THE REPUBLIC OF INDONESIA

REPORT ON SURVEY OF DEVELOPMENT PLAN OF BASIC CHEMICAL INDUSTRIES

MARCH 1973

OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

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INTRODUCTION

The Government of Japan, in accordance with a request from the Government of the Republic of Indonesia has decided to cooperate in the drafting of a Second Five Year Development Plan for the Republic of Indonesia, by studying the possibilities of the development of a basic chemical industry in the Republic, after conducting a survey of its present basic chemical industries, and entrusted the actual work to the Overseas Technical Cooperation Agency.(O. T. C. A.)

OTCA, organized a survey team of 7 experts, headed by Mr. Masayoshi Hamazaki, Assistant General Manager of the Consulting Division of Toyo Engineering Corporation and conducted a field survey for a period of 37 days from September 4th to October 10th 1972.

The team conducted a survey of the existing basic chemical industries and their related industries on the islands of Java, Madura and Sumatra, and tried to establish, for the long future, how the basic chemical industry in the Republic of Indonesia should be, based on these findings.

This report has been put together from the findings of the survey, and we shall be very happy if this could be put to effective use as a development plan for the basic chemical industries in the Republic of Indonesia and consequently will contribute to the economic development of the Republic and also to the good-will between Indonesia and Japan.

In the end I would like to express my deep gratitude to the agencies, concerned of the Government of Republic of Indonesia, particularly the Department of Industry, extended their wholehearted support and cooperation to the survey team.

November 1972

Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency

CONTENTS

APPENDIX

CHAPTER 1 OBJECTIVE AND CONTENTS OF SURVEY

1-1 Organization of Survey Team

Leader (General Supervision)	Masayoshi Hamazaki (Assistant General Manager, Consulting Division, Toyo Engineering Corporation)
Members (Supply & Demand and Economic Survey)	Shiro Hasebe (Manager, Consulting Division, Toyo Engineering Corporation)
(Equipment Planning)	Koki Nakamura (Manager, Proposal Department, Construction Division, Toyo Engineering Corporation)
(Production Plan)	Masaaki Aoki (Chief, First Process Department, Construction Division, Toyo Engineering Corporation)
(Production Plan)	Hideo Ichida (Chief, First Process Department, Construction Division, Toyo Engineering Corporation)
(Survey of Salt Industry)	Masahito Yamaguchi (Chief, First Process Department, Construction Division, Toyo Engineering Corporation)
(Liaison and Accounting)	Yoshio Nakahira (Development Survey Division, Overseas Technical Cooperation Agency)

1-2 Objective of the Survey Team and Substance of Survey

1-2-1 Objective

This survey, made in compliance with a request from the Department of Industry, the Republic of Indonesia, aimed at a survey of the present state and future of basic chemical industries in Indonesia and an investigation of the possibilities of developing basic chemical industries in the Republic.

1-2-2 Substance of Survey

In view of the above objective, the substance may be summarized as follows:

A) present state of basic chemical industry and its evaluation

B) future of Indonesian soda industry

B-1) survey of salt industry in Indonesia

clarification of problems through survey of quality, capacity, prices, etc., and establishment of measures for improvement

B-2) problems of the soda industry

Investigate such problems as the balance between caustic soda and chlorine and the relation with related industries

B-3) demand forecast

forecast the demand of secondary salt derivatives industries (textiles, glass, etc.) and also that for primary derivative industries based on related projects presently being planned,

B-4) evaluation of forecast

evaluate forecasted values from the viewpoint of project finding.

C) examination of possibilities of new project

C-1) planning of project

planning of capacity, location, investment cost.

C-2) evaluation of project

evaluate project from the standpoint of international economy, national economy and each domestic industry.

1-3 Result of the Survey

1-3-1 In conducting our field survey, we were able to visit all places as planned thanks to the cooperation of the Department of Industry and the related corporations.

1-3-2 We have asked the Department of Industry for past statistical data and received almost complete data with exception of detailed demand according to item and industry.

1-3-3 Forecast of demand for chemical fibers was based on the results of "Survey of Rayon and Synthetic Fibers in the Republic of Indonesia" by OTCA.

1-3-4 Forecast of demand for MVC was obtained through preliminary consultations with the United Nations Survey Team (of the Petrochemical Industry in the Republic of Indonesia.)

1-3-5 In forecasting demand, it is normal to forecast future demands from past consumption, but, since the past statistic were not fully usable, we mainly relied on adding up our future plans, consulting a few published reports and actual Japanese data.

1-3-6 Reports from ICI, JETRO (Japan External Trade Organization), the World Bank and other sources were also consulted.

1-3-7 It is suggested that to perform more detail investigation and make feasibility study before implement recommendable project thereafter mentiond.

CHAPTER 2 CONCLUSION AND RECOMMENDATION

2-1 Outline of Basic Chemical Industry

Our team conducted a survey of the possibility of development of a basic chemical industry in Indonesia, and at the same time, investigated what kind of a new product should be started, its economic outlook, plant location, and others assuming that there is such a possibility.

Generally speaking, in forecasting future demand, growth of demand is judged, based on actual past consumption. However, since there is considerable discrepancy between past records and the present in Indonesia, we have forecasted future demand by also consulting various other surveys of the past.

The range of basic chemical industry is a very wide one, and we were requested by the Indonesian Government to conduct a survey on basic chemical industries starting with sea salt and related compounds, but, we also touched on other generally so-called basic chemical industries such as ammonia, methanol, sulfuric acid, phosphoric acid and others. We have also related on the possibilities of collecting bromine, gypsum and magnesium from sea water and bittern.

As regards the ammonia industry, it will be used for the production of urea and ammonium sulfate as fertilizer and its use as material for caprolactam will also be opened with the establishment of a petrochemical industry in the 1980s.

As for the methanol industry, since Indonesia is a producer of natural gas and oil, the production of urea resin for textiles, paper pulp and plywood from existing urea and formalin, may also be a promising enterprise.

The sulfuric acid industry is mostly for fertilizer and production will increase with future establishments of new fertilizer plants. Furthermore, industrial use will also be developed with the development of the textile industry in the late 1970s.

As for the phosphoric acid industry, we would like to expect the realization of the phosphatic fertilizer industry plan which the Indonesian Government it now pushing, and at the same time, hope that the manufacture of tripolyphosphoric acid for synthetic detergents and the use of gypsum be also considered. That is about 650,000 tons of gypsum is gained as a by-product from the planned phosphatic fertilizer plant. Gypsum may be used for cement and building materials such as plaster boards.

The most common usage of sea water is for the manufacture of salt. According to what we have found out through research after our return to Japan, the collection of bromine and magnesium carbonate from sea water or bittern requires small equipment and is simple, whereas the collection of magnesium hydroxide requires considerable equipment with not so simple an operation and therefore, we would not recommend it. Since bromine has many uses such as for insecticides and medical drugs, and magnesium carbonate is used for medical drugs and fillers for rubber, we would like to recommend the collection of these two materials.

The soda and chlorine industries starting from common salt are the most important among the basic chemical industries which can use domestically produced raw materials and are closely related to the textile, glass, petrochemical, food and pharmaceutical industries which are expected to develop in the future. Since these industries are at present importing their basic materials, development of the Indonesian chemical industry cannot be expected without establishing a self sufficient source of these. Therefore, we will relate mainly about the basic chemical industry starting from common salt, namely the soda industry.

2-2 Specific Outlook of Common Salt and Related Industries

2-2-1 Caustic Soda

Caustic soda is used for the production of paper pulp, soap and monosodium glutamate. We have assumed that the construction plan for the new paper mills will be in accordance with the Indonesian Five Year Plan, providing the completion of the newsprint mill is estimated to be in 1976 and that of the kraft paper mill to be in 1978. Further construction of new paper mills during the 1980s will be necessary to keep a balance between demand and supply of paper.

We estimated the increase of demand for soap to be 3% per year, at a ratio of solid soap 1 to synthetic detergents 3.

The demand for monosodium glutamate was estimated to grow to 20,000 tons in 1980 from the present production of 7,200 tons.

We estimated as follows on the textile and related plans which may appear in the future. A 100 ton/day plant of terephthalic acid, which is the material for polyester, to start operating in 1978 and a 100 ton/day caprolactam plant, which is the material for nylon, to start operations in 1980.

The Asahan Aluminum Complex, for the realization of which the Indonesian Government is making a great effort, was estimated to start operations in 1980.

Based on the above estimates the demand for caustic soda will increase to 44,700 tons in 1976, 48,900 tons in 1978 and 121,300 tons in 1980.

2-2-2 Chlorine

Chlorine is used by itself in either liquid or gas form, and also in hydrochloric acid, bleaching powder and bleaching liquor. At present, most of it is consumed for paper pulp and monosodium glutamate, with a little used for sterilizing the water system.

The demand for hydrochloric acid almost parallels the growth of monosodium glutamate. However, when we think of the increased demand for various plastics, construction of a new vinyl chloride monomer plant is desirable. Therefore, we assumed that a 60,000 ton plant will start operating in 1978. In that case, the demand for chlorine in 1978 will be 54,250 tons.

2-2-3 Soda Ash

Almost all soda ash is used for production of glass. In the case of Indonesian glass industry, mostly smaller plants are engaged in reproducing bottles and tumblers from scrap glass. We heard that the total production of glass is 750 ton/day, with only one plant having a furnace, but, that plants to produce plate glass and bottles requiring furnaces will enter into operation in 1973 and 1974.

The production of glass in Indonesia will keep on increasing but further installation of furnaces is almost unthinkable. Although increased production of plate glass after 1980 is deemed necessary, the demand for soda ash in the near future is estimated to increase during 1973 and 1974 with little increase thereafter. That is, demand is thought to settle to somewhere around 40,000 tons a year from 1976 to 1979.

2-2-4 Common Salt

Indonesia once produced 700,000 tons of salt as its climate is suited for the solar evaporation process. The present production is about 400,000 tons, of which only 8,000 tons is used industrially, with the bulk used for food and fisheries.

A large quantity of industrial salt is required for the development of basic chemical industries, but, since supplying this from private salt fields is difficult, P.N. Garam has to undertake to do this. There were times when the production of P.N. Garam exceeded 440,000 tons, but they were estimating only 120,000 tons for 1972.

In order to fulfill the estimated demand for caustic soda and chlorine, 146,000 tons of salt is needed in 1976 and 226,000 tons in 1978. This means that P.N. Garam, which is estimating a production of 150,000 tons for next year, will have to increase production to 376,000 tons by 1978. If this cannot be accomplished, salt must be imported until the target is reached.

2-3 Master Plan for Development of Basic Chemical Industry

2-3-1 Objective of Development of Basic Chemical Industry

During the development stage of a chemical industry, basic raw materials are generally imported to produce the final product. The same applies to Indonesia. If we take the textile industry as an example, raw yarn is imported for spinning, weaving and finishing, and in the plastics industry also, chips and compounds are imported and processed.

The glass, paper pulp and soap industries also rely on importation of soda ash, caustic soda and bleaching powder which are their raw materials.

Indonesia, with a population of 120 million, and being endowed with such resources as natural gas and oil and also being suited for producing salt, should develop a chemical industry, making good use of these resources.

Our main objective is to start an industry, which will make use of existing resources, through domestic production of raw materials for the chemical industry, which are now being imported in large quantities. A plan has already been set and is steadily progressing for the development of the fertilizer industry which is the most elementary among those using natural gas and oil.
We would like to express our opinion on the projects concerning the acid and alkali industries which are related to the petrochemical industry, having a great future, and the presently developing chemical industries.

2-3-2 Priorities and Economic Effects of Thinkable Projects

Recommendations for a project of development of the soda industry is strictly based upon condition that development of the petrochemical and textile industries will take place.

The first thing to do is to start domestic production of raw materials through the development of the soda industry.

In order to do this, it is desirable to take the following two stages.

During the first stage a plant with a capacity of 80,000 tons in soda ash by the Solvay Process is to be completed by 1975 and start production of 40,000 tons of soda ash and 36,500 tons of caustic soda in 1976. The investment cost is estimated at 21 million dollars which, if managed by foreign loans, is repayable within 8 years, when considering only the foreign exchange balance. The savings in foreign exchange will reach $2,750,000 per year after deducting foreign payments. Imports of soda ash and caustic soda will be stopped by the completion of this project and may be filled by domestic supplies.

The second stage will call for construction of a plant in 1978 with a capacity of 47,000 tons of chlorine and 53,500 tons of caustic soda by electrolysis of salt. By the completion of this plant there will be a surplus of 49,200 tons of caustic soda in 1978 and 1979. However, if the Asahan Project enters into operation in 1980, there will be a shortage of about 24,000 tons of caustic soda, which will have to be imported.

If we assume that, among the petrochemical industries, MVC will enter into production in 1978, this project will become an absolute necessity.

The investment cost is about 25 million dollars and is repayable in only 2.2 years if only the foreign exchange balance is taken into consideration, and the resulting savings in foreign exchange will be $11,260,000 a year after deducting foreign payments.

According to our tentative calculations, the product cost by the Solvay process will be $178 per ton for caustic soda and $88 per ton for soda ash and is comparatively high. However, if operated at no profit until completion of the next plant, the cost of chlorine and caustic soda by electrolysis will be very low and if we pool the costs of both plants, according to simple mathematic calculations, the foreign payments can be made within 3.2 years. That means from a national point of view, an annual saving of $14,000,000 can be realized on an investment of 46 million dollars.

To show one example of production cost in this case, if the salt cost is 3,000 Rp, the cost of soda ash will be $88 per ton, that of caustic soda $125 per ton and that of chlorine $96 per ton.

Next comes the constructions of a chain of projects such as the petrochemical and the synthetic fibers industries. This will be as follows:

1977 Construction of a plant with a capacity of 60,000 tons of MVC and 100 tons per day of terephtalic acid.

1979 Construction of a plant with a capacity of 100 ton/day of caprolactam. This will firmly establish the foundation for the Indonesian textile industry and greatly contribute toward the national economy through increased employment and savings in foreign exchange.
The above industries will require ammonia and sulfuric acid, but, at the same time, will produce ammonium sulfate as a by-product.

The third will be production of industrial salt. The demand for industrial salt will go from 146,000 tons in 1976 to 226,000 tons in 1978.

An effort by P.N. Garam is required, but moreover desirable is for the industry to produce a high grade (95% or better) product which can be sold at a cost of about 3,000 Rp per ton. If this cannot be achieved, it may be necessary to consider importing foreign salt. But the alkali industry must be developed even if the salt has to be imported.

The paper and pulp project can be counted as the fourth project. This means starting operations of a mill to produce 60,000 tons of newsprint in 1976 and 60,000 tons of kraft paper in 1978. These papers are now dependent on imports and it has been assumed that 64,000 tons of kraft paper will be required when the fertilizer plant project is completed.

2-3-3 Plant Location

It is quite difficult to decide on a location after having surveyed for only one month, but if we may make a rather broad judgement, after having visited Medan, Palembang, Jakarta, Surabaya and Bandung, we would likt to recommend the Surabaya Area for soda ash plant.

The alkali and petrochemical industries and further the nitrogenous fertilizer industry are all closely related and really should form one chemical complex, furthermore should consider what kind of raw material is used for petrochemical industry.

These plants have a great advantage that the raw materials and products are interchangeable, and therefore, an area, where the basic raw materials which are salt, coke and naphtha can be easily obtained should be selected.

Also, it is easier to move the products, which are resin chips, yarn, caustic soda, soda ash and others, than to transport raw materials. It should not be forgotten that transportation cost comes high.

Jakarta is also considered quite worthy as an industrial city, but, it is already overly congested and may have to yield to Surabaya because of such problems as pollution.

Fortunately, there exist large cement and fertilizer plants in the Gresik area and it may be one idea to form a petrochemical complex around these.

CHAPTER 3 OUTLOOK OF BASIC CHEMICAL INDUSTRY

The field of basic chemical industry is very wide and it is difficult to make a simple definition. But, considering the conditions of self sufficiency of raw materials, that it should be something related to other Indonesian industries and something that is not technically difficult, we would like to limit the field to the following:

Ammonia Industry
Methanol Industry
Phosphoric Acid Industry
Salt and related Industries, the so-called Alkali Industry

The above will be considered as basic chemical industries and be the subject of our studies. These industries have been developed through close interrelationships and interchangeability, and are particularly inseparable from the petrochemical industry, the development of which is expected in the future. For example, ammonia was mainly used for the production of fertilizers, but with the development of the petrochemical industry, it came to be used for the production of such as caprolactam and acrylonitril and advanced into the area of industrial use. Particularly, in the case of caprolactam, it is very closely related through the by-product ammonium sulfate. Also, the development of the petrochemical industry cannot be achieved without caustic soda and chlorine. We will state our outlook of the basic chemical industries hereunder.

3-1 Ammonia Industry

Ammonia has many uses such as for nitrogenous fertilizers, nitric acid, rayon, nylon, acrylonitril, hydrazin, cooling agent, inorganic chemicals, ammonium nitrate explosives, cyanic acid for plating and others.

The production of ammonia in Indonesia is carried out only at the fertilizer plants of Pusri and Petrokimia Gresik and is used entirely for urea and ammonium sulfate only. The aggregate production of the two plants is 400 ton/day. The raw materials used are natural gas at Pusri and oil at Petrokimia Gresik. We heard that there is a surplus of 7,000 tons a year of ammonia at Petrokimia Gresik. We cannot quite understand to design a fertilizer plant where there will be a surplus of ammonia and sulfuric acid which are the materials, and this surplus should be used for producing fertilizers unless there are other purposes. If there is not enough equipment for the production of ammonium sulfate, we wish to recommend immediate installation for increased production of fertilizers. When the sulfuric acid which is considered as surplus is utilized, it will result in an additional production of about 20,000 tons of ammonium sulfate.

According to the OTCA Synthetic Fibers Survey Team, at the time they completed their survey of demands for textiles in Indonesia, they have recommended construction of equipment capable of producing 30,000 ton/year of caprolactam by 1980. If this should be realized, about 24,000 tons of ammonia will be used.

3-2 Methanol Industry

Methanol is produced from natural gas or naphtha and is mostly used as a disinfectant as formalin or to produce urea resin together with urea. This urea resin is used as an adhesive for plywood and for textile and paper treatment.

The lumber production of Indonesia has increased yearly from 1,983,000 cubic meters in 1966 to 7,684,000 cubic meters in 1970. Lumber is now a precious source for obtaining foreign currencies and the amount exported in 1971 reached $152,700,000. On the other hand, although only 858 tons (1969), plywood was imported.
The export of lumber will continue to increase, but a certain percentage should be processed into plywood, thereby raising the added value.

Also, according to the Indonesian Five Year Plan, the target for paper production is 165,000 tons and that for textiles is 900 million yards and these may be reached at least during the 1970s.

The import of methanol and monohydric alcohol is only 100,000 litres but all of the resin for textile and paper treatment is being imported. If, as stated above, export of lumber processed into plywood should be carried out, the demand for methanol will increase sharply.

