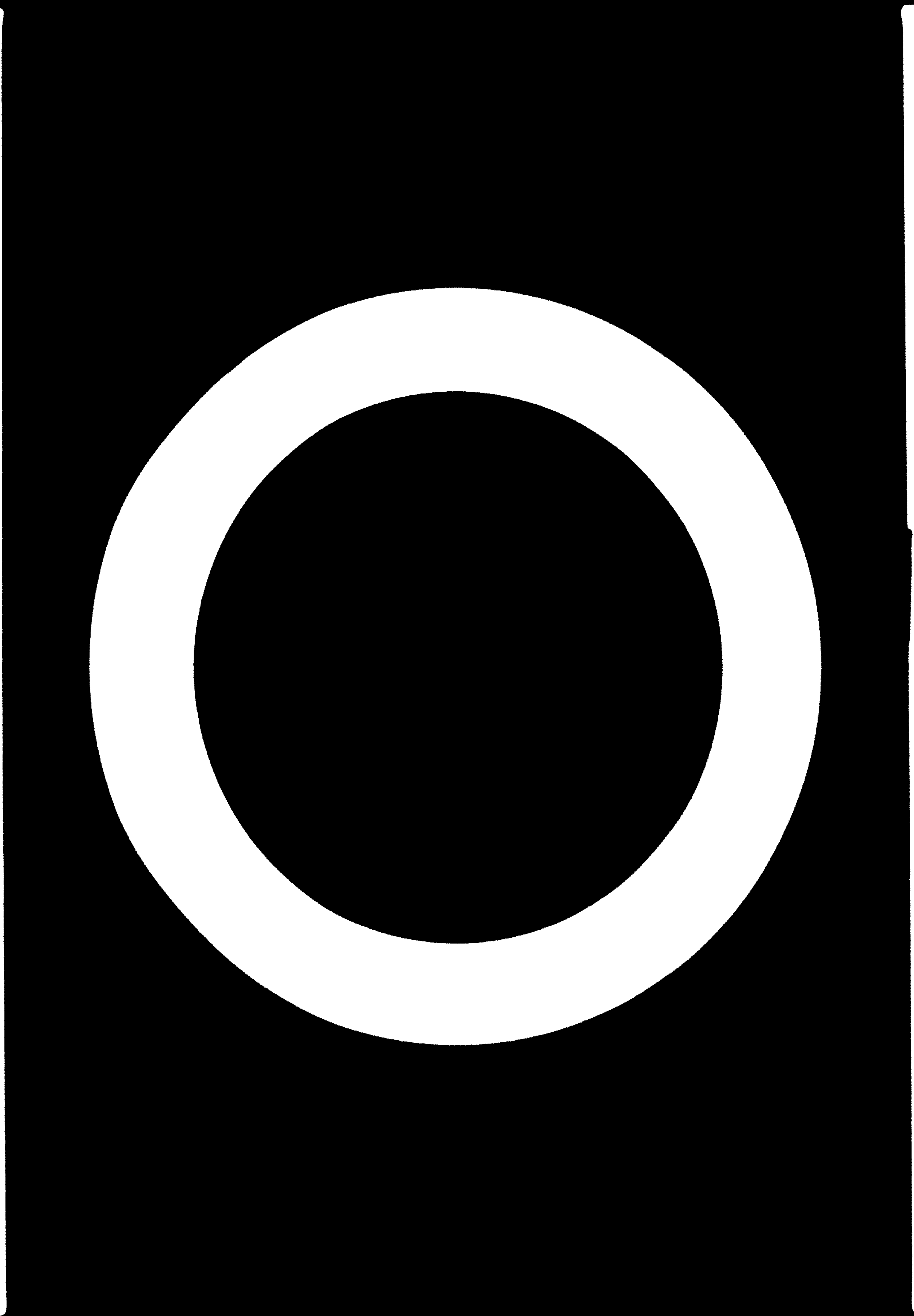

CHLORINE
53,000
VCM PLANT
LDPE PLANT
MDPE PLANT
EO/EG PLANT
STYLENE MONOMER PLANT
PP PLANT
CYCLOHEXANE PLANT
TPA PLANT
ETHYLENE
216,000
GAS CRACKING PLANT
34,900

SECTION 1



VCM PLANT
VCM 15,500
PVC PLANT
PVC 60,000
LDPE PLANT
LDPE 100,000
HDPE PLANT
HDPE 26,000
EO / EG PLANT
E G 30,000
STYLENE MONOMER PLANT
POLYSTYRENE PLANT
POLYSTYRENE 30,000
PP PLANT
P P 30,000
CYCLOHEXANE PLANT
CAPROLACTAM PLANT
CAPROLACTAM
TPA PLANT
TPA

SECTION 2



[illegible] Petrochemical Complex of [illegible] Economic Size

The [illegible] petrochemical complex of [illegible] natural gas as the starting [illegible] regardless of the number of [illegible] though [illegible]

A [illegible]

As the [illegible]

As this complex [illegible]

The [illegible] natural gas [illegible]

A simplified [illegible] are [illegible] in Tables [illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]		[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

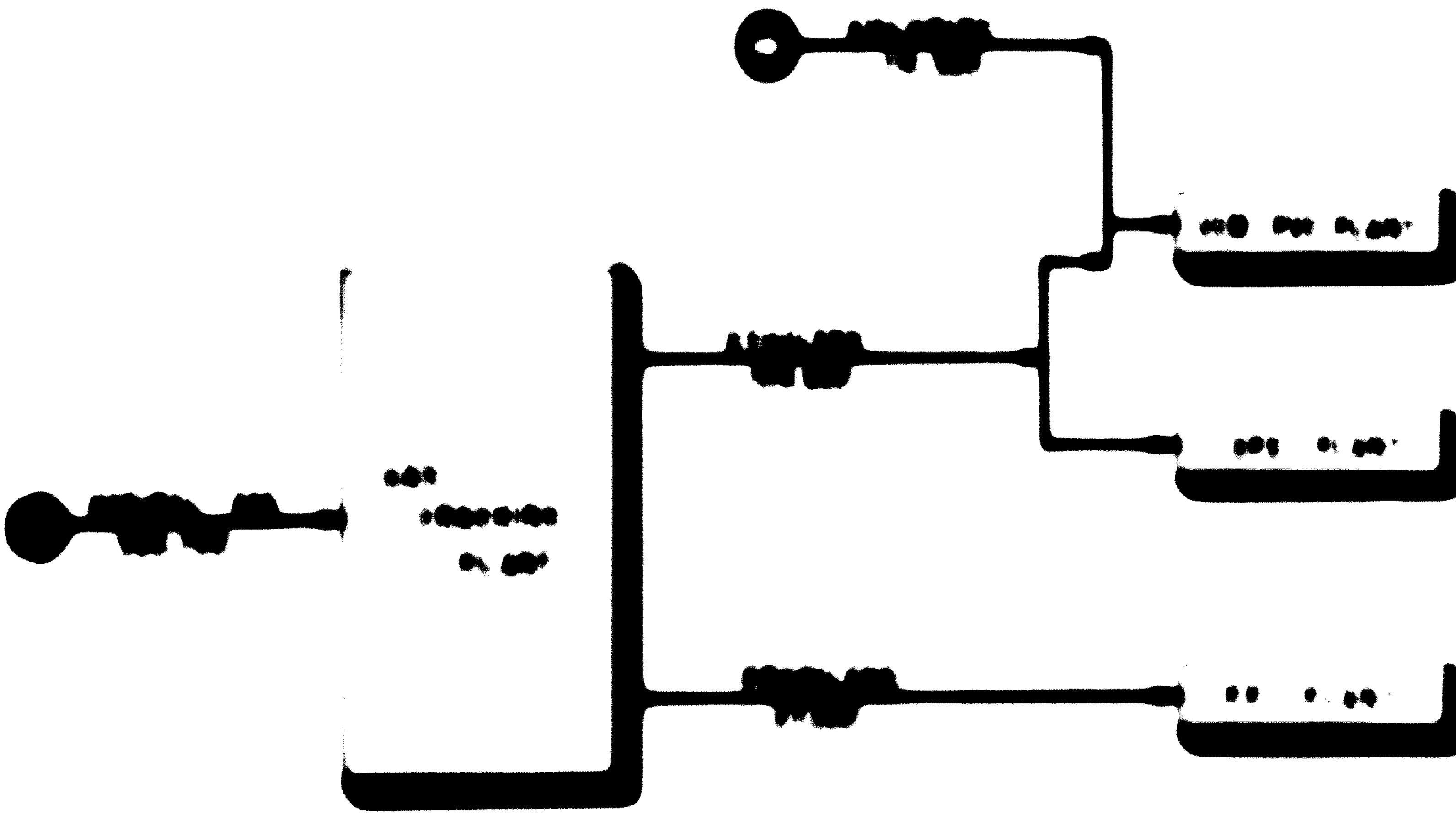
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Table [illegible] Labor Requirements

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	

[illegible]



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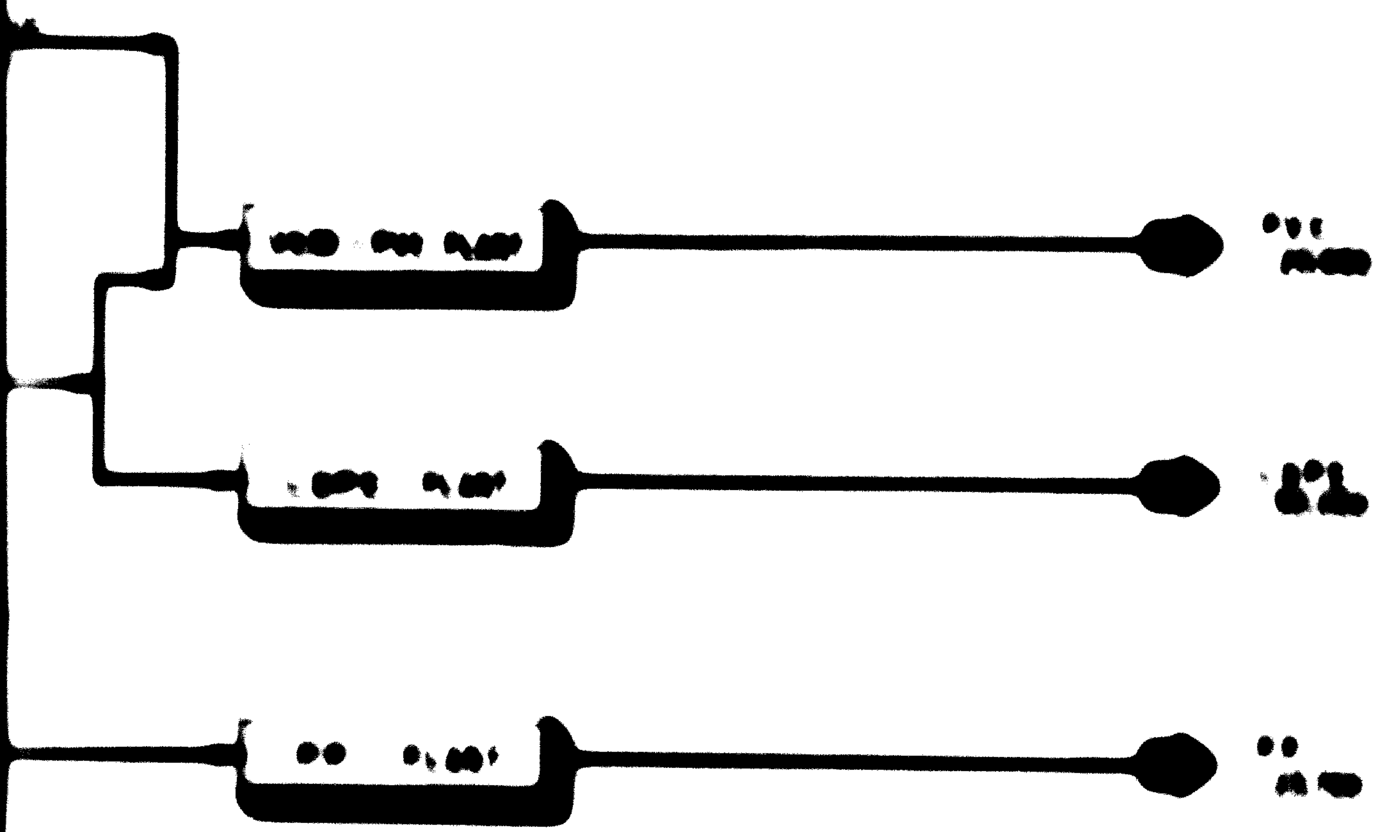

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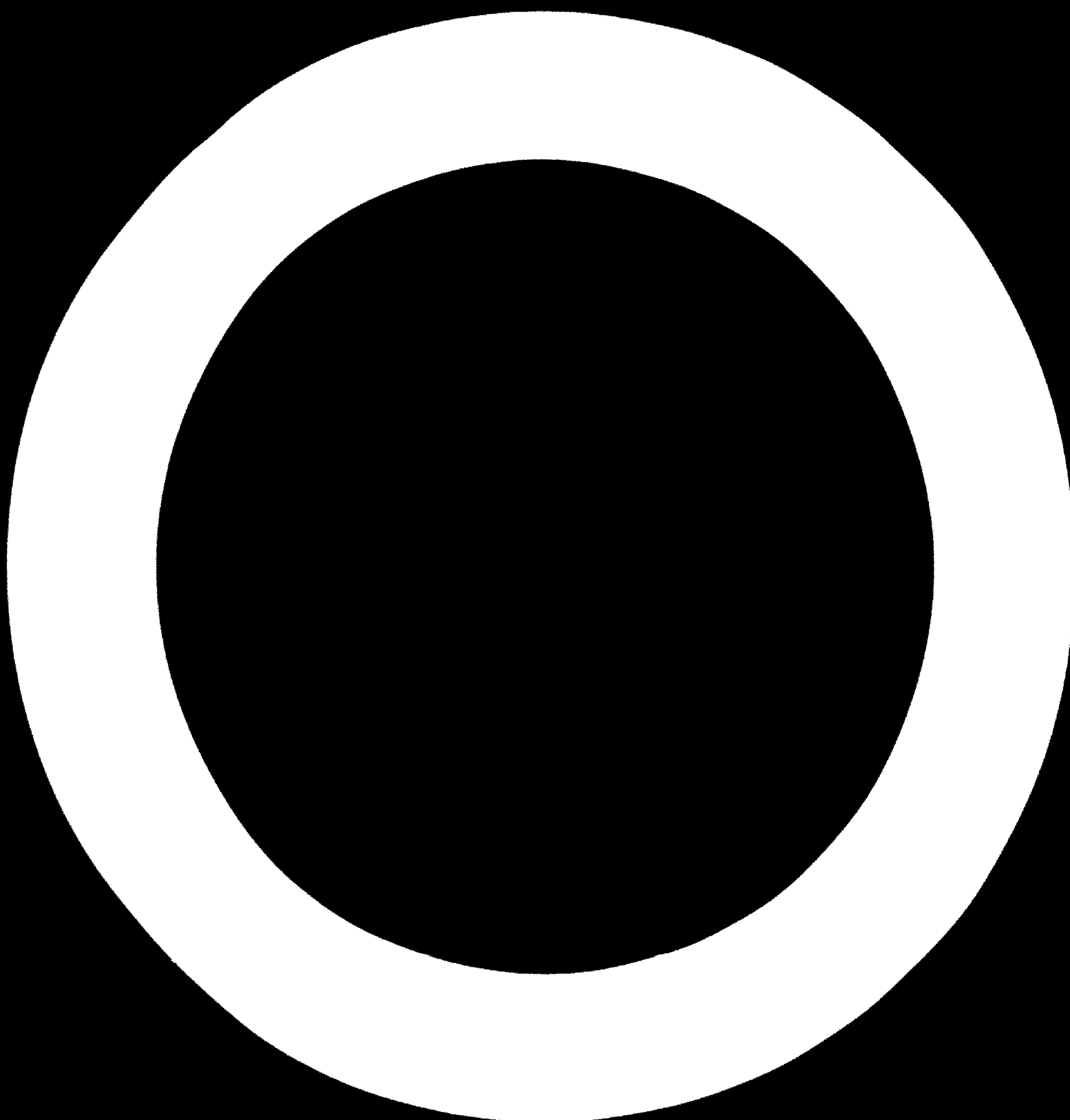

8. Recommendations for Further Study

We in this study conducted long term demand forecasting of the petrochemical product markets in Indonesia and presented a sample of the future petrochemical industry to be set up in Indonesia. In order to proceed with follow up of the study and to work out the Indonesian petrochemical industrialization project more practically and in more details for its future materialization, we hereupon recommend the following points.

(1) Resource Study

We presented two complex schemes based upon naphtha cracking and natural gas cracking and naphtha reforming, and showed that both of these complexes would be feasible on the assumption that all the raw material requirements would be satisfactorily supplied. The following is some comments and suggestions which may help selecting raw materials for the Indonesian petrochemical complex.

Naphtha

Naphtha is one of the products of crude oil refining, and its use in the petrochemical industry does affect necessarily the pattern of demand and supply in oil products. Therefore due consideration to oil product market must be taken. Furthermore, naphtha is an important fraction for motor gasoline and now used even for clean energy. The rapid hike in naphtha price is forecasted and it would be more difficult to secure naphtha for petrochemical industry.

Naphtha in its liquid form is transportable without difficulty so that the plant site can be decided mainly from a market view point.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] natural gas [illegible]

Cracking of natural gas produces mainly ethylene and is suitable for ethylene derivative leading market like in Indonesia market but it does not produce aromatics as that naphtha reforming has

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

It is recommended that a detailed [illegible] be made in Phase II or III taking also the availability of [illegible] and labor [illegible] into consideration.

(d) Development of Related Industries, Particularly [illegible] Processing Industries

The [illegible]

[illegible]

[illegible]

On the other hand, [illegible] give effective [illegible] to related [illegible] selection of processing machinery [illegible] training of operators.

(5) Organization

[illegible]

[illegible]

[illegible]

(6) Finance Problem

Financing [illegible] This is not to say that we underestimated the importance of this problem for the materialization of a petrochemical complex which calls for extensive amounts of investment. Financing methods should be investigated in the forthcoming Phase II and III.

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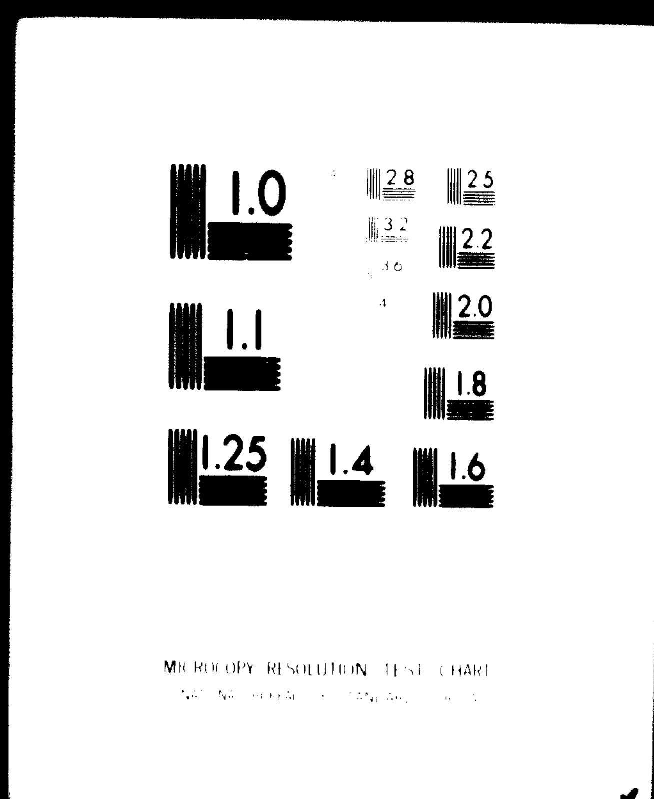
2 OF 8


1.0
2.8
2.5
3.2
2.2
3.6
4
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

24x
E

At the same time, it may also become necessary to plan a less-scale complex based on less commodities, in response to the restriction, if any, in financed amount, while efforts should be made not to lose international competitiveness. On an occasion of such planning, the minimum economic size complex shown in the Annex A will serve as a guide.

03420 (1)

UNIDO CONTRACT NO.72/30
PROJECT No. IS/INS/71/814

SURVEY OF THE PETROCHEMICAL INDUSTRY IN INDONESIA

VOLUME II

Report prepared for the United Nations Industrial Development Organization acting as Participating and Executing Agency for the United Nations Development Program (Special Industrial Services)

APRIL 1973
JAPAN GASOLINE CO., LTD.
Tokyo, Japan

CONTENTS

VOLUME I

VOLUME II

IV. MARKET STUDY (cont'd)

V. RESOURSE STUDY

ANNEX D (cont'd)

ABBREVIATION

ABS	Alkylbenzene Sulfonate
DOP	Di-octyl Phthalate
EG	Ethylene Glycol
EO	Ethylene Oxide
HDPE	High Density Polyethylene
LAS	Linear Alkylbenzene Sulfonate
LDPE	Low Density Polyethylene
n. a.	not available
neg.	negligible
N. G.	Natural Gas
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl Chloride
TPA	Terephthalic Acid
VCM	Vinyl Chloride Monomer

Tons in this report is meant metric tons unless particularly remarked.

The mark of $ refers in this report to the U.S. dollar, unless noted otherwise. The dollar prices stand on the rate of 1 SDR unit = US$0.921053 i.e., the rate which had been used until downard revaluation of the dollar on Feb. 12, 1973.

III. GENERAL CONCEPTION OF PETROCHEMICAL INDUSTRY IN THE WORLD

1. General Features of Petrochemical Industry

Historically the petrochemical industry is said to have started in 1920, when Standard Oil Co., New Jersey of the U.S. inaugurated production of isopropyl alcohol from propylene. However, it is in 1950s even in an developed country such as the U.S. that the petrochemical industry has come to play an important role through combination with techniques from high polymer synthetic chemistry, producing new materials such as synthetic resins, synthetic fibers, synthetic rubber, etc.

Meanwhile, in Europe and Japan, the petrochemical industry started in 1950s and rapidly developed with a background of large-scale development of the petroleum industry caused by shift of energy from coal to petroleum. The petrochemical industry in developed countries took a central position in industrial structure as one of the material-supplying industries, such as steel-making industry.

During 1960s, the petrochemical industries have grown at a production growth rate of 10 to 20% per annum in Western Europe and the U.S. and at a striking growth rate of 20 to 30% per annum in Japan.

Since 1970, world petrochemical industries have been experiencing slower tempo of growth and a problem of over-capacity. Nevertheless, from long-term point of view, continued steady growth is predictable for the world petrochemical industries. For example, the petrochemical industry is estimated to grow at a rate of 10 to 13%

per annum in Europe, at 8 to 10% per annum in the U.S. and at around 10% in Japan. Concurrently with the recovery of business situations, the demand-supply balance of ethylene has been tightening in the U.S., after several years' discontinuance of investments on new plants or scale-up of existing plants. (e.g., the U.S. supply capacity of 10,500,000 tons/yr., a demand of 10 million tons/yr., and an operation rate of 95% in 1972). In Western Europe, a supply capacity of 10,240,000 tons/yr., a demand of 9,020,000 tons/yr. and the present operation rate of 88% are expected to rise to a rate of 90% or more in 1974. In Japan, a supply capacity of 4,810,000 tons/yr., a demand of 3,720,000 tons/yr. and the present operation rate of 77% are expected to move to a rate of 95% in 1975.

In the meantime, since the latter half of 1960s, an increasing number of developing countries has been attempting, as one of objectives of their economic plan, to promote industrialization to change their economic and trade structures which were more dependent upon the primary industry, and thereby to attain economical independency. At the same time, they have been promoting this development from both social and economic aspects, putting more emphasis on the spreading effects resulting in development of various industries within the country, such as increased opportunities of employment, expanded education brought about by industrialization, and increased national more income levels.

The petrochemical industry was adopted by many countries as a key measure for industrialization. Such a trend indicates that petrochemical industrialization will rapidly be under way in Latin America, Asia, and Africa in 1970s and 1980s.

The petrochemical industries in the world are predicted for 1980 as follows:

The U. S. which has taken an outstanding position until 1960 will gradually lower its position. Instead, Europe will outrun the U. S. in ethylene production in 1980, and developing countries will have the ethylene production capacity accounting for about 8% of the world total.

The Association of the Petrochemical Industry (Japan) has been publishing every year a report on worldwide ethylene production capacities, by compiling reliable information from many periodicals. According to its latest report, the ethylene produc-

Table III-1 Worldwide Olefin Production and Trend Forecast

(Unit: x 10^6 tons/yr.)

		1960	1965	1970	1975	1980
Ethylene	U. S. A.	2.6 (76%)	4.6 (61%)	7.5 (46%)	12.0 (39%)	18.0 (36%)
	W. Europe	0.7 (21%)	2.0 (27%)	6.0 (36%)	12.0 (39%)	19.0 (38%)
	Japan	0.1 (3%)	0.8 (11%)	2.4 (14%)	4.4 (14%)	7.0 (14%)
	Others	neg. (0%)	0.1 (1%)	0.7 (4%)	2.1 (7%)	6.0 (12%)
	Total	3.4 (100%)	7.5 (100%)	16.6 (100%)	35.5 (100%)	50.0 (100%)
Propylene	U. S. A.	1.2 (67%)	2.3 (47%)	3.6 (39%)	5.6 (36%)	8.2 (34%)
	W. Europe	0.5 (28%)	1.8 (37%)	3.6 (39%)	5.6 (36%)	8.7 (37%)
	Japan	0.1 (5%)	0.6 (12%)	1.6 (17%)	3.0 (20%)	4.5 (19%)
	Others	neg. (-)	0.2 (4%)	0.5 (5%)	1.2 (8%)	2.4 (10%)
	Total	1.8 (100%)	4.9 (100%)	9.3 (100%)	15.4 (100%)	23.8 (100%)
Butadiene	U. S. A.	0.9 (80%)	1.3 (71%)	1.6 (53%)	1.8 (44%)	2.7 (42%)
	W. Europe	0.2 (18%)	0.4 (22%)	0.8 (27%)	1.4 (34%)	2.3 (35%)
	Japan	0.02 (2%)	0.1 (5%)	0.4 (13%)	0.6 (15%)	1.0 (15%)
	Others	neg. (-)	0.03 (2%)	0.2 (7%)	0.3 (7%)	0.5 (8%)
	Total	1.12 (100%)	1.83 (100%)	3.0 (100%)	4.1 (100%)	6.5 (100%)

(Chemical & Engineering News, June 8, 1970, p. 24) tion capacities in the world as of the end of 1971 are shown in Table III-3.

With respect to petrochemical demands, many interesting forecasts were presented at a conference (Budapest, Hungary) held by the European Chemical Marketing Research Association (ECMRA). Among them, main forecasts are as given in the following tables, from III-4 to III-7.

Table III-2 Ethylene Production Capacity in the World

(Unit: x 10^6 tons/yr.)

	1965	1970	1975	1980
Developed Countries	8.69 (98.7%)	27.8 (92.7%)	46.8-55.2 (92-91.9%)	68.9-78.9 (91.9-91.7%)
Developing Countries	0.11 (1.3%)	2.2 (7.3%)	4.1-4.8 (8-8.1%)	6.1-7.1 (8.1-8.3%)
World Total:	8.8 (100%)	30.0 (100%)	50.9-60.0 (100%)	75.0-86.0 (100%)

Breakdown of Developing Countries

Latin America	0.10 (1.1%)	1.156 (3.9%)	2.40-2.60 (4.7 -4.3%)	3.20-3.75 (4.3 -4.4%)
Asia	0.01 (0.1%)	1.025 (3.4%)	1.60-2.05 (3.1 -3.4%)	2.70-3.10 (3.6 -3.6%)
Africa	- (-)	0.035 (0.1%)	0.10-0.15 (0.2 -0.3%)	0.20-0.25 (0.3 -0.3%)

(Source: K.H. Imhausen; Chemistry & Industry (London), Dec. 5, 1970, p. 1559)

Table III-3 Worldwide Ethylene Production Capacities - end of 1971

(Unit: x 10^3 tons/yr.)

	Existing	In planning	After completion
(North & South America)			
U.S.A. & Puerto Rico	10,231	1,316	11,547
Canada	573	964	1,261
Mexico	71	364	435
South America	295	1,105	1,374
Sub-Total	11,170	3,749	14,617
(Western Europe)			
France	1,163	1,260	2,293
Italy	1,588	1,850	3,274
Netherlands	1,230	850	2,080
United Kingdom	1,510	790	2,240
West Germany	2,723	2,634	5,357
Others	1,389	1,385	2,774
Sub-Total	9,603	8,769	18,018
(Africa & Middle East)	203	1,033	1,212
(Asia & Australia)			
Japan	4,514	300	4,814
Australia	276	60	336
Others	194	1,397	1,591
Sub-Total	4,984	1,757	6,741
Total	25,960	15,308	40,588
Eastern Europe	1,047	3,035	3,982
World Total	27,007	18,343	44,570

According to these tables, the worldwide 1980 demand for synthetic resins is estimated to reach 90 million tons, or more than three times as large as the 1970 figure. The proportion of polyolefins in this total amount will rise from 27% in 1970 to 33% in 1980, running ahead of PVC. Of the polyolefins, LDPE will move from 63% in 1970 down to 56% in 1980, although it will be still a dominant material. PP consumption will grow, and is estimated to be on the same level as that of HDPE. Dr. K. H. Roenitz of Hoechst A. G. predicts that the demands for synthetic resins will steadily grow, despite short-range slow-down, and that in 1980s, these demands will go ahead in terms of volume of the consumption of conventional materials containing metals.

Table III-4 World Demands for Plastics

(Unit: x 10^6 tons/yr.)

	1970	1975	1980
Total Plastics	30.0	53.5	92.0
Polyolefins	8.0	16.0	30.0
Low Density Polyethylene	5.0	9.7	17.0
High Density Polyethylene	1.7	3.5	6.5
Polypropylene	1.3	2.8	6.5

Table III-5 World Demands for Synthetic Fibers

(Unit: x 10^6 tons/yr.)

	All fibers	Synthetics	Polyesters	Nylons	Acrylics
1969	21.2	4.4	1.4	1.8	0.9
1980	30.7	12.0	4.6	4.1	2.3

(Hoechst A.G. estimation, Chemical Age, Jan. 30, 1970)

As for synthetic fibers, Dr. Zwick of Hoechst A.G. predicted an increase of about 2.7 times from 4.37 million tons in 1969 to 12 million tons in 1980. During the same period, polyester was estimated to outrun polyamide (nylon).

As stated above, the world petrochemical industry will undergo still steady expansion and growth. At the same time, it will become more diversified regionally, when such newcomers as developing countries make entry into this field successively.

Table III-6 World Demand for Rubber

(Unit: x 10^6 tons/yr.)

	Natural Rubber	Synthetic Rubber	Total
1970	2.70	6.40	9.10
1980	3.25	8.60	11.85
1985	3.85	11.45	15.30

Table III-7 World Demands for Surface Active Substances

(Unit: x 10^3 tons/yr.)

	Hard ABS	Soft LAS	Syn. high alcs.	Alpha-olefins	Ethylene oxide
1970	154.0	331.0	68.0	63.5	180.0
1975	18.0	661.0	140.0	95.0	310.0
1980	-	838.0	255.0	150.0	460.0

With the waves of technological innovation, petrochemical plants rapidly become expanded, and now, scale of petrochemical complex has reached 200,000 to 500,000 ton per year in terms of ethylene production. However, the merit of large capacities is now highly valued only with a proviso that large amounts of byproduced fractions should be effectively utilized, while keeping a high operating rate. In other words, it is necessary to secure large markets for various petrochemical products derived from olefins, aromatics, and other basic chemicals.

Free competition in construction of large plant in 1960s has given raise to large surplus in plant capacity and unreasonable reduction in prices of petrochemicals in early 1970s. Investment on plant will resume from 1973 in the U.S. and from 1974 or 1975 in Europe and Japan. In those occasions, efforts for adjustment of investment on new plant will have to be made. Cooperation is already in progress on the international level in the world petrochemical industry, especially in West Europe.

New entry of developing countries in this field is under way in such situations. Therefore, whether one likes it or not, the international coordination cannot but become one of the most import way of the world petrochemical industry. This is also the way which other mature key industries have followed.

2. General Pattern of International Trade

Generally speaking, petrochemical processes will become more and more standardized internationally, and the quality of products will also become standardized, so as to be acceptable in international market.

Solvents and monomers are specified as to purity or impurities, such as, for example, sulfur, CO, and H_2O in the polymer grade olefins. Polymers are specified as to their melt index, density, average molecular weight, molecular weight distribution, etc.

Once products can satisfy these standards, their trade will then depend upon their international balances of supply and demand, prices, and other trade conditions.

The following can be in general said for the demand-supply balances of petrochemicals. Demands for a product usually show a continuous growth, whereas its supply shows a stepwise growth pattern which appears each time when construction of a new plant or plant scale-up is materialized.

It is usual, therefore, that an excess or a deficit of supply takes place alternately in the demand-supply balance of petrochemical products. In order to fill the gap between demand and supply, either export or import would become necessary in an alternate manner, likewise. Such a situation would be seen more clearly in the cases of those plants with larger economic scale, and spot export or import caused in such a situation is one of the characteristics observed in the petrochemical trade pattern.

As will be described later, oil-producing countries can fix by themselves raw material prices and for this reason, oil-producing countries can produce petrochemicals at lower costs than in non-producing countries and they can export their "low-cost petrochemical products" in the world market.

The above trend is already observed in ammonia production and its export from Kuwait and Saudi Arabia. The recently announced a butadiene project plan in Algeria and the Iranian petrochemical complex project wherein 40% to 60% of production is intended for export will fall under this pattern.

Table III-8 Propylene Balance in the U. S. A.

(Unit: x 10^6 tons/yr.)

	1970	1975	1980
(Supply)			
Refinery	8.41 - 9.25	9.35 - 12.15	10.20 - 13.90
Ethylene plant	1.59	3.32	5.00
Total	10.00 - 10.84	12.67 - 15.47	15.20 - 18.90
(Demand)			
Economical supply	9.00 - 9.75	11.40 - 13.90	13.80 - 17.10
Chemical use	3.36	5.22	7.65
Refinery use	6.60	7.23	7.55 - 14.60
Total	9.96	12.45	15.20 - 22.25
(Balance)	(-)0.96-(-)0.21	(-)1.05-(+)1.45	(-)1.40-(-)5.15

(Oil & Gas J., Oct. 6, 1969)

Besides this trade pattern, bi-national barter trade is also conceivable. For instance, trading of xylenes mixture and pure-grade o- and p-xylene is undertaken between the U. S. and Japan.

The trade based upon regional differences in the structure of petrochemical industry is one of decisive factors affecting the world trade of petrochemicals.

All over the world, the largest producer and consumer is the U.S.A., but its production structure of the petrochemicals somewhat differs

Table III-9 Butadiene Balance in the U. S. A. and Western Europe

(Unit: x 10^3 tons/yr.)

	1968	1970	1972	1975	1976
(U. S. A.)					
Capacity	1,596	1,921	-	2,288	-
Production	1,513	1,735	1,650	1,990	1,850
Demand	1,546	1,796	1,750	2,173	2,200
Import Required	33	61	100	183	350
(Western Europe)					
Capacity	888	1,024	-	1,495	-
Production	610	801	980	1,050	1,500
Demand	600	738	870	990	1,260
to Export	10	63	100	60	2,200

(Prepared from data of Ericsson Chemical Service, CEER (Tokyo), Jan. 1971, p. 33 and European Chemical News (London), June 30, 1972, p. 4).

from that of other countries. The U.S. petrochemical industry greatly depends upon wet natural gas or refinery gas for raw materials. Then, the yield of ethylene through these raw materials in higher than that in naphtha-based production which is prevailing in other countries. On the other hand, no valuable byproducts are expected, contrary to the case of naphtha cracking.

Actually in the U.S.A., about 80% of propylene is supplied at present from the refineries, where catalytically or thermally cracked gas is produced. For the forecast of propylene supply and demand in the U.S.A., the data of Table III-8.

Party because of exhaust of natural gas resource in the U.S., petrochemical raw materials began to be shifted from natural gas to naphtha or gas oil. Shortage of propylene is still likely to continue in this country.

In the U.S.A., butadiene has also incurred a problem. It has long been produced predominantly by dehydrogenation of butane or butene there, whereas, in Europe and Japan, it is recovered from B-B fraction, a by-product in naphtha cracking. Accordingly, butadiene price is stiff and its supply is apt to be short, as shown in Table III-9.

This table shows some inconsistency due to synthesized data, but the U.S.A. is always short in butadiene supply, while chemicals are always in excess in the Western Europe. Actually, Japan and W. Europe have exported butadiene to the U.S.A. for several years.

In the U.S.A., aromatic hydrocarbons such as benzene, toluene and xylenes (BTX) are also supplied mainly from refineries. BTX supply and demand in the U.S.A. are shown in Table III-10.

BTX seems to be well balanced in the U. S. A. and this country seems to hold additional power to export toluene and xylenes. It is, however, very difficult to foresee future situation, because the progress of the Maskie bill on non-leaded gasoline will affect BTX market. Actually, pure grade o- and p-xylene have been exported to Japan for chemical uses, and xylenes mixture have been reversely imported from Japan to blend them with gasoline.

Table III-10 BTX Supply and Demand in the U. S. A.

(Unit: x 10^6 tons/yr.)

	1965	1970	1975	1980
(Benzene)				
from coal	0.38	0.38	0.36	0.33
from Petroleum, extraction	3.33	3.05	4.13	5.35
from Petroleum, dealkylation	1.90	0.75	1.11	2.00
Supply Total	5.61	4.18	5.60	7.68
Petroleum derived ratio	93.2%	90.9%	93.4%	95.7%
Demand	2.75	4.12	5.36 ~ 5.72	7.11 ~ 7.99
(Toluene)				
Supply	1.85	2.61	3.30	4.70
Petroleum derived ratio	-	97%	-	-
Demand	0.74	1.75	2.30	3.42
(Xylenes)				
Supply	1.15	3.33	3.50	4.0
Petroleum derived ratio	-	99%	-	-
Demand	0.58	1.33	2.33	3.50

(K.H. Loehmer & R.G. Dodge presented at an American Chemical Society/Canadian Chemical Society joint meeting in Toronto).

3. Petrochemical Industrialization in Those Developing Countries which Produce Petrochemical Raw Materials

Rapid growth of the petrochemical industry in developed countries in 1960s is largely attributable to the supply of abundant petroleum at low costs from oil-producing countries through the hands of major international oil companies. Until 1971, the price of petroleum has been always showing a downward trend, but right in that year, the price has turned upward by the changes in world situation which started with requests of OPEC (Organization of Petroleum Exporting Countries) for the price hike and capital participation in oil companies.

In addition, delays in nuclear energy development have made the value of petroleum more and more important, as taking a major position in world energy sources. Despite the forecast that nuclear energy will make 10 times or more growth in 1980 over 1970, it still accounts for about 3.4% of the world total energy. It is estimated that nuclear energy will replace petroleum merely from 2000 on.

As for natural gas, exhaust of this resource has imposed a critical problem in the U.S. (The U.S. energy policies to be decided in 1973 are attracting attention as having large impact on future world energy demands.) On the other hand, development of pipeline networks within each continent and sea transport of natural gas in the form of LNG have done much to give incentive to Europe, the Soviet Union, and other countries, forcing them to actively develop natural gas resource. A 1980/1970 ratio of 1.7 is estimated for the growth of natural gas production. It is also estimated that natural gas will occupy 18.1% of the world total energy in 1980.

As petroleum becomes more important, oil-producing countries will naturally take more advantageous positions in the world petroleum. In other words, it is expected that export of low cost petrochemical products from oil-producing countries will increase its proportion in the world market.

Next, we would like to mention the features of petrochemical industrialization in developing countries having petrochemical raw materials. In a country with a large population, such as Indonesia, the petrochemical industry to be established will be directed, in the first place, to the production of high polymer materials including synthetic resins, synthetic fibers, and synthetic rubber, so as to be able to meet the large demands for commodity goods supported by its large population. High polymer materials are characterized in that they can be combined with the demands of general public for these materials through processing industries which do not necessitate large amount of capital and higher technologies, and have visible effects on the peoples' living way. Furthermore, development of processing industries, with high polymer material in their center, will have a large effect on the industrialization of a developing country.

At the same time, exports of specific intermediate chemical products will be attempted on large amounts (i.e., low-cost export), if the country can conclude a specific contract with a company of another developed country, as Algeria is reportedly planning the butadiene production on the contract with an English company.

Progress in industrialization results in diversification and expansion of the demands for petrochemicals, and thereby increases the demands for intermediates as the raw materials for such diversified chemical products. When these demands reach an economic scale, production will start of intermediate chemical products allocated to domestic demands. This will make the petrochemical industry to grow from restricted production of high polymer materials into a key material-supplying industry which support various industries of a country.

On the other hand, when a less populous oil-producing country wants to establish the petrochemical industry, she cannot be dependent upon the domestic market for its business basis unless she takes the protectionistic measure such as import ban or high tax barrier for her petrochemical industry, and naturally become more dependent upon international market. Such a petrochemical industry, taking advantage of low cost petrochemical production, will be able to secure export markets, but this must be decided from highly strategic point of view.

The present state and future plans of the petrochemical industries in those developing countries having natural resources available as petrochemical raw materials will be described below. In all countries, at least the ethylene production plants, which take the central position in the complexes, are mainly operated by state-owned companies, and this fact indicates that this industry has been developed from a viewpoint of national economy. Of course, the attitude toward development differs by country. A country tries to attain to the self-sufficiency for petrochemical products at first under the domestic industry protecting policies such as tariffs barrier, and then in a step by step manner to expand its petrochemical industry into a large scale industry capable of making big entry into world market. Another country constructs, from the beginning, a large-scale complex that will be able to stand internationally competitive, to take part positively in international markets. Thus any petrochemical complex is decided upon political, social, and economic requirements of the respective country.

Mexico is the only country already having a petrochemical complex among the developing countries which produce petrochemical raw materials. In this country, ethylene production is managed by a state-owned company, Petorleos Mexicanas (PEMEX), of which activities in the petrochemical industry are shown Table III-11.

Among the planned ethylene projects, Pajaritos plants started its operation on March 18, 1972 and Poza Rica plants will complete in 1974 or 1975. Ethylbenzene is dehydrogenated to styrene which in turn is used for production of polystyrene. Ethylene dichloride is dehydrochlorinated to vinyl chloride which in turn is polimerized to polyvinyl chloride. Thus, the Mexican petrochemical industry

Table III-11 Mexican Petrochemical Industry

(Unit x 10^3 tons/yr.)

Location	Madero Tamaulipas	Minatitlan Veracruz	Pajaritos Veracruz	Posa Rica Veracruz	Reynosa Tamaulipas
Raw material	Cat cracker of gass	Cat cracker of gass	Ethane	Ethane	Ethane
Ethylene, existing	14	3	27	-	27
Ethylene, planning	-	-	182	182	-
Ethylene, total	14	3	209	182	27
Derivatives Ethyl benzene	39	8	-	-	-
Acetaldehyde	-	-	45	-	-
Ethyl chloride	-	-	12	-	-
Ethylene dichloride	-	-	114	-	-
Ethylene oxide	-	-	28	-	-
Polyethylene	-	-	-	50	24

*, Before completion of ethylene plant, it was supplied from Pajaritos.

has produced polyethylene, polystyrene and polyvinyl chloride as plastics. In addition to ethylene and its derivatives, the Mexican petrochemical industry has produced aromatics by naphtha reforming and extraction, and also SBR derived from both styrene and butadiene, the latter being produced by dehydrogenation of butane and butenes.

Table III-12 Rumanian Petrochemicals' Production

(Unit x 10^3 tons/yr.)

	1970	1975 (target)
Ethylene	109.6	330.0
Acetylene	45.1	100.0
Propylene	58.5	140.0
Benzene	113.2	185.0
Caprolactam	8.6	25.9
DMT	13.2	40.0
Methanol	90.1	350.0
PVC	86.4	280.0
LDPE	65.9	90.0
HDPE	0	30.0
Polystyrene	11.4	35.0
Polypropylene	0	15.0
Nylon	6.6	14.3
Polyester fiber	10.4	47.7
Acrylic fiber	12.4	35.0
SBR	81.2	146.0
Polyisoprene rubber	0	50.0
Synthetic detergents	8.0	16.5
Insecticides	9.9	30.0

Rumania has two ethylene plants based upon naphtha cracking, operated by state-owned enterprise. Brazi Proiesti complex has a 35,000 ton per year ethylene capacity and been producing 24,000 ton per year of polyethylene and 10,000 ton per year of ethylene oxide. Pitesti has operated a 100,000 ton per year ethylene plant and planned another 220,000 ton per year ethylene plants. At present, ethylene from Pitesti plants has been used for 60,000 ton per year of polyethylene production. Regarding the future plan of the Rumanian petrochemical industry, the following is published on Chemical & Engineering News, Aug. 9, 1971, p. 22.

Algeria has a petrochemical complex to be operated by a state-owned enterprise, SONATRACH, at Skikda which comprises a 120,000 ton per year ethylene plant using ethane as the raw material, a 35,000 ton per year PVC and a 48,000 ton per year LDPE. Reportedly, SONATRACH seems to be considering to construct an extremely large-scale butadiene plant with a capacity of 300,000 ton per year, based upon dehydragenation of butane recovered from natural gas. It is said that such butadiene will be marketed in Western Europe through the International Synthetic Rubber Co. (London) and in the U.S.A.

Venezuela has released its petrochemical project to the undertaken chiefly by a state-owned enterprise, Instituto Venezuelano de Petroquimica (IVP) at Zulia, El Tablazo. The plant will have an ethylene capacity of 150,000 ton per year, together with a propylene capacity of 95,000 ton per year. Derivatives are: 50,000 ton per year of LDPE, which will be in charge of Polimeros del Lago established jointly by IVP, Ethylene Plastique (France) and local companies; 15,000 ton per year of polystyrene in charge of Estirenos del Zulia established jointly by IVP, Dart Industries (U.S.A.) and local companies; 50,000 ton per year of PVC in charge of Plastics de Venezuela established by IVP, B. F. Goodrich (U. S. A.) and local companies, etc. According to the recent information, Venezuela has an intention to join Andes group for early materialization of its petrochemical projects.

Peru has its petrochemical projects to be undertaken by a state-owned enterprise, Induperu at La Pampilla. The first stage of projects is as follows:

(Unit: $\times 10^3$ tons/yr.)

Product	Capacity
Ethylene	40
VCM	25
PVC, suspension	20
emulsion	10
LDPE	22
Phthalic anhydride	5
Synthetic rubbers	20
Maleic anhydride	5

The second stage includes production of HDPE, polypropylene, styrene and polystyrenes, caprolactam, etc. These projects were originally planned as a part of multi-national petrochemical plan of the Andes group, but Peru alone stepped out of line because of the delay of undertaking. Since then, Induperu has once tried to use a fraction of the crude oil discovered in Amazon basin. According to the latest news, Induperu is considering to construct a complex in Northern Bolivia, in response to the offer of Bolivian crude oil supply made by the Bolivian Government. Then, the situation is yet fluid.

Iran established state-owned enterprise, National Petrochemical Co. (NPC) which is a complete subsidiary of National Iran Oil Co. (NIOC). NPC has already been engaged in the petrochemical business. PVC and alkylbenzene are produced by Abadan Petrochemical Co. established by NPC and B. F. Goodrich at a shareholding ratio of 74 : 26. In 1971, NPC decided to establish a new affiliate company by getting a tie-up with a Japanese group. The project is based on natural gas cracking for ethylene production and naphtha reforming for BTX production. Both of which will be carried out by Iran Japan Petrochemical Co. (IJPC) which was established by 50 : 50 joint venture between National Petrochemical Co. (NPC) and Iran Chemical Development Co. (ICDC : Japanese Group).

The plant location is reported to be Bandar Shaphur, and natural gas from the Ahwaz and Murun gas fields and naphtha from the Abadan refinery are planned to be used.

(Unit: x 10^3 tons/yr.)

Product	Capacity
Ethylene	300
LDPE	100
HDPE	50
Ethylene dichloride	300
Ethylene glycol	50
2-Ethyl hexanol	not decided
Chlorine	225
Caustic Soda	250

(Total Investment: $350 million)

4. Petrochemical Industrialization in Developing Countries of ECAFE Region

Table III-13 shows three years' trade balances of those countries belonging to Southeast Asia and Oceania. Many countries in the FCAFE region has such a trade structure that they export primary products, such as mineral resources and agricultural products, and import industrial products. Due to the above structure, they are commonly suffering from shortage of their foreign exchange holdings, and this is one of large factors which prevents them from developing their economy successfully.

Since the latter half of 1960s, however, a worldwide trend toward industrialization has appeared in developing countries, and an increasing number of ECAFE region countries have been making efforts to attain economic independence and balanced trade structure, further, to solve foreign currency problem, and to promote social and economic development as the propagation effects resulting from industrialization.

The ECAFE region countries which are trying, under these circumstances, to develop their own petrochemical industries as a key measure for industrialization include 9 countries of Indonesia, Korea, India, China, Australia, Thailand, Iran, the Philippines, and Singapore. Among them, the three countries of Korea, Australia, and India have already launched their petrochemical industries by putting their respective complexes into operation. Some other countires, such as Iran, Thailand, and China, will be sure to possess their own in the latter half of 1970s.

Petrochemical industries in these countries will be described in details in IV. 5. 2 and after, where country studies are dealt with. As shown in Table III-14, those three countries in which petrochemical complexes are already in operation, have a total ethylene production capacity of 355,000 tons/yr., which accounts for only 1 - 2% of the world total capacity of 30,000 tons/yr., as of 1972. However, if Japan joins these countries, the five-country total will sharply raise its ratio to the world total capacity to 20%, because the Japanese petrochemical industry has an ethylene production capacity of 5,060,000 tons/yr., the second largest of the world, and has fully developed as a key industry.

The petrochemical industries in Europe, the U.S.A. and Japan are already in the era of up to 500,000 ton per year of ethylene plants. Yet among the above three countries, Australia's 150,000 ton per year of ethylene plant is the largest one, and

Table III-13 Trade Balance of Countries in Southeast Asia and Oceania

(Unit: $ million)

		Australia	Korea	Hong Kong	Indonesia	Malaysia	Philippines	India
1968	Exp.	3,529	455	1,744	1,753	1,347	818	1,763
	Imp.	3,887	1,468	2,058	1,463	1,161	1,280	2,489
	Balance	-254	-1,013	-314	290	186	-462	-726
1969	Exp.	4,224	622	2,178	1,833	1,152	855	1,280
	Imp.	4,066	1,825	2,457	1,824	1,178	1,254	2,028
	Balance	158	-1,203	-279	9	-26	-399	-748
1970	Exp.	n.a.	835	2,514	1,957	1,680	998	n.a.
	Imp.	n.a.	1,984	2,905	1,984	1,370	1,210	n.a.
	Balance	n.a.	-1,149	-391	-27	310	-212	n.a.

(Source: International Financial Statistics) the remaining two countries sharted with a 100,000 ton per year of ethylene or less capacity, as shown in Table III-14. These ECAFE region countries could not operate, from the international-scale plants for such reasons as limitation in fund-raising ability or immature domestic petrochemical markets. Therefore, they could not enjoy the scale merit, a large characteristic of petrochemical industry.

In other words, they have never been able to stand competitive, with developed countries such as European countries, the U.S.,

Table III-14 Ethylene Production Capacity in the ECAFE Region - 1972

(Unit: tons/yr.)

	Ethylene Production Capacity	Expansion Plan
Australia	150,000 25,000	
Korea	100,000	+ 50,000
China		(100,000 (300,000
India	20,000 60,000	130,000 (75/76)
Iran		300,000 (76/77)
Thailand		100,000 (79/80)
Japan	5,020,000	
Total (excluding Japan)	355,000	
Total (including Japan)	5,375,000	
World Total	30,000,000	

and Japan, where petrochemicals are produced at low costs in huge plants. At present, the petrochemical industries in these ECAFE region countries are no better than domestic market-oriented ones, which are in operation with an aim of replacing imported petrochemicals by domestically produced counterparts.

However, even if much cannot be expected for exports, and even if considerable amount of foreign currency payments is required for importing machinery and equipment for domestic petrochemical production, still a large amount of savings in the foreign exchange holdings are brought about by domestic production. Furthermore, various spreading effects are achieved by developing the petrochemical industry. The above two advantages are the chief motives of their entry into the petrochemical undertaking.

As their domestic markets become exploited and opened, those countries next intend to expand their petrochemical industries, and market their own products in the export markets in the ECAFE region. As an indicator of the scale of these ECAFE market,

Table III-15 Export of Plastic Materials from Japan - 1971

(Unit: tons)

	All Exports	To Southeast Asia
LDPE	261,155	143,000
HDPE	167,594	60,648
PVC	145,464	44,000
PP	162,115	96,166
Polystyrene	71,700	57,000
Total	808,028	400,814

Japan's total plastics export stood at about 800,000 tons in 1971, of which 50% or 400,000 tons were exported to Southeast Asia. Japan's petrochemical export is now estimated to occupy 70-80% of the Southeast Asian market. This will correspond to 500,000 to 600,000 tons per year, which cannot be regarded as small, even now.

However, even if those ECAFE region countries will have expanded their petrochemical production capacities to obtain international competitiveness in the aspect of prices, the following problem still remains to be solved. The export markets in which they want to start business are mainly other developing countries in the ECAFE region. Exports to these countries will not be possible simply because products have low prices. In many cases, it will be necessary to make efforts for exploitation of export markets in such a way that suppliers offer financial and technical cooperation to such users as plastics processing industry or textile industry for their growth. In this context, Japanese, European and U.S. makers have been cooperating with the ECAFE region countries financially, technically, or managerially for a long time. These efforts for cooperation have strengthened the links between suppliers and users, and made it difficult for newcomers to enter the markets.

In order to overcome the afore-mentioned costly production by small-scale plants and the problem of market exploitation, the following are observed.

(1) The petrochemical industry is made to start first with a small capacity, and as the domestic market grows, it is gradually expanded until an international scale is reached when such a scale can be supported by the domestic market.

During the period, import bans or high customs duties are imposed on imported petrochemicals, with the aim of protecting domestic industry.

(2) International-scale petrochemical industry is established from the beginning by getting partnership with Japan, the U.S. or European countries, which have already occupying large shares in the petrochemical markets in importing countries in the ECAFE region

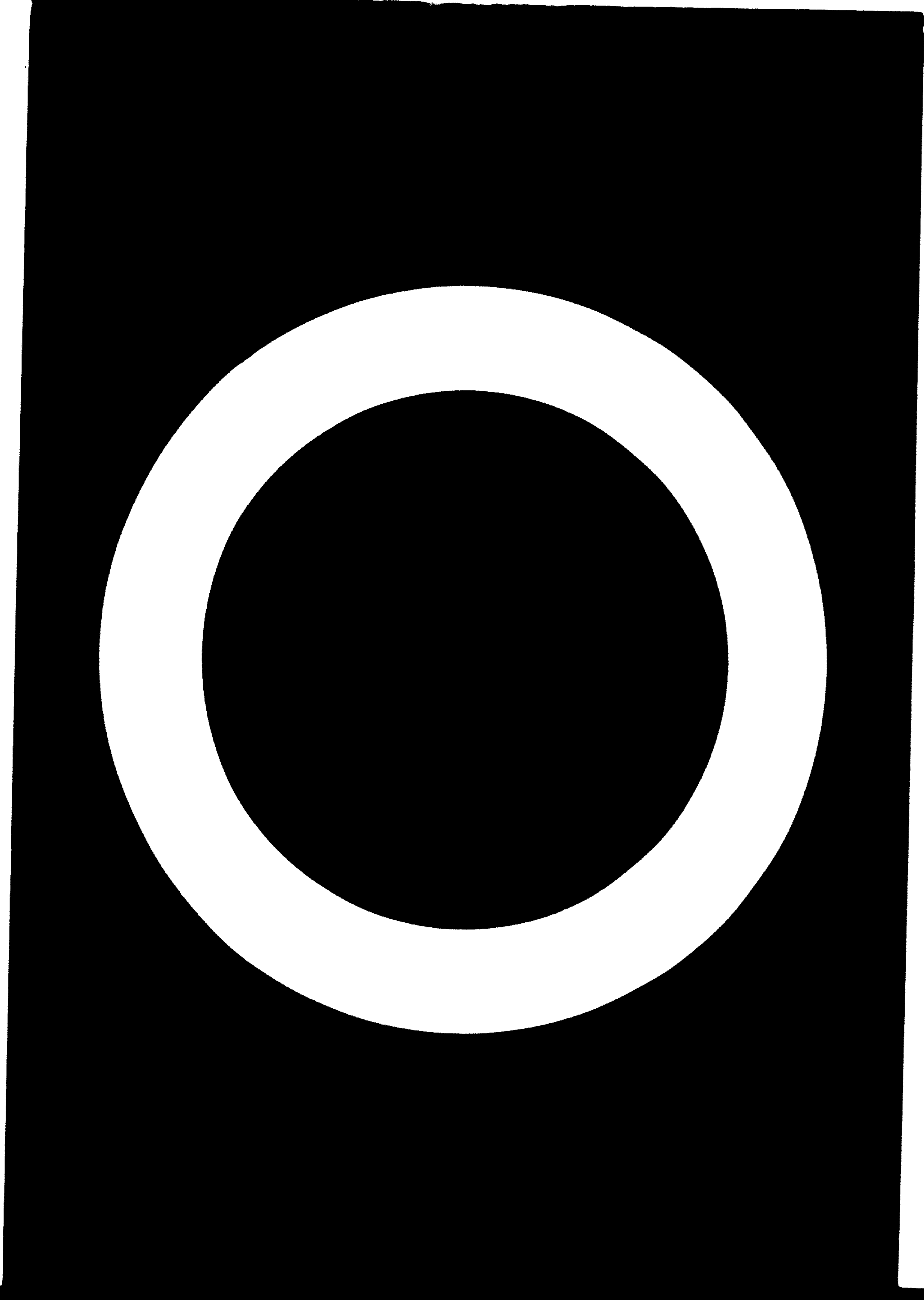
The former is the cases of 4 countries of Korea, India, Australia, and China, where petrochemical production is already commercialized, and Thailand where commercialization is scheduled for the latter half of 1970s. All these countries have planned on construction of new plants or expansion, so as to meet the domestic demands. Their products are marketed domestically, at least during 1970s. Therefore, there may be possibilities of short-term exports to fill the gap of demand and supply in other countries, but from long-term point of view, these countries cannot expect petrochemicals for a strategic role in export. Upon petrochemical industrialization, they are imposing high customs duties or even taking import bans on imported petrochemicals to secure their own domestic markets, and with the growth of domestic markets, they intend to develop their own petrochemical industries into large-scale industries capable of taking full part in international markets.

The latter is observed in Iran, which is now setting forward its petrochemical project with a target of start-up scheduled for 1976. As already described as an example of those countries in which petrochemical industrialization is based upon natural resources of their own, this country aims at starting from the beginning with an international-scale petrochemical complex having a capacity of 300,000 ton per year, using as the starting material abundant natural gas produced within the country. Like Indonesia, Iran has also advantage in the aspect of raw material cost, because of its domestically produced natural resources. In addition, the country has got into the partnership with Japan, so that its products can be exported at once to international markets, particularly to South-east Asian markets, which have been exploited by the Japanese group. Iran's petrochemical project will be outlined in a section of Country Study. It will be enough to mention here that about 40% of 100,000 tons/yr. of LDPE and about 60% of 30,000 tons/yr. of HDPE will be exported. Such an export-oriented petrochemical industry is quite different in its nature from those in other 5 countries.

(3) International-scale petrochemical plant is established from the beginning, by regional cooperation and specialization among countries. That is, swap trade is practised among ECAFE region countries, so that the plant capacity of the country in charge of the derivative can be highly scaled up.

Thus the petrochemical projects for the ECAFE region countries would take a variety of systems, depending upon such conditions as to whether countries have natural resources of their own, whether they start from the beginning with an international-scale petrochemical industry or start with a small-scale plant mainly to meet the domestic market, or how to tie up with related industries or with foreign-capital companies. In any case, these countries are consistently trying to develop their own petrochemical industries as a future key industry. In the course of industrialization, any of them will try to go ahead of the others in its entry into international markets, so that it can gain more foreign exchange holdings and helps develop its own economy. Existing petrochemical industries will further come close to an international scale. In the latter half of 1970s, when petrochemical indsutries will have been materialized in Iran and Thailand, export competition will become severe among countries including Europe, the U.S.A. and Japan.

These are still problems to be solved by the ECAFE region comtries for their petrochemical industrialization For example, those countries with their own natural resources available as the raw materials should take such policies as to take advantage of its superiority in terms of natural resources and be able to produce those products which will be internationally competitive. Measures should be taken to develop the domestic market, particularly related industries such as plastics processing and textile industry, and to effectively exploit the market, so that plants with internationally competitive scales can be put into operation as soon as possible. While solving the above problems, developing countries will divert their petrochemical industries in 1980s from a passive industry working on substitution for imported products into active industries capable of gaining foreign currencies through exports. Thus forward steps of petrochemical industries will become huge strides as a key industry in those developing countries.



IV. MARKET STUDY

1. Introduction

The object of the market study within the scope of this survey is to provide data and information required for selection of promising products, decision of scale of plants and time factor of operation start-up to produce such products, and economic evaluation of the projects. Those data and information are mainly of the volumes and prices of the products to be accepted to the Indonesian domestic and overseas markets.

First thing to be considered is the domestic market situation. In the developing countries the domestic potential market for petrochemicals will be formulated by substitution of import materials and replacement of traditional goods for new products. The domestic demand, therefore, can be determined by the size of the potential market consisting of the above two aspects of which the integration will give its maximum extent. The domestic demand is a function of competitiveness of products against the imported ones and traditional goods. It is obvious that the decisive factor is sales price though quality problems still remain.

Our study as to domestic market has been made in consideration of the following points:

- Attainment of complete substitution for imported petrochemicals must be the prime objective in the establishment of the domestic petrochemical industry.

- The most desirable case is to carry out this substitution without raising price levels so far formed by imported petrochemicals.

This is based on the following understanding. From national point of view, it is unfavourable to raise the domestic petrochemical prices at the time of start of domestic production. Namely, if starting price level is high, it will hamper the subsequent growth of domestic demands. Further, it should be noted that a product of which the production cost is so high as needs preventive custom duties to protect domestic market will not be able to find a promising export market.

With respect to overseas market, exportability of Indonesian petrochemicals are defined by present and future situation of petrochemical industrialization in overseas market, by situation of competition with the petrochemicals produced in other countries, and by policy on import including tax system, import duty and import tax system of each ESCAP region country. Considering the above things, we investigated the exportability of Indonesian petrochemicals to each overseas market.

The outcome of the market study will be presented in the following sequence after methodology of market study.

Selection of products, the first stage of the market study, has a criterion as to whether the demand for a product has reached a certain level of production scale in order to win price competition with an imported counterpart under the present customs level.

The second stage, i.e., demand forecasting, has been conducted on the assumption that the domestically produced petrochemicals under the project would dominate the domestic market so far occupied by imported products, and that they would be marketable even in the overseas markets from the price point of view.

The third object, i.e., price forecasting, is simply based upon the thought that domestic sales prices must not be higher than import prices (CIF prices + charges on import) and that export prices must not be higher than those from the other countries.

2. Methodology of Market Study

(1) Demand forecast

Domestic Market

In the field of demand forecasting, particularly for long-term prediction, it is desirable to try different techniques in order to improve the accuracy of forecasting with cross-checking of the independent results. The following two forecasting techniques are applied in our study for deciding domestic market size which is of particular importance to see the possibility of the Indonesian petrochemical project.

(a) Macro-scopic forecast based upon international comparison study

The pattern of petrochemical consumption differs by country. Behind such difference are there such factors as consumers' preferences, economic levels, industrial structures, climatic and geographical features. Through careful examination of the above factors, a forecasting technique which analyzes the trends in petrochemical demands in the different countries can offer a very effective tool for comparison study.

Especially in the case of long-term forecasts in the developing countries where petrochemical markets have not been established, cross-checked figures are said to be careful examination of the above factors, a forecasting technique which analyzes the trends in petrochemical macro-scopically estimated the future petrochemical demands in Indonesia by comparison study of per-capita consumption of petrochemicals in the world, particularly in Southeast Asian countries.

(b) Micro-scopic estimation by end-uses

The domestically produced petrochemicals are considered to gain and develop demands in accordance with the following three processes.

First, domestically produced materials are substituted for imported materials which have already occupied the markets.

Secondly, petrochemicals are replaced for existing products made of traditional materials, such as wood, paper, metals, cotton, fat and oil, etc.

Thirdly, new markets are created and developed, taking advantages of the characteristics of petrochemicals which traditional materials have not.

Actually, these three processes will often appear in a combination giving a multiple effect upon overall market development in each end-use field followed by the increase in shares of petrochemicals in their growing markets. The steps taken for our study of this procedure are as follows:

1) Finding potential markets in those fields which are likely to become the markets of petrochemical products for substitution or replacement.

2) Estimation of changing shares of petrochemicals in each field.

3) Study on competition among such petrochemicals as plastics and synthetic fibers of general-purpose nature.

4) Review of a possibility of new market creation.

In addition to the above two forecasting techniques, it has been attempted to analyze the development in the Indonesian markets for petrochemicals with life cycle of products. As a result, it has been concluded that major petrochemicals such as synthetic resins and synthetic fibers have passed through the initial period of introduction and entered period of rapid growth.

Regardless of the techniques applied we do not think it realistic to make a simple extraporation based on the past records of demands.

In this study, we have first foreseen the 1980 demand structure of the petrochemicals in Indonesia. Then it has been attempted to review their growth curves pursuing the study of the possibility if such demand structure can be realized in view of the present demand structure.

Export Market

Possible volumes of petrochemical exports from Indonesia are predicted by the following methods.

(a) Selection of potential export markets
Potential export markets for Indonesian petrochemicals are selected from export target markets (i.e., ECAFE member countries) stipulated in the terms of reference of the contract. Marketabilities of Indonesian products in such countries have been studied in accordance with their situation either if they have any petrochemical complexes, or if they are still in planning stage. This

will be further described in details in IV.5 (Pre-requisites of the ECAFE region market survey).

(b) Demand forecasts of petrochemicals

A macroscopic technique is then applied to said potential export markets. Their annual average rates of growth are estimated by trend analysis for the period up to 1980 based upon the past records of all selected products. Demand volumes are then predicted using the above growth rates forecasted.

(c) Estimated production

Volumes of production by product are estimated up to 1980, in consideration of those data on existing plant capacities by country, and of plans now available for construction of petrochemical complexes or independent down-stream plants.

(d) Size of potential markets for the Indonesian products

The potential market of a product is defined as the difference between the demand volume and the estimated production.

(e) Exportabilities of Indonesian petrochemicals

Possible Indonesia's share for the overseas market is estimated within a potential market of a product in a country. We have studied market shares by the present and expected suppliers in that country and supply programs of existing petrochemical project. From this estimated Indonesian market share, we have calculated a possible volume of export by product and by country. It is assumed that possible volumes of export for the period

1981-1985 will remain on the same level as in 1980. Because, despite enlargement of export markets caused by increased demand in importing countries, there will be big possibilities that petrochemical complexes or down-stream industries of their own will be established in the export target countries in 1980s'. Therefore this factor will work toward curtailment of the overseas demand.

(2) Price Forecast

This market study has started with providing necessary data for selection of promising products which will be able to completely substitute for imported petrochemicals without raising price levels of petrochemicals in Indonesia.
Therefore, the maximum domestic sales prices of promising products have come to be limited by import prices (CIF prices) plus import charges, and thus future CIF price movements can be regarded as an indication in forecasting domestic sales price.

International trends in prices of petrochemicals will show push-up of unit price mainly caused by the rise of raw material prices and the rise of plant construction cost wherein additional costs are required for installation of pollution control devices.
It is said that, on the other hand, either recent technical progress on advantage of plant scale-up has not been able to cut such price hike so that the problems will continue to lead the petrochemical price level to upward trend.

The domestic sales price (ex-factory price for domestic sales) of an Indonesian domestically produced petrochemical will be fixed referring the Japanese CIF price in Indonesia and import charges. It is thus necessary, at first, to predict the trend in CIF prices of Japanese products. In doing so, attention should be given to the changes in Japan's export attitude. Prices of petrochemicals exported from Japan have recently stayed on low levels, reflecting inactive domestic demands. Then efforts have been made to avoid unorderly competition and to recover price levels, and such efforts has begun to show evidences of effectiveness since spring in 1972. Both the domestic sales prices and the export prices of promising products have been estimated, following the procedure described below.

(i) The standard values for the petrochemical prices in Southeast Asia are estimated by modifying present CIF prices of Japanese petrochemicals, taking into consideration of the impact of cost increase.

(ii) Domestic sales prices of Indonesian products are fixed within sums of CIF prices from Japan plus import charges.

(iii) Ex-factory price for export are set to the differences obtained by subtracting such charges as freight and insurance from those prices which are obtained in (i), so that both CIF prices of Indonesian and of Japanese petrochemicals can stand on equal basis at the export market.

3. Basic Concepts and Results of Product Selection

Table IV-1 gives a list of products prepared for selection of promising products. In the table, the items under the title of "scale standard" show the scale standards of plants of which the production costs are supposed to form the basis of international price of the selected products in around 1980. All figures have been calculated, based upon plans for the construction of new plants in any countries of the world. Products have been selected at the first step by means of elimination.

A product, of which 1980 domestic demand is foreseen to be far less than the value of the standard plant capacity in the table, is excluded from the view point of marketability in Indonesia. Thus, with respect to selection of promising products from a product group within the survey scope described in contract 2.01.B, the following criteria are used:

- A first requisit for selecting a promising product is such a condition that quantitative level of estimated total demand of that product should satisfy the production scale required to maintain an internationally competitive price.
  However, we must be careful for the application of the above condition. Even if the level of the estimated total demand of a product has already met satisfactory level of production, priority should be given to the domestic demand or market for the first place. Because it will not be a steady policy to depend largely upon the overseas markets which seem not always stable under keen price competion. Therefore, as important condition, it is most necessary to know if the domestic market for that product has already grown up to a considerable scale to be secured by firm users.

° The second criterion for the selection of promising products is whether or not domestic production of the necessary major intermediate is feasible and meet its scale standard in the course of their production from raw materials. Even when a certain product is proved to have a demand enough to fulfill its scale standard at first screening, it is obliged to be disqualified from a promising product, in case said intermediate can not be domestically produced for the reason that its total demand inclusive of uses in other possible end products still stays far below the intermediate scale standard.

Note: As for the products listed in Contract 2.01, B. 5, such as lacquers, carbon black, refrigerants, dyestuffs, pharmaceuticals, and toiletery, possibilities of domestic production will be described in the later chapter only for those products which can be derived from production of promising products, as far as their domestic production is of great significance to the Indonesian economy. However, production of such products is not intended under the designated complex system, since their production will little contribute to the economy of the entire complex. As systems and types of their production used to differ by individual products, it does not seem to be advantage for this project to take them into the integrated complex.

The result of the selection of promising products are as follows:

1) Products not eliminated among the final-products:

- Thermo-plastic resins: LDPE, HDPE, Polystyrene, PVC and PP
- Thermo-setting resin: Urea Resin, Phenol Resin, Melamine Resin
- Plasticizer: DOP
- Synthetic fibers: Nylon, Polyester and Acrylic Fiber
- Synthetic detergent: Alkylbenzene-type Detergent

2) Surviving major intermediates to be used for the production of those items listed in 1) above: (Parenthesized names indicate corresponding final-products).

- Thermo-plastic resins: VCM (PVC), Styrene (Polystyrene), Propylene (PP)

  Note: Such thermo-setting resins as urea resin, phenol resin, and melamine resin have been eliminated because their small demands can not satisfy the scale standard for the production of phenol and methanol as raw materials.

- Synthetic fibers: Caprolactam (Nylon), EG, and Telephthalic Acid (Polyester)

  Note: Acrylonitrile has been eliminated, and Acrylic Fiber have been logically eliminated from promising product list.

- Synthetic detergent: None

  Note: Alkylbenzene (hard type) detergent has been eliminated.

Final Products						Intermediate Products
Products	Main Uses in Indonesia	Domestic Demand 1971	Domestic Demand 1980	Scale Standards	Judgement	Products
LDPE	Household Articles, Film Sundry goods	22,000	90,000	50,000	0	Ethylene
HDPE	- " -	6,400	20,000	20,000	0	"
PVC	Sundry goods, Pipe, Sheet, Film	19,000	65,000	30,000	0	VCM
Polystyrene	Household Articles, Industrial parts	3,500	25,000	15,000	0	Styrene
PP	Household Articles, Sundry goods, Film	4,500	40,000	30,000	0	Propylene
Urea Resins	Adhesives, Molding Materials	300	less than 1,000	2,000	0)	
Phenolic Resins	Paints, Molding Materials	100	1,000	2,000	0)	Methanol
Melamine Resins	Decorative Sheet	-	1,000	2,000	0)	
Poval	Adhesives, Paper Coating	200	less than 1,000	10,000	X	
Polycarbonate	Engineering Plastics	-	1,000	10,000	X	
Nylon Resins	- " -	-	1,000	5,000	X	
Polyester Resins	Building Materials, Boat	500	less than 5,000	20,000	X	
DOP	PVC Plasticizer	4,000	40,000	20,000	0	(Phthalic Anhydr (2 Ethylhexanol
Dibutyl Phthalate	- " -	800	2,000	10,000	X	
Nylon	Clothes, Rope	4,500	20,000	10,000	0	Caprolactam
Polyester	Clothes	17,500	80,000	15,000	0	(Terephthalic A (EG
Acrylic Fiber	Clothes, Blanket, Wig	2,000	5,000	5,000	0	Acrylonitrile
Synthetic Detergent	Cleaner, Dyeing	7,000	16,000	10,000	0	Alkylbenzene
Acetic Acid	Dyeing, Medicine	1,000	less than 5,000	30,000	X	
Acetone	Solvent	100	less than 1,000	30,000	X	
Glycerine	Cosmetics, Solvent, Medicine	100	1,000	10,000	X	
Buthanol	Solvent, Medicine	10	1,000	5,000	X	
Ethyl Acetate	Paints, Printing, Medicine	150	1,000	15,000	X	

Note: * The case where those intermediate are not able to be checked at this stage.

0 The case where the estimated 1980 demand is larger than or close to the produ

X The case where the estimated 1980 demand is far below the production scale s

Source: JGC Estimates

SECTION 1

Selection of Promising Products

(Unit: tons)

Scale Standards	Judgement	Intermediate Products: Products	Domestic Demand 1971	Domestic Demand 1980	Scale Standards	Judgement	Total Judgement
50,000	0	Ethylene				*	0
20,000	0	"				*	0
30,000	0	VCM	-	90,000	50,000	0	0
15,000	0	Styrene	-	25,000	40,000	0	0
30,000	0	Propylene				*	0
2,000	0)			less than			X
2,000	0)	Methanol	150	5,000	300,000	X	X
2,000	0)						X
10,000	X						X
10,000	X						X
5,000	X						X
20,000	X						
20,000	0	(Phthalic Anhydride	-	25,000	15,000	0	0
		(2 Ethylhexanol	-	15,000	20,000	0	
10,000	X						X
10,000	0	Caprolactam	-	22,000	30,000	0	0
15,000	0	(Terephthalic Acid	-	68,000	50,000	0	0
		(EG	-	29,000	25,000	0	0
5,000	0	Acrylonitrile	-	3,500	30,000	X	X
10,000	0	Alkylbenzene	500	1,300	50,000	X	X
30,000	X						X
30,000	X						X
10,000	X						X
5,000	X						X
15,000	X						X

...e are not able to be checked at this stage.

...0 demand is larger than or close to the production scale standards.

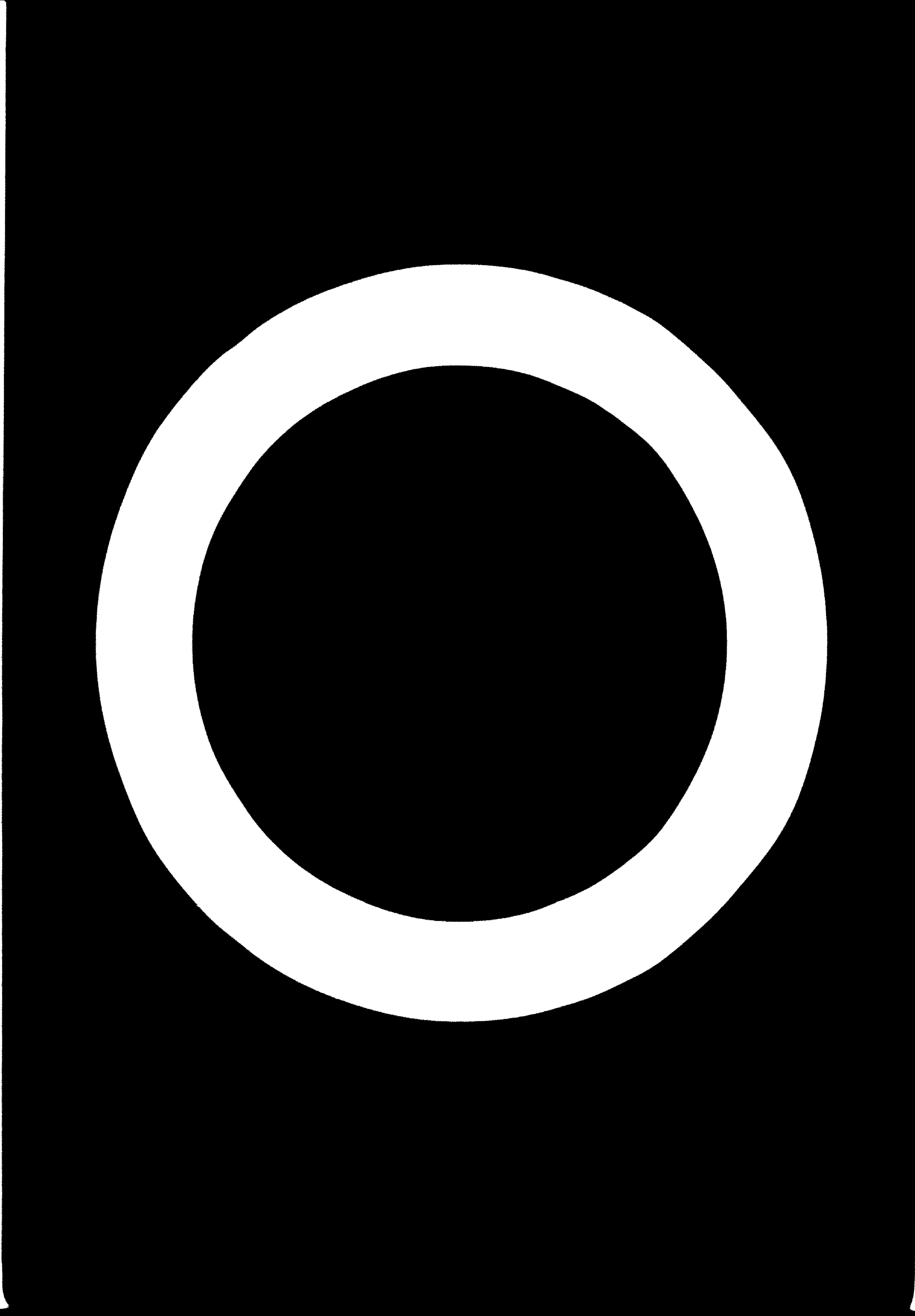
...0 demand is far below the production scale standards.

SECTION 2

- Plasticizer: Phthalic anhydride 2-Ethylhexanol (DOP)

Thus, from the view point of marketability in Indonesia, the following 10 petrochemicals are selected as promising products and studied in detail in later part of Market Study.

- LDPE
- HDPE
- VCM
- PVC
- Polystyrene
- PP
- DOP
- TPA
- EG
- Caprolactam



° **Plasticiser:** Phthalic anhydride, 2-Ethylhexanol (DOP).

Thus, from the view point of marketability in Indonesia, the following 10 petrochemicals are selected as promising products and studied in detail in later part of "Market Study".

- LDPE
- HDPE
- VCM
- PVC
- Polystyrene
- PP
- DOP
- TPA
- EG
- Caprolacam

4. Domestic Market Study

4.1 General Market Situation

(1) Long-Range Prospects for the Indonesian Economy

The Indonesian economy, in its third year of the First 5-Year Development Plan, is said to have paved its way to successful development. Some economic indicators prove this; for example, GNP has been marking 7% of an average growth rate per annum substantially for the past three years. Per-capita GNP has been rising at a rate of 4.5%. The 1971 GNP and per-capita GNP are estimated to have reached $12,500 million and nearly $100, respectively.

The most common opinion is that the Indonesian economy will continue to develop without heavy fluctuations in the future. Such an opinion is based upon the following reasons:

- Progress of the First 5-Year Development Plan indicates that the planned economy is steadily under way for the development of Indonesian industries. Planned economy is a successful means which have done much to raise up Indonesia's potentiality of growth into materialization. This accomplishments of the planned economy will certainly contribute to the future development of Indonesian economy to a large extent.

- The Second 5-Year Development Plan is aimed at industrialization for light industries, such as processing of agricultural and forest resources, refining of mining resources, textile, fabrication, and other types of processing. Therefore, measures will be taken to develop industrial sectors, and thereby investments into those industrial sectors will become more brisk than ever.

- With respect to export, the export pattern of primary product-exporting may not change rapidly, but the proportions of industrial products, including processing of the primary and secondary products, will become large in the future and contribute considerably to the increase in exports.

- In response to increasing investments in production equipment, improvement of infrastructure will proceed. Effects of such investments will directly result in large incomes through employment and purchase of capital goods, indirectly lead to effect of external economy.

Although the manufacturing industry has still only a small proportion in the total Indonesian economy, it is expected to take the leading role in the future economic activity. Its growth rate is likely to range from 12 to 13%, on the added-value basis, which is higher than the objective value of 8% set for the manufacturing industry of developing countries in the U.N. Second Development Decade. We understand the future Indonesian economy as to be hopeful described above, and our analyses are based upon the following indicators as shown in Table IV-2.

Table IV-2 Main Economic Indicators in Indonesia

GNP growth rate per annum	6.5 - 7.5%
Rate of population increase per annum	2.2 - 2.5%
Per-capita GNP growth rate per annum	4 - 5 %
Growth rate of manufacturing industry per annum	12 - 13 %
then per-capita GNP in 1980	$150
population in 1980	150 million

4.2 Plastics

(1) End Use Analysis

In the preceding chapters, we have selected from the view point of marketability in Indonesia, as promising products, six plastics material including LDPE, HDPE, PVC, VCM, Polystyrene and PP.

In this chapter, we will discuss the way of demand expansion of the above plastics along with the moves in the end use field.

Trend in end uses of plastics

Major end use of plastics in Indonesia are grouped into:

Table IV-3 The Plastic Demand in Major End Uses in Indonesia

(Unit: tons)

	1970	1972	1980	1985
Household Articles & Miscellaneous goods	11,000 (25%)	19,000 (26%)	65,000 (23%)	130,000 (21%)
Footwear	6,000 (14%)	10,000 (13%)	26,000 (9%)	42,000 (7%)
Sheets & Film	23,500 (55%)	40,500 (55%)	164,000 (60%)	378,000 (62%)
Construction & Civil Engineering	1,800 (4%)	2,700 (4%)	10,000 (4%)	25,000 (4%)
Industrial Use	1,000 (2%)	1,500 (2%)	10,000 (4%)	30,000 (5%)
Agriculture, Forestry & Fishery	- (-)	- (-)	- (-)	- (-)
Total	43,300 (100%)	73,700 (100%)	275,000 (100%)	605,000 (100%)

* Including 1,000 tons/yr. of imported plastics products

Household and miscellaneous articles (mainly molded articles).

Footwear.

Sheets & Film.

Industrial use.

Construction and civil-engineering materials.

Materials for agriculture, forestry, and fisheries.

The estimation of plastic demand in those major end uses are given in Table IV-3.

Domestic demands for major plastics (LDPE, HDPE, PVC, PP, and Polystyrene) in the Southeast Asian countries and Japan can be also broken down as follows.

The International Comparison of the Ratio of Major Plastics in End Uses

(Unit: %)

<table>
<tr><th>Country</th><th>Thailand</th><th>Singapore</th><th>Korea</th></tr>
<tr><td>Year</td><td>1971</td><td>1969</td><td>1969</td></tr>
<tr><td>Household articles & Miscellaneous goods</td><td>26.5</td><td>15.5</td><td>12</td></tr>
<tr><td>Footwear</td><td>2.5</td><td rowspan="2">62.5</td><td>1</td></tr>
<tr><td>Sheets & Film</td><td>59</td><td>42</td></tr>
<tr><td>Construction & Civil Engineering</td><td>5</td><td>6.0</td><td>16</td></tr>
<tr><td>Industrial use</td><td>7</td><td>4.5</td><td>7</td></tr>
<tr><td>Agriculture, Forestry & Fishery</td><td>-</td><td>4.0</td><td>16</td></tr>
<tr><td>Others</td><td>-</td><td>7.5</td><td>6</td></tr>
<tr><td>Total</td><td>100</td><td>100</td><td>100</td></tr>
</table>

Country			Japan	(Unit: %)	
Year	1965	1966	1967	1968	1969
Household aritlces & Miscellaneous goods	25	22	14	18	17
Footwear	-	-	-	-	-
Packaging	19	22	24	24	24.5
Construction & Civil engineering	30	30	30	28	27.5
Industrial use	20	18.5	17	20	21
Agriculture, Forestry & Fishery	3.5	3.5	4	4	3.5
Others	2.5	4	11	6	6.5
Total	100	100	100	100	100

Source: Thailand ; UNIDO Expert estimates
Korea ; The Government estimates
Singapore ; JGC estimates
Japan ; Research Institute of Industrial Materials

The following can be pointed out from the above table:

- The use as sheets and film has a very high proportion in the total demand in all the countries.
- Trends are toward decrease in the use for household articles and miscellaneous goods, and toward increase in the uses for construction & civil engineering and industrial purposes.
- Degrees of plastics use in agriculture and footwear differ largely by countries, giving no common pattern. Generally in regions with moderate climate, use in agriculture is low, and use for footwear is high.

Taking the above points into consideration, we analyzed the plastics demands of each end use in Indonesia.

Note:

If we put

$A(t)$; **Ratio of plastics demand to potential market scale during a period of t**

$b(t)$; **Growth rate of potential market scale during a period of t**

$Y(t)$; **Plastics demand during a period of t**

$X(t)$; **Potential market scale during a period of t**

$a(t)$; $\dfrac{A(t)}{A(t-1)} - 1$; **Changing ratio**
A kind of substitution ratio of plastics.

in each end use $Y(t) = A(t) \cdot X(t)$

$$Y(t+1) = A(t+1) \cdot X(t+1) = \left\{1 + (t+1)\right\}\left\{1 + b(t+1)\right\} \cdot Y(t)$$

$$\frac{Y(t+1)}{Y(t)} = \left\{1 + a(t+1)\right\}\left\{1 + b(t+1)\right\}$$

We assumed

- **a growth rates per annum of GNP of 7%, and**
- **a growth rates per annum of industrial sector (on the added value basis) of 12 to 13%**
- **a(t) and b(t) will be constant during some periods**

Then $\dfrac{Y(t+1)}{Y(t)} - 1$ **that is, average growth rates per annum of major plastics demand in each user field are obtained as follows:**

Average Annual Growth Rates of Major Plastics Demand in Each End use

(Unit: %)

Period	1972 - 1980			1980 - 1985		
Parameter user fields	a(t)	b(t)	$\frac{Y(t+1)}{Y(t)}-1$	a(t)	b(t)	$\frac{Y(t+1)}{Y(t)}-1$
Household articles and Miscellaneous goods	2.5	14	17	2	14	16
Footwear	1	12	13	-	10	10
Sheets & Film	3.5	15	19	2.5	15	18
Construction & Civil engineering	4.5	13	18	6	13	20
Industrial use	7	17	25	7	17	25
Agriculture, Forestry & Fishery	-	5	5	-	5	5

(a) Household articles and miscellaneous goods

Entry of plastics into the field of household articles is outstanding. Plastics are positively used in various articles, such as cooking utensils, tablewares, scrubbing and cleaning utensils. Situation in utilization of major plastics is as follows:

Kitchen utensils (e.g., baskets, food boxes, cooking utensils, buckets, etc.)
PE, PP and polystyrene.

Tablewares (e.g., bottles, boxes, etc.)
Polystyrene and PP.

Scrubbing and cleaning utensils (e.g., buckets, wash-basins, brushes, etc.)
PE, PP and polystyrene.

<u>Bottles</u> (e.g., vegetable oil, soy-bean sauce, liquid detergent and toiletories)
PE, PP and PVC

Plastics molding processors in developing countries usually enter at first the field of household articles and miscellaneous goods. Indonesian processors are not an exception of this type, and now self-sufficiency is already reached in the country.

With respect to the miscellaneous goods, container will grow to absorb substantial volume of plastics, of which PP and HDPE have suitable properties for this end use.

Household articles and miscellaneous goods are likely to take a main position in the plastics uses in Indonesia. This is because:

- o This field is closely associated with the rise of living standards of consumers.
- o It is expected that plastics will be increasingly substituted for those products made of wood and coconut.

According to our estimates, the plastics demand in the field of household articles and miscellaneous goods amounted to about 11,000 tons/yr. in 1970, which included 1,000 tons/yr. of product import from Hong Kong, etc. The demand in the same field will amount to about 19,000 tons/yr. (including 1,000 tons of product import) in 1972, and will move up to about 65,000 tons/yr. in 1980.

The major plastics used in this field are LDPE, HDPE, PP, polystyrene. In future, PP and polystyrene will take main part of this field. HDPE has many good properties, but will be overcome by PP which will be produced domestically. The demand for PVC will slightly increase in production of records and toys.

In this end use demands for each major plastics and its ratio are given in Tables IV-4.

Table IV-4 Breakdown of Plastics Demands in the Field of Household Articles & Miscellaneous Goods

(Unit: tons)

	1970	1972	1980	1985
LDPE	3,000 (30%)	3,500 (19%)	9,000 (14%)	18,000 (14%)
HDPE	3,500 (35%)	8,000 (45%)	15,000 (23%)	20,000 (15%)
PVC	500 (5%)	500 (3%)	1,000 (1%)	2,000 (1%)
PP	500 (5%)	2,000 (11%)	20,000 (31%)	50,000 (39%)
Polystyrene	2,500 (25%)	4,000 (22%)	20,000 (31%)	40,000 (31%)
Domestic Total	10,000* (100%)	18,000 (100%)	65,000 (100%)	130,000 (100%)

* Exclude 1,000 tons/yr. of imported products of which the breakdown into each plastics item is impossible.

(b) Footwear

Plastic sandals are widely used in Indonesia, as they have such merits as light weight, washableness, and low prices, as compared with leather or rubber-made footwear. Both PVC and LDPE sandals are used now in Indonesia, but PVC sandals with superior durability have occupied a major part of the market despite their prices 3 to 4 times higher than those of LDPE sandals.

This superior position of PVC sandals are likely to continue.

As a competitor with plastic footwear, synthetic-leather footwear has begun to enter the footwear market since 1970.

Recently, a joint-venture company was established for production of synthetic leather in Indonesia. Therefore, growth rate of demand for PVC sandals will be affected by the synthetic-leather footwear, though the potential market of footwear will increase at the rate of 12%, the substitution rate of plastic sandals will stay at the low level of 1%.

Therefore, plastics demand in the field of footwear, which stood at 6,000 tons in 1970 and 10,000 tons in 1972, and will reach 27,000 tons in 1980, and 42,000 tons in 1985. In this end use, demands for each major plastics and it's ratio are given in Table IV-5.

Table IV-5 Breakdown of Plastic Demands in the Field of Footwear

(Unit: tons)

	1970	1972	1980	1985
LDPE	500 (8%)	500 (5%)	1,000 (4%)	2,000 (4%)
HDPE	-	-	-	-
PVC	5,500 (92%)	9,500 (95%)	25,000 (96%)	40,000 (96%)
PP	-	-	-	-
Polystyrene	-	-	-	-
Domestic Total	6,000 (100%)	10,000 (100%)	26,000 (100%)	42,000 (100%)

(c) Sheets and film

Sheets

Plastic sheets find its major uses in school bags, furniture coating clothes, interior materials for automobiles, and seats of motor cycles and bicycles. In the case of the most prevailing PVC sheets, sheet-producing capacities of the calendar so far could not meet the domestic demand and the sheets was imported from Japan in an amount of 3,000 tons in 1970 and 5,500 tons in 1972. In the near future, however, domestically produced PVC sheet will satisfy the whole domestic market.

Film

Use of plastics as film can be grouped into:

- o Non-package film, such as those used in architecture, civil engineering, agriculture, and others. This type will be discussed in the sections of architecture, civil engineering, and agriculture.
- o Package film, which is further sub-divided into:

  Ordinary package film and
  Heavy-duty package film

The general package film is referred to as the film used in package of food, textile, miscellaneous goods, chemicals, etc. Use as food package is most outstanding.

In this field, plastics is competing with paper and cellophane, but plastics is gradually beginning to take the first position in developed countries. Likewise in developing countries, plastics demand will sharply grow, owing to the development of food processing industry and more common practice of package [illegible] at the retail step.

On investigating the future position of each plastic in this field, LDPE will keep its existing position. On the other hand, PVC film will not increase so much because its use in agriculture will not be expected to spread.

When fertilizer, synthetic resins, [illegible], chemicals, crops, sugar and salt are shipped in bags weighing 20 kg or more, strong bags made of paper, [illegible] and vinylon have been used and PVC, LDPE, HDPE and PP are replacing these conventional materials. The plastics have the following outstanding features:

1. Light weight
2. Anti-chemical and anti-corrosive properties
3. Capability of mass production and printing
4. Toughness

Depending on properties of each film, plastic bags are categorized as follows:

Synthetic resin	Heavy Bag	Application Materials
PVC LDPE	20 - 30 kg	Pipe
HDPE PP	20 - 50 kg	[illegible]

LDPE and PVC bags can be easily produced by means of inflation process at low costs, but they are inferior in strength. Therefore, PP or HDPE woven bags should be used for 50 kg or more contents, although processing of such bags is not so simple.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

the following items fall under this category in today's Indonesia.

(i) Electric transmission line coating (mostly made of PVC) with the 1970 demand of 10 to 40 tons/month.

(ii) Photographical and industrial products, made of polystyrene, with the 1970 demand of 10 to 40 tons/month.

Future plastics demands in this field are expected to increase at high rate in Indonesia because this country has three plants for household electric appliances and automotive assembly factories. However, amounts of plastics demands in this field are so small at present that it will not be able to take major part of plastics demands around 1980.

In the case of household electric appliances, [illegible] domestic production of parts are launched in Indonesia, a high increase of new demand will be developed. [illegible] makers of household electric appliances are planning [illegible] produce [illegible] sheets by injecting [illegible] sheets. [illegible] produced [illegible] TV and radio [illegible]

[illegible]

At present, there are [illegible] plants and [illegible] plants for [illegible] assembly in Indonesia. The total [illegible] capacity [illegible] vehicles per year [illegible] 1971. These plants are now assembling imported parts. In the future, plants for production of automotive parts are expected in around 1980, so that streamlined assembly factories will be constructed.

For today's automobile industry in Japan, plastics used in a car accounts for 2 to 4% of the total weight of a car. This percentage corresponds to 20 to 30 kg a car. It is sure that plastics utilization will be more and more enhanced in the future.

If plastics use as automotive parts is increased to 4 to 6%, and if plastics parts domestically produced in Indonesia amount to 10 to 20 kg for each vehicle, then about 2,000 to 4,000 tons/yr of plastics demands will be created for the production of 200,000 cars estimated in 1980.

Demands for each major plastics and its ratio in the end use are given in Table IV-7.

Table IV-7 Breakdown of Plastic Demands in the Field of Industrial Uses

(Unit: ton)

	[illegible]	[illegible]	1980	[illegible]
LDPE				
HDPE				
PVC	[illegible]	[illegible]	[illegible]	[illegible]
PP				
PS	[illegible]	[illegible]	[illegible]	[illegible]
Automotive Parts	[illegible]	[illegible]	[illegible]	[illegible]

(e) Construction and civil engineering

Construction consumption in this field accounts for 20 to 25% of the total plastics consumption, and thus the construction field has become the largest market for plastics in developed countries.

Major uses in this field are given in the Table IV-8.

No construction materials listed in Table IV-8 are produced in Indonesia. Corrugated boards, plain flat boards and tiles are imported from Japan. There is no information on planning to produce these materials in Indonesia in the near future. This may be attributable to the facts that:

- Corrugated and plane boards are competing with zinc coated iron boards which has recently progressed at a rapid rate, [illegible] these plastic boards are more costly than the other.

- Since zinc coated iron board have already penetrated through the country, [illegible] plastic corrugated boards are [illegible]

- [illegible]

[illegible]

Table IV-8 Plastics Uses in the Field of Construction and Civil Engineering

		VCM	Poly-styrene	PE	PP
[illegible]	Corrugated and Plane Boards				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
[illegible]	Corrugated and Plane Boards				
	[illegible]				
	[illegible]				
	[illegible]				
[illegible]	[illegible]				
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[illegible]					
[illegible]					
[illegible]	[illegible]				
	[illegible]				
[illegible]	[illegible]				
	[illegible]				
	[illegible]				

Civil engineering

In developed countries, the largest use of plastics in the civil-engineering sector is for pipes, of which water-works pipe occupies about 50% of all. It is estimated that sooner or later the pipes for industrial use will be superior to the ones for water works.

PVC pipe makers have already appeared in Indonesia but only because such pipes are not yet adopted by regional municipal bodies, the demand has been [illegible]

However, excellent properties of PVC pipe such as anti-corrosiveness, low price and easy construction work are gradually becoming recognized by those authorities which are now [illegible]

[illegible]

[illegible]

and is estimated to reach a market size of about 10 000 tons in 1980. It seems that the major part of this demand will be occupied by corrugated boards, plain boards, tiles, rain-water drains and pipes. Accordingly, PVC will [illegible] in this field.

The HDPE pipe is superior to the PVC pipe in [illegible] and pipe length, but [illegible] in flexibility and price [illegible] with metal pipe [illegible]. [illegible] to be used [illegible] agricultural purposes [illegible]. This [illegible] will be dealt with in the next chapter.

Demands for major plastics and [illegible] in the field of construction and civil engineering are given in Table IV-8.

(f) Agriculture, Forestry, and Fisheries

In developed countries, plastics [illegible] used for green houses, tunnel housing, [illegible], and drainage

Table IV-8 Breakdown of Plastics Demands in the Field of Construction and Civil Engineering

(Unit: tons)

	1970	1975	1980	1985
LDPE				
HDPE				
PVC	[illegible]	[illegible]	[illegible]	[illegible]
PP				
Polystyrene				
Domestic Demand	[illegible]	[illegible]	[illegible]	[illegible]

reservoir and protection of harvests whereas plastics pipes are used for irrigation. The [illegible] demand [illegible] is given in the Table IV.10.

Developing countries [illegible] have quite [illegible] opportunities of [illegible] using plastics film for agricultural use due to different agricultural traditions and techniques. Little [illegible] plastics film has [illegible] observed [illegible] except [illegible] which [illegible] protection [illegible] during [illegible] up [illegible]

In other [illegible] countries such as [illegible] plastics [illegible] being used for agriculture [illegible] and [illegible] protection [illegible] demand [illegible] The demand for [illegible] pipes [illegible]

Table IV.10 [illegible]

[illegible]

It is concluded that total plastics demands in this field will be negligibly small even in 1980's, compared with those demands in other fields.

(2) Market Studies by Product

(a) Plastics

Low Density Polyethylene (LDPE)

Demand trend from 1968 onward

The volumes of LDPE imported by Indonesia over the 1968-1972 period were estimated as shown in Table IV-11 using Japanese export statistics and the data from the Indonesian Central Bureau of Statistics. The 1972 figures are the estimates based upon information obtained from trade sources.

Table IV-11 Actual Import of LDPE in Indonesia

	1968	1969	1970	1971	1972
From Japan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
From Other Countries	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table IV-12 Indonesian Domestic LDPE Demands and Growth Rates

	1968	1969	1970	1971	1972
Domestic demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Growth rate (%)		[illegible]	[illegible]	[illegible]	[illegible]

The annual domestic demands for LDPE and demand growth rates are given in Table IV-12.

During the past 4 years, the LDPE demand has showed a high growth rate of 22% per annum. When we consider that the major use of LDPE is in the field of film, for which sharp growth is expected, the Indonesian LDPE market can be said to have entered the rapid growth phase in the life cycle.

Demand forecast

o **Forecast based upon international comparison**

The LDPE demand is thus developing sharply in Indonesia, though the per-capita consumption when recalculated from the total demand seems to stay on a low level as compared with those in other Southeast Asian countries.

Differences in per-capita consumption depend upon income levels, degrees of export, preference of consumers and social environment. These factors are taken into account for our demand forecasting.

Table IV-13 International Comparison of Per-capita Consumption of LDPE

(Unit: Kg/year)

	1968	1969	1970	1971
Indonesia	0.10	0.11	[illegible]	0.10
Thailand	n.a.	[illegible]	[illegible]	[illegible]
Singapore	[illegible]	[illegible]	[illegible]	[illegible]
Korea	n.a.	n.a.	[illegible]	[illegible]
Malaysia	[illegible]	[illegible]	[illegible]	[illegible]
Philippines	[illegible]	[illegible]	[illegible]	[illegible]

The per-capita consumption of LDPE in Indonesia is estimated to range from 0.65 to 0.85 Kg/yr. against a per-capita GNP of $150 in 1980. As the 1980 population is estimated to be 150 million, we obtain the target LDPE demand in the range of 100,000 to 130,000 tons/yr.

o <u>Microscopic Forecast of demands in end uses</u>

As discussed in the section of end use analysis, the LDPE demands in major end uses are estimated to be as given in Table IV-14 for the years 1970, 1972, 1980, and 1985.

The LDPE demand is predominant in the field of film for use in package and furniture materials, and this trend will grow larger. However, the demand as film will compete with PP.
In the footwear field, the demand for LDPE sandals will continue to increase, although it is behind the demand

Table IV-14 Breakdown of Domestic LDPE Demand in End Uses

(Unit: tons)

	1970	1972	1980	1985
Household articles & Miscellaneous goods	[illegible]	[illegible]	[illegible]	[illegible]
Footwear	[illegible]	[illegible]	[illegible]	[illegible]
Film & Sheets	[illegible]	[illegible]	[illegible]	[illegible]
Construction & Civil Engineering				
Total	[illegible]	[illegible]	[illegible]	[illegible]

for PVC sandals. The LDPE demand in other fields will be negligible even in 1980 and 1985.

o <u>Cross-check of macro- and micro-analytical results</u>

Results of macro- and micro-analyses brought about some differences. PP is very likely to strengthen its position in the plastics market in Indonesia because its domestic production will start in 1973. Taking this situation into consideration, we decided to adopt the micro-analytical results. Therefore, the domestic demand for LDPE from 1975 to 1985 in Indonesia is estimated as given in Table IV-15.

The average growth rate per annum of the domestic demand for LDPE will stay on about 17% until 1985. This is because, film occupying a major part of the LDPE demand will enlarge their market at a constant growth rate.

Table IV-15 Indonesian Estimated Domestic Demand for LDPE

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

High Density Polyethylene (HDPE)

Demand trend from 1968 onward

The volumes of HDPE imported to Indonesia over the 1968-1972 period were estimated as shown in Table IV-16 using Japanese export statistics and the data from the Indonesian Central Bureau of Statistics. The 1973 figures are the estimates based upon information [illegible] ed from Japanese trading firm sources.

The annual domestic demand for HDPE and its growth rate are in Table IV-17.

During the past 4 years, the HDPE demand has been marking a very high growth rate of 73% in average.

Table IV-16 Actual Import of HDPE in Indonesia

(Unit: tons)

	1968	1969	1970	1971	1972
from Japan	840	1,820	3,470	6,110	8,500
from Other Countries	200	600	500	300	500
Total	1,040	2,420	3,970	6,410	9,000

Table IV-17 Indonesians' Domestic HDPE Demand and Growth Rates

	1968	1969	1970	1971	1972
Demand (tons/yr)	1,000	2,400	4,000	6,400	9,000
Growth rate (%)		140%	67%	60%	40%

This was possible because HDPE had been introduced after other plastics and HDPE market began to develop from the latter half of 1960s.

Demand Forecast

1) Forecast based upon international comparison

Indonesia's HDPE demand is compared with those of other Southeast Asian countries in terms of per capita consumption in Table IV-18.

Indonesia's per capita consumption of HDPE ranges from 0.10 to 0.[illegible] kg and the domestic demand is [illegible]

[illegible]

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
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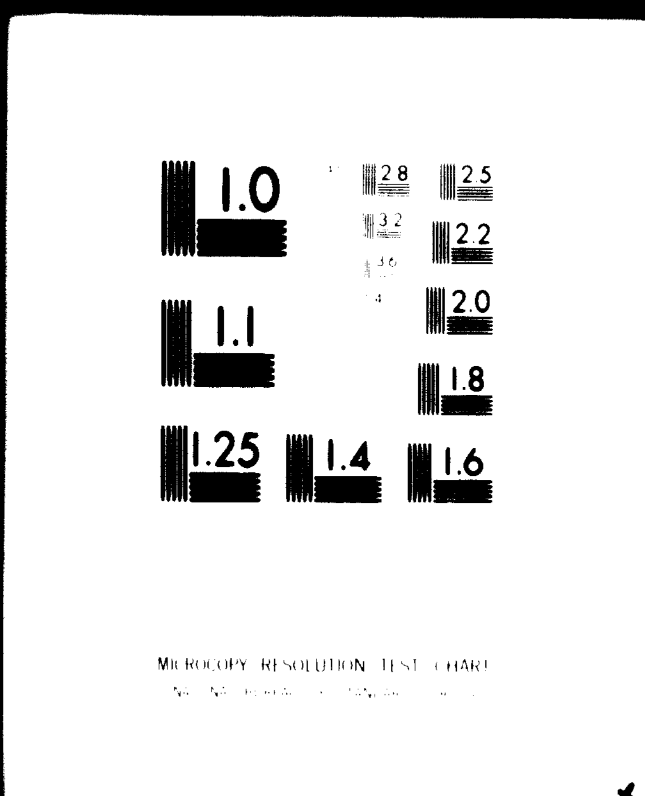
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MICROCOPY RESOLUTION TEST CHART

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PP has the largest demand in the form of film in Indonesia. Most of PP film is used for production of woven bags. As stated already, worldwide trend in heavy-duty package field is toward more substitution of woven plastics bags for the bags made of traditional materials, such as jute and paper. PP will finally win the competition with HDPE which is an other plastics used for heavy-duty package. There will be different type of uses. For example, if the Pusri fertilizer plant, 400,000 tons/yr. of fertilizer is shipped in 50 kg duty bags for which 260 g of PP is used per bag, this plant will use 2,000 tons of PP annually.
If PP is used domestically as bags for transportation of rice, sugar, tapioca, copra, and cement, in addition to fertilizer, then there would be a PP demand of around 30,000 tons in 1980. In addition to the use as film, PP is also used in the household articles and miscellaneous goods. There was a plan to produce PP wash basins once turned out a failure in the middle of 1960s in Indonesia, because of high production cost at that time. However, under the circumstances in which relative cost of PP is not so high, PP will successfully enlarge the demand in this field in Indonesia.

For industrial use, PP can be used as parts of automobiles. The demand for automobiles is estimated to reach about 200,000 cars in 1980. However 10 to 20 kg of plastics may be used for each car, PP will account for a fifth of the total plastics for car use, and thus will have a demand of only 400 to 800 tons per years. Since this range is negligible, as compared with the total PP demand, we excluded the use as automobile parts from the table.

Cross-check of macro- and micro-analytical results

Results of macro-analysis coincided with those of micro-analysis. We therefore calculated future PP demand of Indonesia as given in Table IV-38, preferably using the results of micro-analysis.

PP, now situated in the rapid growth phase, will have a sharply increasing demand for a few years to come, owing to enlarged demand for woven bags. However, growth rates of the domestic demand are gradually trending downward, as seen in 30% for 1972-1975, 27% for 1976-1980, and 18% for 1981-1985. Because the market of PP woven bags will be not so long saturated. In order to get the net domestic demand for PP, 20,000 tons per annum, a planned capacity of Pertamina's PP plant, is subtracted from above figures, as shown in Table IV-39.

Table IV-38 Indonesia's Estimated Domestic Demand for PP (Unit: tons)

'72	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
8,000	17,500	22,500	28,500	36,500	46,500	60,000	71,500	85,000	101,000	120,000	140,000

Table IV-39 Estimated Net Domestic Demand for PP (Unit: tons)

'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
-	2,500	8,500	16,500	26,500	40,000	51,500	65,000	81,000	100,000	120,000

4.3 Synthetic Fibers

General Market Situation

In forecasting the synthetic fiber demand of Indonesia, we could not use a method of microscopic demand forecast based upon summing-up of final demands for various clothing, because statistics of this kind were not available. In this survey, therefore, we made use of the Per-Capita Fiber Consumption Related To Gross Domestic Products 1970, Developing Countries, prepared by FAO and cited on next page, and Indonesia's per-capita GDP of $150 estimated in IV.4 Domestic Market Study, for 1980, to obtain a per-capita fiber consumption of 2.4 kg. Using this value and the estimated 1980 population of 150,000,000, we estimated a total fiber demand at 375,000 tons/yr as shown in Table IV-41.

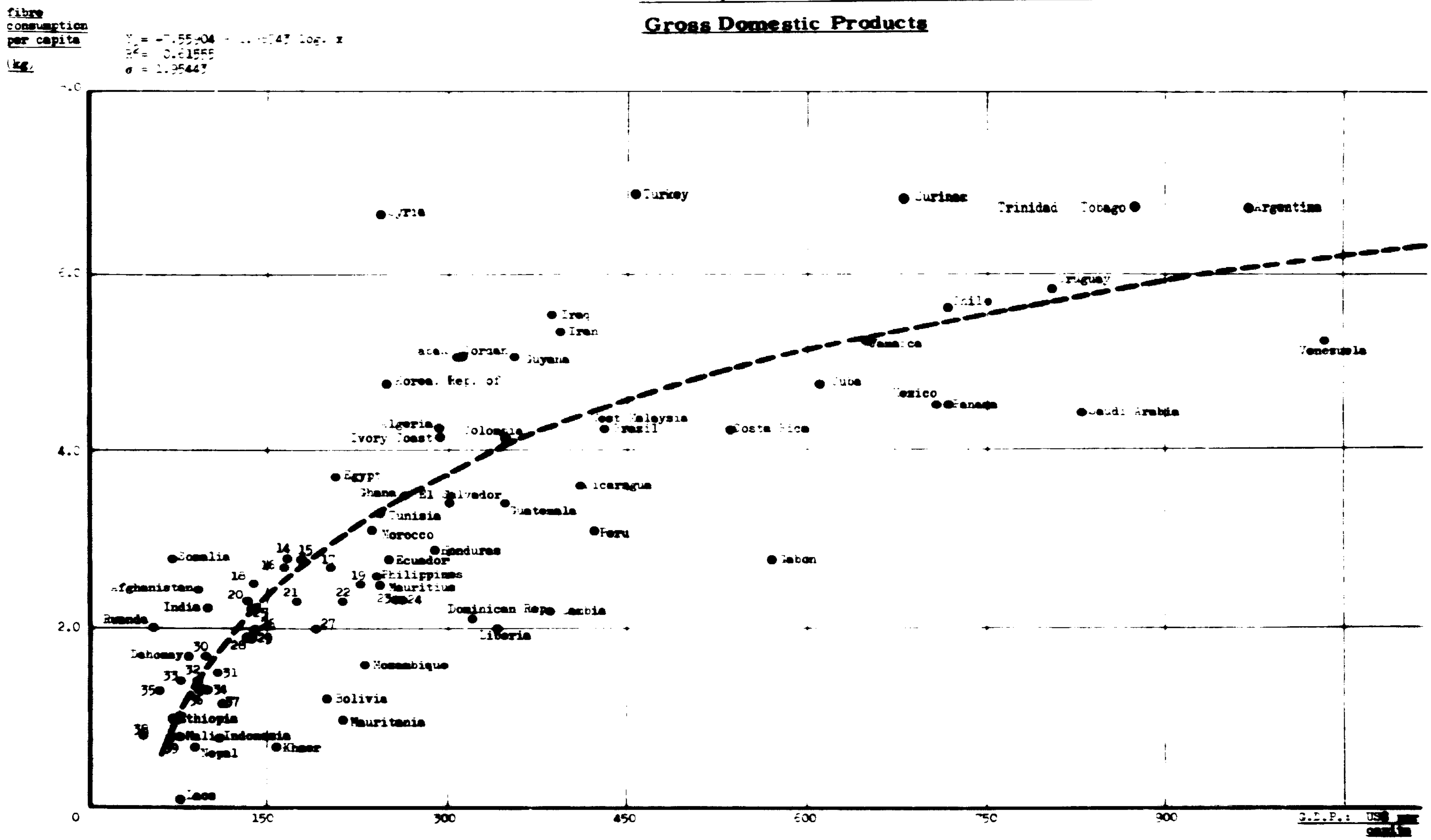
Table IV-40 Demand Pattern of Synthetic Fibers in Indonesia -1970

	Demand	%
Cotton	84,100	83.5%
Rayon	5,400	5.0%
Synthetic fibers	11,600	11.5%
Total	101,100	100.0%

Source: FAO

As of 1970, the fiber demand of Indonesia amounts to 101,100 tons/yr. Thus the demand will increase at 18% per annum from the above value to the 1980 demand, via the following values estimated for the 1970-1980 period: As the next step, we estimated the demands for polyester and nylon fibers, referring to a ratio of synthetic fiber demand to the total fiber demand and proportions of individual fibers in the total synthetic fiber demand, which were available by hearing from Japanese trade firm offices in Indonesia or from the Indonesian textile industry sources.

FIG. IV-1 **Per Capita Fiber Consumption Related to Gross Domestic Products**



Indonesia has now a ratio of the synthetic fiber demand to the total fiber demand of 11.5%, indicating that Indonesia, together with Iran and India, is lagging in this context, as compared with other ECAFE region countries as shown in Table IV-42.

Table IV-41 Estimated Demand for Synthetic Fibers in Indonesia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Synthetic fibers	194,000	221,000	253,000	288,000	329,000	375,000

Source: FAO
JGC, Estimates

Table IV-42 Ratios of Synthetic/Total Fiber Demands in the ECAFE Region Countries - 1970

(Unit: tons)

Australia	26.0%
Hong Kong	17.3%
Iran	15.0%
India	2.0%
Japan	34.0%
Korea	46.0%
Malaysia	21.0%
New-Zealand	25.0%
Philippines	31.0%
Thailand	32.0%

Source: FAO

However, the textile industry, in addition to chemical, paper & pulp, and light industries, is regarded as one of those industries to which higher priority is placed under the first 5-year plan ending in 1973, as can be seen in Table IV-43. Commercialization is particularly brisk in the synthetic fiber industry by the hands of joint-ventures in which Japan and other foreign capital companies take part.

Table IV-43 Scheduled Investments into Major Industrial Sectors

(Unit: Billion RP)

	'69 - '73	%
Fertilizer, cement, & chemicals	114.20	45.7
Textile	41.59	16.6
Pulp, paper	42.05	16.8
Pharmaceuticals	3.70	1.5
Light industries	25.00	9.9
Metal processing & machinery	23.90	9.5
Total	250.44	100.0

For this reason, the ratio of synthetic/total fiber demands is estimated to increase rapidly to 25% in 1975 and 30% in 1980 as shown in Table IV-44.

Table IV-44 Estimated Ratios of Synthetic Fibers/Total Fibers

1975	1976	1977	1978	1979	1980
25%	26%	27%	28%	29%	30%

Using the above ratio of synthetic/total fiber and estimated future fiber demands, we estimated the synthetic fiber demands of Indonesia for the 1975-1980 period, as shown in Table IV-45.

Table IV-45 Estimated Demand for Synthetic Fibers

(Unit: tons)

1975	1976	1977	1978	1979	1980
49,000	57,000	71,000	84,000	97,000	113,000

Source: FAO
JGC Estimates

Nylon & Polyester Fibers

According to the information from Japanese tradefirm offices in Indonesia and the Indonesian Textile industry sources, Nylon and polyester accounted for 30% and 60%, respectively, in 1970, of the synthetic fiber demand. These percentages are estimated to change into 20% - 18% of Nylon and 70% of polyester during 1975-1980. Using the above synthetic fiber demand, we estimated the demands for Nylon and polyester, as shown in Table IV-46.

Table IV-46 Estimated Demand for Nylon and Polyester Fibers in Indonesia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Synthetic fibers demand) (a)	49,000	57,000	71,000	84,000	97,000	113,000
Nylon demand/(a)	20%	20%	20%	19%	18%	18%
Nylon demand	10,000	11,000	14,000	16,000	18,000	20,000
Average annual rate of increase)	15%					
Polyester demand/(a)	70%	70%	70%	70%	70%	70%
Polyester demand	34,000	40,000	49,000	59,000	68,000	80,000
Average annual rate of increase)	18.5%					

It is estimated that the Nylon demand would decrease from the 1975-1980 growth rate of 16% to 10% during 1980-1985, and that the polyester demand would stay on the same level as the 1975-1980 growth rate of 17% during 1980-1985, we estimated their demands for that period, as given in the following Table IV-47.

Table IV-47 **Estimated Demand for Nylon and Polyester Fibers in Indonesia** (Unit: tons)

Nylon	20,000	22,000	25,000	28,000	31,000	34,000
Average annual rate of increase	10%					
Polyester	80,000	94,000	110,000	128,000	150,000	175,000
Average annual rate of increase	17%					

5. Export Market Study by Country

5.1 General

In the previous Chapter IV-3. "Basic Concepts and Results of Products Selection," those petrochemicals capable of being commercialized in Indonesia were selected, based upon the domestic market scale. This chapter deals with a survey on exportabilities of those selected products to the ECAFE region countries from Indonesia over the period 1975-1985.

(1) Premises for the ECAFE Region Market Survey

(a) Survey items

The items to be dealt with in the export market study would include 7 final products and 1 intermediate listed below.

Items for ECAFE Region Market Survey

	Intermediates	Final Products
Synthetic resins		LDPE
		HDPE
	VCM	PVC
		Polystyrene
		PP
Synthetic fibers		Polyester fibers
		Nylon fibers

(b) Countries covered by the survey

The present survey has saught a possibility of exporting petrochemical products from Indonesia to the ECAFE region countries, listed in Table IV-48 (a total of 29 countries for both formal and associate members).

In conducting the survey, these 29 countries were evaluated for the marketability of Indonesian petrochemicals, following the procedure described below, and there were selected those countries to which Indonesian petrochemicals can be exported.

(c) Selection of target countries based on marketability of petrochemicals

Marketability of Indonesian petrochemicals, by country, is given in Table IV-49 for the judgement of a country, three factors of population, per-capita GNP, and past achievements in imports of those petrochemicals under the survey were taken. All countries were evaluated by taking these factors integrally into consideration. With respect to the past achievements in plastics imports, some countries lack the import-export statistics. In such cases, achievements in imports from Japan were used, seeing that Japanese petrochemicals now accounts for 70 to 80% of the total plastics imports by the ECAFE region countries. As for synthetic fibers, import volumes of synthetic fibers in each country were used based upon the FAO's "PER-CAPITA FIBRE CONSUMPTION".

The 15 countries listed in Table IV-51 correspond to those with small or medium potential in terms of the above three factors. Such countries as Laos and Mongolia are merely given only one large factor. These countries, together with British Solomon, Burma, and Fiji, are not considered good export markets for the Indonesian petrochemicals, except as spot markets because of their marketability for petrochemicals, and therefore these countries were excluded from 29 countries.

Of the countries listed in Table IV-50, Afghanistan was also excluded from the possible export market for Indonesian petrochemicals, because in spite of its large population, this country is considered as included in the export territories of either India and European countries where the petrochemical industry has already been established, or Iran where a petrochemical complex with production of 300,000 tons/yr. of ethylene is scheduled for start-up in 1976.

Viet-Nam was excluded because this country was not under normal economic conditions at present, with no prospecting for petrochemical demands. Burma was also excluded, giving consideration to the trend of extremely lowered purchasing potential caused by strict import control and inflation tendency.

Table IV-48 List of the Countries Covered by the Survey

South & East Asia Members	West Asia Members	Oceania Members
1. Afghanistan	21. Iran	22. Australia
2. Brunei*		23. British Solomon*
3. Burma		24. Fiji*
4. Sri-Lanka (Ceylon)		25. New-Zealand
5. China		26. New-Guinea*
6. Hong Kong*		27. Papua*
7. India		28. Tonga
8. Japan		29. Western Samoa
9. Khmer Republic		
10. Korea, Republic of		
11. Laos		
12. Malaysia		
13. Mongolia		
14. Nepal		
15. Naul		
16. Pakistan		
17. Philippines		
18. Singapore		
19. Thailand		
20. Viet-Nam		

* Associate member

The following criteria have been set up as scales for judging marketability:

Population

<10,000,000	Small
≥10,000,000	Large

Per-capita GNP

< $100	Small
$100 to $500	Fair
> $500	Large

Imports of petrochemicals

< 500 tons/yr.	Small
500 to 1,000 tons/yr.	Medium
> 1,000 tons/yr.	Large

Table IV-49 Population, Per-Capita GNP, and Imports of Petrochemicals for Each of 29 ECAFE Countries

		Population (x 10^6)		'69 Percapita GNP ($)		Import of Petrochemical Products '70, '71 *Synthetic Resins (tons)		*Synthetic Fiber (tons)	
		'69	'80	'69	'80	'70	'71	'70	'71
1.	Afghanistan	17	20	95	n.a.	30	646	700	0
2.	Australia	12	15	2,487	4,177[2]	15,343	7,575	35,600	n.a.
3.	Iran	28	36	327	395[2]	4,743	10,893	20,000	n.a.
4.	Brunei	0.1	0.1	850	n.a.	0	2	-	-
5.	Burma	27	34.3	74	100[1]	843	327	n.a.	n.a.
6.	British Solomon	0.1	0.2	210	n.a.	0	0	-	-
7.	Sri-Lanka (Ceylon)	12	15.5	160	214[2]	2,131	3,451	3,000	n.a.
8.	China	822	1,001.44	n.a.	n.a.	36,661	53,526	17,400	n.a.
9.	Fiji	0.5	0.7	380	n.a.	34	263	-	
10.	Hong Kong	4	5.0	777	n.a.	88,798	120,332	53,900	n.a.
11.	India	537	701.15	92	118[2]	710	1,131	7,200	n.a.
12.	Japan	102	115.04	1,687	4,309[2]	-	-	-	-
13.	Khmer	7	9	111	100[1]	0	0	-	-
14.	Korea	31	40.7	196	417	31,653	48,012	56,500	n.a.
15.	Laos	3	4	73	n.a.	465	545	-	-
16.	Malaysia	11	14	351	380[1]	16,890	22,560	10,000	n.a.
17.	Mongolia	1	2	n.a.	n.a.	0	0	-	
18.	New-Zealand	3	3.3	1,856	n.a.	14,812	12,482	7,100	n.a.
19.	**New-Guinea	2	3	210	n.a.	7	9		
20.	Nepal	10	13	80	n.a.	23	0	-	-
21.	Naul	n.a.	n.a.	n.a.	n.a.	0	0	-	-
22.	Pakistan	127	159.62	129	155[2]	9,759	11,845	4,200	n.a.
23.	**Papua	2	3	210	n.a.	7	9		-
24.	Philippines	37	52	251	200[2]	36,882	55,763	29,500	n.a.
25.	Singapore	2	351	801	n.a.	22,011	37,654	41,900	n.a.
26.	Thailand	35	47.5	180	403[1]	41,672	60,354	26,600	n.a.
27.	Tonga	0.08	0.1	310	n.a.	0	0	-	-
28.	Viet Nam	18	23.62	346	n.a.	280	66	-	-
29.	Western Samoa	0.1	0.2	130	n.a.	3	0	-	-

Note: *Synthetic Resin, HDPE, LDPE, PVC, Polystyrene, PP
*Synthetic Fibre, Nylon, Polyester
**Includes Papua (New Guinea)
Figure 1) by Industrial Development Survey '72 UN
2) by SRI Report
Source: Population percapita GNP ... U.N. Statistics
Imports of petrochemicals from Japan

IV-50 **Marketability for Indonesian Petrochemicals by Country**

	Country	Population	Per Capita GNP	Import of Petrochemical Products	Synthetic Fibers
1.	Afghanistan	Large	Small	Medium	Medium
2.	Australia	Large	Large	Large	Large
3.	Iran	Large	Fair	Large	Large
4.	Brunei	Small	Large	Small	Small
5.	Burma	Large	Small	Small	Small
6.	British Solomon	Small	Fair	Small	Small
7.	Sri-Lanka (Ceylon)	Large	Fair	Large	Large
8.	China	Large	n.a.	Large	Large
9.	Fiji	Small	Fair	Small	Medium
10.	Hong Kong	Small	Large	Large	Large
11.	India	Large	Small	Large	Large
12.	Japan	Large	Large	-	-
13.	Khmer	Small	Fair	Small	Small
14.	Korea	Large	Fair	Large	Large
15.	Laos	Small	Small	Medium	Small
16.	Malaysia	Large	Fair	Large	Large
17.	Mongolia	Small	n.a.	Small	n.a.
18.	New-Zealand	Small	Large	Large	Large
19.	New-Guinea	Small	Fair	Small	Small
20.	Nepal	Large	Small	Small	Small
21.	Naul	n.a.	n.a.	Small	Small
22.	Pakistan	Large	Fair	Large	Large
23.	Papua	Small	Fair	Small	Small
24.	Philippines	Large	Fair	Large	Large
25.	Singapore	Small		Large	Large
26.	Thailand	Large	Fair	Large	Large
27.	Tonga	Small	Fair	Small	Small
28.	Viet-Nam	Large	Fair	Small	Large
29.	Western Samoa	Small	Fair	Small	Small

(d) Selection of export markets for Indonesian Petrochemicals based upon existing petrochemical industries and future petrochemical schemes

It is a common practice in developing countries that once domestic production of such basic products as petrochemicals is planned, an import-ban or high-tariffs system is always taken against the counterparts in other countries with a view to protection and development of their own industries.

Table IV-51 Countries Excluded from Indonesian Market Judging from Marketability of Plastics Resins and Synthetic Fibers

	Country	Population	Per Capita GNP	Actual Import of Petrochemicals
1.	Afghanistan	Large	Small	Medium
2.	Brunei	Small	Large	Small
3.	British Solomon	Small	Fair	Small
4.	Burma	Large	Small	Small
5.	Fiji	Small	Fair	Small
6.	Khmer	Small	Fair	Small
7.	Laos	Small	Small	Medium
8.	Mongolia	Small	Small	Small
9.	New-Guinea	Small	Fair	Small
10.	Nepal	Small	Small	Small
11.	Naul	n. a.	n. a.	Small
12.	Papua	Small	Fair	Small
13.	Tonga	Small	Fair	Small
14.	Viet-Nam	Large	Fair	Small
15.	Western Samoa	Small	Fair	Small

Of the 29 target countries, Japan, Korea, India, Australia, and China have already established their own petrochemical industry. Examples of those countries with strong feasibility of launching petrochemical production schemes in the near future include Thailand and Iran.

Apart from Japan where supply has largely exceeded demand for petrochemicals, neither of the remaining 6 countries has developed any supply force to suffice its own domestic petrochemical demand. Furthermore, these countries will slowly go on with domestic production of petrochemicals in the future, and will result in nothing but spot markets for Indonesian petrochemicals.

A country like India takes an import-ban measure for those counterparts of domestically produced petrochemicals. In Australia, high tariffs duties are levied to restrict imports. An attempt to overcome these countermeasures will result in deficit exporting on the part of exporting countries.

Except in the case where unusual preferencial relationship can be established with these countries, those petrochemicals domestically produced in these countries were excluded from the export markets for Indonesian products.

In Japan, today, the petrochemical industry has found difficulty in plant location because of a fear of environ mental impacts, and construction of new complexes and/or scale-up of existing complexes has become more and more difficult without sufficient measures for environmental protection. It is very likely that Japan will more positively look for overseas locations of plant sites under the joint venture system established between Japanese petrochemical firms and those countries where plants are located, and thereby will become an importing country of those products which are produced in overseas plants. However, it is estimated that Japan will still keep its position as a petrochemical-exporting country until 1980, and that from 1980 on those products from overseas Japanese plants will first exported to overseas markets already established by Japan, so that it will be from 1985 on if ever Japan to become a petrochemical-importing country. Following this forecast, Japan was excluded from exporting markets for Indonesian petrochemicals.

Next, let us take up the following four countries where commercialization of petrochemical products is now being studied.

Of these, the Philippines and Singapore will not have their own petrochemical industries of a complex type formed before 1980, judging from the progress in planning seen until now. In the case of the Philippines, no foreign petrochemical firm has so far done business in this country under the circumstances of extremely deficient foreign exchange reserves and the existence of an

	Planned naphtha cracker capacities	Announced date of commercialization
1. Philippines	160,000 tons/yr.	1980s
2. Singapore	Not decided	1980s
3. Thailand	100,000 - 180,000 tons/yr.	1978-1979
4. Iran	300,000 tons/yr.	1976-1977.

investment restriction law which stipulates 40% or less foreign investment in the interests of a Filipino company. Although the Philippine Government has announced petrochemical industrialization by means of the joint venture system with foreign capital companies, it is unlikely that complex-type industrialization will be materialized by 1980.

Similarly as in the Philippines, materialization of the petrochemical industry will not be achieved in Singapore until 1980 because small domestic market of Singapore inevitably lead to higher dependence on exports of petrochemicals.

With regard to a petrochemical project in Thailand, Japanese business groups have committed themselves in plan materialization for the Thai Government, and thereby, the petrochemical industry will be launched in this country sooner or later. However, the project is now encountered by some difficulties. Firstly, negotiations on ethylene price are not moving toward solution between the ethylene supply side (Shell-Thai Petrochemical Co.) and the down-stream side (Japanese groups). Secondly, demands for Thai petrochemicals have sharply dropped from those demands estimated as of the time of planning. It seems, therefore, that the plan materialization will delay for 2 or 3 years from initially scheduled date; it will be possibly in between 1978 and 1979. As described in the country study in details, the Thai petrochemical project includes all items covered by this survey. In our estimation, therefore, Thailand will not be a possible export market for Indonesian petrochemicals from 1979 on.

The Iranian petrochemical project will be described later in details. At present, there is no trouble concerning percentage of capital share in the joint venture, quantities and prices of products, ethylene price, etc. It was thus assumed that the Iranian petrochemical project would be materialized in 1976, as initially estimated. Hence, LDPE, HDPE, VCM, PVC, caprolactam, and Nylon 6 would be excluded from Indonesian petrochemicals-exporting markets.

Pakistan was also excluded for the above 6 items after 1976, the date of the Iranian petrochemical project materialization, taking its geographical conditions and economic corporation between Pakistan, Turkey, and Iran into consideration.

(e) Export markets for Indonesian petrochemicals

When those factors adversely affecting the export of petrochemicals from Indonesia are considered as described in 5.1 (1) (c) and (d), the marketability of each Indonesian product in each country can be summarized as given in Table IV-52.

Table IV-52 Export Possibility of Indonesian Petrochemicals

	LDPE	HDPE	VCM	PVC	Styrene	Poly-stylene	PP	Nylon fibers	Polyester fibers
Afghanistan	x	x	x	x	x	x	x	x	x
Australia	x	x	x	x	x	x	x	x	x
Iran	x	x	x	x	x	x	x	x	x
Brunei	x	x	x	x	x	x	x	x	x
Burma	x	x	x	x	x	x	x	x	x
B. Solomon	x	x	x	x	x	x	x	x	x
Sri Lanka	o	o	x	o	x	o	o	o	o
China	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.
Fiji	x	x	x	x	x	x	x	x	x
Hong Kong	o	o	x	o	x	o	o	o	o
India	x	x	x	x	x	x	x	x	x
Japan	x	x	x	x	x	x	x	x	x
Khmer	x	x	x	x	x	x	x	x	x
Korea	x	x	x	x	x	x	x	x	x
Laos	x	x	x	x	x	x	x	x	x
Malaysia	o	o	x	o	x	o	o	o	o
Mongolia	x	x	x	x	x	x	x	x	x
New-Zealand	o	o	x	o	x	o	o	o	o
New-Guinea	x	x	x	x	x	x	x	x	x
Nepal	x	x	x	x	x	x	x	x	x
Naul	x	x	x	x	x	x	x	x	x
Pakistan	x	x	x	x	x	x	x	x	x
Papua	x	x	x	x	x	x	x	x	x
Philippines	o	o	o	x	x	o	o	o	o
Singapore	o	o	x	o	x	x	o	o	o
Thailand	*	*	*	*	x	*	*	*	*
Tonga	x	x	x	x	x	x	x	x	x
Viet-Nam	x	x	x	x	x	x	x	x	x
Western Samoa	x	x	x	x	x	x	x	x	x

x -- Exports from Indonesia are impossible.

o -- Exports from Indonesia are possible.

* -- Exports will become impossible later.

5.2 AUSTRALIA

(1) General Market Situation

The Australian economy continued to maintain substantial real growth rate ranging from 5 to 6% per annum for a longer period after the war. The increase rate of price was as stable as 2 to 3% per annum, and unemployment rate of around 1% was realized.

However, since investments on resources development came to a pause, plant and equipment investment in the private sector become inactive, and personal consumption expenditure has stopped growing.

Such circumstances made the growth rate of economy down to as low a level as 3.1% in 1970/71 and, the rate of price in consumer goods showed a sharp rise from 2.9% in 1968/69 to 6.1% in 1971/72, and the unemployment rate again, came up to 2% in July 1972, arousing serious problems.

Australia is already on road to industrialization based upon mineral resources abundantly produced within the country. In 1971/72, the industry occupied more than a fourth of the entire economy in the light of production amount and number of employees. Steel-making, alumina, and sugar industries, among others, have sufficient power to fully compete internationally. However, a lot of industries are in developing stage, where their prime object is to meet the domestic demands.

Industrial products, e.g., from the manufacturing industry, occupy only as low a percentage as 20% in the total export. In respect to the petrochemical industry, given in Table IV-53 and IV-54, Altana Petrochemical and Shell Chemical

Table IV-53 Petrochemical Complex in Australia

(1) Name of the Company — Altna Petrochemical

(2) Start of operation — n.a.

(3) Site location — Altona Vic.

(4) Total investment cost — n.a.

(5) Outline of the Petrochemical Complex

	Capacity (tons/yr.)	Remarks
Ethylene	150,000	Altona Petrochemical Co., Ltd.
Butadiene	24,000	
Propylene	40,000	
Synthetic Rubber	35,000	Australian Synthetic Rubber Co., Ltd.
Polybutadiene Rubber	10,000	
Expandable Polystyrene	n.a.	BASF Australia.
Styrene	n.a.	Dow Chemical (Australia) Ltd.
Polystyrene	n.a.	
Epoxy Resins	n.a.	
EDC	n.a.	
Styrene/Butadiene Latex	n.a.	
Polyols	n.a.	
PG		
PVC Resins and Compound	n.a.	BF Goodrich Chemical Ltd.
PVC Latex	n.a.	
Polyethylene (HDPE)	18,000	Hoechst Australia Ltd.
Polyvinyl Acetate	3,000	
Polyethylene (LDPE)	22,000	UCC
(HDPE)	30,000	
Polystyrene	n.a.	Monsanto Australia Ltd.
Formaldehyde	n.a.	
Synthetic Phenol	n.a.	

Table IV-54 Petrochemical Complex in Australia

(1) Name of the Company — Shell Chemical (Australia) Pty Ltd.

(2) Operation Start Up — n. a.

(3) Site Location — Clyde N. S. W.

(4) Total Investment Cost — n. a.

(5) Outline of the Petrochemical Complex

	Capacity (tons/yr.)	Remarks
Ethylene	25,000	Shell Chemical (Australia) Pty Ltd.
Propylene	n. a.	
PP	28,000	
Epoxy Resins	n. a.	
Hydrocarbon Solvents	45,000	
Ketone & Alcohol Solvents	n. a.	
Polyethylene	n. a.	ICI Australia
EO	n. a.	
Ethylene, Butadiene	70,000	
Phathalic Anhydride	20,000	CSR Chemicals
Acetaldehyde	15,000	
Butanol	28,000	
Vinyl Acetate	12,000	
Formaldehyde	10,000	Borden Chemical Co., (Australia) Pty Ltd.
Phenolic Resins	n. a.	
PVC Film	n. a.	
Synthetic Rubbers	20,000	Phillips Imperial Chemical Ltd.
Carbon Black	15,000	
Styrene	n. a.	Australian Petrochemical Ltd.
BTX	70,000	Commercial Solvents Pty Ltd.

Pty Ltd. are now operating their own petrochemical complexes based upon naphtha as raw material with ethylene capacities of 150,000 and 25,000 tons per year, respectively. At present, most of these petrochemicals are consumed within the country, with a part being exported to mainly New-Zealand, Hong Kong, and other British Commonwealth nations. Australian petrochemicals have not so strong international competitiveness, and they are protected by high customs duties in the domestic market. Now that the U.K. has joined EC, the British Commonwealth protection by preferential customs system will be likely to disappear practically. Under these circumstances, future export from Australia will be exposed to more severe situation.

(2) Market Studies by Product

(a) Plastics

By 1970, all the plastic resins contemplated under the Indonesian projects have already been domestically produced.

Petrochemicals, Australia is now applying a high protective customs system to imports, wherein advalorem

Table IV-55 Proportional Usage of Polyethylene Types in Australia

(Unit: %)

	1963	1964	1965	1966	1967
LDPE	74	65	67	70	67
HDPE	26	35	33	30	33
	100	100	100	100	100

duties are combined with support value duties. As a result, more than 80% of the domestic market is occupied by domestic products.

LDPE

Demands

No separate statistics on the demands for LDPE and HDPE have been released in Australia, but the breakdown figures for both plastic resins for the period 1963 - 1967 are given in Table IV-55. According to the table, LDPE accounted for about 70% of the total polyethylene demand. This percentage is unlikely to change largely in the future. The polyethylene demand in Australia shown in Table IV-56 increased from 40, 000 tons in 1966 to 72, 000 tons in 1969 at a growth rate of about 22% per annum. Future demand is expected to grow at 15% per annum, and will reach 170, 000 tons in 1975 and 340, 000 tons in 1980. LDPE finds its largest use in film, which accounts for about 50% of the annual demand.

Table IV-56 Actual and Estimated Demand for LDPE in Australia (Unit: tons)

	1966	1967	1968	1969	1975	1976	1977	1978	1979	1980
(a) Polyethylene demand	40, 000	56, 000	60, 000	72, 000	170, 000					340, 000
Average annual rate of increase	22%				15%					
(b) LDPE demand (a) x 0.7	28, 000	37, 500	42, 000	50, 000	119, 000	137, 000	157, 000	181, 000	208, 000	238, 000
Average annual rate of increase	22%				15%					

Source: JGC Estimates
Commonwealth Statistician

Production/supply

ICI ANZ and UCC Australia, Ltd. are now producing LDPE. ICI ANZ's LDPE plant started with a capacity of 3,000 tons per year in 1957, once expanded in the past, and now the second expansion plan is to end within 1972, although its final capacity is not made public. UCC Australia is now operating a 22,000 tons per year LDPE plant. In addition to the LDPE domestically produced by the above two companies, LDPE is also being imported as shown in Table IV-57.

As shown in the below table, 80% of LDPE imports is occupied by import from Japan. This LDPE is re-exported to Japan in the shape of meat wrapping sheet. In such a case, LDPE is made free from import duties. The LDPE imports from other countries are on the short-term basis, to meet the shortage in domestic production.

Table IV-57 Import of LDPE into Australia by Country of Origin (Unit: tons)

Country of Origin	1968	1969
Japan	1,308	3,274
South Africa	-	500
U.K.	130	112
U.S.A.	132	239
Others	15	32
Total	1,585	4,157

Source: JGC Estimates
Commonwealth Statistician

HDPE

Demands

HDPE has its major uses in consumer goods and packaging. In addition, it has a large demand in agricultural pipings. The HDPE demand stood at 22,000 tons in 1969. Future demand will grow at 15% per annum until 1980. These are shown in Table IV-58.

Production/supply

Hoechst Chemical (Australia) Pty., Ltd., which is the sole HDPE producer, has started operation of a 18,000 tons per year HDPE plant in 1966. At present, the company is stuying the possibility of scale-up of this HDPE plant. Details of the plan is not released.

Like LDPE, HDPE is also partly imported, as shown in Table IV-59. This import has been downward since 1968, as the support value duties were applied to HDPE, and thereby, as the local HDPE plant became in successful operation. Likewise in LDPE, future export of HDPE to

Table IV-58 Actual and Estimated Demand for HDPE in Australia

(Unit: tons)

	1966	1967	1968	1969	1975	1976	1977	1978	1979	1980
(a) Polyethylen demand	40,000	56,000	60,000	72,000	170,000					340,000
(b) HDPE demand - (a) x 0.3	12,000		18,000	22,000	51,000	59,000	67,500	78,000	90,000	102,000
Average annual rate of increase	22% (1966–1969)				15% (1969–1980)					

Source: JGC Estimates
Commonwealth Statistician

Australia is only expected for short-term trade to meet the deficiency in the domestic production.

PVC

Demands

As shown in Table IV-60, the PVC demand rose from about 18,000 tons in 1963 to about 49,000 tons in 1970. The 1967 demand can be divided into 11,000 tons (27%) of plasticized PVC and 30,000 tons (73%) of unplasticized PVC. The future end-use demand is estimated to

Table IV-59 Imports of HDPE into Australia by Country of Origin (Unit: tons)

	1967	1968	1969
Canada	-	-	167
W. Germany	3,312	404	-
India	-	154	-
Japan	6,173	3,040	3,112
U.K.	174	48	-
U.S.A.	405	132	891
Others	1	23	128
Total	10,265	4,281	4,298

Source: Commonwealth Statistician

Table IV-60 Actual and Estimated Demand of PVC in Australia (Unit: tons)

	1963	1966	1967	1970	[illegible]	[illegible]	1977	1978	1979	1980
(a) Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average annual rate of increase	[illegible]		[illegible]		[illegible]			[illegible]		

Source: [illegible] Estimates

grow at 15% per annum by 1980, and at 10% per annum by 1985. As a result, it will reach 78,000 tons in 1975 and 126,000 tons in 1980.

Production/supply

B. F. Goodrich Chemical, Ltd. and ICI ANZ are now producing PVC, but they do not release their production capacities. However, their production is estimated to amount to about 40,000 tons per year. The two companies occupy about 85% of the domestic market, and about 7,000 tons has been imported in 1970. The proportion of import is showing downward trend, because of the increase in domestic production of PVC. To meet the future demand increase, both companies are now planning to expand their PVC plants.

Under these circumstances, Australia will be no better than a spot market to fill the demand-supply gap of domestically produced PVC with imported one.

Polystyrene

Demands

Polystyrene is mainly used in kitchen utensils, refrigerator

Table IV-61 Actual and Estimated Demand for Polystyrene in Australia (Unit: tons)

	1965	1966	1967	1969	1975	1976	1977	1978	1979	1980
Demand	10,446	11,972	12,679	15,000	27,000	30,000	33,000	36,000	40,000	43,000
Average annual rate of increase	'65	9%					10%			

Source: JGC Estimates, Commonwealth Statistician liners, air conditioners, and car interior. The demand, shown in Table IV-61, which was 9,060 tons in 1963, rose to 15,000 tons in 1969. During this period, the demand growth marked a rate of about 9% per annum. Around same growth rate of 10% is expected in the future until 1980 and the demand is estimated to mark 27,000 and 43,000 tons in 1975 and 1980, respectively.

Production/supply

Polystyrene is now being produced in Australia by the following three companies.

BASF Australia, Ltd.
Dow Chemical (Australia), Ltd.
Monsanto Australia, Ltd.

Table IV-62 Import of Polystyrene into Australia by Country of Origin

(Unit: tons)

	1965	1966	1967	1968	1969
Canada	78	66	101	431	947
France	-	-	-	25	-
W. Germany	1,207	1,206	789	537	330
Italy	-	-	-	132	-
Japan	48	308	216	653	152
United Kingdom	76	111	39	245	-
U.S.A.	416	674	273	1,007	667
Others	6	16	14	2	81
Total	1,831	2,381	1,432	3,032	2,177

Source: Commonwealth Statistician

The above three companies are supplied with ethylene from Altona Petrochemical's 150,000 tons per year ethylene unit. All of these companies do not release capacities of their polystyrene plants. It is estimated, however, that polystyrene is domestically produced at 12,000 to 13,000 tons per year, deducing from the fact that these were about 2,000 tons of import is included in 15,000 tons of total demand. It is obvious that the above three companies will scale up their plant capacities, to meet growing domestic demand. Therefore, polystyrene export to Australia will be no better than spot export to fill the gap of domestic production and demand, as shown in Table IV-62. Like LDPE and HDPE, the support value duties are applied to polystyrene. There is little possibility of polystyrene export to Australia too.

Polypropylene

Demands

Australian statistics on polypropylene demands are not released. According to the information obtained from the Japanese trade record, shown in Table IV-63, the

Table IV-63 Actual and Estimated Demand for PP in Australia

(Unit: tons)

	1971	1975	1976	1977	1978	1979	1980
Demand	28,000	35,000	37,000	40,000	43,000	46,000	49,000
Average annual rate of increase	7%						

Source: JGC Estimates, Japanese Trading Company polypropylene demand will reach 35,000 and 49,000 tons, respectively, in 1975 and 1980.

Production/supply

Shell Chemical (Australia) Pty., Ltd. is now producing polypropylene in Australia with a plant capacity of 28,000 ton per year. In addition, the above-mentioned Hoechst Chemical (Australia), Ltd. is planning construction of a polypropylene plant. Although the company does not release the plant capacity, it is reported that the domestic market will be occupied by the two companies, and that surplus will be exported, and its import to Australia cannot be expected for.

(b) Synthetic fibers

As of 1970, about 60,000 tons of synthetic fibers was consumed in Australia. The per-capita consumption stood in 1970 at 4.7 kg, which has been growing at a rate of nearly 20% over the previous year since 1968, as can be seen in Table IV-64.

Table IV-64 Consumption Per-capita of Synthetic Fibers

	Per-capita consumption	Increasing Rate against Previous Year
1967	2.8 (kg)	-
1968	3.3	18.0
1969	4.0	21.0
1970	4.7	17.5
1975	9.5	15.0
1980	14.0	8.0

Source: JGC Estimates, FAO

The synthetic fiber demand is estimated as given in Table IV-65, to grow at 15% per annum until 1975 and at 8% during 1975 - 1980, so as to reach a per-capita consumption of 9.5 kg and a demand of 123,000 tons in 1975, as well as 14.0 kg and 210,000 tons in 1980.

Nylon

Demands

The nylon demand occupied about 30% of the synthetic fiber demand in 1970 in Australia. It is estimated that this rate continues in the future, and the demand is estimated to reach 40,700 tons in 1975 and 65,100 tons in 1980, as shown in Table IV-66.

Production/supply

As of 1970, three companies of Fibremakers Ltd., Fibremakers Penrith Pty., Ltd. and United Carpet Mills Pty.,

Table IV-65 Actual and Estimated Demand for Synthetic Fibers in Australia (Unit: tons)

	1965	1966	1967	1968	1969	1970	1975	1976	1977	1978	1979	1980
Demand	39,000	34,000	42,700	33,700	49,100	58,000	123,000	145,800	159,800	175,000	191,900	210,000

Source: JGC Estimates, FAO

Table IV-66 Estimated Demand for Nylon in Australia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Demand	40,700	45,200	49,500	54,200	59,500	65,100

Source: JGC Estimates, FAO

Ltd. are producing nylon in Australia. Although their respective production capacities are not disclosed, a total of 22, 100 tons was produced by the three companies in 1970, giving nearly 100% of the domestic-production rate.

Polyester

Demands

The polyester fibers demand occupied about 50% of the synthetic fiber demand in Australia now. This rate is assumed to continues in the future, polyester fibers will be consumed there in amounts of 68, 900 and 118, 900 tons,

Table IV-67 Estimated Demand for Polyester Fibers in Australia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Demand	68, 900	76, 900	85, 800	95, 800	106, 900	118, 900

Source: JGC Estimates, FAO

Table IV-68 Potential Market for Polyester Fibers in Australia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Demand	68, 900	76, 900	85, 800	95, 800	106, 900	118, 900
Domestic production ratio	30%	33%	37%	41%	45%	50%
Demand minus Production	48, 200	51, 500	54, 000	56, 000	58, 800	59, 500

Source: JGC Estimates, FAO

respectively, in 1975 and 1980 as shown in Table IV-67.

Production/supply

At present, Fibremakers Ltd. is producing polyester fiber in Australia.

The 1970 production amounted to only 400 tons, and most of the demand is supplied through import. However, domestic production will gradually get under way. It is estimated that the domestic production rate increases to 30% of the polyester-fibers demand in 1975 and 50% in 1980, and the Australian potential market for polyester fiber can be calculated as given in Table IV-68.

(3) Potential Market for the Indonesian Plastics Resins and Synthetic Fibers in Australia

Using demand forecasts of products and the production plans

Table IV-69 Potential Market for the Indonesian Plastics Resins and Synthetic Fibers in Australia

(Unit: tons)

	1975	1976	1977	1978	1979	1980
LDPE	97,000	115,000	135,000	159,000	186,000	216,000
HDPE	33,000	41,000	49,500	60,000	72,000	84,000
VCM	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PVC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Styrene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Polystyrene	14,000	17,000	20,000	23,000	27,000	30,000
PP	7,000	9,000	12,000	15,000	18,000	21,000
Nylon	18,600	23,100	27,400	32,100	37,400	43,000
Polyester	48,200	51,500	54,000	56,500	58,800	59,500

Source: JGC Estimates

already released, we calculated the potential market scale for each product under study for the 1975 - 1980 period. Results of such calculation are given in Table IV-69.

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Australia

Various petrochemical products are already domestically produced in Australia, in its efforts to attain self-sufficiency

Table IV-70 Tax System and Import Duty in Australia

Tax System

Tax System = CIF price + Import Duty + Support Value*

*Support Value system means that, if CIF value plus duty is lower than an amount, the difference is called SVD (Support Value Duty) and SVD of 90% is paid on such difference.

Import Duty

Product	Import Duty	Import Duty Support
PVC	CIF x 40%	$233
LDPE	CIF x 60%	$233
HDPE	CIF x 60%	$339
Polystyrene	CIF x 60%	$466
PP	CIF x 40%	0
Nylon		
Filament	FOB x 20% + 45¢ /lb.	
Staple	FOB x 10%	
Yarn	FOB x 20%	
Polyester		
Filament	FOB x 20% + 45¢ /lb.	
Staple	0%	
Yarn	FOB x 7.5% to 20%	

thereof. From a viewpoint of protecting domestic industries, Australia levies high customs duties as well as support value duties on the imported counterparts of the domestically produced petrochemicals, as shown in Table IV-70. Under these circumstances, Australia cannot be a constant export market in our judgement, although there is a possibility of spot export to fill the gap between demand and supply of domestically produced petrochemicals.

5.3 CHINA

(1) General Market Situation

China recently revealed that the gross industrial and agricultural product was in increase of about 10% over the previous year in 1971, the first year of the fourth 5-year plan period. The above percentage can be regarded as the real economic growth rate in the case of China, where there is no inflation. Major items of mining and industrial production marked high growth rates, except for 8% in coal production, as given in Table IV-71 and IV-72. It is reported that in the agricultural sector, there were considerably increased yields of cash crops in addition to increased food production.

The 1960s saw an agricultural crisis (1960-61) and internal political up-setting during the Great Cultural Revolution period (1967-68), both resulting in decreased production. On the whole, China was forced to attain a growth rate lower than a developing-country's average rate of 5.2%. In 1970, the Chinese economy barely entered a stable growth period for the first time.

Recognizing that the USSR-type policies giving priority to heavy and chemical industries were pursued under the first 5-year plan (1953-57) and resulted in widened gap between industrial and agricultural production, China decided in 1962 to follow the two basic policies; one is an agriculture-supporting policy based upon the "Agriculture builds up foundation, and manufacturing industry develops" principle.

The other is what is called the "Walking with two legs" policy, under which simultaneous development is aimed at between

Table IV-71 Production of Mining and Manufacturing Industries in China

		1957	1970	1957-1970 Growth rates/ annum	1971	1970-1971 Growth rates/ annum
Coal	(10^3 tons)	130,700	255,000	5.3%	276,000	8%
Crude Oil	(")	1,500	20,000	22.7	25,400	27.2
Natural Gas	(")	n.a.	n.a.	n.a.	n.a.	25
Iron Ore	(") =	19,400	45,000	6.1	56,800	26.1
Pig Iron	(")	5,900	20,000	9.9	24,600	23
Crude Steel	(")	5,300	19,000	10.3	22,400	18
Cement	(")	6,900	13,500	5.3	15,800	16.5
Chemical Fertilizers	(")	n.a.	14,000	n.a.	16,800	20.2
Mining Equipment		n.a.	n.a.	n.a.	n.a.	68.8
Metallurgic Equipment		n.a.	n.a.	n.a.	n.a.	24.7
Machinery Industry		n.a.	n.a.	n.a.	n.a.	18
Machinery Industry of which: Agricultural Machinery		n.a.	n.a.	n.a.	n.a.	21

Source: China Authority, Dr. E. Snow

Table IV-72 Growth Rate Indeces of the Chinese Economy

	First 5-year plans 1953-1957	2nd-3rd 5-year plans 1958-1970	1970-1971
Industrial Production	18.0%	6%	10%
Agricultural Production	4.5	n.a.	10
Total	8.9	3.4	10

Source: China Authority, Dr. E.F. Jones

centrally-controlled large-scale industries and local medium or small-scale industries, between coastal and inland industries, and between orthodox and latest technologies. These moderate growth policies balanced between industrial and agricultural production are considered to have achieved good results in outline at last in 1970, so far as we hear about increased yields of crops continuing for a decade since 1962, and the development of industrialization of rural villages.

The fourth 5-year plan is now in progress under positive conditions, such as improved level of industrial technologies, increased number of research workers and favorable international environments surrounding China, in addition to the afore-mentioned stable growth of agricultural production and increased productivity in rural areas. Although there is no concrete indeces devulged by China, overseas observers all indicate that China will attain a growth rate of nearly 10%, which is higher than an average rate of 8.9% attained in the first 5-year plan period, unless there is no political dispute, both domestically and abroad.

The petrochemical industry has its origin in the middle of 1960s, when petroleum development and increased production got under way, and agricultural production began to show a sign of recovery under smooth effect of the agriculture-industry policy. Actually, this industry started in 1965, when small-scale production of raw materials for organic syntheses, such as HDPE, polystyrene, acrylonitrile, etc., started by means of thermal cracking and refining of refinery off-gas in Shanghai. Prior to this production, China concluded import contracts with West Germany and the U.K. to construct Naphtha sand cracker, LDPE and PP plants in Lanchou, which have completed in as late as 1969, after up-setting caused by the Great Cultural Revolution has subsided. This is the first full-scale petrochemical complex in China.

Reportedly, since 1970s, other petrochemical complexes of their own design are in completion or under construction in Peking and the State of Shangtong. When these are taken together, the present state of the Chinese petrochemical industry is as given in Table IV-73.

The fourth 5-year plan regards the promotion of petrochemical industry as an important objective. To accomplish this objective, China is eager to have active technical exchange

Table IV-73 Situation of Petrochemical Industry in China

(Unit: tons)

Products	Site Locations	Start of Production	Estimated Production Capacities	Process
LDPE	Lanchou (Kansu)	1969	24,000	ICI (the U.K.)
HDPE	Shanghai (Shanghai)	1965	10,000	Original
PE	Chilin (Chilin)	1971	n.a.	
Polystyrene	Lanchou (Kansu)	1969	10,000	
	Shanghai (Shanghai)	1965	10,000	
	Peking (Peking)	1971	10,000	
EG	Chinan (Shan Tung)	1969	n.a.	Original
PP	Lanchou (Kansu)	1969	10,000	Vinee (the U.K.)
AN	Lanchou (Kansu)	1969	10,000	
	Shanghai (Shanghai)	1965	n.a.	Original
	Tsu Po (Shan Tung)	1971	n.a.	Sohio
Epichlorohydrin	Chinan (Shan Tung)	1970	n.a.	Original
SBR	Peking	1970	15,000	

with Japan and European countries, aiming at modernizing rapidly its own industry through introduction of advanced technologies.

Negotiations are already in progress with Japan or European countries on import of know-how and plants for use in complexes producing mainly synthetic fiber raw materials, including 100 000 tons per year ethylene, vinyl acetate and Poval (10 000 tons per year), acetaldehyde, DEA, TE, (20 000 tons per year), LDPE, HDPE) and terephthalate (50 000 tons per year), acrylonitrile (50 000 tons per year), caprolactam which is the raw material for Nylon 66, acrylic ester, butadiene, etc. Plants for these materials are likely to go into operation in 1975, the last year of the Fourth 5-year plan period.

It seems that even a 300 000 ton per year ethylene plant has been mentioned in negotiations. If all these come in reality, the Chinese petrochemical industry will possess an outstanding supply capacity in terms of both quantity and types of products in late 1970s.

(2) Market Outline by Product

(a) Plastics

The new era of the Chinese plastics industry has dawned in 1958, when the production of VCM started by using an international technology of carbide acetylene process. In 1959, China began at the second Chemical factory in Peking to produce 6 000 ton per year PVC resin by means of a polyvinyl chloride plant imported from West Germany, using the VCM obtained by the afore-mentioned process.

Full-scale activities of the plastics industry started in 1960, when the CHILIN organic synthesis complex was completed under the assistance of the Soviet Union and went into operation to produce polystyrene, using such a petrochemical raw material as benzene, in addition to the production of PVC resins through the carbide-acetylene process. As of 1970, the plastics production in China, given in Table IV-74, is estimated to have reached about 244,000 tons/yr. for a total of thermo-setting resins, such as phenol, urea, and polyester, and thermoplastic resins, such as LDPE, PP, and Polystyrene.

Apart from the above-described production, China is importing a part of its plastic needs to fill the demand-supply gap. Japan occupied 80% of such imports of thermo-plastic resins in 1970, as shown in Table IV-75,76.

Table IV-77 reveal that estimated demand for plastics totaled about 320,000 tons/yr. in 1970, which is 30 times

Table IV-74 Production Volume of Plastics in China

(Unit: tons)

	1970
Thermo-setting resins	60,000
PVC	120,000
LDPE	24,000
HDPE	10,000
PP	10,000
Polystyrene	20,000
Total	244,000

Source: Institute of Developing Economies Japan as large as the 1957 demand and about 5 times as large as the 1962 demand. The Table also reveal that the plastics demand in China has marked rapid growth over the past 10-15 years.

Table IV-75 Actual Import of Plastics from Japan (Unit: tons)

	1969	1970
Thermo-setting resins	2,308	302
PVC	16,300	30,800
Polyethylene	16,700	20,100
Polystyrene	2,600	5,400
Polypropylene	150	350
ABS	-	2,195
Total	38,058	59,147

Source: Trade Statistics Japan

Table IV-76 Actual Import of Plastics into China

(Unit: tons)

	1970
Thermo-setting resins	3,000**
PVC	38,500*
Polyethyelene	25,000*
Polystyrene	6,800*
Polypropylene	400*
ABS	2,800*
Total	76,500

*Import from Japan x 1.25

*Source: JGC Estimates **Source: Trade Statistics Japan and Western Europe

LDPE

The LDPE demand, given in Table IV-78, has not shown so much growth in China, where market is not opened to film as the major use. For example, the demand rose only slightly from 32,000 tons in 1969 to 34,000 tons in 1971, giving a growth rate as low as 3% per annum. The total production capacity is estimated to be about 30,000 tons/yr., including 24,000 tons/yr. given by a plant now in operation using the ICI process in Lanchou (Kansu).

HDPE

A total of 23,700 tons of HDPE, both domestically produced and imported, were consumed in 1971, as shown

Table IV-77 Estimated Demand for Plastics in China

(Unit: tons)

	1957	1962	1967	1970
Demand	10,000	65,000	205,000	320,000

Source: JGC Estimates

Table IV-78 Actual Demand for LDPE in China (Unit: tons)

	1969	1970	1971
Import	8,100	12,100	9,900
Production	24,000	24,000	24,000
Demand	32,100	36,100	33,900

Source: Trade Statistics (Japan)
Institute of Developing Economies Japan

in Table IV-79. A 10,000 ton per year HDPE plant is now in operation in Shanghai. Since strong demand is expected for industrial uses, expansion to 20,000 or 300,000 tons per year will be planned in the future.

PVC

It is estimated that 100,000 tons of PVC has been produced in 1970 in China, using the VCM domestically produced by the carbide-acetylene process. Together

Table IV-79 Actual Demand for HDPE in China

(Unit: tons)

	1969	1970	1971
Import	11,500	11,400	13,700
(Import from Japan)	(9,200)	(9,100)	(10,900)
Production	10,000	10,000	10,000
Demand	21,500	21,400	23,700

Source: Trade Statistics Japan
Institute of Developing
Economies, Japan

Table IV-80 Actual Demand for PVC in China

(Unit: tons)

	1967	1970
Import	15,000	38,500
Production	90,000	100,000
Demand	105,000	100,000 - 150,000

Source: Trade Statistics Japan
Institute of Developing
Economies, Japan

with imports, mainly from Japan, of 8,500 tons, the total demand will range from 100,000 to 150,000 tons/yr., the largest figure of all plastics.

China had a PVC production capacity of about 90,000 tons per year in 1967 for all 9 plants, all of which are based upon conventional carbide-acetylene process. As the switching of production process is getting under way from the carbide-acetylene to the EDC process with ethylene as the raw material, scale-up of equipment will be planned.

Polystyrene

A total of 30,740 tons of polystyrene, both imported and domestically produced, were consumed in 1971 in China, according to our estimation. (Table IV-81) The 1967 demand stood at 13,500 tons, and thus from 1967 to 1971, the demand has grown at an average rate of about 23% per annum. As of 1971, the polystyrene mainly of general

Table IV-81 Actual Demand for Polystyrene in China (Unit: tons)

	1967	1968	1969	1970	1971
Import	3,500	4,200	3,300	6,800	740
(Import from Japan)	(2,100)	(2,100)	(2,600)	(5,400)	(590)
Production	10,000	10,000	20,000	20,000	30,000
Demand	13,500	14,200	23,300	26,800	30,740

Source: Trade Statistics Japan
Institute of Developing Economies, Japan

purpose grade is being produced domestically at 30,000 tons per year. In the future, domestic production of high-impact polystyrene for use in industrial purposes, particularly in electric machinery, will be in progress.

Polypropylene

Domestic production of polypropylene started in 1969 at a 10,000 ton-per year plant in Lanchou (Kansu). Imports also started in the same year, although their volumes were less than 1,000 tons per year until 1971, as shown in Table IV-82. In addition to the above plant, another PP plant is under construction in the Peking area.

Table IV-82 Actual Demand for PP in China (Unit: tons)

	1969	1970	1971
Import	170	400	510
(Import from Japan)	(150)	(350)	(400)
Production	10,000	10,000	10,000
Demand	10,170	10,400	10,510

Source: Trade Statistics Japan
Institute of Developing Economies, Japan

Table IV-83 Actual Demand for Synthetic Fibers in China

(Unit: tons)

	1967	1968	1969	1970
Production	40,000	40,000	400,000	40,000
Import	10,486	7,064	8,625	16,075
Demand	50,486	47,064	48,625	56,075

Its capacity is unknown.

(b) Synthetic fibers

Historically, the Chinese synthetic fiber industry started in 1954 with test production of Nylon 6. Then an acrylonitrile plant was test-run in 1957. A year after, construction of a pilot synthetic fiber plant was under way in Shanghai as the first step of full entry into this field. In 1959, this plant introduced a Nylon plant from West Germany and started production of Nylon 6 at 400 ton per year. During almost the same period, a synthetic fiber plant and a synthetic fiber pilot plant went into operation in Peking with a capacity of 380 tons per year of Nylon 6, under the assistance of East Germany.

Until today, vinylon, acrilic fiber, vinyl chloride, and polyethylene fiber are already produced in addition to Nylon 6. Plans for further scale-up and construction of new synthetic fiber plants were announced in 1965, and

Table IV-84 Actual Demand for Nylon in China

(Unit: tons)

	1967	1968	1969	1970
Production	11,000	11,000	11,000	11,000
Import	5,000	6,000	6,000	11,000
Demand	16,000	17,000	17,000	22,000

Average annual rate of increase: 11.5%
Source: Institute of Developing Economies, Japan ; JGC Estimates

when such expanded capacity is taken into account, the total capacity of synthetic fiber production is estimated to be 40,000 tons per year, as of 1970.

In addition to the domestic production, China imported about 16,000 tons of synthetic fibers in 1970, as shown in Table IV-83. As a result, the synthetic fiber demand totaled 56,000 tons in 1970.

Nylon

The 1970 demand for nylon stood at about 22,000 tons as the sum of domestic production and import. Since the 1967 demand was 16,000 tons, the nylon demand has grown at an average rate of 11.5% per annum, as given in Table IV-84.

As part of a petrochemical complex, which is scheduled for start-up in 1974/75, a plan for domestic production of caprolactam is now under study. Thus the trend is toward domestic production of nylon and even its raw material.

Polyester Fibers

As of 1970, this country has domestically produced polyester fibers with production capacities and volumes unknown.