The production of methanol is technically close to that of ammonia and the production of urea for fertilizer should reach 400,000 tons with the entering into production of the Pusri No. 2 Plant and the full production by Petrokimia Gresik in the near future. Then, it should be easy to obtain the material for urea resin. We will add, for reference, that the resin required for paper pulp is 0.3 - 2.5% of the pulp and that 250 gram per square meter is needed as an adhesive for plywood.

Taking the above into account, we would like to recommend a production plan for methanol, formalin and urea resin.

3-3 Sulfuric Acid Industry

As far as we have seen, there are at least five sulfuric acid plants operating in Indonesia. These are the 450 ton/day plant of Petrokimia Gresik, the two plants of 20 ton/day and 40 ton/day of Pertamina, and two more plants of 25 to 30 ton/day each.

Sulfuric acid is the basic material for the chemical industry, having an especially wide range of use in the fertilizer, textile and inorganic chemicals industries, in metal refining, steel manufacturing and food production. Sulfuric acid is produced at Petrokimia Gresik for ammonium sulfate, at Pertamina for refining of oil and at the two other plants, mainly for manufacture of aluminum sulfate. Construction of another 30 ton/day plant is also under way now.

1,300 tons of sufuric acid was imported in 1971, but, according to the production manager of Petrokimia Gresik, the designed capacity is 12,000 to 19,000 tons in excess of the requirements for ammonium sulfate. At the time of our visit they were in 75% operation the total demand for 1972 could be estimated at 120, 000 tons. Since it is believed that Petrokimia Gresik will enter into full production in 1973, the total demand will increase to 162, 000 tons.

The Indonesian Government is planning for a phosphate fertilizer plant using 145, 000 ton/year of phosphoric acid in its Five Year Plan. The completion of this plant, when looked at from a purely technical point of view laying aside other problems such as financing, can be estimated to be in 1976 and the start of operations in 1977. At this point, it is our assumption that the plant will enter into operations in 1977. This will mean that the amount of sulfuric acid required will be 400, 000 ton/year. That is, the total demand for sulfuric acid in 1977 will reach 572, 000 ton/year, and further, if the 100 ton/day caprolactam plant enters into operation in 1980, as suggested by the OTCA Textile Survey Team, an additional 50, 000 ton/year will be required. In other words the total Indonesian demand for sulfuric acid will reach 622, 000 ton/year.

If, as stated above, Petrokimia Gresik enters into operation from 1972, producing a surplus of sulfuric acid, and when we consider the surplus ammonia of the preceding paragraph, we would like to recommend that all of the surplus sulfuric acid and ammonia be converted into fertilizer by such methods as increasing the production capacity of ammonium sulfate. We will add that 20, 000 tons of ammonium sulfate can be produced from the surplus sulfuric acid.

It is common that the sulfuric acid to be used in the phosphatic fertilizer plant be produced by a integrated sulfuric acid plant and it is desirable to have additional equipment for the 50, 000 tons of sulfuric acid to be used for textiles installed at Petrokimia Gresik if a chemical industry complex is to be constructed in the Gresik area.

Since the amount of sulfuric acid used for such uses as for the manufacture of aluminum sulfate and batteries, other than for fertilizer or textiles, is quite small and there is danger in transporting it over a long distance, it's supply from a large plant is not necessarily advisable. Moreover, as the manufacturing equipment required for sulfuric acid is rather simple, we consider it advisable to construct separate plants for such minor uses.

3-4 Phosphoric Acid Industry

According to our survey, not only were statistics on import of phosphoric acid quite unclear, but, we were also unable to find any industry using it. If a phosphatic fertilizer plants is to enter into production from 1977 as stated above, it is possible to produce at the same time, tripolysodium phosphate from phosphoric acid and soda ash.

At present, the soap industry has just started to manufacture synthetic detergents and 130, 000 tons of soap is being manufactured in 1972. The annual growth rate is estimated at 3% and that there will be a demand for 141, 250 tons of solid soap and 34, 000 tons of synthetic detergent by 1980. There is a difference according to the quality, but the content of tripolysodium phosphate in detergents is between 20 to 35% and we can say that the average is 25%.
Therefore, the demand for tripolysodium phosphate in 1980 can be estimated to be between 8, 500 to 10, 000 tons. Also gypsum is produced as a by-product

of the phosphoric acid production and this volume is estimated to be about 650,000 tons.

Since 3% of gypsum is mixed in the manufacture of cement and the production of cement in Indonesia during the 1980s is estimated at 2.88 million tons, about 100,000 tons of gypsum will be used for cement production and the surplus can be used as building material in the form of plaster boards or used for other purposes.

3-5 Salt and Related Industries

Indonesian climate is suitable for the solar evaporation process and 600 to 700 thousand tons of sea salt was produced until several years ago. The solar process is the cheapest method to manufacture salt, and since labor is inexpensive, Indonesia should manufacture industrial salt at a low cost and use it for developing industries.

The industry starting from salt is called the soda industry or the chlorine industry, which means that it is an industry that produces soda and chlorine by the simplest and cheapest way. Generally speaking the following three methods are most commonly used.

1) Manufacture of caustic soda and chlorine by electrolysis of common salt.

2) The Solvay process of manufacturing soda ash and caustic soda from common salt, lime and ammonia.

3) The Dual process of manufacturing soda ash and ammonium chloride from common salt, ammonia and lime.

The cheapest method to manufacture caustic soda and chlorine among the above three is the electrolysis process, but, when there is a small demand for chlorine and a large demand for caustic soda, if caustic soda is produced by this process, there will be no use for the chlorine.

Therefore, we have to think of the Solvay process by which soda ash and caustic soda can be produced without producing chlorine, but, in this case, the production cost will be higher compared to the electrolysis process,

At present the dual process, which concurrently produces soda ash and ammonium chloride is being employed. Both soda ash and ammonium chloride can be produced at a low cost by this method, although there is a fault that it requires large quantities of ammonia (345 Kg per ton of ammonium chloride.).

The demand for caustic soda is in the order of soap, paper pulp, monosodium glutamate and textiles, for the Indonesian soda industry in 1972. The total demand estimated at 32,000 ton/years, small amount is produced only by P.N. Soda and the shortage is covered by imports. Even if P.N. Soda increases its production to 20 ton/day in 1974, 28,500 tons will have to be imported. If the Asahan Project is put into effect or the production of synthetic fibers starts in the latter half of the 1970s, the demand is estimated to rise to 121,000 ton/year.

On the other hand, the demand for chlorine is mainly for paper pulp, monosodium glutamate and water sterilization and the largest factor for increase in demand will be increased production and the change in raw material of monosodium glutamate. Aside from this, if the MVC plant enters into operation in 1978, a demand of 39,000 ton/year for MVC is expected and the demand for caustic soda and chlorine will almost balance at this point.

We heard that the glass industry of Indonesia reaches a daily production of 750 tons, but, only P.N. Iglas has a furnace and that almost all the soda is consumed by this plant. All of the soda ash, estimated at about 9,000 tons, is being imported. There are about 100 smaller glass factories in operation, aside from P.N. Iglas, but most of them are reproducing from scrap glass.

When we consider the fact that there are plants under construction and those which have approval for construction and that these will enter into operation, together with the demand for water glass for soap and paper and pulp, we wish to recommend a plant with a capacity of 40,000 tons of soda ic ash to enter into operation from 1976.

3-6 Government Policy on Developmen t of Industry

Increased national income and improved living conditions are emphasized in the basic concepts of the Five Year Development Plan of the Government.

The Government is advancing its farm centered development plan with increased food production as the basis, in accordance with this basic concept and its sober efforts are proving effective.

In executing the Five Year Plan, priorities were established as follows for each division of development, in order to make effective use of funds.

1. Increased agricultural production. (Expansion and reinforcement of rice fields and estates)

2. Reorganization and reconstruction of infrastructure, transportation, communication and electric power.

3. Agricultural promotion related industies (fertilizer, cement, etc.)

4. Industries to replace imports (textiles, paper pulp, tyres, building materials).

5. Mining (oil, natural gas and others).

The operation of the economy appears to be well and particularly in the increase of food production and self sufficiency of rice, the mainstay of the Five Year Plan, the goal has been reached and the development plans for fertilizers, cement and oil are also advancing smoothly.

Our survey team, as stated above, will concentrate on the basic chemical industries, in particular those starting from common salt and their related industries, as industries to replace imports, and relate on their estimated demands and necessary supply plans.

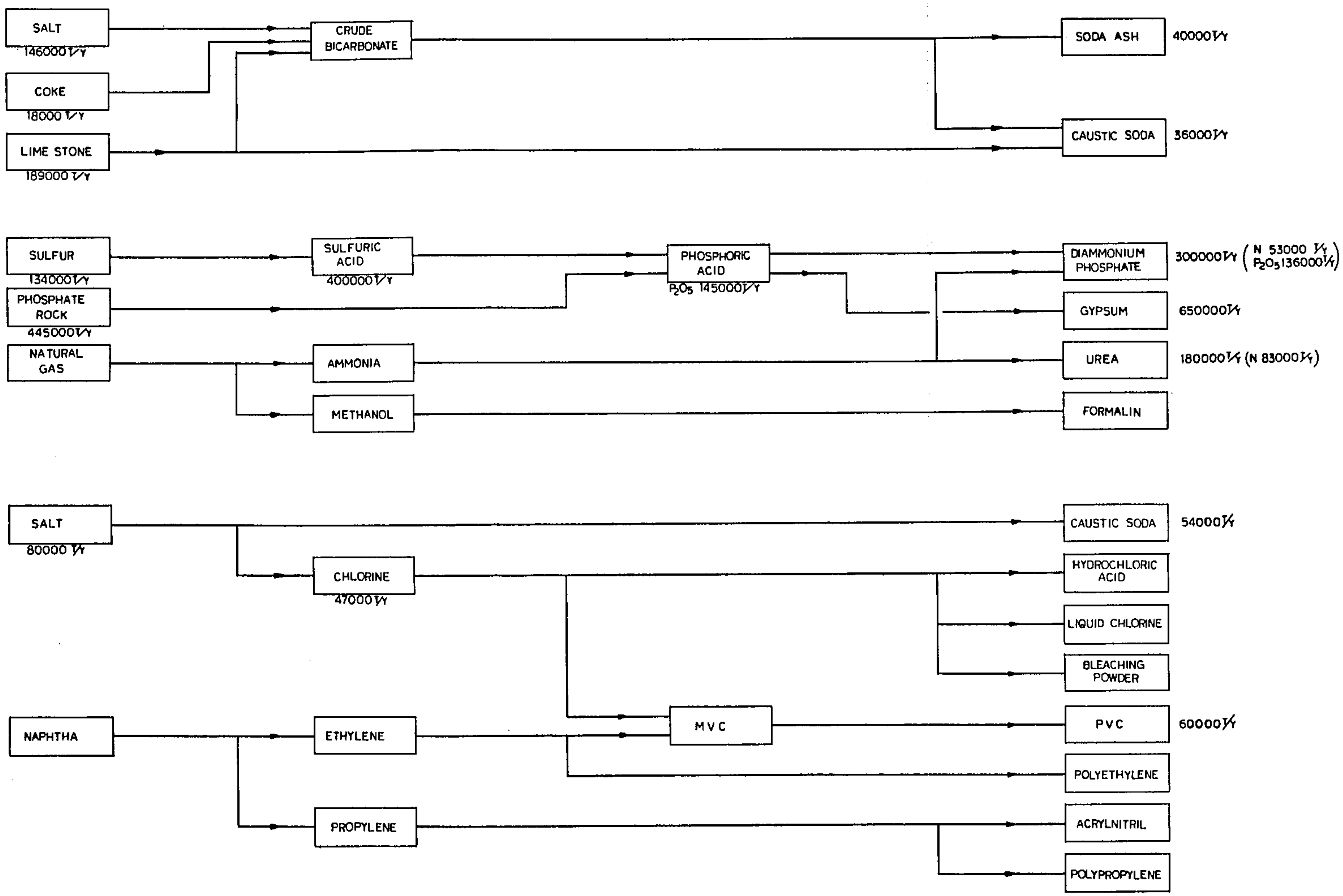
3-7 Wrap-up

So far we have related the outline of the basic chemical industries in Indonesia. Out of these, plans for fertilizer production have already been established for the ammonia, sulfuric acid and phosphoric acid industries, and the plan will be complete in outline with the completion of the phosphatic fertilizer plant, making all necessary fertilizer self sufficient by domestic production.

As for methanol production, the starting of construction should be decided upon establishment of a plan taking into consideration the demand and supply of natural gas and naphtha and the future demand for the products. Therefore, we will draw up our master plan, placing emphasis on the basic chemical industries starting from salt and making estimates up to around 1980. Also due to the desire of our clients, we will not delve deeply into the manufacture of salt, but we will append information on collection of gypsum, magnesium and bromine from sea water or bittern.

We will show the balance of demand and supply of raw materials and products relating to basic chemical industries in Chart 3-1.

FIGURE 3-1 BALANCE FIGURE OF RAW MATERIAL AND PRODUCT (EXPECTED PROJECT)



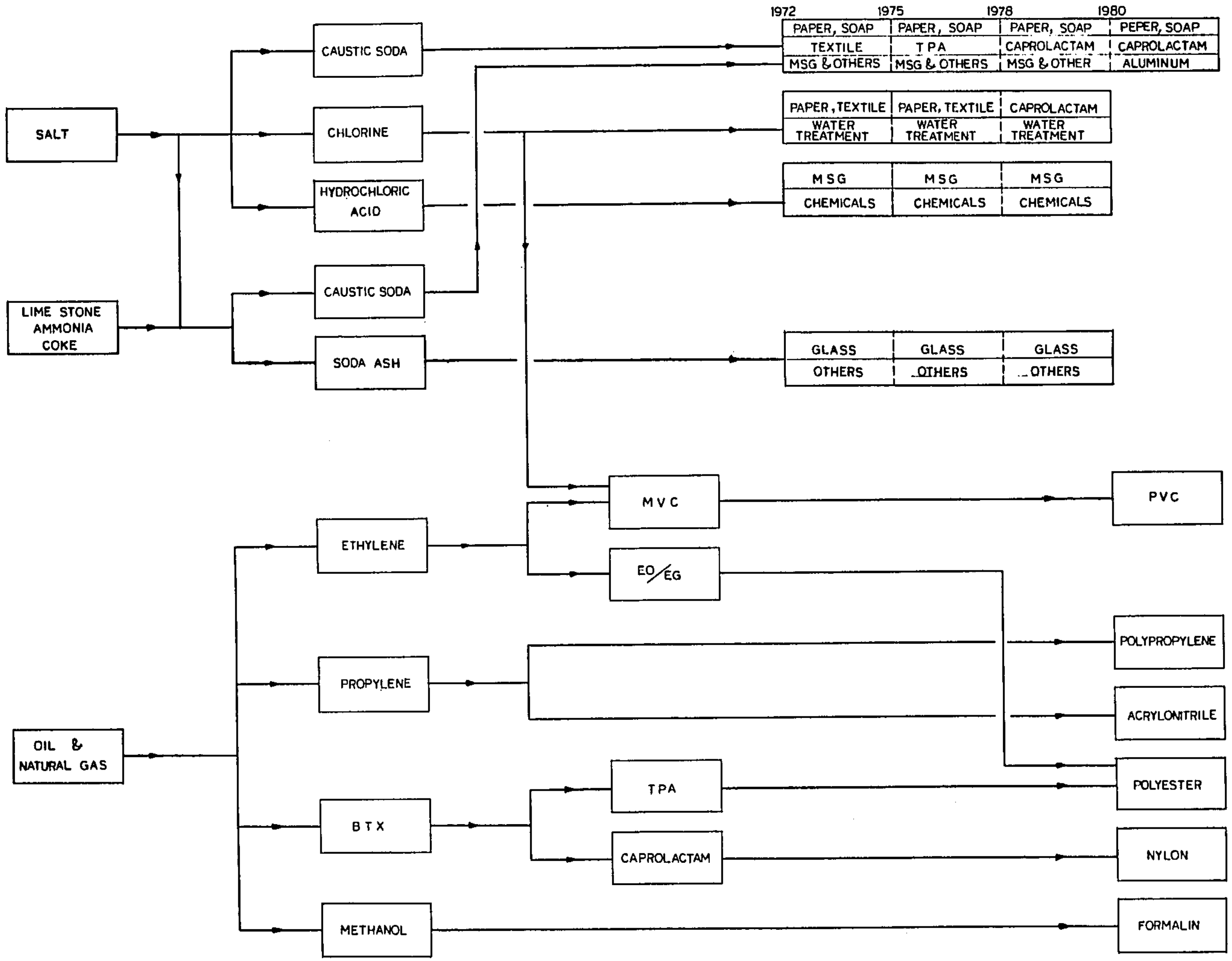


FIGURE 3-2 DEVEIOPMENT PLAN OF BASIC CHEMICAL INDUSTRY
(FROM 1972 TO 1980)

CHAPTER 4 OUTLOOK OF SODA AND CHLORINE RELATED INDUSTRIES

4-1 Outline of Soda Industry

The industry starting from common salt and called either the soda industry or the chlorine industry, among the basic chemical industries, is one which produces caustic soda or chlorine and soda ash from inexpensive common salt.

In the Indonesian salt industry, both private and state operations coexist, but neither product is suitable as industrial salt from the point of quality. The production of salt also has declined to 400,000 tons from a past 600,000 tons total of private and state operations, through decreased production of the state operation (which is about 120,000 tons for 1972).

If a soda industry is to be developed from common salt in the future, the demand for industrial salt can be estimated to reach about 230,000 tons and a plan for increased production will become necessary. Also it must be noted that domestic salt is higher in cost compared to salt produced in other coutries.

The Indonesian soda industry in 1972 has only P. N. Soda in production, manufacturing 10 tons of caustic soda and 8.8 tons of chlorine by the electrolysis process and producing hydrochloric acid, liquid chlorine and bleaching liquor from these. Already a plan to double this production has been decided on and increased production can be expected from 1974.

P. N. Soda, which completed its rehabilitation in 1969, had instability in its operations in the past, but we can expect stable production hereafter. At present, both caustic soda and chlorine are in shortage.

Soda ash is used by the glass industry, but there is no domestic production and all of it is imported.

The electrolysis process is the most inexpensive method for the soda and chlorine industries from common salt. However, 1,000 Kg of caustic soda and 880 Kg of chlorine, which is 88% of the caustic soda, can be obtained from 1,700 kilograms of salt and full operation cannot be expected unless the demands for these two balances. Also, when there is an overproduction of chlorine, there is no use for it, unless it can be exported as bleaching powder.

For that reason, there is the Solvay process which produces soda ash and caustic soda from lime, ammonia, coke and common salt without producing chlorine.

In an underdeveloped country, where there is a demand for caustic soda but small demand for chlorine, the Solvay process is employed, but it has faults in that it requires coke and lime and also that the cost is high. For those countries requiring ammonium chloride for fertilizer and other uses, there is the dual process which concurrently produces soda ash and ammonium chloride. Soda ash can be produced relatively cheaply by this method, but there is a problem in its requirement of ammonia and carbon dioxide. We will give the past actual figures and future demand estimates for the soda and chlorine related industries hereunder.

4-2 Past Results and Estimated Future Demands of Soda and Chlorine Related Industries

Since, it is necessary to grasp the actual facts about their related industries, in order to argue about the possible development of the basic chemical industries centered around soda and chlorine, we will first research the past consumption and make estimates of future demands of soap, paper, pulp, monosodium glutamate and glass industries.

In estimating future demands for a certain industry or product, the normal way is to make future estimates by calculating the demand growth rate on the basis of actual consumption for the past several years. However, since the past situation in Indonesia made it difficult to obtain satisfactory data and there also were items whose demand has rapidly increased in recent years, we made our estimates by including consideration of past conditions in Japan also. As the estimate for the demand for PVC was outside of our range of survey, we followed the opinions of other teams and as for textiles, we took the opinion of the OTCA Textiles Survey Team.

Furthermore, for past consumption, we have used the figures we received from the Department of Industry without altering them. Please refer to Table 4-1 in which we have shown the past consumption and estimated future demands for the above major related industries. We will continue our explanation hereunder in that order.

4-2-1 Soap

The production of soap in Indonesia is carried out by countless smaller companies and the only large manufacturer in Unilever.

The total production during 1971 is estimated at about 130,000 tons.

Since we were unable to find suitable data after having surveyed the Southeast Asian countries in trying to estimate the future demand for soap in Indonesia, we referred to Japanese data from 1956 to 1971 (refer to Chart 4-1, Chemical Almanac). As shown in the Chart, the average increase rate of caustic soda for detergents is only 1.5%, although the consumption of solid soap shows a yearly decline from 1956 against which synthetic detergents are showing a sharp increase. This fact shows that the increase rate will level off after having reached a certain level and parallel that of population growth thereafter. Also the per capita annual consumption of soap in Japan is 20 Kg whereas that in Indonesia is about 1 Kg. These figures almost coincide with the ratio of GNP between the two countries.

We estimated that the 3% annual increase that is double to the Japanese demand of soap will be at a ratio of solid soap 1 to synthetic detergents 3. According to our calculations based on these estimates, the demand around 1980 for solid soap made of oils and fats and caustic soda will be about 140,000 tons and that for synthetic detergents will be about 30,000 tons.

4-2-2 Paper and Pulp

As shown in Table 4-1 the demand for paper in 1971 was 153,000 tons and the past growth rate is estimated at 4 to 5%, but recently it has surpassed 10%. At present, as shown in Table 4-2, the total production for 1972 by P. N. Kertas Letjes and several other state operated companies is estimated at 39,200 tons, which is a shortage in excess of 100,000 tons and particularly no newsprint is produced domestically. A paper and pulp plant has to be carefully examined from the financial and material sides, and cannot be constructed within a short time.

A new plan for annual production of 60,000 tons of newsprint from bagasse and 60,000 tons of kraft paper is entered in the Indonesian Government's Five Year Plan and according to an estimate by the Chemical Industry Bureau, there will be a demand of 62,000 tons of kraft paper for cement and fertilizer in 1974. However, when we think of the various conditions, it would be reasonable to assume that 60,000 tons will be completed by 1975 and another 60,000 tons by 1977 at the earliest. In planning for a new plant, a scale of 200 ton/day may be ideal. Of the above mentioned plants, increased production of 1,500 ton/year of flimsy at P. N. Padalarang and 2,500 ton/year of writing paper at P. N. Letjes is expected, but we estimated that would be completed by the end of 1974 and have assumed that no increase of existing capacity will take place at the other mills.

If we show the estimate for probable domestic production based on the above estimates and assumptions, the domestic production after 1978 can be expected to be 168,000 tons. It is difficult to forecast the demand for the 1980s but if we assume the annual demand increase rate at 10% in accordance with the OTCA Paper and Pulp Survey Team, the total domestic demand in the 1980s can be considered to reach about 300,000 tons. Therefore, there will be a continued need for paper mills after 1980.

4-2-3 Monosodium Glutamate

Unfortunately we were unable to obtain past consumption records although we have asked the Department of Industry to collect them. The production of monosodium glutamate in 1972 is about 600 ton/month for an annual production of 7,200 tons as showin Table 4-2.

Manufacture of monosodium glutamate in Indonesia was done by importing crude glutamic acid and refininng it, but, since imports of this material was prohibited, the production method has to be changed to one starting from molasses.

The present production capacity is 2,400 tons at P. T. Ajinomoto, with eight other companies producing a total of 4,800 tons. P. T. Ajinomoto has already changed its raw material and we assumed that the other will complete the change-over in 1973.

We assumed that the production plans of the above companies will be as shown in Table 4-2 and the resulting estimate for 1978 reaches 20,000 tons. This increase rate is seemignly very large but we took upon ourseleves to use these figures because we found out, through our research, that this is completely in accord with the increase in consumption in Japan from 1957 to 1963.

4-2-4 Glass

The glass industry of Indonesia is composed of about 100 companies of which, in 1972, only P. N. Iglas has a furnace and a production of 20,800 tons. According to the director of P.N. Iglas, the overall production is 750 ton/day with all of the production being reproduction of scrap glass into bottles and tumblers and all plate glass being imported. At present P. T. Asahimas is constructing a plate glass plant, which is said to have a 75 ton/day capacity and is scheduled to enter into operation from 1973.

Besides the above, P. T. Kedaung and P. T. Kanggar are also both expected to enter into operation in 1973. We also heard that P. N. Iglas is planning to install an additional furnace, but we estimated the realization of this to take place in 1975.

Acçording to our estimates, if the above plans for increased production are realized, the production of glass made by furnaces alone will reach 73,800 tons after 1975, but no great increase can be expected from those plants reproducing from scrap glass.

Imports from 1961 to 1971 were all in plate glass and this shortage of supply will continue to exist even after P. T. Asahimas enters into operation.

4-2-5 Vinyl Chloride

It can be seen that the demand for vinyl chloride has rapidly increased from 1969. However, the figures showing actual imports for the years from 1961 to 1970 show the import of all plastics and only the figures for 1971 show PVC resin or compound which reached 15,000 tons. We have shown estimated demand figures only for PVC which is related to chlorine among the petrochemical resins, but, these figures were taken from surveys of other international organizations estimating 60,000 tons for 1978 and 80,000 tons for 1980. The growth rate that we calculated came to about 20%. So we just entered the figures for 20% increases starting from 15,000 tons in 1971.

4-2-6 Formic Acid

Formic acid can be easily made from caustic soda and carbon monoxide, but at present is dependent on imports. From actual figures we can see that imports are gradually decreasing. The decline of the rubber industry is cited as one of the reasons for this but the export of rubber during 1971 amounted to 200 million dollars and it still plays an important role in the acquisition of foreign currency. This chemical is necessary for the processing and finishing of rubber and textiles and an annual demand of four to five thousand tons is estimated for the future.

Among the companies that we visited there were those with plans to produce formic acid and we hope that these plans will be realized. In that case, if the plan were to be initiated now, production can be started in 1976 and a 15 ton/day plant may be suitable.

4-2-7 DDT and Agricultural Chemicals

DDT is necessary for stamping out malaria, but, since its manufacturing process is complicated it may be better to continue to import it in the future.

The imports of agricultural chemicals have increased sharply from 1961 but the breakdown of these is not clear.

Among the agricultural chemicals, the collection of bromine from sea water or bittern is a promising enterprise. Since the Indonesian Government is studying this now, and if the results are promising insecticides will be made with bromine as material, it will be worthwhile to make a study of this problem.

4-2-8 Textiles

The actual consumption and future demand estimates for cotton, rayon and synthetic fibers respectively are shown in Table 4-1, but the figures for future demand estimates were taken from the interim report of the OTCA Textile Survey Team.
According to this Team, the estimated figures for the rayon industry are as stated above, but it is added that further study of Material lumber and pulp is desirable and also that a minimum 50 ton/day scale is desirable for the mill.

As for lactam, construction of a 100 ton/day plant is desirable, but this is on the assumption that there is sufficient processing capacity, since the problem of spinning and other processes has to be considered. The same opinion was also raised for terephthalic acid, which is the material for polyster fiber.

The textile industry of Indonesia is of the type that imports yarn for processing and there is great merit in converting to domestic production of these yarns. However, at present the total spinning facilities of Indonesia are between 480 to 500 thousand spindles working on a daily three shift basis whereas the finishing processes such as dyeing and weaving have room to spare and are on a two shift basis.

A target for weaving 900 million square yards for 1973/74 is established in the Five Year Plan but according to JETRO the total supply for 1970 is 1,027,500,000 square meters, consisting of 506.5 million square meters of domestic production, 356 million square meters of imports and 165 million square meters of imports carried over from 1969. It is also said that roughly 50% of the 405,960,000 square meters of weaving yarn is now being supplied domestically. We tried to establish a reasonable schedule based on the interim report of the OTCA Textile Survey Team and have assumed that plants will be constructed as follows:

1978 100 ton/day terephthalic acid plant to enter into operation.

1980 100 ton/day caprolactam plant to enter into production and terephthalic acid plant to increase capacity by 50 ton/day.

4-2-9 Chlorine Products

The actual consumption and future demand estimates for chlorine products, i.e. bleaching liquor, bleaching powder, liquid chlorine and hydrochloric acid are shown in Table 4-1.

The largest consumption of chlorine products in Indonesia in 1972 is for the manufacture of paper and pulp. However, assuming that the change of raw material for monosodium glutamate is completed in 1974 and increased production will start, the largest consumption of chlorine products after 1974 will be for monosodium glutamate.

Hydrochloric acid is used for monosodium glutamate and bleaching liquor, bleaching powder and liquid chlorine are used for bleaching paper pulp. Bleaching powder or liquid chlorine is used for sterilizing water but opinions differ for each city water department and both will continue to be used on a case by case basis in the future also. According to the Director of Production of the Water Department in Jakarta, the total water supply for all of Indonesia in 1972 is 11,000 litre/second but they are aiming to increase this to 15,000 litre/second in the 1980s.

Chlorine is manufactured by the electrolysis process at P. N. Soda but the operation was unstable until completion of the rehabilitation in 1971 and the price is also high. Whether for this reason or not, we do not know, but according to our survey, some paper mills are making plans to produce enough chlorine for their own consumption and have recieved approval for construction from the Department of Industry.

The greatest demand for chlorine up to 1977 will be for monosodium glutamate, but if we assume that the 60,000 ton MVC plant enters into operation in 1978, 39,000 tons of chlorine will be required for this. When constructing the MVC plant, if it is constructed separately from the salt electrolysis plant, transportation will be a problem as the quantity is large. Therefore it is desirable that the electrolysis plant be constructed adjacent to the MVC plant or to form a chemical plant complex and construct adjoining plants.

(Table 4-1)

Forecast of Consumption and Demand of Soda Related Industries

Item	Source	1961	1963	1965	1967	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Soap	Import	249	93	135	5,196	871	1,816	3,046									
	Domestic			248,000	171,000	133,678	130,910	130,666	(131,000)	(132,000)	(133,000)	(134,000)	(135,000)	(136,000)	(137,000)	(139,000)	(140,000)
1)	Total	249	93	248,135	176,196	134,549	132,726	133,712	134,000	138,000	142,000	146,000	151,000	155,000	160,000	165,000	170,000
Paper	Import	106,679	66,768	66,373	69,524	92,391	113,962	129,951									
	Domestic		11,070	11,193	8,678	14,308	21,727	23,460	39,200	39,200	39,200	48,200	108,200	108,200	168,200	168,200	168,200
2)	Total	106,679	77,838	77,566	78,202	106,699	135,689	153,411									
Glass	Import	14,957	11,953	22,646	8,658	22,051	25,474	32,022									
	Domestic								28,800	52,900	70,500	73,800	73,800	73,800	73,800	73,800	73,800
3)	Total	14,957	11,953	22,646	8,658	22,051	25,474	32,022									
Monosodium Glutamate	Import																
	Domestic																
4)	Total								7,200	7,200	9,600	9,600	14,400	14,400	20,000	20,000	20,000
Polyvinyl Chloride	Import	4,537	9,954	7,391	14,314	60,788	47,568	15,121									
	Domestic																
5)	Total								18,500	22,500	27,000	33,000	40,000	49,000	60,000	70,000	80,000
Chlorine																	
Bleaching Liquor		410	306	128	340	531	1,075	1,230									
Bleaching Powder		933	2,329	467	2,138	1,918	1,490	1,210									
Liquid Chlorine		193,2	44.8	67	133.2	61.9	84	341									
Hydrochloric Acid		125	275	475	340	320	458	455									
6) Total Converted to Cl_2		1,661.2	2,954.8	1,137	2,951.2	2,830.9	3,094	3,236	4,650	5,250	8,900	9,350	12,000	12,200	54,250	54,250	54,550
Textiles 7)		18,166	7,355	15,103	19,037	33,441	32,487	45,122	147,060	164,590	184,230	206,290	231,060	258,670	289,680	324,480	363,380
Formic Acid	Import	884	6,747	5,291	2,117	4,672	2,884	2,635									
	Domestic												4,500	4,500	4,500	4,500	4,500
8)	Total	884	6,747	5,291	2,117	4,672	2,884	2,635					4,500	4,500	4,500	4,500	4,500
Agricultural Chemicals	Import	12,592	12,542	7,724	16,119	23,855	35,298	48,560									
	Domestic																
	Total	12,592	12,542	7,724	16,119	23,855	45,298	48,560									

(Remarks)

1) The increase of demand for soap was considered at 3%. The figures in ( ) after 1972 show solid soap, i.e. the forecast figure less the figures in parenthesis will be that of synthetic detergents.

2) We showed the possibility of increased production up to 1980 on the demand for paper. The demand growth rate for the past ten years showed an average of 3.7% and that for the last three years was 12%. If we assume that the average growth up to 1980 will be 7% the demand is estimated to reach 300,000 tons.

3) In the production of glass we only showed increases in furnaces. It is considered that the increased demand, with the exception of that for plate glass, can be filled by domestic production through increase in furnaces and reproduction from scrap glass.

4) The past actual consumption of monosodium glutamate is not clear, but, the demand growth of Japan in the 1950 was taken as reference, because of the fact that 600 ton/month is being produced now in Indonesia.

5) The figures of the past for PVC represent raw materials for all plastics and only the figures for 1971 show that of PVC resin. The future demand forecast was based on figures from other domestic organizations

6) The demand forecast for chlorine related products was all converted into 100% chlorine.

7) The growth of demand for textiles was made pursuant to that of the OTCA Textile Survey Team. Also, actual consumption for the past combines cottons and synthetics.

8) Formic acid is shown with the intent to have a plant using csustic soda as material and having sufficient capacity for the rubber and dyestuffs industries to be established.

9) As regards agricultural chemicals, we were unable to classify them although we understood that much chemicals were being imported from import statistics. These figures were only presented for future reference when domestic production will be planned and also for reference in the use of bromine and chlorine.

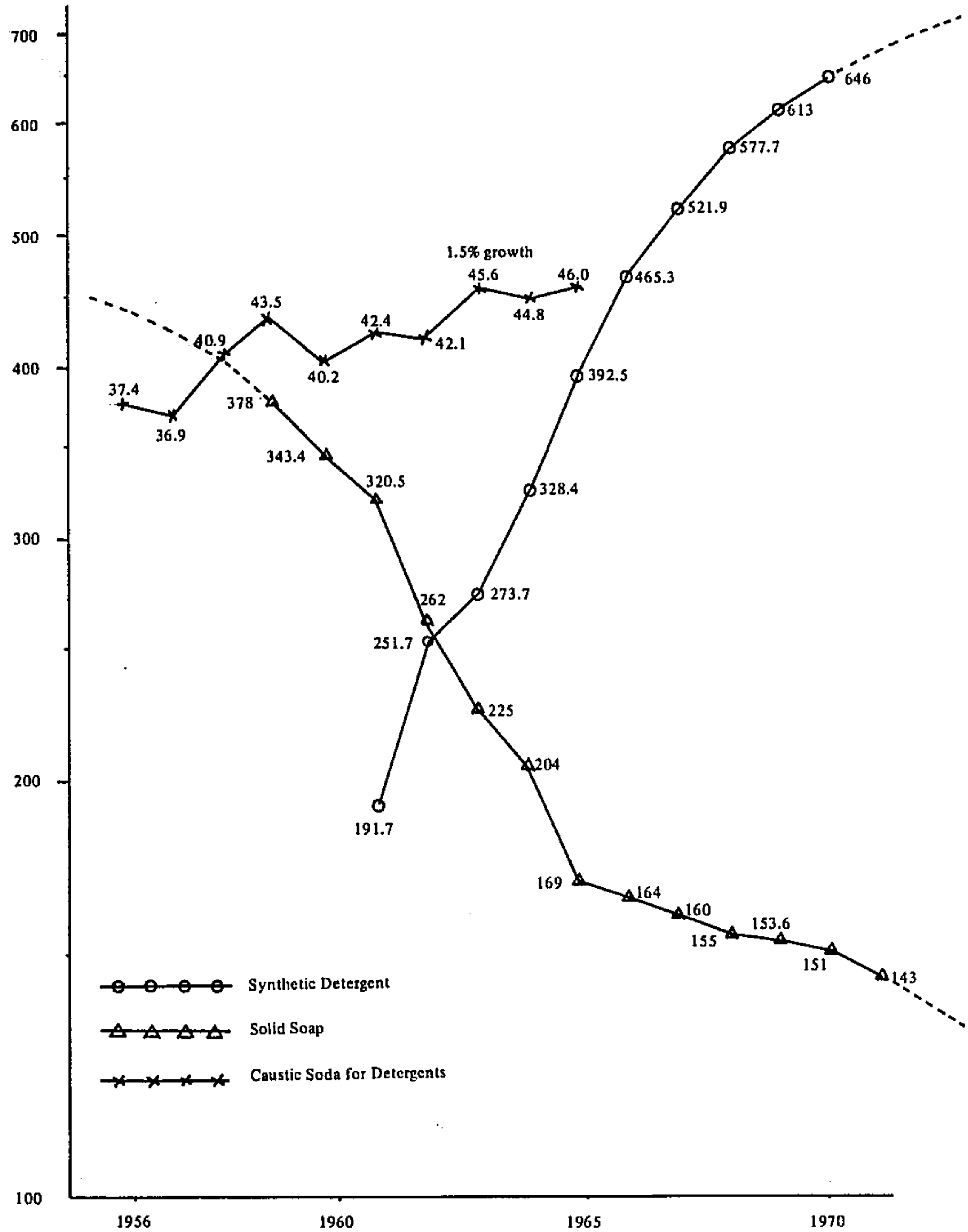
10) The figures from surveys by the Indonesian Department of Industry were used as they were for past actual consumption.