Table IV-85 Actual Import of Polyester Fibers in China 1967-1971

(Unit: tons)

	1967	1968	1969	1970	1971
Import from Japan	4,526	1,096	758	770	6,700

A part of demands for polyester fibers in this country is satisfied by importation from Japan and other countries. Assumed from the amount imported from Japan, the demands are estimated at less than 10,000 tons per year at 1970.
In addition, an indigenous polyester fiber production project is under study included in the aforesaid petrochemical complex, with 25,000 tons per year of feed TPA production capacity. This shows a growing trend toward providing polyester fibers for themselves likewise for nylon.

(3) Potential Market in CHINA and Exportabilities thereto of Indonesian Plastics Resins and Synthetic Fibers

The Chinese economy develops under the planned economy system, in which production and supply is planned in response to the intentionally fixed demand in all fields of industry. For this reason, there is less gap between demand and production, and hence China cannot be a long-term export market. Particularly in connection with the petrochemical industry, a petrochemical complex based upon a 100,000-ton-per year naphtha cracker is scheduled to go into operation in 1974/1975. According to the latest news, China seems planning on construction of another 300,000 tons per year in terms of ethylene petrochemical complex.

It can be predicted that China will eagerly try to attain the self-sufficiency of petrochemicals. In particular, those products of which commercialization is now being studied in Indonesia are either being domestically produced or being studied for future production plan in China, likewise. Therefore, it is unlikely that Indonesia can export its products to China, except in temporary spot exports.

On the other hand, in respect to the exportability of Chinese petrochemicals, the Chinese authorities clarify that they have no intention of export on the principle, because they consider it the foremost objective to meet the domestic demand.

5.4 HONG KONG

(1) General Market Situation

Hong Kong, with its land area of 1,034 km^2 and a population of 4,030,000 (1970), is a typical country which is founded on trade, wherein it imports raw materials and exports products and/or semi-products. As a free port, Hong Kong has never adopted any customs system (except on specific items including tobacco, alcoholic drinks, etc.), nor quotas on imports. Since 1966 the Hong Kong Government has been making efforts for export promotion, fulfillment of competitiveness, and development of an export insurance system, by establishing Hong Kong Trade Development Council, the Hong Kong Productivity Center, and Hong Kong Export Insurance Corporation.

In 1970, the Hong Kong economy marked a recovered growth rate of 23% over the previous year. Successful development of economy is largely attributable to rapid growth of export and a boom in real estate business. Exports were brisk mainly in the field of miscellaneous goods including textile and plastics toy. These latter two items accounted for 36% and 24%, respectively, of the total exports in 1970. The largest part of products or 45.7% of the total is exported to the U.S., followed by the U.K. (11.6%), where preferencial customs of the British Commonwealth are applied to the Hong Kong products, then West Germany (8.0%), and Japan (3.7%).

Meanwhile, textile and plastics raw materials have been supplied through import. Both materials accounted for 17% and 8%, respectively, of the total import in 1970. Of the raw material suppliers, including textile, and plastics, Japan is the biggest, occupying 23% of the total import by Hong Kong in 1970. Followers of Japan are the U.S. (13%), the U.K. (8%), etc.

Since the latter half of 1950's, Hong Kong has been trying to develop export-oriented industries, rather than those alternatives to import. Due to shortage of water and land, such heavy chemical industries as those consuming large amounts of water cannot be established in Hong Kong. Therefore, industrialization is promoted mainly among light industries such as textile, plastics processing, and watch-making. Current tendency is that Hong Kong is aiming at moving from conventional textile-type industrialization toward diversification into a variety of industries including plastics processing.

(2) Market Studies by Product

(a) Plastics

Major four resins of polyethylene, PVC, polystyrene, and polypropylene were consumed in Hong Kong on the whole in an amount of about 180,000 tons in 1970 and 190,000 tons in 1971. Of these resins, polyethylene occupied more than 50% of the total in these two years. Particularly, the LDPE demand destined for production of Hong Kong artificial flowers takes a major part of the plastics demand in Hong Kong.

LDPE

Demands

In 1971, 74,621 tons of LDPE was consumed mainly for production of Hong Kong artificial flowers. Future demand will grow at 10% per annum until 1975 and at 8% during 1975-1980. It will reach 100,700 tons in 1975 and 161,900 tons in 1980, as shown in Table IV-86.

Production, Supply

No LDPE is domestically produced at present in Hong Kong, and total needs are supplied through imports. This trend is expected to continue in the future. The portion of import from Japan of the total LDPE imports was as high as 55% in 1970 and 67% in 1971.

HDPE:

Demands

The HDPE demand, which stood at 6,900 tons in 1969

Table IV-86 Actual and Estimated Demand for LDPE in Hong Kong

Unit: ton

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a) Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]	10%	[illegible]		8%			[illegible]
b) Import from Japan	[illegible]	[illegible]						
	55%	67%						

Source: [illegible]

Table IV-87 Demand Pattern of LDPE in Hong Kong

	67	68	69
Hong Kong Artificial Flower	70%	70%	64%
Others	30%	30%	36%

Table IV-[illegible] Actual Import Price of LDPE in Hong Kong

(Unit: $/ton)

1970	[illegible]	FOB Japan
1971	[illegible]	FOB Japan

was imported [illegible] tons in 1971. During this period, the annual average growth rate has marked [illegible]%. Future demand will grow at about [illegible]% per annum until 1975, and at [illegible]% during 1975-1980, to reach [illegible] tons in 1975 and [illegible] tons in 1980, as given in Table IV-[illegible].

Production, Supply

All the demands are now supplied through import, and there is no future plan for production. Japan occupied about [illegible]% of the total HDPE imports.

Table IV-[illegible] [illegible] Demand for HDPE in Hong Kong [illegible]

[illegible]

Table IV-[illegible] Actual Import Price of HDPE in Hong Kong

(Unit: $/ton)

1970	[illegible]	FOB Japan
1971	[illegible]	FOB Japan

VCM

Demands

There is no present or future plan for PVC production. Hence, there is no possibility of exporting VCM to Hong Kong.

Table IV-91 **Pattern of Import on PVC in Hong Kong**

(Unit: tons)

	'70	'71
PVC Resin	19,914	23,469
PVC Compound	709	938
	20,623	24,407

Table IV-92 **Actual and Estimated Demand for PVC Resin in Hong Kong**

(Unit: tons)

		'70	'71	'75	'76	'77	'78	'79	'80
a)	Demand	19,914	23,469						
b)	Re-Export to Indonesia	382	709						
c)	Total Demand a) - b)	19,532	22,760	29,200	30,700	32,000	33,900	35,600	37,300
	Average Annual Rate of Increase		5% ———	———	———	———	5% ———	———	———
d)	Import from Japan	12,884	16,332						
	a)/d)	65%	70%						

Source: Trade Statistics
: JGC Estimates

PVC

Demands

The PVC demand in Hong Kong has been supplied through import. Of the 1971 total PVC resin import of 24,407 tons, about 95% was imported in the form of PVC resin. This indicates that those makers which import PVC resin and produce compound have already grown up in Hong Kong. Examples of this type are Nylex Plastics, Ltd. and Wo Fuk Plastics Factory.

In 1971, PVC resins were re-exported from Hong Kong in an amount of 1,293 tons, of which 55% was exported to Indonesia. Re-export of PVC compound is negligible.

Table IV-93 Actual and Estimated Demand for PVC Film, Sheet, Plate, Rod, Tube in Hong Kong

(Unit: tons)

		'69	'70	'71	'75	'76	'77	'78	'79	'80
a)	Demand (Import) Plate, Sheet, Film	10,861	11,861	13,446						
	Rod, Tube, etc.	829	1,294	1,312						
b)	Total	11,790	13,155	14,758						
	Resin b) x 0.85	10,000	11,200	12,500	19,700	20,900	22,100	23,500	24,900	26,400
	Average Annual Rate of Increase	—12%—		—12%—		—6%—				
c)	Import from Japan/b)		37.9%	35.9%						

Source: Trade Statistics
: JGC Estimates

A major part of PVC is imported in the form of products such as plates, film, sheets, rods, tubes, etc. Volumes of such imported products were estimated as Table IV-93, taking future possibility of exporting products from Indonesia into consideration.

Production/Supply

At present, the total PVC resin (including PVC film, sheets, plates, rods, tubes) demand is supplied through import, and there is no future plan for PVC production. Japan occupied about 78% of the total import in 1971. Major exporting countries other than Japan is Korea (2%).

Styrene

Hong Kong has no plan for domestic production of polystyrene, and thus there is no possibility of exporting styrene to Hong Kong.

Table IV-94 Actual Import Prices of PVC Resins in Hong Kong

(Unit: $/ton)

1969	206	FOB Japan
1970	220	FOB Japan
1971	212	FOB Japan

	PVC Film		PVC Sheet	PVC Rod & Tube	PVC Plate
	Flexible Type	Rigid Type			
1970	585 FOB Japan	517 FOB Japan	535 FOB	521 FOB Japan	464 FOB Japan
1971	517 FOB Japan	535 FOB Japan	588 FOB Japan	506 FOB Japan	478 FOB Japan

Polystyrene

Demands

Hong Kong's demand for polystyrene amounted to 61,030 tons in 1971, including re-export of 2,676 tons, as given in Table IV-95. This demand level is about 1.5 time as large as the 1968 demand of 41,651 tons. During this period, the annual average rate of growth has been marking 14%. Demand will grow at 7% per annum until 1975 and at 8% during 1975-1980. It will reach 79,900 tons in 1975 and 111,900 tons in 1980.

Table IV-95 Actual and Estimated Demand for Polystyrene in Hong Kong

(Unit: tons)

	'68	'70	'71	'75	'76	'77	'78	'79	'80
a) Demand	41,651	55,921	61,030	79,900	85,500	91,500	97,900	104,700	111,900
Average Annual Rate of Increase	└── 14% ──┘			└─ 7% ─			─ 8% ─		──┘
b) Import from Japan		37,231	36,396						
b)/a)		67%	60%						

Source: Trade Statistics
: JGC Estimates

Table IV-96 Actual Import Prices of Polystyrene in Hong Kong

(Unit: $/ton)

1969	212	FOB Japan
1970	220	FOB Japan
1971	215	FOB Japan

Production/Supply

All demands are supplied through imports both at present and in the future, and there is no domestic production plan. About 60% of the total import has been imported from Japan, followed by the U.S. and Canada.

Polypropylene

Western countries such as the U.K., Italy, and the U.S. had been supplying the Hong Kong market with polypropylene in the past, but in current years have completely disappeared from Hong Kong as they failed to compete against Japan.

Demands

As shown in Table IV-97, the polypropylene consumption

Table IV-97 **Actual and Estimated Demand for PP in Hong Kong**

(Unit: tons)

	'70	'71	'75	'76	'77	'78	'79	'80
a) Demand	5,153	7,908	10,700	11,600	12,500	13,500	14,600	15,800
Average Annual Rate of Increase	40% ('70–'71)	8% ('71–'75)	8% ('75–'80)					
b) Import from Japan/a)	100%	100%						

Source: Trade Statistics
JGC Estimates

Table IV-98 **Actual Import Price of PP in Hong Kong**

(Unit: $/ton)

1969	283	FOB Japan
1970	255	FOB Japan
1971	190	FOB Japan

amounted to 5,153 tons in 1970 and 7,908 tons in 1971. The rate of growth marked a record of about 40% over the previous year, as compared with average 8% in the latter half of 1960's. This is because polypropylene has absorbed PE demand in the field of toy when polypropylene price lowered in 1971. Future demand will grow at 8% per annum until 1980. It will reach 10,700 tons in 1975, and 15,800 tons in 1980 as shown in Table IV-97.

Production/Supply

PP Production will hardly be started in Hong Kong in the future. It is likely that the share of Japan in the total import will drop to some extent because of re-adjustment of production in Japan or protection of price fall by the export, controlling the export volume.

(b) Synthetic Fibers

In Hong Kong, the synthetic fiber demand rose from 2,000 tons in 1965 to about 11,000 tons in 1970, marking an average growth rate of about 40% per annum. Per-capita consumption moved from 0.5 kg in 1965 up to 2.5 kg in 1970, about 5 times as large as in 1965. The demand is estimated to grow at 16.5% per annum until 1975 and at 10% per annum during 1975-1980.

Table IV-98 Actual and Estimated Demand for Synthetic Fibers in Hong Kong

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	2,000	2,800	n.a.	6,300	12,600	10,700	23,400	25,700	28,100	31,100	34,000	37,500
Average Annual Rate of Increase	40%						16.5%	10%				

Source: JKK Estimate FAO

thereby reaching 23,400 tons in 1975 and 37,500 tons in 1980, as shown in Table IV-99.

Nylon

Demands

Nylon fiber occupies about 30% of the total synthetic fiber demand in Hong Kong. We assumed that this rate will continue in the future, the demand for Nylon will stand at 6,300 tons and 10,100 tons in 1975 and 1980, respectively, as shown in Table IV-100.

Production/Supply

The total demand is now supplied through import, and Hong Kong has no intention of producing staple or filaments or further going upstream to such raw materials as caprolactam and TPA.

Table IV-100 Estimated Demand for Nylon in Hong Kong

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Nylon demand	6,300	6,900	7,600	8,400	9,300	10,100

Source: JGC Estimates FAO

Table IV-101 Estimated Demand for Polyester Fibers in Hong Kong

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Polyester fibers	11,500	12,600	13,900	15,200	16,800	18,400

Source: JGC Estimates FAO

Polyester

Demands

In Hong Kong, the polyester fiber demand occupies about 50% of the synthetic fiber demand as given in Table IV-101. This ratio will continue in the future, the polyester demand is estimated to reach 11,500 tons and 18,400 tons in 1975 and 1980, respectively.

Production/Supply

Like nylon, the polyester fiber demand is totally supplied through import, and there is no plan for domestic production in the future.

(3) Potential Market for Plastic Resins and Synthetic Fibers in Hong Kong

As stated above, Hong Kong has no plan for domestic production of all the plastic resins and synthetic fibers. It seems,

Table IV-102 Potential Market for Plastic Resins and Synthetic Fibers in Hong Kong

(Unit: tons)

	1975	1976	1977	1978	1979	1980
LDPE	109,700	118,500	128,000	138,300	149,300	161,300
HDPE	19,400	20,900	22,600	24,400	26,300	28,400
VCM	0	0	0	0	0	0
PVC Resin	29,200	30,700	32,200	33,900	35,600	37,300
Film, Sheet, etc.	19,700	20,900	22,100	23,500	24,900	26,400
PVC Total	48,900	51,600	54,300	57,400	60,500	63,700
Styrene	0	0	0	0	0	0
Polystyrene	79,900	85,500	91,500	97,400	104,700	111,900
Polypropylene	10,700	11,600	12,500	13,500	14,600	15,800
Nylon fiber	6,300	6,900	7,600	8,400	9,300	10,100
Polyester fiber	11,500	12,600	13,900	15,200	16,800	18,400

therefore, that the above estimated demands for those resins and fibers will precisely correspond to their potential market. Table IV-102 shows potential market, by type of resins and fibers, for the period 1975-1980.

(4) Exportabilities of Indonesian Plastic Resins and Synthetic Fibers to Hong Kong

Possible export volumes of Indonesian plastic resins and synthetic fibers are shown in Table IV-103. In calculating possible export volumes of Indonesian plastics resins, it has been assumed that the volumes of export from Japan, the largest occupant of the Hong Kong market, are first subtracted from such potential market as described in section (3) above. Then it has been assumed that the Indonesian products would occupy 20 to 30% of the remaining potential market. However, in the case of PVC products such as film, sheets, plates, etc., were subtracted from the potential market. And likewise the Indonesian PVC products were assumed to occupy 20 to 30% of the remaining PVC market in Hong Kong. As for synthetic fibers, we assumed that Indonesian products would occupy a minimum of 5% and a maximum of 10% of the total demands.

Export Possibility of Indonesian
Table IV-103 Plastics Resins and Synthetic Fibers to Hong Kong

(Unit: tons)

		1975	1976	1977	1978	1979	1980
LDPE	Min.	6,600	7,100	7,700	8,300	9,000	9,700
	Max.	9,900	10,700	11,500	12,400	13,400	14,500
	*	21,900	23,700	25,600	27,600	29,900	32,300
HDPE	Min.	400	400	500	500	500	600
	Max.	600	600	700	700	800	900
	*	3,900	4,200	4,500	4,900	5,300	5,700
VCM	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	0	0	0	0	0	0
PVC Resins	Min.	1,200	1,200	1,300	1,400	1,400	1,500
	Max.	1,800	1,800	1,900	2,000	2,100	2,200
	*	5,800	6,100	6,400	6,800	7,100	7,500
PVC Finished Products	Min.	1,600	1,700	1,800	1,900	2,000	2,100
	Max.	2,400	2,500	2,700	2,800	3,000	3,200
	*	0	0	0	0	0	0
PVC Resins Total	Min.	2,800	2,900	3,100	3,300	3,400	3,600
	Max.	4,200	4,300	4,600	4,800	5,100	5,400
	*	5,800	6,100	6,400	6,800	7,100	7,500
Styrene	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	0	0	0	0	0	0
Polystyrene	Min.	4,800	5,100	5,500	5,900	6,300	6,700
	Max.	7,200	7,700	8,200	8,800	9,400	10,000
	*	16,000	17,100	18,300	19,600	20,900	22,400
Polypropylene	Min.	400	500	500	500	600	600
	Max.	600	700	800	800	900	900
	*	2,100	2,300	2,500	2,700	2,900	3,200
Nylon Fiber	Min.	300	300	400	400	500	500
	Max.	600	700	800	800	900	1,000
Polyester Fiber	Min.	600	600	700	800	800	900
	Max.	1,200	1,300	1,400	1,500	1,700	1,800

* Calculated on the assumption that Indonesian plastics resins would secure 20% of Japanese share.

Table IV-104 Tax System and Import Duty in Hong Kong

Tax System

Tax System = CIF Price + Import Duty

Import Duty

Product	Import Duty
PVC	0%
LDPE	0%
HDPE	0%
Polystyrene	0%
Polypropylene	0%
Nylon	
Filament	0%
Staple	0%
Yarn	0%
Polyester	
Filament	0%
Staple	0%
Yarn	0%

5.5 INDIA

(1) General Market Situation

India has been tackling with 5-year plans since early 1950s, aiming at integral economic development. In 1965, India encountered economic recession, due to failure of crops and crisis in foreign exchange reserves. Execution of the fourth 5-year plan was postponed for three years from 1966 to 1968. During this period, new investments by the Government were reduced, resulting in dull activities of the production goods industry in both of the public and the private sectors. In 1967-1968, agricultural production turned upward, and since then rich harvest has been continuing. The Indian economy is thus on the road to recovery, but as of 1972 the economy still cannot completely get out of the recession.

Particularly with regard to industrial production, the shortage of raw materials for industrial goods and the reluctance

Table IV-105 Rates of Growth Over the Previous Year in Major Economic Indices

	1966 (%)	1967 (%)	1968 (%)	1969 (%)	1970 (%)
Substantial National income	1.5	9.1	2.4	5.1	5.5
Agricultural Production	1.1	22.4	1.0	6.5	5.0
Industrial Production	0.3	0.5	6.7	6.8	4.1
Imports	*6.3	*3.4	*7.3	*17.0	4.0
Exports	*8.9	3.6	13.3	4.1	8.6

Note; * indicates minus

of new investment activities have suppressed the successful progress in industrialization. Nevertheless, India is already the second largest industrialized country in Asia only next to Japan.

The Indian big industries are characterized by expensive integrated systems. [illegible] and systems [illegible] and complete [illegible] products [illegible] in India and [illegible] products [illegible] be made by [illegible] techniques.

However, the industries have suffered high production costs and delivery problems. Operation rates of heavy industries

Table IV-100 Production Capacities of Main Petrochemical Intermediates and Final Products in India 1971

(Unit: tons/year)

	Present Capacity	Capacity Approved
LDPE	[illegible]	[illegible]
HDPE	[illegible]	[illegible]
VCM	[illegible]	[illegible]
PVC	[illegible]	[illegible]
Polystyrene	[illegible]	[illegible]
Polypropylene		[illegible]
DMT		[illegible]
Polyester	[illegible]	[illegible]
Caprolactam		[illegible]
Nylon fibre	[illegible]	[illegible]
Acrylic fibre	[illegible]	[illegible]
DDB	[illegible]	[illegible]
Polybutadiene		[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

1969. According to the forecast of the Indian Petrochemical Institute, the demand will rise to 72,000 tons by 1975 and 115,000 tons/yr. in 1980, as shown in Table IV-107.

Production, supply

LDPE is now being produced by ICI Calcutta and UCC Calcutta. The total production capacity of existing equipment amounts to 25,000 ton per year. It is estimated to reach 68,000 ton per year in 1975 and 118,000 ton per year in 1980 taking both the expansion plan and the new construction plan in Koyali into consideration. India has already enforced an import ban measure, just when domestic production started.

Table IV-107 Actual and Estimated Demand for LDPE in India

Unit: ton

	[illegible]	1975	1976	1977	1978	1979	1980
Demand	[illegible]	72,000	79,000	87,000	95,000	105,000	115,000
Average Annual Rate of Increase	[illegible] 11% [illegible]			10%			[illegible]

Source: Indian Petrochemical Institute

Table IV-108 Actual and Estimated Demand for [illegible] in India

	[illegible]	1975	1976	1977	1978	1979	1980
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]			10%			[illegible]

Source: Indian Petrochemical Institute

HDPE

Demands

The HDPE demand amounted to 5,000 tons in 1969. According to the forecast of the Indian Petrochemical Institute, it is estimated to reach 22,000 tons in 1975 and 35,000 tons in 1980, as shown in Table IV-108.

Production/supply

HDPE is now produced by Polyolefines Industries, Bombay, Ltd. According to its expansion plan, production will reach 30,000 tons/yr. in 1975. An import ban is also placed on HDPE at present.

PVC

Demands

The demand for PVC resins amounted to about 20,000 tons in 1969, mainly in the form of the suspension type. According to the demand estimates by the Indian Petrochemical Institute, the PVC demand will reach a total of 61,000 tons in 197[illegible] as shown in Table IV-10[illegible], which [illegible] 60,000 tons of the suspension type and 1,000 tons of the [illegible]

Table IV-10[illegible] Actual and Estimated Demand for PVC in India

(Unit: tons)

	1969	1975	1976	1977	1978	1979	1980
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]			[illegible]			[illegible]

Source: Indian Petrochemical Institute

emulsion type. The demand will further rise to 75,000 tons in 1980.

Production/supply

PVC is now being produced at a capacity of 47,500 ton per year by Rajatam Vinyl, Ltd., Ohmedabad Mfg. and Calico Printing Co., Ltd., Bombay Chemical and Plastics India, Ltd., Madras, Jawahu Nagar, Haraumi, Madras, National Organic Chemical Industries, Bombay, Shriram Vinyl and Chemical Industries, Ltd., etc. The authorized capacity of each company reaches 92,000 ton per year in total. An import ban has also been placed on PVC.

Table IV-110 Actual and Estimated Demand for Polystyrene in India

([illegible])

	1974	1975	1976	1977	1978	1979	1980
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]%			[illegible]%			

Source: Indian Petrochemical Institute

Table IV-111 Actual and Estimated Demand for Polypropylene in India

([illegible])

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: Indian Petrochemical Institute

Polystyrene

Demand

The polystyrene demand is estimated to reach from 36,000 tons/yr. to 63,000 tons/yr. during the fourth 5-year plan period, (from 1973-1977), and 79,000 tons/yr. in 1980, as shown in Table IV-110.

Production supply

Meanwhile, the capacity of polystyrene production will reach 28,500 tons/yr. concurrently with the completion of the Koyali project. It will rise to 42,000 tons/yr. in 1975, the year of expansion at Koyali, and to 44,500 tons/yr. in 1980.

Polypropylene

Demand

The polypropylene demand is estimated to rise from 1,[illegible] tons/yr. in 19[illegible] to [illegible] tons/yr. in 197[illegible] and 1[illegible] tons/yr. in 1980, as shown in Table IV-111.

Production supply

[illegible]

(b) [illegible]

[illegible]

to reach 165,000 tons/yr. or 2.5 times as large as 65,000 tons during the period of the fourth 5-year plan starting in 1973. The largest demand growth is expected for polyester fiber, which will mark an average growth rate of 24% per annum. Over the same plan period, nylon will mark a growth rate of 17%, polypropylene fiber 15%, and acrylic fiber 11%.

Nylon

Demands

The nylon demand is estimated to rise from 42,400 tons/yr. in 1975 to 91,700 tons/yr. in 1980 as shown in Table IV-112.

Production, [illegible]

In 19[illegible] in India nylon fiber production plants with a total capacity of [illegible] tons per year were in operation, of which [illegible] tons/yr. was produced by [illegible] Ltd., 700 tons/yr. by [illegible] Ltd., and [illegible] tons/yr. by [illegible] Ltd. The 19[illegible] production amounted to [illegible] tons with an operating rate of about [illegible]. In order to meet the growing demand, the [illegible]

Table IV-112 [illegible] Demand for Nylon in India

(Unit: [illegible])

	1975	1976	1977	1978	1979	1980
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]					

capacity is set to 10,200 tons/yr. for the Fourth 5-year plan period.

Meanwhile, the raw material caprolactam is domestically produced at 22,000 tons/yr. from 197[illegible] at Baroda by Gujarat State Fertilizer Co., Ltd., using as the raw material benzene supplied from an Indian [illegible] refinery.

Polyester

Demands

Polyester fiber is a synthetic fiber which has been blessed with the largest demand growth. It is estimated that the demand will increase from [illegible] tons/yr. to 70,[illegible] tons/yr. during the Fourth 5-year plan period, as shown in Table IV-[illegible].

Production capacity

Chemicals and Fibres of India Ltd. is now operating a [illegible] ton per year polyester fiber plant in India, producing [illegible] tons in [illegible]. The authorized capacity of polyester fiber is set to [illegible] tons/yr. for the Fourth 5-year plan period. The raw material [illegible]

Table IV-[illegible] Estimated Demand for Polyester Fibers in India

(Unit: tons/yr)

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]		[illegible]%			[illegible]

Source: [illegible]

Domestically produced at [illegible] [illegible] 1973 by Indian Petrochemical Corp.

(9) **Potential Market for Plastics Resins and Synthetic Fibres in India**

Table IV.116 gives potential market for [illegible] plastics resins and synthetic fibres in India [illegible] the period 1975 – 1980.

Table IV.116 **Potential Market for Plastics Resins and Synthetic Fibres in India**

[illegible]

	1975	1976	1977	1978	1979	1980
LDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polystyrene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polypropylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nylon Fibres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polyester Fibres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: [illegible] of India

[illegible] of [illegible] Plastics Resins and Synthetic Fibres in India

[illegible]

very high customs duties almost resembling import bans have been levied, as can be seen in Table IV - 115 of tax system and import duties. These situations indicate that India cannot be a stable export market for Indonesian products on the long-term basis although it can be a spot market on the short-term basis.

Table IV - 115 Tax System and Import Duty in India

Tax System

Tax System = CIF Price + Import Duty

Import Duty

Product	Import Duty
PVC	170%
LDPE	170%
HDPE	170%
Polystyrene	170%
Polypropylene	[illegible]
Nylon	
Filament	[illegible]
Staple	[illegible]
Yarn	[illegible]
Polyester	
Filament	[illegible]
Staple	[illegible]
Yarn	[illegible]

5.6 **IRAN**

(1) **General Market Situation**

In 1972, Iran entered upon the final year of the fourth 5-year plan. In 1970 and 1971, the Iranian economy marked a substantial GNP growth rate of 14% over the previous year. Such rapid growth is mainly supported by successful increases in export of petroleum, as the major export item, and activated investments based on development programs.

Table IV-116 **Capital Appropriation Percentage for Major Sections of the 4th Economic Development Plan** in Iran

Irrigation	24.7%
Mining and Manufacturing Industries	11.0%
Communication	[illegible]%
Others	21.[illegible]%
Total	100.0%

Iran's oil production amounted to 1,[illegible],[illegible] [illegible] ([illegible] B/D) in 1970, which is the fourth largest in the world, next to the U.S., Soviet Union, and Venezuela. It has been holding a leading position in the Mideast area. In keeping step with the expanded oil production, the proportion of oil in foreign exchange revenue accounted for more than [illegible]%, or $[illegible],[illegible] million. Consequently, the international balance of payments has been kept in the black since 19[illegible].

Iran's industrialization policy has come to put more emphasis on heavy industry sector rather than on light industry sector as it did in the past.

Initially, the public sector had a large proportion, but gradually the development of the private sector began to be encountered under the fourth development plan. The fourth plan corresponds to the first stage of Iran's long-term industrialization scheme, and is aimed at self-sufficiency of consumer goods, less dependence on import of capital goods and intermediate goods and also on oil incomes by means of diversified export of industrial goods. Development of the chemical industry is planned as a factor to attain these objectives. In particular, emphasis is laid on the establishment of a petrochemical complex based upon indigenous natural gas as the raw material.

As shown in Table IV-117 the Iranian petrochemical complex intended to produce 100,000 ton per year of ethylene, and also there from such derivatives as LDPE, HDPE, PVC, et.

The domestic market for these derivatives would be small, as compared with planned production capacity in 1977, i.e., the target year of plan materialization. Therefore, a number of derivatives will have to be dependent on export markets at the initial stage. The project has been set forward by a joint venture established by Iran and Japan (Mitsui group). Depending upon the situations in domestic market growth, the Iranian petrochemicals will be exported to those overseas markets mainly in Asian countries which have been opened by the Mitsui group.

With an exception of Japan, petrochemical industrialization is, at least, aimed at self-sufficiency in the domestic

Table IV- 117 **Petrochemical Complex in Iran**

(1)	Name of the Company	Iran Japan Petrochemical Co.
(2)	Start of operation	1976 - 1977
(3)	Site Location	B. Shapour
(4)	Total Investment Cost	$350,000,000
(5)	Outline of Petrochemical Complex	

	Capacity (Unit: tons/yr.)	Investors
Ethylene	300,000	
Polyethylene (LDPE)	100,000	Toyo Soda Co.
(HDPE)	30,000	Mitsui Petrochemical
EDC	300,000	Toyo Soda Co.
Cl_2) NaOH)	253 (tons/day)	"
Ethylene Oxide	50,000	Mitsui Toatsu
Ethylbenzene	200,000	"
Cumene	150,000	"
SBR	40,000	"
DOP	40,000	Mitsubishi Chemicals
Phthalic Anhydride	30,000	n. a.
2-Ethylhexanol	28,000	n. a.

(6) Other than Petrochemical Projects above

Abadan Petrochemical Company Ltd
(Goodrich, National Iranian Oil Company)

	Capacity		Remarks
	Exist (Unit: tons/yr.)	Expansion (Unit: tons/yr.)	
Ethylene	11,000	[illegible]	[illegible]
EDC	[illegible]	100,000	
PVC	[illegible]	n. a.	n. a.
Dodecylbenzene	10,000	n. a.	n. a.

market, as can be seen in those ECAFE region countries in which petrochemicals have been industrialized, such as Korea, Australia, and India. Contrarily, Iran is intending to establish export-oriented petrochemical industry from the beginning.

(2) Market Studies by Product

(a) Plastics

As of 1970, the demands for major plastics resins such as PVC, polyethylene, polystyrene and polypropylene stand at 10,000, 17,000, 6,000 and [illegible] tons respectively. A total of 3,000 tons of both melamine and urea resins was consumed in addition to the above. This demand totals [illegible] tons per year. According to the information released by the Ministry of Economy of Iran, the consumption of these plastics resins will amount to 110,000 tons per year in 1975, about [illegible] times as large over 1970.

LDPE

Demands

As of 1970, polyethylene has the second largest consumption after PVC resins in Iran. Of the 1970 consumption of polyethylene of 17,000 tons, LDPE occupied [illegible]% or 1[illegible],000 tons. It finds major uses in household articles, [illegible] [illegible] [illegible] [illegible], [illegible] and [illegible]. The LDPE demand is expected to grow at a rate of [illegible]% per annum, and reach [illegible] tons per year in 1975 and [illegible] tons per year in 1980 as shown in Table IV-[illegible].

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]				[illegible]		

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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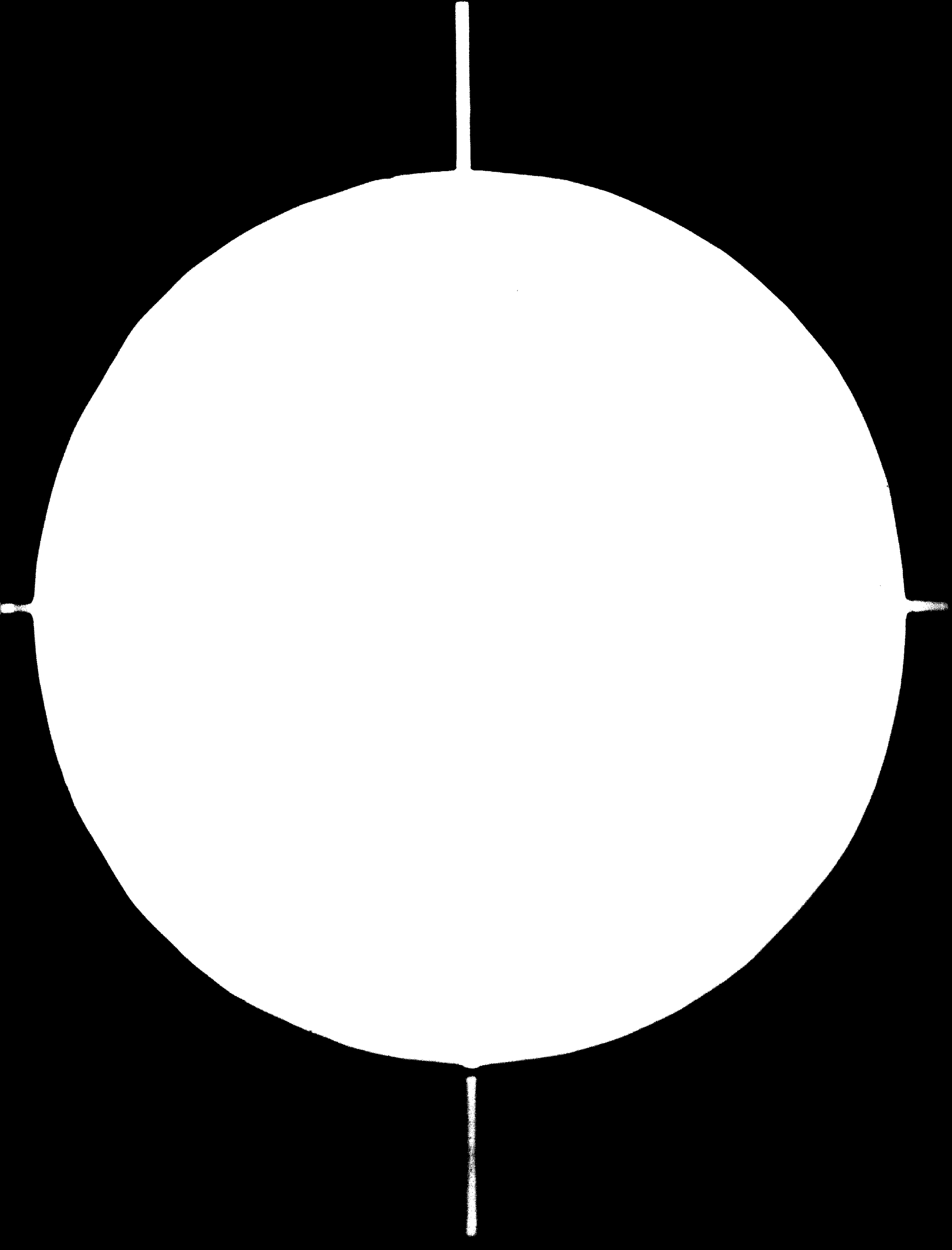

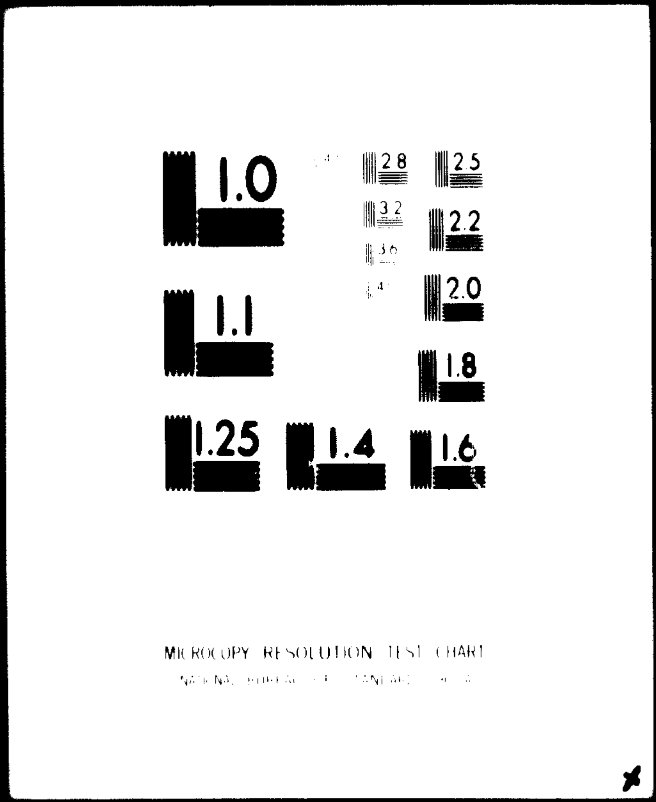
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E

In 1972, the plastics industry has come to make efforts for the recovery of market situation by means of production adjustment for PP, HDPE, and PVC, and "ceasefire" of plant and equipment investments. Meanwhile, the export of plastics accounted for about 25% of the production in 1971, as can be seen in Table IV-129. In order to prevent the effects of upward revaluation of the yen of the worsening company profitability caused by unorderly export competition, an ordery marketing agreement was formed for major exported plastics including PVC, LDPE, HDPE, and PP.

Table IV-129 Actual Export of Main Plastics in Japan

(Unit: tons)

	'69	'70	'71
Thermo Setting Resins	34,236	50,863	48,462
Thermo Plastic Resins	760,696	1,023,456	1,195,915
Others	20,384	24,916	26,385
Total :	815,316	1,099,235	1,270,762

So far the plastics industry had become more and more dependent upon export for its products, of which production capacity was going ahead of the domestic demand to a greater extent. Future prospects are such that the industry will make production adjustment through ceasefire of plant and equipment investments and will shift its policy to orderly exports to overseas markets which it had exported under severe sales competition.

LDPE

Demands

Domestic demands for LDPE stood at 702,499 tons in 1971 mainly for use in food package, agricultural film, processed paper, electric-wire coating, and

Table IV-130 Demand Pattern of LDPE in Japan 1971

(Unit: %)

Package)	59
Agriculture)	
Manufactured Paper	12
Electric Wire Coating	7
Injection Molding	7
Pipe	1
Extrusion Molding	3
Fiber	1
Others	10
	100%

Table IV-131 Actual Demand for LDPE in Japan

(Unit: tons)

	'66	'67	'68	'69	'70	'71
Domestic Demand	301,051	423,879	479,860	528,271	631,002	702,499
Export	129,185	129,159	146,060	165,937	229,654	261,155
Total :	430,236	553,038	625,920	694,208	860,656	963,654
Average Annual Rate of Increase:	17.5%					

injection molding. In addition, 261,155 tons were exported, and the total demand for LDPE reached 963,654 tons in that year, as shown in Table IV-130, 131.

Table IV-132 Estimated Demand for LDPE in Japan

(Unit tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Domestic Demand	766,000	821,000	887,000	940,000	1,006,000	-	-	-	-
Export	200,000	220,000	220,000	220,000	220,000	-	-	-	-
Total	1,026,000	1,041,000	1,107,000	1,160,000	1,226,000	1,281,000*	1,345,000*	1,412,000*	1,482,000
Average Annual Rate of Increase	4%			5%					

* JOC Estimates

Source: The Association of Petrochemical Industry in Japan

Production/supply

As of 1972, the capacity of LDPE production totals 1,102,000 ton per year for all 12 companies, as shown in Table IV-133. Since this capacity level can meet the 1974 demand, The Association of Petrochemical Industry in Japan and the Ministry of International Trade and Industry have reached an agreement on the discontinuance of plant and equipment investment for LDPE as far as the end of 1974.

Table IV-133 **Production Capacity of LDPE in Japan 1972**

(Unit: tons/yr.)

Company	Site	Present Capacity	Expansion Schedule
Sumitomo Chemical Co., Ltd.	Ohe	115,000	65,000
Sumitomo Chiba Chemical Co., Ltd.	Chiba	135,000	-
Mitsubishi Chemical Co., Ltd.	Yokkaichi	155,000	50,000
"	Kashima	50,000	-
Mitsui Poly-chemical Co., Ltd.	Ohtake	60,000	-
"	Chiba	60,000	60,000
Nippon Yunika Co., Ltd.	Kawasaki	159,000	-
Asahi-Dow Co., Ltd.	Kawasaki	35,000	-
"	Mizushima	63,000	-
Ube Kosan Co., Ltd.	Goi	120,000	20,000
"	Sakai	-	50,000
Nippon Petrochemical Co., Ltd.	Ukishima	60,000	-
Toyo Soda Mfg. Co., Ltd.	Ohita	30,000	40,000
Kasei Mizushima Petrochemical Co., Ltd.	Mizushima	30,000	30,000
Idemitsu Petrochemical Co., Ltd.	Chiba	30,000	50,000
Total :		1,102,000	365,000

HDPE

Demands

The HDPE demand has continued high growth at 30% per annum during 1966-1970, then its growth began to slow down as rates of 15% in 1971 and 10% in 1972,

both over the previous year were recorded. As shown in the Table IV-134, the domestic demands can be broken down into 37% injection molding, 22% extrusion molding, 7% film, elongated tape, and 14% fibers. The total demand including export reached 422,972 tons in 1971, as shown in Table IV-135.

Table IV-134 Demand Pattern for HDPE in Japan-1971

(Unit: %)

Injection Molding	37
Extrusion Molding	22
Film	7
Elongated Tape	15
Fibers	14
Pipe	2
Others	5
Total :	100%

Table IV-135 Actual Demand for HDPE in Japan

(Unit: tons)

	'66	'67	'68	'69	'70	'71
Domestic Demand	96,874	126,018	170,747	231,924	285,319	255,378
Export	20,939	32,618	32,618	47,024	83,566	167,594
Total :	117,813	158,636	203,365	278,948	368,885	422,972
Average Annual Rate of Increase:	29%					

Source: The Association of Petrochemical Industry in Japan

Table IV-136 Estimated Demand for HDPE in Japan

(Unit: tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Domestic Demand	280,000	321,000	363,000	414,000	469,000	-	-	-	-
Export	167,000	172,000	177,000	182,000	187,000	-	-	-	-
Total	447,000	493,000	542,000	596,000	636,000	721,000*	793,000*	873,000*	961,000
Average Annual Rate of Increase	10%								

* JGC Estimates

Source: The Association of Petrochemical Industry in Japan

Production/supply

As of 1972, HDPE is being produced by 10 makers, with their total capacity reaching 579,000 ton per year as shown in Table IV-137 which is more than two times as large a scale as the capacity of 310,000 ton per year at the end of 1969. With the background of such a supply pressure, stiff sales competition has been observed since 1970, and the profitability of each maker became extremely worsened by the drop of price. They, therefore, organized an anti-depression cartel (which was broken off in October 1972), trying to recover the market situation through restricted production. Furthermore, they decided to discontinue the investment on plant and equipment untill the end of 1974, to attain the balanced demand and supply.

Table IV-137 Production Capacity of HDPE in Japan-1972

(Unit: tons/yr.)

Company	Site	Present Capacity	Expansion Schedule
Mitsui Petrochemical Co., Ltd.	Ohtake	48,000	-
"	Ohita	123,000	120,000
Japan Olefin Chemicals Co., Ltd.	Kawasaki	90,000	5,000
"	Ohita	18,000	60,000
Nisseki Plastic Company	Kawasaki	83,000	-
Kasei Mizushima Petro-chemical Co., Ltd.	Mizushima	30,000	50,000
Mitsubishi Petrochemical Co., Ltd.	Yokkaichi	30,000	-
Asahi Chemical Industry Co., Ltd.	Mizushima	60,000	-
Chisso Petrochemical Co., Ltd.	Goi	30,000	6,000
Nissan Polyethylene Co., Ltd.	Goi	30,000	-
Chubu Chemical Co., Ltd.	Yokkaichi	30,000	-
Sumitomo Chemical Co., Ltd.	Ohe	7,000	50,000
Idemitsu Petrochemical Co., Ltd.	Chiba	-	60,000
Tokuyama Soda Co., Ltd.	Tokuyama	-	30,000
Total :		579,000	381,000

VCV

Demands

As the export of Japanese consumer goods made of PVC to U.S. decrease by the dollar crisis in 1971, the VCM demand dropped to 1,270,000 tons in 1971, as shown in Table IV-138 leaving a maximum of 1,310,000 tons in 1970. The demand is estimated to further decrease to 1,230,000 tons in 1972.

Table IV-138 Actual Demand for VCM in Japan

(Unit: tons)

	'67	'68	'69	'70	'71
Demand	76,000	1,010,000	1,150,000	1,310,000	1,270,000
Average Annual Rate of Increase:	←		10%		→

Source: Japanese PVC Association

Much is not expectable in the future for the hard-and soft-type PVC demand in the fields of plane boards, corrugated boards, and pipes exported to the U.S. In the aspect pollution control, PVC is most difficult to dispose of. In the light of these situations, it seems difficult to recover the successful growth of the demand.

According to the estimation of the Japanese PVC Association, the demand will grow, after it drops to the

Table IV-139 Estimated Demand for VCM in Japan

(Unit tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Demand	1,230,000	1,280,000	1,380,000	1,480,000	1,530,000	1,840,000	1,930,000	2,029,000	2,130,000
Average Annual Rate of Increase:	←	5.8%		→	←		8%		→

Source: Japanese PVC Association

bottom of 1,230,000 tons in 1972, and will reach 1,530,000 tons in 1976 and 2,130,000 tons in 1980, as shown in Table IV-139.

Production/supply

In 1970 was completed the shift of VCM production from the carbide process to the Oxychlorination process using ethylene as the raw material. Scale-up of plant and equipment has been under way since then, keeping steps with this change. Today, the existing capacity has reached a total of 2,386,000 ton per year, as of 1972, and together with those from new construction or expansion plans, the capacity will be above 2,500,000 ton per year, as shown in Table IV-140.

On the other hand, the demand is estimated to be 2,130,000 tons for 1980. Accordingly, considerable imbalance of demand and supply is likely to continue for the time being.

PVC

Demands

The domestic PVC demand stood at 917,734 tons in 1971, which was mainly used in various types of boards and plates, pipes, film, sheets, electric-wire coating, etc. as shown in Table IV-141, 142. Together with 145,464 tons of export, the total demand amounted to 1,063,198 tons in 1971. Since the 1967 demand including export stood at 712,306 tons, the demand has grown at about 10% per annum during 1967-1971.

Table IV-140 **Production Capacity of VCM in Japan-1972**

(Unit: tons/yr.)

Company	Site	Capacity	Expansion
Kashima VCM Co., Ltd.	Kashima	220,000	200,000
Kurepa Chemical Industry Co., Ltd.	Nishiki	40,000	100,000
Nippon Zeon Co., Ltd.	Takaoka	130,000	
Sanyo Monomer Co., Ltd.	Mizushima	120,000	48,000
Chiba VCM Co., Ltd.	Chiba	160,000	
Ryonichi Co., Ltd.	Mizushima	50,000	150,000
Toyo Soda Manufacturing Co., Ltd.	Yokkaichi Nanyo		
San-aro Chemical Co., Ltd.	Takuyama	110,000	50,000
Central Chemical Co., Ltd.	Kawasaki	60,000	60,000
Mitsui Toatsu Chemical Co., Ltd.	Nagoya	60,000	
Mitsui Senboku Petrochemical Inc.	Senboku	60,000	60,000
Chisso Corporation	Minamata	51,000	
Kanegafuchi Chemical Industry Co., Ltd.	Takasago	168,000	
Asahi-Pen Chemical Co., Ltd.	Chiba	50,000	
Sumitomo Chemical Co., Ltd.	Kikumoto	50,000	10,000
Nissan Chemical Industries, Ltd.	Chiba	50,000	
Mitsubishi Monsanto Chemical Co.	Yokkaichi	63,000	
The Electro Chemical Industrial Co., Ltd.	Seikai Chiba	(36,000)	
Toa Gosei Chemical Industry Co., Ltd.	Tokushima	48,000	
Showa Denko K.K.	Tsuruzaki		100,000
Shunan Petrochemical Corporation	Tokuyama	200,000	
Central Chemical Co., Ltd.	Kawasaki	166,000	
Nihon Poly-vinyl Co., Ltd.	Chiba	80,000	
Nippon Zeon Co., Ltd.	Tomakomai		60,000
Total :		2,386,000	988,000

Table IV-141 Demand Pattern of PVC in Japan - 1971

(Unit: %)

Hard Type	**56.6%**
Plane Boards	3.4
Sheets	8.8
Corrugated Boards	6.5
Pipes	26.7
Joints	2.5
Tubes	3.7
Others	5.0
Soft Type	**31.0**
Film and Sheets	
General	11.5
Agricultural	4.9
Leather	6.5
General Extruded Article	5.6
Others	2.5
Electric Wires	8.6
Floor Material	2.1
Fibers	1.2
Others	0.5
Total :	100.0%

Table IV-142 Actual Demand for PVC in Japan

(Unit: tons)

	'67	'68	'69	'70	'71
Domestic Demand	666,288	867,982	961,166	983,356	917,734
Export	46,018	67,851	111,272	139,361	145,464
Total :	712,306	935,833	1,072,438	1,122,717	1,063,198
Average Annual Rate of Increase:	10.3%				

Source: Japanese PVC Association

According to the demand forecast by the Japanese Association, the PVC demand will grow as given in the Table IV-143.

Table IV-143 Estimated Demand for PVC in Japan

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	1,310,000	1,380,000	1,450,000	1,520,000	1,600,000	1,680,000
Average Annual Rate of Increase:	5%					

Source: Japanese PVC Association
JGC Estimates

Production/supply

PVC production amounted to a total of 1,555,300 ton per year in 1972 for all 17 companies as shown in Table IV-144. On the other hand, the PVC demand stood at only 1,122,717 tons in 1971. This over-supply made the market price situation soft and profitability of makers worse. An anti-depression cartel was thus formed for PVC and VCM in 1972, with a view to getting out of such a situation.

This cartel involved production adjustment which included a seal of suplus equipment and limitation of operation rate to 65%. As a result of this measure, demand and supply became more stable and the market situation more recovered.

The anti-depression cartel was due in October 1972, but the PVC industry has agreed on the discontinuance of the plant and equipment investment until 1976, as a measure to be taken after the cartel.

Table IV-144 **Production Capacity of PVC in Japan-1972**

(Unit: tons/yr.)

Company	Site	Capacity	Expansion
The Electro Chemical Industrial Co., Ltd.	Seikai	60,000	
"	Chiba	35,000	
Gunma Chemical Co., Ltd.	Shibukawa	60,000	
Kanegafuchi Chemical Industry Co., Ltd.	Takasago	81,000	
"	Osaka	43,200	
"	Kashima	50,000	
Kureha Chemical Industry Co., Ltd.	Nishiki	120,000	
Mitsui Toatsu Chemical Co., Ltd.	Nagoya	57,380	
Mitsui Senpoku Petrochemical Inc.	Senboku	45,120	
Mitsubishi Monsanto Chemical Co.	Yokkaichi	90,000	
"	Nagoya	6,000	
Nippon Zeon Co., Ltd.	Takaoka	102,600	
"	Mizushima	65,400	
The Sin-etsu Chemical Industry Co., Ltd.	Naoetsu	38,000	
"	Tokuyama	30,000	
"	Kashima	130,000	
"	Takeo	6,000	
Chisso Corporation	Goi	32,000	
"	Mizushima	24,000	
"	Minamata	47,000	
Sumitomo Chemical Co., Ltd.	Kikumoto	50,000	
"	Chiba	50,000	
Tekkosha Co., Ltd.	Yokkaichi	36,000	
Toa Gosei Chemical Industry Co., Ltd.	Tokushima	57,000	
"	Kawasaki	30,000	
"	"		30,000
Tokuyama Sekisui Chemical Co., Ltd.	Tokushima	57,000	
Sun-aro Chemical Co., Ltd.	"	60,000	
Asahi-Pen Chemical Yugen Kaisha	Chiba	4,200	
	Mizushima	84,000	
Ryonichi Co., Ltd.		80,400	
Total :		1,555,300	30,000

Styrene

Demands

The styrene demand stood domestically at 169,275 tons in 1965, which was used for polystyrene, synthetic rubber (SBR), unsaturated polyester resins, ABS resins, and other as shown in Table IV-145, 146. In addition, 1,509 tons was exported in that year. Thus the total demand amounted to 170,784 tons in 1965. According to the information released by the Styrene Committee, the domestic styrene demand amounted to 810,454 tons, or 851,487 tons together with export, in 1971.

Table IV-145 Demand Pattern of Styrene in Japan

(Unit: %)

Usage	'70	'71
Domestic Demand	92	94
Polystyrene	60	62
SBR	14	15
Polyester Resins	5	5
ABS Resin	11	10
Others	2	2
Export	8	6
Total :	100	100

Source: Styrene Committee

From 1965 to 1971, the styrene demand marked a rapid growth with a rate above 30% per annum. Its use in polystyrene, which occupies about 60%, showed slow-down of growth, owing to dull activities in the

Table IV-146 Actual Demand for Styrene in Japan

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'71
Domestic Demand	169,275	250,409	333,901	446,704	603,848	743,800	810,454
Export	1,509	4,865	1,186	1,482	15,544	62,900	41,033
Total	170,784	255,274	335,087	448,186	619,392	806,700	851,487
Average Annual Rate of Increase:	30%						

Source: Styrene Committee

Electronics industry and the decrease of Form Styrene demand caused by critisism of extravagant package and waste disposal problem resulting in a slight growth rate of 2% over the previous year.

As given in the Table IV-147, the demand is estimated to grow at 10% per annum, according to the Styrene Committee. Such a rate will lead to a demand of 1,232,800 tons in 1975 and 1,991,000 tons in 1980.

Table IV-147 Estimated Demand for Styrene in Japan

(Unit: tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Domestic Demand	866,700	964,600	1,078,700	1,197,300	1,325,800	-	-	-	-
Export	56,500	29,500	32,500	35,500	38,500	-	-	-	-
	923,200	994,100	1,111,200	1,232,800	1,364,300	1,480,000*	1,646,000*	1,810,000*	1,991,000*

* JKK' Estimates
Source: Styrene Committee

Production/supply

As of 1972, styrene is produced by 9 companies, with production reaching 1,080,000 ton per year. The production capacity will be scaled up to 1,505,000 ton per year by 1974 as shown in Table IV-148.

Meanwhile, the demand will stay on the 1,364,300 ton level even in 1976. Therefore, the industry circles have agreed on the postponement of expansion plans until 1974. Depending upon future trend in demand,

Table IV-148 Production Capacity of Styrene in Japan

(Unit: tons/yr.)

Company	Site	Present Capacity	Expansion Schedule
Asahi-Dow Co., Ltd.	Kawasaki	60,000	-
"	Mizushima	300,000	-
Mitsubishi Petrochemical Co., Ltd.	Kashima	80,000	-
"	Yokkaichi	205,000	150,000
Sumitomo Chemical Co., Ltd.	Chiba	80,000	50,000
Osaka Styrene Co., Ltd.	Sakai	80,000	-
The Electro Chemical Industrial Co., Ltd.	Chiba	72,000	-
Nippon Steel Chemical Industrial Co., Ltd.	Tobata	20,000	-
"	Tsurusaki	40,000	-
Tokuyama Styrene Co., Ltd.	Tokuyama	65,000	-
Osaka Gas Co., Ltd.	Torishima	18,000	-
Chubu Chemical Co., Ltd.	Kasumigaura	60,000	-
Teijin, Ltd.	Sakai	-	50,000
Nihon Oxiran Co., Ltd.	Chiba	-	225,000
Total :		1,080,000	475,000

makers intend to discontinue the operation of, or abandon, the depreciated equipment.

Polystyrene

Demands

The domestic demand for polystyrene stood at 332,700 tons in 1971, up 7% over the previous year as shown in Table IV-150. This indicates that the demand has slowed down to a greater extent, as compared with the 1970 growth rate of 29% over the previous year. This is mainly attributable to the stagnation in such industries as TV, radio sets, and electric refrigerators, which have usually occupied 30% of the domestic demand, as shown in Table IV-149.

Table IV-149 Demand Pattern of Polystyrene in Japan - 1971

(Unit: %)

Industrial Use	36.7	30.2
TV	8.3	6.8
Refregirator	3.9	3.2
Radio	3.3	2.7
Other industrial use	21.3	17.5
Daily Necessaries	63.3	52.1
Package	26.7	22.0
Household articles	26.7	22.0
Toys	5.7	4.7
Office supplies	4.2	3.4
Total domestic demand	100.0	82.3
Export		17.7
Grand Total		100.0

Due to business recession and the effects of dollar crisis, their growth rate dropped to -5% over the previous year. On the contrary the polystyrene for uses in household utensils, and miscellaneous goods, has grown at 10% on the whole, owing to a large increase of 57% attained by the uses in packaging and containers. The polystyrene demand for use in furniture, construction materials, and synthetic paper marked a rapid growth rate of 57% over the previous year. Meanwhile, 71,700 tons was exported up more than 9% over the previous year, in 1971. Of this amount, the export to Southeast Asia accounted for 80% or 56,000 tons, of which 50% was exported to Hong Kong.

Table IV-150 Actual Demand for Polystyrene in Japan

(Unit: tons)

	'66	'67	'68	'69	'70	'71
Domestic Demand	113,800	154,100	189,910	253,200	311,300	332,700
Export	14,700	19,340	30,480	56,600	66,000	71,700
Total :	128,500	173,440	219,490	309,800	377,300	404,400
Average Annual Rate of Increase:	26%					

Source: The Association of Petrochemical Industry in Japan
: Styrene Committee

As given in the next Table IV-151, the future demand is estimated to reach 434,600 tons in 1972, 636,000 tons in 1975, and 1,049,500 tons in 1980.

Table IV- 151 **Estimated Demand for Polystyrene in Japan**

(Unit: tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Domestic Demand	360,600	416,100	487,300	558,600	638,600	-	-	-	-
Export	74,000	75,500	76,600	77,400	78,200	-	-	-	-
Total :	434,600	491,600	563,900	636,000	716,800	788,500*	867,300*	954,000*	1,049,500*
Average Annual Rate of Increase	12% ('72–'75)				10% ('75–'80)				

* JGC Estimates

Source: The Association of Petrochemical Industry in Japan

Production/supply

The polystyrene production capacity is already 674,000 ton per year for all 10 companies, as of 1972 as shown in Table IV- 152. When compared with future demand levels, the above level is in an over-supply condition. If the plans for new construction and/or expansion are taken into accounts, the capacity now clarified will reach 915,000 ton per year, which will correspond to the 1978 demand.

Polypropylene

Demands

The polypropylene demand showed a high growth rate of 60% per annum during 1966-1967, but the 1970 growth rate stayed on 30% over the previous year. The demand growth rate further slowed down to 17% in 1971, under the effects of stagnation in those industries which call for PP, such as automobiles, household electric applicance, etc. as shown in Table IV-153, 154.

Table IV-152 **Production Capacity of Polystyrene in Japan**

(Unit: tons/yr.)

Company	Site	Present Capacity	Expansion Schedule
Asahi-Dow Co., Ltd.	Kawasaki	59,000	-
"	Mizushima	135,000	-
"	Nagaura	-	35,000
Mitsubishi Monsanto Chemical Co., Ltd.	Yokkaichi	91,000	-
Nihon Polystyrene Co., Ltd.	Kawasaki	48,000	52,000
Toyo Polystyrene Co., Ltd.	Kawasaki	60,000	40,000
"	Senhoku	34,000	50,000
Denka Petrochemical Industrial Co., Ltd.	Chiba	70,000	-
Nippon Steel Chemical Industrial Co., Ltd.	Tobata	50,000	-
"	Kimitsu	-	15,000
Idemitsu Petrochemical Co., Ltd.	Tokuyama	40,000	-
Dainippon Ink and Chemicals Inc.	Chiba	12,000	-
"	Yokkaichi	-	18,000
Toyo Soda Mfg. Co., Ltd.	Yokkaichi	-	16,000
Kanegafuchi Chemical Industry Co., Ltd.	Kashima	8,400	-
"	Takasago	24,000	15,000
Yuka Badische Co., Ltd.	Yokkaichi	42,600	-
Total :		674,000	241,000

Export reached about 160,000 tons in 1971, up 23% over the previous year. This increase is largely attributable to the growth of export to Asia, particularly to China (25,000 ton per year) and the Philippines (22,000 ton per year).

Table IV-153 **Demand Pattern of PP in Japan**

(Unit: %)

	1971
Injection Molding	30.8%
Film	17.4
Flat Yarn	8.7
Fibers	7.8
Blow Molding	1.6
Extrusion Molding	74.2
Export	25.8
	100.0%

Table IV-154 **Actual Demand for Polypropylene in Japan**

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'71
Domestic Demand	57,000	97,408	156,828	241,064	332,160	399,491	460,010
Export	1,200	2,418	4,610	15,969	74,346	129,604	159,391
Total :	58,200	99,826	161,438	257,033	406,506	529,095	619,401
Average Annual Rate of Increase:	48.5%						

Source: The Association of Petrochemical Industry in Japan

The future demand is estimated to show such a trend as given in the next Table IV-155 from 1972 on. This trend is characteristically affected by not only the slow-down of the domestic demand, but also by the reduction in assistance exports to Western Countries expected as a result of a fact that the supply system has become perfect in such countries. It is also possible that the rate of growth may drop from 17% in 1971 to even 10% or below in the future.

Table IV-155 Estimated Demand for PP in Japan

(Unit: tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Domestic Demand	500,000	545,000	594,000	641,000	686,000	-	-	-	-
Export	130,000	135,000	140,000	145,000	150,000	-	-	-	-
Total :	630,000	680,000	734,000	786,000	836,000	886,000*	939,000*	996,000*	1,055,000*
Average Annual Rate of Increase:	6%								

* JGC Estimates

Source: The Association of Petrochemical Industries in Japan

Production/ supply

Reflecting the slowing trend in the PP demand growth, its supply is now under an excessive condition. This condition pushed the PP industry to form an anti-depression cartel in March 1972 (which was due at the end of October 1972), so that the market situation may be recovered by production adjustment. PP is now being produced by the 9 companies listed in Table IV-156, reaching a total nominal capacity of 665,000 ton per year or a actual capacity of 798,000 ton per year. This indicates that the present capacity can meet the demand until 1975. Therefore, these companies dicided to discontinue the plant and equipment investment until 1974.

Table IV-156 Production Capacity of PP in Japan

(Unit: tons)

Company	Site	Present Capacity	Expansion Plan
Mitsui Toatsu Chemicals, Inc.	Ohtake	80,000	-
Mitsui Senpoku Petrochemical Co., Ltd.	Senpoku	30,000	30,000
Mitsubishi Petrochemical Co., Ltd.	Yokkaichi	105,000	50,000
"	Kashima	45,000	40,000
Sumitomo Chemical Co., Ltd.	Ohe	30,000	-
"	Chiba	90,000	40,000
Chisso Corp.	Goi	110,000	35,000
Mitsui Petrochemical Co., Ltd.	Chiba	55.000	30,000
Japan Olefin Chemicals Co., Ltd.	Tsurusaki	60,000	10,000
Ube Kosan Co., Ltd.	Sakai	60,000	-
Tokuyama Soda Co., Ltd.	Tokuyama	30,000	50,000
Tonen Petrochemical Co., Ltd.	Kawasaki	-	30,000
Idemitsu Petrochemical Co., Ltd.	Chiba	-	30,000
Chubu Chemical Co., Ltd.	Yokkaichi	-	30,000
Total :		665,000	375,000

(b) <u>Synthetic Fibers</u>

The synthetic fiber industry was hard hit, particularly in the aspect of export, by a series of economic fluctuations including business recession within the country during the latter half of 1970, the agreement concluded between the US and the Japanese Governments on the quota of textile exports to the U.S. in 1971, and the upward revaluation of the yen in December 1971. And the industry is now suffering from dull activities. Already in October 1971, production of nylon filament, polyester staple, and acrylic staple was reduced by 10-15% under the self-control of the industry.

Similarly, the polyester filament production has been reduced since April 1972.

As a result, the synthetic fiber production amounted to 1,159,914 tons in 1971 as shown in Table IV-158, up only 8% over the previous year. Such a growth rate was quite low, as compared with 19% and 28%, both over the previous year, achieved in 1969 and 1970, respectively. However, when the fiber demands are broken down by types of fibers, the ratio of chemical fiber demand to the total fiber demand was year by year trending upward, due to stagnation of natural fiber demand. Concurrent with this trend, the ratio of the synthetic fiber demand to the chemical fiber demand, or so-called synthetic fiber ratio, moved up from 42.4% in 1970 to 46.5% in 1971, as shown in Table IV-157. That year, the synthetic fiber demand occupied almost half the total fiber demand, i.e., 1,165,000 tons. Of this amount, big three of Nylon, Polyester, and Acrylic fibers accounted for about 90%, or 1,012,300 tons.

Table IV-157 Breakdown of Fiber Demand in Japan

(Unit: %)

Natural Fibers	'69	'70	'71
Cotton	28.3	26.6	26.2
Wool	9.2	9.2	8.5
Silk	1.4	1.6	1.3
Twine	0.4	0.4	0.3
Others	0.4	0.5	0.4
Sub-Total	39.7	38.3	36.7
Chemical Fibers			
Rayon yarn	5.4	4.7	3.7
Staple fiber	14.2	12.9	11.5
Acetate	1.7	1.7	1.6
Synthetic fibers	39.0	42.4	46.5
Sub-Total	60.3	61.7	63.3
Total	100.0	100.0	100.0

Table IV-158 Production of Synthetic Fibers in Japan

(Unit: tons)

	'69	'70	'71
Nylon	265,477	311,530	305,719
Polyester	237,719	338,486	404,451
Acrylic	202,267	280,464	291,106
Vinylon	71,923	75,798	74,383
Polypropylene	38,504	46,365	50,083
Others	31,646	34,371	34,172
Total :	847,536	1,087,014	1,159,914
Growth rate against previous year	19%	28%	8%

Nylon

Demands

The demand for Nylon fibres has shown a growth rate in the range of 15-20% per annum until 1970. The 1971 demand of 304,700 tons (domestic 128,800 tons and export 175,900 tons) was lower than the 1970 demand of 318,600 tons as shown in Table IV-159. This is ascribed to the slow-down of demand growth in the field of industrial materials, such as Nylon tyre codes, caused by business recession within the country.

In the course of overall slow-down of the Nylon demand, only the panty-stocking demand was brisk in 1971, but underselling took place in 1972, due to oversupply and rapid increases in import of the similar commodity, forcing the stocking industry to run their plants at a rate 30% lower than before. This also adversely affected the Nylon demand.

Table IV-159 Actual Demand for Nylon Fibers in Japan

(Unit: tons)

	'66	'67	'68	'69	'70	'71
Domestic Demand	96,200	116,200	128,100	143,800	170,300	128,800
Export	62,600	77,000	96,200	121,800	148,300	175,900
Total :	158,800	193,200	224,300	265,600	318,600	304,700
Average Annual Rate of Increase:	23%					

Source: Bureau of Textile

Future demand is estimated to grow at 5% per annum amounting to 363,000 tons in 1975 and 421,000 tons in 1980 as shown in Table IV-160.

Table IV-160 Estimated Demand for Nylon in Japan

(Unit tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Demand	314,000	330,000	346,000	363,000	374,000	385,000	397,000	409,000	421,000
Average Annual Rate of Increase	5%								

Source Bureau of Textile

Production/supply

Under the impact of worsended business situation caused by the aforementioned slow-down of the Nylon demand, Nylon makers have been practising reduced production voluntarily since the lattar half of 1971. Such reduction in production accounted for 25%. Since there is already unfavourable prospecting for the demands for industrial materials, such as tyre codes, the industry has reached an arrangement for discontinuance of the plant and equipment investments until 1973.

Production capacities of nylon in Japan are shown in the Table IV-161.

Polyester

Demands

The Polyester fiber demand rose from 128,400 tons in 1966 to 418,000 tons in 1971 as shown in Table IV-162

Table IV-161 **Production Capacity of Nylon in Japan**

(Unit: tons/day)

Company	Present Capacity	Expansion Plan
Nylon 6		
Toray Industries Inc.	324.3	
Unitika Ltd.	182	
Teijin Ltd.	107	
Asahi Chemical Industry	86.5	
Kanebo Ltd.	102.3	
Toyobo Co., Ltd.	87.0	15
Sub-Total	889.1	15
Nylon 66		
Asahi Chemical Industry Co., Ltd.	15	15
Toray Industries, Inc.	10	
Sub-Total	25	15
Total	914.1	30

The demand growth of 30% attained during this period was higher than the Nylon fiber demand growth of 20% over the same period. As a result,

Table IV-162 **Actual Demand for Polyester Fibers in Japan**

(Unit: tons)

	'66	'67	'68	'69	'71
Domestic Demand	69,700	90,600	103,100	132,300	n.a.
Export	58,700	66,600	84,900	107,700	n.a.
Total :	128,400	157,200	188,000	240,000	418,000
Average Annual Rate of Increase	26.6%				

the polyester demand outran the Nylon fiber demand in 1970. However, because of too much dependence upon exports of mainly polyester filaments to the U.S. (a ratio of export to the U.S. of 42% in 1971), the polyester fiber industry was affected by the afore-mentioned governmental agreement on textile quota, so that the 1972 demand will decrease by 5% over the previous year.

In the future, a trend toward more demand for polyester will be strengthened under the circumstances of worldwide shortage and high cost of cotton. Particularly, the demand for polyester fibers is estimated to reach 563,000 tons in 1975 and 718,000 tons in 1980 as shown in Table IV-163.

Table IV-163 Estimated Demand for Polyester Fibers in Japan

(Unit: tons)

	'72	'73	'74	'75	'76	'77	'78	'79	'80
Filament	191,000	220,000	253,500	-	-	-	-	-	-
Staple	232,000	243,600	258,000	-	-	-	-	-	-
	423,000	463,600	511,500	563,000*	591,000*	620,000*	652,000*	684,000*	718,000*
Average Annual Rate of Increase	7.8%			5%					

* JGC Estimates

Source: The Bureau of Textile

Production/supply

As stated above, the polyester fiber industry is suffering from over-supply and dull business situation, caused by sharp decrease in export in 1972 and stagnant demand situation. Thus the industry has been practising voluntarily reduced production of polyester filaments since April 1972. The 9 companies has at present a total capacity of polyester fiber production of 1,116 ton per day, which is broken down into 543 ton per day of filament produced by 9 companies and 573 ton per day of staples produced by 5 companies, as shown in Table IV-164.

Table IV-164 **Production Capacity of Polyester Fibers in Japan**

(Unit: tons/day)

Company		Present Capacity	Total
Teijin Ltd.	(F) (S)	127 155	282
Toray Industrial, Inc.	(F) (S)	127 150	277
Kuraray Co., Ltd.	(F) (S)	45 95	140
Nippon Ester Co., Ltd.	(F) (S)	40 100	140
Toyobo Co., Ltd.	(F) (S)	67 73	140
Shinko Ester Co., Ltd.	(F)	40	40
Kanebo Ltd.	(F)	40	40
Asahi Chemical Industry Co., Ltd.	(F)	40	40
Pet Code Co., Ltd.	(F)	17	17
Total :	(F) (S)	543 573	1,116

(F) : Filament

(S) : Staple

(3) Potential Market for Plastics Resins and Synthetic Fibers in Japan

As shown in Table IV-165, the potential market for those plastics resins within the scope of this survey will hold on the over-supply tendency until 1977 or 1978. As for such synthetic fibers as nylon and polyester, the present capacities, together with those under planning, exactly correspond to the 1975 demands. Therefore, form 1975 on, the potential market scale will become larger.

Table IV-165 Potential Market for Plastics Resins and Synthetic Fibers in Japan

	'75	'76	'77	'78	'79	'80
LDPE	0	0	0	32,000	99,000	169,000
HDPE	0	0	0	42,000	122,000	210,000
VCM	0	0	266,000	356,000	455,000	556,000
PVC	0	0	0	0	40,000	120,000
Styrene	141,000	0	0	69,000	233,000	414,000
Polystyrene	0	0	0	42,000	161,000	295,000
Polypropylene	0	0	0	21,000	77,000	140,000
Nylon Fibers	13,000	24,000	35,000	47,000	59,000	71,000
Polyester Fibers	56,000	84,000	213,000	245,000	277,000	311,000

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Japan

As stated before, Japan has the second largest petrochemical industry of the world, with its ethylene capacity of 4,800,000 ton per year. During the development of its petrochemical industry, two large objectives were to achieve strong international competitiveness and to prevent product import.

As shown in Table IV-166, Japan became a big exporting country of petrochemicals in 1965, when the export amount of $68.9 million outran the import amount of $50 million.

Table IV-166 **Export and Import Situation of Petrochemical Products in Japan**

($100,000)

Year	Import	Export
1959	597	-
1960	764	-
1961	856	28
1962	756	81
1963	694	142
1964	833	222
1965	503	689
1966	469	986
1967	553	900
1968	703	1,047
1969	525	1,811
1970	419	2,708
1971	356	3,203

Exports of derivatives have high proportions in the total demands for those derivatives. The 1971 export accounted for 27% in LDPE, 40% in HDPE, 18% polystyrene, and 26% in PP. Domestically, planning on expansion or construction of new plants will become more and more difficult, due to pollution problem and difficulties in finding plant sites. From long-term point of view, Japan will lose exporting strength, as the domestic demand will grow. There is even a possibility that Japan may become an importing country of petrochemicals.

However, such outcome will not be seen until the latter half of 1980s. Until then, there is little possibility of exports of Indonesian petrochemicals to Japan, with exceptions of a case where a part of derivatives is taken into Japan from petrochemical complexes established with a joint venture of Japanese overseas companies, or a case where products are tentatively imported to fill the demand-supply gap.

5.8 KOREA

(1) General Market Situation

The Republic of Korea has inaugurated the third 5-year economic development plan in 1972. The priority target of the plan is to correct the strains brought about under the execution of the first and the second plans during the period referred to as the "time of rapid progress," and to establish the foundation of the country on the basis of industrialization. The basic strategy comprises the following three points:

- o Modernization of the agricultural sector which has been behind industrialization;
- o Promotion of heavy industries; and
- o Adjustment of export-import balance to improvement of international balance of payments.

For the materialization of these strategic measures, the economic growth rate will be kept 8.6% for the third 5-year plan period. Other targets are set for GNP which is boosted from $8,100 million in 1971 to $13,400 million in 1976, the year of plan termination, and for per-capita national income which is raised from $389 to $440.

Up to the target year, the gross national product for each of the major industries will become as given in following Table IV-167, and higher industrial structure will have been attained.

Korea has already tried to develop its heavy and chemical industries under the first and the second 5-year plans, and

Table IV-167 Composition Ratio of GNP in Korea

	1971	1976
Mining and Manufacturing Industries	25.6%	29.6%
Agriculture Forestry and Fisheries Industries	24.5	21.1
Social Indirect Capital	13.4	16.2
Other Services	36.5	33.1
	100.0	100.0

now the petrochemical industry, metal smelting, electronic industry, etc., are rapidly growing. In addition, chemical fertilizer and cement industries have been ready for self-sufficiency systems, and have grown to permit export.

Particularly in respect to the petrochemical industry, a 100,000 ton per year naphtha cracking plant was completed by the investment of Korean Petroleum Corp. at the Government controlled industrial development in the Ulsan area in November 1972 as shown in Table IV-168. The downstream plants of this naphtha craker, such as VCM, polyethylene, and PP plants, will also start operation by the end of the year.

Since naphtha cracker and major downstream industries have less scales than international levels, it is considered necessary to take some protective measures for the Korean petrochemical industry. In fact, it is reported that Korea will enforce a special import system, wherein volume of import shall be determined by not only the current customs system but also demand-supply balances, effective

Table IV - 168 Petrochemical Complex in Korea

(1)	Name of the company	Ulsan Petrochemical Complex
(2)	Start of operation	Oct. 11th, 1972
(3)	Site location	Ulsan City
	Area	3,306 km^2
(4)	Total investment cost	$214 million

(5) Outline of the first-stage petrochemical complex

Products	Capacity (Unit: tons)	Undertakers	Fund Reauirements (Unit: $1,000)
Ethylene	100,000	Korea Oil Corporation	60,000
Polyethylene & VCM	50,000 60,000	Chungji Fertilizer Corporation	41,000
Synthetic ethanol & acetaldehyde	50,000 25,000		18,140
Acrylonitrile	26,400	Tong-Suh Petrochemical	20,300
Alkylbenzene	10,000	Esso Chemical Industrial Co., Ltd.	3,764.11
Polypropylene	20,000	Korea Petrochemical Industry Co., Ltd.	14,000
S. B. R.	15,000	Korea Synthetic Rubber Co., Ltd.	8,841.24
Caprolactam	33,000	Hankook Caprolactum Corporation	31,930
Industrial water power	40,000MT/D 35,000KW 730MT/D		16,196
		Total :	214,081.35

(6) Second stage plan

Caprolactam	33,000	Start up in 1974 Construction of a new 33,000 ton per year plant 1976
Methanol	45,000	
Styrene	40,000	Start up in 1975
DMT	60,000	Start up in 1975
Ethylene Glycol	25,000/30,000	Start up in 1975
Polyethylene (HDPE)	40,000	Start up in 1975
VCM	60,000	Start up in 1976

as soon as the petrochemical complex is put into operation.

Meanwhile, the Korean petrochemical industry will make a big stride from the chemical industry based upon imported raw materials to that based upon self-supplied raw materials.

Besides, according to a draft plan of the Korean Government, operation of the petrochemical complex will make it possible to produce $75 million worth of petrochemicals a year, saving $65 million of foreign currency reserves yearly. If the expansion plan now under investigation is materialized, additional $30 million of foreign currency reserves will be saved. The petrochemical industry is thus likely to contribute largely to the improvement of international balance of payments, which is one of the objectives under third 5-year plan.

(2) Market Studies by Product

(a) Plastics

The demand for major plastics in Korea amounted to 95,748 tons in 1970, about 9 times as large as 11,482 tons in 1965. Average growth rate reached 53% per annum during 1965-1970.

LDPE

Demands

The LDPE demand, which stood at 4,100 tons in 1965, was boosted to 29,500 tons in 1970, about 7 times as large as in 1965, as shown in Table IV-169. According to the estimation by the Ministry of Commerce of

Korea, the LDPE demand will further rise to 80,300 tons in 1975 and 175,000 tons in 1980 as given in the same table.

Table IV-169 Actual and Estimated Demand for LDPE in Korea

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	4,100	6,637	11,700	17,300	20,250	29,500	80,300	96,000	115,000	133,000	152,000	175,000
Average Annual Rate of Increase				48%			20%			11%		

Source: Ministry of Commerce of Korea

Production/ supply

As part of the petrochemical complex which was put into operation in October 1972, Korea Pacific Chemical Co., Ltd. started operation of a 50,000 ton per year LDPE production plant. Under the production program, it is scheduled to produce 20,000 ton per year by 1973, and 50,000 ton per year from 1974 in full operation. Expansion of another 50,000 ton per year plant is further planned in 1975, taking growth of domestic demands into consideration.

HDPE

Demands

The HDPE demand in Korea was moved up from 2,700 tons in 1967 to 12,900 tons in 1970. According to the announcement of the Ministry of Commerce of Korea, the HDPE demand is further boosted to 42,500 tons in 1975 and 93,000 tons in 1980 as shown in Table IV-170.

Table IV-170 Actual and Estimated Demand for HDPE in Korea

(Unit: tons)

	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	2,700	5,500	8,000	12,900	42,500	51,000	61,000	70,000	81,000	93,000
Average Annual Rate of Increase	64%				27.4%	17%				

Source: Ministry of Commerce of Korea

Production/Supply

HDPE is now not domestically produced, and the total demand is supplied through import, although in 1975, Korea Pacific Chemical Co. is to start production of 40,000 ton per year of HDPE.

VCM

Demands

According to the demand forecasting by the Ministry of Commerce of Korea, the VCM demand is likely to mark 55,400 ton per year in 1972, 84,400 ton per year in 1975, and 155,000 ton per year in 1980. Average growth rate per annum is estimated at 15% for the period 1972/1975 and 13% for 1975/1980 as shown in Table IV-171.

Table IV-171 Actual and Estimated Demand for VCM in Korea

(Unit: tons)

	'69	'70	'72	'75	'76	'77	'78	'79	'80
Demand	na	na	55,400	84,400	97,000	112,000	128,000	144,000	155,000
Average Annual Rate of Increase			15%	13%					

Source: Ministry of Commerce of Korea

Production/supply

Korea Pacific Chemical Co. started operation of a 60,000 ton per year VCM plant in 1972. The schedule-ed production for 1972 amounts to 24,000 tons, but from 1973 on, the plant will be in full operation. Expansion of additional 60,000 ton per year is also planned in 1976.

PVC

Demands

The demand for PVC resin, which stood at 8,031 ton per year in 1965, reached 36,700 ton per year in 1970, five times as large over 1965. Future demand is estimated to grow at 17% per annum until 1975 and at 13% per annum during 1975-1980 as shown in Table IV-172.

Table IV-172. Actual and Estimated Demand for PVC in Korea

(Unit: [illegible])

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	8,031	12,[illegible]	[illegible]	20,[illegible]	[illegible]	36,700	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Rate of Increase	[illegible]		17%			17%	[illegible]			13%		

Source: Ministry of [illegible] of Korea

Production/supply

As listed in Table IV-173, five PVC production plants are now in operation in Korea, of which three units are producing PVC resins, using imported VCM. The other two units are based upon the carbide process. All these plants will make use of domestically produced

VCM as the raw material from 1972, when the petro-chemical complex is put into operation.

Table IV-17: Polyvinyl Chloride Plant in Korea

(Unit: ton)

Company	Design	Capacity Production	Raw Material
Daehan Plastics	8,650	8,250	Carbide
Kong Yong Chemical	8,000	7,500	VCM
Korea Chemical	18,000	18,750	
Woosung Chemical	18,000	18,750	
Tong Yang Chemical	8,000	7,500	Carbide
	60,650	60,750	

Styrene

Demands

A polystyrene plant with a capacity of 12,000 ton per year is now in operation in Korea. The total styrene requirement of this plant is supplied through import.

Production/supply

As part of the first-stage expansion plan for the petro-chemical complex, domestic production of styrene at 60,000 ton per year is scheduled for 1973.

Polystyrene

Demands

The polystyrene demand is estimated to rise from 661 tons in 1966 to 7,400 ton per year in 1970, then 23,600 ton per year in 1975 and 50,000 ton per year in 1980 as shown in Table IV-18.