(Table 4-2)

Demand Forecast for Soda and Chlorine Related Industries

	Plant	Present Capacity	1972	1973	1974	1975	1976	1977	1978	1979	1980	Remarks
M.S.G.	P.T. Ajinomoto	200 T/M	* 1,200/6M 1,200/6M	2,400	4,800 *	4,800	7,200	7,200	12,000	12,000	12,000	* Conversion of Raw Material from October 1972
	Others M.S.G.	400 T/M	4,800	4,800	4,800	4,800	7,200	7,200	8,000	8,000	8,000	* Conversion of Raw Material
	Total		7,200	7,200	9,600	9,600	14,400	14,400	20,000	20,000	20,000	
Pulp & Paper	Blabag (Straw)	20 T/D	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	
		Pulp 3000 T/Y	3,200	3,200	3,200	4,700	4,700	4,700	4,700	4,700	4,700	Imported Pulp 1,000 T/Y
	Padalarang (Straw)	Paper 3500 T/Y	4,200	4,200	4,200	5,700	5,700	5,700	5,700	5,700	5,700	
		15 T/D + 25 T/D										
	Letjes (Straw)	=40 T/D	12,000	12,000	12,000	19,500	19,500	19,500	19,500	19,500	19,500	
	Gowa (Bamboo)	30 T/D	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	
	Banjuwangi (Bamboo)	30 T/D	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	
	New Plant (Bagasse)						60,000	60,000	60,000	60,000	60,000	Newsprint
	New Plant								60,000	60,000	60,000	Kraft Paper
	Total		39,200	39,200	39,200	48,200	108,200	108,200	168,200	168,200	168,200	
Glass	P.T Kedaung	25 T/D	-	9,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100	Tumbler
	P.T. Kanggar	50 T/D	-	18,200	18,200	18,200	18,200	18,200	18,200	18,200	18,200	Bottles
	P.T Asahimas	75 T/D	-	16,400	23,200	27,300	27,300	27,300	27,300	27,300	27,300	Plate Glass Bottles
	P.N. Iglass (Surabaya)	80 T/D	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	Tumblers
	P.N. Iglass (Jakarta)	75 T/D	-			27,300	27,300	27,300	27,300	27,300	27,300	
	Total		35,000	78,700	85,500	116,900	116,900	116,900	116,900	116,900	116,900	
Textile	Rayon		6,190	7,380	8,670	9,560	10,840	12,210	13,550	15,040	16,690	
	Lactam		10,350	12,980	15,670	18,460	21.280	24,410	27,330	30,620	34.390	
	T.P.A.		24,260	31,410	38,670	45,940	53,400	61,550	68,930	77,210	86,470	
	Total											
Others	Formic Acid						4,500	4,500	4,500	4,500	4,500	15 T/D (NaOH 0.975 t/t)

(Chart 4-1) Actual Consumption of Detergents in Japan



CHAPTER 5 OUTLOOK OF ALKALI AND ACID INDUSTRIES

Since we have put together the results of our survey in Tables 5-1 and 5-2 and Charts 5-1 through 5-4, we would like to explain in detail along these tables and charts.

5-1 Outlook of Alkali Industry

5-1-1 Sea Salt

The actual production of common salt since 1961 is recorded in Table 5-1 but the figures in this Table exclude private production and deal only with P. N. Garam.

There must be good reasons for the ups and downs in the salt production of P. N. Garam, but, an all out effort to increase production and to lower costs must be made if a basic chemical industry based on common salt is to be developed. We will naturally admit that such an effort was already being made at the time we visited P. N. Garam in 1972 and hope that this effort will bear fruit.

As we will relate about salt production later in this report, we will not touch on that subject in this chapter.

Regarding estimates of future demands, the production of 1972 is estimated at 120, 000 tons and actual production may very well surpass this estimate.

We related on the estimated development of related industries in the preceding chapter and if we follow these estimates, a soda ash plant by the Solvay process is to enter into production in 1976 in order to curb imports of soda ash and caustic soda. Roughly 150, 000 tons of common salt is required for this and P. N. Garam will have to complete rehabilitation of its salt field so as to be able to produce 300, 000 tons of salt. Further, if in 1978 the MVC plant which is part of the petrochemical industry should enter into operation, an electrolysis plant will become necessary to fill the sharply increased demand for chlorine and 80, 000 tons of common salt will be needed for this The total demand for common salt at this point will reach 676, 000 tons, assuming that 300, 000 tons will be supplied by private salt fields. Also, if the Asahan Aluminum Production Plan now being planned by the Indonesian Government is realized, 70, 000 tons of caustic soda will be required. However, in that case, an electrolysis plant cannot be constructed unless some industry needing chlorine is started, and the shortage of caustic soda will have to be covered by imports. Therefore, the total requirement of industrial salt in Indonesia is estimated at about 230, 000 tons. Provided that private production will continue to supply the common salt which is in shortage as it is doing now, a production of 380, 000 tons must be undertaken by P. N. Garam in 1978.

5-1-2 Caustic Soda

We showed actual consumption and estimated demand of caustic soda in Table 5-1. The consumption over the past ten years shows almost no change and is about 30, 000 tons. Only P. N. Soda is in production and judging from past consumption it must have been operating at less than 50% of capacity. As its rehabilitation has been completed,we expect it to enter into normal operations from 1972. Furthermore the double expantion plan was accepted by the government, so from 1976 P. N. Soda will produce 6, 000 tons of caustic soda. The demand is for monosodium glutamate, paper, pulp, soap and textiles and we shall explain the estimate for the years 1972 through 1980.

The quantity of caustic soda used for the production of monosodium glutamate will increase in proportion to the increase of the product.

We have assumed for the paper and pulp industry, that existing plants will equip their own electrolysis process plants during 1974. We consider the construction plan of newsprint and kraft paper mills in accordance with the Five Year Development Plan of the Indonesian Government a very significant project from a national point of view and expect that these will be completed in 1975 and 1977 respectively. However, we have judged that it would be more convenient to adopt a process which does not require caustic soda, even when these mills are completed, and therefore, have assumed that there will be no increase in the demand for paper and pulp after 1977.

In calculating demand of caustic soda for soap, we estimated the growth rate of the demand at an annual 3% with the ratio of the growth rate of synthetic detergents to that of solid soap at 3 to 1. If we assume the demand in 1972 to be 135, 000 tons, there will be an increase of 36, 000 tons by 1980, and as one fourth of that will be produced as solid soap, the increased demand for caustic soda in 1980 will be 1, 700 tons. In order to avoid the complexity of increasing small figures for each year in this Table, we have shown increases of 1, 700 tons from 1976.

We quoted from talks at K. T. S. M. (P. T. Kanebo Tomen Sandang Synthetic Mills) on the 1972 demand of caustic soda for the textile industry. That is K. T. S. M. alone uses 30 tons a month and since K. T. S. M. has a 25% share of textiles in Indonesia, we have judged the annual consumption of caustic soda to be 1, 500 tons.

As the textile mills under construction now will enter into operation from 1973 and the production of nylon and polyester fabrics is expected to double, we put the demand for caustic soda up to 1976 at 3, 000 tons. In case the polyester 100 ton/day plant enters into operation in 1978, in accordance with the OTCA Textile Survey Team's report, 1,400 tons of caustic soda will be required. Also, if we assume that the construction of a 100 ton/day caprolactam plant and a 50 ton/day increase of polyester production is carried out in 1980, the total demand for caustic soda for textiles will reach 6, 800 tons.

Formic acid is used as a congealing agent for rubber, an auxiliary agent for dyeing and tanning of leather. Judging from statistics, imports appear to be gradually decreasing since 1963, but it is considered necessary to continue imports of at least 3, 000 tons. According to data of JETRO, the production of rubber was 750, 000 tons in 1966, 776, 000 tons in 1969 and 750, 000 tons in 1970, and on the other hand, exports show a yearly decrease from a peak of $337, 200, 000 in 1960 to $213, 500, 000 in 1970, and $199, 400, 000 in 1971, but this is thought to be due to the decline in international prices.

We will also add that the use of auxiliary agents will increase in the future *with the development of the textile industry.*

The production of formic acid is not such a difficult task and among manufacturers that we have visited there were those who have plans for production of formic acid. We considered it worthwhile to construct a formic acid plant in Indonesia and assumed that at 4,500 ton/year plant will enter into production around 1975. We will add that 4,400 tons of caustic soda is needed for an annual production of 4,500 tons of formic acid.

The Relation with the Asahan Project

The Indonesian Government has a plan to produce 200,000 tons of aluminum from bauxite and is making efforts towards the realization, but since the timing is unknown and about 70,000 tons of caustic soda is required for production of 400,000 tons of almina from bauxite, when we consider the total chlorine requirement in 1980 for MVC and the textile industry, the production of caustic soda in Indonesia will be limited to a maximum of 98,000 tons unless some other chlorine related industries are developed, it will be impossible to produce domestically the 70,000 tons of caustic soda required for the Asahan Project.
In case the Asahan Project is realized in 1980, the total demand of caustic soda will be about 121,000 tons and there will be a shortage of 23,000 tons even when a 36,000 ton production by the Solvay process begins from 1976 and 54,000 tons by the electrolysis process from 1978. However, according to this Table there will be surplus productions of about 49,000 tons each in 1978 and 1979, but we will relate on the disposition of this surplus later.

5-1-3 Soda Ash

Almost all of the demand for soda ash is taken by the glass industry. We heard that the Indonesian glass industry produces 750 tons per day, but, that there are many smaller companies which do not have furnaces and use scrap glass for material. Only P.N. Iglas has a furnace and is producing bottoles and tumblers, with a 96 ton/day production in 1972. This means that 9,500 tons of soda ash is consumed at this plant and all of it is being imported.

The 3 plants, including a plate glass plant, which are under construction now are expected to enter into operation in 1973 and the demand for soda ash will be 24,500 tons if we estimate the operational rate at 50 to 60% for the first year. We also assumed that these plants will enter into full operation in 1975 and also that the construction plan of a new 75 ton/day furnace by P.N. Iglas will be approved and will enter into operation in 1975. In this case, the demand for soda ash will be about 37,000 tons. We estimate that there will be no change until 1980 because no increase in furnace can be expected for the time being.

The other item is water glass. Water glass has a wide range of uses such as compounding agent for soap, accelerator for cement, cleaner for paper pulp and iron casting. According to statistics for 1971, 6,000 tons of water glass has been imported but its uses are not clear.

There are two companies which have received approval for the construction from the Indonesian Government to enter into production of 12,000 tons per year respectively, with one company estimated to enter into operation in 1974 and the other in 1976. Even though the demand for water glass in Indonesia is not clear, we assumed that both plants will produce a total of 12,000 tons for the time being, although they may enter into full production in the future, then the soda ash required for this will be 4,800 tons. If 60,000 tons of newsprint is to be produced from bagasse from 1976, 650 tons of water glass and 1,300 tons of sodium thiosulfate will be required and the necessary soda ash for this will be 970 tons (almost 1,000 tons).

5-2 Outlook of the Acid Industry

5-2-1 Chlorine, Bleaching Powder and Hydrochloric Acid

The Industry producing caustic soda and chlorine from salt by the electrolysis process is called the electrolytic soda industry. There are three stages in the development of an electrolytic soda industry.

The so-called first stage is the age of inorganic chemicals, where there is a demand for caustic soda mainly for soap, paper, pulp and rayon and the only use for chlorine is for sterilization of water and for insecticides, therefore, resulting in a shortage of caustic soda and a surplus of chlorine, which is the underdeveloped nation type.

The second stage is where both the inorganic and organic chemical industries have been developed and where the demand and supply of caustic soda and chlorine are balanced. This is called the developing nation type.

The third stage is where the organic chemical industry has been highly developed and the demand for chlorine surpasses that for caustic soda. This is the so-called advanced nation type.

The soda industry of Indonesia is in a transitional period from the underdeveloped to developing nation type. As the demand for alkali still exceeds that for chlorine in Indonesia during the 1970s and the capacity of an electrolysis plant is limited by the demand for chlorine, in case of construction of a new plant, the production capacity and operation rate must be decided from the viewpoint of demand for chlorine. This is an electrolysis plant to balance with the demand for chlorine should be constructed and if it does not balance, a way to make up the shortage of alkali by employment of the Solvay or some other process should be considered.

A normal electrolytic plant has equipment for the manufacture of liquid chlorine, hydrochloric acid and bleaching powder or bleaching liquor. Hydrochloric acid is made by absorption of hydrogen chloride by water and is used for monosodium glutamate, dyes and their intermediaries, inorganic chemicals and pickling of steel materials. In Indonesia, it is mainly used for the production of monosodium glutamate.

Bleaching power is manufactured by the reaction of chlorine against slaked lime and can be classified into normal bleaching powder and strong bleaching powder, according to the contents of effective chlorine. Bleaching liquor is produced by blowing chlorine gas into lime milk. The main use of bleaching powder and liquor is for the paper pulp and textile industries and it is also used for sterilization of the city water systems. At present, plans for using chlorine gas for sterilization is being studied by the water departments of Jakarta, Surabaya and Bandung, but no unified opinion seems to have been reached.

Since industries to produce various plastics from imported materials are developing in Indonesia, we expect a 60,000 ton MVC plant to enter into operation in 1978.

We have shown the estimated demand for chlorine in Table 5-1. Naturally, bleaching powder, bleaching liquor and hydrochloric acid should be produced and marketed according to each respective purpose as stated above, but we have converted all figures herein to 100% chlorine. Chlorine is produced only at P. N. Soda and we have entered 5,300 tons as its production on the assumption that its production will be doubled in 1974.

The paper and pulp manufacturers are all said to have received approval from the Government to have their own equipment for chlorine production and we have supposed that these will all enter into production in 1975 with a capacity of 1,950 tons. That is, the domestic production for 1972 and 1973 respectively will be 2,650 tons by P. N. Soda and 5,300 tons in 1974 by P. N. Soda. If we assume that all the paper and pulp manufacturers install their own equipment for production of chlorine in 1975, this will come to 1,950 tons and the aggregate domestic production for 1975 will reach 7,250 tons.

We will hereunder state the basis for our estimated demand of chlorine products.

35% hydrochloric acid is used for monosodium glutamate. Up to 1972, crude glutamate was imported and refined. However, there is an active demand for monosodium glutamate in Indonesia and we have assumed that all monosodium glutamate manufacturers will change over their raw material to molasses by 1974. P. T. Ajinomoto has already completed the change over of raw material to molasses and has entered into production by the new process. By changing the raw material from crude glutamate to molasses the consumption of hydrochloric acid per 100 tons of product will increase from 20 to 160 tons. In calculating the consumption of hydrochloric acid for 1972, we assumed that during April through September of 1972 all of the 600 ton/month of monosodium glutamate will be made from crude glutamate and that during the period of October 1972 to April 1973, the 200 ton/month by P. T. Ajinomoto will use molasses as raw material and all the other monosodium glutamate manufacturers will use crude glutamate for their production of 400 ton/month and we further assumed that the production of monosodium glutamate will increase to 9,500 tons in 1974 with all of that using molasses for raw material.

We estimated that the production of monosodium glutamate will increase to 14,400 tons annually in 1976 and 1977 and to 20,000 tons after 1978, which is almost the same as the demand for Japan in 1962.

The amount of bleaching powder or liquor used for paper pulp differs with the raw material of pulp. In 1972, there are in Indonesia 2 mills making paper from bamboo and 3 mills from straw and other materials and we have varied the amount of chlorine in our calculations. We expect the newsprint plant from bagasse to enter into operation in 1978 and that for kraft paper from wood in 1980, but, since these paper do not require bleaching, there will be no change in the usage of chlorine. Therefore, the demand for chlorine from 1972 to 1974 will be 1,650 ton/year and will increase to 1,950 tons from 1975.

Sterilization of City Water

Bleaching powder is used for sterilizing city water and in some cases, sterilization by chlorine gas is also done. The amount of chlorine added for sterilization varies according to the water department, but our survey shows that the Water Department of Jakarta adds to its water 1.5 gram/ton, that of Surabaya 2 gram/ton and that of Tjirebon, 2-3 gram/ton. Also the amount of water supplies is 5,000 litre/second in Jakarta, 1,570 litre/second in Surabaya and 11,000 litre/second for all of Indonesia, according to the Water Department.

The City Water Department of Jakarta is planning to increase the supply from 5,000 litre/second to 9,000 litre/second by 1980 and to increase the supply for all of Indonesia to 15,000 litre/second. If we calculate the amount of chlorine required for sterilization of city water from the above, it will be 500 ton/year when the supply is 11,000 litre/second and 710 ton/year at 15,000 litre/second. In the Table we have entered 550 tons each for the year 1972 through 1979 for the sake of convenience, and adjustments of minor increases can be made with "others" column.

It is needless to say that bleaching powder is also used for drinking wells aside from city water departments. However, since this amount is not clear we have entered it into the "others" column.

5-2-2 Sulfuric Acid

The manufacturers of sulfuric acid in Indonesia in 1972 are Pertamina, Indonesian Acid Industry LTD. and one other, and Petrokimia Gresik. We have shown the estimated demand for sulfuric acid in Table 5-2.

The production capacity is 60 ton/day at Pertamina, 25 ton/day at IAI with the one other manufacturer estimated to be about the same and 400 ton/day at Petrokimia Gresik. The largest use is for ammonium sulfate and Pertamina uses it for the refining of oil and IAI and the other use it for aluminum sulfate and batteries. If the phosphate fertilizer and textile industries are constructed in the future, a further large amount of sulfuric acid will be used.

The amount of imports has gradually increased from 1961, reaching 1,314 tons in 1971. Therefore, the total potential capacity of sulfuric acid in Indonesia in 1972 can be calculated to be an aggregate of 120,000 tons by adding the sub-total of 30,000 tons from the 60 ton/day production by Pertamina, 25 ton/day by IAI and one other to the 90,000 tons produced by Petrokimia Gresik from May. Naturally, this will make imports unnecessary.

Petrokimia Gresik is expected to enter into full production in 1973, producing 132,000 tons. The 30 ton/day plant now under construction by IAI will enter into operation by 1974, but since the use of the product is not clear, we assumed an increased production of 7,000 tons.

Construction of a phosphate fertilizer plant is planned in the First Five Year Plan, the capacity of which we understand to be 145,000 tons of P_2O_5. The sulfuric acid required for this plant will be 400,000 tons.

Also, if the formic acid plant which we have recommended is constructed, 3,200 tons of sulfuric acid will be needed for this also.

If we assume that the above plants will enter into operation from 1977, the increased use of sulfuric acid for that year will be 400,000 tons and the total demand for 1977 will reach 572,200 tons. In case a 100 ton/day caprolactam plant is constructed in 1980, 49,000 tons of sulfuric acid will be required. In other words, the demand for sulfuric acid in 1980 will increase by 49,000 tons bringing the total to 621,000 tons.

It is desirable to connect the equipments for producing these large amounts of sulfuric acid with the plants using them or construct them adjoining the plants, in order, not only to save the transportation cost, but also to avoid trouble en route or in handling.

Since it is difficult to produce sulphur in Indonesia, the necessary sulphur will have to be imported. As it is not too difficult to transport sulphur and as the construction cost of a small scale sulfuric acid plant is low and the operation is simple, it may be better to construct necessary plants at the required sites.

(Table 5-1)

Actual Consumption and Forecasted Demand for Acid and Alkali

Item	Source	1961	1963	1965	1967	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Salt (as 90%)	Import					1,575	116	-									
	Domestic	444,658	444,390	230,372	88,345	185,500	62,890	42,198	120,000	150,000	150,000	150,000	296,000	296,000	376,000	376,000	376,000
For Soda Ash, Caustic Soda	Demand												(146,000)				
For Caustic Soda,P V C Chlorine															(80,000)		
	Total	444,658	444,390	230,372	88,345	187,075	63,070	42,198	120,000	150,000	150,000	150,000	296,000	296,000	376,000	376,000	376,000
Caustic Soda (as 100%)	Import	33,609	23,100	11,882	23,451	18,029	34,335	28,839									
			(671)	(618)	(501)	(445)	(709)	(1,639)					36,500		53,500		
(40%)	Domestic		1,677	1,544	1,252	1,112	1,772	4,099	3,000	3,000	6,000	8,200	8,200	44.700	44,700	98,200	98,200
For M.S. G. (as 100%)	Demand								3,600	3,600	4,800	4,800	7,200	7.200	10,000	10,000	10,000
For Paper & Pulp (")									7,100	7,100	7,100	8,900	8,900	8,900	8,900	8,900	8,900
For Soap (")									19,500	19,500	19,500	19,500	21,200	21,200	21,200	21,200	21,200
For Textile (")									1,500	3,000	3,000	3,000	3,000	3,000	4,400	4,400	6,800
For Formic Acid (")												4,400	4,400	4,400	4,400	4,400	4,400
For Aluminum Refining (")																	70,000
	Total	33,609	23,771	12,500	23,952	18,474	35,044	30,478	31,700	33,700	34,400	40,600	44,700	44,700	48,900	48,900	121,300
					(168)		(1-6)										
Soda Ash	Import				6,128	6,672	6,428	9,000									
For Glass Industries	Domestic												40,000	40,000	40,000	40,000	40,000
For Water Glass and Others	Demand								9,500	24,500	31,600	31,600	31.600	31,600	31,600	31,600	31,600
											3,400	3,400	5,900	5,900	5,900	5,900	5,900
	Total				6,128	6,672	6,428	9,000	9,500	24,500	35,000	35,000	37,500	37,500	37,500	37,500	37,500
Chlorine	Import																
	Domestic					288	490	1,137	2,650	2,650	5,300	7,250	7,250	7,250	7,250	7,250	7,250
For M.S.G (As Chlorine)	Demad								10,50	1,650	5,250	5,250	7,850	7,850	10,900	10,900	10,900
For Paper & Pulp (")									1,640	1,650	1,650	1,950	1.950	1,950	1,950	1,950	1,950
For Water Sterilization (")									550	550	550	550	550	550	550	550	550
For P V C (")									-	-	-	-	-	-	39,000	39,000	39,000
Others (")									1,400	1,400	1,450	1,600	1,650	1,850	1,850	1,850	1,850
	Total	1,661.2	2,954.8	1,137	2,951.2	2,830.9	3,094	3,314	4,640	5,250	8,900	9,350	12,000	12,200	54,250	54,250	54,250

(Table 5-2)

Actual Consumption and Forecasted Demand for Acid and Alkali

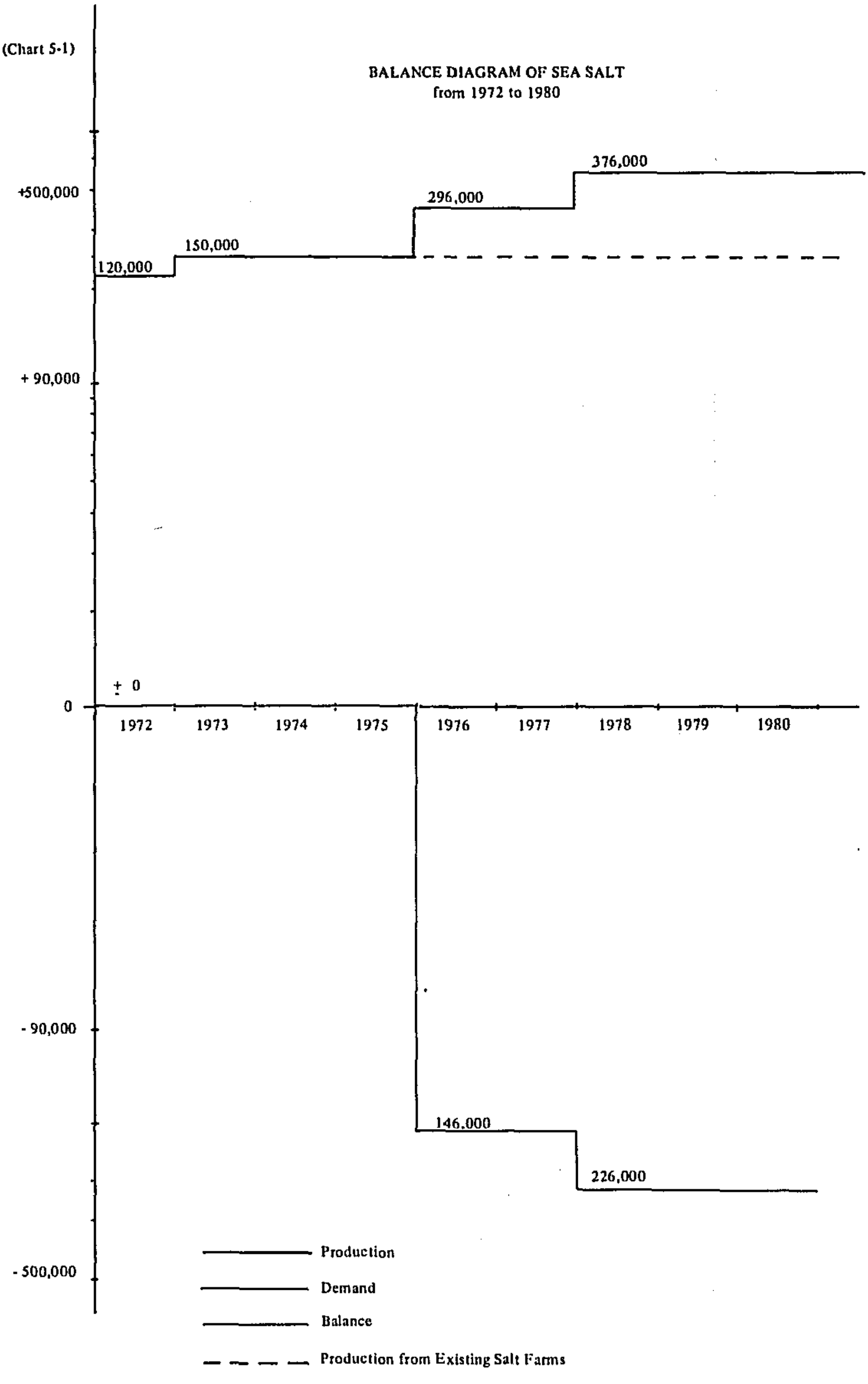
Item	Classification	1961	1963	1965	1967	1969	1970	1971	1972
Sulfuric Acid	Imports	1,601	1,229	451	913	2,133	1,699	1,314	
	Domestic Demand						2,100	6,660	120,000
For Ammonium Sulfate									90,000
For Phosphatic Acid									
For the Textile Industry									
For Formic Acid									
For Others									30,000
	Total	1,601	1,229	451	913	2,133	3,799	7,974	120,000

Item	Classification	1973	1974	1975	1976	1977	1978	1979	1980
Sulfuric Acid	Imports								
	Domestic Demand	162,000	169,000	169,000	169,000	572,200	572,200	572,200	621,200
For Ammonium Sulfate		132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000
For Phosphatic Acid						400,000	400,000	400,000	400,000
For the Textile Industry									49,000
For Formic Acid						3,200	3,200	3,200	3,200
For Others		30,000	37,000	37,000	37,000	37,000	37,000	37,000	37,000
	Total	162,000	169,000	169,000	169,000	572,200	572,200	572,200	621,200

(Notes) 1) It is assumed that P.N. Soda will complete the doubling of its capacity by 1974 and the paper pulp mills will complete their own chlorine and caustic soda equipment by 1975

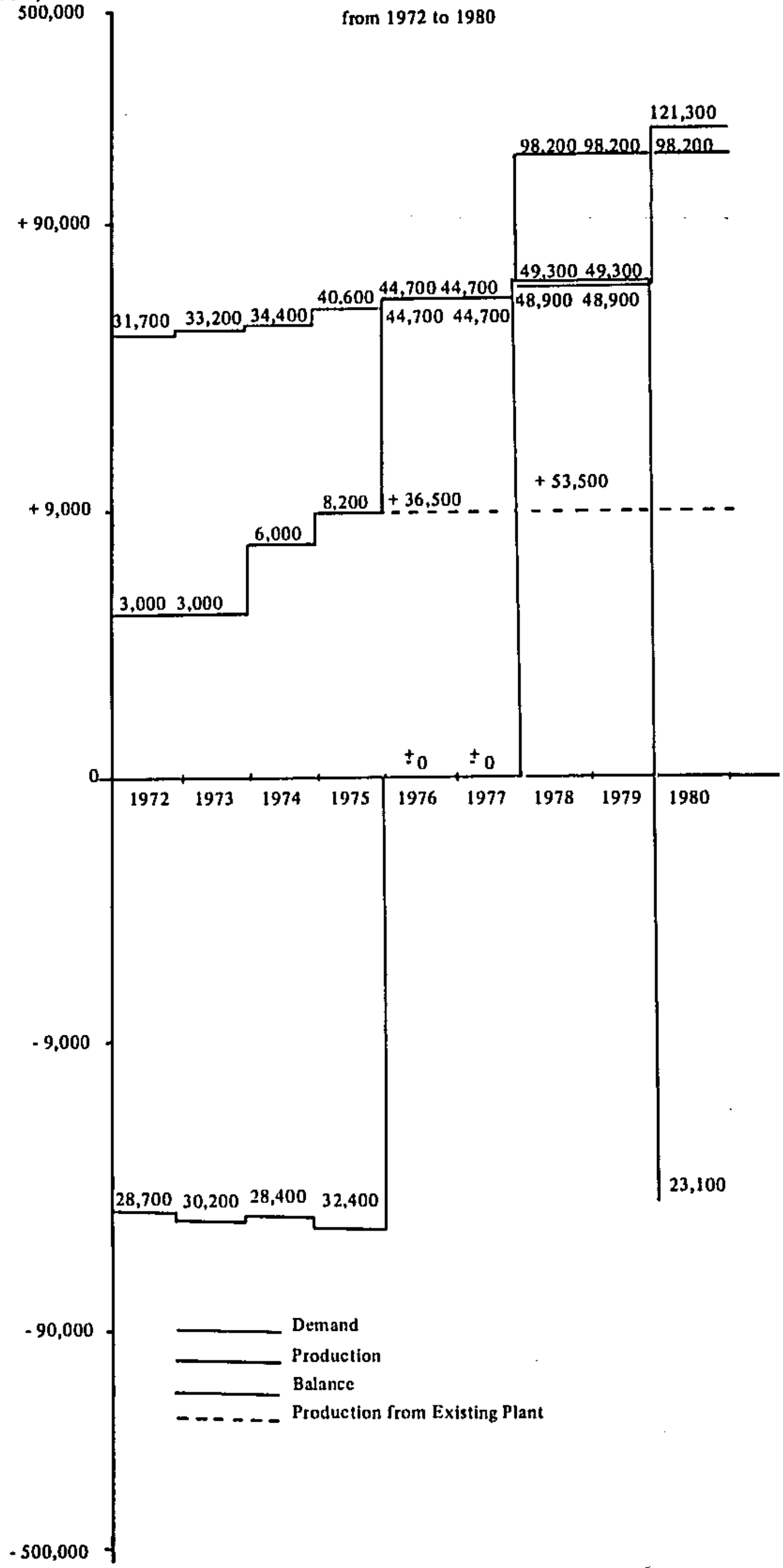
2) The figures obtained from the Indonesian Department of Industry were used for past actual consumption

(Chart 5-1)


BALANCE DIAGRAM OF SEA SALT
from 1972 to 1980
+500,000
+ 90,000
0
- 90,000
- 500,000
376,000
296,000
150,000
120,000
± 0
1972
1973
1974
1975
1976
1977
1978
1979
1980
146,000
226,000
Production
Demand
Balance
Production from Existing Salt Farms

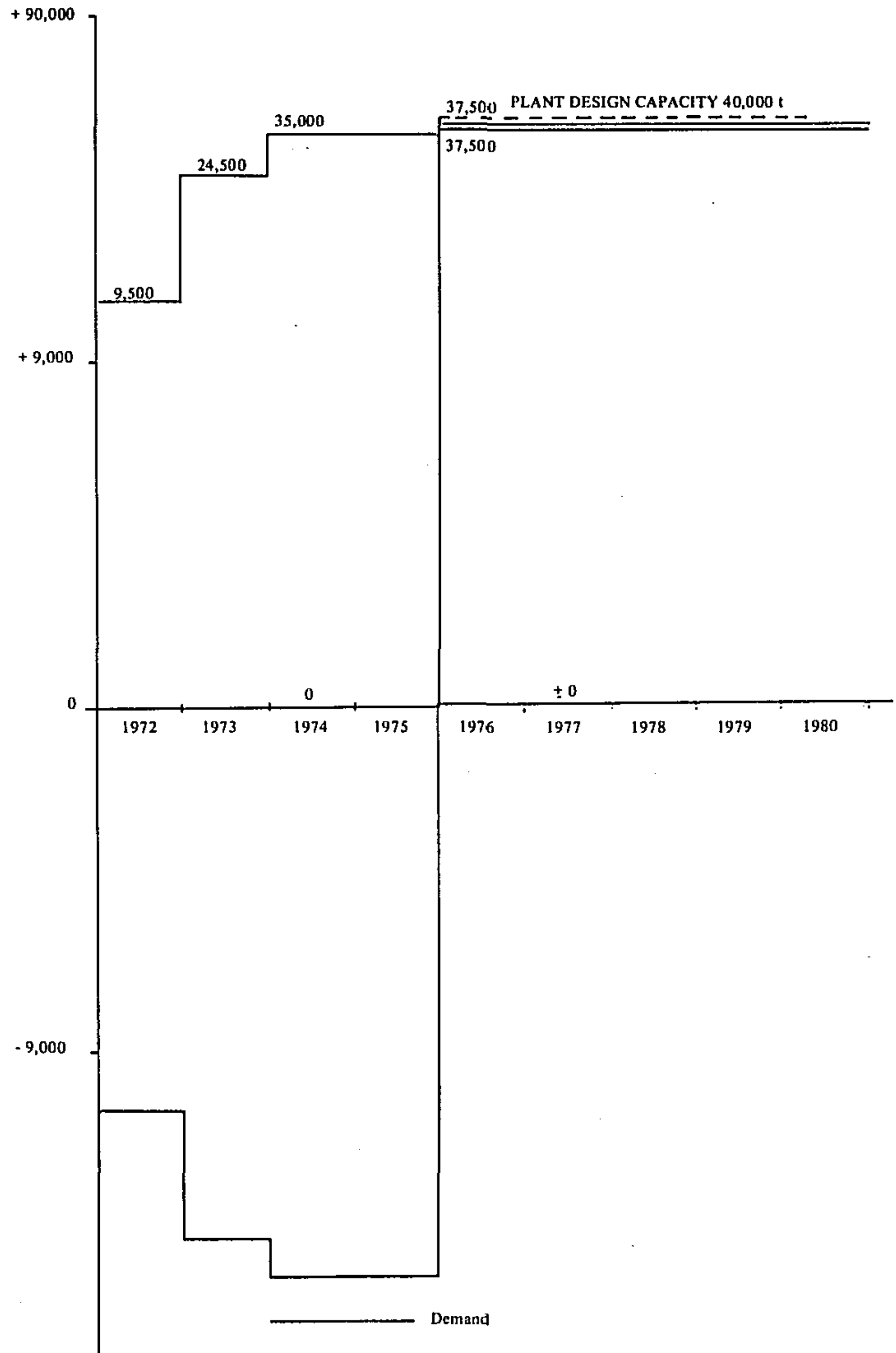
(Chart 5-2)

BALANCE DIAGRAM OF CAUSTIC SODA
from 1972 to 1980



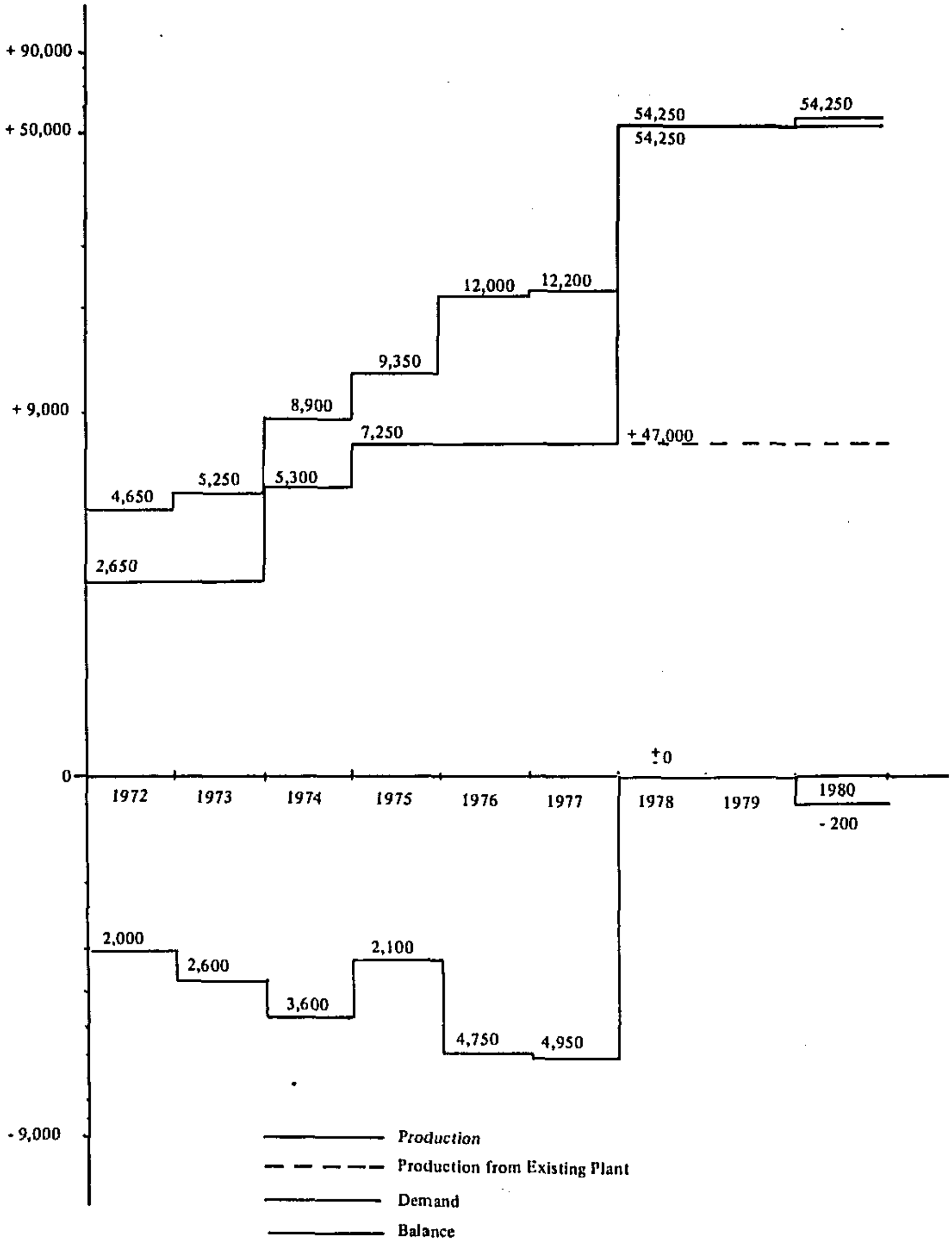
(Chart 5-3)

BALANCE DIAGRAM OF SODA ASH
from 1972 to 1980



(Chart 5-4)

BALANCE DIAGRAM OF CHLORINE
from 1972 to 1980



CHAPTER 6 THE SALT INDUSTRY IN INDONESIA

6-1-1 The Present State of the Industry

The salt fields of Indonesia were constructed while under Dutch rule and are desinged in a rational manner, making full use of the solar evaporation process. A monopoly system was adopted until 1959, but this has been abolished and both State operated and private salt industries coexist today.