Table IV-174 Actual and Estimated Demand for Polystyrene in Korea

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	661	1,500	2,000	2,834	4,673	7,384	23,500	28,200	33,800	40,100	48,700	58,400
Average Annual Rate of Increase	43% ('65–'70)						27% ('70–'75)	20% ('75–'80)				

Source: Ministry of Commerce of Korea

Polypropylene

Demands

The polypropylene demand rose from 417 ton per year in 1965 to 9,264 ton per year in 1970, about 25 times as large as the 1965 figure. The Ministry of Commerce of Korea forcecasts that it will further grow into 34,000 ton per year in 1975 and 78,000 ton per year in 1980 as shown in Table IV-175. Of the total polypropylene demand, the use in fiber production will account for 44% or about 15,000 tons in 1975 and 38% or about 30,000 tons in 1980.

Table IV-175 Actual and Estimated Demand for Polypropylene in Korea

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	417	760	2,986	3,856	4,800	9,264	34,000	45,000	53,600	63,400	72,000	78,000
Average Annual Rate of Increase	41% ('65–'70)						30% ('70–'75)	18% ('75–'80)				

Source: Ministry of Commerce of Korea

(b) Synthetic Fibers

The Korean textile industry started operation of synthetic fibers in early 1950s, and today, fiber products occupy 30% of the total export from Korea. Construction of synthetic fiber plants started in earlier days than that of other petrochemical plants.

A polyvinyl alcohol plant and two Nylon 6 filament yarn plants started operation in 1959 and 1964, respectively. The demands for synthetic fibers have shown rapid growth, and are likely to continue successful development in the future. The Korean Government is promoting to develop synthetic fiber industry, in order to make it one of strategic industries for export.

Nylon

Demands

The demand for Nylon marked 35,422 tons 1970, about 4 times as large as 9,880 tons in 1966. During this period, the growth rate reached about 36% per annum, and is expected to hold 15% until 1975 and 4% over the period 1975-1980. As a result, production seems to reach 70,500 tons until 1975 and 85,000 tons in 1980 as shown in Table IV-176.

Table IV-176 Actual and Estimated Demand for Nylon in Korea

(Unit: tons)

	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	9,880	23,375	28,670	33,221	35,422	70,500	74,800	74,400	79,800	82,000	85,000
Average Annual Rate of Increase	36% ('66–'70)					15% ('70–'75)	4% ('75–'80)				

Source: Ministry of Commerce of Korea

Production/ supply

As of 1971, three Nylon filament production plants are in operation in Korea, giving a total production capacity of 117.8 ton per day. The raw material caprolactam is increasingly being produced domestically, and it is planned that caprolactam is domestically produced at 33,000 ton per year in 1975 and at 66,000 ton per year in 1980.

Polyester

Demands

The demand for polyester fibers rose from 1,289 tons in 1966 to 19,368 tons in 1970. It is estimated to further increase to 70,535 ton per year in 1975 and 85,000 ton per year in 1980 as shown in Table IV-177.

Table IV-177 Actual and Estimated Demand for Polyester Fibers in Korea

(Unit: tons)

	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	1,289	4,901	10,019	19,037	19,368	70,535	74,842	77,400	79,800	82,000	85,000
Average Annual Rate of Increase	200% ('66–'70)					30% ('70–'75)	4% ('75–'80)				

Source: Ministry of Commerce of Korea

Production/ supply

In Korea, 58 ton per day of polyester filament and 20 ton per day of polyester fibers are being domestically produced, as of 1971. The raw material DMT is domestically produced from 1975 at a capacity of 60,000 ton per year.

(3) Potential Market for Plastics Resins and Synthetic Fibers in Korea

Potential demand volume is obtained by substracting production from demand for each of plastic resins and synthetic fibers. Table IV-178 shows potential demand volumes of plastics and synthetic fibers in Korea over the period 1975-1980.

Table IV-178 Potential Market for Plastics Resins and Synthetic Fibers in Korea

(Unit: tons)

	'75	'76	'77	'78	'79	'80
LDPE	0	0	15,000	33,000	52,000	75,000
HDPE	2,500	11,000	21,000	30,000	41,000	53,000
VCM	24,400	0	0	8,000	21,000	32,000
PVC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Styrene	0	0	5,870	15,040	26,050	39,260
Polystyrene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Polypropylene	4,000	13,000	23,600	33, 00	42,000	48,000
Nylon Fiber	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Polyester Fiber	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Korea

As stated above, inauguration of the naphtha cracker with a capacity of 100,000 ton per year in the petrochemical complex in 1972 indicates that Korea will go on with domestic production of all those products, of which commercialization is also intended in Indonesia. As shown in Table IV-178 much may be expectable for Korea as potential market for some products, but from long-term point of view, Korea can be no more than a spot market on the short-term basis for Indonesian products. This is because domestic production is gradually in progress in Korea, and because import ban is also conceivable on the counterparts of domestically produced items from the fact that the special import system has been additionally enforced, together with the current customs system, as shown in Table IV-179 of tax system and import duties.

Table IV-179 **Tax System and Import Duty in Korea**

Tax System

In case of AID commodity

Tax System = CIF price + Import Duty + Commodity Tax (20%) + Other Import Expense (5%)

In case of KFX (Korean Fund Exchange) commodity

Tax system = CIF price + Import Duty + Commodity Tax (20%) + Other Import Expense (5%) + Special Import Duty*

* Special Import Duty = Domestic Wholesale Price - (CIF Price + Import Duty + Commodity Tax + Other Expense) x 70%

** Domestic wholesale price is determined by the Korean Government at two months intervals.

*** Under the recommendation import system, the Ministry of Commerce and Industry is controlling the volumes of import, while putting an eye on the domestic demand-supply balance of the domestically produced petrochemicals.

Import Duty

Product	Import Duty
PVC Monomer	CIF x 20%
Resin	CIF x 50%
LDPE	CIF x 20%
HDPE	CIF x 20%
Polystyrene	CIF x 20%
Polypropylene	CIF x 20%
Nylon	
Filament	CIF x 30 ~ 60%
Staple	CIF x 60%
Yarn	CIF x 80%
Polyester	
Filament	CIF x 30 ~ 60%
Staple	CIF x 60%
Yarn	CIF x 80%

5.9 MALAYSIA

(1) General Market Situation

The 1971 GNP of Malaysia stood at $4,040 million, up 4.9% over the previous year. This growth rate shows considerable drop, as compared with the past two years' economic growth rates, i.e., 9.4% in 1969 and 6.8% in 1970.

Such slow-down in economic growth is largely attributable to a drop of rubber price and reduction in tin production. Rubber and tin two major products of Malaysia, have been threatened by unstable prices and the fear of exhaust of deposit.

Malaysia has launched a long-term economic plan for the period 1965-1985, with the aim of getting rid of such mono-cultural economy as affected by trend in export of limited primary products and achieving economic development by means of industrialization and diversification of agrigultural sector. This year, 1972, is the third year under the Second Malaysian Plan which sets the target date to 1975.

The economic growth during this period is set to 6.8% on annual average, and the industrial sector is expected to contribute to achieve this objective. That is, the added value-based annual average growth rate of the manufacturing sector is estimated to reach at least 12.5%, and as a result, the proportion of the manufacturing sector in GDP will move up from 13.1% in 1970 to 17% in 1975.

IIA (Investment Incentive Act) has been enforced as one of the policies to achieve the objective of industrialization, and preferential measures in the aspect of taxation have been available to labor intensive industries, with to regard to the extent of capital.

This resulted in brisk applications of foreign-capital companies for starting business in Malaysia in the fields of labor intensive industries such as electronics, clothes and textile.

Such industries, together with plastics processing, transportation equipment, and electric appliances, are likely to support future industrialization.

In the field of petrochemical-related industries, including oil refining, fertilizer, dyestaff, medicine, and plastics processing, major domestic companies have got ties with foreign-capital companies in the form of joint ventures. So far, there has been no plan for a petrochemical complex, mainly because of immature petrochemical market in Malaysia.

There is no prospect for a petrochemical complex at least until 1980. Therefore, Malaysia will continue to be an importing country of petrochemicals in the years to come. Japanese firms are now occupying a total share in the range of 70 to 80% of the total import of petrochemical products in Malaysia. Recently, such firms often came to secure interest in joint ventures, with a proviso that raw materials shall be supplied by them, just as it is the case of commercialization of PVC resin by imported VCM. Under these circumstances, Malaysia cannot be simply listed up as one of export markets for Indonesian petrochemicals.

(2) Market Studies by Product

(a) Plastics

Malaysia's plastics demands are growing, along with successful development of plastics processors, which have been favorably taken as a pioneer industry. Of the various types of plastics, remarkable growth can be seen in polyethylene which has found its way to bags and film as major products. In the future, however, growth of PVC is expected for, because sharp growth is estimated in the demands for such products as pipes, tubes, and plates.

LDPE

Demands

Malaysia's import statistics do not deal with LDPE and HDPE separately, but polyethylene as a whole. Polyethylene as a whole was imported in an amount

Table IV-180 Actual and Estimated Demand for LDPE in Malaysia

(Unit: tons)

		'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	12,800	14,700	25,700	28,300	31,100	34,200	37,600	41,400
	Average annual rate of increase	35%		15%	10%				
b.	Import from Japan	4,703	11,427						
	b / a	37%	77.7%						

Source: Trade Statistics Malaysia, Japan

: JGC Estimates

of 16,000 tons in 1970 and 18,400 tons in 1971, of which LDPE was estimated to occupy about 80% or 12,800 tons in 1970 and 14,700 tons in 1971, respectively. Future demand is expected to grow at 15% per annum until 1975 and at 10% per annum during 1975-1980. Thereby reach 25,700 tons in 1975 and 41,400 tons in 1980 as shown in Table IV-180.

Production/supply

There is and will be no plan for domestic production of LDPE in Malaysia. Total demands have been supplied through import, and Japan's share reached about 80% in 1971. Major suppliers other than Japan are the U.K., the U.S.A., West Germany, and Australia.

Actual Import Price of LDPE in Malaysia

(Unit: $/ton)

'70	255	FOB Japan
'71	231	FOB Japan

HDPE

Demands

On the assumption that the HDPE demand has accounted for 20% of the total polyethylene demand, it is estimated that HDPE has been consumed in an amount of 3,200 tons in 1970 and 3,700 tons in 1971. The annual average growth rate of the HDPE demand has remained as large as 36% for the past five years, although in 1971 the growth rate dropped down to 16% over the previous year. Future demand will grow at 15% per annum until 1975 and at 10% during 1975-1980 as shown in Table IV-181.

Table IV-181 Actual and Estimated Demand for HDPE in Malaysia

(Unit: tons)

		'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	3,200	3,700	6,500	7,200	7,900	8,700	9,500	10,500
	Average annual rate of increase	36%		15%		10%			
b.	Import from Japan	1,663	3,136						
	b / a	52%	85%						

Source: Trade Statistics Malaysia, Japan

: JGC Estimates

Production/ supply

The total HDPE demand is supplied through import, and there is no future plan for domestic production. Similarly as in LDPE, Japan has the largest share of all HDPE suppliers. In 1971, Japan's share reached 85% of the total HDPE import.

Actual Import Price of HDPE in Malaysia

(Unit: $/ton)

1970	225	FOB Japan
1971	199	FOB Japan

VCM

Malaysia has two plans to produce PVC resins. Both plans are already granted approval of the Ministry of Commerce and Industry. Of these plans, Scientific Resin Malaysia's 10,000 ton per year plant in Prai, State of Penang, already in operation since August this year, is scheduled for expansion to a capacity of 18,000 ton per year in the near future. Sumitomo Shoji Kaisha, Ltd., of Japan secured interest in the company and is supplying the company with the total amount of VCM through export from Japan. The other plan is concerned with a joint venture established by Malaysia, Singapore. The joint company is to start production of 10,000 ton per year of PVC in late this year at Johore Bahru, the State of Johore.

Demands

These two plans for domestic production of PVC necessitate 21,000 ton per year of VCM in 1972 as shown in Table IV-182, but since those companies participating in the joint venture have secured interest in it with a proviso that they themselves supply VCM, it is impossible for the third party to act as a supplier.

Table IV-182 Actual and Estimated Demand for VCM in Malaysia

(Unit: tons)

		'72	75	'76	'77	'78	'79	'80
a.	Demand	21,000	21,000	21,000	21,000	21,000	21,000	21,000
b.	Import from Japan	21,000						
	b / a	100%						

Source: Estimated Demand for PVC in Malaysia

Production/supply

There is no plan for domestic production of VCM, as it is supplied by participating companies of Japan.

PVC

If the two domestic production plans are materialized as described in the VCM section, the total production capacity reaches 30,000 ton per year, which will outrun the Malaysian PVC demand to a large extent. Therefore, there is strong possibilities that measures on import restriction will be taken with a view to protecting domestic products. Furthermore, it is expected that export of PVC resins, which stood at only 152 tons in 1969, will increase in the future.

Demands

PVC was consumed in an amount of 2,930 tons in 1969 and 1,[illegible] tons in 1970, mainly for use in pipes and tubes as shown in Table IV-101. With the aforementioned domestic production of PVC resins, the demand is expected to rapidly increase.

Table IV-101 [illegible]

		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a	Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average annual rate of increase	[illegible]	[illegible]	[illegible]						
b	Import from Japan	[illegible]	[illegible]	[illegible]	[illegible]					
	b/a	[illegible]	[illegible]	[illegible]						

Source: [illegible]

Production, supply

[illegible] the demands for PVC resins in Malaysia have been supplied through import. Large suppliers are the U.S., Japan and West Germany. [illegible] with the progress in the above two domestic production plans, Malaysia may shift from PVC resin importing country to exporting country. [illegible] PVC resins in Malaysia cannot be expected [illegible] accordingly.

[illegible] Import Price of PVC in Malaysia

[illegible]

[illegible]	[illegible]	FOB Japan
[illegible]	[illegible]	FOB Japan

[illegible]

At present, [illegible] Malaysia is granted governmental approval for the commercialization of polystyrene. Date of commercialization and production capacity have not yet been clarified. After commercialization, it is sure that [illegible] group of Japan which has showed interest in the company will supply the company with styrene. It is unlikely that another supplier will supply the company with styrene.

Polystyrene

Demand

Malaysia's polystyrene demand has [illegible] from [illegible] tons in [illegible] to [illegible] tons in 1976. An annual average rate of growth was [illegible] in the years [illegible]–1976.

as shown in Table IV-184. The demand is expected to grow, mainly for use in the packaging industry.

Table IV-184 **Actual and Estimated Demand for Polystyrene in Malaysia**

(Unit: tons)

		'69	'70	'75	'76	'77	'78	'79	'80
a.	Demand	1,221	1,750	3,500	3,900	4,200	4,700	5,100	5,600
	Average annual rate of increase	'66 ⎿ 28% ⏌		⎿ 15% ⏌	⎿ 10%				⏌
b.	Import from Japan	963	1,600						
	b / a	79%	92%						

Source: JGC Estimates

Production/ supply

At present, the total polystyrene demands are supplied through import. In 1970, the import from Japan occupied 92% of the total polystyrene import. As stated before, Scientific Resins Malaysia is planning on domestic production of polystyrene, but the date of commercialization is not yet clarified.

Actual Import Price of Polystyrene in Malaysia

(Unit: $/ton)

1969	206	FOB Japan
1970	234	FOB Japan
1971	241	FOB Japan

Polypropylene

In Malaysia, polypropylene is statistically grouped in

"Other polymerization products", and isolated figures are not available for polypropylene only. The total demand is now supplied through import. In both 1970 and 1971, polypropylene from Japan occupied almost 100% share.

Demands

PP was consumed in an amount of 2,183 tons in 1970 and 4,608 tons in 1971 as shown in Table IV-185, mainly for use in woven bags. Future demand is estimated to grow at 20% per annum until 1975 and at 15% during 1975-1980.

Table IV-185 Actual and Estimated Demand for Polypropylene in Malaysia

(Unit: tons)

		'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	1,192	2,183	4,608	7,000	8,000	9,000	11,000	12,000	14,000
	Average annual rate of increase			20%				15%		
b.	Import from Japan	1,192	2,183	4,608						
	b / a	100%	100%	100%						

Source: JGC Estimates

Production/ supply

There is and will be no plan for domestic production of polypropylene. As stated above, the total demand was supplied through import from Japan in 1971.

Actual Import Price of Polypropylene in Malaysia

(Unit: $/ton)

'69	307	FOB Japan
'70	281	FOB Japan
'71	195	FOB Japan
'72 June	202	FOB Japan

(b) Synthetic Fibers

In Malaysia, the 1970 demand for synthetic fibers stood at 9, 300 tons, with per-capita consumption amounting to 0. 8 kg. The per-capita consumption has been increasing by 0. 1 kg each year since 1965. If this upward trend will continue until 1980, it is estimated that the per-capita consumption rises to 1. 3 kg and the total demand to 17, 000 tons in 1975. They will further rise to 1. 8 kg and 26, 600 tons, respectively, in 1980 as shown in Table IV-186.

Table IV-186 Actual and Estimated Demand for Synthetic Fibers in Malaysia

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	2, 100	1, 900	3, 200	5, 000	8, 000	9, 300	17, 000	18, 700	20, 600	22, 600	24, 700	26, 600

Source: FAO
JGC Estimates

Nylon

Demands

The Nylon demand occupied about 20% of the synthetic fiber demand in 1970 in Malaysia. This rate is estimated to continue in the future, the consumption of

Nylon will amount to 3,600 tons in 1975 and 5,600 tons in 1980 as shown in Table IV-187.

Table IV-187 **Estimated Demand for Nylon in Malaysia**

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	3,600	3,900	4,300	4,700	5,200	5,600

Source: FAO
JGC Estimates

Production/ supply

At present, the total demand is supplied through import, and there is no plan for domestic production.

Polyester

Demands

As of 1970, the polyester demand occupies about 60% of the synthetic fiber demand in Malaysia. This rate is applied to the 1975 and 1980 demands to give 10,700 tons and 16,800 tons, respectively as shown in Table IV-188.

Table IV-188 **Estimated Demand for Polyester in Malaysia**

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	10,700	11,800	13,000	14,200	14,900	16,800

Source: FOA
JGC Estimates

Production/supply

The total demand is supplied through import and there is no domestic production plan.

(3) Potential Markets for Plastics Resins and Synthetic Fibers in Malaysia

Potential market scale has been calculated for each item plastic resins and synthetic fibers from its demand and its volume of production, and the results of calculation are given in Table IV-189.

Table IV-189 Potential Market for Plastics Resins and Synthetic Fibers in Malaysia

(Unit: tons)

	'75	'76	'77	'78	'79	'80
LDPE	25,700	28,300	31,100	34,200	37,600	41,400
HDPE	6,500	7,200	1,900	8,700	9,500	10,500
VCM	21,000	21,000	21,000	21,000	21,000	21,000
PVC	0	0	0	0	0	0
Styrene	na	na	na	na	na	na
Polystyrene	3,500	3,900	4,200	4,700	5,100	5,600
Polypropylene	7,000	8,000	9,000	11,000	12,000	14,000
Nylon Fiber	3,600	3,900	4,300	4,700	5,200	5,600
Polyester Fiber	10,700	11,800	13,000	14,200	14,900	16,800

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Malaysia

Possible volumes of export were calculated on the assumption that Indonesian products would occupy 20 to 30% of the remaining share, after Japan's estimated share has been subtracted from the entire potential market for each plastic resin as given in Table IV-180. For reference, values obtained when Indonesia has occupied 20% of the Japanese share are also given. PVC resins and polystyrene are showing the trend toward domestic production, but since monomer suppliers are already determined, there is no possibility of export from Indonesia. As for synthetic fibers, we assumed that Indonesian products would occupy 5-10% of the entire potential market as shown in Table IV-190.

Table IV-190 **Export Possibility of Indonesian Plastics Resins and Synthetic Fibers to Malaysia**

(Unit: tons)

		'75	'76	'77	'78	'79	'80
LDPE	Min.	1,300	1,400	1,600	1,700	1,900	2,100
	Max.	2,100	2,300	2,500	2,700	3,000	3,300
	*	5,100	5,700	6,200	6,800	7,500	8,300
HDPE	Min.	300	300	300	300	400	400
	Max.	400	400	500	500	600	600
	*	1,300	1,400	1,600	1,700	1,900	2,100
VCM	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	2,100	2,100	2,100	2,100	2,100	2,100
PVC	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	0	0	0	0	0	0
Styrene	Min2.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
		na	na	na	na	na	na
Poly-styrene	Min.	100	100	100	100	100	100
	Max.	100	100	100	100	200	200
		700	[illegible]	[illegible]	[illegible]	1,000	1,100
Poly-propylene	Min.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Max.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		1,[illegible]	1,[illegible]	[illegible]	[illegible]	2,[illegible]	[illegible]
Nylon Fiber	Min.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Max.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polyester Fiber	Min.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Max.	1,[illegible]	[illegible]	[illegible]	[illegible]	1,[illegible]	1,[illegible]

[illegible]

Table IV-191 **Tax System and Import Duty in Malaysia**

Tax System

Tax System = CIF Price + Import Duty + Sur Tax (2% of CIF Price)

Import Duty

Product	Import Duty
PVC	0%
LDPE	0%
HDPE	0%
Polystyrene	0%
Polypropylene	0%
Nylon	
Filament	0%
Staple	0%
Yarn	0%
Polyester	
Filament	0%
Staple	0%
Yarn	0%

5.10 NEW-ZEALAND

(1) General Market Situation

The New-Zealand economy must have experienced continuously growing inflation in the year 1971/1972, with its substantial growth rate remaining on the 4% level.

In order to put down inflation, the Government took various measures in 1971, e.g., price justification scheme, tight-money policy, tax hike, etc., which in turn resulted in lowered corporate profit, reduction in investment on plant and equipment in private sectors, and overall stagnant conditions in economic activities.

In the manufacturing industry, growth of production sharply dropped from 9.1% in 1970 to a 3.6% in 1971. It should be noted that the national economy has been supported by processing of domestic agricultural products and the country depends on import for most of industrial goods as shown in Table IV-192.

Table IV-192 Import Structure in New-Zealand

	1970
Food	5%
Raw Materials	6%
Fuel and Oil	8%
Industrial Products	81%
Total	100%

The Government has recently been making much efforts to develop modern industries with high added value, aiming at getting rid of this situation. However, because of labor shortage, insufficient funds, and small domestic market, the Government may not be able to reform its conventional pattern of agricultural economy in so short period.

There has been no plan for petrochemical industrialization, and the past trend of petrochemical import will be followed in the future.

In 1970, New-Zealand imported $123 million worth of chemicals (16.5% increase over the previous year) including plastics raw materials. This corresponds to about 12% of the total 1970 import ($1,033 million). Since New-Zealand is a member of the British Commonwealth, a

Table IV-193 **Each Export Country's Share of Polymers and Co-polymers in New-Zealand**

	'63	'65	'67	'69
	%	%	%	%
The U. K.	48	46	34	24
Japan	5	11	23	33
Australia	5	16	18	16
U. S. A.	30	18	13	10
West Germany	5	4	8	6
South Africa	-	-	-	4
Canada	-	-	-	3
France	2	1	-	-
Italy	2	1	2	1
Netherlands	1	1	2	1
China	-	-	-	1
Others	2	2	-	1
Total	100	100	100	100

major amount is imported from the member countries for which preferencial measures are taken in the customs duties. By money term about 65% of the total import came from member countries in 1970. In the case of petrochemicals, however, a recent tendency is that the Japanese share is taking place of the U.K. and the U.S.

Table IV-194, shows trend in shares of exporting countries in the markets of polymers and co-polymers.

(2) Market Studies by Product

(a) Plastics

In January 1970, the New-Zealand Government has abolished the import licensing system, except on PVC resin and compound, which had been set up for coordination of import volumes (Under the system, importer other than licensed ones cannot do import business). This will promise more growth of import of various plastic resins in 1970's. Major resin suppliers to

Table IV-194 Each Country's Share in Plastics Market in New-Zealand

	'63	'65	'67	'69
Japan	5%	11%	23%	33%
The U. K.	48%	46%	34%	24%
Australia	5%	16%	18%	16%
U. S. A.	30%	18%	13%	10%
W. Germany	5%	4%	8%	7%
Canada	-	-	-	3%
Others	7%	5%	4%	7%
Total	100%	100%	100%	100%

New-Zealand both in 1965 and 1969 are as given in Table IV-194.

Japan had already the largest share of [illegible] in 1969, and owing to the abolition of the afore-mentioned import licensing system, Japan is expected to enlarge its share during 1970's.

LDPE

Demands

There was 14,852 tons of LDPE consumption in 1971, mainly for use in cable insulation, sheets, and coating. Future demand is estimated to grow at 10 [illegible]% per annum until 1975 and at 7% per annum during 1975-1980 as shown in Table IV-195

Table IV-195 Actual and Estimated Demand for LDPE in New-Zealand

[illegible]

		'69	'70	'71	'75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a.	Demand	12,300	13,605	14,852	22,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average annual rate of increase	[illegible] 10 [illegible]		[illegible] 10 [illegible]			[illegible]			
b.	Import from Japan		4,750	[illegible]						
	b/a		15%	16%						

Source: [illegible]

Production/supply

Alex Harvey Industries is studying the possibility of domestic production of LDPE, but the company has not decided on the production scale and the date of [illegible] [illegible], as of the present time. It is [illegible] likely that production [illegible] in 1970.

Actual Import Price of [illegible] in New Zealand

1970	[illegible]	[illegible]
1971	[illegible]	[illegible]

[illegible]

Demand

The 1971 demand for [illegible] reached [illegible] [illegible] as large as [illegible] demand [illegible] [illegible]. The annual average growth rate of [illegible] was marked during the period [illegible] 1971. [illegible] demand is expected to grow at [illegible] per annum until 1971 and at [illegible] per annum during [illegible] as shown in Table [illegible].

[illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

already been produced in the country, and import license is necessary for importing PVC compound.

Production, supply

PVC compound was produced in an amount of 7,004 tons in 1969 and 9,148 tons in 1970. The PVC resin required has been supplied through import. There is no future plan for domestic production of PVC resin. At present, Japan and the U.K. occupy larger shares in the PVC resin market.

Actual Import Prices of PVC Resins in New Zealand

(Unit: $/ton)

1969	[illegible]	FOB Japan
1970	[illegible]	FOB Japan
1971	[illegible]	FOB Japan

Styrene

Demand

Polystyrene is not domestically produced now and in the future, and no demand will be expected for styrene.

Polystyrene

Demand

[illegible]

Table IV - 198 Actual and Estimated Demand for Polystyrene in New-Zealand

(Unit : tons)

		'68	'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	4,0[illegible]	n.a	n.a	n.a	7,000	8,000	[illegible]	[illegible]	9,000	10,500
	Average annual rate of increase	10% ('64-68)		10%					6%		
b.	Import from Japan	[illegible]	789	1,075	1,[illegible]						

Source : Trade Statistics
IC Estimates

Production/supply

Total needs are supplied through import, with no domestic production being planned.

Actual Import Price of Polystyrene in New-Zealand

(Unit : $ ton)

1969	275	FOB Japan
1970	27[illegible]	FOB Japan
1971	[illegible]	FOB Japan

Polypropylene

Demand

Polypropylene demand stood at [illegible] tons in 1969 and [illegible] tons in 1970. During this period, and annual average growth rate of [illegible]% was recorded. Future demand will grow at [illegible]% per annum until 1975 and at [illegible]% per annum during 1976-1980 as shown in Table IV-199.

Table IV-199 Actual and Estimated Demand for Polypropylene in New-Zealand

(Unit: tons)

		'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	1,000	n.a.	1,300	2,000	2,200	2,300	2,500	2,800	3,000
	Average annual rate of increase	14%		11%	9%					
b.	Import from Japan	129	386	491						
	b/a	13%	n.a.	38%						

Source: Trade Statistics; [illegible] Estimates

Production/supply

The total polypropylene demand is now supplied through import, with no plan for domestic production.

Actual Import Prices of Polypropylene in New Zealand

(Unit: $/ton)

1969	[illegible]	FOB Japan
1970	[illegible]	FOB Japan
1971	[illegible]	FOB Japan

(b) Synthetic Fibers

[illegible]

We assumed that if the per-capita consumption trends upward at the same rate of 0.44 kg per annum as during 1965-1970, it is estimated to reach 6.7 kg in 1975 and 8.9 kg in 1980. As a result, the demand will amount to 26,500 tons in 1975 and 40,600 tons in 1980 as shown in Table IV - 200.

Table IV - 200 [illegible]

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Table IV - [illegible]

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Production/supply

Fibremakers (N.Z.) Ltd. and Chemical Fibers Division of Holeproof Mills, Ltd. are producing Nylon in New-Zealand. Although their production capacities are not opened the total Nylon production of both companies amounted to 1,[illegible] tons in 1970, resulting in about [illegible]% of the rate of domestic production.

Polyester

Demands

The polyester fiber demand occupied [illegible] of the synthetic fiber demand in 1970. The demand will not be varied from this rate, it will reach [illegible] tons in 1975 and 11,[illegible] tons in 1980 as shown in Table IV-[illegible].

Table IV-[illegible] Estimated Demand for Polyester Fibers in New-Zealand

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Demand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: [illegible]

Production/supply

[illegible]

[illegible]

(9) Potential Market for Plastics Resins and Synthetic Fibres in New Zealand

Table IV.(9) shows potential market [illegible] and synthetic fibres in New Zealand [illegible]

Table IV.(9) Potential Market [illegible] Plastics Resins and Synthetic Fibres [illegible] New [illegible]

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VCM	[illegible]	[illegible]	[illegible]			[illegible]
PVC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Styrene	[illegible]	[illegible]	[illegible]			
Polystyrene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polypropylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nylon Fibre	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polyester Fibre	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Fibres in New Zealand

[illegible]

Table IV.-[illegible] [illegible] in New Zealand

		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]						
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]						
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Table IV-[illegible] **Tax System and Import Duty in New-Zealand**

Tax System

Tax System : CIF Price + Import Duty

Import Duty

Product	Import Duty
PVC	[illegible]
LDPE	[illegible]
HDPE	[illegible]
Polystyrene	[illegible]
Polypropylene	[illegible]
Nylon	
Filament	Market Price [illegible]
Staple	[illegible]
Yarn	Market Price [illegible]
Polyester	
Filament	Market Price [illegible]
Staple	[illegible]
Yarn	Market Price [illegible]

5.11 THE PHILIPPINES

(1) General Market Situation

The Philippine economy has attained a substantial growth rate of GNP as high as 6% on average during 1967-1970, under the economic expansion policies taken in the 4-year plan. This surely encouraged the demands for imports of mainly machinery and capital goods, but on the other hand, sharp reduction in foreign exchange reserves was incurred in around 1969 as shown in Table IV-[illegible].

Table IV-[illegible] Foreign Exchange Reserves in the Philippines

(Unit: $1,000,000)

'66	'67	'68	'69	'70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

In order to avoid economic troubles that may be caused by such reduction in reserves, the Government [illegible] measures to suppress imports in 1970 [illegible]

[illegible]

In the case of manufacturing industry, its proportion in the national net production dropped from 17.1% in 1969 to 16.7% in 1970, chiefly because of difficulty in obtaining raw materials and tight-money situation.

In the petrochemical industry, four refineries have been put into operation since the start of oil refining in 1959. Using off-gas from these refineries, 4 chemical fertilizer makers, 5 synthetic detergent makers, and 2 synthetic textile makers are doing business. However, at present, there is no petrochemical industry of the integrated complex type.

The petrochemical industry is listed in the second investment priority plan ([illegible]-1970) as an industry included in those sectors to which the highest priority is given. [illegible] has already conducted a feasibility study on a petrochemical complex, as shown in Table IV-[illegible], in which a 100,000 ton per year ethylene plant is the center. Result of this study has been reflected in the fourth investment priority plan ([illegible]).

[illegible]

Table IV-207 Petrochemical Planning by BOI of the Philippines

(Unit: tons/yr.)

Ethylene	300,000
LDPE	165,000
HDPE	80,000
Polypropylene	52,000
PVC	120,000

Fund Requirements

(Unit: $1,000)

(a)	Without customs duties on naphtha	170,700
(b)	With customs duties on naphtha	178,300

The Project's estimated returns

	(a)	(b)
Returns on [illegible]	[illegible]	[illegible]
Returns on investment	[illegible]	[illegible]

[illegible]

[illegible]	[illegible] years	[illegible] years
Investment	[illegible] years	[illegible] years

[illegible]

[illegible]

the annual average growth rate has continued to stay as high as [illegible]%.

Except in the case of PVC, all the resins within the survey scope are supplied by imports. Japan occupies a share as large as [illegible]% of the total import.

LDPE

Demands

Philippines demand for LDPE amounted to about [illegible] tons in [illegible], which was mainly used for [illegible] molding and extrusion. Future demand is estimated to grow at [illegible]% per annum until 1975 and at 10% per annum during 1975 - [illegible] as shown in Table IV - [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

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[illegible]	[illegible]	[illegible]
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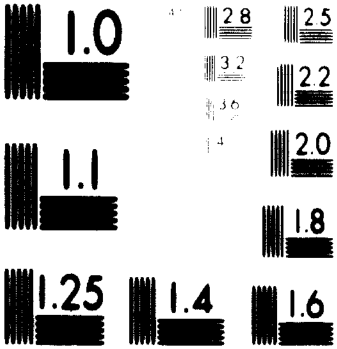

MICROCOPY RESOLUTION TEST CHART

24x

E

Affected by this line of industrial policies, the petrochemical complex construction plan, though once actively studied, is now making no actual progress. The Sumitomo Chemical group, C Itoh & Co. group, and Mitsubishi group, as candidates for plan execution, have not shown their big efforts for plan realization. Major international oil companies in Singapore have also had no intention to act as the direct plan executors, since 1968 when AIDC announced a plan for construction of a petrochemical center of naphtha cracking type in Singapore.

Meanwhile, Economic Development Board (E. D. B.) i. e., the institution in charge of industrialization of Singapore, has admitted that no application nor investigation was made for the realization of the petrochemical center in Singapore, although the said plan was again confirmed and recommended in the AIDC Report published in 1972 and yet the Singapore Government seemed not to give up its establishment. The delay found in Singapore's petrochemical industrialization is probably due to the following reasons:

Domestic demand only can hardly catch up with the scale of the petrochemical industry. Therefore, the plan executor must secure overseas markets sufficient to absorb a major part of production. Even if a Japanese group makes use of its sales ability, this may not be possible unless products are taken into Japan. However, recent demand tightness in Japan would make the situation more difficult.

There is reportedly a limitation in supply capacity of industrial water in Singapore. In fact, establishment of water-consuming industries such as dyestaff, spinning, and paper-making is extremely restricted. Therefore, Singapore provides no suitable location conditions for the petrochemical industry which requires a large amount of purified industrial water.

As the afore-mentioned problems can not be solved in not-so-distant future, Singapore is not likely to have a petrochemical complex until after middle 1980's, during which time Japan is anticipated to become an importing country of petrochemical intermediates and finished products.

(2) Market Studies by Product

(a) Plastics

According to Singapore's import statistics, imports of various plastic resins and compound from Japan reached 80 to 90% of the total import in 1971.

LDPE

LDPE and HDPE are not separately dealt with in External Trade Statistics published by Singapore. However, judging from the fact that they are almost supplied from Japan. We can apply a demand ratio 80: 20 for LDPE and HDPE in the Singapore market according to the Japanese export statistics.

Demands

About 18,000 tons of LDPE was consumed in 1971 for use in film, drinking straws, and for miscellaneous uses. LDPE demand is estimated to grow at 15% per annum until 1975 and at 11% per annum during 1975-1980 as shown in Table IV-224, 225.

Table IV-224 Demand Pattern of LDPE in Singapore

Film	75%
Drinking Straws	10%
Miscellaneous	15%
	100%

Source: Japanese Trading Company

Table IV-225 Actual Demand for LDPE in Singapore

(Unit: tons)

		'69	'70	'71	'75	'76	'77	'78	'79	'80
(a)	Demand	12,900	15,200	17,600	30,800	34,200	37,900	42,200	46,700	51,600
	Average annual rate of increase	29%		15%		11%				
(b)	Import from Japan	10,300	13,100							
	(b)/(a)	80%	86%							

Source: Trade Statistics
JGC Estimates

Production/supply

The largest LDPE supplier is Japan, which supplied 13,100 tons of LDPE or 86% of the total import in 1970. There is no future plan for domestic production.

Actual Import Price of LDPE in Singapore

(Unit: $/ton)

1970	264	FOB Japan
1971	232	FOB Japan

HDPE

Demands

HDPE was imported in an amount of 3,400 tons in 1970 and 4,400 tons in 1971, mainly for use in household utensils, monofilaments and tapes. Future HDPE demand will grow at 15% per annum until 1975 and at 11% per annum during 1975-1980 as shown in Table IV-226, 227.

Table IV-226 Demand Pattern of HDPE in Singapore

Film	4%
Household Utensils	70%
Monofilament & Tapes	35%
Miscellaneous	1%
	100%

Source: Japanese Trading Company

Table IV-227 Actual and Estimated Demand for HDPE in Singapore

(Unit: tons)

		'70	'71	'75	'76	'77	'78	'79	'80
(a)	Demand	3,400	4,400	7,700	8,500	9,500	10,500	11,700	12,900
	Average annual rate of increase	'66 — 29% — (to '71)		— 15% — (to '75)			— 11% — (to '80)		
(b)	Import from Japan	2,067	3,765						
	(b)/(a)	61%	86%						

Source: Trade Statistics
JGC Estimates

marked a high degree (30%) of contribution to industrial

Production/supply

At present, total demands are supplied through import, and there is no plan for domestic production. About 90% of the total import depends on Japan.

Actual Import Prices of HDPE in Singapore

(Unit: $/ton)

1970	241	FOB Japan
1971	201	FOB Japan

VCM

Demands

In 1971 Singapore Polymer jointly established by Singapore Development Bank, and China Gulf started production of 10,000 ton per year of PVC resins. Thus VCM has been consumed by the company at about 11,000 ton per year as shown in Table IV-228.

Table IV-228 Actual and Estimated Demand for VCM in Singapore

(Unit: tons)

	'72	'75	'76	'77	'78	'79	'80
(a) Demand	11,000	11,000	11,000	11,000	11,000	11,000	11,000
(b) Import from Japan	11,000						
(b)/(a)	100%						

Production/supply

There is no plan for VCM production in Singapore. At present, the VCM need is all supplied from Sumitomo

Chemical Co. of Japan to Singapore Polymer. VCM purchasing from the Sumitomo group is a condition provided when the group has taken interest in Singapore Polymer, VCM will be supplied solely by Sumitomo Chemical in the future.

PVC

PVC resin and compound are the sole plastics raw materials, on which customs duties are levied with a view to protecting domestic industry. PVC compound makers in Singapore are shown in Table IV-229.

Table IV-229 Singapore PVC Compound Makers

Name of Companies	Production (Unit: tons/month)
Mazuda	350
Greenland	200
Nmatow	100
Yamatai	100
Kongjw	250

Demands

PVC was imported in an amount of 15,935 tons in 1971, mainly for use in extrusion and injection molding sky leather, floor tiles, etc. Of this amount, 1,771 tons were re-exported. Domestic demand stood at 14,341 tons. Future demand will grow at 15% per annum until 1975 and 10% per annum during 1975-1980 as shown in Table IV-230, 231.

Table IV-230 Demand Pattern of PVC in Singapore

Extrusion and Injection Molding	60%
Sky Leather	25%
Floor Tiles	10%
Miscellaneous (including bottles)	5%
	100%

Table IV-231 Actual and Estimated Demand for PVC in Singapore

(Unit: tons)

	'69	'70	'71	'75	'76	'77	'78	'79	'80
(a) Import	8,233		15,935						
(b) Re-export	850		1,771						
(c) Demand (a)-(b)	7,383		14,341	25,100	27,600	30,400	33,400	36,700	49,400
Average annual rate of increase			15%		10%				
(d) Import from Japan	4,739	6,665	9,712						
(b)/(a)	58%		61%						

Source: Trade Statistics
JGC Estimates

Production/ supply

As described in the preceding VCM section, Singapore Polymer started PVC production in the autumn of 1971 in an amount of 10,000 ton per year to meet the domestic demands.

Actual Import Price of PVC in Singapore

(Unit: $/ton)

	PVC Resins		PVC Compound	
1969	285	FOB Japan	323	FOB Japan
1970	235	FOB Japan	335	FOB Japan
1971	235	FOB Japan	309	FOB Japan

Styrene

As a joint-venture of Idemitsu Petrochemical of Japan and Singapore Polymer Co., for 10,000 ton per year polystyrene production is said to be realized within one year or two, we can expect a considerable market for styrene in the future as shown in Table IV-232.

Table IV-232 Actual and Estimated Demand for Styrene in Singapore

(Unit: tons)

	'69	'70	'71	'75	'76	'77	'78	'79	'80
(a) Demand	0	0	0	10,200	10,200	10,200	10,200	10,200	10,200
(b) Import from Japan	0	0	0	10,200	10,200	10,200	10,200	10,200	10,200
(b)/(a)				100%	100%	100%	100%	100%	100%

Source: Trade Statistics
JGC Estimate

Polystyrene

Demands

As shown in Table IV-233, 234, polystyrene was imported in an amount of 4,162 tons in 1971, for use in containers, decorative materials, and for miscellaneous uses. Of this amount, 624 tons was re-exported, leaving 3,538 tons for domestic demand. However, concurrently with the domestic production plan described above and the development of the electronics industry, the polystyrene demand is expected to largely increase in the future for use in packaging and molded casings. Future demand is estimated to grow at 20% per annum until 1975 and at 12% per annum during 1975-1980.

Table IV-233 **Demand Pattern of Polystyrene in Singapore**

Containers	60%
e. g. Custom Molding	
Other Packaging	
Decorative Materials	30%
Toys	5%
Miscellaneous	5%
	100%

Table IV-234 **Actual and Estimated Demand for Polystyrene in Singapore**

(Unit: tons)

	'69	'70	'71	'75	'76	'77	'78	'79	'80
(a) Import	2,843	n.a.	4,162						
(b) Re-export			624						
(c) Demand (a)-(b)			3,538	7,400	8,300	9,300	10,400	11,600	13,000
Average annual rate of increase				20%		12%			
(d) Import from Japan	1,937	2,160	2,517						
(d)/(a)	69.3%	n.a.	62%						

Source: Trade Statistics
JGC Estimate

Production/supply

At present total demands are supplied through import. As for the shares of suppliers in the total import, Japan occupied an outstanding share of 72% in 1970. The rest are 12% of West Germany and 11% of the U.S. As described before, it is said to be realized 10,000 ton per year plant of polystyrene within one year or two. After completion of the plant, it seems that there is no possibility to export polystyrene to Singapore.

Actual Import Price of Polystyrene

(Unit: $/ton)

1969	202	FOB Japan
1970	212	FOB Japan
1971	233	FOB Japan

Polypropylene

Demands

Polypropylene was imported in an amount of 1,000 tons in 1969 and 1,500 tons in 1970, mainly for use in stretch tapes for typewriters, household utensils, and film for packaging. The demand is expected to grow by exploitation of new demand fields such as carpets and

Table IV-235 Demand Pattern of Polypropylene in Singapore

Stretch Tapes (for Typing)	55%
Household Utensils	20%
Film for Packaging	20%
Miscellaneous	5%
	100%

artificial grass. We assum the demand will grow at 22% per annum during 1971-1975 and at 18% per annum during 1975-1980 as shown in Table IV-235, 236.

Table IV-236 Actual and Estimated Demand for Polypropylene in Singapore

(Unit: tons)

	'69	'70	'71	'75	'76	'77	'78	'79	'80
(a) Demand	1,000	1,500	4,300	4,000	4,700	5,500	6,500	7,600	9,000
Average annual rate of increase		22%			18%				
(b) Import from Japan	700	1,000	3,420						
(b)/(a)	70%	70%	80%						

Source: Trade Statistics
JGC Estimates

Production/ supply

Total PP demand is supplied through import, and there is no future plan for domestic production. Japan occupied the largest share of 70% in 1970 and 80% in 1971.

(b) Synthetic Fibers

As of 1970, synthetic fibers are not domestically produced in Singapore, and a demand of 41,900 ton per year is imported in 1970. This amount includes re-export of 6,900 tons, and the actual domestic demand stood at 35,000 tons. The 1965 demand amounted to 2,800 tons domestically, and thus the demand has grown at a high average rate of 60% during 1965-1970.

However, so far as recent three years are concerned, the growth rate stayed on a 30% level, because the demand may hit the ceiling. As we assume demand growth will be 20% per annum until 1975 and 10% during 1975-1980, the demand will reach 87,500 tons in 1975 and 140,000 tons in 1980 as shown in Table IV-237.

Table IV-237 Actual and Estimated Demand for Synthetic Fibers in Singapore

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	2,800	6,700	9,100	21,200	28,300	35,000	87,500	96,300	105,900	110,500	128,100	140,000
Average annual rate of increase	60% ('65–'70)					20% ('70–'75)		10% ('75–'80)				

Source: FAO
JGC Estimates

Nylon

Demands

The Nylon demand occupied about 30% of the synthetic fiber demand in 1970 in Singapore. We assumed that this rate will continue in the future, the demand is estimated to reach 25,400 tons in 1975 and 40,600 tons in 1980 as shown in Table IV-238.

Table IV-238 Estimated Demand for Nylon in Singapore

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	25,400	27,900	30,700	33,800	37,000	40,600

Source: FAO
JGC Estimates

Production/supply

Total demand is supplied through import, and there is no plan for domestic production.

Polyester

Demands

The polyester demand occupied about 60% of the synthetic fiber demand in 1970. We assume that this rate will continue in the future, the demand is estimated to reach 54, 300 tons in 1975 and 86, 800 tons in 1980 as shown in Table IV- 239.

Table IV- 239 Estimated Demand for Polyester Fibers in Singapore

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	54, 300	59, 700	65, 700	72, 200	79, 400	86, 800

Source: FAO
JGC Estimates

Production/ supply

At present, Singapore Nylon Corporation (PTE), Ltd. is producing polyester fiber, but its production capacity is not disclosed.

(3) Potential Market for Plastics Resins and Synthetic Fibers in Singapore

The potential market of resins and synthetic fibers has been summerized for the period 1975-1980, as shown in Table IV-240. VCM, PVC Styrene and Polystyrene markets have been decided taking into account the volumes of domestically produced PVC resin and polystyrene.

Table IV-240 Potential Market for Plastics Resins and Synthetic Fibers in Singapore

(Unit: tons)

	'75	'76	'77	'78	'79	'80
LDPE	30,800	34,200	37,900	42,200	46,700	51,600
HDPE	7,700	8,500	9,500	10,500	11,700	12,900
VCM	11,000	11,000	11,000	11,000	11,000	11,000
PVC	14,100	17,600	20,400	23,400	25,700	30,400
Styrene	10,200	10,200	10,200	10,200	10,200	10,200
Polystyrene	0	0	0	0	0	0
Polypropylene	4,000	4,700	5,500	6,500	7,600	9,000
Nylon Fiber	25,400	27,900	70,700	33,800	37,000	40,600
Polyester Fiber	54,300	59,700	65,700	72,200	79,400	86,800

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Singapore

Based upon the potential markets of resins and fibers in Singapore possible exports of Indonesian products have been calculated, as shown in Table IV-241, assuming a share range of Indonesian products. As for plastics, Japan will continue to be the largest supplier in the Singapore plastics market in the future. Thus Indonesia's minimum and maximum shares have been set to 20% and 30%, respectively, of the remaining market, after Japan's share has been subtracted from the entire potential market. As reference values, those figures obtained when Indonesia has occupied 20% of the Japanese share are also given. As for synthetic fibers, we assumed that Indonesian products would occupy 5-10% of the entire potential market.

Table IV-241 Export Possibility of Indonesian Plastics Resins and Synthetic Fibers to Singapore

(Unit: tons)

		'75	'76	'77	'78	'79	'80
LDPE	Min.	700	700	800	800	900	1,000
	Max.	900	1,100	1,100	1,300	1,400	1,500
	*	6,200	6,800	7,600	8,400	9,300	10,000
HDPE	Min.	200	200	200	200	200	300
	Max.	200	300	300	300	400	400
	*	1,500	1,700	1,900	2,100	2,300	2,600
VCM	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	2,200	2,200	2,200	2,200	2,200	2,200
PVC	Min.	700	900	1,200	1,400	1,700	2,000
	Max.	1,100	1,400	1,700	2,100	2,500	2,900
	*	1,800	2,300	2,900	3,500	4,000	4,900
Styrene	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	2,000	2,000	2,000	2,000	2,000	2,000
Poly-styrene	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	0	0	0	0	0	0
Poly-propylene	Min.	200	200	200	300	300	400
	Max.	200	300	300	400	500	500
	*	800	900	1,100	1,300	1,500	1,800
Nylon Fiber	Min.	1,300	1,400	1,500	1,700	1,900	2,000
	Max.	2,500	2,000	3,100	3,400	3,700	4,100
Polyester Fiber	Min.	2,700	3,000	3,300	3,600	4,000	4,300
	Max.	5,400	6,000	6,600	7,200	7,900	8,700

* Calculated on the assumption that Indonesian plastics resins would secure 20% of Japanese Share.

Table IV-242 Tax System and Import Duty in Singapore

Tax System

Tax System = CIF Price + Import Duty

Import Duty

Product	Import Duty
PVC	5%
LDPE	0%
HDPE	0%
Polystyrene	0%
Polypropylene	0%
Nylon	
Filament	0%
Staple	0%
Yarn	0%
Polyester	
Filament	0%
Staple	0%
Yarn	0%

5.13 SRI-LANKA

(1) General Market Situation

Sri-Lanka's GDP hit the highest level of a substantial growth rate of 8.3% over the previous year in 1968, but sharply dropped down to 5.1% in 1969, 4.1% in 1970, and 0.9% in 1971. This is mainly due to decreased exports, the Government's intensified restriction of bank loans to reduce the demands for consumer goods, and depressed production in the private sector caused by restrictive import. The 1971 gross domestic products (GDP) can be broken down into the industry sectors as shown in Table IV-243.

Table IV-243 Proportion of the GDP by Industry in Sri-Lanka

	1971
Agriculture & fisheries	32.5%
Mining	0.7
Manufacturing	12.5
Construction	6.2
Electricity, gas, & water-works	0.3
Transportation, communications, & warehouses	10.0
Trade firms	15.1
Financing & real estate	1.3
Administration & defense	3.4
Others	17.4
	100.0%

As can be seen in Table IV-243, agriculture has a large proportion in the GDP. Manufacturing industry sector marked a high degree (30%) of contribution to industrial production in 1971. This contribution came mainly from the petroleum refining industry which started in 1970 and the cement industry which started in 1971.

In November 1971, there was announced a new 5-year plan. Its basic strategy is to cope with shortage of foreign exchange reserves and unemployment situation. Basic measures to attain these objectives are development of light industries for enlarging employment opportunities without using foreign money, efficient operation of existing industries, diversified agricultural production, reduction in food imports, introduction of foreign capital into important basic industries, etc.

Major projects to be carried out during the 5-year plan period include construction of those plants for spinning, urea fertilizer, titanium dioxide, fat and oil chemicals, petroleum refining, and paper making. However, any petrochemical project is not included in the said plan, that this country will continue to be an importing country of various petrochemicals.

In view of the tariffs system of this country, approximately 5% of the customs duties are levied on the CIF prices upon basic raw materials including petrochemical products. Moreover, it is very likely that this country will become promising as the market for exporting petrochemicals from non-commonwealth countries.

(2) Market Studies by Product

(a) Plastics

Plastics demand of this country is totally supplied through import. Extent of demand for each resin is not clear, but as import from Japan is reportedly 70% of the total in 1971, the demand for each resin will be estimated, based upon the data on export from Japan.

LDPE

Demands

Sri-Lanka imported 2,582 tons of LDPE from Japan in 1971. Since this amount corresponds to 70% of the LDPE demand in this country, the total demand can be estimated at 3,700 tons. The 1970 import from Japan amounted to 1,606 tons, and the 1971 growth rate rose to 60% over the previous year. Future demand is estimated to grow at 34% per annum until 1975 and at 15% per annum during 1975-1980 as shown in Table IV-244.

Table IV-244 Actual and Estimated Demand for LDPE in Sri-Lanka

(Unit: tons)

		'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	2,300	3,700	12,000	13,800	15,900	18,300	21,000	24,100
	Average annual rate of increase	60%	34% (1971–1975)		15% (1975–1980)				
b.	Import from Japan	1,606	2,582						
	b / a	70%	70%						

Production/ supply

There is no plan for domestic production of LDPE, and the demand is to be supplied through import in the future. As stated, Japan is the largest LDPE-exporting country which occupied about 70% of the total import in 1971. Exporting countries other than Japan are the U.K. and West Germany, the shares of which are about 20% and 10%, respectively, in 1971.

Actual Import Price of LDPE in Sri-Lanka

(Unit: $/ton)

1970	220	FOB Japan
1971	204	FOB Japan

HDPE

Demands

The HDPE demand of this country amounts to only 2 0 tons, as of 1971. Future demand is estimated to grow at 80% per annum until 1975 and at 15% per annum during 1975-1980.

Table IV-245 Actual and Estimated Demand for HDPE in Sri-Lanka

(Unit: tons)

		'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	Neg.	100	200	2,000	2,300	2,600	3,000	3,500	4,000
	Average annual rate of increase		└ 200% ┘	└ 80% ┘	└ 15% ┘					
b.	Import from Japan		57	124						
	b / a		57%	62%						

Source: JGC Estimates

Production/ supply

There is and will be no plan for domestic production of HDPE, and the total demand will have to depend upon import. Likewise as in LDPE, Japan is the largest exporting country. Major exporting countries other than Japan are the U.K. and West Germany.

Actual Import Price of HDPE in Sri-Lanka

(Unit: $/ton)

1970	420	FOB Japan
1971	360	FOB Japan

VCM

The total volume of PVC is imported in the form of compound. Since there is no plan for domestic production of PVC resins, this country cannot be regarded as a VCM market.

PVC Resins

Demands

As stated in the previous VCM section, no manufacturers of PVC resins exists in the country. Total PVC is imported in the form of PVC compound. Table IV - 246 gives actual and estimated demand of PVC compound and necessary volumes for PVC resins calculated from the former.

Production/ supply

There is no plan for domestic production of PVC resins. Japan is now the largest supplier of PVC compound.

Table IV-246 Actual and Estimated Demand for PVC Compound and PVC Resins in Sri-Lanka

(Unit: tons)

	'68	'69	'70	'71	'75	'76	'77	'78	'79	'80
PVC Compound Demand	1,900	2,500	2,200	3,100	6,400	7,400	8,500	9,800	11,300	13,000
Average annual rate of increase	17.7% ('68–'70)			20% ('71–'75)		15% ('76–'80)				
Import from Japan	1,334	1,754	1,522	2,152						
				70%						
PVC Resins Demand	1,600	2,100	1,800	2,600	5,300	6,100	7,100	7,100	9,400	10,800

Actual Import Price of PVC Compound in Sri-Lanka

(Unit: $/ton)

1968	350	FOB Japan
1969		
1970	330	FOB Japan

Styrene

There is no plan for domestic production of polystyrene in Sri-Lanka. It is predicted that total polystyrene will have been supplied through import at earliest by 1980. Therefore, there is no possibility of exporting styrene to this country.

Polystyrene

Demands

Polystyrene was consumed in an amount of about 1,000 tons in 1971. This corresponds to about 1.5 times as large as the 1970 consumption of 700 tons, or about

60% of growth rate over the previous year. Future demand will grow at 15% per annum until 1980 as shown in Table IV-247.

Table IV-247 Actual and Estimated Demand for Polystyrene in Sri-Lanka

(Unit: tons)

		'68	'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	100	200	700	1,000	2,000	2,300	2,600	3,000	3,500	4,000
	Average annual rate of increase			60%		15%					
b.	Import from Japan	75	165	462	741						
	b / a	75%	83%	66%	70%						

Source: JGC Estimates

Production/supply

Total polystyrene is supplied through import, and there is no plan for domestic production. Japan is the largest exporting country, which occupied about 70% of the total polystyrene import.

Actual Import Price of Polystyrene

(Unit: $/ton)

1968	293	FOB Japan
1969	251	FOB Japan
1970	271	FOB Japan

Polypropylene

The demand for polypropylene has not reached the 10 ton per year level in both 1970 and 1971, so that the PP demand can be considered as negligible.

Present situation in PP demand indicates no evidence of growing PP market in this country by 1980. Hence, this country can not be an export market for Indonesian products.

(b) Synthetic Fibers

The synthetic fiber demand in Sri-Lanka stood at 3,000 tons in 1970, with per-capita consumption amounting to 0.2 kg. The above demand corresponds to a figure about 10 times as large as 300 tons demanded in 1965. On the other hand, the per-capita consumption doubled from 0.1 kg consumed in 1965. It is estimated that the per-capita consumption will increase from this 1970 figure to 2 and 4 times thereof in 1975 and 1980, respectively. As a result, the demand will reach 5,500 tons in 1975 and 12,400 tons in 1980 as shown in Table IV-248.

Table IV-248 Actual and Estimated Demand for Synthetic Fibers in Sri-Lanka

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	300	1,200	1,000	900	3,600	3,000	5,500	6,500	7,600	9,900	10,500	12,400

Source: FAO
JGC Estimates

Nylon

Demands

The Nylon demand occupied 35% of the synthetic fiber demand in 1970. This rate will continue in the future, the Nylon demand will reach 1,900 tons in 1975 and

4,300 tons in 1980. as shown in Table IV-249.

Table IV-249 Estimated Demand for Nylon Fiber in Sri-Lanka

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	1,900	2,300	2,700	3,500	3,700	4,300

Source: FAO
JGC Estimates

Production/ supply

Nylon fiber is being produced domestically by Ceylon Petroleum Corp., as of 1972. Its production capacity is not divulged.

Polyester

Demands

The polyester fiber demand occupied about 40% of the synthetic fiber demand in 1970 in this country. This rate will continue in the future, the polyester fiber demand is estimated to reach 2,100 tons and 4,700 tons, respectively, in 1975 and 1980 as shown in Table IV-250.

Table IV-250 Estimated Demand for Polyester Fibers in Sri-Lanka

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	2,100	2,500	2,900	3,800	4,000	4,700

Source: FAO
JGC Estimates

Production/ supply

The total polyester fiber demand is supplied by import, and there is no plan for domestic production.

(3) Potential Market for Plastics Resins and Synthetic Fibers in Sri-Lanka

Table IV-251 gives potential markets for plastics resins and synthetic fibers in Sri-Lanka for the period 1975-1980.

Table IV-251 Potential Market for Plastics Resins and Synthetic Fibers in Sri-Lanka

(Unit: tons)

	'75	'76	'77	'78	'79	'80
LDPE	12,000	13,800	15,900	18,300	21,000	24,100
HDPE	2,000	2,300	2,600	3,000	3,500	4,000
VCM	0	0	0	0	0	0
PVC	5,300	6,100	7,100	8,100	9,400	10,800
Styrene	0	0	0	0	0	0
Polystyrene	2,000	2,300	2,600	3,000	3,500	4,000
Polypropylene	-	-	-	-	-	-
Nylon Fiber	1,900	2,300	2,700	3,500	3,700	4,300
Polyester Fiber	2,100	2,500	2,900	3,800	4,000	4,700

Source: JGC Estimates

(4) Exportabilities of Indonesian Plastics Resins and Synthetic Fibers to Sri-Lanka

In respect to plastics, possible volumes of export were calculated on the assumption that Indonesian products would occupy 20 to 30% of the remaining share, after the Japanese share has been subtracted from the entire potential market.

Figures obtained when Indonesian products occupy 20% of the Japanese share are also given in Table IV-252. As for synthetic fibers, we assumed that Indonesian products would occupy 5-10% of the entire potential market.

Table IV-252 Export Possibility of Indonesian Plastics Resins and Synthetic Fibers to Sri-Lanka

(Unit: tons)

		'75	'76	'77	'78	'79	'80
LDPE	Min.	700	800	1,000	1,100	1,300	1,400
	Max.	1,100	1,200	1,400	1,600	1,900	2,200
	*	2,400	2,800	3,200	3,700	4,200	4,800
HDPE	Min.	100	100	200	200	200	200
	Max.	200	200	200	300	300	400
	*	400	500	500	600	700	800
VCM	Min.						
	Max.	0	0	0	0	0	0
	*						
PVC	Min.	300	400	400	500	600	600
	Max.	500	500	600	700	800	1,000
	*	1,100	1,200	1,400	1,600	1,900	2,200
Styrene	Min.						
	Max.	0	0	0	0	0	0
	*						
Poly-styrene	Min.	100	100	200	200	200	200
	Max.	200	200	200	300	300	400
		400	500	500	600	700	800
Poly-propylene	Min.						
	Max.	NEG	NEG	NEG	NEG	NEG	NEG
Nylon Fiber	Min.	100	100	100	200	200	200
	Max.	300	200	200	400	400	400
Polyester Fiber	Min.	100	100	100	200	200	200
	Max.	200	300	300	400	400	400

* Calculated on the assumption that the Indonesian plastics resins would secure 20% of Japanese share.

Actual Price of PP in Thailand

5.14 THAILAND

(1) General Market Situation

Thailand achieved the Second 5-Year Plan in September 1971, and is now in its first year of the Third 5-Year Economic and Social Development Plan. During the Second 5-Year Plan period, emphasis industrialization was put on those industries which produce substitution for the imports, such as consumer goods. It is reported that industrialization has almost been completed in those sectors of consumer goods production, including textile and electric appliances. With the start of the Third 5-Year Plan, Thailand is now contemplating export of industrial goods, and is also being orientated, on the long-term basis, toward development of capital intensive heavy industries for steelmaking and petrochemical industry.

Along this line, a petrochemical project is now being studied among Thai Petrochemical Co. (in charge of ethylene supply) and a two Japanese groups of Mitsui Thai group and Mitsubishi Thai group (both in charge of down-stream), for operation scheduled for 1976. The project can be summarized as follows in Table IV-253.

This project is likely to be delayed, seeing the facts that styrene, polystyrene, and expandable polystyrene plans have been given up and that the Japanese groups have actually proposed three years' delay for BTX-, p-Xylene, DMT-, and foamed polystyrene plans. Upon our field surveys the project will be materialized in 1979.

country has a production capacity of 4,800 ton per

Table IV-253 **The Plan of Petrochemical Complex in Thailand**

Ethylene	180,000 tons/yr.	Thai Petrochemical Co.
LDPE	70,000 tons/yr.	Mitsubishi Thai Group (Mitsubishi Petrochem Co., Mitsubishi Shoji, Local Company)
HDPE	24,000 tons/yr.	Mitsui Thai Group (Mitsui Petrochem Co., Mitsui Bussan, Local Company)
PP	24,000 tons/yr.	Mitsui Thai Group, Local Company
Styrene	20,000 tons/yr.	"
Polystyrene	12,000 tons/yr.	"
Foam Polystyrene	4,000 tons/yr.	"
VCM	42,000 tons/yr.	"
PVC	40,000 tons/yr.	"
Alkylbenzene	20,000 tons/yr.	Mitsubishi Thai Group (Nisseki Senzai, Mitsubishi Shoji, Local Company)
B	25,000 tons/yr.)	
T	18,000 tons/yr.)	Mitsubishi Thai Group
X	13,000 tons/yr.)	
PX	15,000 tons/yr.	Teijin Thai Group
DMT	20,000 tons/yr.	"
TPA	15,000 tons/yr.	"

as shown in Table IV-266.

(a) Taking into account the discontinuance or postponement of the plans for styrene, polystyrene, and BTX, the material balance in the planned scheme is as follows:

Ethylene

	(a) Amount of Production (tons/yr.)	(b) Required Ethylene (tons/yr.)	(c) Production of Ethylene (tons/yr.)	(d) = (c)-(b) (tons/yr.)
LDPE	70,000	76,830		
HDPE	24,000	30,000		
VCM	42,000	19,500		
		126,330	180,000	53,670 (excess)

Propylene

	(a) Amount of Production (tons/yr.)	(b) Required Propylene (tons/yr.)	(c) Production of Propylene (tons/yr.)	(d) = (c)-(b) (tons/yr.)
Poly-propylene	24,000	30,000		
Alkyl-benzene	20,000	21,500		
		51,500	90,000	38,500 (excess)

Benzene

	(a) Amount of Production (tons/yr.)	(b) Required Benzene (tons/yr.)	(c) Production of Benzene (tons/yr.)	(d) = (c)-(b) (tons/yr.)
AB	20,000	7,000		
		7,000	35,000	28,000 (excess)

and the domestic product will be able to meet the

Xylene

	(a) Amount of Production	(b) Required Xylene	(c) Production of Xylene	(d) = (c)-(b)
	(tons/yr.)	(tons/yr.)	(tons/yr.)	(tons/yr.)
p-Xylene	15,000	45,000	8,000	37,000 (shortage)

Apparently the above table shows unbalanced fractions, and there is a possibility that the ethylene capacity itself is reconsidered in the future.

(b) In consideration of OPEC's price policy for crude oils, Thai Petrochemical Co., the raw material supplier, appealed that the ethylene price would be raised from initial 4.6 c/lb to 6.08 c/lb. The Japanese groups now stand against this price, stating that the project would not be feasible unless it is below 5.5 c/lb.

(c) As to the share of interests in the joint venture to be taken by the Japanese group, negotiations have been continuing between the Japanese groups and the Thai Government. They are now discussing on how to establish the unified company system, wherein Thai Petrochemical Co., the Japanese groups, and in addition, the Thai Government take interests in the joint venture to manage the complex. The talks seems to have not reached any solution.

Some more ups and downs will be seen for realization of the Thai petrochemical project. On the other hand, there are favorable movements to actively promote this project. For instance, the Japanese groups have

(4) Exportabilities of the Indonesian Plastic Resins and Syn-

rendered commitment on realization of the project to the Thai Government and Thai Petrochemical Co., i.e., the Thai company in charge of this petrochemical project, recently acquired land in the area at the outskirts of Bangkok. Recently Thai Oil Refinery was granted approval of National Economic Council (NEC) for construction of a new 100,000 BSD refinery from which raw material naphtha would be supplied to the complex. With background of these facts, it is hoped that the Thai petrochemical project would have been able to start by 1979.

Refineries in Thailand

Companies	Capacities
Summit	35,000 BPSD
Thai Oil Refinery	60,000 "
	60,000 "
Esso	30,000 "
	185,000 BPSD

(2) Market Studies by Product

(a) Plastics

Thailand imported 102,191 tons ($33.5 million) of plastics intermediates and final products in 1971. Recently, import of final products are trending downward concurrent with growth of domestic processors. The 1971 import of final products accounted for only 5.5% in volume or 20% in money of the total plastics import.

LDPE

Demands

As shown in Table IV-254, the LDPE demand in Thailand has marked an annual growth rate of 16.5% during the period 1965-1971, particularly in such fields as plastic film injection-molded articles, and cable coatings. Future demand is estimated to grow at 18% per annum until 1975 and at 14% per annum during 1975-1980 as shown in Table IV-255.

Table IV-254 Demand Pattern for LDPE in Thailand

Plastic Film	90%
Injection Molding	10%
Cable Coating	-

Table IV-255 Actual and Estimated Demand for LDPE in Thailand

(Unit: tons)

		'65	'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	12,000	25,000	30,000	30,000	58,000	66,000	75,000	86,000	96,000	112,000
	Average Annual Rate of Increase	16.5% ('65–'71)				18% ('71–'75)	14% ('75–'80)				
b.	Import from Japan	n.a.	n.a.	21,128	28,938						
	b / a			70%	93%						

Source: Japanese Trading Company
JGC Estimates

Table IV-270 Tax System and Import Duty in Thailand

Production/ supply

As part of the afore-mentioned Thai petrochemical project, LDPE will be domestically produced at 70,000 ton per year in 1979. At present, all needs are supplied through import, of which 90% is by Japan.

Actual Import Price of LDPE in Thailand

(Unit: $/ton)

'68		264	CIF Bangkok
'69		297	CIF Bangkok
'70		270	CIF Bangkok
'72	July	254	CIF Bangkok
	December	300	CIF Bangkok

HDPE

Demands

As shown in table, below, HDPE was imported in an amount of 10,000 tons in 1971 for use in monofilaments, injection molding, and blow molding as shown in Table IV- 256. Future demand will grow at 18% per annum until 1975, and at 16% per annum during 1975-1980 as given in Table IV-257.

Table IV- 256 Demand Pattern for HDPE in Thailand

Monofilament	40%
Injection Molding	40%
Blow Molding	20%

6. Price

Table IV-257 Actual and Estimated Demand for HDPE in Thailand

(Unit: tons)

		'65	'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	4,000	7,000	10,000	15,000	28,000	33,000	38,000	44,000	51,000	58,800
	Average Annual Rate of Increase	16.5% ('65–'71)			18% ('71–'75)		16% ('75–'80)				
b.	Import from Japan			13,587							
	b / a			93%							

Source: Japanese Trading Co.
JGC Estimates

Production/Supply

As part of the Thai petrochemical project, HDPE will be domestically produced at 24,000 ton per year in 1979. At present, all demand is met by import, of which as large a percentage as 90% or more is from Japan.

Actual Import Price of HDPE in Thailand

(Unit: $/ton)

'68	350	CIF Bangkok
'69	330	CIF Bangkok
'70	285	CIF Bangkok
'72 Aug.	260	CIF Bangkok

VCM

Thai Plastics, Ltd. is now producing PVC at 10,000 ton per year, using the carbide-acetylene process.

Demands

As of 1971, there was a 11,000 ton per year demand for VCM for use in PVC resin. This demand level is expected to move up to 22,000 ton per year, as the PVC resin equipment will be doubled in 1973 as shown in Table IV-258.

Table IV-258 Actual and Estimated Demand for VCM in Thailand

(Unit: tons)

	'71	'75	'76	'77	'78	'79	'80
Demand	11,000	22,000	22,000	22,000	22,000	22,000	22,000
Import from Japan	100%						

Production/supply

At present, the afore-mentioned Thai Plastics, Ltd. is producing and supplying the total VCM needs. Recently, Mitsui & Co., Mitsui Toatsu, and Thai Asahi secured interest in this company with the plan of doubling the PVC resin production capacity in 1973 and converting company's raw material production to those used in petrochemicals. When the Thai petrochemical complex is put into operation in 1979, VCM will be domestically produced at 42,000 ton per year. Until that year, all of VCM will be imported from Japan.

PVC

Demands

As shown in Table IV-259, 260, the 1971 PVC demand

Table IV-271 Import Charges per 1$ Petrochemical Products reached 14,000 ton per year, mostly in the fields of artificial leather, rigid pipe, electric cable, etc. Future demand is estimated to grow at 15% per annum until 1980.

Table IV-259 **Demand Pattern for PVC in Thailand**

Artificial Leather	33%
Rigid Pipe	21%
Flexible Pipe	11%
Foot Wear	11%
Electric Cable	19%
Floor Tiles	2%
Blow Molding	3%
	100%

Table IV-260 **Actual and Estimated Demand for PVC in Thailand**

(Unit: tons)

	'65	'69	'70	'71	'75	'76	'77	'78	'79	'80
a. Demand	5,000	10,000	12,000	14,000	24,000	28,000	32,000	37,000	42,000	48,000
Average Annual Rate of Increase		18%			15%			15%		
b. Import from Japan			7,418	6,604						
b / a			62%	47%						

Source: Japanese Trading Co.
JGC Estimates

Production/ supply

As described above, Thai Plastics, Ltd. would double the using the carbide acethylene process. Furthermore, as part of the Thai petrochemical project,

6.2 Plastics and Others

40,000 ton per year of PVC is to be domestically produced in 1979. At present, 50% of the total demand is supplied through imports from Japan.

Actual Import Price of PVC in Thailand

(Unit: $/ton)

'68		230	FOB Bangkok
'69		305	FOB Bangkok
'70		285	FOB Bangkok
'72,	Aug.	220	FOB Bangkok
	Sept.	240	FOB Bangkok

Styrene

Demands

Polystyrene is not domestically produced now in Thailand, nor is there any domestic production plan. Hence, there is no demand for styrene at present and in the future.

Polystyrene

Demands

The 1971 polystyrene demand in Thailand mainly consisted of 4,300 tons of general purpose grade, 600 tons of expandable grade, 600 tons of high impact grade, 30 tons for use in styrene-base ion exchange resin, and 10 tons for ABS resin. Future demand is estimated to grow at 14% per annum until 1975 and at 15% per annum during 1975-1980 as shown in Table IV-261.

Table IV-261 Actual and Estimated Demand for Polystyrene in Thailand

(Unit: tons)

	'65	'69	'70	'71	'75	'76	'77	'78	'79	'80
a. Demand	2,000	4,500	5,000	6,500	11,000	13,000	15,000	17,000	20,000	23,000
Average Annual Rate of Increase	22% (spanning '65–'71)			14% (spanning '71–'75)		15% (spanning '75–'80)				
b. Import from Japan	3,730	4,295	5,920							
b / a	85%	86%	90%							

Source: Japanese Trading Co.
JGC Estimates

Production/ supply

Commercial production of 20,000 ton per year styrene and 12,000 ton per year of polystyrene were included in the initial Thai petrochemical project, but excluded from the present plan. The total amounts of these two are now imported, and this situation will continue in the future.

Actual Price of Polystyrene in Thailand

(Unit: $/ton)

'68	310	CIF Bangkok
'69	330	CIF Bangkok
'70	342	CIF Bangkok
'72	240	CIF Bangkok

Polypropylene

Demands

There was about 8,000 ton per year of polypropylene consumption in Thailand in 1971, mainly in the fields

In 1971, 167,600 tons of HDPE was exported from Japan, of of injection molding, film and tape, rope, etc. as shown in Table IV-262. Demand has marked an annual growth rate of 40% during the period of 1965-1970, and is estimated to grow at 14% per annum until 1975 and at 15% per annum during 1975-1980 as given in Table IV-263.

Table IV-262 Demand Pattern for PP in Thailand

Injection Molding	50%
Film and Tape	35%
Monofilament for Rope	15%
	100%

Table IV-263 Actual and Estimated Demand for PP in Thailand

(Unit: ton)

		'65	'69	'70	'71	'75	'76	'77	'78	'79	'80
a.	Demand	2,000	4,500	5,500	8,000	14,000	17,000	20,000	22,000	26,000	30,000
	Average Annual Rate of Increase	40% ('65–'71)				14% ('71–'75)	15% ('75–'80)				
b.	Import from Japan		3,306	5,500	8,000						
	b / a		73%	100%	100%						

Production/supply

As part of the Thai petrochemical project, domestic production of 24,000 ton per year of polypropylene is expected in 1979. At present, the total PP needs depends on imports from Japan.

PVC

Actual Price of PP in Thailand

(Unit: $/ton)

'68		352 CIF Bangkok
'69		335 CIF Bangkok
'70		305 CIF Bangkok
'72		210 (Min.) CIF Bangkok
	Aug.	270 CIF Bangkok

(b) Synthetic Fibers

The demand for synthetic fibers was 31,400 tons in 1970 in Thailand, with per-capita consumption amounting to 0.9 kg, which was almost 5 times as large as 0.2 kg in 1965. The growth rate of per-capita consumption has marked 35% per annum for the 1965-1970 period. Assuming a growth rate of 15% until 1975, per-capita consumption will reach 1.8 kg in 1975 and also assuming a rate of 10% per annum for the 1975-1980 period, a per-capita consumption of 2.9 kg will result, the synthetic fiber demand is estimated to reach 73,800 tons and 137,800 tons in 1975 and 1980, respectively as shown in Table IV-264.

Table IV-264 Actual and Estimated Demand for Synthetic Fibers in Thailand

(Unit: tons)

	'65	'66	'67	'68	'69	'70	'75	'76	'77	'78	'79	'80
Demand	[illegible]	10,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73,800	[illegible]	[illegible]	107,000	122,000	137,800

Source: [illegible]
[illegible] Estimates

Thailand is already domestically producing Nylon and Polyester, using imported caprolactam and TPA. The country has a production capacity of 4,800 ton per year of Nylon and Polyester fibers in 1970, accounting for about 15% of the total demand for Nylon and Polyester. If the petrochemical complex now under study is materialized, then caprolactam and TPA will be domestically produced in due course.

Nylon

Demands

Nylon accounted for about 25% of the total synthetic fiber demand in 1970. We assumed this ratio will continue in the future, the Nylon demand reaches 17,700 tons in 1975 and 33,100 tons in 1980 as shown in Table IV-265.

Table IV-265 Estimated Demand for Nylon in Thailand

(Unit: tons)

	'75	'76	'77	'78	'79	'80
Demand	17,700	20,100	22,800	25,800	29,300	33,100

Source: JGC Estimates

Production/supply

As of 1970, Nylon 6 is produced in an amount of 4,800 ton per year (10% of the total demand) by two companies, Asia Fiber Co., Ltd. and Toray Nylon Thai Co. domestic production of Nylon will further get under way in the future. We assumed that domestic production will be 40% for 1975 and 100% for 1980, when the petrochemical complex goes into operation, the rate of dependence on import is estimated to show such a trend as shown in Table IV-266.

Table IV-266 **Estimated Rate of Dependence on Import of Nylon in Thailand**

	1975	1976	1977	1978	1979	1980
Rate of dependence on import	60%	52%	42%	31%	17%	0%

Source: JGC Estimates

Polyester

Demands

The polyester demand occupies about 40% of the synthetic fiber demand in Thailand. As this ratio seems to continue in the future, the polyester fiber demand will reach 31,700 tons in 1975 and 56,500 tons in 1980 as shown in Table IV-267.

Table IV-267 **Estimated Demand for Polyester Fibers in Thailand**

(Unit: tons)

	1975	1976	1977	1978	1979	1980
Demand	31,700	36,000	40,900	46,300	52,500	0

Source: FAO
JGC Estimates

Production/supply

Thai Tetoron Co., Ltd. and Toray Nylon Thai Co., Ltd. are producing polyester fiber. The rate of domestic production will continue to rise year by year, and the domestic product will be able to meet the total polyester demand in 1980, when the petrochemical complex goes into operation. Assuming that the rate of domestic production of polyester fiber would follow a similar course to that of Nylon fiber, we calculated the potential market for this item, as shown in Table IV- 268.

(3) Potential Market for Plastics Resins and Synthetic Fibers in Thailand

Potential market of those resins and synthetic fibers within the scope of this survey are as given in the Table IV- 268.

Table IV- 268 Potential Market for Plastics Resins and Synthetic Fibers in Thailand

(Unit: tons)

	1975	1976	1977	1978	1979	1980
LDPE	58,000	66,000	75,000	86,000	96,000	42,000
HDPE	28,000	33,000	38,000	44,000	51,000	35,000
VCM	22,000	22,000	22,000	22,000	22,000	0
PVC	4,000	8,000	12,000	17,000	22,000	0
Styrene	0	0	0	0	0	0
Polystyrene	11,000	13,000	15,000	17,000	20,000	23,000
Polypropylene	14,000	17,000	20,000	22,000	26,000	6,000
Nylon Fiber	10,600	10,500	9,000	8,000	5,000	0
Polyester Fiber	19,000	18,700	17,200	14,400	8,900	0

(4) Exportabilities of the Indonesian Plastic Resins and Synthetic Fibers to Thailand

There is a strong possibility that high tariffs duties will be levied on import of the counterparts of those products which will be domestically produced from 1979 on in Thailand. For this reason, there would be no possibility of exporting almost Indonesian resins, and synthetic fibers, from 1980 on. Share range, from minimum to maximum, of the Indonesian plastics was calculated for the period 1975-1979, as shown in Table IV-269, on the assumption that the Indonesian plastics would occupy 20 to 30% of the remaining market, after the Japanese share has been subtracted from the entire market. For reference, the table also contains possible volumes of exports of the Indonesian plastics, which were estimated on the assumption that the Indonesian plastics would secure 20% of the Japanese share. Table IV-269 also gives possible volumes of export of synthetic fibers, which were calculated on the assumption that Indonesian products would occupy 5-10% of the entire potential market.

Table IV-269 Export Possibility of Indonesian Plastics Resins and Synthetic Fibers to Thailand

(Unit: tons)

		'75	'76	'77	'78	'79	'80
LDPE	Min.	1,200	1,300	1,500	1,700	1,900	0
	Max.	1,800	2,000	2,300	2,600	2,900	0
	*	11,600	13,200	15,000	17,200	19,200	0
HDPE	Min.	400	700	800	900	1,000	0
	Max.	500	1,000	1,100	1,300	1,500	0
	*	3,600	6,600	7,600	8,800	10,000	0
VCM	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	8,800	8,800	8,800	8,800	8,800	0
PVC	Min.	400	800	1,200	1,700	2,200	0
	Max.	600	1,200	1,800	2,600	3,300	0
	*	800	1,600	2,400	3,400	4,400	0
Styrene	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	0	0	0	0	0	0
Poly-styrene	Min.	200	300	300	300	400	500
	Max.	300	400	500	500	600	700
	*	2,200	2,600	3,000	3,400	4,000	4,600
Poly-propylene	Min.	0	0	0	0	0	0
	Max.	0	0	0	0	0	0
	*	2,800	3,400	4,000	4,400	5,200	6,000
Nylon Fiber	Min.	500	500	500	400	300	0
	Max.	1,100	1,100	1,000	800	500	0
Polyester Fiber	Min.	1,000	900	900	700	400	0
	Max.	1,900	1,900	1,700	1,400	900	0

* Calculated on the assumption that the Indonesian Plastics resins would secure 20% of Japanese share.

Table IV-270 Tax System and Import Duty in Thailand

Tax System

Tax System = CIF price + Import Duty + Business Tax*
+ Municipality Tax**

* Business Tax = (CIF price + Import Duty + expect profit) x Tax rate

** Municipality Tax = Business Tax x 10%

Import Duty

Product	Import Duty
PVC	40%
LDPE	40%
HDPE	40%
Polystyrene	40%
Polypropylene	40%
Nylon	
Filament	20%
Staple	20% or 14.4 ¢/kg
Yarn	20% or 14.4 ¢/kg
Polyester	
Filament	20%
Staple	20% or 14.4 ¢/kg
Yarn	20% or 14.4 ¢/kg

6. Price

6.1 General

As described in IV-2. "Methodology of Market Study", the sales prices of petrochemical products domestically produced in Indonesia are determined based upon a simple model of price competition in the Southeast Asian region. Its backgrounds are:

- Japan is and will be the price leader in respect to petrochemicals in Southeast Asia. This fact can be confirmed by its outstanding supply volumes of petrochemicals and competitive delivery prices.

- However, recently, Japanese makers have been facing keen competition price and begun to make much efforts to recover the prices of petrochemicals to reasonable levels which will have been accomplished by the middle of 1973 in various petrochemicals, particularly in plastics, when consideration is given to the situation in the recovery of demand-supply balances in Japan.

- Therefore, by adjustment of the prices of products exported from Japan, the price levels of petrochemicals marketed in Southeast Asia will rise. And even if reasonable levels have been reached in the middle of 1973, those levels will further continue to rise at about 2% per annum, in order to absorb the naphtha price and equipment cost increases.