The total production of salt in Indonesia at present is around 400,000 tons with private production made by numerous small salt fields accounting for about 300,000 tons. Almost all of the salt is consumed for food or fisheries and only 8,000 tons is used for industrial use.

Our team did not concern itself with private production and survey only the State operation.

6-1-2 Outline of P.N. Garam

P.N. Garam is one of the state operated businesses that come under the direction of the Chemical Bureau of the Department of Industry.

It inherited the old organization as it was in 1959, at the time of the abolition of the monopoly system and has its head office in Jakarta with a vast array of equipment and facilities including a nationwide sales network, shipping, port facilities and welfare facilities. It has six salt fields, of whic 5 are located on the Island of Madura and 1 in Eastern Java, with a total area of 6,000 hectares. Howver, only 3,960 hectares is in operation now and the production which once claimed 350,000 tons has also declined to 100 to 150 thousand tons. We can give as the largest reason for this the fact that there is a great difference in price with private production. But we were told that effort is being made to greatly improve both in price and quality during an interview with the Director of Operation and Finance at P.N. Garam and will look forward to its future.

6-2 Salt Production by P.N. Garam

6-2-1 The Climate of Madura

Salt production by the solar process is greatly affected by the conditions of the location, namely the weather. Madura is an island northeast by east of Java and across from Surabaya, with an area of about 400 square kilometers, situated at 7 degrees South latitude and between 113 to 114 degrees East longitude. The north side of the island faces the Java Sea and the southern side face the Straits of Madura. The salt fields of P.N. Garam are located on the southern and southeastern side of the island, in 5 locations, as shown in figure 6-1. The terrain of southern Madura is clayey beach, shallow to a distance and suited for constructing salt field, but the Straits of Madura receive the rainfall from the eastern half of Java and the sea water becomes diluted during the rainy season. Also the Straits of Madura are connected with the Java Sea and the narrowest part between Surabaya and Madura is shallow and the current is slow with diluted water staying on the surface, making it unsuitable for the manufacture of salt.

We have heard that Djeneponto at the southern tip of Sulawesi has a dry season of 9 months and is most suited for high quality, low cost salt production.

6-2-2 Production

The salt fields of P. N. Garam on Madura are designed very rationally and so as to keep production cost at a minimum by Dutch technology. It is constructed so that the water will flow down naturally for a distance of 20 to 30 kilometers passing through the evaporation pond and crystallization pond. Salt production starts at the beginning of the dry season which is from May to mid-June and continues untill November. For the two large reasons of the large capacity of the salt field and of the thinness of the sea water, collection of salt generally starts in the middle of July and the peak of the season is reached in September.

The annual production for recent years is shown in Table 6-2 which shows a general decrease in the salt field area and decline of production and also fluctuation from year to year caused greatly by the change in weather.

It is not an overstatement to say that increased salt production is the keypoint to the development of the Indonesian basic chemical industry, If we here refer to the Japanese consumption of salt in 1971, we find that 6, 215, 000 tons out of a total 7, 835, 000 tons was for the soda industry and only about 1 million ton was for food. This shows the importance of the role of salt in a basic chemical industry. We will show the changes in area of operating salt fields in Table 6-4 and the scheduled salt production for 1972 in Table 6-2.

6-2-3 Quality of Salt

As the use of Indonesian salt is mostly for food and fisheries and not for industrial use, a fragile and fine crystal is preferred and it contains large quantities of $MgSO_4$. Furthermore, because unsaturated brine is entered into the crystallizing pond for extraction of salt during the initial period of the season, salt of low purity containing $CaSO_4$ is produced.

At present, the depth of the crystallizing pond is 5 centimeters and there are some parts where the crystallized salt is surfaced before collection. The shallowness of the crystallizing pond results in strong supersaturation and formation of fine crystals of low purity. Therefore, the purity of the present salt is 85 - 90% and P. N. Garam plans to rehabilitate the three fields of Gresik Putih, Nembakor and Sumpang from 1972 to 1973, deepening the depth of the crystallizing ponds to 20 centimeters from 5 centimeters, thereby upgrading the quality to 92%.

This fact shows that P. N. Garam is making efforts to somehow improve the old operation procedures.

6-2-4 Price of Salt

We were able to visit Nembakor among the 5 fields on Madura and have discussions with the persons in charge. Therefore, we will relate about Nembakor.

The Nembakor salt field occupies a total area of 1,400 hectares, but this year's operating area was about 700 hectares. The field has 4 production lines, of which 3 were operating in 1972. The area of the crystallizing ponds is 15% of that of the evaporating ponds and the production target was 25,000 tons. There were 94 employees of P.N. Garam, 685 contract workers and 380 seasonal workers, for a total of 1,159, working at this salt field. P.N. Garam is using contract workers and seasonal workers at its other field also. Contract workers are on a piece rate basis, receiving 50 Rp/ton for harvesting and 100 Rp/ton for transporting to the warehouse. Seasonal workers are used for miscellaneous work in the field and for water drawing, receiving 100 Rp/day.

The price structure for P.N. Garam is as follows:

Salt field stock yard	1,895.8 Rp/ton	in bulk
Loaded on barge from salt field	2,095.8 Rp/ton	in bulk
F.O.B.	2,495.8 Rp/ton	in bag
Selling price including overhead	5,500 Rp/ton	in bag

It is said that the stockyard price can be lowered to 1,000 Rp/ton if production of 300,000 tons can be realized. The sales price including overhead is quoted at 5,500 Rupiah per ton, but the total number of employees at P.N. Garam is said to be 11,000 and a drastic organizational reform is necessary besides the lowering of cost by increase production.

6-3 Problems Concerning Industrial Salt

6-3-1 Production

Of the total production of salt in Indonesia, only 8,000 tons is used industrially and most of the 400,000 tons production is used for food and fisheries. In other words, the present production can be said to be the minimum required production. If a basic chemical industry is to be developed in the future, 150,000 tons in 1976 and 80,000 tons in 1978 totaling 230,000 tons will be needed as raw material and P.N. Garam, in order to supply this, will have to rehabilitate its salt fields and make an all out effort to increase its production.

Since the private salt fields are producing salt suited for food but unsuitable for industrial use, and also their scale is small, it would be best to let them supply general use and rely on State operated fields to supply large scale consumption such as industrial use. P.N. Garam can significantly contribute to the development of Indonesian industry by utilizing large scale, personnel and organization, and adopting production systems suited to supply large users. As P.N. Garam has at one time produced 440,000 tons a year, they should not consider imports from overseas and take full measures to supply these needs, including rehabilitation of their salt fields.

6-3-2 Quality

The present salt of P.N. Garam is of 85 - 90% grade and they are trying to improve this to 92% through their efforts. We will not say that a 92% grade is not usable as industrial salt but salt of better purity is desired because in case salt of this grade is used, considerable expenses are required for lessening pollution from the effluent and solid waste, and also for refining. This means that it will result in higher cost of primary products such as caustic soda and soda ash, and therefore, a high grade product with an average 95% purity is desired. In refining low grade salt, refining equipment and expenses are required, mainly for the removal of Ca and Mg, and this expense will be about 1,500 to 2,000 Rp/ton. On the other hand only 100 to 150 Rp/ton is needed for refining salt of better than 97% purity. As an example, the Chinese salt imported into Japan is composed of 93.97% NaCl, 0.56% SO_4, 0.18% Ca, 0.13% K and 3.39% H_2O and is still considered lacking in purity. Also Indian salt composed of 94.09% NaCl, 0.51% SO_4, 0.14% Ca, 0.15% Mg, 0.05% Mg, 0.03% K and 4.02% H_2O was considered lacking in purity and its import was suspended from 1971. Recently Australian Dampier salt with 98.17% NaCl, 0.07% SO_4, 0.03% Ca, 0.02% Mg. 0.02% K and 1.24% H_2O is being imported as being of desirable purity.

6-3-3 Price

At present, P.N. Garam is selling at 5,500 Rp/ton, but judging from the fact that the deal concluded between Mexico and Japan is for F.O.B. $3.56/long ton, the producer's price of Australia, Mexico and China can be estimated at around 3 to 4 dollars per ton (1,000 - 1,600 Rp) for an average 98% grade product. Also from the fact that Indonesia exported to Japan in 1968 at $4/ton, it may be said that the selling price by P.N. Garam can be lowered to around 2,000 to 3,000 Rupiah.

When we take the case of production of caustic soda by electrolysis of common salt, if the price of salt is lowered by 1,000 Rp/ton, the price of caustic soda will decline by 1,700 Rp/ton.

At present, P.N. Garam appears to be making efforts to reduce the price of salt through reorganization and reduction of personnel and we are expectant of the realization of this, and hope that further reduction of cost can be made through increased production of about 230,000 tons. Yet, to try to reduce personnel will be in conflict with the basic policy of the Indonesian Government which is to increase employment. Therefore, it is most desirable that P.N. Garam should aggressively cultivate demands, thereby increasing the operational rate of its salt fields and consequently lower its cost.

There was little demand for industrial salt in the past and the price was determined in proportion to that of edible salt. However, if the salt industry is to establish itself as a supplier of raw material to modern industries, it should make international quality and price level its goal and determine the price in a rational manner by differentiating from edible salt in the size of the production and sales lot and packaging.

The imporvement of the quality of industrial salt and the lowering of costs is one of the big problems facing P. N. Garam in order to develop basic chemical industries in Indonesia.

We will now relate about what development plans can be considered for the development of basic chemical industries in Indonesia, wrapping up what we have said from Chapter 3 to this Chapter, and about the projects we would like to suggest, their priorities and their influence to the national economy.

(Table 6-1) Amount of Rainfall (1963)

(Unit : mm.)

Month	Sumenep Gresik Putih	Surabaya Gresik	Sumenep Nembakor	Sampang	Pamekasan	Sumenep Palebunan
1	393.5	218.0	296.0	171.0	296.5	291.0
2	104.5	219.0	158.0	176.0	93.5	147.0
3	406.0	279.0	437.0	410.0	316.5	314.5
4	44.0	115.0	106.0	92.0	87.5	85.5
5	104.5	35.0	102.0	26.0	71.5	70.0
6	5.0	2.0	0	7.0	6.0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	6.0	0	11.0	0	0
12	163.0	194.0	207.0	300.0	179.0	229.5

Weather of Surabaya (Science Almanac)

Month	1	2	3	4	5	6
Rainfall (mm)	226	279	213	137	94	56
Humidity (%)	78	78	79	78	75	72
Temp. (Co)	27.2	27.2	27.2	27.2	27.0	26.1
Month	7	8	9	10	11	12
Rainfall (mm)	25	5	5	18	61	165
Humidity (%)	68	66	65	64	68	74
Temp. (Co)	25.9	25.9	26.7	27.5	28.1	27.2

(Table 6-2) SALT PRODUCTION (P.N. GARAM)

(Unit : ton/year)

	Semenep	Pamekasan	Sampang	Nembakor	Gresik Surabaya	Gresik Putih	Production	Sale
1960	51,145	38,172	33,393	37,984	7,060	27,271		
1961	101,746	86,298	99,917	84,942	19,357	52,396	444,656	157,540
1962	55,338	50,158	60,757	42,831	11,552	32,657	253,293	126,470
1963	101,754	89,377	96,483	79,065	25,327	54,962	446,971	109,130
1964	8,270	11,299	16,572	5,816	2,688	7,612	52,259	89,390
1965	46,099	46,010	54,599	36,674	12,851	34,136	230,372	94,570
1966	-	-	-	-	-	-	-	100,173
1967	28,537	38,452	-	21,201	9,817	5,210	107,687	161,591
1968	13,160	6,145	580	4,786	265	3,949	28,500	243,991
1969	36,022	44,477	16,485	21,320	15,927	18,734	185,499	143,975
1970	12,620	12,933	8,227	8,836	9,372	5,719	62,959	40,953
1971	5,505	16,246	4,809	4,200	5,352	5,187	-	-

(Table 6-3) Solar Pond Area

(Unit : ha)

	Sumenep	Pamekasan	Sampang	Nembakor	Gresik Surabaja	Gresik Putih
1960	1,469	974	1,199	1,205	414	556
1961	1,469	974	1,199	1,205	414	556
1962	1,469	974	1,199	1,205	414	556
1963	1,469	974	1,199	1,205	414	556
1964	1,469	974	1,199	1,205	414	556
1965	1,469	974	1,199	1,205	414	556
1966	-	-	-	-	-	-
1967	557	974	-	618	363	87
1968	1,469	974	380	1,196	8	181
1969	1,469	974	380	1,205	394	265
1970	1,090	974	380	794	404	265
1971	1,055	973	369	643	339	311

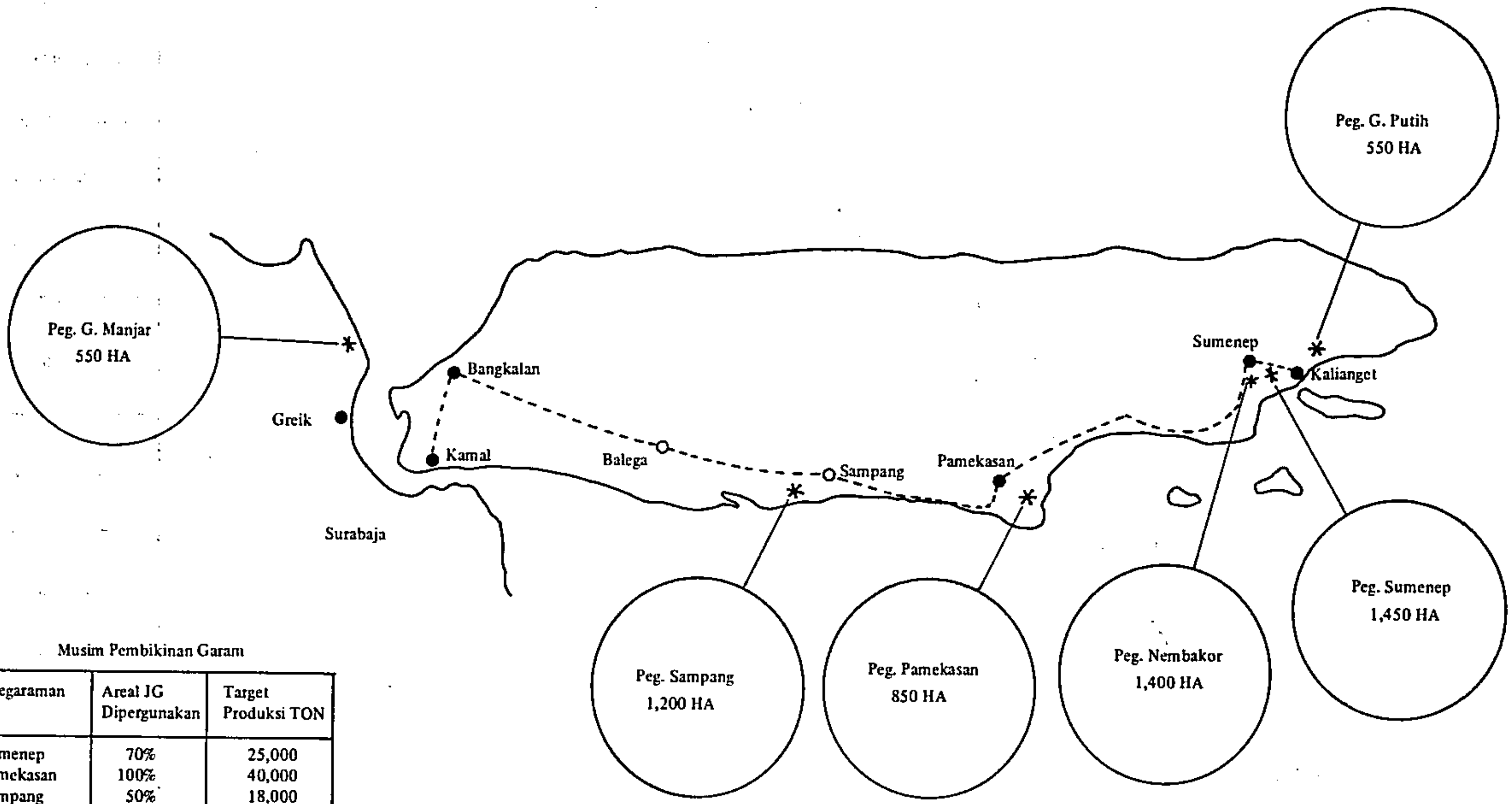
(Table 6-4) Production

(Unit : Ton per ha/yr.)

	Sumenep	Panekasan	Sampang	Nembakor	Gresik Surabaya	Gresik Putih
1960	34.8	39.1	27.8	31.5	17.1	49.1
1961	69.0	88.8	83.2	70.5	46.7	94.5
1962	37.8	51.6	50.8	35.4	27.9	58.9
1963	69.0	91.8	80.5	65.9	61.1	99.0
1964	5.6	11.6	13.8	4.8	6.5	13.7
1965	31.4	41.1	45.5	30.4	31.0	61.5
1966	-	-	-	-	-	-
1967	51.2	39.5	-	34.5	27.0	60.0
1968	8.9	6.3	15.2	4.0	33.0	21.7
1969	24.5	45.6	43.5	17.7	40.4	70.8
1970	11.6	13.2	21.6	11.1	23.2	21.6
1971	5.8	16.7	13.0	6.5	15.8	16.7

(Chart 6-1)

Location Map of Salt Farms of P. N. GARAM

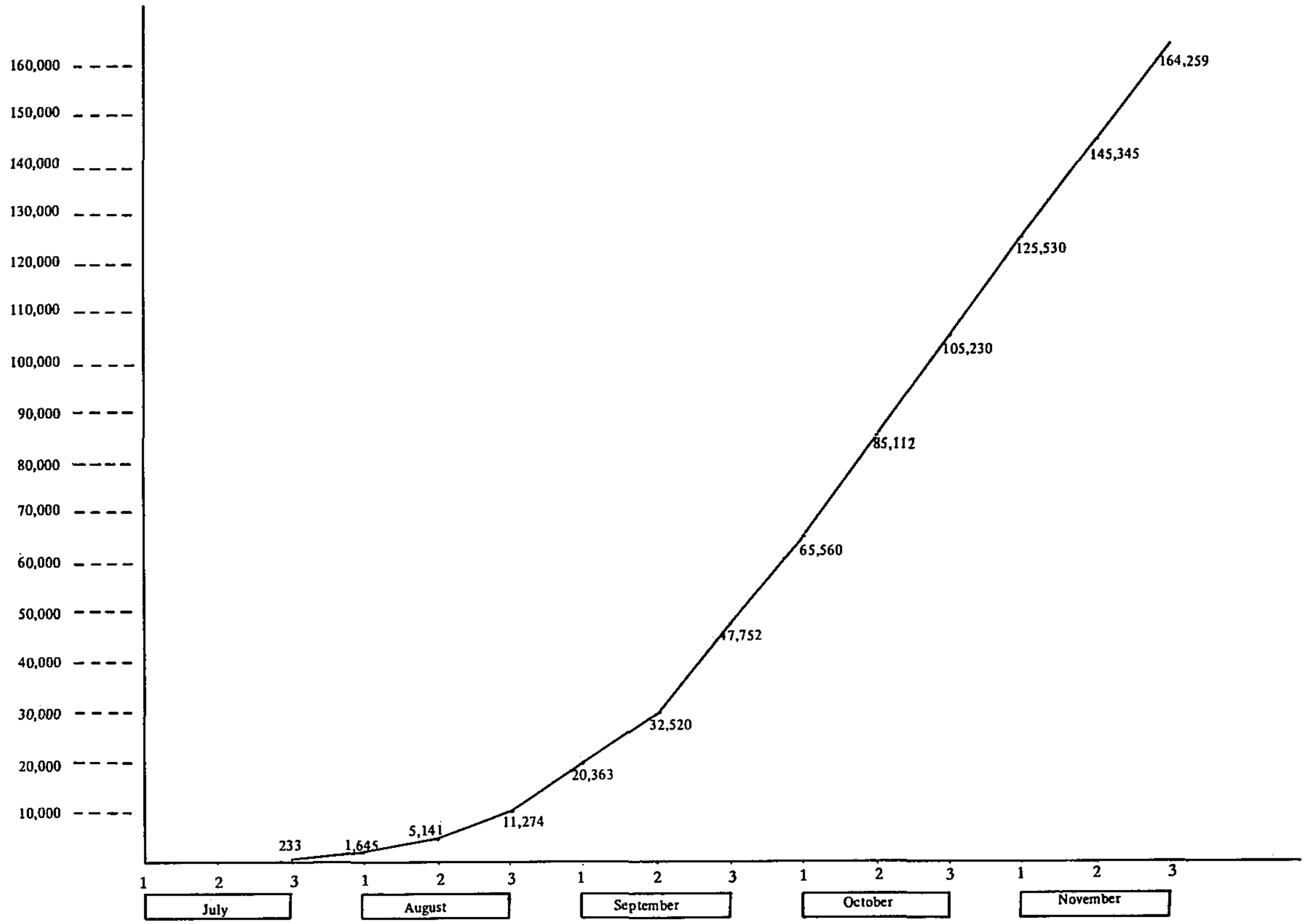


Musim Pembikinan Garam

Pegaraman	Areal JG Dipergunakan	Target Produksi TON
Sumenep	70%	25,000
Pamekasan	100%	40,000
Sampang	50%	18,000
Nembakor	50%	25,000
Gresik Manjar	100%	12,000
Gresik Putih	60%	15,000
		135,000

(Chart 6-2)

Production Target of P. N. Garam for 1972



CHAPTER 7 MASTER PLAN FOR THE DEVELOPMENT OF BASIC CHEMICAL INDUSTRIES

When we wrap up what we have related about estimated demand and supply for basic chemical industries from Chapter 3 to the preceding Chapter, it will be as shown in Table 7-1.

7-1 Outlook of New Proj.ects, Particularly Those Related to Basic Chemical Industries for the Development of Indonesian Industry

As a result of our survey, the following projects can be considered for the development of basic chemical industries in Indonesia.

1) Increased production of ammonia (to coincide with the construction of the caprolactam plant in 1980).

2) Equipment for increased production of ammonium sulfate using surplus ammonia and sulfuric acid (20,000 tons, the earlier the better).

3) Construction of a methanol plant and an urea resin plant (at an appropriate time).

4) Increased production of sulfuric acid (1976, 1978).

5) Construction of a phosphate fertilizer plant (1976).
Tripolysodium phosphate plant (planning will be same time, realizing at a appropriate time) gypsum and plaster board plant (ditto)

6) Construction work to increase salt production capacity (146,000 tons and 80,000 tons respectively in 1976 and 1978).

7) Soda ash plant (soda ash 40,000 tons, caustic soda 36,000 tons - 1976).

8) Construction of newsprint mill (1976).

9) Construction of kraft paper mill (1978).

10) Electrolysis plant (caustic soda 53,500 tons, chlorine 47,000 tons - 1978).

11) MVC plant (60,000 tons - 1978).

12) Terephthalic acid plant (100 ton/day - 1978).

13) Caprolactam plant (100 ton/day - 1980).

14) Aluminum plant (200,000 tons - 1980).

15) Industries utilizing sea water and bittern (plan after studying).

As the fertilizer plant among the above projects to be considered is already entered in the Five Year Plan as a definite project and the Governmnet is making an all-out effort for its realization, we will exclude this from our studies. However, as stated above, we find it difficult to understand that there is a surplus of ammonia and sulfuric acid at Petrokimia Gresik and we would like to add that, unless there are other specific plans, a plan for increased production of ammonium sulfate should be studied at the earliest chance since there still is a shortage of fertilizers in Indonesia.

Besides these, projects for MVC and textiles will become necessary as part of the petrochemical industry after 1977.

The aluminum plant will also enter into operation in the 1980s.

7-2 Priorities for the Effective Projects

We would now like to consider the priorities of the basic projects among the projects enumerated above. We would like to decide the priorities as first the development of the alkali industry, second the development of the petrochemical industry and third, production increase at P. N. Garam.

A plan to develop the alkali and chlorine industries should be studied first. This can be considered in the following two stages. That is, during the first stage imports of necessary soda ash and caustic soda are replaced by domestic production and during the second stage complete self sufficiency of chlorine is to be attained. In other words, it is desirable to construct a plant to produce 40,000 tons of soda ash and 36,000 tons of caustic soda by the Solvay process during the first stage. It is advisable to carry out this project, even if the increased production of P. N. Garam as stated above is delayed and foreign salt has to be imported.

The savings in foreign currency resulting from the stopping of imports of soda ash and caustic soda in 1976 will amount to $2,758,000 for both chemicals and a great contribution can be made to the Indonesian national economy through increased employment by the related industries. Therefore, we feel that this is a project that should be realized as part of the first stage at all costs.

The second stage calls for the construction of a plant to produce 53,500 tons of caustic soda and 47,000 tons of chlorine. This project is aimed at supplying the demand for chlorine in Indonesia for several years after 1978 and to check imports. We can almost say that there will be no development of the petrochemical industry unless this project is realized. That means that no advance from the status of an underdeveloped nation importing all of its raw materials can be expected because of the difficulty of importing large quantities of chlorine either in liquid or gas form.

There will be a shortage of about 5,000 tons of chlorine in 1978, while this projects is on its way to completion, but this can be imported in the form of bleaching powder. We can also consider the construction of a small electrolysis plant to cover the shortage of chlorine as an alternative for the first stage. The production capacity in this case will be 40,000 tons of soda ash, 34,000 tons of caustic soda by the Solvay process and 5,000 tons of chlorine and 5,750 tons of caustic soda by the electrolysis process. This will be a total of 40,000 tons of soda ash, 34,000 tons of caustic soda and

5,000 tons of chlorine, and this will enable domestic production of all the demand for soda ash, chlorine and caustic soda in 1976. However, the construction of a small electrolysis plant will cost rather high, resulting in high production cost and is not advantageous.

In 1978 the demand for caustic soda and that for chlorine will reverse and the satisfaction of the demand for chlorine will cause a surplus of saustic soda. The surplus of caustic soda is about 49,000 tons but there will be another reversal with the completion of the aluminum plant in 1980 causing a 24,000 tons shortage of caustic soda. We consider this project worthy of carrying out even though there is a 49,000 ton surplus of caustic soda for each of the years 1978 and 1979. That is, because we are anticipating these projects to be carried out in the same enterprise and we feel that export is possible by allotment of costs as explained in a later chapter. The selling price can be adjusted at will by adjusting and appropriating the production cost between soda ash, caustic soda and chlorine as shown in Table 7-3, and as an example of the price structure, when exports of surplus caustic soda is to be not considered, if the price of soda ash is fixed at $80 and that of chlorine at $110, the price of caustic soda will be $120. The international price of caustic soda as of June 1972 is $121-$110 and it will be possible to somehow lower it to the international level by properly adjusting the prices of soda ash and chlorine. The contribution of this project to the Indonesian economy is something decisive in the sense that the development of a real petrochemical industry in Indonesia cannot be expected without the realization of this project. The route to the development of petrochemical industries such as vinyl chloride and the synthetic fibers industry of nylon and polyester will be cleared by the realization of this project and the savings of foreign currency through replacement of imports by domestic production of such raw materials as plastic resin, compounds, lactam and terephthalic acid will be enormous.

The second will be the realization of the initial petrochemical projects starting with terephthalic acid and MVC in 1978. The reason for the advisability of this is because it is related to the first step as stated above.

The third will be the increase of the production capacity and improvement of quality at P. N. Garam. Efforts should be made to supply at least 150,000 tons of industrial salt in 1976 and an additional 80,000 tons in 1978, making rehabilitations if deemed necessary by further studies. It is most desirable for P. N. Garam to increase its production but if this cannot be achieved, the shortage must be covered by imports and the foreign exchange payments at CIF basis will amount to about $700,000 even if imported from Australia, the closest source. Also, $100,000 will have to be paid even though P. N. Garam's own ships or other Indonesian ships are used. However, since 36,000 tons of caustic soda and 40,000 tons of soda ash can be produced from 146,000 tons of salt and the savings realized from checking imports amount to $2,758,000 for both caustic soda and soda ash, foreign salt can be imported until P. N. Garam increases its production, in the unfortunate event that increased production cannot be reached in time.

7-3 Plant Location

We consider it desirable to establish a basic chemical industry by first developing the soda industry, as a result of our survey, and this is not only inseparable from the petrochemical industry for the second step, but also inseparable from the third step of increased production at P. N. Garam. Ammonia and sulfuric acid also have a very close relation to the above-mentioned chemical industries.

Normally the petrochemical industry and the chlorine and ammonia industries have a great merit in the interchangeability of their raw materials and products, and generally form a chemical complex considering the reduction of costs resulting therefrom.

We have surveyed the five cities of Madan, Palembang, Jakarta, Surabaya and Bandung, and feel that the three cities of Jakarta, Surabaya and Palembang are suitable candidates for the formation of such a complex in Indonesia. Medan produces oil but it is mainly used as an export port and cannot be said as being suitable because of the inconvenience in transporting products and also salt as the raw material. Bandung, although located in the center of the island of Java, also is not suited for heavy industry.

Jakarta, Surabaya and Palembang each has its merits and demerits. Palembang is a producer of oil and has the qualifications for heavy industry but is at a disadvantage compared to the two other cities in the acquisition of such materials as salt and lime.

Jakarta is quite suitable from the point of its petrochemical, glass and other industries, the electric power supply, the employment situation and the national policy to industrialize it.

However, it is already overpopulated and it is also at a disadvantage to Surabaya in the acquisition of salt and lime.

The transportation of materials and products becomes an important point in considering a petrochemical complex in Indonesia.

The freight charges between Jakarta and Surabaya amount to 7,000 Rp/ton even when shipping by a freight car. If we assume that complex is constructed in Jakarta or Surabaya, then we think that the products must be shipped to other cities, we can see that the shipping of raw materials is not easy while the shipping of products is easy.

7-4 Construction Cost and Production Cost

As a result of our surveys and studies up to now, we would like to recommend the following construction, in view of the balance of demand and efficient use of money.

As the first step

1976	40,000 ton/year	soda ash
	36,500 ton/year	caustic soda

as the second step

1978	53,500 ton/year	caustic soda
	47,000 ton/year	chlorine

We made rough calculations of the production costs for the above projects. (please refer to Table 7-2)

Case A in the Table shows the first step project and case B that of the second step, and the case where case A and case B are intergrated in the same enterprise is shown as case AB. We also thought of case A' where a small electrolysis plant is to be constructed for domestic production of the about 5,000 tons of chlorine which will be in shortage during 1976 and 1977 (refer to Table 7-1) without relying on imports

As can be seen from Table 7-2, in case A, if both the soda ash and caustic soda are sold without profit, sale at a price similar to market prices is possible. That means, the price will be \$92/ton for soda ash and \$182/ton for caustic soda (inclusive of packaging). In the electrolysis process of case B, caustic soda will be \$88/ton and chlorine will be \$96/ton and it can be a very promising industry because sales at around international market prices are possible even after adding reasonable profits.

For case AB, which is an integration of cases A and B, we showed in Table 7-3 the prices which have been adjusted, giving consideration to products of related industries. This Table shows how the price of caustic soda can be adjusted when the price of soda ash is changed from \$66 to \$80 and \$95, and that of chlorine is changed from \$95 to \$180.

According to this Table, if the price of soda ash is set at \$66/ton and that of chlorine at \$115/ton, caustic soda can be sold at \$124/ton, and if soda ash is sold at \$80/ton and chlorine at \$110/ton, caustic soda should be sold at \$120/ton. At the above price, all the raw materials which have been dependent on imports could be produced domestically and supply of materials at a cost lower than the present becomes possible.

It is needless to say that the above allocation of sales prices is only an example and that further free adjustment in accordance with national policy is possible.

In case A', the investment cost will be rather high because the scale is too small, resulting in a production cost of \$147/ton for caustic soda and \$206/ton for chlorine, making it more profitable to import. However, even in this case, it is not an unthinkable project if cases A, B and A' are considered as one business from a national point of view, although inefficient use of fund will be made.

(Table 7-1)

Forecasted demand for ALKAI : Industry

Item	MT/Y	1972	1973	1974	1975	1976	1977	1978	1979	1980
Caustic Soda	Total Domestic Demand	31,700	33,200	34,400	40,600	44,700	44,700	48,900	48,900	121.300
	Total Domestic Production	3,000	3,000	6,000	8,200	8,200	8,200	8.200	8,200	8,200
	Shortage of Supply	28,700	30,200	28,400	32,400	36,500	36,500	40,700	40,700	113,100
	New Production	-	-	-	-	36,500	36,500	36,500 53,500	90,000	90,000
	Required Imports	28,700	30,200	28,400	32,400	-	-			23,100
	Required Exports							49,300	49,300	
Chlorine	Total Domestic Demand	4,650	5,250	8,900	9,350	12,000	12,200	54,250	54,250	54,250
	Total Domestic Production	2,650	2,650	5,300	7,250	7,250	7,250	7,250	7,250	7,250
	Shortage of Supply	2,000	2,600	3,600	2,100	4,750	4,950	47,000	47,000	47,000
	New Production							47,000	47,000	47,000
	Required Imports	2,000	2,600	3,600	2,100	4,750	4,950	-	-	-
	Required Exports									
Soda Ash	Total Domestic Demand	9,500	24,500	35,000	35,000	37,500	37,500	37,500	37,500	37,500
	Total Domestic Production	-	-	-	-	-	-	-	-	-
	Shortage of Supply	9,500	24,500	35,000	35,000	37,500	37,500	37,500	37,500	37,500
	New Production					40,000	40,000	40,000	40,000	40,000
	Required Imports	9,500	24,500	35,000	35,000					
	Required Exports					2,500	2,500	2,500	2,500	2,500
Common Salt	Total Domestic Demand	120,000	150,000	150,000	150,000	296,000	296,000	376,000	376,000	376,000
	Total Domestic Production	120,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Shortage of Supply	-	-	-	-	146,000	146,000	146,000 80,000	226,000	226,000
	New Production	-	-	-	-	146,000	146,000	226,000	226,000	226,000
	Required Imports				-	-	-	-	-	-
	Required Exports				-					

(Table 7-2)

Production Cost Table

(Unit - Rupiah, figures in ( ) show those in $)

Items	Total Cost	Soda Ssh	Caustic Soda	Chlorine	Production Capacity, Construction Cost, Etc.
Case A					Production Capacity:
Cost of Raw Materials	28,590				Soda Ash 40,000 ton/year
Auxiliary Materials Cost	34,324				Caustic Soda 36,500 ton/year
Sub-total	62,914				Investment Cost: $21,000,000
Fixed Charges	13,618				Process : Solvay Method
Amortization	21,787				
Interest	13,072				
Sub-total	48,477				
		(96)	(189)		
Total	111.391	39,847	78,417		
Case B					Production Capacity :
Cost of Raw Materials	25,750				Caustic Soda 53,500 ton/year
Auxiliary Material Cost	6,638				Chlorine 47,000 ton/year
Sub-total	32,388				Investment Cost: $25,000,000
Fixed Charges	11,800				Process : Electrolysis of Salt
Amortization	19,025				
Interest	11,635				
Sub-total	42,460				
			(92)	(101)	
Total	74,848		38,267	41,846	
Integrated AB					
		(96)	(131)	(101)	Production Capacity :
Salt 5,000 Rp/ton		39,847	54,550	41,846	
					Soda Ash 40,000 ton/year
		(88)	(125)	(96)	
Salt 3,000 Rp/ton		36,507	51,652	39,950	Caustic Soda 90,000 ton/year
		(82)	(119)	(93)	Chlorine 47,000 ton/year
Salt 1,500 Rp/ton		34,002	49,478	38,528	
					Investment Cost: $46,000,000
Case A'					
Cost of Raw Materials	25,378				Production Capacity :
Auxiliary Material Cost	6,666				Caustic Soda 5,700 ton/year
Sub-total	32,044				Chlorine 5,000 ton/year
Fixed Charges	30,357				Investment Cost: $6,900,000
Amortization	45,086				Process : Electrolysis of Salt
Interest	30,149				
Sub-total	105,592				
			(147)	(206)	
Total	137,636		62,762	85,356	

Remarks

1) The table of costs at left shows the cost when the salt cost is 5,000 Rp/ton, but we have also made calculations at salt costs of 3,000 Rp/ton and 1,500 Rp/ton

2) We have applied the approximate figures in Japan for Utility costs.

3) We have entered 3% of the cost of equipment per annum for repairs and maintenance.

4) Amortization was entered for a fixed amount depreciation over a ten year period.

5) Interest was entered at 12% per annum but in this calculation the average yearly burden was fixed at 6% in consideration of the repayments.

6) Overhead was calculated at 3% of cost of equipment per annum. It may be less if Cases A and B are operated under a single management, but we have entered the above figure in this Table.

7) Generally the allotment of cost is made from the sales price using an equivalent ratio, where two different products are produced from the same Material and using the same equipment, but in this calculation we allotted costs in accordance with international market prices as sales prices.