- Meanwhile Japan's potentiality for export will be weaken, some countries are planning on the next-stage large petrochemical complexes, and additional new complexes will appear in Southeast Asian countries. On such occasions, the structure of petrochemical-supply systems in Southeast Asia will undergo drastic changes, and a new form of price competition will take place. In this study such a situation is estimated to come in around 1985. It was then assumed that from that year on, price levels of petrochemicals will stay at a constant level in Southeast Asia, despite that there will be cost-raising factors.

- In order to accomplish successful substitution of domestic products for imported goods and exporting to overseas markets, the prices of Indonesian products must satisfy the following conditioning equations:

<u>In domestic market</u>

Ex-factory prices for domestic market + sales charges = CIF prices of exported Japanese products + import charges

<u>In overseas markets</u>

Ex-factory prices for export market + freight + insurance = CIF prices of exported Japanese products

- On the premise that the current customs system will continue, the import charges necessary for those products taken into Indonesia are as given in Table IV- 271.

Namely, the import charges correspond to about 20% of CIF prices. If it is assumed that charges (sales tax & commission) necessary for domestic prices are at the same rate as for imported goods, then the difference between domestic prices of Indonesian products and CIF prices of Japanese products will be around 10%. Therefore, Indonesian domestic prices can be calculated as the estimated CIF prices of exported products from Japan plus the values corresponding to this 10%.

Table IV-271 Import Charges per 1$ Petrochemical Products in Indonesia

CIF Price (1$)			RP	415.00
Bank Charge + Cable Charge	CIF x	1%	"	4.15
Import Commission	"	3%	"	13.45
MPO	"	3%	"	13.45
Import Duty	"	5%	"	20.75
Sales Tax	"	5%	"	20.75
Clearance Charge	"	2%	"	8.30
Sub Total			RP	495.85
Damage	495.85 x	1.5%		7.48
Final Sales Price			RP	503.33

On the other hand, in order to calculate export prices of Indonesian petrochemicals, it is necessary to know the freight and insurance to overseas markets. Actual figures for such costs are not available. However, seeing that exports from Indonesia will be concentrated into neighboring Southeast Asian countries, we think it reasonable to fix those charges at around $40 per ton for those petrochemicals exportable from Indonesia, on the basis of information obtained from trading firm in Indonesia and other neighboring countries. Accordingly, the export prices of Indonesian petrochemicals are obtained by subtracting around $40 from the CIF prices of exported Japanese products. The price estimated for each of petrochemicals domestically produced in Indonesia will be described in the next chapter.

6.2 Plastics and Others

LDPE

Table IV-272 Import Price of LDPE (CIF Price from Japan)

(Unit: $/ton)

1969	1970	1971	1972 (July)
230-240	260	250	250

Reference Values

1972 (July)	Japanese HDPE CIF Price	in Singapore	250$/ton
"	"	in Malaysia	270$/ton

Source: Japanese Trading Firms

The volume of LDPE exported from Japan to Southeast Asia amounted to 143,000 tons in 1971, accounting for 55% of the total export. This corresponds to 80% of the total LDPE import by Southeast Asian countries. In spite of this favorable marketing condition, the LDPE price sharply dropped to $120-130 in late 1971 on the FOB Japan basis, owing to a series of incidents, such as stagnant conditions in domestic demand, the yen revaluation, and the penetration from Western makers. Since the summer of 1972, however, reduction in operation performed by LDPE makers, and the recovery of the domestic price has made the export price come back to $225 on the FOB basis ($260-270 on the CIF basis).

The Japanese LDPE makers are expecting $300 on the CIF basis in the spring of 1973 but this is considered difficult to attain, because European and US makers are also trying to secure some shares in Southeast Asia. Therefore, the price is likely to settle on the $280-290 line at that time. From then on, the export price will rise at around 2% per annum, reflecting the cost-pushing condition, and will reach $320 on the CIF basis in 1980. The domestic price and export price of the LDPE domestically produced in Indonesia were thus calculated based upon this value as the standard, as given in Table IV - 273.

Table IV - 273 LDPE Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	330	336	343	350	353	356	360	363	365
Export Price	262	268	274	280	283	286	290	293	295

Reference Values

1972	Japanese LDPE CIF Price in Indonesia	260$/ton
1973	"	290$/ton

Source: JGC Estimates

HDPE

Table IV - 274 Import Price of HDPE (CIF Price from Japan)

(Unit: $/ton)

1970	1971	1972 (July)
322	245	210-220

Reference Values

1972 (July)	Japanese HDPE CIF Price in Singapore	250$/ton
"	" in Malaysia	240$/ton

Source: Japanese Trading Firms

In 1971, 167,600 tons of HDPE was exported from Japan, of which exports to Southeast Asia accounted for about a thirds and are considered to have occupied about 80% of the total import of HDPE by Southeast Asian countries. After the yen revaluation, there was some drop in terms of HDPE price. Yet the 1971 export marked a high growth rate of 35% over the previous year, partly because Japanese exporter's are in strong cooperative link with Asian markets through processing technologies.

From 1973 on, the price is estimated to rise at 2% per annum until 1985 under the price hike based on cost-pushing condition. Therefore, the CIF price of Japanese HDPE is estimated at $340 in 1980.

Based upon this value as the standard, the domestic price and export price of HDPE domestically produced in Indonesia are given in Table IV-275.

Table IV-275 HDPE Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	347	354	362	370	374	378	381	385	390
Export Price	287	294	302	310	314	318	321	335	330

Reference Values

1972 (July)	Japanese HDPE CIF Price in Indonesia	220$/ton
1973	"	330$/ton
1980	"	340$/ton

PVC

Table IV-276 Import Price of PVC Resin (CIF Price from Japan)

(Unit $/ton)

1968	1969	1970	1971	1972 (July)
273	250	270	240	250

Reference Values

1972 (July) Japanese PVC CIF Price in Singapore 250$/ton

" " in Malaysia 200$/ton

Source: Japanese Trading Firms

The PVC export from Japan has grown, marking 145,000 tons in 1971, up 5% over the previous year. The export from Japan to Southeast Asia accounted for about 10% of the above amount. This corresponds to 65% of the total PVC import in the same area. However, like in other plastics, the export price sharply dropped. This was partly because of the competition from some Asian countries, which import VCM from Japan at a low price and then export PVC at lower prices than that of Japanese PVC.

As a result of various efforts, the FOB price of PVC exported to Southeast Asia from Japan rose by 20-25% during the three months of April through June 1972, and the CIF price was recovered to a level of $250-260, which is estimated to further rise to $280 in 1973. However, as analysed in "Country Study", Southeast Asian countries are eager to produce PVC and imported PVC will be increasingly replaced by domestically produced PVC in the future. For this reason, the CIF price of PVC exported from Japan is estimated to rise at an average rate of 1% per annum from 1973 and will reach $310 in 1980.

The domestic price and export price of the PVC domestically produced in Indonesia are given in Table IV-277.

Table IV-277 PVC Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	322	328	334	340	343	346	349	353	355
Export Price	252	258	264	270	273	276	279	283	285

Reference Values

1972 (July) Japanese PVC CIF price in Indonesia 250$/ton

1973 " 280$/ton

1980 " 310$/ton

Source: JGC Estimates

VCM

Since no VCM has yet been imported to Indonesia, we estimated the VCM price in Indonesia, taking into account the trend in VCM export from Japan to the Philippines, Korea, etc. Japan's VCM export to Southeast Asia ammounted to 83,000 tons in 1971, (4 times over the previous year and almost 100% of the Southeast Asian total VCM import.) In the background of this increasing VCM export from Japan, there was a problem of keen competition in the export price.

The low price level did not turn upward in early 1972, and even dropped to $90 per ton on the FOB basis (or a CIF price of $110 per ton). As of October 1972, the CIF price recovered to $130, and is predicted to reach a preferable level of $160 in the middle of 1973. The CIF price of Japanese VCM is estimated to grow at an average rate of 2% per annum from 1973 on and will reach $180 in 1980. Using this value as the standard, the calculated the domestic price of the VCM domestically produced in Indonesia, results of which are as given in Table IV-278.

Table IV-278 VCM Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	192	195	198	200	201	203	205	207	210

Reference Values

1972 Japanese VCM CIF Price in the Philippines 130$/ton

1980 " in Indonesia 180$/ton

Source: JGC Estimates

Polystyrene

Table IV-279 Import Price of Polystyrene (CIF Price from Japan)

(Unit: $/ton)

1969	1970	1971	1972 (July)
240	250	245	240

Reference Value

1972 (July) Japanese Polystyrene CIF Price in Malaysia 230$/ton

Source: Japanese Trading Firms

The polystyrene export from Japan marked 71,700 tons in 1971, up 9% over the previous year. Of this amount, 80% was exported to Southeast Asia, and particularly it is noted that 50% of the total export was to Hong Kong. Japan's polystyrene export to Southeast Asia is estimated to be about 65% of its total import of polystyrene. Similarly as in other plastics products, the polystyrene export price dropped as a result of competition among Japanese makers having excessive production capacities, but from around spring of 1972, it showed a sign of recovery, reflecting better domestic balance of demand and supply in Japan. The price is likely to climb up in 1973 to a CIF price of $290, which is considered as a reasonable level. However, as in the case of PVC, more Southeast Asian countries are inclined to possess their own polystyrene plants, and this trend probably serves to control the rise of polystyrene export price.

In the final analysis, the CIF price of Japanese polystyrene, which will be on a $290 level in the middle of 1973, is

Table IV- 280 Polystyrene Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	336	341	345	350	352	354	357	359	360
Export Price	266	271	275	280	282	284	287	289	290

Reference Values

1972	Japanese Polystyrene CIF Price in Indonesia	240$/ton
1973	"	290$/ton
1980	"	320$/ton

Source: JGC Estimates

estimated to increase at an average rate of about 1.5% per annum to $320 in 1980. The domestic and export price of the polystyrene domestically produced in Indonesia are given in Table IV-280.

Polypropylene (PP)

Table IV-281 Emport Price of PP (CIF Price from Japan)

(Unit: $/ton)

1968	1969	1970	1971	1972 (July)
340	330	345	248	200

Reference Values

1972 (July) Japanese PP CIF Price in Singapore 230$/ton
" in Malaysia 270$/ton

Source: Japanese Trading Firms

The Japanese PP export started in 1965, and since then it has rapidly grown to reach 162,000 tons in 1971, which accounted for about 25% of the total sales volume. Of this amount, about 93,000 tons were exported to Southeast Asia, accounting for about 70% of the total import of all the countries in this region. 300,000 ton ethylene plants newly constructed in Japan since 1970, resulting in a great increase of PP supply capacity, caused a sharp drop of the PP price. Thus by the end of 1971, a FOB price came down to $160 which was probably accelarated by the severe competition from the European and US makers. Now the Japanese PP makers are trying to get the price back to the more favorable one by orderly marketing. Their target price is reported to be $300 or more CIF in the Southeast Asian countries.

Accurate information was not available on the domestic sales price of the PP to be domestically produced in Indonesia commencing from spring in 1973. However, PP import from Japan will continue after that, and the price will not be largely different from the CIF price level of Japanese product. The domestic price and export price of the PP domestically produced in Indonesia were calculated on the assumptions that the above target price comes in reality in 1973, and also that the price will continue to grow at an average rate of 2% per annum. Results of calculation are given in Table IV-282.

Table IV-282 PP Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	357	364	371	380	384	388	391	395	400
Export Price	287	294	300	310	314	318	321	325	330

Reference Values

1972	Japanese PP CIF Price in Indonesia	230$/ton
1973	"	290$/ton
1980	"	350$/ton

Source: JGC Estimates

Dioctyl Phthalate (DOP)

Japan's DOP export to Southeast Asia stood at about 31,000 tons in 1971, accounting for 90% of the total DOP export from Japan.

However, this amount is estimated to decrease, because European makers have been actively making efforts to market their product in this region. Under the impact of upward trend in the price of octanol, one of the raw material for DOP production, the CIF price of Japanese product will increase from the present $270-280 to $300 in the middle of 1973, and to $350 in 1980. Using this value as the standard, we calculated domestic price of the DOP domestically produced in Indonesia results of which are as given in Table IV-283.

Table IV-283 DOP Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	367	374	382	390	394	398	401	406	410

Source: JGC Estimates

Ethylene Glycol (EG)

Japan's EG export marked at 47,000 tons in 1971, down about 20% over the previous year. Its export to Southeast Asia occupied about 55% of the above volume, and is estimated to correspond to 80% of the southeast Asian total import of EG. Sharp decrease in EG export from Japan was brought about by the fact that Japan's domestic demand-supply balance turned to tight situation in the latter half of 1970 leading to price increase. Under these circumstances, the CIF price in the range of $210-220 of Japanese EG can be reasonable one.

We assumed that the CIF price continues to rise at 2% per annum in the future, it will reach $250 in 1980. The ex-factory price for domestic sales of the EG domestically produced in Indonesia are given in Table IV-284.

Table IV-284 EG Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	257	261	266	270	272	274	276	278	280

Source: JGC Estimates

Caprolactam

Japan's caprolactam production occupies about a fifth of world total production. The Japanese Nylon industry mainly produce Nylon 6, whereas the United States and Western depend more upon Nylon 66. The caprolactam export to Southeast Asia marked at about 26,000 tons in 1971 (about 65% of the total export), and is estimated to increase by 30% in 1972, reflecting the retirement of Allied Chemical of the U.S. from Southeast Asian markets and successful Nylon production in Korea, Thailand, Hong Kong, the Philippines, and India.

However, again by the the unfavorable market situation in Japan, the export price dropped by 20% from the 1970 level, and is now estimated to stay on $450 on the CIF basis for the export to Southeast Asia. Future trend in the CIF price of caprolactam will be affected both on one hand by the activated domestic demands in Southeast Asian countries and Japan, and on the other hand, by the self-sufficiency plans for this product in Korea, which has been main importers of Japanese caprolactam. From long-term point of view, the CIF price will increase to $550 in 1980 on the basis of which we calculated domestic price of the caprolactam domestically produced in Indonesia, as given in Table IV-285.

Table IV-285 Caprolactam Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	565	576	588	600	612	624	637	649	660

Source: JGC Estimates

Terepatharic Acid (TPA)

Indonesia has so far imported no TPA. Even those Southeast Asian countries which have polyester plants are importing DMT and Japanese export of TPA to Southeast Asia was as quite small 210 tons in 1971. This is because polyester production from TPA was commercialized in recent years, and it may be said that international price of TPA may have not yet been fixed in Southeast Asia.

However, by the moves of the domestic TPA price in Japan and the information obtained from manufacturers we estimated a reasonable CIF price of TPA to be about $360. The CIF price will move up 2% per annum, reflecting the rise of production cost and the CIF price of the Japanese TPA will become $430 in 1980. Based upon this estimate, we calculated the domestic price of TPA in Indonesia, as shown in Table IV-286.

Table IV-286 TPA Price Table

(Unit: $/ton)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Domestic Price	440	450	460	470	480	490	500	510	520

Reference Values

1973	Japanese TPA CIF Price	360$/ton
1980	"	430$/ton

Source: JGC Estimates

V. RESOURSE STUDY

1. Petroleum

1.1 Crude Oil Situation in Indonesia

Indonesia is the second largest oil-producing country after Iran in the ECAFE region. Trends in production and exports of Indonesian oil are as given in Table V-1 below.

Table V-1 Trends in Oil Production and Export in Indonesia

Year	Production ($x\ 10^3$ kl)	Exports ($x\ 10^3$ kl)	Percentage of exports (%)
1965	28,150	15,314	54.4
1966	27,283	15,087	55.3
1967	29,782	17,918	60.2
1968	35,178	23,127	65.7
1969	43,080	30,021	69.7
1970	49,536	36,295	73.3
1971	55,396	n.a.	n.a.
1972*	70,386	n.a.	n.a.
1973*	80,628	n.a.	n.a.

* Predicted figures.

Source: Ministry of Mining, the Government of Indonesia

In order to show how large a position petroleum takes in the Indonesian economy, let us make a reference to the Report on International Balance of Payments published by Bank Indonesia. Of the total 1970 exports of $1,204 million, petroleum exports amounted to $443 million, which accounted for 36.8% of the total.

Of the corresponding 1971 figure of $1,364 million (estimated value), the oil exports amounted to $574 million, accounting for 42.1%. The percentage of oil exports is trending upward year by year, as it is predicted that in 1972 the oil exports will reach $1,014 million or 54% of the total exports of $1,889 million.

Indonesian crude oils are particularly characterized by their low sulfur content as compared with Middle East crudes (e.g., average 0.1% of sulfur content in contrast to average 2.3% in the Middle East crudes). This characteristic makes the Indonesian crude oils quite valuable for the control of environmental pollution, which is now arousing worldwide concerns. As of May 1972, the posted price of Indonesian Minas crude is $2.96/bbl ($18.62/Kl), as compared with about $2.5/bbl ($15.73/Kl) of the Mideast crudes (the price of the high-sulfur Khafji crude is $2.25/bbl ($14.15/Kl)).

Table V-2 Volumes of Oil Production by Producer

(Unit: x 10^3 Kl)

	1971		1972*		1973*	
Pertamina Unit I-V	7,585.73	(13.7%)	6,529.81	(9.5%)	8,832.77	(11.0%)
Caltex	45,415.97	(82.0%)	51,618.08	(75.0%)	50,548.49	(62.7%)
Stanvac	1,620.05	(2.9%)	4,230.67	(6.0%)	4,874.94	(6.0%)
Others	774.33	(1.4%)	8,007.08	(11.5%)	16,372.23	(20.3%)
Total	55,396.08		70,385.64		80,628.43	

* Predicted figures

Source: Ministry of Mining, the Government of Indonesia.

With respect to oil production, the 1% or less sulfur crude oil accounts for about 900 x 10^6 Kl of the world total production of 2,000 x 10^6 Kl. If the U.S. crudes of low-sulfur contents are eliminated, the remaining low-sulfur crude production is about 400 x 10^6 Kl, of which Indonesian crudes occupy 14%.

It is predicted in Indonesia that Pertamina's crude production from existing oil wells will trend downward in the future. But Indonesia is now strongly setting forward the development of the petroleum and natural gas resources, which have a decisive advantage of low-sulfur content, with a background of world-wide sharp growth of the demand for clean energy. Since 1968, 43 new oil and gas fields have been discovered. Therefore, the total oil production is estimated to increase in the years to come.

According to Table V-1, above, taken from the Ministry of Mining statistics (Indonesia), upward trend in oil production is showin in Table V-3.

Table V-3 Increase of Production

Year	Percent over the previous year
1969	125
1970	115
1971	112
1972	124*
1973	117*

* Predicted values.

For example, the Djatibarang oil field, recently developed by Pertamina, with a reserve of estimated 630 x 10^6 bbls (100 x 10^6 Kl) of low-sulfur crude oil, is expected to produce 30,000 BPCD (4,770 Kl/D) of oil by March 1973 and even 150,000 BPCD (23,850Kl/D) in the latter half of 1973.

Caltex, occupying about 80% of the Indonesian total oil production, has announced that it would make an additional investment of $60 million, to increase oil production to a 1,000,000 BPCD (159,000 Kl/D) level in the near future. The company recently signed an execution contract with Pertamina to the effect that the company's activities under the production share system would be extended until 2001, and thus the company will increasingly make more active and steady efforts in developing new oil fields.

Under these circumstances, President Sutowo of Pertamina has stated that the oil production would reach 1,500,000 BPCD (or 87.1 x 10^6 Kl annually) in 1973, 2,000,000 BPCD (or 116.1 x 10^6 Kl annually) in 1975 and 3,000,000 BPCD (or 174.1 x 10^6 Kl annually) in 1980.

As for crude oil exports, 56.7% of the 1969 crude exports and 69.2% of the 1970 ones were destined for Japan. As a large oil-consuming country, where concerns for environmental protection are becoming higher and higher, Japan will increasingly import Indonesian crude oils. Japan's low-sulfur crude import, which stood at 36.6 x 10^6 Kl in 1970 (of which: Minas, 19.8 x 10^6 Kl, and Duri 1.75 x 10^6 Kl), is estimated to be 55 x 10^6 Kl in 1973.

1.2 Petroleum Product Market in Indonesia

(1) Refineries in Indonesia

Table V-4 Refineries in Indonesia

(Unit: Upper figures - BPSD
Lower parenthetical figures - Kl/D)

Refinery Name	Name of Unit		Topping	Vacuum Distillation	Cracking	Reforming	Wax Production (tons day)	Others
Pangkalan Brandan	Pertamina Unit I	N. Sumatra	7,000 (1,113)					Asphalt plant Lube oil treating plant
Pladju	Pertamina Unit II	S. Sumatra	110,000 (17,490)	25,000 (1,975)	(thermal) 10,000 (1,590)	(thermal) 9,000 (1,431)		Alkylation unit, Polypropylene unit of 20,000 ton per year, end of 1972
Sungai Gerong	Pertamina Unit II	S. Sumatra	75,000 (11,925)	8,200 (1,304)	(catalytic) 18,900 (3,005) (thermal) 18,370 (2,921)		100	Stripping unit Alkylation unit
Wonokromo	Pertamina Unit III	E. Java	3,000 (477)					Asphalt plant
Balikpapan	Pertamina Unit IV	E. Kalimantan	65,000 (10,335)	11,300 (1,797)			104	
Jjepu	LEMIGAS	E. Java	6,000 (954)					
Sungai Pakning	Pertamina Unit VI	C. Sumatra	30,000 (4,770) 50,000 (7,950)					
Dumai	Pertamina Unit VI	C. Sumatra	100,000 (15,900)			6,200 (986)		
Total			396,000 (62,964)	44,500 (7,076)	47,270 (7,516)	15,200 (2,417)	204	

(Lemigas) ...... (Lembagan Minjak dan Gas Bumi)

1975 figure

All the refineries in Indonesia are operated by Pertamina, excepting Tjepu refinery owned by LEMIGAS. Present state of these refineries are as given in the Table V-4.

A lube oil plant is in operation at 40,000 tons/yr. in Tandjung Priok, Jakarta, and the other one in operation is located at Pangkalan Brandan. In addition, a plant is under construction at Surabaya, and another is in planning stage. Domestic demand for lube oil, standing at 85,000 tons/yr. will be thus in the self-sufficient stage.

As for asphalt, there are a 15,000 ton per year plant in Pangkalan Brandan, and two 70,000 ton per year plants each in Wonokromo and in Plaju. A nationally operated asphalt company (Perusahaan Aspal Negara) is producing natural asphalt at 30,000 tons/yr. on Buton Island.

It is reported that Pertamina has decided that the maximization of kerosene production would be taken in both the Sungai Gerong refinery and the Plaju refinery after the Dumai refinery is put into operation, but that both refineries would be diverted so as to produce petrochemical raw materials in future.

(2) Structure of Demands for Indonesian Oil Products

More than half of the oil products was consumed domestically in Indonesia until 1970. However, it is estimated that the domestic consumption will be outrun by exports from 1971 on. On the contrary, kerosene, gas oil, and asphalt depend partly on imports because their production can not catch up with domestic demands.

The 1970 statistics will reveal the above-mentioned circum-stances.

Table [illegible] Statistics of Petroleum Products (1970)

[illegible]

Products	Production	Export		Domestic consumption	%
[illegible] gasoline	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Automobile gasoline	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jet fuel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kerosene	[illegible]			[illegible]	[illegible]
Gas oil	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]			[illegible]	[illegible]
[illegible] oil	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]		
Asphalt	[illegible]			[illegible]	
[illegible]	[illegible]	[illegible]		[illegible]	

[illegible]

[illegible]

[illegible]

[illegible]

Source: [illegible]

[illegible]

[illegible]

With regard to asphalt, about 90% of 200,000 tons/yr. of present annual demand can be supplied domestically, when the Pladju refinery is put into full operation. However, it is stressed that infrastructure should be further expanded for the purpose of Indonesian industrialization, and asphalt demand is continuously growing larger.

NOTE: In case asphalt is to be produced, it is more advantageous to use high-sulfur, but inexpensive crude oil, such as, e.g., Khafji crude, than to use costly Minas crude. If about 560,000 tons are expected for the 1980 asphalt demand, necessary Khafji crude oil amounts to 40,000 BPSD, (6,360 KL/D), from which about 300,000 tons/yr. of naphtha is available. And if this amount of naphtha is allocated to the petrochemical raw material, about 100,000 tons/yr. of ethylene will be produced.

About 90% of oil exports is in the forms of residues and heavy oil valuable as fuel sources, reflecting the benefit of low-sulfur of Indonesian crudes.

1. 1 Availability of Naptha as Petrochemical Raw Material in Indonesia

According to the information given by Pertamina, the naphtha available for petrochemical use are at present 5,000 BPSD (795 KL/D) of Minas naphtha and 5,000 BPSD (795 KL/D) of Java Sea naphtha.

Meanwhile, as stated above, crude oil development is in active progress, and various plans for construction of new refineries have been reported although there is some uncertainty in these plans. The production pattern for oil products would be set up in such a way that the demands can be satisfied for a given period under that pattern.

If the supply price of naphtha is to be fixed at an international price (i. e., FOB price in Indonesia), then we would be able to expect that the naphtha quantity necessary for the petrochemical industry in the future would be provided when this demand is acceptable from the view point of national economy.

Indonesia is trying to set forward both the resources development and the industrial development simultaneously. Therefore, if a long-term industrialization project is planned based upon the information on present state of resources, there is a possibility that such a project will turn out to be too pessimistic. Rather, in anticipation of future success of the resources development now in active progress, the Indonesian Government expects for a petrochemical complex to be planned in such a way that the planning is not based upon present availability of natural resources, but should contribute to the future development of petroleum resource and the future programs for supplying oil products.

Such an object can be achieved in this preliminary study, by planning on a petrochemical industrialization project based upon market forecasting of petrochemical products and by clarifying the quality and quantity of the raw material naphtha required for that project.

2. Natural Gas

2.1 Natural Gas Situation in Indonesia

Indonesia's natural gas deposits are registered as given in Table V-6, below. (Those figures do not include recently discovered new gas fields in onshore and offshore areas.)

Table V-6 Natural Gas Reserve

(Unit: $\times 10^6$ Nm^3)

North Sumatra	5,060
Central Sumatra	22,199
South Sumatra	21,104
Java	6,188
Kalimantan	3,561
Total:	58,112

Source: Directorate General of Oil and Gas, The Indonesian Government. (Jan. 1969)

Despite these abundant reserve, the situation in natural gas production and utilization is still on the unsatisfactory level. Since as late as 1969 it has been used only in part for fertilizer production, and present state of its production and utilization is as given in Tables V-7, V-8 and V-9.

The present activities and future plans are as follows:

Pertamina [illegible] is supplied the [illegible] plant and the carbon black plant [illegible] with a [illegible] ton per year with 110 x 10^6 Nm^3/y of natural gas in 1971. [illegible]

Table [illegible] Production and Properties of Natural Gas

No.	Name of Gas Field	Name of Operating Company	Production (10⁶ Nm³) Annual Production Record 1971	Production (10⁶ Nm³) Forecast of Production 1972	Properties: Compositions (vol %) C_1	C_2	C_3	C_4	C_5	H_2S, CO_2 Content: H_2S (vol %)	CO_2 (vol %)	Pressure (atm)	Heat Value (Kcal/Nm³)	Price (In $/10³ Nm³) Ex-Well Price
[illegible]	[illegible]	[illegible]	[illegible]	n.a	[illegible]	[illegible]	10.4	6.6	2.9	nil.	0.5	n.a	7,120 to 15,130	7.46 to 11.19
[illegible]	[illegible]	[illegible]	[illegible]	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	7.46 to 11.19
[illegible]	[illegible]	[illegible]	[illegible]	n.a	75.6	6.[illegible]	7.78	2.[illegible]	0.54	0.001	7.20	40	10,547	7.46 to 11.19
[illegible]	[illegible]	[illegible]	[illegible]	n.a	54.4	11.9	5.1	4.9	4.0	nil.	19.7	40	9,363	7.46 to 11.19
[illegible]	[illegible]	[illegible]	21	n.a	[illegible].2		3.2	0.5	nil.	nil.	2.2	8	7,120 to 15,130	7.46 to 11.19
[illegible]	[illegible]	[illegible]	[illegible]	n.a	50.0	15.0	15.0	7.0	2.0	nil.	1.5	n.a	7,120 to 15,130	7.46 to 11.19
[illegible]	[illegible]	[illegible]	[illegible]	n.a	75.80		0.60	1.0	nil.	nil.	18.60	n.a	7,120 to 15,130	7.46 to 11.19
[illegible]	[illegible]	[illegible]	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a

Source: Ministry of Mining, Indonesia

Table V-8 Uses of Natural Gas

(Unit: x 10^3 Nm^3)

[illegible]	1968	1969	1970	1971
1. [illegible]	[illegible] (for all Companies)	1,318,600 (for all Companies)	959,600 (for all Companies)	930,500 (for all Companies)
2. For [illegible]	10,100 (only from P. T. Stanvac - fields)	19,200 (only from P. T. Stanvac - fields)	36,600 (only from P. T. Stanvac - fields)	32,500 (only from P. T. Stanvac - fields)
3. For [illegible]				
a. [illegible]	[illegible] (only from P. T. Stanvac - fields)	99,100 (only from P. T. Stanvac - fields)	132,900 (only from P. T. Stanvac - fields)	112,200 (only from P. T. Stanvac - fields)
b. [illegible]	[illegible] (only from Pertamina [illegible] fields)	[illegible] (only from Pertamina Unit II fields)	800 (only from Pertamina Unit II fields)	500 (only from Pertamina Unit II fields)
c. [illegible]		--	63,900 (only from Pertamina Unit I fields)	115,600 (only from Pertamina Unit I fields)
4. [illegible]	[illegible] (from all Companies)	[illegible] (from all Companies)	1,715,700 (from all Companies)	2,029,800 (from all Companies)
Total	[illegible]	[illegible]	2,909,500	3,221,100

Source: Ministry of Mining, Indonesia

Table [illegible] [illegible] of Natural Gas in 1971

(Unit: [illegible])

Name of Company	Production	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Gas to Refinery	Gas to P.C. Plant & Carbon Black Plant	Losses and to Flare	Gas Injection
[illegible]	[illegible]				[illegible]			[illegible]	[illegible]	-
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]			[illegible]	-
[illegible]	[illegible]				[illegible]					
[illegible]	[illegible]				[illegible]				[illegible]	
[illegible]	[illegible]				[illegible]				[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]				[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

operation, they are estimated to consume 154 x 10^6 Nm^3/yr. of natural gas. In other words, natural gas will not be available to the new project, as long as the present production level of [illegible] x 10^6 Nm^3/yr. is maintained.

Pertamina Unit II and Stanvac: As of 1971, the Pusri fertilizer plant received 111 x 10^6 Nm^3 of natural gas from Stanvac to produce 100 000 tons/yr of urea. As a leading fertilizer plant in Indonesia, this plant is expected to scale up to reach production of 400 000 tons/yr of urea in the middle of 1974 and has already made reservations for the supply of [illegible] x 10^6 Nm^3/D of natural gas from Pertamina Unit II and Stanvac.

Pertamina Unit III: Pertamina is now making efforts for oil field development in the Djatibarang area, and at the same time has discovered natural gas. However, the 1971 production of natural gas was as small as 21.8 x 10^6 Nm^3/yr, and future prospects for production are unknown. For this reason, it will be too early to discuss the natural gas from this area; we should wait until data will have been established.

Pertamina Unit IV: The 1971 production in this area is 607 x 10^6 Nm^3/yr. The natural gas from this area has a gas composition suitable as a petrochemical raw material (C_2 [illegible] 10.0 vol %). Moreover, the infrastructure of this area is extremely undeveloped, and the transportation of the petrochemical products to markets (mainly to Java Island, or the Indonesian domestic market) will be of a hard problem. It is not recommendable to establish a petrochemical base in this area.

Caltex: The company is producing about 80 per cent of the total Indonesian crude oils, mainly from Minas and Duri. The 1971 production amounted to 449 x 10^6 Nm^3/yr. However, the company has not made public the gas composition. In order to take the Caltex gas into consideration, special negotiations will be required with the company.

Pertamina Unit V and Lemigas: Production is negligible in both cases.

2.2 Regional Relationship between Natural Gas Production Areas and a Petrochemical Complex

At present, sulfur-free LNG is attracting worldwide attention as a clean energy source. LNG liquefaction bases are under construction or in planning stage in such countries as Brunei, Iran, and Abu Dhabi, etc. It has been estimated through these projects that about 1,000,000 ton per year is the economic turning point in the scale of LNG production, taking into account the plant cost and the costs of LNG tankers.

Since stable energy supply is strongly requested, it is desirable to have two series or more of liquefaction plant (about 2,000,000 ton per year of production). Namely, a LNG base has to produce about at least 3,000 x 10^6 Nm^3/yr [illegible] considerable amount of natural gas. In other words, only when the above quantity of natural gas can be secured, it is possible for the first time to liquefy methane in the natural gas into LNG for export and to transport the C_2+ fraction as a condensate to a petrochemical base.

Whether a petrochemical base can be located at a remote distance from natural gas producing areas is determined on the premise that natural gas is produced in such large volumes that the LNG base can pay.

2.3 Availability of Natural Gas as Petrochemical Raw Material in Indonesia

According to the Ministry of Mining, present volume of natural gas production available for the petrochemical raw material is simply such a volume as to permit production of 60,000 ton per year of ethylene.

On the other hand, Indonesia has an abundant reserve of natural gas and the Government is optimistic on the future production with a background of the present day active development of petroleum and natural gas resources, although quantitative forecasting is not available.

Therefore, in respect to natural gas the Indonesian Government has informed us of its intention that the present petrochemical industrialization project should be planned based upon future prospect of petrochemical markets, and the study should serve as an aid in natural gas development planning by clarifying the quality and quantity of the raw material natural gas required for the petrochemical project.

3. Lignite

3.1 Coal Situation in Indonesia

The following two tables show the coal production and demand in Indonesia in the past several years.

Table V-10 Coal Production

(Unit: tons)

Year	Ombilin	Bukit Asam	Mahakam	Others	Total
1940	577,616	847,835	245,058	329,171	2,000,630
1965	93,046	259,290	40,212	-	390,548
1966	100,655	184,936	34,288	-	319,829
1967	76,194	112,038	21,042	-	209,274
1968	79,870	78,850	16,353	-	175,073
1969	69,187	112,701	8,232	-	190,120
1970 (estimated)	60,000	100,000	0	-	160,000
1971 (records)	89,730	108,530	0	-	198,260

Table V-11 Coal Demands

(Unit: tons)

Year	National Railway	Power	Tin Mining	Cement	Vessels	Export	Others	Total
1940	428, [illegible]	9,462	56,552	60,354	236,222	472,147	355,331	1,618,500
1965	202,202	18,600	3,492	43,987	-	2,534	11,059	202,522
1966	147,761	10,429	12,702	29,110	-	-	7,052	216,134
1967	140,036	4,689	53,613	15,144	-	8,369	8,701	194,422
1968	[illegible] 76[illegible]	2,613	6,000	33,510	-	6,305	9,420	116,624
Percentage								
1940	26.47	0.58	3.50	3.74	14.59	29.17	21.95	100
1968	50.10	2.24	5.14	28.70	0	5.41	8.08	100

The table V-10 shows that the coal production in Indonesia has been falling year by year. The reasons are out-of-date production facilities, insufficient funds, and decrease in coal demand.

Particularly, the adoption of diesel locomotives by the Indonesia National Railway resulted in a sudden decrease in demand in 1965.

The Mahakam mine stopped production in 1970. Coal mines of the Mahakam coal field are scattered along the River of Mahakam in Eastern Kalimantan, spacing quite a long distance up to the coast (the River of Mahakam is 740 km long). This incurred a serious economic problem.

The coal reserves in the Ombilin mine are estimated at approximately 480 x 10^6 tons. Reserves within a depth of 700 m or less from ground surface, an easily producible range, are estimated at about 240 x 10^6 tons, of which approximately 130 x 10^6 tons are expected to be actually producible. The Bukit Asam coal reserves are estimated at approximately 280 x 10^6 tons.

3. 2 Analyses of the Ombilin and Bukit Asam Coals

We made detailed analyses on samples of the Ombilin and Bukit Asam coals. Detailed discussions are given in Annex C. In this discussion, the criterions used to rank the Japanese tertiary coals were applied to evaluate the usage of these coals, because Japanese tertiary coals have been studied most thoroughly of all the tertiary coals.
An outline of the two coals is as follows:

(a) Both of the Ombilin and Bukit Asam coals characterized as the tertiary coals. Detailed data indicate that the coals have H-contents lower than those averages of Japanese tertiary coals.

(b) The Ombilin coal is a subbituminous coal, and the Bukit

Asam coal is a lignite. Both of these coals have no caking property.

(c) Though they are low-rank coals, they have considerably high fuel ratio (fixed carbon/volatile matter), as compared with those of coals of same rank. This may be due to the low H-content.

(d) They have no such fusite as contained in the Australian coal. Bukit Asam coal has semifusinized constituent but in quite small quantities.

(e) Contents of ash, sulfur, and phosphorus are low. This is remarkable in the Ombilin coal.

(f) In the Ombilin basin, the thickness of the coal seams and the qualities of the coals are expected to be uniform. To the contrary, in the Bukit Asam basin it is supposed that the qualities of coals varies remarkably by place due to the thermal metamorphism by igneous intrusion. In addition, the environmental circumstances of coal deposition in the latter basin seem to warn of probability in future production of higher S-content coal.

It may be somewhat rough conclusion that H-content in these coals are less than those of the Japanese tertiary coals. The fact that many of the existing data show the higher number of fuel ratio seems to support the above assumption. In Bukit Asam basin, the coal is changed into the higher rank coal by the thermal metamorphism by igneous intrusion. However, no yield of the strong caking coal for use in blast furnace should be expected from this basin because original coal unaltered is regarded as the lignite with less hydrogen.

It is reported that the marine bed has been recognized in a horizon (B1) of Bukit Asam coal-bearing formation. In general, the coal seam accompanied by [illegible] and has higher S content. Although the S content in the Bukit Asam coal appears comparatively lower as far as the available data concerned, it is desirable to pay attention to the sulfur content in future.

3.1 Usage

Worldwidely, the following two classes of coal quality are in great demand.

(a) Coking coals: Widely used for coke production.
This is a carboniferous coal mainly produced in Europe, the United States, and some other countries such as Australia, China, etc.

(b) Semi-anthracite: Mainly used for electrode production.
A representative semi-anthracite is produced in Vietnam.

As previously noted, the Ombilin and the Bukit Asam coals are subbituminous and lignite, respectively. Therefore their uses are limited to the general uses such as fuel, gasification, cement sintering, etc.

Since they are not coking coals, they can hardly be used for a chemical purpose.

The low ash and sulfur, and very low phosphorus in these coals are very noticeable. However, such characteristics, enhancing

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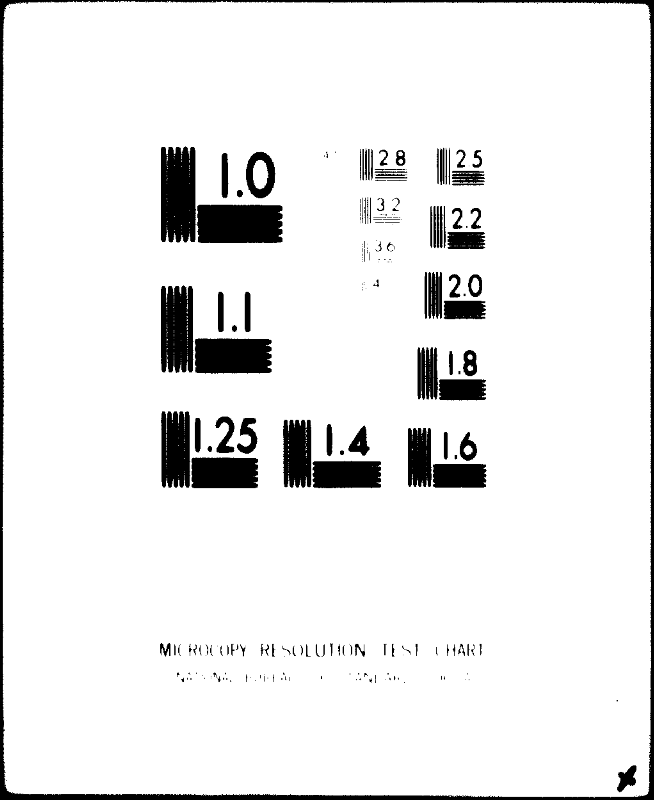
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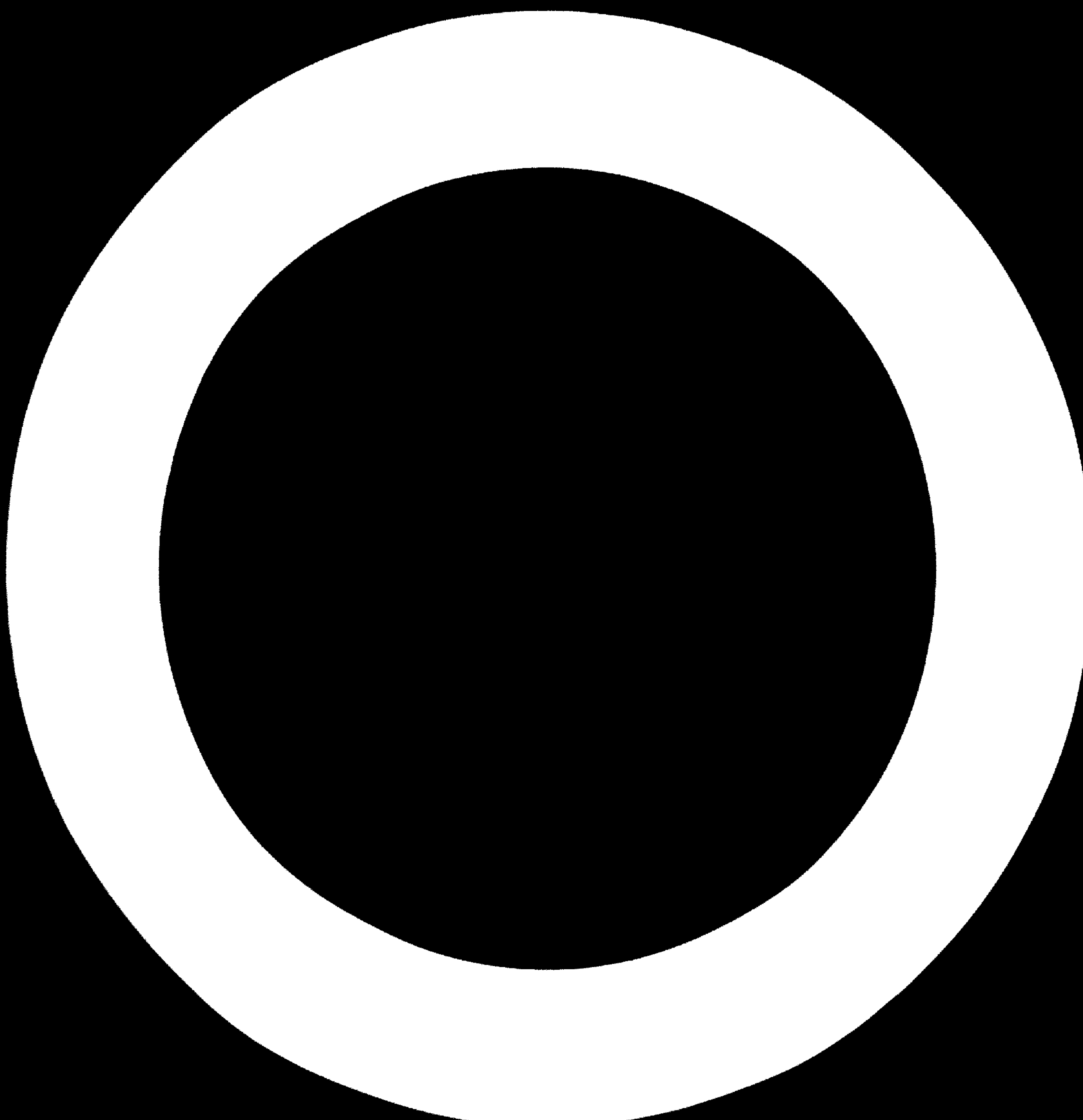


VI. PETROCHEMICAL COMPLEX

1. General

Results of market demands forecasting, described in details in Chap. IV. MARKET STUDY, have led us to select the following 10 commodities as promising petrochemical products with sufficient demands to afford their domestic-production in Indonesia; namely, VCM, PVC, LDPE, HDPE, Ethylene Glycol, Polystyrene, PP, DOP, Caprolactam, and Terephthalic Acid.

In this chapter we will show how these promising petrochemicals can be produced in Indonesia, and for this purpose, we will present examples of typical and reasonable petrochemical complexes using naphtha and natural gas available in Indonesia as the starting feedstocks and reflecting technical, economical, and other pertinent factors.

1.1 Premises

The following premises were first laid down in considering petrochemical complexes:

(1) As a principal attitude toward a measure to cope with varying market demands, we would consider complexes on such scales as to meet as fully as possible the estimated demands in market. This is because:

a) In the case of petrochemical complexes with a large scale merit, it is more advantageous to construct as large plants as possible, only if there are large demands;

b) Since a huge amount of investment is needed, expansion will not be readily performed, and therefore, opportunity cost is large for the time when the demand will outrun the supply; and

c) The market structure comprises approximately 80% domestic and 20% export market. Because this degree of dependence upon export fall within a reasonable range, there is no fear that a suitable operation rate cannot be maintained, even if we consider a complex on such a scale as to depend upon the above market structure.

(2) As a domestic market condition, we would consider petrochemical complexes with a proviso that there would not be taken strong protective measures for the domestic petrochemical industry, such as import banns or high tariffs barrier against import of overseas petrochemicals. In other words, the products coming from the petrochemical complex which we are now studying on will have to be produced at such costs as to enable them to stand competitive against those petrochemicals flowing into Indonesia from abroad.

(3) As stated in a section in Chap. V. RESOURCE STUDY, the Indonesian Government asked us to plan on petrochemical complexes, and to submit the qualitative and quantitative requirements for petrochemical raw materials, giving our regards to the demands from markets and giving little regard to the present availability of such raw materials as naphtha and natural gas. Therefore, we would plan on petrochemical com-

plexes on the assumption that all the requirements for raw materials are satisfactorily supplied.

(4) Orientation of complex sites are not made.

The complex site is not necessarily limited to a natural gas producing area when condensate produced in LNG production is used for petrochemical raw material. It should be noted, however, that the required minimum economic size of a LNG production plant is 2 x 10^6 ton per year in terms of LNG or 3,200 x 10^6 Nm^3 per year in terms of natural gas.

When the production of natural gas does not reach to this amount, LNG production is not feasible, and then the price of C_2+ fraction can not help increasing since gaseous met. ne is of no value unless it is used as fuel or for other purposes in or near the natural gas producing area. Therefore the plant site based on natural gas cracking is recommended to be near the natural gas producing area.

At the present stage, we will not pinpoint any specific producing area so that orientation of complex site is left for the following study.

1.2 Alternative Complex Scheme Associated with Products

As concluded in Chap. IV, MARKET STUDY, results of this market study have left the 10 commodities as the promising petrochemical products which are likely to have reasonable demands in the Indonesian market. The following pairs of products, among others, are interrelated with each other.

In order to produce PVC, of course VCM production is necessary, but since VCM can be externally marketed in the form of monomers, it is numbered as a commodity. From view point of production, VCM/PVC may be regarded as a unit in the complex organization. Both of ethylene glycol and terephthalic acid are used as the raw materials for polyester fibers, and it is desirable to produce both of them domestically so far as there is no extremely bad economic feasibility with them. DOP is a plasticizer necessary for PVC processing, and it is also desirable to produce it domestically unless its economics is extremely bad.

From the foregoing, it is not of importance to study an alternative scheme by changing types of products from such small numbers of products in the downstream sector. Therefore, we planned on complexes organized with the above 10 commodities, and studied their economic feasibility.

1.3 Alternative Complex Scheme Associated with Processes

Naphtha and natural gas are conceivable as the petrochemical raw materials in Indonesia.

Note: Although kerosene, gas oil, and crude oil may also be mentioned as the petrochemical raw materials, kerosene is an oil product with the largest demand in Indonesia; kerosene and gas oil cracking usually results in larger amounts of propylene and C_4 fractions, and it is not advantageous to use them at a complex in Indonesia, where the demand for ethylene is especially large. As for crude oil, the cracking technology imposes a problem and is unusable in a commercial plant.

Naphtha cracking co-produces olefins and aromatics, both usable as the basic chemicals for petrochemicals production, whereas natural gas brings about olefins only, and little aromatics. If natural gas is used for the complex, it is convenient to make use of a naphtha reforming process additionally, in order to obtain aromatics. Therefore, we planned a complex based upon naphtha cracking, and as the alternative scheme associated with processes, we planned another complex based upon both natural gas cracking and naphtha reforming.

1.4 Scale and Start-up Year of Complex

Competitiveness of a complex is determined by the types of products from the downstream sector of the complex, production scales thereof, and the prices of basic chemicals such as olefins and aromatic supplied to the downstream sector.

The above discussion leaves us to a fact that the competitiveness of a complex is directly dependent upon production costs of basic chemicals, namely, the complex scale.

The trend in the scale of petrochemical complexes in the world is as shown in Table VI-1.

Table VI-1 Scales of Petrochemical Complexes

Scales (Unit: 1,000 ton per year of ethylene)	No. of complexes
≤ 200	13
> 200	18
≥ 300	11
400 - 550	11

(These complexes are now in completion of construction, under construction, and in planning stage, as of 1972)

Most of complexes with less than 200,000 ton per year of ethylene capacities are possessed by those countries in which special protective measures are taken. The world-wide standard of internationally competitive scale is considered to fall between 200,000 and 550,000 ton per year in terms of ethylene.

According to the Market Study, the ethylene demand in Indonesia is found as the table VI-2.

It is generally acknowledged that an economically desirable operation rate of a plant is at least 70%, although any plant is operable within a range of 60-110%.

For a complex with naphtha as the raw material, we fixed its scale at a mid-point level of international-scale complexes (200,000-550,000 ton per year), i.e., 300,000 ton per year in terms of ethylene production. Then we found the year of operation start-up at 1980.

Table VI-2 Ethylene Demand in Indonesia

(Unit: tons)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
FOR LDPE	53,600	62,400	73,900	87,200	101,900	116,600	133,400	153,300	177,500	205,800	232,100
FOR HDPE	17,100	19,500	21,900	24,200	27,400	29,100	31,200	33,300	35,600	37,400	39,500
FOR VCM	22,000	25,000	29,000	33,500	39,300	46,500	53,000	62,000	71,000	82,500	90,000
FOR Ethylene-glycol	19,100	21,900	25,200	29,500	34,100	39,100	44,700	51,600	59,800	69,300	80,100
FOR Polystyrene	4,700	5,600	6,500	7,600	8,900	10,700	12,200	13,700	15,900	18,300	21,400
Total:	116,500	134,400	156,500	182,000	211,600	242,000	274,500	313,900	359,800	413,300	463,100

Note: Since in Indonesia ethylene glycol will be used together with terephthalic acid for production of polyester fiber, we have made the production amount of ethylene glycol correspond to that of terephthalic acid. The naphtha cracker of 300,000 ton per year in terms of ethylene gives 34,500 tons/yr. of terephthalic acid, then the corresponding amount of ethylene glycol is 15,000 tons/yr., thereby the ethylene demand for this ethylene glycol being 18,000 tons/yr.

Therefore, ethylene demands total 195,500 tons in place of 211,600 tons for 1979, and 220,900 tons in place of 242,000 tons for 1980 in table VI-2. The operation start-up year of complex is so set as to permit more than 70% of operation rate for naphtha cracker, and the start-up year is decided for 1980.

We also fixed the scale of a complex based upon natural gas cracking and naphtha reforming at 200,000 ton per year in terms of ethylene, with its operation start-up scheduled for 1977. The year 1977 is also the earliest year of plant start-up, when attention is paid to the period necessary for plant construction from now on.

1.5 Capacities of Downstream Plants of the Complex

As for the downstream plants, we would fix their capacities so as to meet the demand from market as much as possible. In a normal manner, the plant capacity is fixed at such a level as to afford full operation within several years of start-up. In this case, we would fix the plant capacities in such a way that the production at an operation rate of 70% is equal to the demand in the year of start-up.

It should be noted, though, that we would also take rates of growth in demands into consideration, if it is predicted that the demands for certain products will either grow sharply or merely at slow rates.

1.6 Criteria upon which to Evaluate the Economic Feasibility of Petrochemical Plants

The petrochemical industry should not be regarded simply as a material-supplying industry, but as a key industry to have propagation effects on national economy and society and give incentive to the industrialization of a country. Whether the petrochemical industry should be established or not will have to be considered not merely from a viewpoint of profitability, but from a higher standpoint.

The petrochemical complex can be grouped into a sector to produce basic chemicals, i.e., olefins such as ethylene, propylene, etc., and aromatics such as benzene, toluene, and xylenes, and a downstream sector to produce various intermediate chemicals, synthetic resins, and raw materials for synthetic fibers.

In developing countries, the basic chemicals production sector, which is the central part of a petrochemical complex, is usually operated under a state-owned or a partly state-owned company. On the other hand, the downstream products sector necessitates different sales networks for its various products, and requires elaborated sales techniques, such as, for example, technical services to users, managerial and capital assistance, etc. It is thus desirable for the latter sector to be operated by half private or wholely private companies.

The basic chemicals production sector should supply the downstream products sector with basic chemicals at as low prices as possible within the limit of allowable minimum profits, rather than pursuing as much profits as possible. This attitude is desirable for the project to be so attractive for private companies to take part in the complex, and therefore is desirable for sound development of the downstream products sector.

We depend herein on the rate of return on investment, based upon the discounted cash flow method, for a means of evaluating economic feasibility of plants and complexes. Since private chemical industries generally set a necessary rate of return on investment to preferably 15% or more, or at least 10%, we would use such percentages as the criteria of evaluating profitability of the downstream products sector.

On the other hand, we set a criteria of 7.5% for the basic chemicals sector, because its products, such as olefins and aromatics, are consumed within the complex and have no fear in marketing them and because there is also no risk in the aspect of production technologies. (Refer to the standard value cited in John W. Hackney, "Control and Management of Capital Projects," John Willy & Sons, Inc., New York, (1966), p. 196. This standard is a value which Mr. W. Hackney obtained from the studies of 300 or more projects while he was working for Standard Oil Co., New Jersey, and is used not only in the U.S. but also worldwidely in developed countries.)

2. Petrochemical Complex based on Naphtha Cracking (Case I)

2.1 Complex Integration

(1) Complex organization

In organizing the complex, we primarily tried to meet as far as possible the demands for those products which were regarded as promising from a viewpoint of market demands. However, seeing that naphtha cracking necessarily produces ethylene, propylene, and other fractions at a constant ratio, we determined the types and capacities of plants to be integrated into the complex, taking effective utilization of these fractions, volumes of available basic chemicals, and other pertinent factors into overall consideration. Capacities of the LDPE, VCM, PVC, polystyrene, and PP plants were fixed in such a way that the production with an operation rate of 70% can meet the demand in 1980, the year of plant start-up.

The HDPE plant capacity was fixed so that an operation rate of 80% will lead to sufficient production to meet its demand in 1980, since HDPE will have a slower demand growth rate from 1980 on. Aromatics production is determined by the volume of cracked gasoline from naphtha cracking.

Toluene with no demand in Indonesia is disproportionated to convert it into benzene and xylenes, wherein such as aromatics production system as to maximize p-xylene production would be used in the light of large demand for polyester fiber. Under such a system, capacities of the terephthalic acid and the cyclohexane/caprolactam plants were determined by the quantities of p-xylene and benzene produced.

The EG plant capacity was determined in response to that of the terephthalic acid plant, as both are used as the raw materials for polyester fiber.

Since p-xylene maximization is contemplated, o-xylene necessary as the raw material for DOP has to be obtained from elsewhere. As described below, it would be imported from the U.S. C_4 fraction by-produced from naphtha cracking contains a large amount of butadiene. For effective utilization of this fraction, the butadiene would be extracted for export to the U.S. Its price is set at a lower level than usual, because this butadiene is totally dependent upon overseas markets and because it will have to compete stiffly with European and Japanese products.

However, by combining butadiene export to the U.S. with o-xylene import from the same country, we would consider on some merits, such as easy trade of butadiene, and reduction in transportation cost resulting from reciprocative use of carriers. There is also another indirect merit that the DOP production leads to higher utilization of C_3 fraction.

From the above, we have the following plants organized the complex based upon naphtha cracking, which is scheduled for operation in 1980.

The Block Flow Diagram is shown in Fig. VI-1, and operation rates of all plants are as given in Table VI-3.

	Plant Name	Capacity (tons/yr.)
(i)	Naphtha	302,000 (ethylene)
(ii)	Selective Hydrogenation	217,000 (feed; cracked gasoline)
(iii)	Aromatics Extraction	217,000 (feed; cracked gasoline)
(iv)	Disproportionation	26,000 (feed; toluene)
(v)	Isomerization & p-Xylene Separation	29,400 (feed; xylenes)
(vi)	VCM	128,800
(vii)	PVC	110,000
(viii)	LDPE	160,000
(ix)	HDPE	35,000
(x)	EO/EG	15,000
(xi)	Styrene	50,000
(xii)	Polystyrene	50,000
(xiii)	PP	60,000
(xiv)	Oxo Gas	35,900
(xv)	2-Ethylhexanol	41,700
(xvi)	Phthalic Anhydride	23,400
(xvii)	DOP	60,000
(xviii)	Butadiene Extraction	57,500
(xix)	Cyclohexane	36,700
(xx)	Caprolactam	33,400
(xxi)	Terephthalic Acid	34,700

NOTE: For the technological and economic calculation, the following plants are regarded as one unit.

(i) Styrene/polystyrene plant: As the total amount of styrene is supplied to the polystyrene plant of the complex and is not sold in the market, styrene plant is combined with the polystyrene plant.

(ii) DOP-related plants: The products from Oxo-gas, 2-ethylhexanol and phthalic anhydride plants are used as the feeds to the DOP plant, and they are not sold in the market. Therefore, these plants are grouped into one unit.

(iii) Aromatics-related plants: All of selective hydrogenation, aromatics extraction, disproportionation, isomerization and p-xylene separation plants are concerned with the production of aromatics (benzene and p-xylene), and these plants are grouped into one unit.

(iv) Cyclohexane and caprolactam plants: According to the above conception, cyclohexane and caprolactam plants must be regarded as one unit, but they are separately dealt with for convenience of economic calculation, because the former has a depreciation period of 10 years, while the latter has 8 years.

The chlorine-caustic electrolysis plant, the sulfuric acid plant and the air separation plant are located at a site near the complex to supply it with auxiliary raw materials. The water treatment plant and the electric power station to supply the complex with utilities are located at a site adjacent to the complex.

(2) Detailed processes used in Basic-chemicals Plants

Naphtha showing such properties as given in Table VI-4 is first fed into the cracking furnace, where it is cracked under given cracking conditions.

The cracked gas from the cracking furnace is passed through the steps of quenching, compression, separation and purification, to give olefins and cracked gasoline, etc. A part of methane is used as a raw material for producing oxo-gas, and the remaining methane is used as fuel.

Table VI-3 Operation Rate (Case I)

(Unit: %)

Plant Name	Calendar Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Ordinal Year	1	2	3	4	5	6	7	8	9	10
	Capacity (tons/yr.)										
Naphtha Cracker	302,000 (Ethylene)	71	81	92	100	100	100	100	100	100	100
VCM	128,800	72	84	96	100	100	100	100	100	100	100
PVC	110,000	68	80	96	100	100	100	100	100	100	100
LDPE	160,000	69	79	91	100	100	100	100	100	100	100
HDPE	35,000	80	86	91	97	100	100	100	100	100	100
EO/EG	15,000	71	81	92	100	100	100	100	100	100	100
Styrene & Polystyrene	50,000	70	80	90	100	100	100	100	100	100	100
PP	60,000	73	93	100	100	100	100	100	100	100	100
DOP-related	60,000	67	77	90	100	100	100	100	100	100	100
Butadiene	57,500	71	81	92	100	100	100	100	100	100	100
Aromatics-related	76,100 (Benzene) 24,700 (p-Xylene)	71	81	92	100	100	100	100	100	100	100
Cyclohexane	36,700	71	81	92	100	100	100	100	100	100	100
Caprolactam	33,400	71	81	92	100	100	100	100	100	100	100
Terephthalic Acid	34,700	71	81	92	100	100	100	100	100	100	100

Hydrogen is used in the downstream plants, and surplus hydrogen is mixed with methane to be used as fuel. A cracked product, ethylene, is purified to a polymer grade (a purity of 99.9 vol %). Ethane, separated in the ethylene purification step, is recycled to the cracker.

Another cracked product, propylene, is purified to a polymer grade (a purity of 99.9 wt %) in a quantity enough to meet the polymer requirement, and the remaining propylene is purified to a chemical grade (96.5% purity), and partly supplied to the 2-ethylhexanol plant and the residual quantity is used as fuel. Propane separated in the propylene purification is used as fuel. Still another cracked product, C_4 fraction, is produced in a quantity of 121,000 tons. Since this contains about 50% butadiene, the C_4 fraction is subjected to butadiene extraction, in anticipation of butadiene export to the U.S. where butadiene is short. Raffinate is used as fuel.

Cracked gasoline is passed through the selective hydrogenerator into the aromatics extraction plant, where benzene,

Table VI-4 Specification of Feed Naphtha (Case I)

TBP Cut	IBP		49°C (120°F)
	EP		180°C (355°F)
Yield on Crude		12.6 (vol %)	11.3 (wt %)
Specific Gravity		0.733	
API (60/60°F)		61.5	
PONA Analysis (vol %)		Paraffin: 62	
		Olefin: 0	
		Naphthene: 37	
		Aromatics: 1	

toluene, and xylenes are separated from the feed by extraction. Since toluene has little demand, it is introduced into the disproportionation plant to convert it into benzene and xylenes. Benzene from both the aromatics extraction plant and the disproportionation plant is supplied to the styrene monomer plant and the cyclohexane plant. Xylenes are introduced into the isomerization plant, where o-, m-xylenes, and ethylbenzene are isomerized to p-xylene, which is separated in the p-xylene separation plant and sent to the terephthalic acid plant. Off gas, raffinate and heavy end which are produced during aromatics extraction, disproportionation, isomerization and p-xylene separation are all evaluated as fuel.

2.2 Summarized Data on Complex

(1) Investment Cost

Table VI-5 gives necessary construction costs and working capital of all plants, by which the complex is organized. The complex based upon naphtha cracking costs a total of $416.0 million, of which $60.9 million is financed by local loans in Indonesia and set aside for working capital. About $284.1 million or 80% of the remaining investment cost is covered by overseas long-term loans, and the last $71.0 million by the owned capital.

(2) Material Balance

The material balance is shown in Table VI-6.

(3) Utilities Requirements

Table VI-7 gives quantities of utilities consumed within

Table VI-5 Investment Cost (Case I)

(Unit: $1000)

Plant Name	Capacity (tons/yr.)	Investment Cost: Battery Limit	Investment Cost: Off-site	Investment Cost: Total Investment	Working Capital	Total
Naphtha Cracker	302,000 (Ethylene)	56,100	16,400	72,500	12,500	85,000
VCM	128,800	12,800	3,300	16,100	2,800	18,900
PVC	110,000	12,700	3,800	16,500	2,900	19,400
LDPE	160,000	50,800	15,200	66,000	11,600	77,600
HDPE	35,000	11,100	3,300	14,400	2,500	16,900
EO/EG	15,000	4,000	1,100	5,100	800	5,900
Styrene & Polystyrene	50,000	15,700	4,500	20,200	3,600	23,800
PP	60,000	24,100	7,200	31,300	5,500	36,800
DOP-related	60,000	30,000	7,700	37,700	5,900	43,600
Butadien	57,500	3,600	900	4,500	700	5,200
Aromatics-related	76,100 (Benzene) 24,700 (p-Xylene)	12,000	3,100	15,100	2,400	17,500
Cyclohexan	36,700	1,100	300	1,400	200	1,600
Caprolactam	33,400	30,800	9,200	40,000	7,000	47,000
Terephthalic Acid	34,700	11,000	3,300	14,300	2,500	16,800
Total:		275,800	79,300	355,100	60,900	416,000

Table VI-6 **Material Balance (Case I)**

Plant Name	Feeds			Products		
	Name	tons/hr.	tons/yr.	Name	tons/hr.	tons/yr.
Naphtha Cracker	Naphtha	126.6	1,003,000	Hydrogen	1.5	12,100
				Methane	21.0	166,500
				Ethylene	38.1	302,000
				Polymer Grade Propylene	8.7	69,000
				Propane	0.3	2,500
				Chemical Grade Propylene	0.86	68,000
				C_4 Fraction	1.5	12,100
				Cracked Gasoline	27.4	217,000
				Heavy Fuel	5.7	45,200
VCM	Ethylene	8.1	64,400			
	Chlorine	11.3	89,100	VCM	16.3	128,800
PVC	VCM	14.3	113,300	PVC	13.4	110,000
LDPE	Ethylene	21.2	168,000	LDPE	20.2	160,000
HDPE	Ethylene	4.6	36,400	HDPE	4.4	35,000
EO/EG	Ethylene	2.3	18,200	Ethylene Glycol	1.9	15,000
				Diethylene Glycol	0.33	2,600
Styrene & Polystyrene	Ethylene	1.9	15,000			
	Benzene	5.3	42,000	Polystyrene	6.3	50,000
PP	Polymer grade Propylene	8.7	69,000	PP	7.6	60,000
DOP-related	Chemical grade Propylene	5.7	45,000	DOP	7.6	60,000
	Methane	2.3	17,900	Fuel Gas	3.9	30,500
	o-Xylene	2.8	22,200	Heavy Fuel	0.67	5,300
	Hydrogen	0.58	4,600			
Butadiene	C_4 Fraction	15.3	121,000	Butadiene	7.3	57,500
Aromatics-related	Cracked Gasoline	27.4	217,000	Off Gas	3.2	25,250
	Hydrogen	0.18	1,420	Benzene	9.6	76,100
				p-Xylene	31	24,700
				Raffinate & Heavy end	11.7	92,550
Cyclohexane	Benzene	4.3	34,200			
	Hydrogen	0.29	2,300	Cyclohexane	4.6	36,700
Caprolactam	Cyclohexane	4.6	36,700			
	Hydrogen	1.9	1,470			
	Sulfuric Acid	7.6	60,100			
	Ammonia	4.2	33,400	Ammonium Sulfate	11.0	86,800
	Oxygen	2.4	19,200	Caprolactam	4.2	33,400
Terephthalic Acid	p-Xylene	3.1	24,700			
	Acetic Acid	0.048	382	Terephthalic Acid	4.4	34,700

Table VI-7 Utilities Requirement (Case I)

Plant Name	Electricity (Kw)	Steam (tons/hr.)	Cooling Water: Sea (tons/hr.)	Cooling Water: Industrial (tons/hr.)	Boiler Feed Water* (tons/hr.)	Fuel ($x10^6$Kcal/hr.)
Naphtha Cracker	3,230	-	21,800	1,100	178	180
VCM	1,950	7	12,500	500	100	15
PVC	5,830	26	1,730	90	42	-
LDPE	40,400	30	4,980	270	-	-
HDPE	3,240	11	1,040	50	-	-
EO/EG	3,000	15	1,770	100	2	17
Styrene & Polystyrene	2,230	42	740	40	-	-
PP	4,550	23	2,160	110	-	-
DOP-related	8,140	110	7,810	410	33	-
Butadiene	720	25	108	6	-	-
Aromatics-related	1,820	28	1,370	80	-	53
Cyclohexane	340	1	24	2	5	1
Caprolactam	3,800	51	560	30	-	13
Terephthalic Acid	2,940	20	1,300	70	110	30
Total	82,190	389	57,892	2,858	470	309

*) Includes Process Water

Note: Total requirement of Inert Gas in this complex is estimated about 4,000 Nm^3/hr.

battery limits by process plants, by which the complex is organized. The total quantity is supplied from the utilities center which is located at a site adjacent to the complex. We planned power generation by means of extraction turbines which enable simultaneous steam generation. Up to 95% of cooling water is covered by sea water.

(4) Fuel Balance

As shown by the fuel balance of Table VI-8, the fuel requirements of the complex can be fully covered by the fuel emitting within the complex. Surplus fuel is supplied to the power station and sold in markets.

(5) Operating Labor

The petrochemical industry calls for labor force as small as 866 persons directly in charge of operation of a relatively large-scale complex. Table VI-9 gives labour requirements of all plants. Based upon estimated wages paid by big enterprises in Indonesia in 1972, and also taking account of GNP growth in the range of 6.5-7.5% estimated until 1980s, we fixed the labor cost at $4,400/man-year for supervisors, $3,370/man-year for operators and analysis, and $1,820/man-year for laborers.

2.3 Economic Study

As stated above, economic study was made by calculation of rate of return on investment using the Discounted Cash Flow Method. In attempting economic calculation, prices and costs of materials and utilities were determined as described below.

Table VI-8 Fuel Balance (Case I)

(Unit: $\times 10^6$ Kcal/hr.)

Plant Name	Production	Consumption
Naphtha Cracker	331	180
VCM	-	15
PVC	-	-
LDPE	-	-
HDPE	-	-
EO/EG	2	-
Styrene & Polystylene	-	17
PP	-	-
DOP-related	45	-
Butadiene	87	-
Aromatics-related	151	53
Cyclohexane	-	1
Caprolactam	-	13
Terephthalic Acid	-	30
Total:	616	309
Balance	+ 307	

Table VI-9 Labor Requirement (Case I)

Plant Name	Supervisor (Man/day)	Operator & Analyst (Man/day)	Operator & Analyst (Man/shift)	Laborer (man/shift)	Total Supervisor	Total Operator & Analyst	Total Laborer
Naphtha Cracker	1	1	12	-	1	49	-
VCM	1	-	10	-	1	40	-
PVC	2	-	7	8	2	28	32
LDPE	2	-	20	30	2	80	120
HDPE	1	-	4	13	1	16	52
EO/EG	1	-	5	-	1	20	-
Styrene & Polystyrene	1	-	14	15	1	56	60
PP	1	-	7	7	1	28	28
DOP-related	3	-	14	-	3	56	-
Butadiene	1	-	3	-	1	12	-
Aromatics-related	1	-	9	-	1	36	-
Cyclohexane	1 (Cyclohexane and Caprolactam combined)	-	4	-	1 (Cyclohexane and Caprolactam combined)	16	-
Caprolactam		-	9	12		36	48
Terephthalic Acid	1	-	4	5	1	16	20
Total:	17	-	122	90	17	489	360
Grand Total						866	

(1) Price of Naphtha

The price of naphtha for 1980 in Indonesia was estimated in the following manner:

(i) Trend in naphtha price in Asia largely depends upon the movement of naphtha price in Japan, the largest naphtha consumer of Asia.

At present, CIF price of Middle East naphtha used by Japan's petrochemical industry is estimated to be in the range of $22 to $26 per ton, except for the spot market price. Taking these prices into account, we estimate the actual FOB price of Middle East naphtha will range from $17 to $21 per ton.

Since the Indonesian naphtha price has a merit of less transportation cost to Japan ($2.5 per ton lower cost), as compared with the price of Middle East naphtha, the FOB price of Indonesian naphtha for the petrochemical industry will be at about $19.5 - 23.5 per ton, except for spot trading at present.

Meanwhile, OPEC and major international oil companies concluded at the Teheran conference a contract to the effect till 1975 that the rise of Middle East crude price shall be calculated by means of a basic calculation equation of:

(Current price x 2.5% + 5¢) per year per bbl.

Since the rate of increase in naphtha price is generally smaller than that of the crude oil price, the naphtha price is likely to move up at an annual rate of about 2%. Therefore, the FOB price of Indonesian naphtha on the long-term contract basis is estimated to range from $23 to 27.5 per ton, average $25.3 per ton in 1980.

(ii) Natural gas deficiency has imposed a large problem on the U.S. energy industry. In order to cope with this problem, they are planning the import of LNG and production of SNG by means of steam reforming of naphtha. When SNG production plants using naphtha as the raw material, now under construction or in planning stage, are put into operation, 400,000 bbls/day of naphtha will be necessary. In 1974 or 1975, when naphtha demand begins to occur for SNG, it is predicted that the CIF price of naphtha on the East Coast of the U.S. will rise sharply to a level of $34 to $39 per ton.

However, this sharp rise of the naphtha price is caused by rapid changes in the demand-supply structure of energy in these years in the U.S. It is thus predicted that the price will settle from 1974 or 1975 on. Since then the naphtha price is likely to move up at an annual rate of about 2%.

Meanwhile, movement of the prices of the U.S. Petroleum products has great impact on the price system in Caribbean Sea countries and Canada, then with some time lag, on the price systems in Middle East, Europe, and finally in Asia. When consideration is given to a transportation cost of about $11 per ton needed between Asia and East Coast of the U.S., the effect of the naphtha demand destined for energy industry in the U.S. will result in a naphtha price in Indonesia ranging from $23 to $28 per ton, in about 1975. Then in 1980, the price will be $25.4 to $31 per ton, average $28.2 per ton.

The petrochemical industry hopefully foresees an Indonesian naphtha price of $25 per ton for 1980, whereas the energy industry foresees a higher price of $28 per ton. As a matter of fact, there may be an adjustment of naphtha purchase between both industries. Those fractions other than naphtha, such as kerosene and gas oil, will become more and more utilised in both industries and will act as the opponents to price hike of naphtha. Since, however, prices generally come close to higher side in many cases, we expect that the naphtha price will settle on around $27 per ton for 1980 in Indonesia.

(2) Prices of Other Raw Materials and Intermediates

Table VI-10 gives estimated prices of raw materials and intermediates used in the complex.

We assumed that the naphtha price would go up at 2% per annum. Prices of ethylene, polymer-grade propylene, chemical-grade propylene, and cracked gasoline were each determined by cost allocation, giving consideration to the economic feasibility of the ethylene- and propylene-derivatives production plants and the aromatics-related plants.

Prices of chlorine, hydrogen, oxygen, caustic soda, and sulfuric acid are the estimates obtainable when those materials are produced, using similarly priced utilities as shown in Table VI-12, at the electrolysis plant, the air separation plant, and sulfuric acid plant, which are located near the complex.

The prices of o-xylene and acetic acid were the estimated CIF prices. As for ammonia, it was assumed that the complex would buy a part of it from the urea plant (PUSRI).

Table VI-10 **Price List of Raw Materials & Intermediates (Case I)**

(Unit: $/ton)

Calendar Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Ordinal Year	1	2	3	4	5	6	7	8	9	10
Naphtha	27	28	28	29	29	30	31	31	32	32
Ethylene	100	101	103	105	106	107	110	111	113	115
Propylene for PP	75	76	77	78	79	80	81	82	83	85
Propylene for 2-Ethyl-hexanol	55	56	57	58	59	60	61	62	63	65
C_4 Fraction	29	29	30	31	32	33	33	34	35	36
Butadiene	←					100				→
Cracked Gasoline	40	40	41	41	42	42	43	44	44	45
Benzene	80	81	83	84	85	87	88	89	91	92
p-Xylene	300	301	302	303	304	306	307	308	309	310
Cyclohexane	100	104	107	110	112	114	118	121	123	127
Chlorine	70	70	71	71	71	72	72	72	73	73
Hydrogen	←					218				→
Oxygen	←					15				→
o-Xylene	129	132	134	137	140	142	145	148	151	154
Sulfuric Acid	←					27				→
Ammonia	61	61	62	63	63	64	65	65	66	66
Acetic Acid	240	242	245	247	250	252	255	257	260	262

Table VI-11 Price List of By-Products (Case I)

(Unit: $/ton)

Calendar Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Ordinal Year	1	2	3	4	5	6	7	8	9	10
Hydrogen for Fuel	75	77	79	81	83	85	87	89	91	94
Methane	31	32	33	33	34	35	36	37	38	39
Propane	29	29	30	31	32	33	33	34	35	36
Propylene for Fuel	28	29	30	31	31	32	33	34	35	35
Heavy Fuel	25	26	27	27	28	29	30	30	31	32
Fuel Gas from DOP-related	27	28	28	29	30	30	31	32	33	34
Raffinate from Butadiene Extraction	28	29	29	30	31	32	33	33	34	35
Off Gas from Aromatics-related	28	29	30	30	31	32	33	33	34	35
Raffinate from Aromatics-related	23	24	25	25	26	26	27	28	28	29
Ammonium Sulfate	←				39					→

Gresik) in which ammonia is produced as an intermediate raw material. This purchase would be made at an international price, seeing that this urea plant has an international scale.

(3) Prices of By-products

As for prices of by-products, the heat of combustion of the by-products was valued at $2.6/$10^6$ Kcal for 1980, based upon the estimated 1980 price of heavy oil in Indonesia, and this value was recalculated to give prices per unit weight.

The ammonium sulfate price employed is the current price in Indonesia, assuming that fertilizer prices will not under the agriculture promotion policy of the Indonesian Government.

(4) Prices of Utilities

Table VI-12 gives prices of utilities used by the complex. These prices were estimated on the premise that the power station and the water treatment plant would produce sufficient quantities to meet the utilities requirements given in Table VI-7 and the requirements from off-site and general facility (the latter requirements being estimated at about 30% of the battery limit). In general, the investment cost for the utilities facilities can be estimated at about 10% of the total investment cost for the complex, although depending upon location conditions of the complex.

(5) Rates of Return on Investment

A rate of return on investment was obtained for each plant or each unit of plants, using the DCF calculation method.

Table VI-12 Price List of Utilities (Case I)

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Ordinal Year	1	2	3	4	5	6	7	8	9	10
Electricity	¢/Kw	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Steam	$/ton	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5
Cooling Water	¢/ton	←					1.0				→
Boiler Feed water	¢/ton	←					6.1				→
Fuel	$/10⁶ Kcal	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.2

Results are given in Table VI-13, and for details refer to Annex D. In Case I-1 of the above table, there are given those rates of return obtained when no special preferencial step is taken by the Government. In the Case I-1, naphtha cracker (6.8%), LDPE plant (12.4%), EO/EG plant (3.0%), PP plant (12.8%), DOP plant (4.3%), aromatics-related plants (6.3%), cyclohexane plant (7.6%), caprolactam plant (5.4%), and terephthalic acid plant (12.3%), the rates of return are not satisfactory. (Refer to 1.6 of this chapter (page 379). For this reason, we assumed 5 years' tax holiday applied to those plants, and the calculation results based upon such an assumption are shown as Case I-2 in Table VI-13.

Tax holiday applied to the LDPE plant, the PP plant and the terephthalic acid plant resulted in satisfactory rates of return are not satisfactory. For this reason we assumed 5 years' tax holiday applied to those plants and the calculation results based upon such an assumption are shown as Case I-2 in Table VI-13.

Small rate of return of the ethylene glycol is mainly caused by its capacity of 15,000 tons per year, which is less than the scale standard. This capacity was fixed so as to meet the capacity of terephthalic acid production, and, therefore, cannot be increased. Since EO/EG, together with terephthalic acid, are essential raw materials for the production of polyethylene terephthalate, the EO/EG plant and the terephthalic acid plant taken in combination would overcome the inferior economic feasibility of the former.

Tax holiday gives the DOP plant an improved rate of return of 5.6%, yet this level is not satisfactory. Since DOP is an essential substance used as a plasticizer for PVC, the DOP plant and the PVC plant taken in combination would overcome the bad economic feasibility of the former, as in the EO/EG plant.

It may be conceivable that accelerated depreciation and other special preferencial steps are applied to those plants with unsatisfactory rates of return. The rate of return on investment for the entire complex is valued at 13.4% which

Table VI-13 Rate of Return on Investment (Case 1)

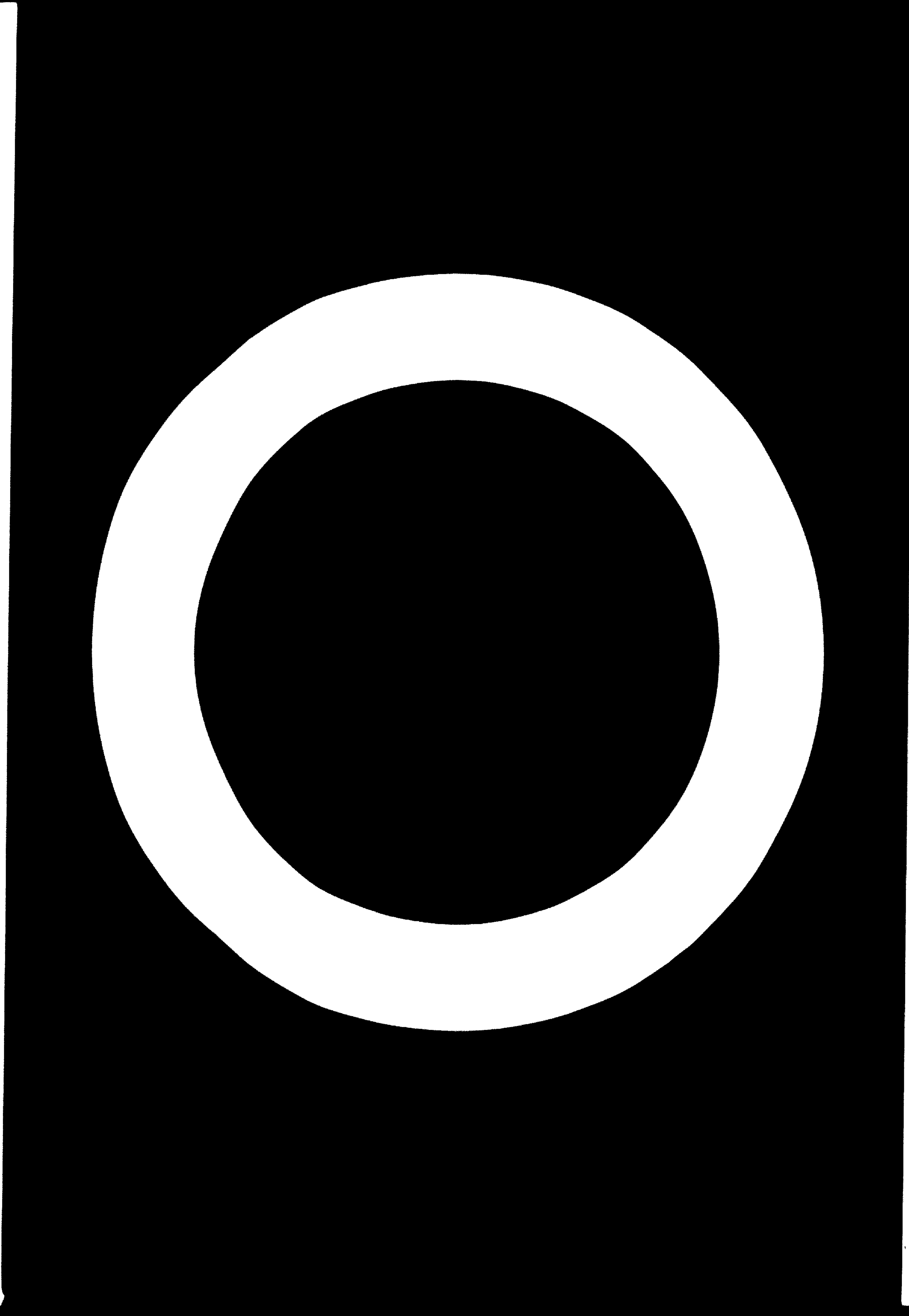
	Capacity (tons/yr.)	Rate of Return on Investment (%) (Case I-1)	(Case I-2)
Naphtha Cracker	302,000 (Ethylene)	6.8	8.8*
VCM	128,800	23.3	23.3
PVC	110,000	24.4	24.4
LAPE	160,000	12.4	16.9*
HDPE	35,000	15.4	15.4
EO/EG	15,000	3.0	4.1*
Styrene & Polystylene	50,000	19.0	19.0
PP	60,000	12.8	17.9*
DOP-related	60,000	4.3	5.6*
Butadiene	57,500	24.8	24.8
Aromatics-related	76,100 (Benzene) 24,700 (p-Xylene)	6.3	6.2*
Cyclohexane	36,700	7.6	9.0*
Caprolactam	33,400	5.4	6.6*
Terephthalic Acid	34,700	12.3	16.4*
Total Complex:		11.2	13.4

Case I-1: No tax holiday applied.

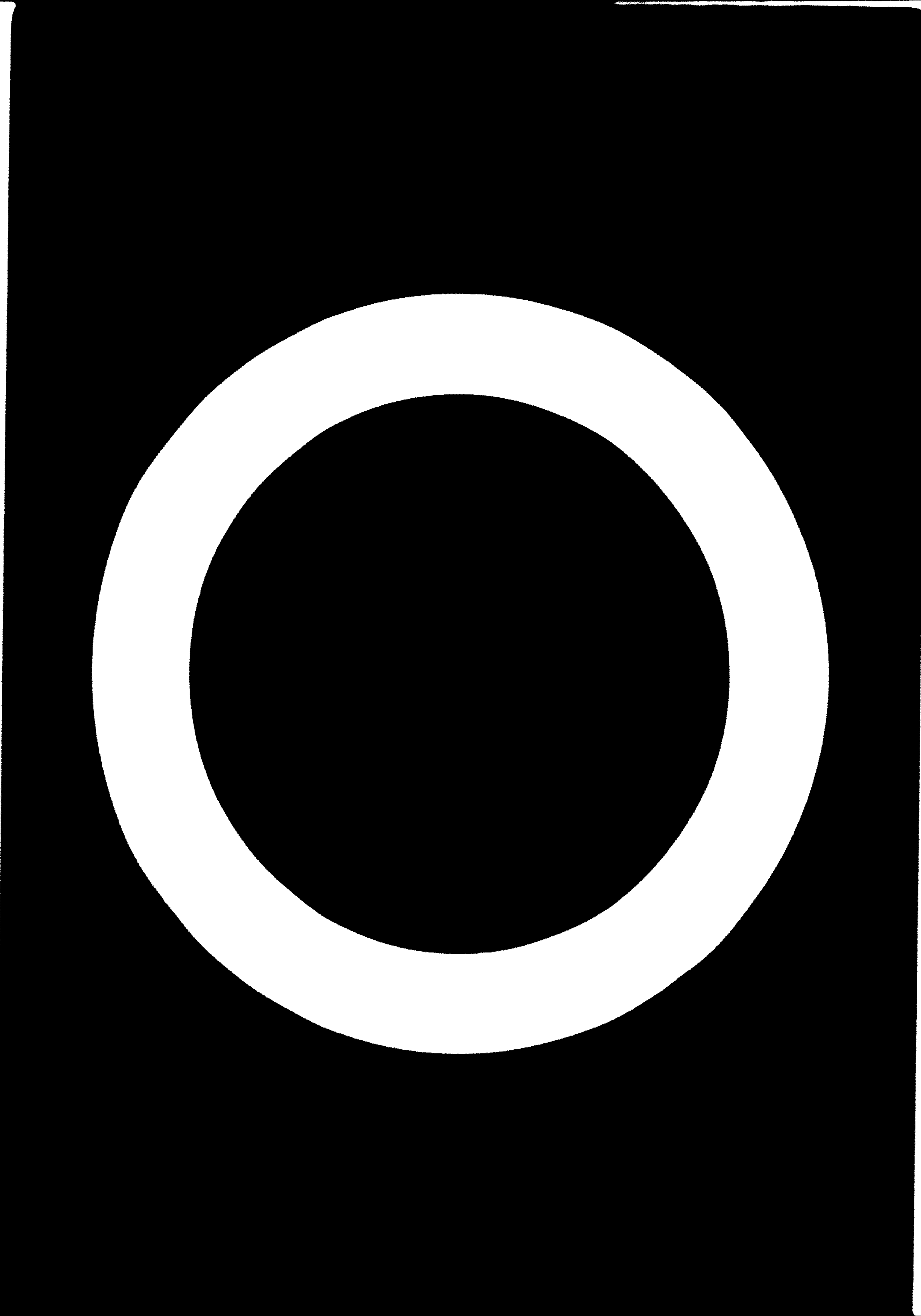
Case I-2: 5 years' tax holiday applied to those plants with asterisked figures.

can be considered nearly satisfactory for a national project.

It is concluded that the complex based upon naphtha cracking to produce 302,000 ton per year of ethylene can be put into operation in 1980 and is feasible from economic point of view.



NAPHTHA 1,003,000
NAPHTHA CRACKING PLANT
HYDROGEN 12,000
METHANE 148,600
METHANE 17,900
METHANE 166,500
CHLORINE 89,100
ETHYLENE 302,000
POLYMER GRADE PROPYLENE 69,000
PROPANE 2,500
CHEMICAL GRADE PROPYLENE 68,000
C4 FRACTION 121,000
CRACKED GASOLINE 217,000
HEAVY FUEL 45,000
SECTION 1
VCM PLANT
PVC PLANT
LDPE PLANT
HDPE PLANT
EO-EG PLANT
STYRENE PLANT
POLYSTYRENE PLANT
P P PLANT
OXO GAS PLANT
2-ETHYL HEXANOL PLANT
PHTHALIC ANHYDRIDE PLANT
DOP PLANT
BUTADIENE EXTRACT'N PLANT
RAFFINATE 63,500
IMPORTED o-XYLENE 22,200
SECTION 2
FOR FUEL 2,200
HYDROGEN 9,800
FOR FUEL 148,600
VCM 15,500
PVC 110,000
LDPE 160,000
HDPE 35,000
ETHYLENE GLYCOL 15,000
POLYSTYRENE 30,000
P P 60,000
DOP 60,000
BUTADIENE 57,500
HEAVY FUEL 46,000
SECTION 3
CRACKED GASOLINE 217,000
SELECTIVE HYDROGENATION AROMATICS EXTRACTION PLANT
DISPROPORTIONATION PLANT
CYCLOHEXANE PLANT
CAPROLACTAM PLANT
TEREPHTHALIC ACID PLANT
AIR AS OXYGEN 27,100
ACETIC ACID 300
FOR FUEL 92,460
SECTION 4
UNIT TON PER YEAR
CAPROLACTAM 33,400
TEREPHTHALIC ACID 34,700
SECTION 5
UNIT TON PER YEAR
JAPAN GASOLINE CO., LTD.
FIG VI-1
PETROCHEMICAL COMPLEX BASED ON NAPHTHA CRACKING (Case I)



3. Petrochemical Complex based on Natural Gas Cracking and Naphtha Reforming (Case II)

3.1 Complex Integration

(1) Complex Organization

In a similar manner as in Case I, we tried to meet as far as possible the demands for promising products. A natural gas cracking plant with a capacity corresponding to an ethylene demand would be combined with a naphtha reforming plant with a capacity corresponding to a quantity of p-xylene used to meet a large polyester fiber demand.

Capacities of VCM, PVC, LDPE, EO/EG, polystyrene, terephthalic acid were determined in such a way that production with an operation rate of 70% would meet the demands in 1977, the year of plant start-up. As for HDPE and PP with demands growing slowly for the former and sharply for the latter from the year of start-up onward, their capacities were determined, taking such growth rates into account.

In the light of a large demand for polyester fiber in Indonesia, a system to allow p-xylene maximization was taken in aromatics production. The quantity of benzene thus produced under this system necessarily determined the capacities of cyclohexane/caprolactam plants. By chance, their demands in the year of startup coincided with the production volumes attained by an operation rate of 70%. A production system with emphasis on p-xylene maximization imposes a problem on the procurement of o-xylene, the raw material for DOP. Natural gas cracking produces only 24,000 tons per year of C_4 fraction which cannot afford economic butadiene extraction, thereby failing to make swap trade between butadiene and o-xylene, as is done in Case I. Therefore, DOP production is not carried out.

From the above, the following plants would organise the complex based on natural gas cracking and naphtha reforming, which complex is scheduled to go into operation in 1977:

	Plant Name	Capacity (tons/yr.)
(i)	Gas Cracker	216,000 (ethylene)
(ii)	Naphtha Reformer	186,000 (feed)
(iii)	Selective Hydrogenation	41,000 (feed: C_5^+ fraction)
(iv)	Aromatics Extraction	209,000 (feed: reformate & hydrogenated gasoline)
(v)	Disproportionation	33,000 (feed: toluene)
(vi)	Isomerization & p-Xylene Separation	60,100 (feed: xylenes)
(vii)	VCM	77,000
(viii)	PVC	60,000
(ix)	LDPE	100,000
(x)	HDPE	26,000
(xi)	Ethylene Glycol	30,000
(xii)	Styrene	30,000
(xiii)	Polystyrene	30,000
(xiv)	PP	30,000
(xv)	Cyclohexane	26,400
(xvi)	Caprolactam	24,000
(xvii)	Terephthalic Acid	71,000

See Block Flow Diagram in Fig. VI-2.

For the technological and economic calculation, the following plants are regarded as one unit:

(i) **Styrene/Polystyrene:** As all amount of styrene is supplied to polystyrene plant of the complex and is not sold in the market, styrene plant is combined to polystyrene plant.

(ii) **Aromatics-related:** Aromatics extraction, disproportionation, isomerization and p-xylene separation plants are grouped into one unit as they are related to produce aromatics (benzene and p-xylene).

(iii) **Reformer-related:** Selective hydrogenation plant for C_5^+ fraction in gas cracking is combined with reforming plant to make a unit.

It was also assumed as in Case I that auxiliary raw materials and utilities would be supplied from facilities located near the complex.

Operation rates of all plants are as given in Table VI-14.

(2) **Detailed Processes used in the Basic Chemicals Plants**

The natural gas having such properties as shown in Table IV-15 is collected from gas wells and introduced into the gas treating tower, where amine washing removes a small amount of carbon dioxide gas from the natural gas.

The treated natural gas is then introduced into the demethanizer, where C_2 and higher fractions are absorbed into the kerosene oil to separate C_1 fraction.

The C_2^+ fraction absorbed is separated from oil by distillation, and introduced into the gas cracker. The feed to the gas cracker consists of the above C_2^+ fraction and in addition, uncracked ethane and propane recycled from the subsequent steps.

Table VI-14 Operation Rate (Case II)

(Unit: %)

Plant Name	Calendar Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	Ordinal Year	1	2	3	4	5	6	7	8	9	10
	Capacity (tons/yr.)										
Gas Cracker	216,000	72	84	98	100	100	100	100	100	100	100
VCM	7,700	75	87	100	100	100	100	100	100	100	100
PVC	60,000	69	84	100	100	100	100	100	100	100	100
LDPE	100,000	70	83	97	100	100	100	100	100	100	100
HDPE	26,000	81	90	100	100	100	100	100	100	100	100
EO/EG	30,000	70	82	95	100	100	100	100	100	100	100
Styrene & Polystyrene	30,000	71	83	97	100	100	100	100	100	100	100
PP	30,000	38	66	100	100	100	100	100	100	100	100
Reformer-related	209,000 *	70	81	94	100	100	100	100	100	100	100
Aromatics-related	50,000 (Benzene) 50,400 (p-Xylene)	70	81	94	100	100	100	100	100	100	100
Cyclohexane	26,400	70	81	94	100	100	100	100	100	100	100
Caprolactam	24,000	70	81	94	100	100	100	100	100	100	100
Terephthalic Acid	71,000	70	81	94	100	100	100	100	100	100	100

* Reformate and Hydrogenated Gasoline.

A cracked product, i.e., ethylene, is purified to a polymer grade (a purity of 99.9 vol %), and supplied to the downstream plants. Ethane, separated in the ethylene purification step, is recycled to gas cracker.

Another cracked product, propylene, is purified to a polymer grade (a purity of 99.9 wt %) in a quantity necessary to produce polypropylene, and the remaining mixture of propane and propylene is used as fuel. The propane, separated in the propylene purification step, is recycled to the gas cracker. Still another cracked product, C_4 fraction, is obtained only in

Table VI-15 Specification of Natural Gas and Naphtha

(Unit: vol %)

Natural Gas

Methane	66.5
Ethane	13
Propane	10
C_4 Fraction	7
C_5 Fraction	3
Hydrogen Sulfide	nil
Carbon Dioxide	0.5

Naphtha from Java Sea Crude Oil

Cut Range		82.2 - 149°C (180° - 300°F)
API	(60/60°F)	59
PONA Analysis (vol %)		
Paraffin		39
Olefin		0
Naphthene		47
Aromatics		14

a small quantity, and thus is used as fuel, without subjecting to butadiene extraction.

Cracked gasoline having comparatively large amounts of aromatics is passed through the selective hydrogenator into the aromatics extraction plant.

Reformate obtained by reforming naphtha given in Table VI-15, after mixed with hydrogenated cracked gasoline, is introduced into the aromatics extraction plant. By-products of reforming, hydrogen gas and off gas (C_5 - fraction), are used for chemical purpose and as fuel, respectively.

In the aromatics extraction plant, benzene, toluene, and xylenes are separated by extraction of the feed. Since toluene has no demand, it is introduced into the disproportionation plant to convert it into benzene and xylenes. Xylenes are fed into the isomerization plant to produce p-xylene, which is supplied to the TPA plant. The raffinate separated in the aromatics extraction plant and the off gas by-produced both in the disproportionation plant and the xylenes isomerization plant are used as fuel.

3.2 Summarized Data on the Complex

(1) Investment Cost

Table VI-16 gives necessary construction costs and working capital of all the plants. The complex based upon natural gas cracking and naphtha reforming costs a total of $291.2 million, of which approximately $42.5 million equivalent to working capital is financed by Indonesian local loans, $199.0 million (80% of the total investment) by overseas long-term loans, and

Table VI-16 Investment Cost and Working Capital (Csee II)

(Unit: $1,000)

Plant Name	Capacity (tons/yr.)	Investment Cost			Working Capital	Total
		Battery Limits	Off-site	Total Investment		
Gas Cracker	216,000	45,000	13,200	58,200	10,000	68,200
VCM	77,000	9,400	2,400	11,800	1,800	13,600
PVC	60,000	8,300	2,500	10,800	1,900	12,700
LDPE	100,000	36,000	10,800	26,800	8,200	55,000
HDPE	26,000	8,800	2,600	11,400	2,000	13,400
EO/EG	30,000	5,800	1,600	7,400	1,200	8,600
Styrene & Polystyrene	30,000	11,500	3,300	14,800	2,500	17,300
PP	30,000	14,900	4,500	19,400	3,400	22,800
Reformer-related	209,000 *	5,000	1,400	6,400	1,100	7,500
Aromatics-related	50,000 (benzene) 50,400 (p-Xylene)	11,200	2,800	14,000	2,100	16,100
Cyclohexane	24,600	1,000	200	1,200	200	1,400
Caprolactam	24,000	20,200	6,100	26,300	4,600	30,900
Terephthalic Acid	71,000	15,500	4,700	20,200	3,500	23,700
Total :		192,600	56,100	248,700	42,500	291,200

* Reformate and Hydrogenated Gasoline.

remaining $49.7 million (20% of the total investment) by owned capital.

(2) Material Balance

Material balance is shown in Table VI-17 by plant or group of plants.

(3) Utilities Requirement

Table VI-18 gives utilities requirement to be consumed within the battery limits by all process plants. They are supplied from a utilities center constructed at a site adjacent to the complex. In this study, we planned a system of power generation by means of extraction turbines, by which steam generation can be simultaneously conducted. Cooling water is covered by sea water up to 95%, the remainder is supplied from river.

(4) Fuel Balance

Fuel balance is shown in Table VI-19.

It can be seen from the above table that the fuel for use in the complex can be covered by the gas by-produced therein. Surplus gas fuel is supplied to the power station. Fuel oil would be sold in markets.

(5) Operating Labor

Table VI-20 gives labor requirements of all plants. The total employees directly in charge of operation of the complex amount to 679 persons. The labor cost was calculated in accordance with the method used in Case I at

$3,300 per man per year for supervisors;

$2,500 per man per year for operators and analysts; and

$1,370 per man per year for laborers.

Table VI-17 **Material Balance (Case II)**

Plant Name	Feeds			Products		
	Name	tons/hr.	tons/yr.	Name	tons/hr.	tons/yr.
Gas Cracker	Natural Gas	100.5	796,000	Methane	57.1	452,000
				Ethylene	27.3	216,000
				Polymer Grade Propylene	4.4	34,500
				Propylene for Fuel	2.7	21,500
				C_4 Fraction	3.0	24,000
				C_5^+ Fraction	5.2	41,000
VCM	Ethylene	4.9	39,000	VCM	9.7	77,000
	Chlorine	6.7	53,000			
PVC	VCM	7.8	61,500	PVC	7.6	60,000
LDPE	Ethylene	13.3	105,000	LDPE	12.6	100,000
HDPE	Ethylene	3.4	27,000	HDPE	3.3	26,000
EO/EG	Ethylene	4.5	36,000	Ethylene Glycol	3.8	30,000
				Diethylene Glycol	0.64	5,100
Styrene & Polystyrene	Ethylene	1.1	9,000	Polystyrene	3.8	30,000
	Benzene	3.2	25,000			
PP	Propylene	4.4	34,500	PP	3.8	30,000
Reformer-related	Naphtha	30.0	186,000	Reformate	21.2	168,000
	C_5^+ Fraction	5.2	41,000	Hydrogenated Gasoline	5.2	41,000
	Hydrogen	0.025	200	Hydrogen	0.5	4,300
				Off Gas	1.7	13,800
Aromatics-related	Hydrogenated Gasoline	5.2	41,000	Benzene	6.3	50,000
	Reformate	21.2	168,000	p-Xylene	6.4	50,400
	Hydrogen	0.15	1,200	Off Gas	0.7	5,600
				Fuel	13.2	104,200
Cyclohexane	Benzene	3.2	25,000	Cyclohexane	3.3	26,400
	Hydrogen	0.12	1,700			
Caprolactam	Cyclohexane	3.3	26,400	Caprolactam	3.0	24,000
	Sulfuric Acid	5.4	43,000	Ammonium Sulfate	7.8	62,000
	Ammonia	3.0	24,000			
	Oxygen	1.8	14,000			
Terephthalic Acid	p-Xylene	6.4	50,400	Terephthalic Acid	9.0	71,000
	Acetic Acid	0.1	800			

Table VI-18 Utilities Requirement (Case II)

Plant Name	Electricity (Kw)	Steam (tons/hr.)	Cooling Water Sea (tons/hr.)	Cooling Water Industrial (tons/hr.)	Boiler Feed Water * (tons/hr.)	Fuel ($x10^6$ Kcal/hr.)
Gas Cracker	5,130	-	4,120	220	90	100
VCM	1,170	4	7,470	300	60	10
PVC	3,100	15	900	50	23	-
LDPE	25,250	20	3,120	170	-	-
HDPE	2,410	8	770	37	-	-
EO/EG	5,920	30	3,500	200	4	-
Styrene and Polystyrene	1,340	25	440	24	-	10
PP	2,200	12	1,000	55	-	-
Reformer-related	310	27	340	18	-	23
Aromatics-related	2,600	35	80	5	1	50
Cyclohexane	250	1	17	1	4	1
Caprolactam	2,730	37	400	22	-	10
Telephthalic Acid	6,020	40	2,660	143	225	68
Total :	58,590	254	24,937	1,245	407	272

*) Includes Process Water.

Note: Total requirement of Inert Gas in this Complex is estimated about 3,000 Nm^3/hr.

Table VI-10 **Fuel Balance (Case II)**

(Unit: x 10^6 Kcal/hr.)

Plant Name	Production	Consumption
Gas Cracker	754	100
VCM	-	10
PVC	-	-
LDPE	-	-
HDPE	-	-
EO/EG	4	-
Styrene & Polystyrene	-	10
PP	-	-
Reformer-related	37	23
Aromatics-related	139	50
Cyclohexane	-	1
Caprolactam	-	10
Terephthalic Acid	-	66
Total :	934	272
Balance	+662	

Table VI-20 Labor Requirement (Case II)

Plant Name	Supervisor (Man/day)	Operator & Analyst (Man/day)	Operator & Analyst (Man/shift)	Laborer (Man shift)	Total Supervisor	Total Operator & Analyst	Total Laborer
Gas Cracker	1	1	9	-	1	37	-
VCM	1	-	6	-	1	24	-
PVC	1	-	5	6	1	20	24
LDPE	1	-	16	25	1	64	100
HDPE	1	-	4	10	1	16	40
EO/EG	1	-	6	-	1	24	-
Styrene and Polystyrene	1	-	12	10	1	48	40
PP	1	-	5	4	1	20	16
Reformer-related	2	-	8	-	2	32	-
Aromatic-related	2	-	7	-	2	28	-
Cyclohexane		-	3	-		12	-
Caprolactam	1	-	7	10	1	28	40
Terephthalic Acid	1	-	5	8	1	20	32
Total:	14	1	93	73	14	373	292
Grand Total:						679	

3.[illegible] Economic Study

In attempting economic calculation, prices and costs of materials and utilities were set as follows:

(1) Prices of Natural Gas and Naphtha

Natural gas prospecting and development are actively in progress now in Indonesia. In case large quantities of natural gas reserves are discovered and large scale production is actualized, LNG production will start, and the natural gas price will undergo large changes.

In our study this time, we estimated the natural gas price at $0.2 per MMBTU ($6.8 per ton) for the 1977-1981 period and $0.3 per MMBTU ($9.9 per ton) for 1982-1986, using the current price informed by the Ministry of Mining, because the natural gas price can be set quite politically unless it is used as LNG which is traded in export markets.

As for naphtha price, see Section 2.3(1).

(2) Prices of other Raw Materials and Intermediates

Prices of raw materials and intermediates other than natural gas and naphtha were estimated similarly as described in 2.3(2). These estimated prices are listed in Table VI-21.

(3) Prices of By-products

Among the by-product prices given in Table II-22, the current price in Indonesia is used for the price of ammonium sulfate based on the same reason as in Case I.

In appraising the prices of methane, off gas and fuel oil, we assumed consumption of gas components either up to the

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	2	3	4	5	6	7	8	9	10
[illegible]	←		8.0		→	←		12.0		→
[illegible]	←		7.5		→	←		11.0		→
[illegible]	←		7.6		→	←		11.1		→
[illegible]	26	26	26	26	26	27	37	28	29	30
[illegible]	←		17		→	←		23		→
[illegible]	←				30					→

vicinity of the complex, because they are difficult to transport for a long distance as economically as in the case of liquid fuel. Standing on the above assumption, we evaluate the prices of these gases by calculating the heat of combustion and taking the price of natural gas as standard.

Liquid fuel oil can be transported economically, and its heat of combustion was valued at \$2.4/10^6 Kcal for 1977, as in Case I.

(4) **Prices of Utilities**

Table VI-23 gives prices of utilities for use in the complex. See also Section 2.3(4).

(5) **Rates of Return on Investment**

Economic feasibility of the above-described complex was appraised by rate of return calculated by the DCF method, and the results are given in Table VI-24, and for details refer to Annex D Case II-1 of the table is the results obtained when preferencial steps are not taken by the Government.

These results revealed that in this case the rate of return of gas cracker (5.8%), LDPE (12.3%), styrene/polystyrene (9.0%), PP (5.8%), cyclohexane (7.6%) and caprolactam (7.9%) are not satisfactory, as compared with the criteria given in Section 1.6 of this chapter. It is desirable, therefore, to apply 5 years' exemption from taxes to the above plants. Such a step will result in Case II-2 of the table. Profitability of the complex thus becomes roughly satisfactory in the light of criteria given in Section 1.6 of this chapter.

Table VI-23 Price List of Utilities (Case II)

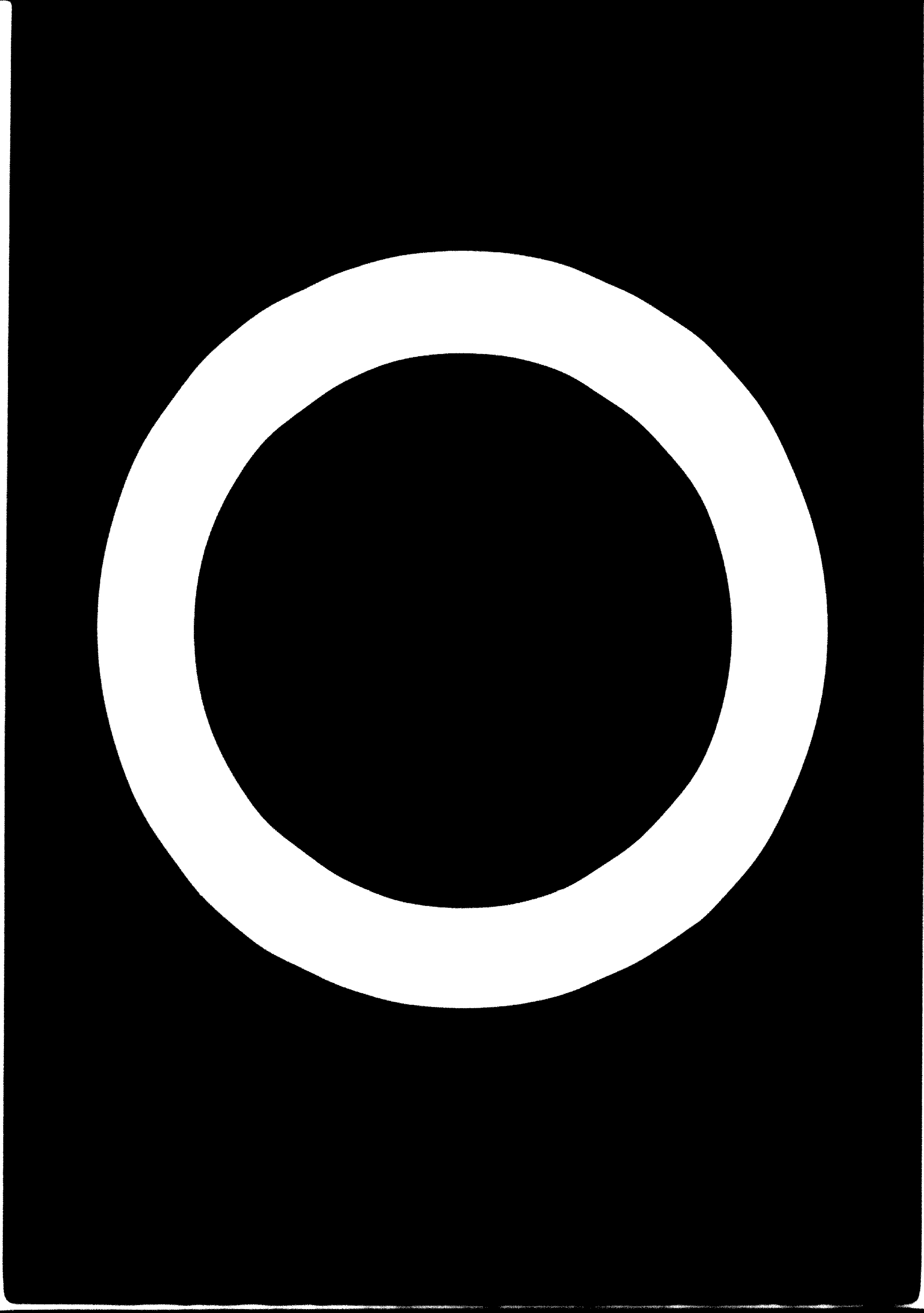
	(Unit)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	Ordinal Year	1	2	3	4	5	6	7	8	9	10
Electricity	¢/Kw	←		0.8		→	←		1.0		→
Steam	$/ton	←		2.0		→	←		2.1		→
Cooling Water	¢/ton	←					0.7				→
Boiler Feed Water	¢/ton	←					7.3				→
Fuel	$/$10^6$ Kcal	←		0.58		→	←		0.87		→

NATURAL GAS
796,000
ACID GAS TREATER
789,000
DEMETHANIZER
432,000
METHANE
357,000
METHANE & HYDROGEN
95,000
GAS CRACKING PLANT
METHANE & HYDROGEN
452,000
FOR FUEL
452,000
CHLORINE
53,000
39,000
105,000
27,000
36,000
9,000
ETHYLENE
216,000
POLYMER GRADE PROPYLENE
34,500
CHEMICAL GRADE PROPYLENE
21,500
C_4 FRACTION
24,000
C_5^+ FRACTION
41,000
VCM PLANT
VCM
71,000
PVC PLANT
LDPE PLANT
HDPE PLANT
EG-EG PLANT
STYRENE PLANT
STYRENE
30,000
POLYSTYRENE PLANT
PP PLANT
BENZENE
25,000
VCM
15,500
PVC
60,000
LDPE
100,000
HDPE
26,000
ETHYLENE GLYCOL
30,000
POLYSTYRENE
30,000
PP
30,000
FOR FUEL
21,500
FOR FUEL
24,000
C_5+FRACTION
41,000
FOR FUEL
100
C_5+FRACTION
41,000
FOR FUEL
13,700
FOR FUEL
100
SECTION 1
SECTION 2
OFF GAS
100
FOR FUEL
100
C_5+FRACTION
41,000
FOR FUEL
13,700
FOR FUEL
100
HYDROGEN
4,000
BENZENE
25,000
CYCLOHEXANE PLANT
CAPROLACTAM PLANT
CAPROLACTAM
24,000
FOR FUEL
SECTION 3
SECTION 4

PP production serves to consume propylene co-produced with ethylene. Although its rate of return (7.9%) is not favorable, a PP plant should be constructed in any case. Desirably accelerated depreciation and other preferencial measures should be specifically taken for the PP plant.

The rate of return on investment for the entire complex is valued at 11.1%, which can be considered satisfactory for a national project.

It is concluded that the complex based upon natural gas cracking and naphtha reforming to produce 210,000 ton per year of ethylene and 110,000 ton per year of aromatics can be put into operation in 1977 and is feasible from economic point of view.



ANNEX

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Important Data on Complex

1. Investment Cost

(Unit: $1,000)

Plant Name	Plant Capacity (tons/yr.)	Investment Cost: Battery Limits	Off-site	Total Investment	Working Capital	Total
Gas Cracker	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VCM/PVC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

2. [illegible]

Plant Name	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gas Cracker	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				[illegible]	[illegible]	[illegible]
				[illegible]	[illegible]	[illegible]
				[illegible]	[illegible]	[illegible]
VCM/PVC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]			
LDPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5. Fuel Balance

(Unit: x 10^6 Kcal/hr)

Plant Name	Production	Consumption
Gas Cracker	[illegible]	[illegible]
VCM/PVC	-	[illegible]
LDPE	-	
PP	-	
Total	[illegible]	[illegible]
Balance		[illegible]

6. Utilities Requirements

Plant Name	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fuel [illegible]
Gas Cracker	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
VCM/PVC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LDPE	[illegible]	[illegible]	[illegible]	[illegible]		
PP	[illegible]	[illegible]	[illegible]	[illegible]		
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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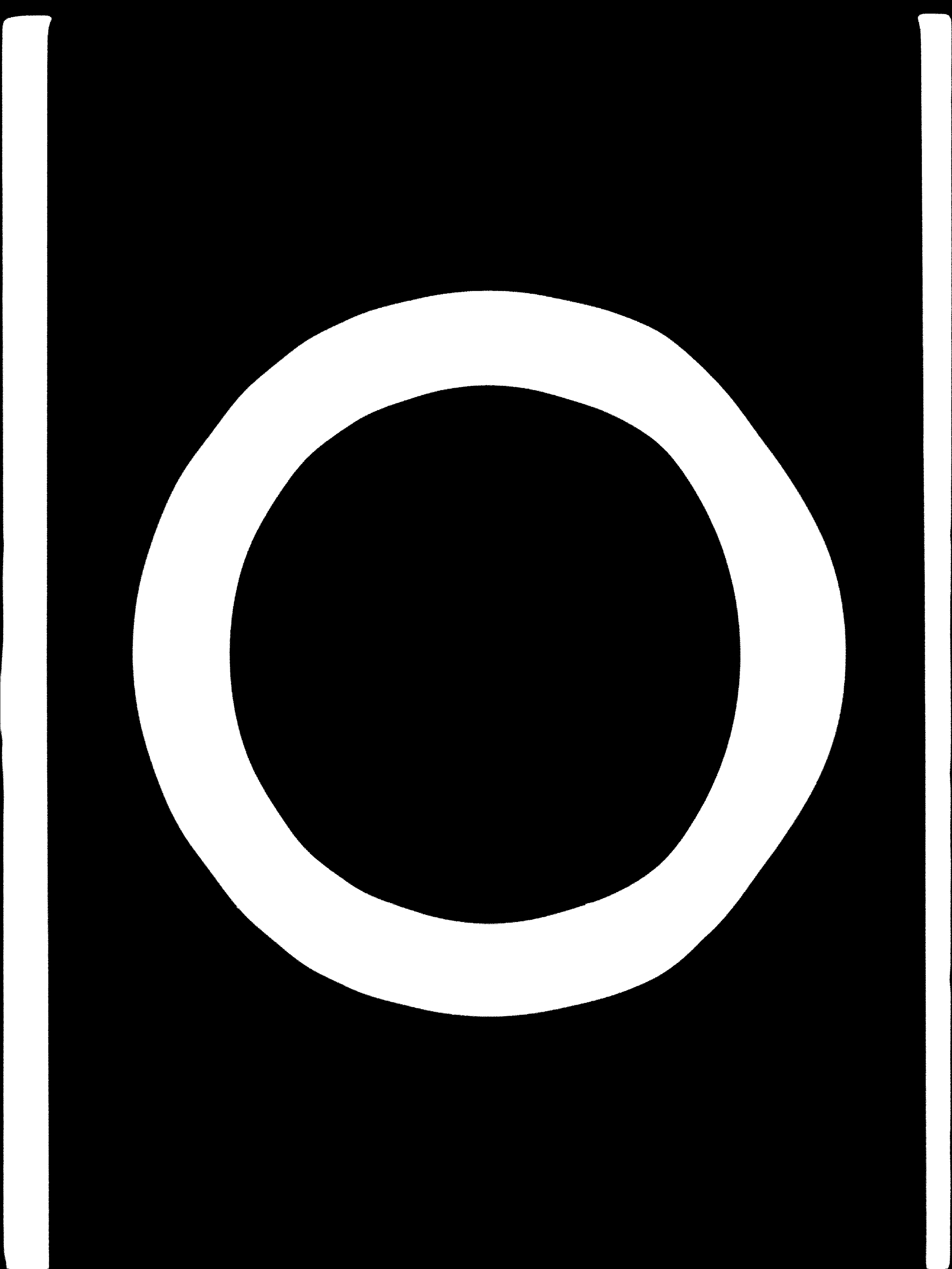

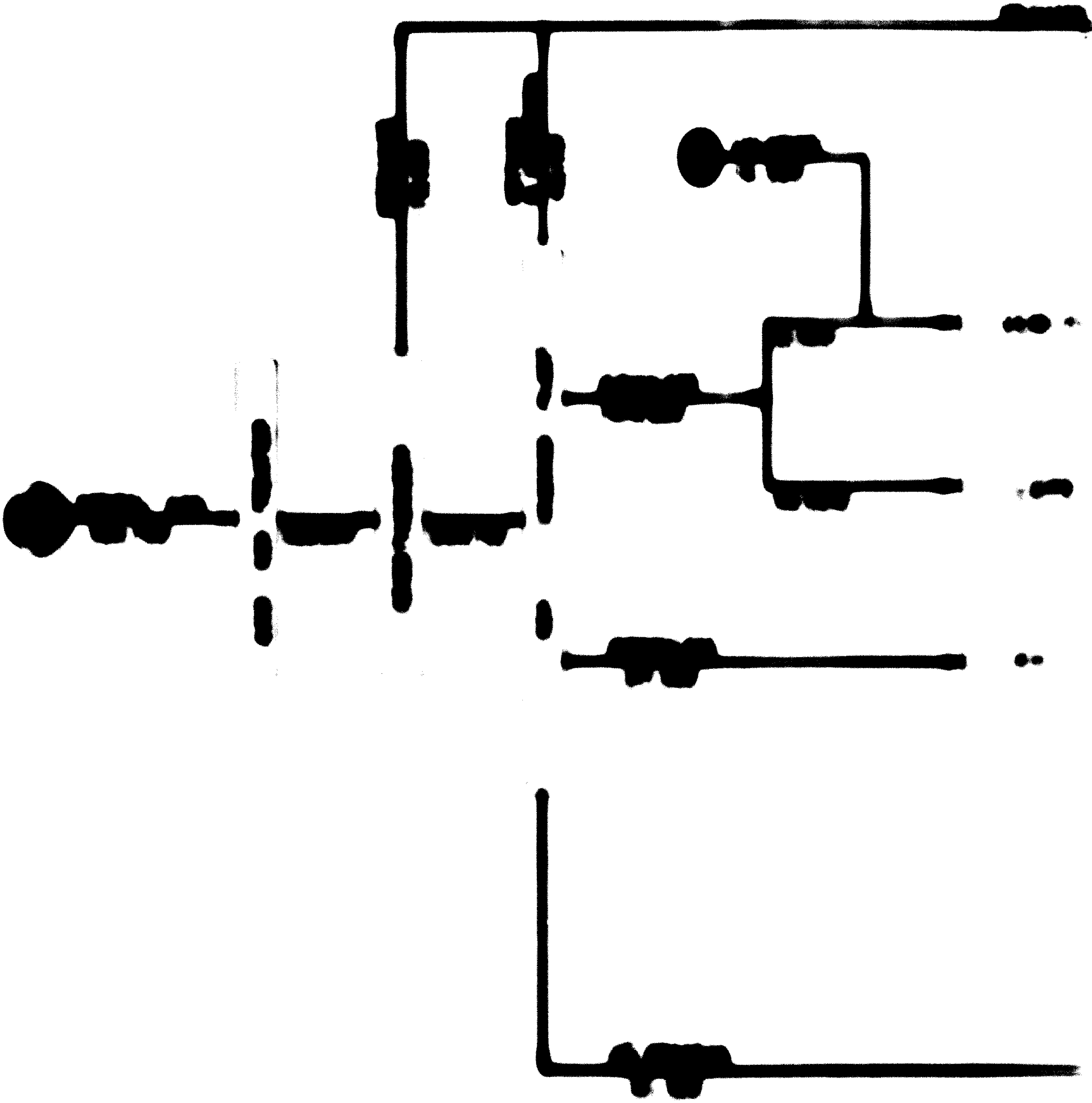

ANNEX B

MULTILATERAL APPROACH TO THE DEVELOPMENT OF INDONESIAN PETROCHEMICAL INDUSTRY

In accordance with the request of the Indonesian Government, the multilateral approach to the development of the Indonesian petrochemical industry is suggested in this Annex.

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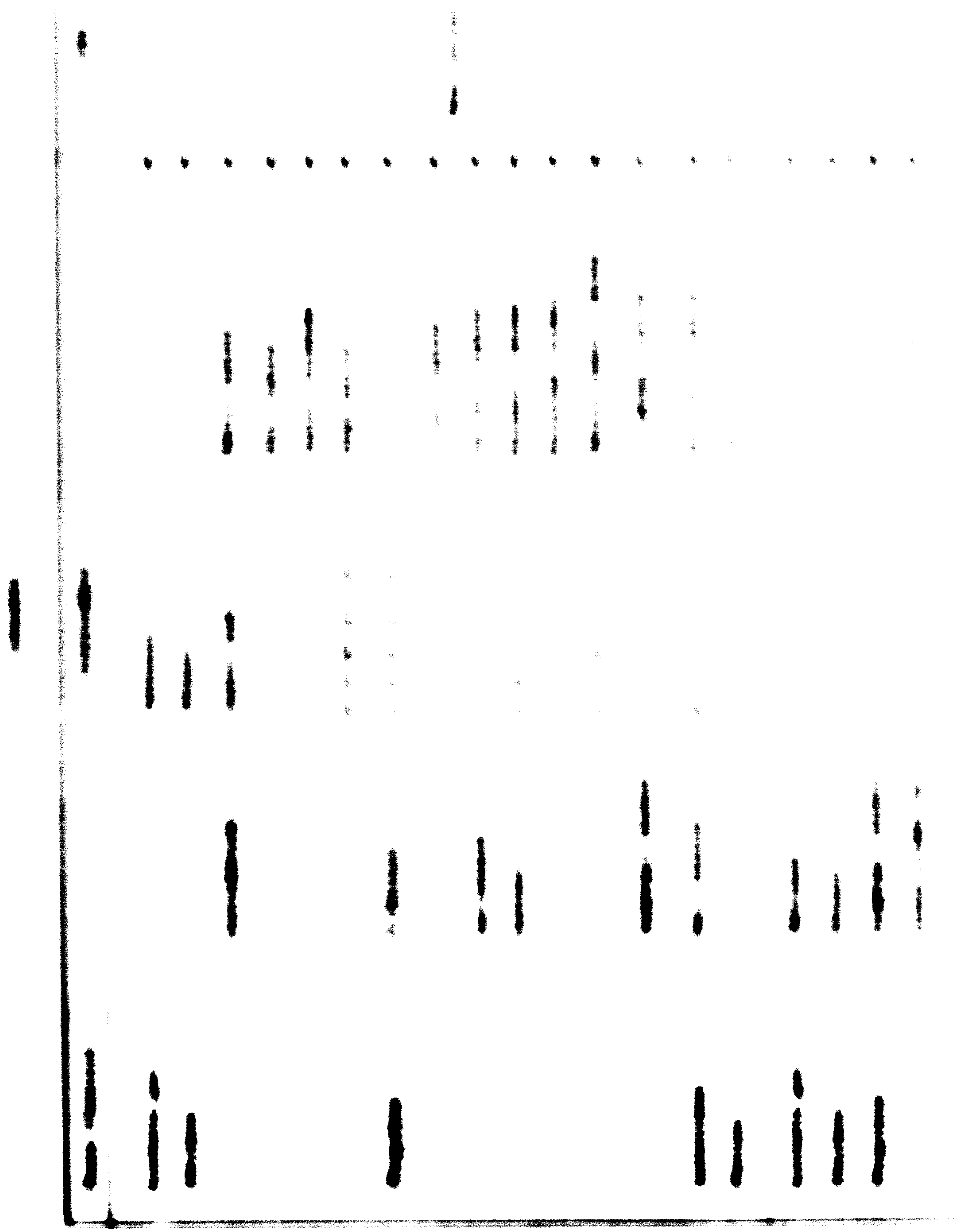

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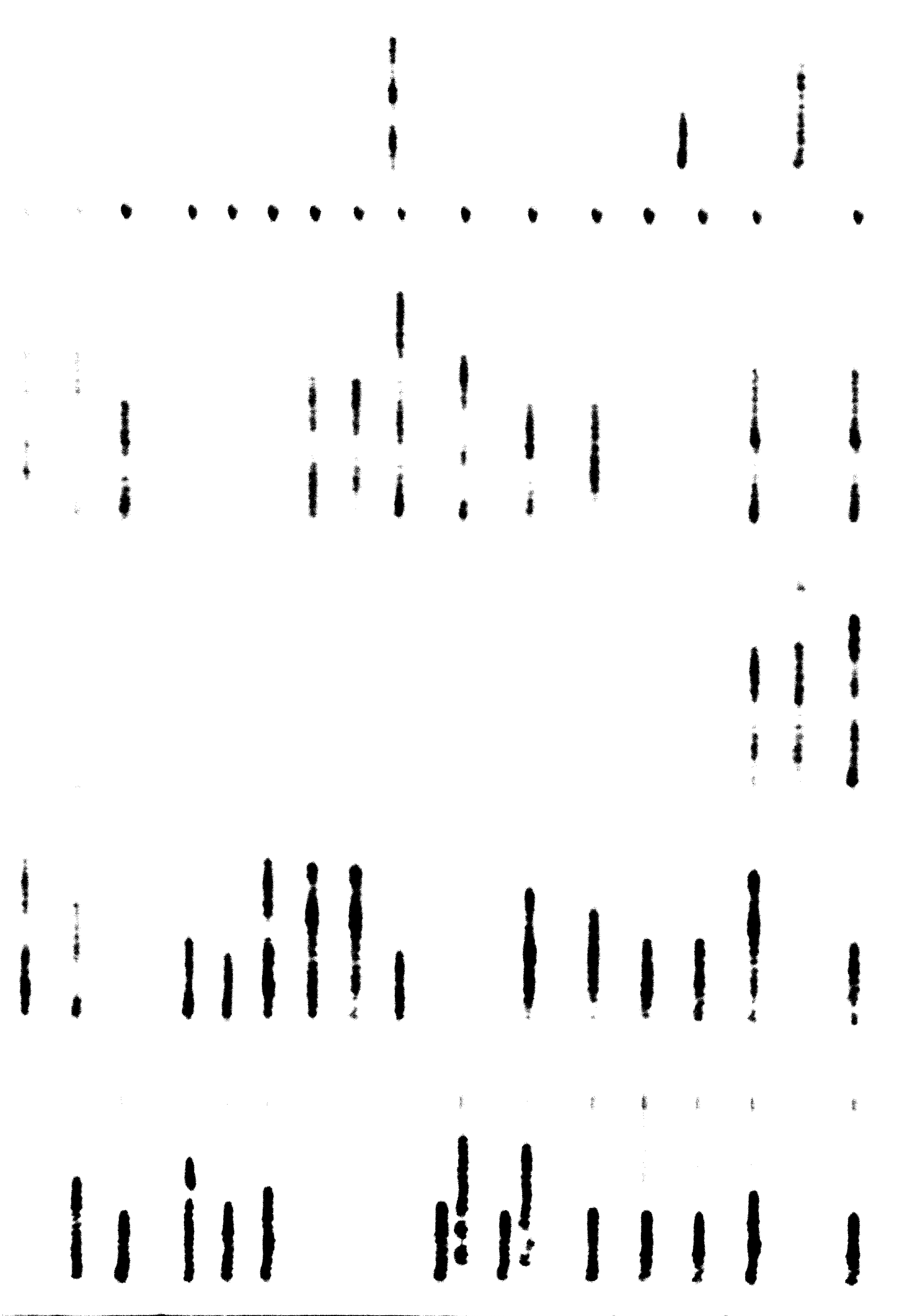

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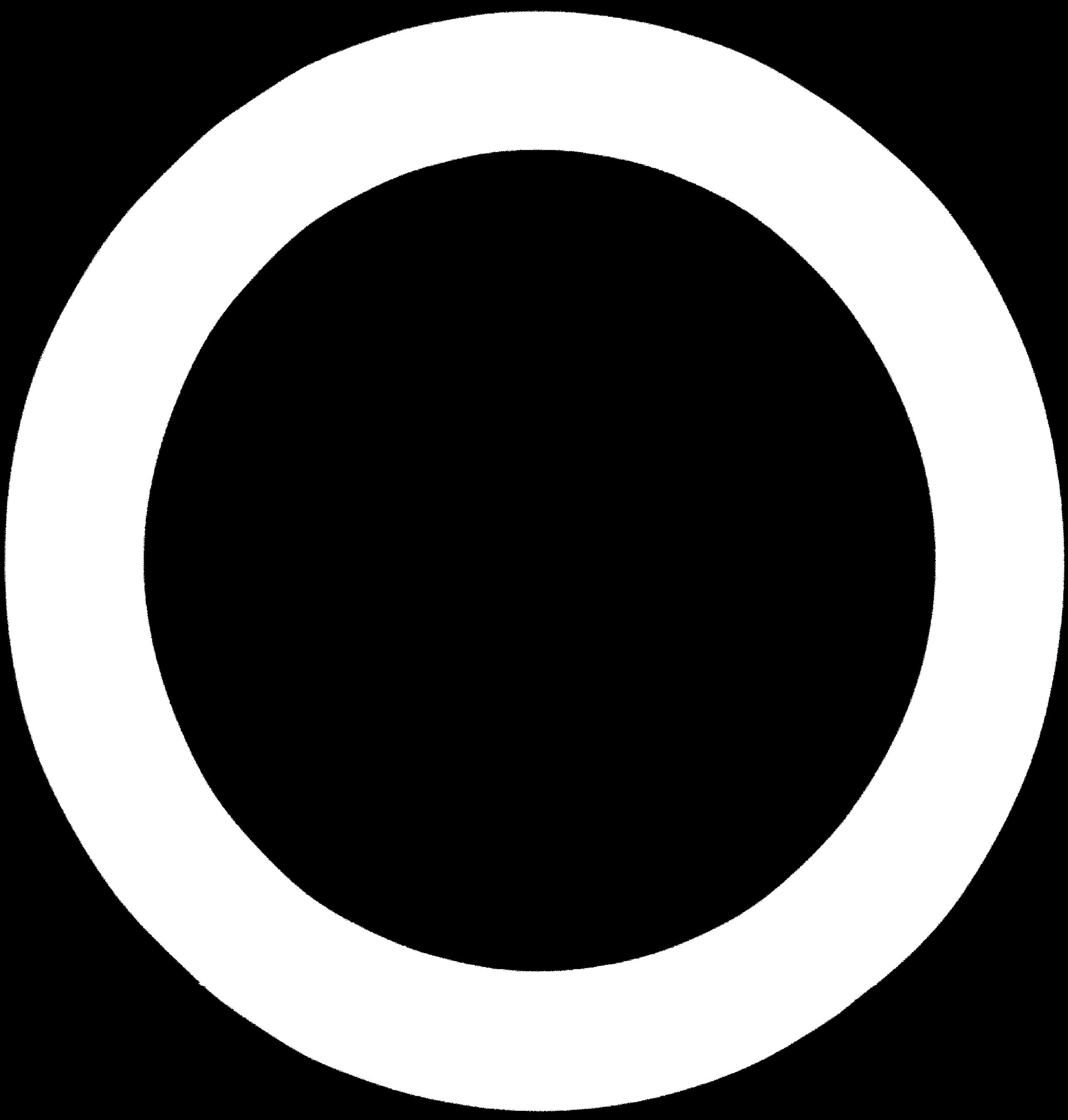

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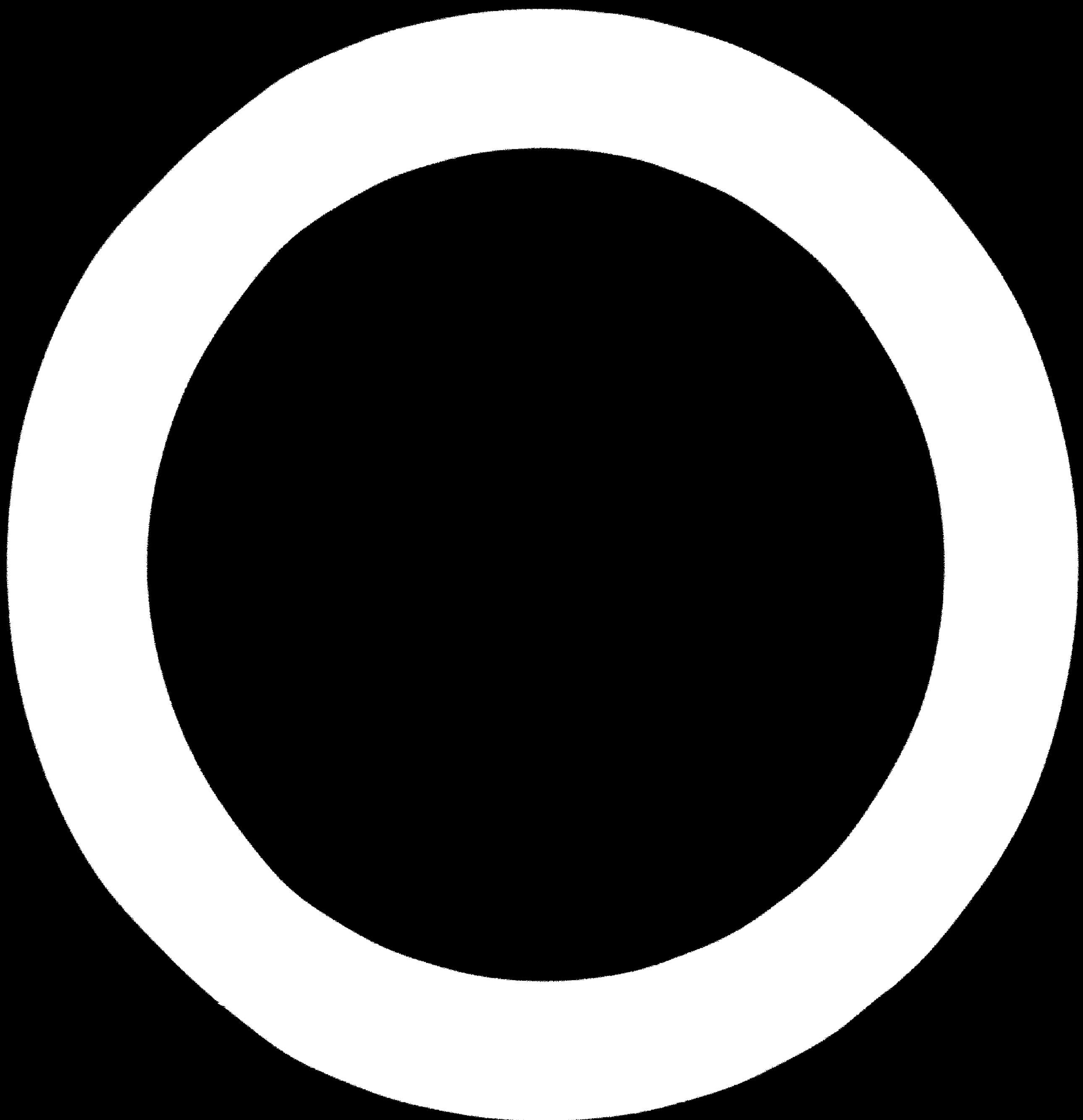

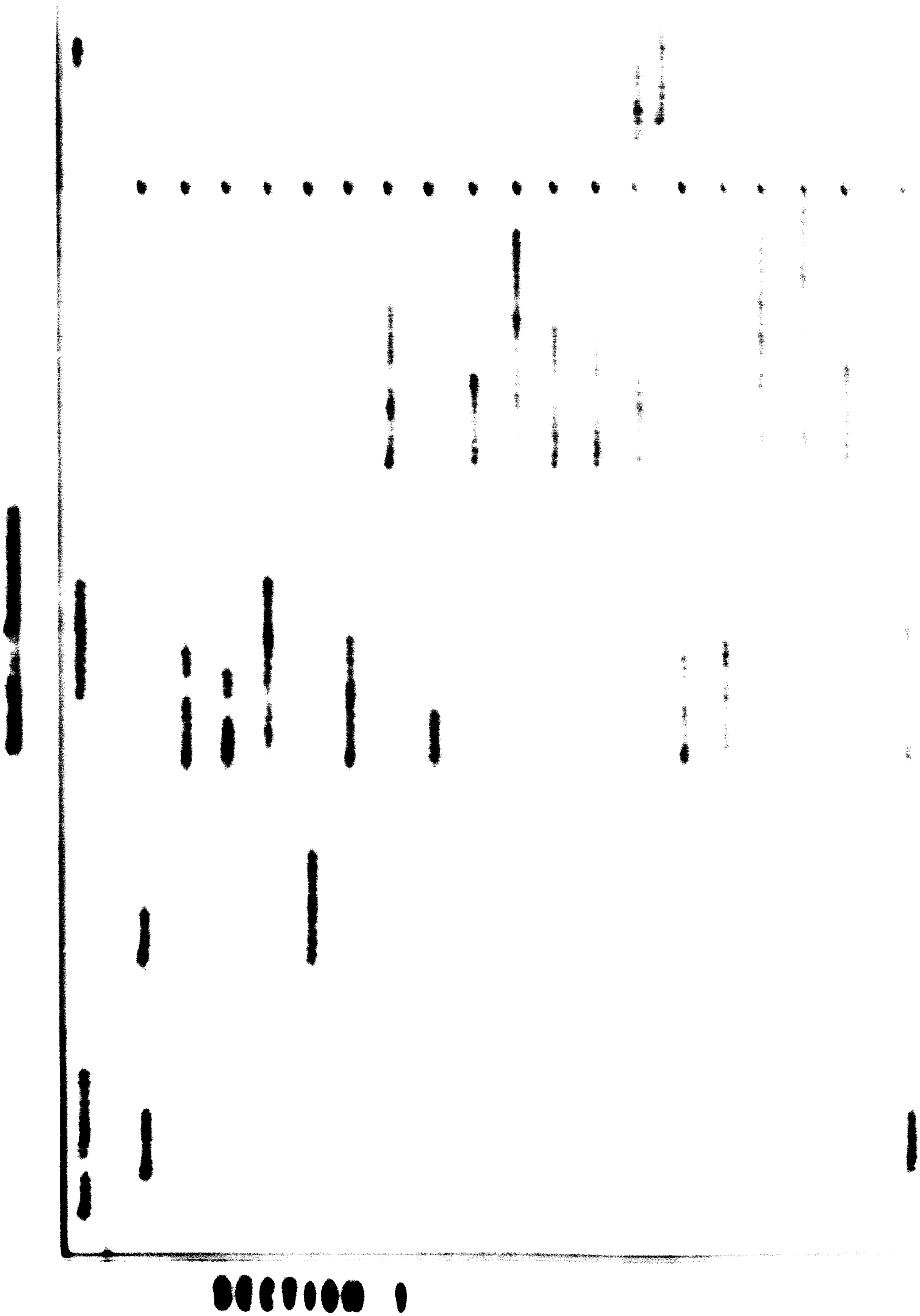

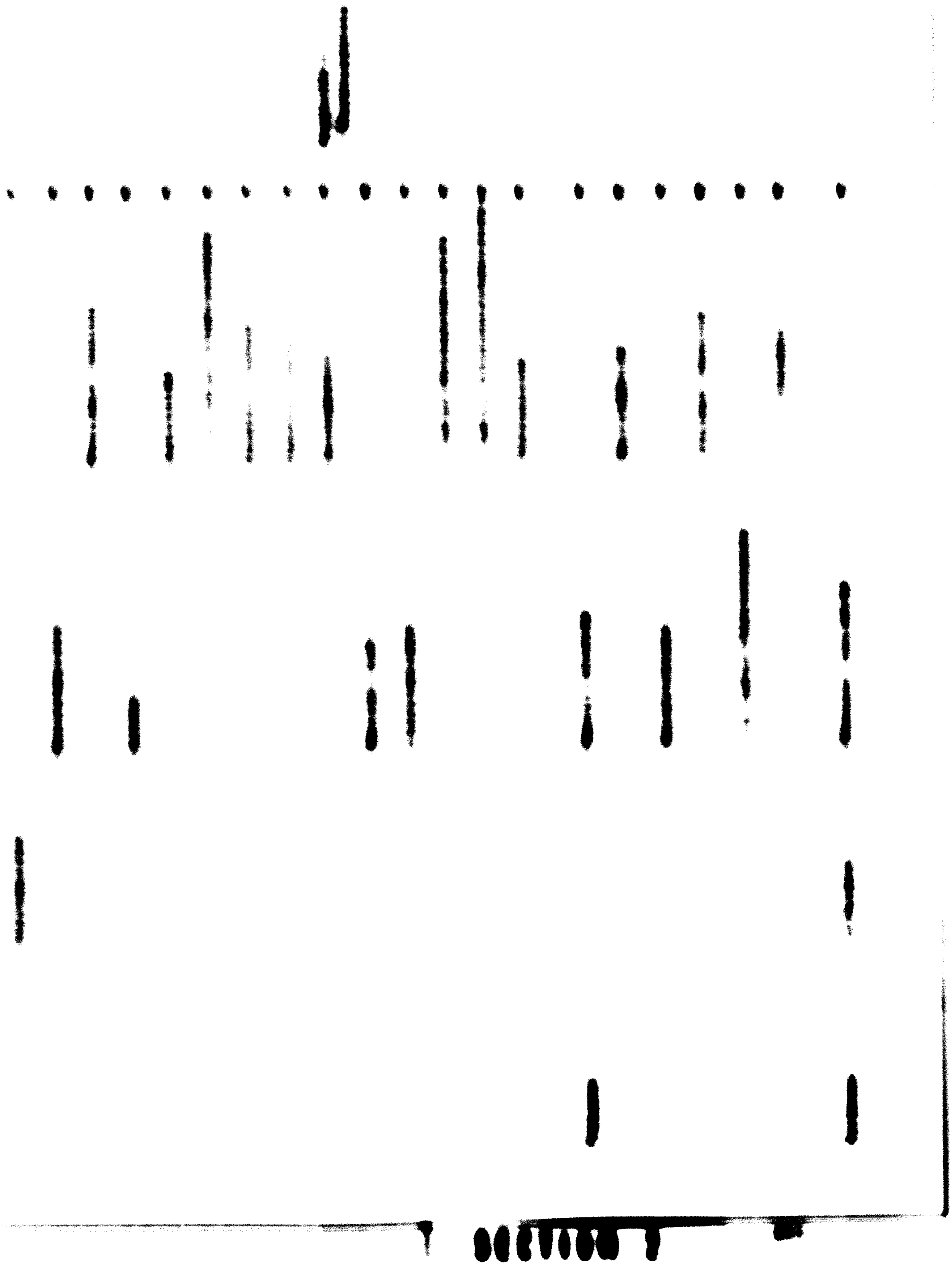

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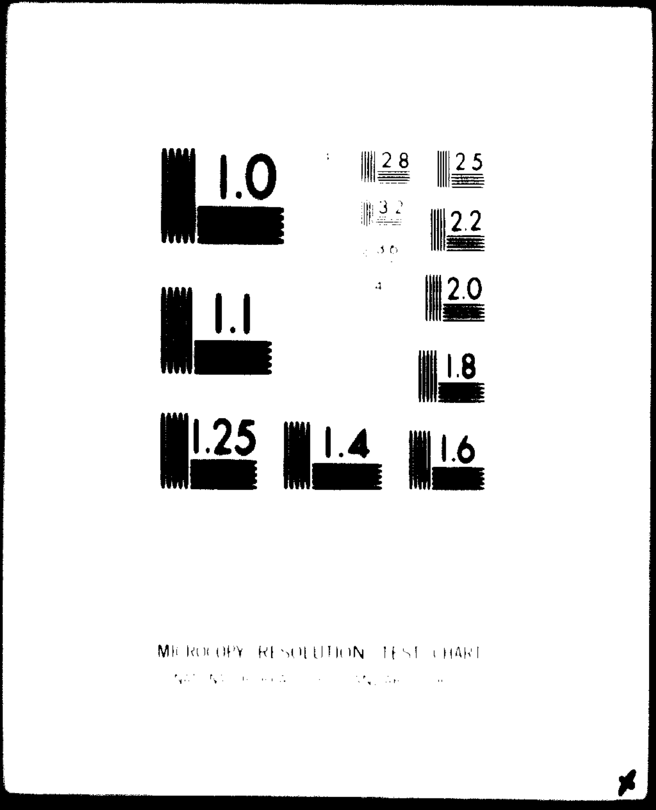
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MICROCOPY RESOLUTION TEST CHART

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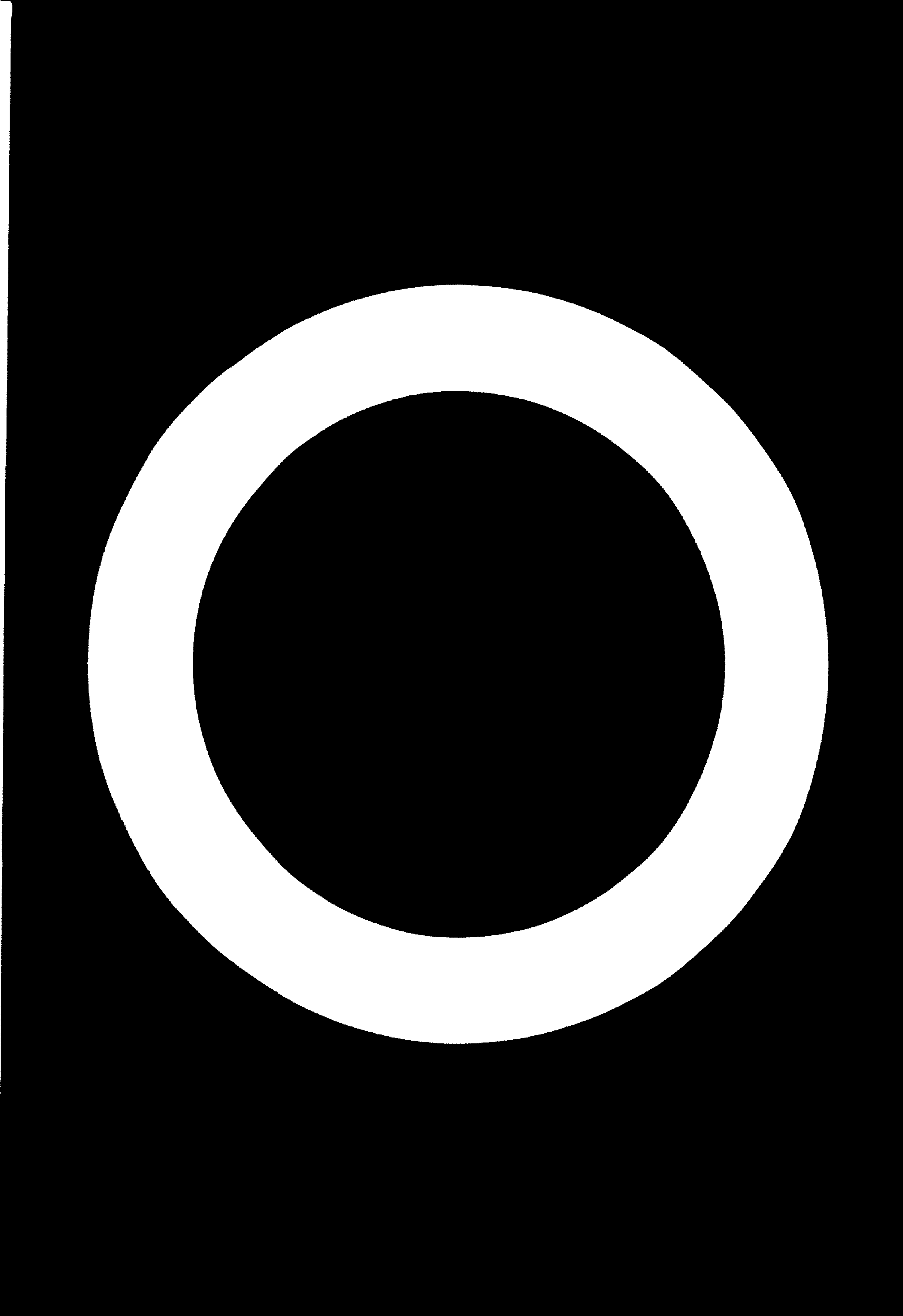


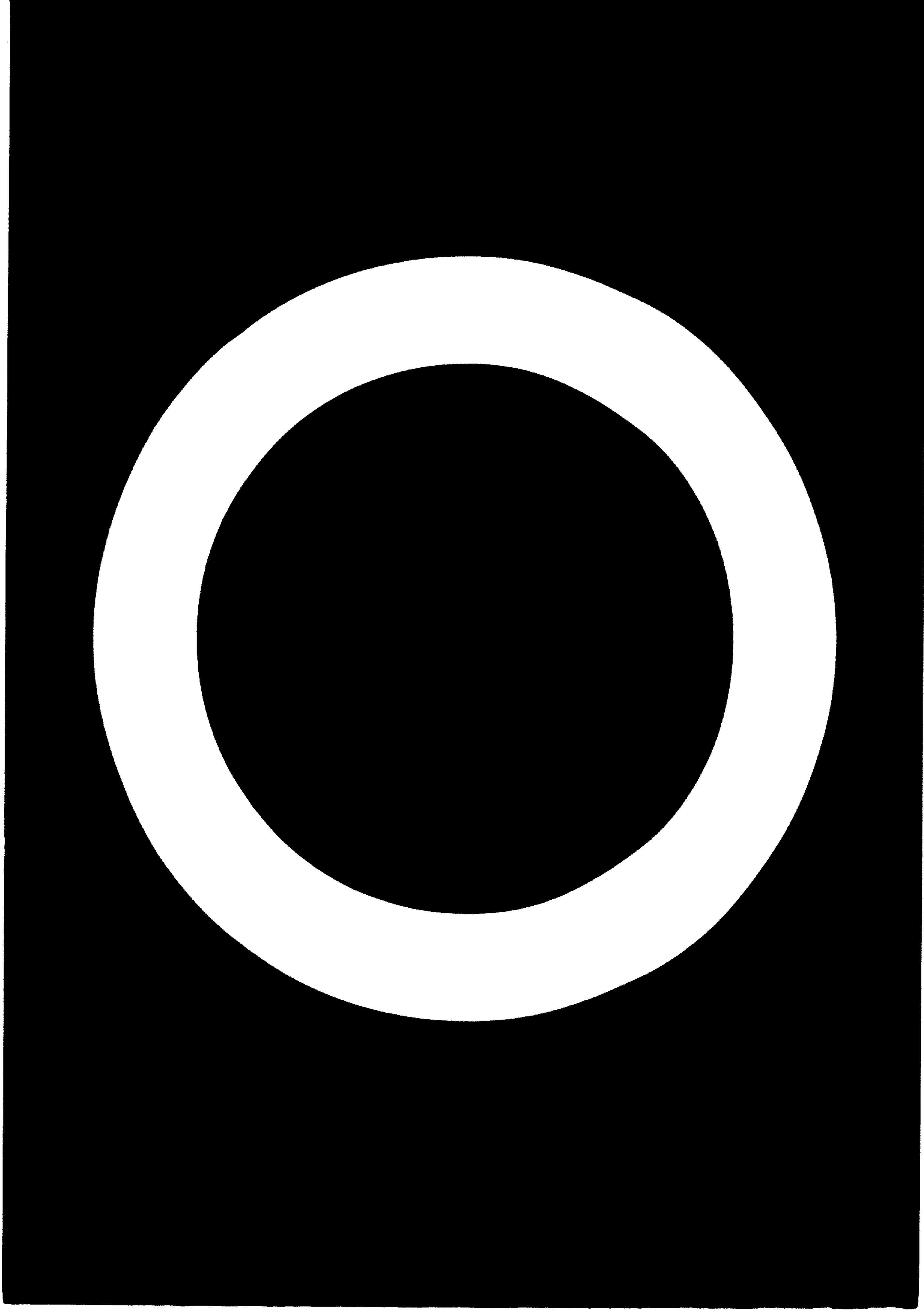
SECTION 1

Toiletry

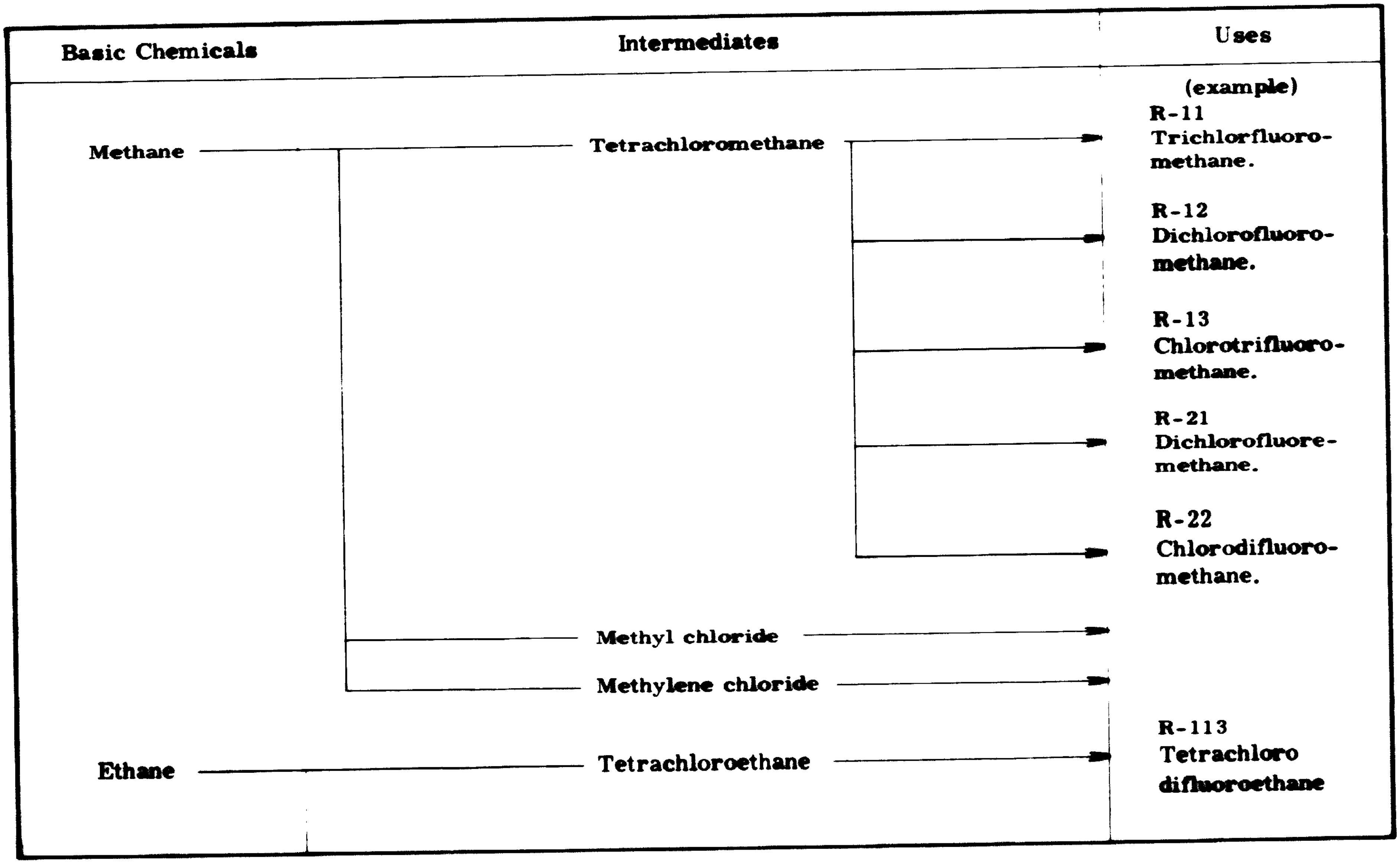
Basic Chemicals	Intermediate			Uses
Propylene		Isopropyl alcohol		Fatty oil & Mas substitute
		Butyl alcohol		
		Glycerine *		
Xylenes	o-Xylene	Phthalic anhydride		
Ethylene		Ethylene glycol		Surfactants (non ionic)
		Polyethylene glycol		
Propylene		Propylene glycol		
		Glycerine *		
		Propylene oxide		
Ethylene	Acetic acid	Vinyl acetate	Polyviny acetate	Thickners
			Polyvinyl alcohol	
Ethylene	Ethylene oxide	Ethylene glycol		Humectants
		Diethylene glycol		
Propylene		Propylene glycol		
		Glycerine *		
Benzene		Phenol		
			Salicylic acid	Preservatives

Raw material	Intermediate	Product	Derivative	Use
Xylenes	o-Xylene	Phthalic anhydride		
Ethylene		Ethylene glycol		Surfactants (non ionic)
		Polyethylene glycol		Surfactants (non ionic)
Propylene		Propylene glycol		Surfactants (non ionic)
		Glycerine *		Surfactants (non ionic)
		Propylene oxide		Surfactants (non ionic)
Ethylene	Acetic acid	Vinyl acetate	Polyviny acetate → Polyvinyl alcohol	Thickners
Ethylene	Ethylene oxide	Ethylene glycol		Humectants
		Diethylene glycol		Humectants
Propylene		Propylene glycol		Humectants
		Glycerine *		Humectants
Benzene		Phenol		Preservatives & germicides
			Salicylic acid	Preservatives & germicides
Toluene		Benzoic acid		Preservatives & germicides
		Cresol		Preservatives & germicides
Propylene		Propylene alcohol		Antioxidants
Isobutylene		(Isobutylene)		Antioxidants

*: In Indonesia, fatty oil saponification process may be preferable.



Refrigerants



Pesticides

Basic Chemicals	Intermediate	Uses
Benzene	(Benzene)	Insecticides
	Phenol	
	Chlorobenzene	
Toluene	(Toluene)	
	Cresol	
Xylenes	3, 4-Xylenol	
Ethylene	Ethylene diamine	Fungicides
Benzene	Phenol	
Benzene	Phenol	Herbicides
	Nitrobenzene	
Toluene	o-Cresol	

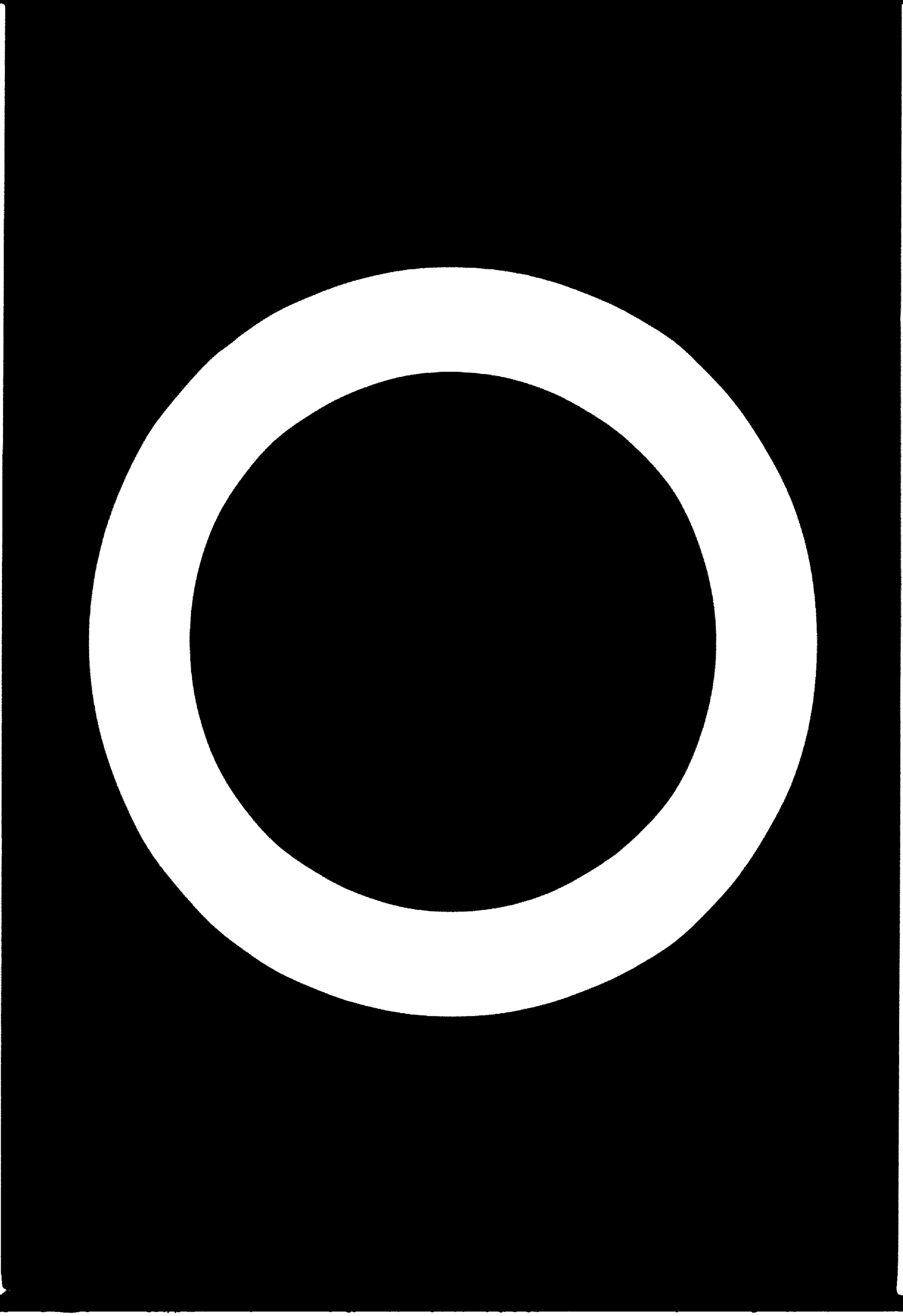
Carbon Blacks

Carbon black is broken down into gas black, oil black and acetylene black, from a viewpoint of the raw materials.

Classifications	Raw materials	Uses
Gas black	Natural gas	Reinforcing Agent for Natural Rubber & Coloring Agent
Oil black	Heavy oil	Reinforcing Agent for Synthetic Rubber & Coloring Agent
Acetylene black	Acetylene	Dry Batteries

Remarks:

At present, gas black is being produced in Indonesia for use with natural rubber. There will be no need of producing oil black, using the bottom fraction from the naphtha cracker, until synthetic rubber will be used in Indonesia.



5. Conclusion

ANNEX C

EXPERIMENTAL REPORT ON LIGNITE

SUBJECT: QUALITY OF OMBILIN COAL AND BUKIT ASAM COAL, SUMATRA, INDONESIA

Tomijiro Murata and Yasuo Nakayanagi

Research & Development Division

1. Foreword

We were requested to conduct microscopic observations, proximate and ultimate analyses of Ombilin coal and Bukit Asam coal, both in South Sumatra, Indonesia, in order to rate their qualification as industrial raw materials. The proximate and the ultimate analyses were commissioned to The Coal Mining Research Centre. Microscopic observations were conducted at Coal Section, the Geological Survey of Japan, and photographs were taken at Ore Research Section of the same institute, both by one of the authors.

Taking results of the above analyses into consideration, and also referring to the survey results so far reported by some institutions and offered to us through the courtesy of these institutions, we will describe below the quality of coal from these coal fields.

points will be advantageous in their utilization. In the case

2. Analytical Methods

The coal consists of several major substances, and has varying chemical properties, depending upon their proportions in the coal. The sample was microscopically observed to classify the types of mixing of constituents, using the oil immersion lens. The proximate and the ultimate analyses were conducted by normal procedures (JIS). But, it is to be noticed that the moisture of coal is determined with the coal sample holding the equilibium moisture.

Microscopic Photographs

The following microscopic photographs were taken by using an oil

3. Results

(1) Qualitative Investigation by Microscope

Similarity of ground mass indicates that these two coals have a microscopic texture very resembling to the Japanese tertiary coals. Bukit Asam coal had a lower reflectivity and Ombilin coal had a slightly higher reflectivity than that of the former. (See photographs)

i) Ombilin coal

Cutinite-clarite exists in a large amount, and vitrite was relatively less. Sporinite-clarite is also contained in considerable amount and often includes cutinite. Inertinite existed to some extent, but little fusite was observed.

ii) Bukit Asam coal

This coal contains a very large amount of vitrite which shows quite varied inner structures, especially cork tissue. Such a semifusinized structure or fusite seems to be about several percent. Sporinite-clarite was relatively less.

It has been found from these observations that the above two coals have similar characteristics to those of the Japanese tertiary coals and do not contain any significant amount of fusite. This clearly indicates that in evaluating analytical values we can deal with them on almost the same basis as that for the Japanese tertiary coals.

(2) Proximate and ultimate analyses

Table C-1 gives results of the proximate and the ultimate analyses of Ombilin coal and Bukit Asam coal.

Table C-1 Results of Proximate and Ultimate Analyses of Ombilin Coal and Bukit Asam Coal

(Unit: wt %, except for calorific values (Kcal/Kg) and Coke-button index)

	Proximate Analysis						Ultimate Analysis						
	Moisture	Ash	Volatile Matter	Fixed Carbon	Calorific Value	Coke Button Index	Ash	C	H	O	N	S	P*
Ombilin	5.5	1.2	41.4	51.9	7440	1	1.3	80.2	5.8	10.9	1.6	0.2	tr. 0.000
			(44.4)	(55.6)				(81.2)	(5.9)	(11.1)	(1.6)	(0.2)	
Bukit Asam	13.3	1.9	41.7	43.1	5940	0	2.2	71.5	5.2	18.8	1.2	1.1	0.001
			(49.2)	(50.8)				(73.2)	(5.3)	(19.2)	(1.2)	(1.1)	

Source: The Coal Mining Research Centre, August 1972.

Note:
1. Samples are given from the P.N. Coal Mine.
2. Parenthetical figures are on a dry ash-free basis.
3. Asterisked (*) phosphorus content of coal is recalculated from measured P content of ash.

Following Murata's method,[7] results of the above ultimate analysis were modified to represent ratios of atomic number, which are given in Table C-2.

Table C-2 Ratios of Atomic Number Modified from the Found Values in Table C-1

	[H]	[O]	[N]	[S]
Ombilin	85	10	1.7	0.09
Bukit Asam	87	20	1.4	0.63

(Figures mean the number of atoms obtained when C = 100)

Currently, it is a more common practice to use values of ultimate analysis on the dry ash free basis, in order to determine the rank of coal. According to such a practice, Ombilin coal is named as weakly caking sub-bituminous coal (80-83% C content), and Bukit Asam coal is named as lignite (70-78% C content). However, Ombilin coal has a coke button index (CBI) of 1, which is too small, as compared with around 5 for usual weakly caking coal. Even if Ombilin coal is ranked as non-caking sub-bituminous coal (78-80% C) having a CBI of 3, its observed value, 1, is too small, and its fuel ratio (fixed carbon/volatile matters) seems somewhat higher.

Fig. C-1 illustrates relations[8] of carbon percentage (in dry ash-free basis) to the percentage of moisture. When the two coals were plotted in this figure, both of them

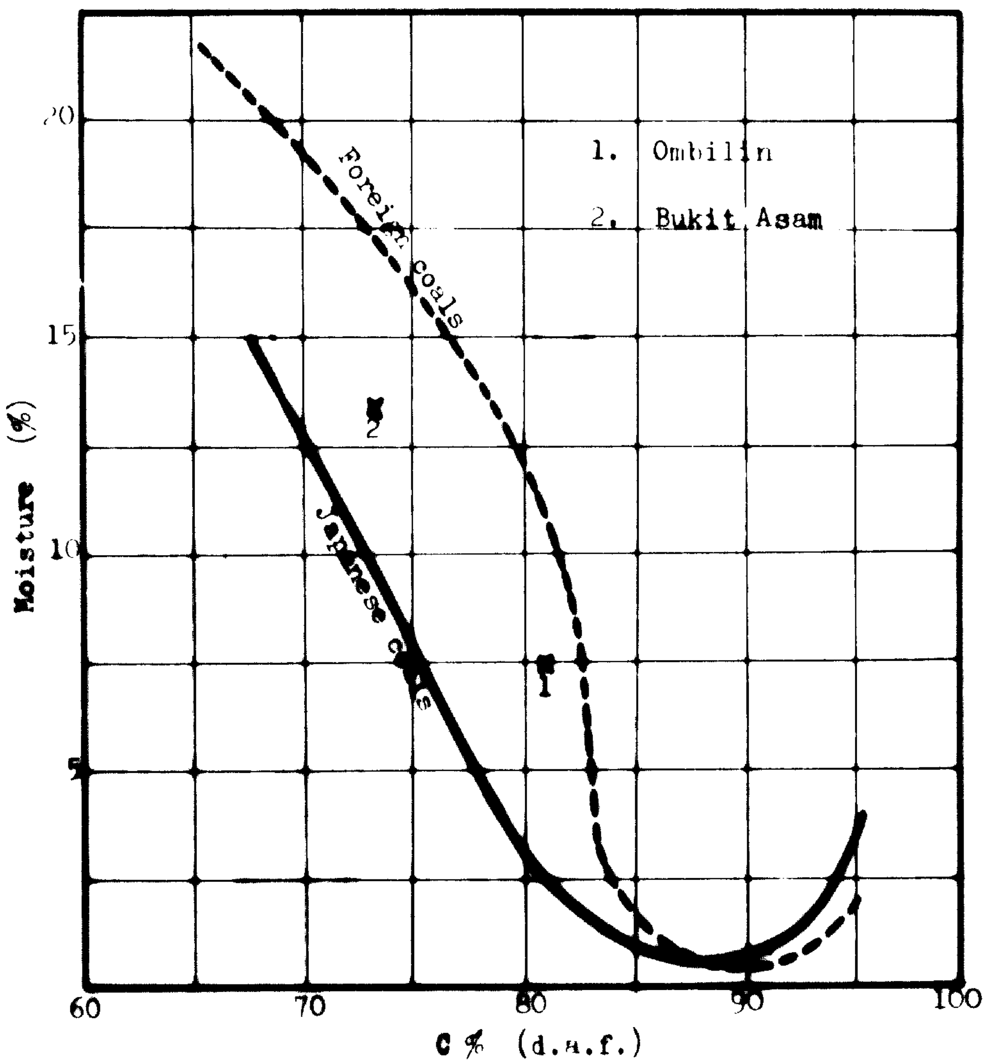


Fig. C-1 Relations between the Percentages of Moisture and Carbon

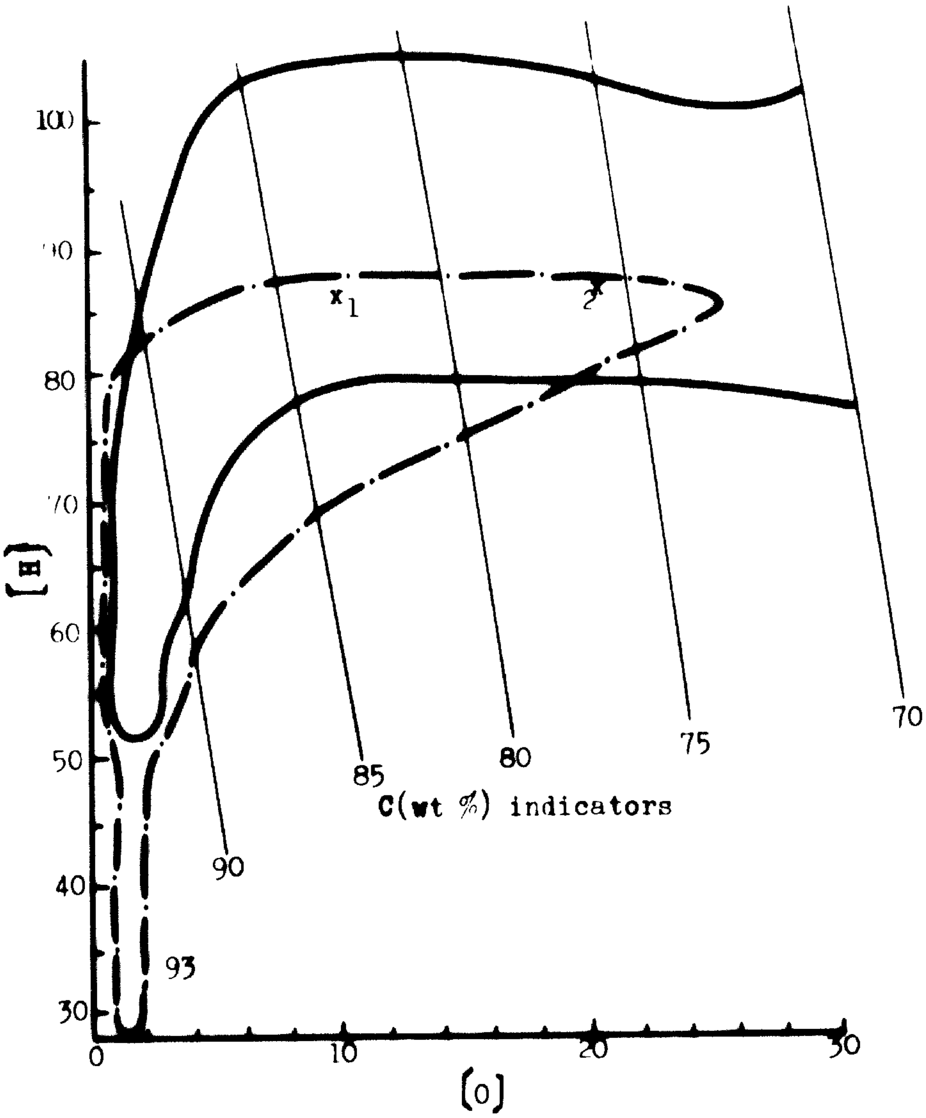


Fig. C-2 (H) - (O) Coal Bands

x 1	:	**Ombilin Coal,**
x 2	:	**Bukit Asam Coal**
(solid line symbol)	:	**Indicates the Band of the Japanese Tertiary Coal.**
(dash-dot line symbol)	:	**Indicates the Band of European and American Carboniferous Coals.**

deviate much distant from the average line for the Japanese coals.

Fig. C-2 illustrates a part of [H] - [O] coal bands, and the values given in Table C-2 were plotted therein. The figure shows that the both coals are located near the upper limit of the European and American carboniferous coal band. It seems to be convenient to deem that their positions are within the band of the Japanese tertiary coals. However, their positions are in H-poor site of the band for the Japanese coals.

Also referring to the lines showing C content in Fig. C-2, the two coals are located at somewhat poorer [H] and slightly richer [O] sites, as compared with those coals with same degrees of coalification.

Contents of ash, sulfur, and phosphorus often incur some problems in the utilization of coals. As long as the above results of analyses are concerned, ash content is very low, sulfur content is low, and phosphorus content is extremely low.

Particularly with respect to phosphorus, Table C-3 gives comparison of the two coals with other coals. Bukit Asam coal has a P-content as low as 0.001, and Ombilin coal has even a lower value of tr (0.000), whereas other coals commonly have a value of at least 0.004 or more. Such low values are worthy of notice, although it cannot be clarified at present how much technical value is added to the coals by the fact that these low-rank coals have low P-contents.

In the final analysis, Ombilin coal is a non-caking to weakly caking sub-bituminous coal, and Bukit Asam coal is

Table C-3 P Contents of Coals in the World

(Unit: wt %)

	Ash	P
Indonesia		
Ombilin	1.3	tr. (0.000)
Bukit Asam	2.2	0.001
Japan		
Takashima	6.1	0.023
Yubari	7.3	0.030
Miike	6.6	0.023
Oonoura	7.8	0.016
Shakanoo	7.2	0.007
U. S. A.		
Itman, Poca No. 3	5.9	0.013
New River	4.3	0.006
Bird B	4.6	0.004
Australia		
Coal Cliff	10.4	0.053
Liddell	8.8	0.091
Moura	7.5	0.058
U.S.S.R.		
Kuznetsk	7.5	0.043
China		
Kailan	12.2	0.069
Philippines		
Malangas	11.2	0.027
Sarawak		
Sarawak No. 24	8.1	0.009

lignite. When compared with a similar rank of Japanese tertiary coals, the two coals hold considerably much water and have somewhat higher fuel rations.

In the case of Ombilin coal, its coke button index is too small for a coal of this class; on the other hand, they have less (H) and somewhat higher (O) contents.

Ash content is low, and sulfur content poses no problem in both coals. Phosphorus content is extremely low. It is in a trace amount in Ombilin coal. However, a merit of low phosphorus is not clear, since these coals are not strongly caking coals.

4. Changes in Quality of Coals from Both Coal Fields

In attempting to utilize those coals from the two coal fields, consideration will have to be given to the changes in coal quality. This problem is now discussed, referring to existing data.

Several surveys[1-6] have been made for both Ombilin and Bukit Asam coal fields, and we can make access to a considerable number of analytical test results, which are attached to this report. Unfortunately, only proximate analyses have been carried out in these surveys, unabling us to discuss the problem in such details as described in the previous section. It is possible, however, to interprete a trend in quality changes of those coals from the two coal fields.

Now that found values of volatile matters and fixed carbon may vary, depending upon moisture and ash content, we took the fuel ratios of fixed carbon/volatile matters as the factor to estimate any changes in the quality of pure coal (i.e., volatile matters plus fixed carbon).

(1) Ombilin coal field

Table C-4 Quality Range of Ombilin Coal

	Moisture (wt%)	Ash (wt%)	Fuel ratio	CBI	S (wt%)
Total	3.3 - 5.8	1.2 - 9.0	1.1 - 1.5	1 - 3.5	0.2 - 1.3
Areas other than Swalunto area	"	"	1.1 - 1.2	"	"

Seven analytical data were collected and one datum gives a range of quality of A seam coal. These were tabulated in Table C-4 showing ranges of values. According to the past surveys,[1) 5)] the coal seam is fairly stable.

The table seems to reveal considerably stable quality of coal except for the coal from Swalunto area. Since however, open-cut mining has been practiced in an area,[5)] it may be necessary to take some deterioration caused by weathering into consideration. Such deterioration may have given rise to the smaller coke button indeces aforementioned.

(2) Bukit Asam coal field

There are nearly 120 analytical data, including those for unnamed coal seam. Half the number of data are from the Air Laja area. Table C-5 gives ranges of coal quality for each area.

Igneous rock has intruded into the coal measure in this field, to progress the coal into higher rank.[1, 2, 5)] Analytical results collected fluctuate over a wide range from lignite to anthracite. As long as Table C-5 is concerned, the coal from the Endikat River area seems to have relatively stable quality, although it would be premature to conclude that the quality of coal from the area will be stable likewise also in the future.

Bukit Asam coal has a relatively low sulfur content from 0.2 to 2.2%. It is reported that many marine fossil shells occur in the layer directly under B_1 seam.[5)] It is generally said that the coal seam accompanied by such a marine bed has a high S content, therefore there is a

Table C-5 <u>Quality Range of Bukit Asam Coal</u>

		Moisture (wt%)	Ash (wt %)	Fuel ratio	CBI	S (wt %)
Total		0.1-28.1	0.3-24.5	0.7-24.8	0, 4	0.2-2.2
Air Laja Area	(53)	0.1-18.8	0.7-24.5	0.8-5.4	-	0.3-1.0
Muaratiga Area	(15)	0.6-17.1	1.0-5.8	1.0-2.5	-	-
Endikat Area	(9)	17.6-19.3	1.1-2.9	0.8-1	-	-
Kelawas Area	(4)	10.7-15.6	0.3-2.5	1.1-1.2	-	-
Tandjung Enim Area	(2)	12.2, 13.7	1.9, 3.0	1, 1.1	0, 0	0.2
Air Petai Area	(2)	23.2, 23.8	1.6, 5.5	1, 1	-	0.3, 0.8
Air Manggus Area	(1)	5.8	0.3	1.4	-	0.5
Ulu Berangan Area	(1)	1.0	1.6	1.1	-	1.6
Bukit Japuan Area	(1)	1.0	0.8	24.8	-	0.5
Muruman Area	(1)	8.7	2.4	1.2	4	0.5
Tanah Hitam Area	(1)	15.7	0.4	1.1	-	0.4
Unknown	(28)	1.0-28.1	0.4-18.3	0.7-24.8	- (1.2-1.7)	0.3-2.2

fear that Bukit Asam coal may have a higher S content than so far detected. Attention should be paid in this respect.

Finally, Bukit Asam coal undergoes alteration of quality, ranging from lignite to anthracite. There is a possibility that strongly caking coal may be produced from some area in this field (It is already produced locally in this field.) However, much has not been expected for such a probability as above, probably because of its violent changes in coal quality. As previously described, attention should be paid to the changes in sulfur content.

5. Conclusion

Samples of both Ombilin coal and Bukit Asam coal were subjected to microscopic investigation, proximate and ultimate analyses. Both coals were further investigated on their quality by making reference to existing survey data, particularly to analytical data.

Microscopically, both coals have less amounts of inert substances such as fusite, and have similar characteristics to those of the Japanese tertiary coals. It was therefore ascertained that utilization of those coals may be diagnosed according to the criterion for Japanese tertiary coal which has been studied most deeply of all the tertiary coals.

Ombilin coal is a non-caking to weakly caking sub-bituminous coal, of which quality seems to be fairly stable within the basin. However, open-cut mining locally practiced in this field makes it necessary to take the effect of weathering into consideration in such a place. Bukit Asam coal is lignite, some of which has been affected by igneous intrusion, thereby producing up to anthracite. Careful attention should be paid to such changes in quality of this coal, and we cannot expect much for the production of higher rank coals.

Both coals have higher fuel ratios than those of Japanese coals of same rank. With respect to the coke button index, even Ombilin coal is non-caking. Ultimate analysis seems to indicate less [H] and higher [O] in both coals. They have very small amounts of ash and sulfur contents, and quite small amounts of phosphorous which are lower than the minimum in the existing data. It should be noted that Ombilin coal, in particular, has only a trace amount of phosphorous. These points will be advantageous in their utilization. In the case of Bukit Asam coal, environmental characteristics of coal deposition seem to warn of probability in future production of higher S-content coal, and thus attention will have to be paid in this respect.

Although Ombilin and Bukit Asam coals have many advantageous properties, their utilization is restricted by the fact that both are not strongly caking bituminous coal (Ombilin is sub-bituminous and Bukit Asam is lignite). Both coal fields have not so large scales.[1, 5] If the development of these coal fields and utilization of these coals are intended, it is necessary to take the above points into consideration.

In closing, we would like to express our sincere tanks to the personnel of Coal Section of the Geological Survey of Japan, the Coal Mining Research Centre, and Technical Dept., Japan Overseas Coking Coal Development Co., Ltd. for kind offer of their data, and to the personnel of Ore Research Section and Coal Section of the Geological Survey of Japan for the permission for our use of its microscope.

Microscopic Photographs

The following microscopic photographs were taken by using an oil immersion objective lens, with about 115 magnifications.

No. 1 Ombilin coal. Most characteristic cutinite-clarite, with some sporinite-clarite. In the left-hand side is observed the vitrite layer.

No. 2 Ombilin coal. Mostly sporinite-clarite, with some cutinite therein.

No. 3 Bukit Asam coal. Accumulation of vitrite with various side. On the right upper part is observed fusite (semi-fusinite).

No. 4 Bukit Asam coal. Accumulation of vitrite showing cork tissue is illustrated together with sporinite-clarite. The latter contains white-colored sclerotinite.

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9) Others

ANNEX D

BASIC ASSUMPTIONS AND CALCULATION SHEETS FOR ECONOMIC APPRAISAL OF THE PETROCHEMICAL COMPLEX

ABBREVIATIONS

ACETIC	Acetic Acid
AMMO SUL	Ammonium Sulfate
AROMATICS R.	Aromatics Related
CAPROLAC	Caprolactam
CAT CHEM	Catalyst and Chemicals
CHX	Cyclohexane
CRACKGAS or C.G.	Cracked Gasoline
C4 FRACT	C_4 Fraction
C5 + FRACT	C_5 Heavier Fraction
DI - EG	Di-ethylene Glycol
EO/EG	Ethylene Oxide/Ethylene Glycol
HDPE	High Density Polyethylene
HP.	High Pressure
HV.	Heavy
HYDRGAS.	Hydrogenated Gasoline
HYDROFUE	Hydrogen for Fuel
INT.	Interest
INV	Investment
LDPE	Low Density Polyethylene
LP	Low Pressure
MP	Medium Pressure
NAPHTHA CRAC	Naphtha Cracking
N.G.	Natural Gas
PP	Propylene
PROJ	Project
PROPYCHE	Chemical Grade Propylene

ABBREVIATIONS (Cont'd)

PROPYFUE	:	Propylene for Fuel
PROPYLEN	:	Propylene
PVC	:	Polyvinyl Chloride
RAFF.	:	Raffinate
REFORMAT	:	Reformate
REFORMER R.	:	Reformer Related
REF & H.G.	:	Reformate and Hydrogenated Gasoline
SM/PS	:	Styrene Monomer/Polystyrene
SULFACID	:	Sulfuric Acid
TPA	:	Terephthalic Acid
UNIFORM-PRIN.	:	Uniform-Principal
VCM	:	Vinil Chloride Monomer

BOILER FEED WATER in (3) UTILITIES of DIRECT PRODUCTION COST includes process water.

Required pressure for steam was assumed to be medium.

Basic Assumptions Laid for Economic Appraisal of the Petrochemical Complexes

1. **Finance**

Category:

Own Capital :	Estimated at 20% of the total investment cost.
Foreign Loan :	Estimated at 80% of the total investment cost.
Local Loan :	Working capital.

Sources:

Foreign Loan :	From international financing institutions.
Local Loan :	From official financing institutions in Indonesia.

Interests:

Foreign Loan :	Estimated at 7.5% per annum.
Local Loan :	Estimated at 12% per annum.

(Although current interest rate on local loans is set to about 20% per annum in Indonesia, it is estimated from the study of BAPPENAS and other Indonesian city banks that the domestic official interest rate will drop to around 12% by 1980.)

Repayment Method:

Foreign Loan :*	Left unredeemed for 5 years; yearly installments for 7 years with Equally Separated Principle.

*) Two years' period of construction work was assumed, and foreign loan set aside for plant and equipment investment is made two years before the start-up of operation.

Local Loan : Repaid over 3 years with no period of deferment. Yearly installments for 3 years with Equally Separated Principle.

2. **Investment Cost**

Category: The investment cost was categorized as follows:

Battery Limit Investment Cost.

Off-site Investment Cost.

Working Capital.

Battery Limit Investment Cost includes costs of the following each item.

Material Cost.

Freight.

Engineering & Construction Fee.

Interest during Costruction.

Royalty (Paid-up).

Start-up Expenses.

Initial Charge of Catalyst & Chemicals.

Contingencies.

Off-site Investment Cost includes costs of the following each item.

Material Cost.

Freight.

Engineering & Construction Fee.

Building Cost.

The investment cost excludes those costs associated with infra-structures, such as land purchase cost, site creation cost, and foundation construction cost. Land is assumed to be lent by the Government, and the rent of land is not counted.

3. Operation Conditions

Plant life:	10 years.
Plant in operation :	For 330 days annually.

4. Fixed Cost

Depreciation:

Battery Limit :	10 years by the straight line method. (Or, 8 years by the same method in cases of severely corrosive plants, such as PVC, VCM, and caprolactam plants.)
Off-site :	15 years by the straight line method. As the DCF calculation is made for 10 years, the balance of depreciation for the remaining 5 years (33%) is counted as salvage at the 10th year.

Plant Overhead Cost:	Estimated at 5% of the total investment cost. The plant overhead cost includes: Administrative Expenses. Distribution and Selling Expenses. Research & Development Cost.
Maintenance & Repirs:	Estimated at 3% of the depreciable investment cost.
Tax (municipal property) & Insurance:	Estimated at 1% of the depreciable investment cost.

5. <u>Corporate Taxes</u> 45% of Profit.

6. <u>Equation for Rate of Return</u>

The rate of return is calculated by the following equation.

$$I = \sum_{n=1}^{10} \left(\frac{Rn}{(1+i)^n} \right) + \frac{S}{(1+i)^n}$$

I	:	Total Investment Cost
Rn	:	Net Cash Flow in nth year
S	:	Salvage Value
i	:	Rate of Return

PRODUCT COST ESTIMATION AND DISCOUNTED CASH FLOW

** CALCULATION RESULTS **

REC. NO 10C
JOB NO 07290050

CUSTOMER UNIDO
PROJECT INDONESIAN PC INDUSTRY
PRODUCTS PETROCHEMICALS

CURRENCY EXCHANGE RATE 300.00YEN/1US$

PROCESS UNIT	NAPHTHA CRAC	UNIT				
CAPACITY	302000.	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	80.	%				
WORKING CAPITAL	100.	%				
TAX	UNIFORM					
INCOME TAX RATE	45.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	10.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	33.	%	0.	%
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	56100.	1000$				
PROCESS INVESTMENT COSTS	56100.	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSES	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	56100.	1000$				
OFF-SITE	16400.	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	72500.	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	72500.	1000$				
WORKING CAPITAL	12500.	1000$				

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.71	0.81	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	215628.	244318.	278746.	300792.	302000.	302000.	302000.	302000.	302000.	302000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
NAPHTHA	(1000$/YR)	19367.	22722.	25956.	28999.	29087.	30090.	31093.	31093.	32096.	32096.
(2) CATALYSTS AND CHEMICALS	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	146.	166.	213.	230.	230.	230.	230.	256.	256.	256.
FUEL	(1000$/YR)	2651.	3114.	3558.	3980.	4134.	4134.	4277.	4419.	4562.	4562.
COOLING WATER	(1000$/YR)	1297.	1467.	1676.	1808.	1814.	1814.	1814.	1814.	1814.	1814.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	61.	70.	79.	86.	86.	86.	86.	86.	86.	86.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	170.	170.	170.	170.	170.	170.	170.	170.	170.	170.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	23692.	27709.	31652.	35271.	35520.	36523.	37669.	37837.	38983.	38983.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	5610.	5610.	5610.	5610.	5610.	5610.	5610.	5610.	5610.	5610.
OFF-SITE	(1000$/YR)	1094.	1094.	1094.	1094.	1094.	1094.	1094.	1094.	1094.	1094.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	4350.	4350.	4350.	4350.	3729.	3107.	2486.	1864.	1243.	621.
INT. ON WORKING CAPITAL	(1000$/YR)	1500.	1000.	500.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	2175.	2175.	2175.	2175.	2175.	2175.	2175.	2175.	2175.	2175.
(4) TAXES AND INSURANCE	(1000$/YR)	725.	725.	725.	725.	725.	725.	725.	725.	725.	725.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	15454.	14954.	14454.	13954.	13332.	12711.	12090.	11468.	10847.	10225.
PLANT-OVERHEAD COSTS	(1000$/YR)	3625.	3625.	3625.	3625.	3625.	3625.	3625.	3625.	3625.	3625.
FACTORY COSTS	(1000$/YR)	42771.	46287.	49731.	52850.	52478.	52859.	53383.	52930.	53454.	52833.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	42771.	46287.	49731.	52850.	52478.	52859.	53383.	52930.	53454.	52833.
UNIT PRODUCT COST	($/TON)	198.35	189.46	178.41	175.70	173.77	175.03	176.77	175.27	177.00	174.94

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
BY-PRODUCTS CREDITS											
(H2 FUEL)											
PRICE	($/TON)	75.00	77.00	79.00	81.00	83.00	85.00	87.00	89.00	91.00	94.00
AMOUNT	(TONS/YR)	1571.	1781.	2024.	2191.	2235.	2235.	1235.	1235.	1235.	1235.
VALUE	(1000$/YR)	118.	137.	160.	177.	186.	190.	107.	110.	112.	116.
(METHANE)											
PRICE	($/TON)	31.00	32.00	33.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00
AMOUNT	(TONS/YR)	106100.	120217.	137158.	140000.	140600.	146600.	140600.	140600.	140600.	140600.
VALUE	(1000$/YR)	3289.	3847.	4526.	4604.	5052.	5201.	5356.	5490.	5647.	5795.
(PROPANE)											
PRICE	($/TON)	29.00	29.00	30.00	31.00	32.00	33.00	33.00	34.00	35.00	36.00
AMOUNT	(TONS/YR)	1832.	2141.	2494.	2500.	2500.	2500.	2500.	2500.	2500.	2500.
VALUE	(1000$/YR)	53.	62.	75.	78.	80.	83.	83.	85.	88.	90.
(PROPYLENE)											
PRICE	($/TON)	28.00	29.00	30.00	31.00	31.00	32.00	33.00	34.00	35.00	35.00
AMOUNT	(TONS/YR)	17158.	17057.	16762.	21675.	23000.	23000.	23000.	23000.	23000.	23000.
VALUE	(1000$/YR)	480.	495.	503.	672.	713.	736.	759.	782.	805.	805.
(C4 FRACT)											
PRICE	($/TON)	29.00	29.00	30.00	31.00	32.00	33.00	33.00	34.00	35.00	36.00
AMOUNT	(TONS/YR)	86394.	97889.	111683.	120516.	121000.	121000.	121000.	121000.	121000.	121000.
VALUE	(1000$/YR)	2505.	2839.	3350.	3736.	3872.	3993.	3993.	4114.	4235.	4356.
(HV.FUEL)											
PRICE	($/TON)	25.00	26.00	27.00	27.00	28.00	29.00	30.00	30.00	31.00	32.00
AMOUNT	(TONS/YR)	32130.	36405.	41535.	44820.	45000.	45000.	45000.	45000.	45000.	45000.
VALUE	(1000$/YR)	803.	947.	1121.	1210.	1260.	1305.	1350.	1350.	1395.	1440.
MAIN PRODUCT COST											
ANNUAL MAIN PRODUCT COST	(1000$/YR)	35522.	37961.	39995.	42093.	41315.	41352.	41742.	40991.	41173.	40230.
UNIT MAIN PRODUCT COST	($/TON)	164.74	155.38	143.48	139.94	136.80	136.93	138.22	135.73	136.33	133.21

PLANT LIFE (YEARS)		1	2	3	4	5	6	7	8	9	10
CALENDER YEAR (YEAR)		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SALES VALUE											
(ETHYLENE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	100.00	101.00	103.00	105.00	106.00	107.00	110.00	111.00	113.00	115.00
SALES AMOUNT	(TONS/YR)	215628.	244316.	278746.	300792.	302000.	302000.	302000.	302000.	302000.	302000.
SALES VALUE	(1000$/YR)	21563.	24676.	28711.	31583.	32012.	32314.	33220.	33522.	34126.	34730.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	21563.	24676.	28711.	31583.	32012.	32314.	33220.	33522.	34126.	34730.
(PROPYLEN)											
(1) DOMESTIC											
SALES PRICE	($/TON)	75.00	76.00	77.00	78.00	79.00	80.00	81.00	82.00	83.00	85.00
SALES AMOUNT	(TONS/YR)	50600.	59200.	69000.	69000.	69000.	69000.	69000.	69000.	69000.	69000.
SALES VALUE	(1000$/YR)	3795.	4499.	5313.	5382.	5451.	5520.	5589.	5658.	5727.	5865.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	3795.	4499.	5313.	5382.	5451.	5520.	5589.	5658.	5727.	5865.
(PROPYCNE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	55.00	56.00	57.00	58.00	59.00	60.00	61.00	62.00	63.00	65.00
SALES AMOUNT	(TONS/YR)	30015.	34500.	40500.	45000.	45000.	45000.	45000.	45000.	45000.	45000.
SALES VALUE	(1000$/YR)	1651.	1932.	2309.	2610.	2655.	2700.	2745.	2790.	2835.	2925.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	1651.	1932.	2309.	2610.	2655.	2700.	2745.	2790.	2835.	2925.
(CRACKGAS)											
(1) DOMESTIC											
SALES PRICE	($/TON)	40.00	40.00	41.00	41.00	42.00	42.00	43.00	44.00	44.00	45.00
SALES AMOUNT	(TONS/YR)	154938.	175553.	200291.	216132.	217000.	217000.	217000.	217000.	217000.	217000.
SALES VALUE	(1000$/YR)	6198.	7022.	8212.	8861.	9114.	9114.	9331.	9548.	9548.	9765.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

(3) TOTAL SALES VALUE	(10000$/YR)	6190.	7022.	8212.	8861.	9114.	9114.	9331.	9548.	9548.	9765.
(HYDROGEN)											
(1) DOMESTIC											
SALES PRICE	($/TON)	210.00	210.00	210.00	210.00	210.00	210.00	210.00	210.00	210.00	210.00
SALES AMOUNT	(TONS/YR)	7000.	7930.	9086.	9761.	9800.	9800.	9800.	9800.	9800.	9800.
SALES VALUE	(10000$/YR)	1526.	1730.	1965.	2120.	2136.	2136.	2136.	2136.	2136.	2136.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(10000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(10000$/YR)	1526.	1730.	1965.	2120.	2136.	2136.	2136.	2136.	2136.	2136.

([illegible] TAX HOLIDAY)

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 6.8%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
PRE. + CONST	78 -2	72500. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	79 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION	80 1	12593. *2	34732.	35522.	-790.	0.	-790.	6704.	5914.	0.93649	5539.	70515.
START-UP	81 2	0.	39060.	37961.	1099.	854.	[illegible]	6704.	7748.	0.87700	6795.	
	82 3	0.	40510.	39995.	6515.	2932.	[illegible]	6704.	10287.	0.82130	[illegible]	
	83 4	0.	50564.	42093.	8472.	3812.	[illegible]	6704.	11363.	0.76914	[illegible]	
	84 5	0.	51360.	41315.	[illegible]	[illegible]	[illegible]	6704.	12233.	0.72029	[illegible]	
	85 6	0.	51784.	41352.	10433.	[illegible]	5750.	6704.	12442.	0.67454	8392.	
	86 7	0.	53021.	41742.	11280.	5076.	[illegible]	6704.	12908.	0.63170	8154.	
	87 8	0.	53654.	40991.	12663.	5699.	[illegible]	6704.	13669.	0.59157	[illegible]	
	88 9	0.	54372.	41173.	13200.	5940.	[illegible]	6704.	13964.	0.55400	7736.	
	89 10	0. *3	55421.	40230.	15191.	6836.	8355.	6704.	15059.	0.51081	7683.	
		0. *4									70515.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 6.9 %

([illegible])

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = [illegible]	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
PRE. + CONST	78 -2	72500. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	79 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION	80 1	12500. *2	34732.	35522.	-790.	0.	-790.	6704.	5914.	0.91951	[illegible]	[illegible]
START-UP	81 2	0.	39060.	37961.	1099.	0.	1099.	6704.	[illegible]	0.84550	7273.	
	82 3	0.	40510.	39995.	6515.	0.	6515.	6704.	13219.	0.77744	10277.	
	83 4	0.	50564.	42093.	8472.	0.	8472.	6704.	15175.	0.71487	[illegible]	
	84 5	0.	51360.	41315.	[illegible]	0.	[illegible]	6704.	16757.	0.65733	[illegible]	
	85 6	0.	51784.	41352.	10433.	[illegible]	5738.	6704.	12442.	[illegible]	[illegible]	
	86 7	0.	53021.	41742.	11280.	5076.	[illegible]	6704.	12908.	0.55577	7174.	
	87 8	0.	53654.	40991.	12663.	5699.	[illegible]	6704.	13669.	0.51103	[illegible]	
	88 9	0.	54372.	41173.	13200.	5940.	7260.	6704.	13964.	[illegible]	6562.	
	89 10	0. *3	55421.	40230.	15191.	6836.	8355.	6704.	15059.	0.43200	6507.	
		0. *4									[illegible]	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 6.6 %

[illegible] UNIT	[illegible]	UNIT				
CAPACITY	12000.	TONS/YR				
PLANT LIFE	10	YEARS				
[illegible] CAPITAL						
TOTAL INVESTMENT COSTS	80.	%				
WORKING CAPITAL	100.	%				
TAX	[illegible]					
INCOME TAX RATE	46.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	0.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.90	%				
YEARS TO PAY	7.	YEARS				
[illegible]	[illegible]-PROD. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
[illegible]	[illegible]-PROD. ONLY					
SALVAGE VALUE PART.LIMITS,OFF-SITE,BUILDINGS	0.	%	33.	%	0.	%
INVESTMENT COSTS						
[illegible]	0.	[illegible]				
[illegible]	0.	[illegible]				
ENGINEERING AND CONSTRUCTION	12000.	[illegible]				
[illegible] INVESTMENT COSTS	12000.	[illegible]				
INTERESTS DURING CONSTRUCTION	0.	[illegible]				
CONTINGENCIES	0.	[illegible]				
[illegible]	0.	[illegible]				
START-UP EXPENSES	0.	[illegible]				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	[illegible]				
SPARE PARTS	0.	[illegible]				
BATTERY LIMITS	12000.	[illegible]				
OFF-SITE	[illegible]	[illegible]				
BUILDINGS	0.	[illegible]				
DEPRECIABLE INVESTMENT COSTS	[illegible]	[illegible]				
LAND	0.	[illegible]				
TOTAL INVESTMENT COSTS	[illegible]	[illegible]				
WORKING CAPITAL	[illegible]	[illegible]				

[illegible]	(YEARS)	1	2	3	4	5	6	7	8	9	10
[illegible]	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
[illegible]	(-)	0.72	[illegible]	[illegible]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
[illegible]	(TONS/YR)	[illegible]	[illegible]	[illegible]	120000.	120000.	12000C.	120000.	12000C.	120000.	120000.
[illegible]											
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	6871.	6761.	6825.	6898.	7003.	7147.	7276.	7405.
[illegible]	[illegible]	[illegible]	5250.	6077.	6320.	6320.	6415.	6415.	6415.	6504.	6504.
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	773.	773.	773.	773.	773.	773.	773.
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	130.	130.	130.	130.	130.	154.	154.	154.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	303.	305.	305.	350.	360.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1030.	1030.	1030.	1030.	1030.	1030.	1030.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	112.	122.	122.	120.	120.	133.	133.	130.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]											
	[illegible]	[illegible]	[illegible]	130.	130.	130.	130.	130.	130.	130.	130.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]											
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	270.	130.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]											
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DISCOUNTED CASH FLOW CALCULATION RESULTS ([illegible])

	END OF YEAR		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 22.38		
[illegible]	79	-2	10000.	01	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	80	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	2000.	02	16567.	15544.	3003.	1351.	1652.	1020.	3672.	0.81746	2090.	10527.
	81	2	0.		21392.	17322.	4010.	1605.	2200.	1020.	4020.	0.66825	2690.	
	82	3	0.		25131.	19216.	5082.	2047.	3235.	1020.	5055.	0.54627	2761.	
	83	4	0.		26606.	19057.	6567.	2946.	3681.	1020.	5421.	0.44655	2421.	
	84	5	0.		26662.	1979[illegible].	[illegible]	[illegible]	3776.	1020.	5596.	0.36504	[illegible]	
	85	5	0.		27046.	19817.	7236.	3256.	3977.	1020.	5797.	0.29861	17[illegible].	
	86	7	0.		27046.	19884.	7166.	3626.	3980.	1020.	5760.	0.24394	1405.	
	87	8	0.		27046.	19843.	7205.	3242.	3968.	1020.	5703.	0.19964	1139.	
	88	9	0.		27040.	18335.	8713.	3921.	4792.	220.	5012.	0.16301	817.	
	89	10	0.	03	27040.	18331.	8717.	3923.	4794.	220.	5014.	0.13326	668.	
			0.	04									10527.	

01) INVESTMENT COSTS
02) WORKING CAPITAL
03) SALVAGE VALUE
04) LAND

RATE OF RETURN ON INVESTMENT 22.3 %

PROCESS UNIT	PWC	UNIT				
CAPACITY	110000.	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	80.	$				
WORKING CAPITAL	100.	$				
TAX	UNIFORM					
INCOME TAX RATE	45.	$				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	8.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	$				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	$				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	$	33.	$	0.	$
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	12700.	1000$				
PROCESS INVESTMENT COSTS	12700.	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSYS	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	12700.	1000$				
OFF-SITE	3000.	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	16500.	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	16500.	1000$				
WORKING CAPITAL	2900.	1000$				

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.68	0.80	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	75020.	88000.	10505C.	110000.	110000.	110C00.	110000.	110000.	110000.	110000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
VCM	(1000$/YR)	15523.	18224.	22031.	23234.	23460.	23800.	23800.	23800.	23800.	23800.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	248.	290.	347.	363.	363.	363.	363.	363.	363.	363.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	253.	296.	390.	416.	416.	416.	416.	462.	462.	462.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	99.	115.	130.	144.	144.	144.	144.	144.	144.	144.
PROCESS WATER)	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	14.	16.	19.	20.	20.	20.	20.	20.	20.	20.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	282.	346.	414.	453.	453.	474.	474.	494.	494.	515.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	162.	162.	162.	162.	162.	162.	162.	162.	162.	162.
(5) RUNNING ROYALTIES	(1000$/YR)	744.	882.	1088.	1150.	1167.	1171.	1171.	1171.	1171.	1171.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	17325.	20331.	24577.	25941.	26105.	26549.	26549.	26616.	26616.	26637.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	1598.	1500.	1500.	1500.	1500.	1500.	1500.	1500.	0.	0.
OFF-SITE	(1000$/YR)	253.	253.	253.	253.	253.	253.	253.	253.	253.	253.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	990.	990.	990.	990.	849.	707.	566.	424.	283.	141.
INT. ON WORKING CAPITAL	(1000$/YR)	348.	232.	116.	0.	0.	C.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	495.	495.	495.	495.	495.	495.	495.	495.	495.	495.
(4) TAXES AND INSURANCE	(1000$/YR)	165.	165.	165.	165.	165.	165.	165.	165.	165.	165.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	3839.	3723.	3607.	3491.	3350.	3208.	3067.	2925.	1196.	1055.
PLANT-OVERHEAD COSTS	(1000$/YR)	825.	825.	825.	825.	825.	825.	825.	825.	825.	825.
FACTORY COSTS	(1000$/YR)	21989.	24879.	29009.	30257.	30359.	30582.	30441.	30366.	28637.	28516.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	21989.	24879.	29009.	30257.	30359.	30582.	30441.	30366.	28637.	28516.
UNIT PRODUCT COST	($/TON)	293.11	282.71	276.15	275.06	275.99	278.02	276.73	276.06	260.34	259.24

PLANT LIFE / CALENDER YEAR	(YEARS) / (YEAR)	1 / 1980	2 / 1981	3 / 1982	4 / 1983	5 / 1984	6 / 1985	7 / 1986	8 / 1987	9 / 1988	10 / 1989
SALES VALUE											
(PVC)											
(1) DOMESTIC											
SALES PRICE	($/TON)	340.00	343.00	346.00	349.00	353.00	355.00	355.00	355.00	355.00	355.00
SALES AMOUNT	(TONS/YR)	65000.	78000.	95000.	110000.	110000.	110000.	110000.	110000.	110000.	110000.
SALES VALUE	(1000$/YR)	22100.	26754.	32870.	38390.	38830.	3905C.	39050.	39050.	39050.	39050.
(2) EXPORT											
SALES PRICE	($/TON)	27C.00	273.00	276.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	10000.	10000.	10000.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	2700.	2730.	2760.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	24800.	29484.	35630.	38390.	38830.	3905C.	39050.	39050.	39050.	39050.

DISCOUNTED CASH FLOW CALCULATION RESULTS

([illegible] TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 24.4%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	78	-2	16500. *1	0.	0.	0.	0.	0.	0.	0.	C.C	0.	0.
	79	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION	80	1	2900. *2	24800.	21989.	2811.	1265.	1546.	1841.	3387.	0.80391	2723.	19073.
START-UP	81	2	0.	29484.	24879.	4605.	2072.	2533.	1841.	4374.	0.64627	2827.	
	82	3	0.	35630.	29009.	6621.	2979.	3641.	1841.	5482.	0.51954	2848.	
	83	4	0.	38390.	30257.	8133.	3660.	4473.	1841.	6314.	0.41766	2637.	
	84	5	0.	38830.	30359.	8471.	3812.	4659.	1841.	6500.	0.33576	2182.	
	85	6	0.	39050.	30582.	8468.	3810.	4657.	1841.	6498.	0.26992	1754.	
	86	7	0.	39050.	30441.	8609.	3874.	4735.	1841.	6576.	0.21699	1427.	
	87	8	0.	39050.	30366.	8684.	3908.	4776.	1841.	6617.	0.17444	1154.	
	88	9	0.	39050.	28637.	10413.	4686.	5727.	253.	5980.	0.14023	839.	
	89	10	0. *3	39050.	28516.	10534.	4740.	5793.	253.	6047.	0.11274	682.	
			0. *4									19073.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 24.4 %

PROCESS UNIT	LDPE	UNIT				
CAPACITY	160000.	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	80.	%				
WORKING CAPITAL	100.	%				
TAX	UNIFORM					
INCOME TAX RATE	45.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	10.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	33.	%	0.	%
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	50000.	1000$				
PROCESS INVESTMENT COSTS	50000.	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSYS	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	50000.	1000$				
OFF-SITE	15200.	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	66000.	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	66000.	1000$				
WORKING CAPITAL	11600.	1000$				

		1	2	3	4	5	6	7	8	9	10
YEARS OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.69	0.79	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	111040.	127040.	146080.	160000.	160000.	160000.	160000.	160000.	160000.	160000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	11708.	13522.	15834.	17638.	17806.	17974.	18478.	18646.	18982.	19318.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	1889.	2160.	2481.	2711.	2711.	2711.	2711.	2711.	2711.	2711.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	1784.	2040.	2635.	2880.	2880.	2880.	2880.	3200.	3200.	3200.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	290.	331.	381.	416.	416.	416.	416.	416.	416.	416.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	331.	398.	457.	523.	523.	546.	546.	570.	570.	594.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	497.	497.	497.	497.	497.	497.	497.	497.	497.	497.
(5) RUNNING ROYALTIES	(1000$/YR)	1150.	1331.	1553.	1747.	1792.	1800.	1800.	1800.	1800.	1800.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	17649.	20279.	23838.	26411.	26624.	26824.	27328.	27840.	28176.	28535.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.
OFF-SITE	(1000$/YR)	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	3960.	3960.	3960.	3960.	3394.	2829.	2263.	1697.	1131.	566.
INT. ON WORKING CAPITAL	(1000$/YR)	1392.	928.	464.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	1980.	1980.	1980.	1980.	1980.	1980.	1980.	1980.	1980.	1980.
(4) TAXES AND INSURANCE	(1000$/YR)	660.	660.	660.	660.	660.	660.	660.	660.	660.	660.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	14086.	13622.	13158.	12694.	12128.	11562.	10997.	10431.	9865.	9300.
PLANT-OVERHEAD COSTS	(1000$/YR)	3300.	3300.	3300.	3300.	3300.	3300.	3300.	3300.	3300.	3300.
FACTORY COSTS	(1000$/YR)	35035.	37201.	40295.	42405.	42052.	41686.	41625.	41571.	41341.	41135.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	35035.	37201.	40295.	42405.	42052.	41686.	41625.	41571.	41341.	41135.
UNIT PRODUCT COST	($/TON)	315.52	292.83	275.84	265.03	262.83	260.54	260.15	259.82	258.38	257.09

SALES VALUE

(LDPE)

		1	2	3	4	5	6	7	8	9	10
PLANT LIFE	(YEARS)										
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
(1) DOMESTIC											
SALES PRICE	($/TON)	360.00	363.00	366.00	370.00	373.00	375.00	375.00	375.00	375.00	375.00
SALES AMOUNT	(TONS/YR)	90000.	106000.	125000.	148000.	160000.	160000.	160000.	160000.	160000.	160000.
SALES VALUE	(1000$/YR)	32400.	38478.	45750.	54760.	59680.	60000.	60000.	60000.	60000.	60000.
(2) EXPORT											
SALES PRICE	($/TON)	280.00	283.00	286.00	290.00	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	21000.	21000.	21000.	12000.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	5880.	5943.	6006.	3480.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	36280.	44421.	51756.	58240.	59680.	60000.	60000.	60000.	60000.	60000.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
											R = 12.4%		
ENG. + CONST	78	-2	66000. *1	0.	0.	0.	0.	0.	0.				
	79	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	11600. *2	38280.	35035.	3245.	1460.	1785.	6094.	0.	0.0	0.	0.
	81	2	0.	44421.	37201.	7220.	3249.	3971.	6094.	7878.	0.88936	7007.	74009.
	82	3	0.	51756.	40295.	11461.	5157.	6303.	6094.	10065.	0.79096	7961.	
	83	4	0.	58240.	42405.	15835.	7126.	8709.	6094.	12397.	0.70345	8721.	
	84	5	0.	59680.	42052.	17628.	7932.	9695.	6094.	14803.	0.62562	9261.	
	85	6	0.	60000.	41686.	18314.	8241.	10072.	6094.	15789.	0.55640	8785.	
	86	7	0.	60000.	41625.	18375.	8269.	10106.	6094.	16166.	0.49484	8000.	
	87	8	0.	60000.	41571.	18429.	8293.	10136.	6094.	16200.	0.44010	7130.	
	88	9	0.	60000.	41341.	18659.	8397.	10263.	6094.	16230.	0.39140	6352.	
	89	10	0. *3	60000.	41135.	18865.	8489.	10376.	6094.	16355.	0.34810	5694.	
			0. *4							16470.	0.30959	5099.	
												74009.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 12.4 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
											R = 16.9%		
ENG. + CONST	78	-2	66000. *1	0.	0.	0.	0.	0.	0.				
	79	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	11600. *2	38280.	35035.	3245.	0.	3245.	6094.	0.	0.0	0.	0.
	81	2	0.	44421.	37201.	7220.	0.	7220.	6094.	9339.	0.85532	7987.	75169.
	82	3	0.	51756.	40295.	11461.	0.	11461.	6094.	13314.	0.73157	9740.	
	83	4	0.	58240.	42405.	15835.	0.	15835.	6094.	17554.	0.62573	10984.	
	84	5	0.	59680.	42052.	17628.	0.	17628.	6094.	21929.	0.53520	11736.	
	85	6	0.	60000.	41686.	18314.	8241.	10072.	6094.	23721.	0.45777	10859.	
	86	7	0.	60000.	41625.	18375.	8269.	10106.	6094.	16166.	0.39154	6330.	
	87	8	0.	60000.	41571.	18429.	8293.	10136.	6094.	16200.	0.33489	5425.	
	88	9	0.	60000.	41341.	18659.	8397.	10263.	6094.	16230.	0.28644	4649.	
	89	10	0. *3	60000.	41135.	18865.	8489.	10376.	6094.	16356.	0.24500	4007.	
			0. *4							16470.	0.20955	3451.	
												75169.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 16.9 %

PROCESS UNIT	HDPE	UNIT
CAPACITY	35000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
TAX		
INCOME TAX RATE	UNIFORM 45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0. %	
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	11100.	1000$
PROCESS INVESTMENT COSTS	11100.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSYS	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	11100.	1000$
OFF-SITE	3300.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	14400.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	14400.	1000$
WORKING CAPITAL	2900.	1000$

YEARS OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.80	0.86	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	28000.	29995.	31990.	33985.	35000.	35000.	35000.	35000.	35000.	35000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	2915.	3156.	3434.	3721.	3862.	3898.	4008.	4044.	4117.	4190.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	420.	450.	480.	511.	525.	525.	525.	525.	525.	525.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	164.	176.	211.	225.	231.	231.	231.	257.	257.	257.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	69.	74.	79.	84.	86.	86.	86.	86.	86.	86.
PROCESS WATER)	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	139.	157.	167.	186.	192.	200.	200.	209.	209.	210.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	153.	153.	153.	153.	153.	153.	153.	153.	153.	153.
(5) RUNNING ROYALTIES	(1000$/YR)	290.	321.	349.	374.	382.	401.	404.	408.	410.	410.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	4150.	4487.	4875.	5254.	5481.	5495.	5607.	5682.	5757.	[illegible]
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	1110.	1110.	1110.	1110.	1110.	1110.	1110.	1110.	1110.	1110.
OFF-SITE	(1000$/YR)	220.	220.	220.	220.	220.	220.	220.	220.	220.	220.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	864.	864.	864.	864.	741.	617.	494.	370.	247.	123.
INT. ON WORKING CAPITAL	(1000$/YR)	300.	200.	100.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	432.	432.	432.	432.	432.	432.	432.	432.	432.	432.
(4) TAXES AND INSURANCE	(1000$/YR)	144.	144.	144.	144.	144.	144.	144.	144.	144.	144.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	3070.	2970.	2870.	2770.	2647.	2523.	2400.	2276.	2153.	2030.
PLANT-OVERHEAD COSTS	(1000$/YR)	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.
FACTORY COSTS	(1000$/YR)	7947.	8177.	[illegible]	[illegible]	[illegible]	8738.	8727.	[illegible]	8630.	[illegible]
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	7947.	8177.	[illegible]	[illegible]	[illegible]	8738.	8727.	[illegible]	8630.	[illegible]
UNIT PRODUCT COST	($/TON)	283.80	272.61	[illegible]	[illegible]	[illegible]	249.67	249.35	247.96	246.57	245.37

PLANT LIFE CALENDAR YEAR	(YEARS) (YEAR)	1 1980	2 1981	3 1982	4 1983	5 1984	6 1985	7 1986	8 1987	9 1988	10 1989
SALES PLAN											
([illegible])											
(1) DOMESTIC											
SALES PRICE	($/TON)	370.00	370.00	370.00	381.30	[illegible]	396.00	[illegible]	[illegible]	[illegible]	[illegible]
SALES AMOUNT	(TONS/YEAR)	[illegible]	22000.	24000.	26000.	28000.	30000.	32000.	34000.	[illegible]	[illegible]
SALES VALUE	(1000$/YEAR)	[illegible]	8220.	8872.	[illegible]	10700.	11700.	12400.	[illegible]	[illegible]	[illegible]
(2) EXPORT											
SALES PRICE	($/TON)	[illegible]	300.00	310.00	321.00	325.00	330.00	330.00	330.00	0.0	0.0
SALES AMOUNT	(TONS/YEAR)	[illegible]	[illegible]	[illegible]	9000.	7000.	5000.	3000.	1000.	0.	0.
SALES VALUE	(1000$/YEAR)	[illegible]	[illegible]	2900.	2900.	2275.	1650.	990.	330.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YEAR)	[illegible]	12740.	[illegible]	[illegible]	[illegible]	13350.	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

		1	2	3	4	5	6	7	8	9	10
YEARS OF OPERATION	(YEARS)										
CALENDAR YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.71	0.81	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	10053.	12297.	14030.	15130.	15200.	15200.	15200.	15200.	15200.	15200.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	1303.	1409.	1734.	1907.	1934.	1949.	2004.	2022.	2050.	2095.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	22.	25.	28.	30.	30.	30.	30.	30.	36.	30.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	130.	154.	190.	213.	214.	214.	214.	230.	230.	230.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	106.	120.	137.	140.	140.	140.	140.	140.	140.	140.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	170.	202.	231.	261.	264.	273.	273.	285.	285.	297.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	72.	72.	72.	72.	72.	72.	72.	72.	72.	72.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	1809.	2001.	2400.	2031.	2057.	2007.	[illegible]	[illegible]	[illegible]	[illegible]
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	400.	400.	400.	400.	400.	400.	400.	400.	400.	400.
OFF-SITE	(1000$/YR)	73.	73.	73.	73.	73.	73.	73.	73.	73.	73.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	306.	306.	306.	306.	262.	219.	175.	131.	87.	44.
INT. ON WORKING CAPITAL	(1000$/YR)	96.	64.	32.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	153.	153.	153.	153.	153.	153.	153.	153.	153.	153.
(4) TAXES AND INSURANCE	(1000$/YR)	51.	51.	51.	51.	51.	51.	51.	51.	51.	51.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	1079.	1047.	1015.	983.	940.	896.	852.	809.	765.	721.
PLANT-OVERHEAD COSTS	(1000$/YR)	255.	255.	255.	255.	255.	255.	255.	255.	255.	255.
FACTORY COSTS	(1000$/YR)	3143.	3304.	3670.	3070.	3052.	3030.	3049.	3059.	3052.	3057.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	3143.	3304.	3670.	3070.	3052.	3030.	3049.	3059.	3052.	3057.
UNIT PRODUCT COST	($/TON)	289.61	273.53	261.61	255.01	253.42	252.52	253.24	253.91	253.43	253.75

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
BY-PRODUCTS CREDITS											
(DI-EG)											
PRICE	($/TON)	14.00	14.00	14.00	15.00	16.00	16.00	16.00	17.00	17.00	17.00
AMOUNT	(TONS/YR)	1845.	2090.	2305.	2574.	2584.	2584.	2584.	2584.	2584.	2584.
VALUE	(1000$/YR)	26.	29.	33.	39.	41.	41.	41.	44.	44.	44.
MAIN PRODUCT COST											
ANNUAL MAIN PRODUCT COST	(1000$/YR)	3117.	3334.	3637.	3031.	3011.	3797.	3000.	3015.	3000.	3013.
UNIT MAIN PRODUCT COST	($/TON)	207.23	271.15	259.23	253.06	250.70	249.00	250.52	251.02	250.54	250.84

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SALES VALUE											
(86)											
(1) DOMESTIC											
SALES PRICE	($/TON)	270.00	272.00	274.00	276.00	278.00	280.00	280.00	280.00	280.00	280.00
SALES AMOUNT	(TONS/YR)	10053.	12297.	14030.	15130.	15200.	15200.	15200.	15200.	15200.	15200.
SALES VALUE	(1000$/YR)	2930.	3345.	3844.	4170.	4226.	4256.	4256.	4256.	4256.	4256.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	2930.	3345.	3844.	4170.	4226.	4256.	4256.	4256.	4256.	4256.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NO TAX HOLIDAY)

	END OF YEAR 1980		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 3.0%		
ENG. + CONST	78	-2	5100.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	79	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	800.	*2	2930.	3117.	-187.	0.	-187.	473.	286.	0.97084	278.	5305.
	81	2	0.		3345.	3334.	10.	5.	6.	473.	479.	0.94253	452.	
	82	3	0.		3844.	3637.	207.	93.	114.	473.	587.	0.91504	537.	
	83	4	0.		4178.	3831.	347.	156.	191.	473.	664.	0.88836	590.	
	84	5	0.		4226.	3811.	415.	187.	228.	473.	702.	0.86245	605.	
	85	6	0.		4256.	3797.	459.	207.	252.	473.	726.	0.83730	608.	
	86	7	0.		4256.	3808.	448.	202.	246.	473.	720.	0.81288	585.	
	87	8	0.		4256.	3815.	441.	198.	242.	473.	716.	0.78918	565.	
	88	9	0.		4256.	3808.	448.	202.	246.	473.	720.	0.76617	551.	
	89	10	0.	*3	4256.	3813.	443.	199.	244.	473.	717.	0.74382	533.	
			0.	*4									5305.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 3.0 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

	END OF YEAR 1980		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 4.1%		
ENG. + CONST	78	-2	5100.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	79	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	800.	*2	2930.	3117.	-187.	0.	-187.	473.	286.	0.96063	275.	5365.
	81	2	0.		3345.	3334.	10.	0.	10.	473.	484.	0.92281	447.	
	82	3	0.		3844.	3637.	207.	0.	207.	473.	681.	0.88648	603.	
	83	4	0.		4178.	3831.	347.	0.	347.	473.	821.	0.85158	699.	
	84	5	0.		4226.	3811.	415.	0.	415.	473.	888.	0.81805	727.	
	85	6	0.		4256.	3797.	459.	207.	252.	473.	726.	0.78585	570.	
	86	7	0.		4256.	3808.	448.	202.	246.	473.	720.	0.75491	543.	
	87	8	0.		4256.	3815.	441.	198.	242.	473.	716.	0.72519	519.	
	88	9	0.		4256.	3808.	448.	202.	246.	473.	720.	0.69664	501.	
	89	10	0.	*3	4256.	3813.	443.	199.	244.	473.	717.	0.66921	480.	
			0.	*4									5365.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 4.1 %

PROCESS UNIT	SNVPS	UNIT				
CAPACITY	50000.	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	80.	%				
WORKING CAPITAL	100.	%				
TAX	UNIFORM					
INCOME TAX RATE	45.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	10.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRINC. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRINC. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	33.	%	0.	%
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	15700.	1000$				
PROCESS INVESTMENT COSTS	15700.	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSES	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	15700.	1000$				
OFF-SITE	4500.	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	20200.	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	20200.	1000$				
WORKING CAPITAL	[illegible]	1000$				

		1	2	3	4	5	6	7	8	9	10
YEARS OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	35000.	40000.	45000.	50000.	50000.	50000.	50000.	50000.	50000.	50000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	1046.	1209.	1380.	1572.	1587.	1602.	1647.	1662.	1691.	1721.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	772.	882.	992.	1103.	1103.	1103.	1103.	1103.	1103.	1103.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	[illegible]	113.	143.	159.	159.	159.	159.	177.	177.	177.
FUEL	(1000$/YR)	245.	291.	327.	377.	390.	390.	404.	417.	431.	431.
COOLING WATER	(1000$/YR)	43.	49.	56.	62.	62.	62.	62.	62.	62.	62.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible] STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible] STEAM	(1000$/YR)	480.	559.	629.	732.	732.	765.	765.	798.	798.	832.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	303.	303.	303.	303.	303.	303.	303.	303.	303.	303.
(5) RUNNING MAINTENANCE [illegible]	(1000$/YR)	347.	402.	456.	521.	539.	540.	540.	540.	540.	540.
TOTAL DIRECT PRODUCTION COST	(1000$/YR)	3322.	3864.	4295.	4827.	4874.	4923.	4981.	5061.	5104.	5167.
FIXED COSTS											
(1) DEPRECIATION											
DEPREC. PLANT	(1000$/YR)	1570.	1570.	1570.	1570.	1570.	1570.	1570.	1570.	1570.	1570.
OFF-SITE	(1000$/YR)	300.	300.	300.	300.	300.	300.	300.	300.	300.	300.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL FIXED COST	(1000$/YR)	1212.	1212.	1212.	1212.	1039.	866.	693.	519.	346.	173.
INT. ON WORKING CAPITAL	(1000$/YR)	432.	288.	144.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIR	(1000$/YR)	606.	606.	606.	606.	606.	606.	606.	606.	606.	606.
(4) TAXES AND INSURANCE	(1000$/YR)	202.	202.	202.	202.	202.	202.	202.	202.	202.	202.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COST	(1000$/YR)	[illegible]	4178.	4034.	3890.	3717.	3544.	3371.	3198.	3024.	2851.
PLANT OVERHEAD	(1000$/YR)	1010.	1010.	1010.	1010.	1010.	1010.	1010.	1010.	1010.	1010.
PRODUCTION COSTS	(1000$/YR)	[illegible]	[illegible]	9339.	9727.	9601.	9477.	9362.	9269.	9139.	9029.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND MARKETING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL PRODUCT COST	(1000$/YR)	[illegible]	[illegible]	9339.	9727.	9601.	9477.	9362.	9269.	9139.	9029.
UNIT PRODUCT COST	($/TON)	267.20	[illegible]	207.54	194.55	192.01	189.54	187.24	185.37	182.77	180.57

[illegible]	[illegible]	1	2	3	4	5	6	7	8	9	10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	INCOME BEFORE TAX	TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 19.00	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
[illegible]	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible]	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible]	[illegible]	1808.	[illegible]	1070.	[illegible]	0.84001	2909.	23170.
[illegible]	[illegible]	1975.	[illegible]	1070.	4204.	0.70562	3021.	
[illegible]	[illegible]	2091.	[illegible]	1070.	5110.	0.59273	3029.	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	6030.	0.49790	3002.	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	[illegible]	0.41824	2703.	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	6950.	0.35133	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	6621.	0.29512	1954.	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	6673.	0.24790	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	6700.	0.20824	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	1070.	[illegible]	0.17492	1190.	
							23870.	

[illegible]

[illegible]

[illegible] UNIT	[illegible]		UNIT			
CAPACITY		[illegible].	TONS/YR			
PLANT LIFE		10	YEARS			
[illegible] CAPITAL						
TOTAL INVESTMENT COSTS		[illegible].	%			
WORKING CAPITAL		[illegible].	%			
TAX		UNIFORM				
INCOME TAX RATE		46.	%			
DEPRECIATION		STRAIGHT LINE METHOD				
YEARS TO DEPRECIATE		10.	YEARS			
[illegible]						
INTEREST RATE ON TOTAL INVESTMENT COSTS		7.50	%			
YEARS TO PAY		7.	YEARS			
SCHEME		UNIFORM-PRIN. ONLY				
INTEREST RATE ON WORKING CAPITAL		12.00	%			
YEARS TO PAY		3.	YEARS			
SCHEME		UNIFORM-PRIN. ONLY				
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING		0.	%	33.	%	0. %
INVESTMENT COSTS						
[illegible]		0.	1000$			
[illegible]		0.	1000$			
ENGINEERING AND CONSTRUCTION		24[illegible].	1000$			
PROCESS INVESTMENT COSTS		24[illegible].	1000$			
INTERESTS DURING CONSTRUCTION		0.	1000$			
CONTINGENCIES		0.	1000$			
ROYALTIES		0.	1000$			
START-UP EXPENSES		0.	1000$			
INITIAL CHARGES OF CATALYSTS AND CHEMICALS		0.	1000$			
SPARE PARTS		0.	1000$			
BATTERY LIMITS		24[illegible].	1000$			
OFF-SITE		7[illegible].	1000$			
BUILDING		0.	1000$			
DEPRECIABLE INVESTMENT COSTS		31300.	1000$			
LAND		0.	1000$			
TOTAL INVESTMENT COSTS		31300.	1000$			
WORKING CAPITAL		5500.?	1000$			

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
STREAM FACTOR	(-)	0.73	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	43980.	51480.	60000.	60000.	60000.	60000.	60000.	60000.	60000.	60000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
PROPYLEN	(1000$/YR)	3794.	4512.	5312.	5381.	5450.	5519.	5588.	5657.	5726.	5864.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	1201.	1409.	1637.	1637.	1637.	1637.	1637.	1637.	1637.	1637.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	211.	248.	324.	324.	324.	324.	324.	360.	360.	360.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	132.	155.	180.	180.	180.	180.	180.	180.	180.	180.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	267.	329.	383.	401.	401.	419.	419.	437.	437.	455.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
(5) RUNNING ROYALTIES	(1000$/YR)	493.	631.	680.	704.	712.	720.	720.	720.	720.	720.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	6248.	7434.	8666.	8777.	8854.	8949.	9018.	9141.	9210.	9366.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	2410.	2410.	2410.	2410.	2410.	2410.	2410.	2410.	2410.	2410.
OFF-SITE	(1000$/YR)	480.	480.	480.	480.	480.	480.	480.	480.	480.	480.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	1878.	1878.	1878.	1878.	1610.	1341.	1073.	805.	537.	268.
INT. ON WORKING CAPITAL	(1000$/YR)	660.	440.	220.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.
(4) TAXES AND INSURANCE	(1000$/YR)	313.	313.	313.	313.	313.	313.	313.	313.	313.	313.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	6680.	6460.	6240.	6020.	5752.	5484.	5215.	4947.	4679.	4411.
PLANT-OVERHEAD COSTS	(1000$/YR)	1565.	1565.	1565.	1565.	1565.	1565.	1565.	1565.	1565.	1565.
FACTORY COSTS	(1000$/YR)	14493.	15459.	16471.	16362.	16171.	15998.	15798.	15653.	15454.	15342.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	14493.	15459.	16471.	16362.	16171.	15998.	15798.	15653.	15454.	15342.
UNIT PRODUCT COST	($/TON)	329.54	300.30	274.51	272.70	269.51	266.63	263.31	260.89	257.57	255.70

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989

SALES VALUE

(PP)

(1) DOMESTIC											
SALES PRICE	($/TON)	380.00	384.00	378.00	391.00	395.00	400.00	400.00	400.00	400.00	400.00
SALES AMOUNT	(TONS/YR)	40000.	51560.	60000.	60000.	60000.	60000.	60000.	60000.	60000.	60000.
SALES VALUE	(1000$/YR)	15200.	19776.	22680.	23460.	23700.	24000.	24000.	24000.	24000.	24000.
(2) EXPORT											
SALES PRICE	($/TON)	310.00	314.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	4000.	4000.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	1240.	1256.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	16440.	21032.	22680.	23460.	23700.	24000.	24000.	24000.	24000.	24000.

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 19OO		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE 12.0	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
CONSTR.	78	-2	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	79	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	80	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	81	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	82	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	83	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	84	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	85	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	86	7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	87	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	88	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	89	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
			[illegible]									[illegible]	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT [illegible]

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
CONSTR.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OPERATION START-UP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

RATE OF RETURN ON INVESTMENT [illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

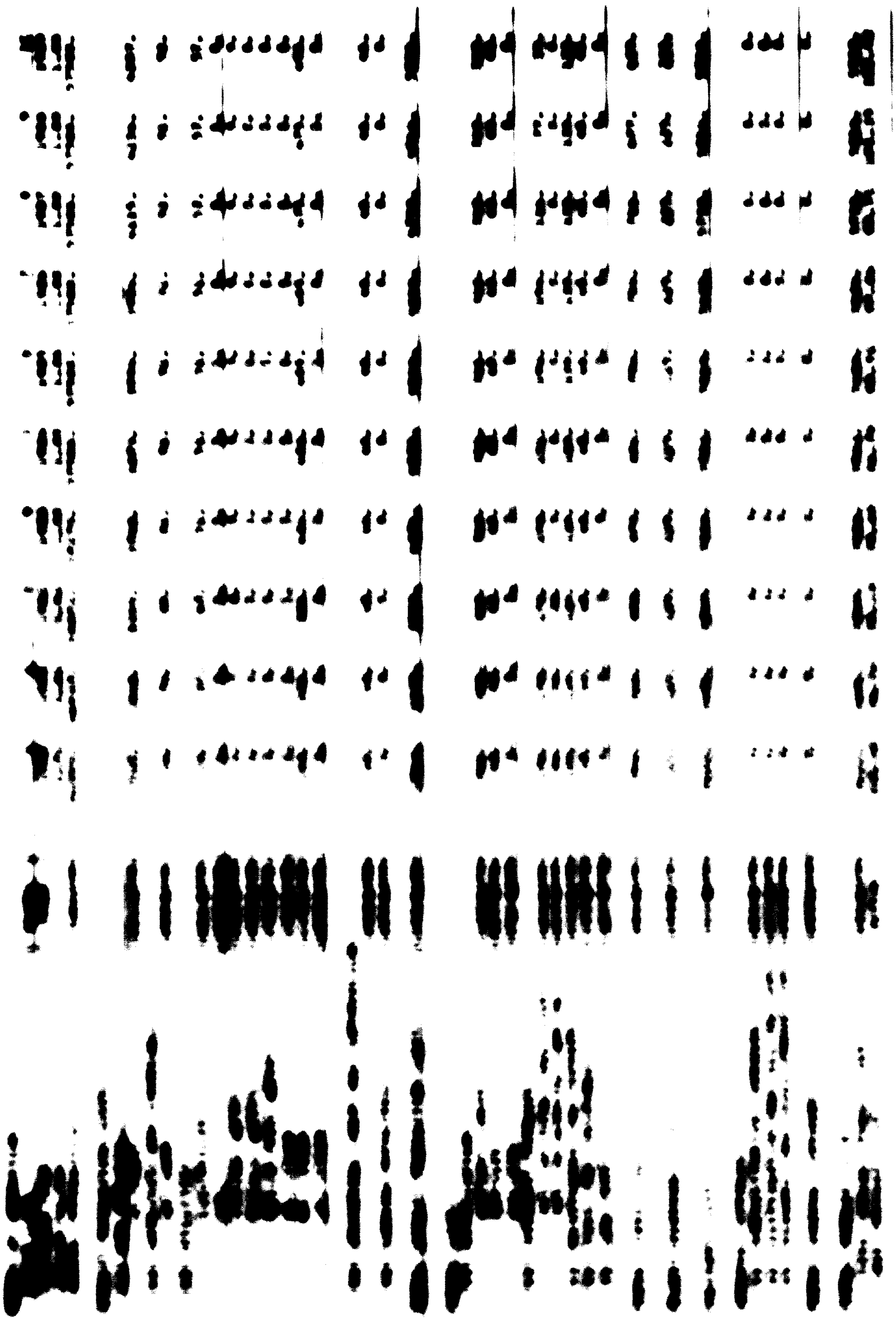
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]



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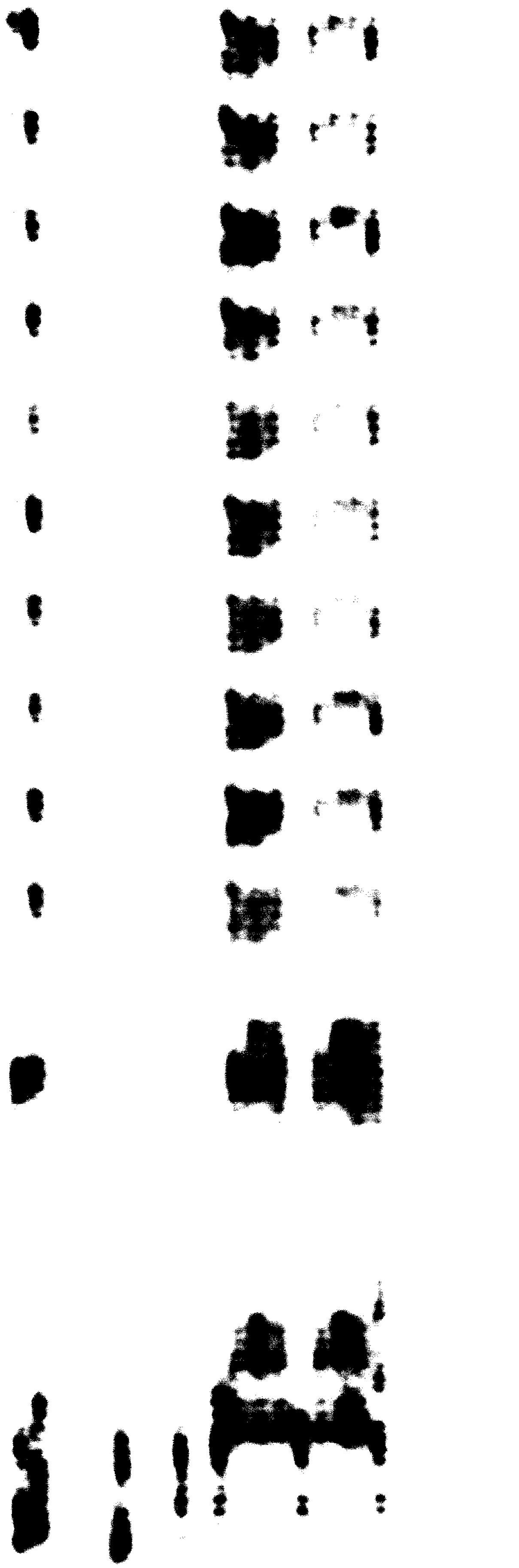
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	981.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	295.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115.	115.	115.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.	0.	0.	0.	3.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	3.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	407.	207.	[illegible]	207.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	3.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	191.	[illegible]	191.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2270.	2140.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 197.90	[illegible]	[illegible] 197.07	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]



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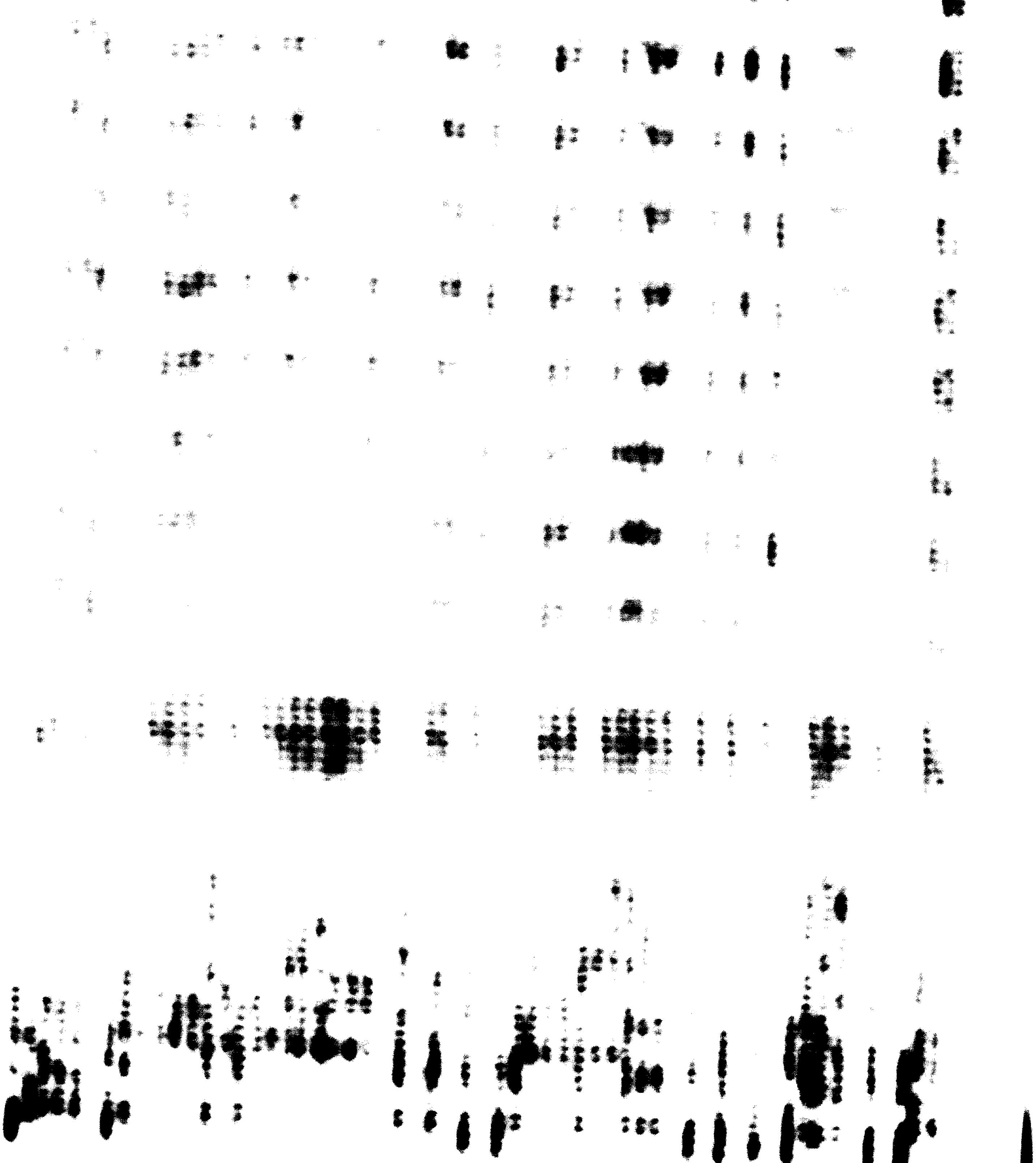

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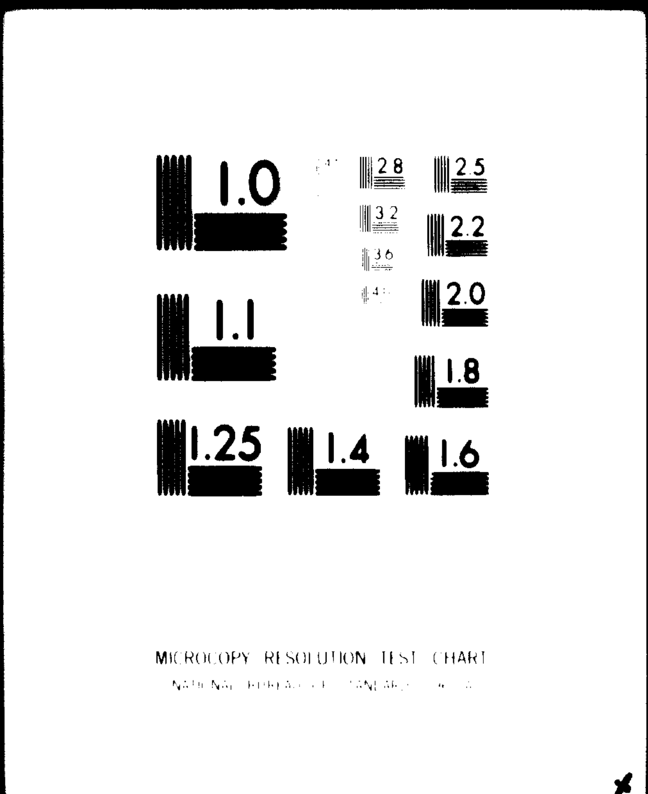

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MICROCOPY RESOLUTION TEST CHART

24x

E

DISCOUNTED CASH FLOW CALCULATION RESULTS TOTAL (NON TAX HOLIDAY)

END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE P = 11.28	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
78	-2	399890.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
79	-1	0. 0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
80	1	0. 60910.	*2	219866.	202579.	12487.	7895.	4592.	34272.	38864.	0.89939	34954.	394864.
81	2	0. 0.		299450.	217125.	39333.	15163.	10170.	34272.	52442.	0.80891	42421.	
82	3	0. 0.		299422.	235156.	55265.	24860.	30396.	34272.	64660.	0.72753	47040.	
83	4	0. 0.		317085.	245250.	71827.	32322.	39505.	34272.	73777.	0.65433	48275.	
84	5	0. 0.		323826.	243505.	79522.	35785.	43737.	34272.	78009.	0.58850	45909.	
85	6	0. 0.		326274.	242646.	83627.	37632.	45995.	34272.	80267.	0.52930	42485.	
86	7	0. 0.		327878.	242864.	85013.	38616.	47198.	34272.	81469.	0.47605	38783.	
87	8	0. 0.		329842.	240[illegible].	[illegible].	39613.	48615.	34272.	82887.	0.42815	35403.	
88	9	0. 0.		329870.	232729.	97141.	43713.	53428.	27235.	80662.	0.38500	31061.	
89	10	0. 0.	*3	331167.	230917.	100250.	45112.	55137.	27235.	82372.	0.34634	28528.	
		0.	*4									396867.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 11.2 %

DISCOUNTED CASH FLOW CALCULATION RESULTS TOTAL (TAX HOLIDAY)

END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
									P = 13.4%		
78	-2395050. *1 0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
79 -1	0. 0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
80 1	60910. *2 0.	215066.	232579.	12487.	5353.	7133.	34272.	41405.	0.88195	36517.	398617.
81 2	0. 0.	250458.	217125.	33333.	7746.	25587.	34272.	59859.	0.77783	46560.	
82 3	0. 0.	290422.	235155.	55265.	10576.	44689.	34272.	78961.	0.68600	54167.	
83 4	0. 0.	317085.	245258.	71827.	12659.	59168.	34272.	93440.	0.60502	56533.	
84 5	0. 0.	323026.	243505.	79522.	13541.	65981.	34272.	100253.	0.53359	53494.	
85 6	0. 0.	326274.	242565.	93627.	37632.	45995.	34272.	80267.	0.47060	37773.	
86 7	0. 0.	327878.	242066.	85813.	38616.	47198.	34272.	81469.	0.41504	33813.	
87 8	0. 0.	329842.	240814.	89029.	39613.	49415.	34272.	82687.	0.36605	30267.	
88 9	0. 0.	329870.	232729.	97141.	43713.	53428.	27235.	80662.	0.32283	26060.	
89 10	0. *3 0. *4	331167.	230917.	100250.	45112.	55137.	27235.	82372.	0.28472	23453.	
										398619.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 13.4 %

PRODUCT COST ESTIMATION AND DISCOUNTED CASH FLOW

** CALCULATION RESULTS **

REC. NO 200

JOB NO 07200050

CUSTOMER UNIDO

PROJECT INDONESIAN PC INDUSTRY

PRODUCTS PETROCHEMICALS

******************** CURRENCY EXCHANGE RATE 300.00YEN/1US$

PROCESS UNIT	GAS CRACKER	UNIT				
CAPACITY	216000.	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	80.	%				
WORKING CAPITAL	100.	%				
TAX	UNIFORM					
INCOME TAX RATE	45.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	10.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	33.	%	0.	%
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	65000.	1000$				
PROCESS INVESTMENT COSTS	65000.	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSES	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	65000.	1000$				
OFF-SITE	13290.	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	78290.	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	78290.	1000$				
WORKING CAPITAL	10000.	1000$				

MODES OF OPERATION	(YEARS)	1	2	3	4	5	6	7	8	9	10
PLANT LIFE	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
CALENDER YEAR	(-)	0.72	0.86	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
STREAM FACTOR	(TONS/YR)	155520.	181440.	211680.	216000.	216000.	216000.	216000.	216000.	216000.	216000.
ANNUAL PRODUCTION											
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
N.G.	(1000$/YR)	3790.	4426.	5159.	5253.	5253.	7889.	7889.	7889.	7889.	7889.
(2) CATALYSTS AND CHEMICALS	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	234.	274.	319.	325.	325.	406.	406.	406.	406.	406.
FUEL	(1000$/YR)	331.	387.	451.	459.	459.	685.	685.	688.	688.	688.
COOLING WATER	(1000$/YR)	174.	203.	236.	241.	241.	241.	241.	241.	241.	241.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	38.	44.	51.	52.	52.	52.	52.	52.	52.	52.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	96.	96.	96.	96.	96.	96.	96.	96.	96.	96.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	4441.	5428.	6311.	6426.	6426.	9364.	9364.	9364.	9364.	9364.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	4530.	4530.	4500.	4500.	4500.	4500.	4500.	4500.	4500.	4500.
OFF-SITE	(1000$/YR)	880.	880.	880.	880.	880.	880.	880.	880.	880.	880.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	3432.	3492.	3492.	3492.	2993.	2494.	1995.	1497.	998.	499.
INT. ON WORKING CAPITAL	(1000$/YR)	1200.	800.	400.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	1746.	1746.	1746.	1746.	1746.	1746.	1746.	1746.	1746.	1746.
(4) TAXES AND INSURANCE	(1000$/YR)	582.	582.	582.	582.	582.	582.	582.	582.	582.	582.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	12400.	12000.	11600.	11200.	10702.	10293.	9704.	9205.	8706.	8207.
PLANT-OVERHEAD COSTS	(1000$/YR)	2910.	2910.	2910.	2910.	2910.	2910.	2910.	2910.	2910.	2910.
FACTORY COSTS	(1000$/YR)	19977.	20339.	20821.	20536.	20038.	22476.	21977.	21479.	20980.	20481.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	19977.	20339.	20821.	20536.	20038.	22476.	21977.	21479.	20980.	20481.
UNIT PRODUCT COST	($/TON)	129.42	112.10	98.36	95.08	92.77	104.06	101.75	99.44	97.13	94.82

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
BY-PRODUCTS CREDITS											
(METHANE)											
PRICE	($/TON)	9.00	8.00	9.00	9.00	9.00	12.00	12.00	12.00	12.00	12.00
AMOUNT	(TONS/YR)	325460.	379680.	442060.	452000.	452000.	452000.	452000.	452000.	452000.	452000.
VALUE	(1000$/YR)	2534.	3937.	3544.	3616.	3616.	5424.	5424.	5424.	5424.	5424.
(PROPYLENE)											
PRICE	($/TON)	7.30	7.30	7.30	7.30	7.30	11.00	11.00	11.00	11.00	11.00
AMOUNT	(TONS/YR)	27217.	26270.	20380.	21900.	21599.	21900.	21900.	21500.	21500.	21530.
VALUE	(1000$/YR)	199.	177.	149.	157.	157.	237.	237.	237.	237.	237.
(C4 FRACT)											
PRICE	($/TON)	7.30	7.30	7.30	7.30	7.30	11.00	11.00	11.00	11.00	11.00
AMOUNT	(TONS/YR)	17207.	20160.	29520.	24000.	24000.	24000.	24000.	24000.	24000.	24000.
VALUE	(1000$/YR)	126.	147.	172.	175.	175.	264.	264.	264.	264.	264.
MAIN PRODUCT COST											
ANNUAL MAIN PRODUCT COST	(1000$/YR)	17963.	16977.	16957.	16500.	16090.	16552.	16053.	15554.	15095.	14556.
UNIT MAIN PRODUCT COST	($/TON)	100.50	93.57	90.11	76.00	74.60	76.63	74.72	72.01	69.79	67.39

PLANT LIFE (YEARS)		1	2	3	4	5	6	7	8	9	10
CALENDER YEAR (YEAR)		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
SALES VALUE											
(ETHYLENE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	89.00	89.00	89.00	89.00	89.00	91.00	91.00	91.00	91.00	91.00
SALES AMOUNT	(TONS/YR)	155520.	181440.	211680.	216000.	216000.	216000.	216000.	216000.	216000.	216000.
SALES VALUE	(1000$/YR)	13841.	16148.	18840.	19224.	19224.	19656.	19656.	19656.	19656.	19656.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	13841.	16148.	18840.	19224.	19224.	19656.	19656.	19656.	19656.	19656.
(PROPYLEN)											
(1) DOMESTIC											
SALES PRICE	($/TON)	59.00	59.00	59.00	59.00	59.00	61.00	61.00	61.00	61.00	61.00
SALES AMOUNT	(TONS/YR)	13110.	22770.	33810.	34500.	34500.	34500.	34500.	34500.	34500.	34500.
SALES VALUE	(1000$/YR)	773.	1343.	1995.	2036.	2036.	2105.	2105.	2105.	2105.	2105.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	773.	1343.	1995.	2036.	2036.	2105.	2105.	2105.	2105.	2105.
(C5 FRACT)											
(1) DOMESTIC											
SALES PRICE	($/TON)	43.00	44.00	44.00	45.00	45.00	46.00	46.00	47.00	47.00	48.00
SALES AMOUNT	(TONS/YR)	29520.	29520.	40180.	41000.	41000.	41000.	41000.	41000.	41000.	41000.
SALES VALUE	(1000$/YR)	1259.	1299.	1768.	1845.	1845.	1886.	1886.	1927.	1927.	1968.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	1259.	1299.	1768.	1845.	1845.	1886.	1886.	1927.	1927.	1968.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 5.89		
ENG. + CONST	75	-2	58200.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	10000.	*2	15004.	17063.	-1190.	0.	-1150.	5300.	4221.	0.94557	3991.	62486.
	78	2	0.		18790.	16977.	1813.	916.	897.	5300.	6378.	0.89410	5702.	
	79	3	0.		22002.	16957.	5645.	2540.	3105.	5300.	9495.	0.84544	7174.	
	80	4	0.		23105.	16588.	6516.	2932.	3584.	5300.	8964.	0.79947	7166.	
	81	5	0.		23105.	16090.	7015.	3157.	3858.	5300.	9239.	0.75591	6984.	
	82	6	0.		23647.	16552.	7095.	3193.	3902.	5300.	9283.	0.71477	6635.	
	83	7	0.		23647.	16053.	7594.	3417.	4176.	5300.	9557.	0.67586	6459.	
	84	8	0.		23600.	15554.	8133.	3660.	4473.	5300.	9854.	0.63907	6297.	
	85	9	0.		23600.	15055.	8632.	3885.	4748.	5300.	10120.	0.60429	6120.	
	86	10	0.	*3	23729.	14556.	9172.	4127.	5045.	5300.	10425.	0.57140	5957.	
			0.	*4									62486.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 5.8 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 7.79		
ENG. + CONST	75	-2	58200.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	10000.	*2	15004.	17063.	-1190.	0.	-1190.	5300.	4221.	0.92016	3918.	69495.
	78	2	0.		18790.	16977.	1813.	0.	1813.	5300.	7194.	0.86140	6197.	
	79	3	0.		22002.	16957.	5645.	0.	5645.	5300.	11925.	0.79958	9016.	
	80	4	0.		23105.	16588.	6516.	0.	6516.	5300.	11897.	0.74214	8829.	
	81	5	0.		23105.	16090.	7015.	0.	7015.	5300.	12396.	0.68902	8558.	
	82	6	0.		23647.	16552.	7095.	3193.	3902.	5300.	9283.	0.63934	[illegible]	
	83	7	0.		23647.	16053.	7594.	3417.	4176.	5300.	9557.	0.59346	5671.	
	84	8	0.		23600.	15554.	8133.	3660.	4473.	5300.	9854.	0.55077	5427.	
	85	9	0.		23600.	15055.	8632.	3885.	4748.	5300.	10120.	0.51129	5178.	
	86	10	0.	*3	23729.	14556.	9172.	4127.	5045.	5300.	10425.	0.47460	[illegible]	
			0.	*4									69495.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 7.7 %

PROCESS UNIT	VCM	UNIT
CAPACITY	77000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	8.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0. %	
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	9430.	1000$
PROCESS INVESTMENT COSTS	9400.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	9400.	1000$
OFF-SITE	2400.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	11800.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	11800.	1000$
WORKING CAPITAL	1800.	1000$

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.75	0.87	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	57750.	66990.	77000.	77000.	77000.	77000.	77000.	77000.	77000.	77000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	2596.	3014.	3454.	3454.	3454.	3532.	3532.	3532.	3532.	3532.
CHLORINE	(1000$/YR)	3031.	3520.	4033.	4033.	4033.	4135.	4139.	4139.	4139.	4139.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	347.	493.	462.	462.	462.	462.	462.	462.	462.	462.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	56.	65.	74.	74.	74.	93.	93.	93.	93.	93.
FUEL	(1000$/YR)	35.	40.	46.	46.	46.	69.	69.	69.	69.	69.
COOLING WATER	(1000$/YR)	374.	376.	431.	431.	431.	431.	431.	431.	431.	431.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	26.	30.	35.	35.	35.	35.	35.	35.	35.	35.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	48.	55.	63.	63.	63.	67.	67.	67.	67.	67.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	53.	63.	63.	63.	63.	63.	63.	63.	63.	63.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	6524.	7567.	8661.	8661.	8661.	8889.	8889.	8889.	8889.	8889.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	1175.	1175.	1175.	1175.	1175.	1175.	1175.	1175.	0.	0.
OFF-SITE	(1000$/YR)	150.	160.	160.	160.	160.	160.	160.	160.	160.	150.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	790.	708.	708.	708.	607.	506.	405.	303.	202.	101.
INT. ON WORKING CAPITAL	(1000$/YR)	216.	144.	72.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	354.	354.	354.	354.	354.	354.	354.	354.	354.	354.
(4) TAXES AND INSURANCE	(1000$/YR)	119.	118.	119.	118.	118.	118.	118.	118.	118.	119.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	2731.	2659.	2587.	2515.	2414.	2313.	2212.	2111.	834.	733.
PLANT-OVERHEAD COSTS	(1000$/YR)	590.	590.	590.	590.	590.	590.	590.	590.	590.	590.
FACTORY COSTS	(1000$/YR)	9846.	10816.	11838.	11766.	11665.	11792.	11691.	11590.	10314.	10212.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	9846.	10816.	11838.	11766.	11665.	11792.	11691.	11590.	10314.	10212.
UNIT PRODUCT COST	($/TON)	170.49	161.45	153.74	152.80	151.49	153.14	151.83	150.52	133.96	132.63

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986

SALES VALUE

(VCN)

(1) DOMESTIC											
SALES PRICE	($/TON)	192.00	195.00	198.00	200.00	201.00	203.00	205.00	207.00	210.00	210.00
SALES AMOUNT	(TONS/YR)	57750.	66990.	77000.	77000.	77000.	77000.	77000.	77000.	77000.	77000.
SALES VALUE	(1000$/YR)	11088.	13063.	15246.	15400.	15477.	15631.	15785.	15939.	16170.	16170.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	11088.	13063.	15246.	15400.	15477.	15631.	15785.	15939.	16170.	16170.

(NON TAX HOLIDAY)

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 1980		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
											R = 18.5%		
ENG. + CONST	75	-2	11000. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION	77	1	1000. *2	11900.	9846.	1242.	559.	683.	1335.	2018.	0.84377	1703.	13271.
START-UP	78	2	0.	13063.	10016.	2747.	1511.	1236.	1335.	2571.	0.71187	1830.	
	79	3	0.	15244.	11830.	3408.	1534.	1874.	1335.	3209.	0.60067	1928.	
	80	4	0.	15400.	11766.	3634.	1635.	1999.	1335.	3334.	0.50676	1689.	
	81	5	0.	15477.	11665.	3812.	1715.	2097.	1335.	3432.	0.42757	1467.	
	82	6	0.	15631.	11792.	3839.	1728.	2111.	1335.	3447.	0.36075	1243.	
	83	7	0.	15785.	11691.	4094.	1842.	2252.	1335.	3587.	0.30437	1092.	
	84	8	0.	15939.	11590.	4349.	1957.	2392.	1335.	3727.	0.25681	957.	
	85	9	0.	16170.	10314.	5856.	2635.	3221.	160.	3381.	0.21667	733.	
	86	10	0. *3	16170.	10212.	5958.	2681.	3277.	160.	3437.	0.18281	628.	
			0. *4										
												13271.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 18.5 %

PROCESS UNIT	PVC	UNIT
CAPACITY	60000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	8.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.00	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0. %	
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	8300.	1000$
PROCESS INVESTMENT COSTS	8300.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	8300.	1000$
OFF-SITE	2000.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	10300.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	10300.	1000$
WORKING CAPITAL	1000.	1000$

YEARS OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.60	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	[illegible]	[illegible]	60000.	60000.	60000.	60000.	60000.	60000.	60000.	60000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
[illegible]	($1000/YR)	8195.	10140.	12237.	12355.	12417.	12501.	12666.	12700.	12973.	12973.
(2) CATALYSTS AND CHEMICALS											
CAT COST	($1000/YR)	137.	167.	190.	190.	190.	190.	190.	190.	190.	190.
(3) UTILITIES											
ELECTRICITY	($1000/YR)	190.	170.	201.	201.	201.	252.	252.	252.	252.	252.
FUEL	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	($1000/YR)	90.	90.	95.	95.	95.	95.	95.	95.	95.	95.
PROCESS WATER	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	($1000/YR)	0.	11.	13.	13.	13.	13.	13.	13.	13.	13.
HP. STEAM	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	($1000/YR)	194.	200.	230.	230.	230.	249.	249.	249.	249.	249.
LP. STEAM	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	($1000/YR)	96.	96.	96.	96.	96.	96.	96.	96.	96.	96.
(5) OPERATING ROYALTIES	($1000/YR)	590.	605.	600.	612.	617.	623.	629.	635.	639.	639.
TOTAL DIRECT PRODUCTION COSTS	($1000/YR)	9157.	11311.	13012.	13559.	13925.	14017.	14146.	14276.	14466.	14466.
FIXED COSTS											
(1) DEPRECIATION											
[illegible]	($1000/YR)	1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.	0.	0.
[illegible]	($1000/YR)	167.	167.	167.	167.	167.	167.	167.	167.	167.	167.
[illegible]	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL PRO. COSTS	($1000/YR)	640.	640.	640.	640.	555.	403.	370.	278.	185.	93.
INT. ON WORKING CAPITAL	($1000/YR)	270.	192.	70.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	($1000/YR)	324.	324.	324.	324.	324.	324.	324.	324.	324.	324.
(4) TAXES AND INSURANCE	($1000/YR)	190.	190.	190.	190.	190.	190.	190.	190.	190.	190.
(5) LAND RENT	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	($1000/YR)	2512.	2456.	2360.	2280.	2192.	2095.	2007.	1914.	786.	691.
PLANT-OVERHEAD COSTS	($1000/YR)	540.	540.	540.	540.	540.	540.	540.	540.	540.	540.
FACTORY COSTS	($1000/YR)	12210.	14200.	16512.	16505.	16557.	16656.	16692.	16730.	15798.	15697.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	($1000/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	($1000/YR)	12210.	14200.	16512.	16505.	16557.	16656.	16692.	16730.	15798.	15697.
UNIT PRODUCT COST	($/TON)	296.92	[illegible]	275.21	276.30	275.95	277.60	278.21	278.84	263.16	261.62

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986

SALES VALUE

(PVC)

(1) DOMESTIC											
SALES PRICE	($/TON)	322.00	320.00	334.00	340.00	343.00	346.00	349.00	353.00	355.00	355.00
SALES AMOUNT	(TONS/YEAR)	36000.	44000.	54000.	60000.	60000.	60000.	60000.	60000.	60000.	60000.
SALES VALUE	(1000$/YEAR)	11592.	14092.	18036.	20400.	20580.	20760.	20940.	21180.	21300.	21300.
(2) EXPORT											
SALES PRICE	($/TON)	252.00	290.00	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YEAR)	5200.	[illegible]	6800.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YEAR)	1310.	[illegible]	1904.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YEAR)	12902.	[illegible]	[illegible]	20400.	20580.	20760.	20940.	21180.	21300.	21300.

DISCOUNTED CASH FLOW CALCULATION RESULTS

(NON TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 18.4%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75	-2	10800.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	1900.	*2	12902.	12210.	693.	312.	381.	1206.	1985.	0.84426	1338.	12390.
	78	2	0.		16032.	14288.	1744.	785.	959.	1206.	2163.	0.71278	1542.	
	79	3	0.		19620.	16512.	3198.	1398.	1799.	1206.	2913.	0.60177	1753.	
	80	4	0.		20400.	16583.	3817.	1718.	2099.	1206.	3396.	0.50805	1678.	
	81	5	0.		20580.	16557.	4023.	1810.	2213.	1206.	3417.	0.42893	1444.	
	82	6	0.		20700.	16656.	4104.	1847.	2257.	1206.	3461.	0.36213	1253.	
	83	7	0.		20900.	16692.	4208.	1911.	2396.	1206.	3600.	0.30573	1092.	
	84	8	0.		21100.	16730.	4490.	2002.	2447.	1206.	3652.	0.25812	943.	
	85	9	0.		21300.	15790.	5510.	2480.	3031.	167.	3197.	0.21792	697.	
	86	10	0.	*3	21300.	15697.	5603.	2521.	3082.	167.	3248.	0.18398	598.	
			0.	*4									12390.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 18.4 %

PROCESS UNIT	LDPE	UNIT
CAPACITY	100000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0.	%
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	36000.	1000$
PROCESS INVESTMENT COSTS	36000.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	36000.	1000$
OFF-SITE	10000.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	46000.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	46000.	1000$
WORKING CAPITAL	8200.	1000$

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.70	0.83	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	70000.	83000.	97000.	100000.	100000.	100000.	100000.	100000.	100000.	100000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	6552.	7784.	9119.	9375.	9375.	9586.	9586.	9586.	9586.	9586.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	1136.	1419.	1662.	1709.	1709.	1709.	1709.	1709.	1709.	1709.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	112.	133.	155.	160.	160.	200.	200.	200.	200.	200.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	128.	151.	177.	182.	182.	182.	182.	182.	182.	182.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	272.	263.	308.	317.	317.	333.	333.	333.	333.	333.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	391.	391.	391.	391.	391.	391.	391.	391.	391.	391.
(5) RUNNING ROYALTIES	(1000$/YR)	571.	814.	975.	1056.	1099.	1099.	1110.	1119.	1125.	1129.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	9191.	10865.	12690.	13190.	13132.	13409.	13420.	13429.	13435.	13435.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	3630.	3630.	3630.	3630.	3630.	3630.	3630.	3630.	3630.	3630.
OFF-SITE	(1000$/YR)	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	2808.	2808.	2808.	2808.	2407.	2006.	1605.	1203.	802.	401.
INT. ON WORKING CAPITAL	(1000$/YR)	986.	656.	328.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	1474.	1474.	1404.	1404.	1404.	1404.	1474.	1404.	1404.	1474.
(4) TAXES AND INSURANCE	(1000$/YR)	458.	468.	468.	468.	468.	469.	468.	469.	469.	458.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	9966.	9656.	9328.	8890.	8599.	8198.	7797.	7396.	6995.	6594.
PLANT-OVERHEAD COSTS	(1000$/YR)	2360.	2360.	2360.	2360.	2360.	2360.	2360.	2360.	2360.	2360.
FACTORY COSTS	(1000$/YR)	21516.	22861.	24364.	24440.	24071.	23966.	23557.	23164.	22760.	22359.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	21516.	22861.	24364.	24440.	24071.	23966.	23557.	23164.	22760.	22359.
UNIT PRODUCT COST	($/TON)	307.37	275.43	251.20	244.40	240.71	239.66	235.57	231.64	227.60	223.59

		1	2	3	4	5	6	7	8	9	10
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
SALES VALUE											
(LLPE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	340.00	346.00	353.00	360.00	363.00	366.00	370.00	373.00	375.00	375.00
SALES AMOUNT	(TONS/YR)	52030.	63000.	75000.	90000.	100000.	100000.	100000.	100000.	100000.	100000.
SALES VALUE	(1000$/YR)	17690.	21798.	26475.	32400.	36300.	36600.	37000.	37300.	37500.	37500.
(2) EXPORT											
SALES PRICE	($/TON)	262.00	268.00	274.00	280.00	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	18400.	20000.	22000.	10000.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	4821.	5360.	6028.	2800.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	22511.	27158.	32503.	35200.	36300.	36600.	37000.	37300.	37500.	37500.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

R = 12.39

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75	-2	46000.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	8200.	*2	22501.	21516.	985.	443.	542.	4320.	4862.	0.88955	4330.	52427.
	78	2	0.		27150.	22061.	4297.	1934.	2363.	4320.	6684.	0.78907	5201.	
	79	3	0.		32903.	24366.	8137.	3662.	4475.	4320.	8796.	0.70627	6212.	
	80	4	0.		35200.	24440.	10760.	4842.	5918.	4320.	10239.	0.62886	6446.	
	81	5	0.		36300.	24071.	12229.	5503.	6726.	4320.	11046.	0.56012	6187.	
	82	6	0.		36600.	23946.	12654.	5694.	6960.	4320.	11280.	0.49881	5627.	
	83	7	0.		37000.	23557.	13443.	6050.	7394.	4320.	11714.	0.44427	5206.	
	84	8	0.		37300.	23164.	14136.	6361.	7775.	4320.	12095.	0.39560	4785.	
	85	9	0.		37500.	22769.	14731.	6629.	8102.	4320.	12422.	0.35230	4376.	
	86	10	0.	*3	37500.	22368.	15132.	6809.	8323.	4320.	12643.	0.31376	3967.	
			0.	*4									52428.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 12.3 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

R = 14.39

	END OF YEAR 1980		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75	-2	46000.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	8200.	*2	22501.	21516.	985.	0.	985.	4320.	5305.	0.86012	4563.	53189.
	78	2	0.		27150.	22061.	4297.	0.	4297.	4320.	9618.	0.73981	6375.	
	79	3	0.		32903.	24366.	8137.	0.	8137.	4320.	12457.	0.63633	7927.	
	80	4	0.		35200.	24440.	10760.	0.	10760.	4320.	15081.	0.54732	8254.	
	81	5	0.		36300.	24071.	12229.	0.	12229.	4320.	16549.	0.47076	7791.	
	82	6	0.		36600.	23946.	12654.	5694.	6960.	4320.	11280.	0.40491	4567.	
	83	7	0.		37000.	23557.	13443.	6050.	7394.	4320.	11714.	0.34827	4080.	
	84	8	0.		37300.	23164.	14136.	6361.	7775.	4320.	12095.	0.29956	3623.	
	85	9	0.		37500.	22769.	14731.	6629.	8102.	4320.	12422.	0.25766	3201.	
	86	10	0.	*3	37500.	22368.	15132.	6809.	8323.	4320.	12643.	0.22161	2802.	
			0.	*4									53189.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 14.3 %

PROCESS UNIT	HDPE	UNIT					
CAPACITY	26000.	TONS/YR					
PLANT LIFE	10	YEARS					
BORROWED CAPITAL							
TOTAL INVESTMENT COSTS	80.	%					
WORKING CAPITAL	100.	%					
TAX	UNIFORM						
INCOME TAX RATE	45.	%					
DEPRECIATION	STRAIGHT LINE METHOD						
YEARS TO DEPRECIATE	10.	YEARS					
INTEREST PAYMENTS							
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%					
YEARS TO PAY	7.	YEARS					
METHOD	UNIFORM-PRIN. ONLY						
INTEREST RATE ON WORKING CAPITAL	12.00	%					
YEARS TO PAY	3.	YEARS					
METHOD	UNIFORM-PRIN. ONLY						
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	33.	%	0.	%	
INVESTMENT COSTS							
MATERIAL	0.	1000$					
FREIGHT	0.	1000$					
ENGINEERING AND CONSTRUCTION	9000.	1000$					
PROCESS INVESTMENT COSTS	9000.	1000$					
INTERESTS DURING CONSTRUCTION	0.	1000$					
CONTINGENCIES	0.	1000$					
ROYALTIES	0.	1000$					
START-UP EXPENSES	0.	1000$					
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$					
SPARE PARTS	0.	1000$					
BATTERY LIMITS	9000.	1000$					
OFF-SITE	2000.	1000$					
BUILDING	0.	1000$					
DEPRECIABLE INVESTMENT COSTS	11000.	1000$					
LAND	0.	1000$					
TOTAL INVESTMENT COSTS	11000.	1000$					
WORKING CAPITAL	2900.	1000$					

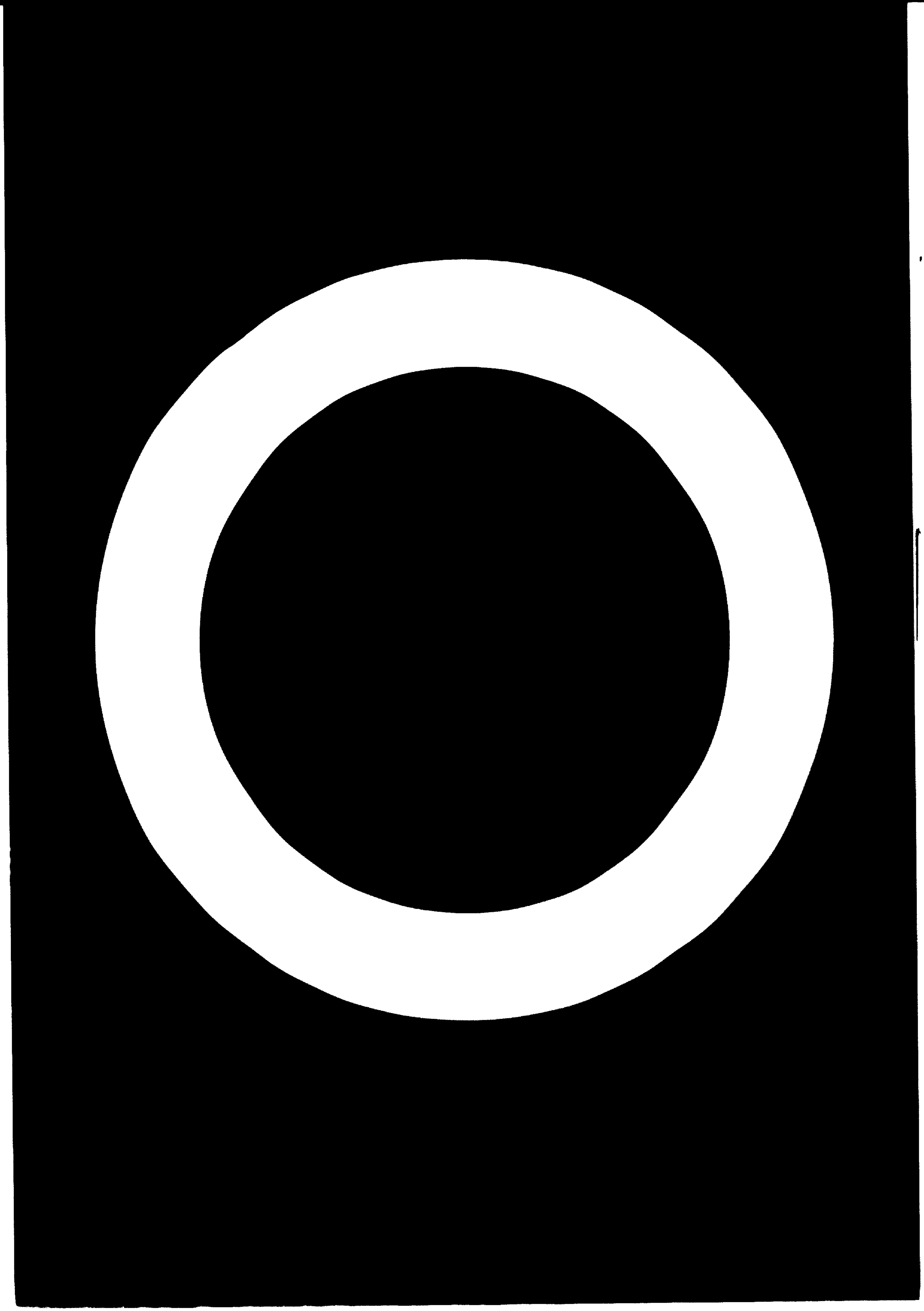
MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.81	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	21059.	23400.	26000.	26000.	26000.	26000.	26000.	26000.	26000.	26000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	1946.	2157.	2397.	2397.	2397.	2450.	2450.	2450.	2450.	2450.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	292.	324.	360.	360.	360.	360.	360.	360.	360.	360.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	124.	137.	153.	153.	153.	191.	191.	191.	191.	191.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	36.	40.	45.	45.	45.	45.	45.	45.	45.	45.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	173.	114.	127.	127.	127.	133.	133.	133.	133.	133.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	90.	90.	90.	90.	90.	90.	90.	90.	90.	90.
(5) RUNNING ROYALTIES	(1000$/YR)	219.	295.	267.	270.	295.	291.	297.	300.	306.	394.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	2819.	3186.	3446.	3457.	3464.	3568.	3574.	3577.	3581.	3581.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	800.	800.	800.	800.	800.	800.	800.	800.	800.	800.
OFF-SITE	(1000$/YR)	173.	173.	173.	173.	173.	173.	173.	173.	173.	173.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	604.	604.	604.	604.	506.	409.	391.	293.	195.	98.
INT. ON WORKING CAPITAL	(1000$/YR)	260.	160.	80.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	347.	342.	342.	342.	342.	342.	342.	342.	342.	347.
(4) TAXES AND INSURANCE	(1000$/YR)	114.	114.	114.	114.	114.	114.	114.	114.	114.	114.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	2433.	2353.	2273.	2193.	2096.	1998.	1900.	1803.	1705.	1607.
PLANT-OVERHEAD COSTS	(1000$/YR)	570.	570.	570.	570.	570.	570.	570.	570.	570.	570.
FACTORY COSTS	(1000$/YR)	5822.	6029.	6209.	6220.	6129.	6136.	6044.	5950.	5856.	5758.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	5822.	6029.	6209.	6220.	6129.	6136.	6044.	5950.	5856.	5758.
UNIT PRODUCT COST	($/TON)	276.47	257.65	241.09	239.24	235.75	236.00	232.48	228.83	225.23	221.47

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986

SALES VALUE

(HDPE)

(1) DOMESTIC											
SALES PRICE	($/TON)	347.00	354.00	362.00	370.00	374.00	378.00	381.00	385.00	390.00	390.00
SALES AMOUNT	(TONS/YR)	14500.	16000.	18000.	20000.	22000.	24000.	26000.	26000.	26000.	26000.
SALES VALUE	(1000$/YR)	5032.	5664.	6516.	7400.	8228.	9072.	9906.	10010.	10140.	10140.
(2) EXPORT											
SALES PRICE	($/TON)	287.00	294.00	302.00	310.00	314.00	318.00	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	6630.	7300.	8000.	6000.	4000.	2000.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	1904.	2146.	2416.	1860.	1256.	636.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	6936.	7810.	8932.	9260.	9484.	9708.	9906.	10010.	10140.	10140.



PROCESS UNIT	ENVEG	UNIT
CAPACITY	30000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	90.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0.	%
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	5800.	1000$
PROCESS INVESTMENT COSTS	5800.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	5800.	1000$
OFF-SITE	1600.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	7400.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	7400.	1000$
WORKING CAPITAL	1200.	1000$

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.70	0.82	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	21000.	24630.	28500.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	2220.	2605.	3018.	3172.	3172.	3243.	3243.	3243.	3243.	3243.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	42.	49.	57.	60.	60.	60.	60.	60.	60.	60.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	253.	300.	357.	375.	375.	469.	469.	469.	469.	469.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	144.	168.	195.	205.	205.	205.	205.	205.	205.	205.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	333.	399.	452.	475.	475.	499.	499.	499.	499.	499.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	53.	63.	63.	63.	63.	63.	63.	63.	63.	63.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	3046.	3586.	4145.	4353.	4353.	4542.	4542.	4542.	4542.	4542.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	580.	580.	580.	580.	580.	580.	580.	580.	580.	580.
OFF-SITE	(1000$/YR)	107.	107.	107.	107.	107.	107.	107.	107.	107.	107.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	444.	444.	444.	444.	380.	317.	254.	190.	127.	63.
INT. ON WORKING CAPITAL	(1000$/YR)	144.	96.	48.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	222.	222.	222.	222.	222.	222.	222.	222.	222.	222.
(4) TAXES AND INSURANCE	(1000$/YR)	74.	74.	74.	74.	74.	74.	74.	74.	74.	74.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	1571.	1523.	1475.	1427.	1363.	1300.	1236.	1173.	1110.	1046.
PLANT-OVERHEAD COSTS	(1000$/YR)	370.	370.	370.	370.	370.	370.	370.	370.	370.	370.
FACTORY COSTS	(1000$/YR)	5007.	5479.	5990.	6150.	6086.	6212.	6148.	6085.	6021.	5958.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	5007.	5479.	5990.	6150.	6086.	6212.	6148.	6085.	6021.	5958.
UNIT PRODUCT COST	($/TON)	238.42	222.71	210.18	205.00	202.87	207.07	204.93	202.83	200.71	198.60

[illegible]	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
BY-PRODUCTS CREDITS											
([illegible])											
PRICE	($/TON)	12.[illegible]	12.[illegible]	13.[illegible]	14.[illegible]	14.[illegible]	14.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AMOUNT	(TONS/YR)	[illegible]	[illegible]	[illegible]	5[illegible]	5[illegible]	5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VALUE	(1000$/YR)	[illegible]	[illegible]	[illegible]	71.	71.	71.	77.	[illegible]	[illegible]	[illegible]
GROSS PRODUCT COST											
ANNUAL GROSS PRODUCT COST	(1000$/YR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UNIT GROSS PRODUCT COST	($/TON)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible] ([illegible])

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-2	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.0	0.
[illegible]	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1201.	[illegible]	[illegible]
[illegible]	3	0.	[illegible]	[illegible]	1975.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	4	0.	[illegible]	[illegible]	2022.	[illegible]	1112.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	5	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	7	0.	[illegible]	[illegible]	[illegible]	[illegible]	1215.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	8	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1972.	[illegible]	[illegible]
[illegible]	9	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]								[illegible]	

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

PROCESS UNIT	S[illegible]	UNIT				
CAPACITY	[illegible].	TONS/YR				
PLANT LIFE	10	YEARS				
BORROWED CAPITAL						
TOTAL INVESTMENT COSTS	[illegible].	%				
WORKING CAPITAL	[illegible].	%				
TAX	UNIFORM					
INCOME TAX RATE	[illegible]5.	%				
DEPRECIATION	STRAIGHT LINE METHOD					
YEARS TO DEPRECIATE	10.	YEARS				
INTEREST PAYMENTS						
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%				
YEARS TO PAY	7.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
INTEREST RATE ON WORKING CAPITAL	12.00	%				
YEARS TO PAY	3.	YEARS				
METHOD	UNIFORM-PRIN. ONLY					
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0.	%	3[illegible].	%	0.	%
INVESTMENT COSTS						
MATERIAL	0.	1000$				
FREIGHT	0.	1000$				
ENGINEERING AND CONSTRUCTION	11[illegible].	1000$				
PROCESS INVESTMENT COSTS	11[illegible].	1000$				
INTERESTS DURING CONSTRUCTION	0.	1000$				
CONTINGENCIES	0.	1000$				
ROYALTIES	0.	1000$				
START-UP EXPENSES	0.	1000$				
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$				
SPARE PARTS	0.	1000$				
BATTERY LIMITS	11[illegible].	1000$				
OFF-SITE	[illegible].	1000$				
BUILDING	0.	1000$				
DEPRECIABLE INVESTMENT COSTS	[illegible].	1000$				
LAND	0.	1000$				
TOTAL INVESTMENT COSTS	[illegible].	1000$				
WORKING CAPITAL	[illegible].	1000$				

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.71	0.83	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	21330.	24900.	29100.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
ETHYLENE	(1000$/YR)	552.	644.	754.	775.	775.	793.	793.	793.	793.	793.
BENZENE	(1000$/YR)	1137.	1308.	1627.	1673.	1698.	1723.	1749.	1776.	1825.	1850.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	470.	548.	642.	660.	660.	660.	660.	660.	660.	660.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	60.	70.	83.	85.	85.	106.	106.	106.	106.	106.
FUEL	(1000$/YR)	33.	38.	45.	46.	46.	65.	69.	69.	69.	69.
COOLING WATER	(1000$/YR)	18.	21.	25.	26.	26.	26.	26.	26.	26.	26.
PROCESS WATER1	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	292.	329.	385.	396.	396.	416.	416.	416.	416.	416.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.
(5) RUNNING ROYALTIES	(1000$/YR)	198.	237.	282.	305.	317.	318.	321.	323.	324.	324.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	2929.	3434.	4021.	4144.	4181.	4205.	4317.	4365.	4398.	4422.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	1190.	1190.	1190.	1190.	1190.	1190.	1190.	1190.	1190.	1190.
OFF-SITE	(1000$/YR)	220.	220.	220.	220.	220.	220.	220.	220.	220.	220.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	908.	908.	908.	908.	761.	634.	507.	381.	254.	127.
INT. ON WORKING CAPITAL	(1000$/YR)	300.	200.	100.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	444.	444.	444.	444.	444.	444.	444.	444.	444.	444.
(4) TAXES AND INSURANCE	(1000$/YR)	148.	148.	148.	148.	148.	148.	148.	148.	148.	148.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	3150.	3050.	2950.	2850.	2723.	2596.	2470.	2343.	2216.	2089.
PLANT-OVERHEAD COSTS	(1000$/YR)	760.	760.	760.	760.	760.	760.	760.	760.	760.	760.
FACTORY COSTS	(1000$/YR)	6829.	7224.	7711.	7734.	7644.	7625.	7527.	7427.	7392.	7251.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	6829.	7224.	7711.	7734.	7644.	7625.	7527.	7427.	7392.	7251.
UNIT PRODUCT COST	($/TON)	320.14	290.11	264.98	257.80	254.81	254.18	250.90	247.58	245.97	241.69

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
SALES VALUE											
(SM/PS)											
(1) DOMESTIC											
SALES PRICE	($/TON)	336.00	341.00	345.00	350.00	352.00	354.00	357.00	359.00	360.00	360.00
SALES AMOUNT	(TONS/YR)	13500.	16500.	20000.	25000.	30000.	30000.	30000.	30000.	30000.	30000.
SALES VALUE	(1000$/YR)	4536.	5627.	6900.	8750.	10560.	10620.	10710.	10770.	10800.	10800.
(2) EXPORT											
SALES PRICE	($/TON)	266.00	271.00	275.00	280.00	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	7800.	8500.	9200.	5000.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	2075.	2303.	2530.	1400.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	6611.	7930.	9430.	10150.	10560.	10620.	10710.	10770.	10800.	10800.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 9.0%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75 -2	14000. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77 1	2500. *2	6611.	6815.	-208.	0.	-208.	1370.	1162.	0.91781	1066.	16240.
	78 2	0.	7930.	7224.	706.	318.	388.	1370.	1758.	0.84297	1481.	
	79 3	0.	9430.	7711.	1719.	774.	945.	1370.	2315.	0.77213	1788.	
	80 4	0.	10150.	7734.	2416.	1087.	1329.	1370.	2699.	0.70958	1915.	
	81 5	0.	10560.	7644.	2916.	1312.	1604.	1370.	2974.	0.65126	1937.	
	82 6	0.	10620.	7625.	2995.	1348.	1647.	1370.	3017.	0.59773	1803.	
	83 7	0.	10710.	7527.	3183.	1432.	1751.	1370.	3121.	0.54860	1712.	
	84 8	0.	10770.	7427.	3343.	1504.	1839.	1370.	3209.	0.50351	1616.	
	85 9	0.	10800.	7352.	3448.	1552.	1896.	1370.	3266.	0.46212	1510.	
	86 10	0. *3	10800.	7251.	3549.	1597.	1952.	1370.	3322.	0.42414	1409.	
		0. *4									16240.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 9.0 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 11.7%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75 -2	14000. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77 1	2500. *2	6611.	6819.	-208.	0.	-208.	1370.	1162.	0.89550	1041.	14670.
	78 2	0.	7930.	7224.	706.	0.	706.	1370.	2076.	0.80207	1665.	
	79 3	0.	9430.	7711.	1719.	0.	1719.	1370.	3089.	0.71832	2219.	
	80 4	0.	10150.	7734.	2416.	0.	2416.	1370.	3786.	0.64331	2436.	
	81 5	0.	10560.	7644.	2916.	0.	2916.	1370.	4286.	0.57614	2469.	
	82 6	0.	10620.	7625.	2995.	1348.	1647.	1370.	3017.	0.51598	1557.	
	83 7	0.	10710.	7527.	3183.	1432.	1751.	1370.	3121.	0.46210	1442.	
	84 8	0.	10770.	7427.	3343.	1504.	1839.	1370.	3209.	0.41385	1328.	
	85 9	0.	10800.	7352.	3448.	1552.	1896.	1370.	3266.	0.37063	1211.	
	86 10	0. *3	10800.	7251.	3549.	1597.	1952.	1370.	3322.	0.33193	1103.	
		0. *4									14670.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 11.7 %

PROCESS UNIT	DD	UNIT
CAPACITY	30000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	90.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0.	%
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	14500.	1000$
PROCESS INVESTMENT COSTS	14500.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	14500.	1000$
OFF-SITE	4900.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	19400.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	19400.	1000$
WORKING CAPITAL	3400.	1000$

MODES OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.38	0.66	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	11630.	19800.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
PROPYLEN	(1000$/YR)	785.	1358.	2056.	2056.	2056.	2126.	2126.	2126.	2126.	2126.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	313.	541.	819.	819.	819.	819.	819.	819.	819.	819.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	55.	95.	144.	144.	144.	181.	181.	181.	181.	181.
FUEL	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
COOLING WATER	(1000$/YR)	24.	42.	63.	63.	63.	63.	63.	63.	63.	63.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	73.	126.	190.	190.	190.	200.	200.	200.	200.	200.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
(5) RUNNING ROYALTIES	(1000$/YR)	120.	299.	327.	342.	346.	345.	352.	356.	360.	360.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	1491.	2492.	3721.	3736.	3740.	3850.	3861.	3865.	3869.	3869.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	1630.	1630.	1600.	1600.	1600.	1600.	1600.	1600.	1600.	1600.
OFF-SITE	(1000$/YR)	330.	330.	300.	300.	300.	300.	300.	300.	300.	300.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	1154.	1164.	1164.	1164.	998.	831.	665.	499.	333.	156.
INT. ON WORKING CAPITAL	(1000$/YR)	430.	272.	136.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	592.	582.	582.	582.	582.	582.	582.	582.	582.	582.
(4) TAXES AND INSURANCE	(1000$/YR)	136.	194.	194.	194.	194.	194.	194.	194.	194.	194.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	4130.	4002.	3966.	3730.	3564.	3398.	3231.	3065.	2899.	2732.
PLANT-OVERHEAD COSTS	(1000$/YR)	970.	970.	970.	970.	970.	970.	970.	970.	970.	970.
FACTORY COSTS	(1000$/YR)	6590.	7465.	8557.	8436.	8274.	8226.	8063.	7900.	7738.	7572.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	6590.	7465.	8557.	8436.	8274.	8226.	8063.	7900.	7738.	7572.
UNIT PRODUCT COST	($/TON)	570.80	377.00	285.24	281.20	275.79	274.10	268.75	263.34	257.93	252.39

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986

SALES VALUE

(PO)

(1) DOMESTIC											
SALES PRICE	($/TON)	357.00	364.00	371.00	380.00	384.00	388.00	391.00	395.00	400.00	400.00
SALES AMOUNT	(TONS/YR)	8500.	16500.	26500.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
SALES VALUE	(1000$/YR)	3035.	6006.	9832.	11400.	11520.	11640.	11730.	11850.	12000.	12000.
(2) EXPORT											
SALES PRICE	($/TON)	287.00	294.00	300.00	310.00	0.0	310.00	310.00	310.00	310.00	310.00
SALES AMOUNT	(TONS/YR)	3000.	3200.	3400.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	861.	941.	1020.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	3896.	6947.	10852.	11400.	11520.	11640.	11730.	11850.	12000.	12000.

(NON TAX HOLIDAY)

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 5.8%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75	-2	15400.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	3400.	*2	3896.	6599.	-2704.	0.	-2704.	1790.	-914.	0.94511	-863.	20967.
	78	2	0.		6947.	7465.	-518.	0.	-518.	1790.	1272.	0.89324	1137.	
	79	3	0.		10852.	8557.	2294.	1032.	1262.	1790.	3052.	0.84421	2577.	
	80	4	0.		11400.	8436.	2964.	1334.	1630.	1790.	3420.	0.79788	2729.	
	81	5	0.		11520.	8274.	3246.	1461.	1785.	1790.	3576.	0.75405	2696.	
	82	6	0.		11640.	8226.	3414.	1536.	1878.	1790.	3668.	0.71270	2614.	
	83	7	0.		11730.	9063.	3667.	1650.	2017.	1790.	3807.	0.67358	2564.	
	84	8	0.		11850.	7900.	3950.	1777.	2172.	1790.	3963.	0.63661	2523.	
	85	9	0.		12000.	7738.	4262.	1918.	2344.	1790.	4134.	0.60167	2487.	
	86	10	0.	*3	12000.	7572.	4428.	1993.	2436.	1790.	4226.	0.56865	2403.	
			0.	*4									20967.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 5.8 %

(TAX HOLIDAY)

DISCOUNTED CASH FLOW CALCULATION RESULTS

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 7.0%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75	-2	15400.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77	1	3400.	*2	3896.	6599.	-2704.	0.	-2704.	1790.	-914.	0.92669	-867.	21212.
	78	2	0.		6947.	7465.	-518.	0.	-518.	1790.	1272.	0.85974	1093.	
	79	3	0.		10852.	8557.	2294.	0.	2294.	1790.	4085.	0.79577	3250.	
	80	4	0.		11400.	9436.	2964.	0.	2964.	1790.	4754.	0.73743	3506.	
	81	5	0.		11520.	9276.	3266.	0.	3266.	1790.	5036.	0.68336	3442.	
	82	6	0.		11640.	8226.	3414.	1536.	1878.	1790.	3668.	0.63325	2323.	
	83	7	0.		11730.	8063.	3667.	1650.	2017.	1790.	3807.	0.58682	2234.	
	84	8	0.		11950.	7500.	3950.	1777.	2172.	1790.	3963.	0.54380	2155.	
	85	9	0.		12000.	7738.	4262.	1918.	2344.	1790.	4134.	0.50393	2083.	
	86	10	0.	*3	12000.	7572.	4428.	1993.	2436.	1790.	4226.	0.46659	1973.	
			0.	*4									21212.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 7.0 %

PROCESS UNIT	REFORMER-B.	UNIT
CAPACITY	200000.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
TAX	UNIFORM	
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0.	%
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	5040.	1000$
PROCESS INVESTMENT COSTS	5040.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	5040.	1000$
OFF-SITE	1380.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	6420.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	6420.	1000$
WORKING CAPITAL	1000.	1000$

YEARS OF OPERATION	(YEARS)	1	2	3	4	5	6	7	8	9	10
PLANT LIFE	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
CALENDER YEAR	(-)	0.70	0.81	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
STREAM FACTOR / ANNUAL PRODUCTION	(TONS/YR)	146370.	169290.	196460.	209000.	209000.	209000.	209000.	209000.	209000.	209000.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
NAPHTHA	(1000$/YR)	4326.	5017.	6066.	6415.	6653.	6653.	6808.	6899.	7128.	7364.
C5-PRODUCT	(1000$/YR)	1260.	1472.	1709.	1953.	1953.	1996.	1996.	1936.	1936.	1977.
HYDROGEN	(1000$/YR)	21.	24.	28.	30.	30.	30.	30.	30.	30.	30.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	59.	80.	93.	99.	99.	99.	99.	99.	99.	99.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	14.	16.	19.	20.	20.	25.	25.	25.	25.	25.
FUEL	(1000$/YR)	74.	86.	100.	106.	106.	158.	158.	158.	158.	158.
COOLING WATER	(1000$/YR)	14.	16.	19.	20.	20.	20.	20.	20.	20.	20.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	330.	367.	403.	428.	428.	449.	449.	449.	449.	449.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
(5) NET ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	6088.	7192.	8458.	9013.	9251.	9371.	9605.	9650.	9888.	10156.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	536.	536.	904.	904.	904.	904.	506.	506.	506.	536.
OFF-SITE	(1000$/YR)	92.	92.	92.	92.	92.	92.	92.	92.	92.	92.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	385.	385.	385.	385.	330.	275.	220.	165.	110.	55.
INT. ON WORKING CAPITAL	(1000$/YR)	127.	85.	42.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	193.	193.	193.	193.	193.	193.	193.	193.	193.	193.
(4) TAXES AND INSURANCE	(1000$/YR)	54.	64.	64.	64.	64.	64.	64.	64.	64.	64.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	1385.	1323.	1280.	1239.	1183.	1128.	1073.	1018.	963.	908.
PLANT-OVERHEAD COSTS	(1000$/YR)	321.	321.	321.	321.	321.	321.	321.	321.	321.	321.
FACTORY COSTS	(1000$/YR)	7794.	8705.	10059.	10572.	10755.	10820.	11003.	[illegible]	11171.	11385.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	7794.	8705.	10059.	10572.	10755.	10820.	11003.	[illegible]	11171.	11385.
UNIT PRODUCT COST	($/TON)	53.21	51.46	51.20	50.59	51.46	51.77	52.64	52.50	53.45	54.52

PLANT LIFE CALENDAR YEAR	(YEARS) (YEAR)	1 1977	2 1978	3 1979	4 1980	5 1981	6 1982	7 1983	8 1984	9 1985	10 1986
BY-PRODUCTS CREDITS											
([illegible])											
PRICE	($/TON)	[illegible]	[illegible]	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
AMOUNT	(TONS/YR)	[illegible]	3002.	[illegible]	4200.	4200.	4200.	4200.	4200.	4200.	4200.
VALUE	(1000$/YR)	441.	510.	597.	630.	630.	630.	630.	630.	630.	630.
(OFF GAS)											
PRICE	($/TON)	7.40	7.40	7.40	7.40	7.40	11.10	11.10	11.10	11.10	11.10
AMOUNT	(TONS/YR)	[illegible]	11170.	12972.	13000.	13000.	13000.	13000.	13000.	13000.	13000.
VALUE	(1000$/YR)	71.	83.	96.	192.	192.	153.	153.	153.	153.	153.
([illegible])											
PRICE	($/TON)	17.00	17.00	17.00	17.00	17.00	23.00	23.00	23.00	23.00	23.00
AMOUNT	(TONS/YR)	[illegible]	81.	[illegible]	100.	100.	100.	100.	100.	100.	100.
VALUE	(1000$/YR)	1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
GROSS PRODUCT COST											
ANNUAL GROSS PRODUCT COST	(1000$/YR)	7271.	8851.	[illegible]	[illegible]	10021.	[illegible]	10717.	[illegible]	[illegible]	[illegible]
UNIT GROSS PRODUCT COST	($/TON)	[illegible]	[illegible]	47.60	47.07	47.95	48.91	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	1	2	3	4	5	6	7	8	9	10
		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
[illegible]											
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	([illegible])	1	2	3	4	5	6	7	8	9	10
[illegible]	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
BY-PRODUCTS CREDITS											
([illegible])											
PRICE	($/[illegible])	7.00	7.00	7.00	7.00	7.00	11.10	11.10	11.10	11.10	11.10
AMOUNT	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VALUE	([illegible])	30.	36.	39.	41.	41.	42.	42.	42.	52.	52.
([illegible])											
PRICE	($/[illegible])	26.00	26.00	25.00	25.00	26.00	27.00	27.00	28.00	28.00	29.00
AMOUNT	([illegible])	72069.	[illegible]	[illegible]	106200.	106200.	106200.	106200.	106200.	106200.	106200.
VALUE	([illegible])	1791.	[illegible]	[illegible]	[illegible]	[illegible]	2013.	2013.	[illegible]	[illegible]	[illegible]
GROSS PRODUCT COST											
ANNUAL GROSS PRODUCT COST	([illegible])	[illegible]	[illegible]	12700.	[illegible]	13100.	[illegible]	[illegible]	[illegible]	[illegible]	13352.
UNIT GROSS PRODUCT COST	($/[illegible])	[illegible]	292.9[illegible]	[illegible]	[illegible]	269.21	266.17	[illegible]	267.44	267.34	[illegible]

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDER YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986

SALES VALUE

(BENZENE)

(1) DOMESTIC											
SALES PRICE	($/TON)	63.00	65.00	66.00	66.00	67.00	68.00	69.00	70.00	72.00	73.00
SALES AMOUNT	(TONS/YR)	[illegible]	[illegible]	47000.	50000.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES VALUE	(1000$/YR)	2275.	2633.	3102.	3300.	3350.	3400.	3450.	3500.	3600.	3650.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	2275.	2633.	3102.	3300.	3350.	3400.	3450.	3500.	3600.	3650.

(P-XYLENE)

(1) DOMESTIC											
SALES PRICE	($/TON)	232.00	234.00	236.00	238.00	240.00	243.00	244.00	246.00	250.00	252.00
SALES AMOUNT	(TONS/YR)	[illegible]	40000.	47400.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES VALUE	(1000$/YR)	9130.	9367.	11186.	12044.	12144.	12247.	12300.	12350.	12600.	12731.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	9130.	9367.	11186.	12044.	12144.	12247.	12300.	12350.	12600.	12731.

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

	END OF YEAR 1900		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 8.27	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. & CONST	75	-2	14000.	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION	77	1	2100.	*2	10395.	10446.	-52.	0.	-52.	1307.	1255.	0.92363	1159.	15151.
START-UP	78	2	0.		12180.	11443.	737.	332.	405.	1307.	1712.	0.85306	1461.	
	79	3	0.		14200.	12700.	1580.	711.	869.	1307.	2176.	0.78794	1715.	
	80	4	0.		15346.	13305.	1961.	897.	1070.	1307.	2385.	0.72777	1736.	
	81	5	0.		15696.	13100.	2396.	1051.	1295.	1307.	2592.	0.67219	1742.	
	82	6	0.		15867.	13300.	2339.	1053.	1286.	1307.	2593.	0.62086	1610.	
	83	7	0.		15840.	13397.	2451.	1103.	1348.	1307.	2655.	0.57344	1522.	
	84	8	0.		16090.	13302.	2667.	1200.	1467.	1307.	2774.	0.52965	1469.	
	85	9	0.		16200.	13367.	2833.	1275.	1558.	1307.	2865.	0.48920	1401.	
	86	10	0.	*3	16791.	13352.	2999.	1349.	1649.	1307.	2956.	0.45184	1336.	
			0.	*4									15151.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 8.3 %

PROCESS UNIT	CHR	UNIT
CAPACITY	26400.	TONS/YR
PLANT LIFE	10	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	80.	%
WORKING CAPITAL	100.	%
	UNIFORM	
TAX		
INCOME TAX RATE	45.	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	10.	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.50	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.00	%
YEARS TO PAY	3.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	0. % 33. % 0. %	
INVESTMENT COSTS		
MATERIAL	0.	1000$
FREIGHT	0.	1000$
ENGINEERING AND CONSTRUCTION	1000.	1000$
PROCESS INVESTMENT COSTS	1000.	1000$
INTERESTS DURING CONSTRUCTION	0.	1000$
CONTINGENCIES	0.	1000$
ROYALTIES	0.	1000$
START-UP EXPENSES	0.	1000$
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	0.	1000$
SPARE PARTS	0.	1000$
BATTERY LIMITS	1000.	1000$
OFF-SITE	200.	1000$
BUILDING	0.	1000$
DEPRECIABLE INVESTMENT COSTS	1200.	1000$
LAND	0.	1000$
TOTAL INVESTMENT COSTS	1200.	1000$
WORKING CAPITAL	200.	1000$

YEARS OF OPERATION											
PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
STREAM FACTOR	(-)	0.7?	0.81	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ANNUAL PRODUCTION	(TONS/YR)	1946?.	21384.	24816.	26400.	26400.	26400.	26400.	26400.	26400.	26400.
DIRECT PRODUCTION COSTS											
(1) RAW MATERIALS											
BENZENE	(1000$/YR)	1118.	1390.	1576.	1673.	1698.	1723.	1765.	1776.	1825.	1850.
HYDROGEN	(1000$/YR)	123.	116.	134.	143.	143.	143.	143.	143.	143.	143.
(2) CATALYSTS AND CHEMICALS											
CAT CHEM	(1000$/YR)	14.	16.	19.	20.	20.	20.	20.	20.	20.	20.
(3) UTILITIES											
ELECTRICITY	(1000$/YR)	11.	13.	15.	16.	16.	20.	20.	20.	20.	20.
FUEL	(1000$/YR)	3.	4.	4.	5.	5.	7.	7.	7.	7.	7.
COOLING WATER	(1000$/YR)	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
PROCESS WATER	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BOILER FEED WATER	(1000$/YR)	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
HP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MP. STEAM	(1000$/YR)	11.	13.	15.	16.	16.	17.	17.	17.	17.	17.
LP. STEAM	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(4) OPERATING LABOR AND SUPERVISION	(1000$/YR)	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
(5) RUNNING ROYALTIES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL DIRECT PRODUCTION COSTS	(1000$/YR)	1273.	1516.	1780.	1900.	1914.	1966.	1977.	1997.	2048.	2073.
FIXED COSTS											
(1) DEPRECIATION											
BATTERY LIMITS	(1000$/YR)	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
OFF-SITE	(1000$/YR)	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
BUILDING	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) INTEREST PAYMENTS											
INT. ON TOTAL INV. COSTS	(1000$/YR)	72.	72.	72.	72.	62.	51.	41.	31.	21.	10.
INT. ON WORKING CAPITAL	(1000$/YR)	24.	16.	8.	0.	0.	0.	0.	0.	0.	0.
(3) MAINTENANCE AND REPAIRS	(1000$/YR)	36.	36.	36.	36.	36.	36.	36.	36.	36.	36.
(4) TAXES AND INSURANCE	(1000$/YR)	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
(5) LAND RENT	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL FIXED COSTS	(1000$/YR)	257.	240.	241.	233.	223.	213.	202.	192.	182.	172.
PLANT-OVERHEAD COSTS	(1000$/YR)	50.	60.	60.	60.	60.	60.	60.	60.	60.	60.
FACTORY COSTS	(1000$/YR)	1580.	1825.	2082.	2192.	2197.	2219.	2234.	2249.	2290.	2305.
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(2) DISTRIBUTION AND SELLING EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) RESEARCH AND DEVELOPMENT EXP.	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GENERAL EXPENSES	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	1580.	1825.	2082.	2187.	2197.	2215.	2234.	2249.	2290.	2305.
UNIT PRODUCT COST	($/TON)	86.74	85.36	83.89	82.84	83.21	83.9?	84.62	85.19	86.72	87.29

[illegible]	([illegible])	1	2	3	4	5	6	7	8	9	10
[illegible]	([illegible])	1977	[illegible]	1979	[illegible]	1981	1982	[illegible]	[illegible]	[illegible]	[illegible]
SALES [illegible]											
([illegible])											
(1) [illegible]											
SALES [illegible]	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	92.[illegible]	[illegible]	[illegible]	[illegible]	97.[illegible]
SALES [illegible]	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES [illegible]	([illegible])	[illegible]	[illegible]	2102.	[illegible]	237[illegible].	242[illegible].	[illegible]	[illegible]	[illegible]	[illegible]
(2) [illegible]											
SALES [illegible]	([illegible])	[illegible]	[illegible]	0.[illegible]	[illegible]	[illegible]	0.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES [illegible]	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	[illegible]
SALES [illegible]	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	[illegible]
(3) TOTAL SALES [illegible]	([illegible])	[illegible]	[illegible]	2102.	[illegible]	237[illegible].	242[illegible].	[illegible]	[illegible]	[illegible]	[illegible]

DISCOUNTED CASH FLOW CALCULATION RESULTS (NON TAX HOLIDAY)

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 7.6%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75 -2	1200. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77 1	200. *2	1573.	1550.	-17.	0.	-17.	113.	96.	0.92965	89.	1306.
	78 2	0.	1840.	1825.	16.	7.	9.	113.	122.	0.86[illegible]	105.	
	79 3	0.	2182.	2082.	101.	45.	55.	113.	169.	0.80294	135.	
	80 4	0.	2350.	2182.	168.	76.	92.	113.	206.	0.74625	153.	
	81 5	0.	2376.	2197.	179.	91.	88.	113.	212.	0.69365	147.	
	82 6	0.	2425.	2219.	210.	96.	115.	113.	229.	0.64471	147.	
	83 7	0.	2455.	2234.	221.	100.	122.	113.	235.	0.59923	141.	
	84 8	0.	2482.	2249.	233.	105.	128.	113.	241.	0.55696	134.	
	85 9	0.	2558.	2289.	265.	110.	135.	113.	248.	0.51766	128.	
	86 10	0. *3	2561.	2305.	256.	115.	141.	113.	254.	0.48114	122.	
		0. *4									1306.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 7.6 %

DISCOUNTED CASH FLOW CALCULATION RESULTS (TAX HOLIDAY)

	END OF YEAR 1900	INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE R = 9.6%	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
ENG. + CONST	75 -2	1200. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76 -1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
OPERATION START-UP	77 1	200. *2	1579.	1550.	-17.	0.	-17.	113.	96.	0.91252	87.	1320.
	78 2	0.	1860.	1825.	16.	0.	16.	113.	129.	0.83270	107.	
	79 3	0.	2187.	2082.	101.	0.	101.	113.	214.	0.75985	163.	
	80 4	0.	2390.	2182.	168.	0.	168.	113.	281.	0.69338	195.	
	81 5	0.	2376.	2197.	179.	0.	179.	113.	293.	0.63273	185.	
	82 6	0.	2425.	2219.	210.	96.	115.	113.	229.	0.57738	132.	
	83 7	0.	2455.	2234.	221.	100.	122.	113.	235.	0.52687	124.	
	84 8	0.	2482.	2249.	233.	105.	128.	113.	241.	0.48078	116.	
	85 9	0.	2558.	2289.	265.	110.	135.	113.	248.	0.43872	109.	
	86 10	0. *3	2561.	2305.	256.	115.	141.	113.	254.	0.40[illegible]	102.	
		0. *4									1320.	

*1) INVESTMENT COSTS
*2) WORKING CAPITAL
*3) SALVAGE VALUE
*4) LAND

RATE OF RETURN ON INVESTMENT 9.6 %

PROCESS UNIT	CAPROLACTAM	UNIT
CAPACITY	[illegible].	TONS/YR
PLANT LIFE	1?	YEARS
BORROWED CAPITAL		
TOTAL INVESTMENT COSTS	[illegible].	%
WORKING CAPITAL	[illegible].	%
TAX	UNIFORM	
INCOME TAX RATE	[illegible].	%
DEPRECIATION	STRAIGHT LINE METHOD	
YEARS TO DEPRECIATE	[illegible].	YEARS
INTEREST PAYMENTS		
INTEREST RATE ON TOTAL INVESTMENT COSTS	7.[illegible]	%
YEARS TO PAY	7.	YEARS
METHOD	UNIFORM-PRIN. ONLY	
INTEREST RATE ON WORKING CAPITAL	12.[illegible]	%
YEARS TO PAY	[illegible].	YEARS
METHOD	UNIFORM-PRIN. ONLY	
SALVAGE VALUE BATT.LIMITS,OFF-SITE,BUILDING	[illegible]. % 3?. % [illegible]. %	
INVESTMENT COSTS		
MATERIAL	[illegible].	[illegible]
FREIGHT	0.	[illegible]
ENGINEERING AND CONSTRUCTION	[illegible].	[illegible]
PROCESS INVESTMENT COSTS	[illegible].	[illegible]
INTERESTS DURING CONSTRUCTION	[illegible].	[illegible]
CONTINGENCIES	0.	[illegible]
ROYALTIES	0.	[illegible]
START-UP EXPENSES	[illegible].	[illegible]
INITIAL CHARGES OF CATALYSTS AND CHEMICALS	[illegible].	[illegible]
SPARE PARTS	0.	[illegible]
BATTERY LIMITS	[illegible].	[illegible]
OFF-SITE	[illegible].	[illegible]
BUILDING	[illegible].	[illegible]
DEPRECIABLE INVESTMENT COSTS	[illegible].	[illegible]
LAND	[illegible].	[illegible]
TOTAL INVESTMENT COSTS	[illegible].	[illegible]
WORKING CAPITAL	[illegible].	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL [illegible] COSTS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FIXED COSTS											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL FIXED COSTS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLANT-OVERHEAD COSTS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FACTORY COSTS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GENERAL EXPENSES											
(1) ADMINISTRATIVE EXPENSES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(2) DISTRIBUTION AND SELLING EXP.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(3) RESEARCH AND DEVELOPMENT EXP.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL GENERAL EXPENSES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL PRODUCT COST											
TOTAL ANNUAL PRODUCT COST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UNIT PRODUCT COST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PLANT LIFE CALENDAR YEAR	(YEARS) (YEAR)	1 [illegible]	2 [illegible]	3 [illegible]	4 [illegible]	5 [illegible]	6 [illegible]	7 [illegible]	8 [illegible]	9 [illegible]	10 [illegible]
SALES VALUE											
([illegible])											
(1) DOMESTIC											
SALES PRICE	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES AMOUNT	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SALES VALUE	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(2) EXPORT											
SALES PRICE	([illegible])	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	([illegible])	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	([illegible])	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DISCOUNTED CASH FLOW CALCULATION RESULTS (NO TAX HOLIDAY)

	END OF YEAR 19[illegible]		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 25.4%		
[illegible] • COSTS		-2	[illegible]	*1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	76	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible] START-UP	77	1	3540.	*2	21950.	15929.	5927.	2262.	2765.	1859.	4624.	0.79764	3688.	23311.
	78	2	0.		[illegible]	16756.	7113.	3233.	3915.	1859.	5774.	0.63623	3674.	
	79	3	0.		[illegible]	20807.	9775.	4390.	5376.	1859.	7235.	0.50749	3672.	
	80	4	0.		33370.	21909.	11461.	5150.	6304.	1859.	8163.	0.40479	3304.	
	81	5	0.		[illegible]	34510.	1562.	793.	859.	1859.	2718.	0.32288	878.	
	82	6	0.		[illegible]	22124.	12000.	5700.	6466.	1859.	[illegible]	0.25754	2275.	
	83	7	0.		35900.	22160.	13360.	6012.	7348.	1859.	9207.	0.20543	1891.	
	84	8	0.		36210.	22158.	14052.	6323.	7729.	1859.	9588.	0.16386	1571.	
	85	9	0.		36920.	22073.	14847.	6681.	8166.	1859.	10025.	0.13070	1310.	
	86	10	0.	*3	34920.	22304.	14916.	6712.	8204.	1859.	10063.	0.10425	1049.	
			0.	*4									23311.	

*1 INVESTMENT COSTS
*2 WORKING CAPITAL
*3 SALVAGE VALUE
*4 LAND

RATE OF RETURN ON INVESTMENT 25.4 %

DISCOUNTED CASH FLOW CALCULATION RESULTS TOTAL (NON TAX HOLIDAY)

END OF YEAR 19**		INVESTMENT	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
										-P = 11.3-		
75		-22[illegible]. *1	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
76	-1	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
77	1	62900. *2	139934.	131656.	6400.	6208.	192.	23040.	24140.	0.89808	21680.	270653.
78	2	0.	163737.	141984.	21753.	10022.	11731.	23040.	35679.	0.80655	20777.	
79	3	0.	197149.	154370.	42779.	19247.	23520.	23040.	47071.	0.72435	34306.	
80	4	0.	209348.	156425.	52923.	23015.	29100.	23040.	53055.	0.65053	34514.	
81	5	0.	21[illegible].	165610.	47276.	21274.	26002.	23040.	49950.	0.58423	29182.	
82	6	0.	215700.	155709.	55955.	20980.	32975.	23040.	56923.	0.52469	29867.	
83	7	0.	219975.	156550.	63024.	20721.	35103.	23040.	58051.	0.47121	27026.	
84	8	0.	[illegible]	152985.	67990.	30557.	37307.	23040.	61295.	0.42319	25939.	
85	9	0.	224100.	146095.	76263.	34317.	41963.	19230.	61193.	0.38006	23242.	
86	10	0. *3 *4	229[illegible].	145942.	78231.	35204.	43027.	19230.	62237.	0.34132	21243.	
											270050.	

*1 INVESTMENT COSTS
*2 WORKING CAPITAL
*3 SALVAGE VALUE
*4 LAND

RATE OF RETURN ON INVESTMENT 11.3 %

[illegible] CASH FLOW CALCULATIONS [illegible] TAX HOLIDAY

[illegible]	[illegible]	TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
									= 13.10		
[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible] -1	[illegible]	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible] 1	[illegible]	1[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	2[illegible].	[illegible].	[illegible]	21[illegible].	270713.
[illegible] 2	[illegible]	[illegible].	1[illegible].	21[illegible].	[illegible].	19010.	2[illegible].	[illegible].	0.70223	[illegible].	
[illegible]	[illegible]	1[illegible].	1[illegible].	[illegible].	13[illegible].	[illegible].	2[illegible].	[illegible].	0.[illegible]103	[illegible].	
[illegible]	[illegible]	2[illegible].	1[illegible].	[illegible].	121[illegible].	[illegible].	2[illegible].	[illegible].	0.[illegible]	[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	2[illegible].	[illegible].	0.[illegible]117	[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	2[illegible].	[illegible].	0.[illegible]	27[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	20721.	[illegible].	2[illegible].	[illegible].	0.[illegible]	[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	2[illegible].	[illegible].	0.3[illegible]	22[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	[illegible].	[illegible].	0.33113	20[illegible].	
[illegible]	[illegible]	[illegible].	1[illegible].	[illegible].	[illegible].	[illegible].	[illegible].	[illegible].	0.[illegible]	1[illegible].	
										2[illegible].	

[illegible] COSTS
[illegible] CAPITAL
[illegible]
[illegible]

[illegible] 13.1 [illegible]

[illegible]

[illegible]	[illegible]
PRODUCT	[illegible] PC INDUSTRY
PRODUCTS	[illegible] ECONOMIC SIZE

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	10	YEARS
[illegible]	[illegible]	%
[illegible]	[illegible]	%
[illegible]	[illegible]	%
[illegible]	STRAIGHT LINE METHOD	
[illegible]	10.	YEARS
[illegible]	[illegible]	%
[illegible]	[illegible]	YEARS
[illegible]	12.00	%
[illegible]	[illegible]	YEARS
[illegible]	[illegible]	%
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	[illegible]	10000
[illegible]	[illegible]	10000
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	0.	10000
[illegible]	27000.	10000
[illegible]	[illegible]	10000
[illegible]	0.	10000
[illegible]	[illegible]	10000
[illegible]	0.	10000
[illegible]	[illegible]	10000
[illegible]	[illegible]	10000

[illegible]	(units)	1	2	3	4	5	6	7	8	9	10
[illegible]	(YEARS)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
[illegible]	[illegible]	[illegible]	[illegible]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
[illegible]	[illegible]	[illegible]	[illegible]	104000.	104000.	104000.	104000.	104000.	104000.	104000.	104000.
[illegible]											
[illegible]	(1000$/YR)	2037.	2900.	2900.	2900.	2900.	3010.	3010.	3010.	3010.	3010.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	130.	192.	103.	103.	103.	199.	199.	199.	199.	199.
[illegible]	(1000$/YR)	103.	200.	225.	225.	225.	330.	330.	330.	330.	330.
[illegible]	(1000$/YR)	[illegible]	100.	117.	117.	117.	117.	117.	117.	117.	117.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	25.	25.	25.	25.	25.	25.	25.	25.
[illegible]	(1000$/YR)	20.	20.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	2527.	2020.	3842.	3842.	3842.	4563.	4563.	4563.	4563.	4563.
[illegible]											
[illegible]	(1000$/YR)	2700.	2700.	2700.	2700.	2700.	2700.	2700.	2700.	2700.	2700.
[illegible]	(1000$/YR)	530.	530.	530.	530.	530.	530.	530.	530.	530.	530.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	2097.	2097.	2097.	2097.	1797.	1490.	1190.	890.	599.	300.
[illegible]	(1000$/YR)	732.	400.	200.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	1049.	1049.	1049.	1049.	1049.	1049.	1049.	1049.	1049.	1049.
[illegible]	(1000$/YR)	350.	350.	350.	350.	350.	350.	350.	350.	350.	350.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	7457.	7213.	6909.	6725.	6426.	6126.	5827.	5527.	5227.	4928.
[illegible]	(1000$/YR)	1740.	1740.	1740.	1740.	1740.	1740.	1740.	1740.	1740.	1740.
[illegible]	(1000$/YR)	11732.	11009.	11059.	11015.	11315.	12437.	12137.	11830.	11530.	11239.
[illegible]											
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL ANNUAL PRODUCT COST	(1000$/YR)	11732.	11009.	11059.	11015.	11315.	12437.	12137.	11830.	11530.	11239.
UNIT PRODUCT COST	($/T)	130.93	121.39	113.16	110.83	107.97	118.67	115.01	112.96	110.10	107.24

PLANT LIFE	(YEARS)	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	(YEAR)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
BY-PRODUCTS CREDITS											
[illegible]											
PRICE	($/TON)	8.00	8.00	8.00	8.00	8.00	11.50	11.50	11.50	11.50	11.50
AMOUNT	(TONS/YR)	175200.	203670.	219000.	219000.	219000.	219000.	219000.	219000.	219000.	219000.
VALUE	(1000$/YR)	1402.	1629.	1752.	1752.	1752.	2519.	2519.	2519.	2519.	2519.
[illegible]											
PRICE	($/TON)	19.40	19.80	20.10	20.40	20.80	22.10	22.50	22.90	23.30	23.80
AMOUNT	(TONS/YR)	25200.	29295.	31500.	31500.	31500.	31500.	31500.	31500.	31500.	31500.
VALUE	(1000$/YR)	489.	580.	633.	643.	655.	696.	709.	721.	734.	750.
MAIN PRODUCT COST											
ANNUAL MAIN PRODUCT COST	(1000$/YR)	9061.	9079.	9074.	9220.	8908.	9222.	8910.	8598.	8286.	7970.
UNIT MAIN PRODUCT COST	($/TON)	117.30	99.31	90.40	87.98	85.00	88.00	85.02	82.04	79.06	76.05

PLANT LIFE CALENDAR YEAR	(YEARS) (YEAR)	1 1977	2 1978	3 1979	4 1980	5 1981	6 1982	7 1983	8 1984	9 1985	10 1986
SALES VALUE											
(POLYETHYLENE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	[illegible]	101.00	101.00	101.00	101.00	103.00	103.00	103.00	103.00	103.00
SALES AMOUNT	(TONS/YR)	[illegible]	97663.	104000.	104000.	104000.	104000.	104000.	104000.	104000.	104000.
SALES VALUE	(1000$/YR)	[illegible]	9863.	10505.	10505.	10505.	10794.	10794.	10794.	10794.	10794.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	[illegible]	9863.	10505.	10505.	10505.	10794.	10794.	10794.	10794.	10794.
(POLYPROPYLENE)											
(1) DOMESTIC											
SALES PRICE	($/TON)	72.00	72.00	72.00	72.00	72.00	74.00	74.00	74.00	74.00	74.00
SALES AMOUNT	(TONS/YR)	21843.	25390.	27300.	27300.	27300.	27300.	27300.	27300.	27300.	27300.
SALES VALUE	(1000$/YR)	1572.	1828.	1966.	1966.	1966.	2020.	2020.	2020.	2020.	2020.
(2) EXPORT											
SALES PRICE	($/TON)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALES AMOUNT	(TONS/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VALUE	(1000$/YR)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
(3) TOTAL SALES VALUE	(1000$/YR)	1572.	1828.	1966.	1966.	1966.	2020.	2020.	2020.	2020.	2020.

DISCOUNTED CASH FLOW CALCULATION RESULTS — TAX HOLIDAY

	END OF YEAR 19[illegible]		INVESTMENT		TOTAL SALES VALUE	TOTAL PRODUCT COST	INCOME BEFORE TAX	INCOME TAX	INCOME AFTER TAX	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	PRESENT VALUE	PRESENT VALUE AT PROJ. START-UP
												R = 7.[illegible]		
[illegible] • CONSTR.	[illegible]	-2	[illegible]	01	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
	[illegible]	-1	0.		0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.
[illegible] START-UP	77	1	6130.	02	1[illegible]	[illegible]	194.	0.	19[illegible].	3230.	[illegible]	0.93037	3191.	[illegible]
	78	2	0.		11672.	[illegible]79.	1992.	0.	1992.	3230.	5223.	0.[illegible]	4921.	
	79	3	0.		12990.	[illegible]	3077.	0.	3077.	3230.	6307.	0.[illegible]533	5079.	
	80	4	0.		12990.	[illegible]20.	3330.	0.	3330.	3230.	6560.	0.[illegible]	4915.	
	81	5	0.		12990.	[illegible]	[illegible]2.	0.	[illegible]2.	3230.	6472.	0.[illegible]	4[illegible].	
	82	6	0.		1[illegible]	[illegible]27.	[illegible]2.	1617.	[illegible]	[illegible]	52[illegible].	0.[illegible]	[illegible]	
	83	7	0.		1[illegible]	[illegible]	[illegible]	1757.	2107.	3230.	5[illegible].	0.[illegible]	32[illegible].	
	84	8	0.		1[illegible]	[illegible]	4217.	1897.	2319.	3230.	[illegible]	0.[illegible]	3119.	
	85	9	0.		1[illegible]	[illegible]	[illegible]	2030.	[illegible]1.	3230.	5721.	0.52239	2[illegible].	
	86	10	0.	03	12[illegible].	7073.	[illegible]	2180.	[illegible]	3230.	[illegible]	0.[illegible]	2[illegible].	
			[illegible]	[illegible]									[illegible]	

01 [illegible]
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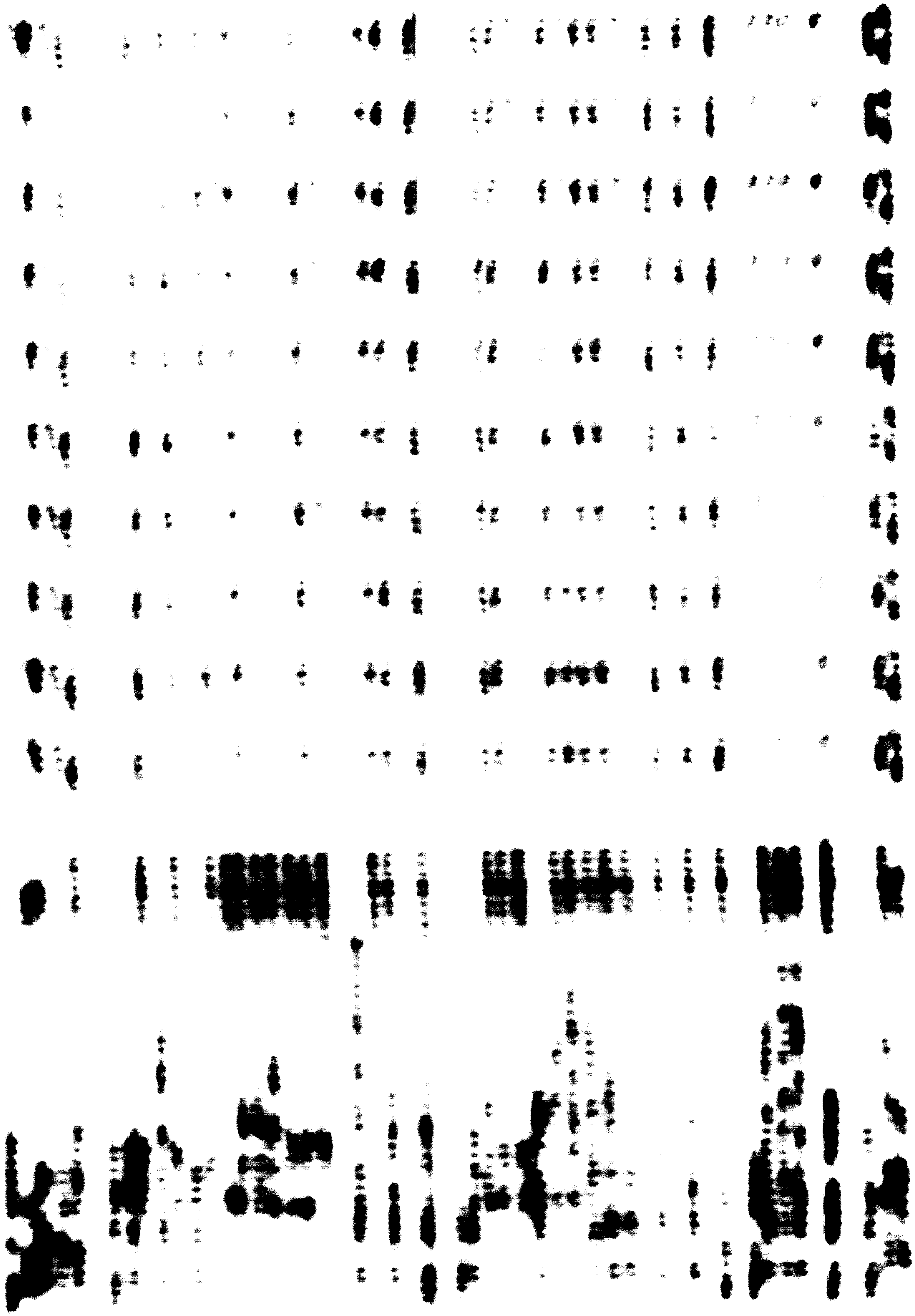

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