Table 7-3 Table of Adjustment of Selling Prices (Example)

Total cost 1,000 Rp/yr	Soda Ash 40,000 tn/yr Total cost 1,000 Rp	Rp/tn	$/tn	Caustic Soda 90,000 tn/yr Total cost 1,000 Rp	Rp/tn	$/tn	Chlorine 47,000 tn/yr Total cost 1,000 Rp	Rp/tn	$/tn
7,986,771	1,062,400	26,560	64	4,668,750	51,875	125	2,251,621	47,992	115.6
	1,095,600	27,390	66	5,038,191	55,980	135	1,852,975	39,425	95
				4,940,671	54,896	132.3	1,950,500	41,500	100
				4,843,146	53,813	129.6	2,048,025	43,575	105
				4,745,621	52,728	127	2,145,550	45,650	110
				4,648,096	51,645	124.4	2,243,075	47,725	115
				4,550,571	50,562	121.8	2,340,600	49,800	120
				4,453,046	49,478	119.2	2,438,125	51,875	125
				4,355,521	48,395	116.6	2,535,650	53,950	130
				4,257,996	47,311	114	2,633,175	56,025	135
				4,160,471	46,227	111.3	2,730,700	58,100	140
				4,062,946	45,144	108.2	2,828,225	60,175	145
				3,965,421	44,060	106.1	2,925,750	62,250	150
				2,867,896	52,977	103.5	3,023,275	64,325	155
				3,770,371	41,893	100.9	3,120,800	66,400	160
				3,672,846	40,809	98.3	3,218,325	68,475	165
				3,575,321	39,726	95.7	3,315,850	70,550	170
				3,477,796	38,642	93.1	3,413,375	72,625	175
				3,380,271	37,559	90.5	3,510,900	74,700	180
	1,328,000	33,200	80	4,805,796	53,398	128.6	1,852,975	39,425	95
				4,708,271	52,314	126.0	1,950,500	41,500	100
				4,610,746	51,231	123.4	2,048,025	43,575	105
				4,513,221	50,147	120.8	2,145,550	45,650	110
				4,415,696	49,063	118.2	2,243,475	47,725	115
				4,318,171	47,974	115.6	2,340,600	49,800	120
				4,220,646	46,896	113	2,438,125	51,875	125
				4,123,121	45,812	110.3	2,535,650	53,950	130
				4,025,596	44,729	107.7	2,633,175	56,025	135
				3,928,071	43,645	105.1	2,730,700	58,100	140
				3,830,546	42,562	102.5	2,828,225	60,175	145
				3,733,021	41,478	99.9	2,925,750	62,250	150
				3,635,496	40,394	97.3	3,023,275	64,325	155
				3,537,971	39,311	94.7	3,120,800	66,400	160
				3,440,446	38,227	92.1	3,218,325	68,475	165
				3,342,921	37,144	89.5	3,315,850	70,550	170
				3,245,396	36,060	86.9	3,413,375	72,625	175
				3,147,871	34,976	84.2	3,510,900	74,700	180
	1,577,000	39,425	95	4,556,796	50,631	122	1,852,975	39,425	95
				4,459,271	49,547	119.3	1,950,500	41,500	100
				4,361,746	48,464	116.7	2,048,025	43,575	105
				4,264,221	47,380	114.2	2,145,550	45,650	110
				4,166,696	46,297	111.6	2,243,075	47,725	115
				4,069,171	45,213	108.9	2,340,600	49,800	120
				3,971,646	44,129	106.3	2,438,725	51,875	125
				2,874,121	43,046	103.7	2,535,650	53,950	130
				3,776,596	41,962	101.1	2,633,175	56,025	135
				3,679,071	40,878	98.5	2,730,700	58,100	140
				3,581,546	39,795	95.9	2,828,225	60,175	145
				3,484,021	38,711	93.3	2,925,750	62,250	150
				3,386,496	37,628	90.6	3,023,275	64,325	155
				3,288,971	36,544	88	3,120,800	66,400	160
				3,191,446	35,460	85.4	3,218,325	68,475	165
				3,093,921	34,376	82.8	3,315,850	70,550	170
				2,996,396	33,293	80.2	3,413,375	72,625	175
				2,898,871	32,210	77.6	3,510,900	74,700	180

CHAPTER 8 A STUDY OF THE ECONOMICS OF THE PROJECTS

We have reached the conclusion that it is desirable to construct the two plants of

	1976	Soda Ash	40,000 ton/year
		Caustic Soda	56,500 ton/year
and	1978	Caustic Soda	53,500 ton/year
		Chlorine	47,000 ton/year

based on our surveys and studies until today. The construction of these two plants was recommended primarily from the viewpoint of a balanced demand and supply and we will hereunder proceed to study what economic effects the construction of these two plants will have.

8-1 Study of Economic Effects

We can say that varied conclusions can be drawn from arguing economic effects according to the different viewpoints taken, such as the government, business or others. Since the position we are taking is that of government to government, the viewpoint of the studies will have to be macroscopic. Therefore, we will not touch upon such calculations as returns on investments and profits on sales which are done by private business.

We would also like to give some consideration to the economic characteristics of these projects. As we will refer to later, we are concerned with the influence to the foreign exchange reserves as one of the items among the economic effects of the projects. In other words, we will try to measure the effects of replacing imports. That is, these projects are for the production of basic living necessities related to food, clothing and shelter of the people such as glass, textiles, soap, paper and seasoning, the demand for which can be expected to increase with rise in the state of the nation. Further, as will also be stated in the passage on the effect on foreign exchange reserves, we can expect a favorable foreign exchange account as a result of the construction of these new projects.

8-2 Effect on Foreign Exchange Reserves

When we consider the present state of foreign exchange reserve in Indonesia and the future, we feel that it would be very difficult to raise the funds necessary for the construction of these plants in the domestic market. Therefore, in this report, we have considered the problem on the assumption that the total amount will be raised overseas. (the cases A and B referred to herein are the same as those in paragraph 7-4)

Case A

(Foreign Currency Income)

Soda Ash	$2,400,000
Caustic Soda	3,852,000
Total	6,252,000

(Foreign Currency Expenditures)

Coke	2,016,000
Maintenance and Repairs	313,000
Interests	1,165,000
Total	3,494,000
Balance	2,758,000

$21,000,000 ÷ $2,758,000 = 7.7 years

(Notes)

1) Foreign currency income from soda ash and caustic soda indicate savings by replacement of imports.

2) The above is based on the 1970 CIF import prices of Indonesia of $60/ton for soda ash and $107/ton for caustic soda. (Central Bureau of Statistics)

3) It has been assumed that all coke would be imported at $120/ton.

4) 60% of the maintenance cost item is materials of which 80% is expected to be imported.

5) The interest rate has been estimated at 5%.

Case B

(Foreign Currency Income)

Caustic Soda	$4,393,000
Chlorine	8,460,000
Total	12,853,000

(Foreign Currency Expenditures)

Maintenance and Repairs	350,000
Interests	1,242,000

Total	1,592,000
Balance	11,261,000

$25,000,000 ÷ $11,261,00 = 2.2 years

(Notes)

1) Here also the foreign currency income indicates savings by replacement of imports, and exports (caustic soda - 1978 and 1979) and the figures for chlorine were calculated at $180/ton based on the international prices since actual import prices were rather high due to imports in small lots.

2) Maintenance cost and interests were calculated on the same basis as in case A.

Case A'

(Foreign Currency Income)

Caustic Soda	$610,000
Chlorine	900,000
Total	1,510,000

(Foreign Currency Expenditures)

Maintenance and Repairs	99,000
Interests	344,000
Total	443,000
Balance	1,067,000

$6,900,000 ÷ $1,067,000 = 6.4 years

According to the above calculations the foreign currency loans can be repaid in over seven years and in case B in 2.2 years (since the actual loans will possibly be on a deferred payment basis the repayment period will be even shorter).

Also, since the only difference is in the timing of construction of these plants and they should be considered as on enterprise from a macroscopic viewpoint, the foreign loans can be repaid in 3.3 years if we consider the foreign currency income and expenditures collectively. That is, there always will be a surplus in the balance of foreign exchange unless the principal is repaid at once in a short period of time.

8-3 Comparison with International Prices

The costs of the products by the plants that we have assumed to be constructed are as shown in Table 7-2, but, the comparison with international market prices of chemicals is shown as follows for reference(- Taken from the October 30, 1972 issue of the Chemical Industry Journal).

Unit: US$

Remarks		Soda Ash	Caustic Soda	Chlorine
International Market Price				
	High	66	121	149
	Low	36	99	86
	Average	51	110	117
Sales Price (At a salt price of 3,000 Rp/ton)		66	110	140
		66	124	115
		80	126	100
		80	120	110

a) The above international market prices were taken from U.S.A., U.K., Germany, France, Italy, Belgium and Netherland (as published in October 1972 issue of the Chemical Industry Journal in Japan).

b) The prices of soda ash is high even when the prices of caustic soda and chlorine are set at high or average international prices.

c) The chlorine price is at about the average international market price.

d) As stated above, if the prices of caustic soda and chlorine, which both have a large production, are to be set at average international prices, the price of soda ash becomes higher than the international market price. However, there is a way left to reduce the cost through lowering of overhead by uniting cases A and B under a single management, lowering of the interest rates which are high and reexamination of the locations of both cases.

8-4 The Effect on the National Economy

8-4-1 The Effect on GNP

A comparison of the consumer prices and imported prices of sóda ash, caustic soda and chlorine, which are almost entirely dependent on imports at present, and the estimated consumer prices for products from the new plants can be shown as follows.

Item	Present Consumer Prices (A)	Prices of Imports (CIF) (B)	Estimated Consumer Prices (C)
Soda Ash	100	60	96
Caustic Soda	180	107	151
Chlorine	360	298	120

(Notes)

1) The estimated consumer prices for the products of the new plan· s are bare costs plus 20% for packaging and dealer margin. Also, the above figures are those when the price of salt is 3, 000 Rp/ton.

2) The present consumer prices were obtained from consumers during on the spot surveys.

3) The prices of imports were gained from the import statistics for 1970 (Central Bureau of Statistics).

The difference between the present consumer prices and the prices of imports is made up of such as duties and dealers' margins and has been counted as part of the national income heretofore. Therefore, C - (A - B) is newly entered as national income. This can be seen as follows.

Soda Ash	929	million	Rupiah
Caustic Soda	2,913	"	"
Chlorine	1,131	"	"
Total	4,973	"	"

In other words, while dependent on imports as heretofre, duty and dealer margin were entered as added value to the national economy, but the above amount of 4,973 million rupiah is newly entered as added value and will contribute to the future economy of Indonesia.

8-4-2 Effect on Related Industries

As stated before, the prices of soda ash and caustic soda, among the estimated sales prices for the new plants, will not show such a marked reduction, but the price of chlorine is estimated to be lowered considerably and it is expected to contribute towards rationalization in the related industries.

The major related industries for soda ash, caustic soda and chlorine are the glass, textile, soap, paper, chemical seasoning and resin industries, all of which are basic to the people's living and if we also consider the expectations of future population and economic growth, we can anticipate a further large increase of demand. The mutual reliance between the soda industry and its related industries will continue to grow and develop, and that is the way it should be.

8-4-3 Employment and Others

New employment at the two new plants that we have planned for will be 170 persons and this figure is small, but if we think of the indirect employment for related jobs, such as maintenance, repairs and transportation, the figure is not necessarily small.

Also, the chemical industry of Indonesia, with the exception of some parts such as the fertilizer industry, is still developing, but if the plants that we have planned will be constructed, it will mean another step toward a modern chemical industry and such effects as increased self confidence towards the chemical industry in Indonesia and educational contributions can also be expected.

CHAPTER 9 ACTIVITIES, ITINERARY AND DISCUSSIONS OF THE SURVEY TEAM

	Places Visited	Subjects of Discussion and Remarks
9/4 (Mon)		The advance party of Leader Messrs. Hamazaki and Hasebe, left Tokyo and arrived in Jakarta. Discussed itinerary and other subjects with Mr. Namiki of the Japanese Embassy and Mr. Weda of JETRO.
9/5 (Tue)		Mohammedan holiday
9/6 (Wed)	Japanese Embassy and Department of Industry	Courtesy call on Ambassador. Visited Department of Industry with Mr. Namiki and discussed about assistance, itinerary and subject of survey with directorate Mr. Anwar Ibrahim in charge of the Chemical Industry and his staff after paying our respects. Discussed about survey with Messrs. Namiki and Weda.
9/7 (Thu)	Department of Industry	Discussed in detail the itinerary for survey with our Indonesian counterparts Mr. Soenarjo and two other gentlemen.
9/8 (Fri)	Department of Industry	Paid a call on Mr. Notosoewarso, Chief of the Foreign Bureau and exchanged opinions. Visited Mr. Siahaan of the Asahan Aluminum Complex and heard an explanation of the Asahan Project.
9/9 (Sat)	Pertamina and Department of Industry	Met with Mr. Bangbang Pramono, because Mr. Suto of the Planning & Development Section was away on an overseas business trip, to hear about the projects related to our survey. Later, visited Department of Industry to ask for early delivery of questionnairs.
9/11(Mon)	Department of Industry	Change and reconfirmation of itinerary at the Department of Industry. Mr. Nakamura and four others arrived at Jakarta.
9/12(Tue)	Ministry of Health, Japanese Embassy and Department of Industry	Exchange of opinions on malaria control with Mr. Prawirosujanto, Director General of Pharmacy, Ministry of Health. Paid courtesy call on Minister Tsuge at the Japanese Embassy. Then visited Director Mr. Anwar Ibrahim at the Department of Industry for basic exchange of opinions on the survey.

9/13(Wed)	P.N. Garam, Central Bureau of Statistics, City Water Department and Japanese Consultants on Water system	The Leader and Mr. Yamaguchi visited Mr. John Anwar, Director of P.N. Garam and the remaining members with Mr. John Tutuarima, Chief of Trade Statistics Section and Mr. Sumarman Chief of Industry Section, both of the Central Bureau of Statistics, to hear their opinions and to ask them for data relevant to the survey. Heard about present state and plans on water treatment at the City Water Department and then all members visited the consultants of the World Bank Projects, engaged in drafting basic plans for water systems in Banjuwangi and 6 other cities, and ask for the opinions on the water system in Indonesia in general from Mr. Nakajima the Director and his staff.
9/14(Thu)		Visited our counterpart Mr. Soenarjo to ask his assistance on the questionnairs of the survey.
9/15(Fri)	P.N. Garam and Gresik Cement	The entire team moved to Surabaya from Jakarta with the Leader and Mr. Yamaguchi visiting P.N. Garam, the remaining members visited Gresik Cement and heard the opinions of the President.
9/16(Sat)	P.N. Garam and P.T. Ajinomoto	Exchanged opinions on present state and problems with the Directors, Mr. John Anwar and Mr. Moh, Tajib, Mr. Bupati and Mr. Bahaudin. Abdul Rachman and Bahaudin at P.N. Garam. Visited P.T. Ajinomoto located at Mojokerto and heard about the outline of the plant, future plans and present conditions of the industry from President Soichi Ino.
9/17(Sun)		Leader and Mr. Yamaguchi returned to Surabaya from Madura.
9/18(Mon)	Power Station and City .Water Department	Heard about the electric power situation in Eastern Java from Director Mr. Samhir at the Power Station. Then visited City Water Department and heard outline of water system in Surabaya from Director Mr. Iman.

9/19(Tue)	P.N. Soda Waru and P.N. Iglas	Heard about the outline of the plant and a particularly detailed explanation on supply and demand after the rehabilitation from Mr. A. Nawawi, Director of Administration at P.N. Soda (the President and Chief Engineer were visiting Japan) and then made a tour of the plant. Later, heard about the present state of the plant, future plans and conditions of the industry from Managing Director Mr. B. Sediono Adhiwinoto and one other gentleman at P.N. Iglas.
9/20(Wed)	P.N. Kertas Letjes	Heard about outline of plant, industry conditions and future plans from President Oetjok B. Notokoesoemo of P.N. Kertas Letjes located at Letjes. Stopped at a soap plant located at Probolinggo on the way back and asked about production quantity and basic unit of chemicals but were unable to receive clear answer.
9/21(Thu)	Petrokimia Gresik and U.D. Anekakimia	Met with Mr. Djarot Djojokusumo, Technical Manager of Petrokimia Gresik and asked about outline of plant and future plans. On the way back visited U.D. Anekakimia a dealer of Soda Waru Products to inquire about supply and demand and future estimates.
9/22(Fri)		Moved to Jakarta from Surabaya.
9/23(Sat)		Moved to Bandung from Jakarta.
9/24(Sun)		The whole team engaged in putting together the results of past surveys.
9/25(Mon)	K.T.S.M. and City Water Department	Visited P.T. Kanebo Tomen Sandang Synthetic Mills and heard about the present state of synthetic fibers and the outline of the mill from Mr. Y. Yamasaki, the President, then proceeded to City Water Department to inquire about present water treatment. Mr. Yamaguchi returned to Japan.
9/26(Tue)	P.N. Kertas Padalarang	Visited P.N. Kertas Padalarang to ask about present state of plant and future plans for expansion. Moved from Bandung to Jakarta in the afternoon.

9/27(Wed)		Had meeting during morning and afternoon to discuss secondary derivative of salt and tentatively calculated costs of new soda ash plant.
9/28(Thu)	P. T. Pusri	Moved from Jakarta to Palembang. Visited P. T. Pusri and met with Mr. Soebronto to hear about present plant conditions.
9/29(Fri)	Pertamina Unit II	Visited Pertamina Unit II to ask about the outline of the plant and plans for the petrochemical industry.
9/30(Sat)		The Leader and Mr. Nakamura moved to Medan from Palembang and the remaining four moved to Jakarta.
10/1(Sun)		Putting together of results of survey.
10/2(Mon)	Pertamina Unit I	Visited Pertamina Unit I at Pangkalan Brandan and heard about the general situations at the plant from Lt. Col. Husni, the General Manager. Moved to Jakarta in the afternoon. Also worked at putting together results of survey.
10/3(Tue)	Unilever Factory	Inquired about the outline of the plant and the Indonesian soap industry from Mr. Soemarso Setjomardojo and other gentlemen at the Unilever Jakarta Factory during the morning and held a meeting of the whole team in the afternoon.
10/4(Wed)	Indonesian Acid Industry Ltd.	The Leader and Mr. Hasebe visited I. A. I. to hear about sulfuric acid and aluminum sulfate from Director E. Sjamsuddin Apan, while the rest of the team worked at putting together the survey results.
10/5(Thu)	Japanese Embassy	Worked at putting together results of the survey during the morning and visited Japanese Embassy in the afternoon to report on the outline of the progress and results of the survey to Messrs. Udagawa and Namiki of the Embassy and Mr. Ueda of JETRO.
10/6(Fri)	Department of Industry	Made an interim report to Directors Mr. Anwar Ibrahim and Surgi and asked for their opinions.

10/7(Sat)	Japansese Embassy	Reported finalized draft of interim report to Japanese Embassy.
10/8(Sun)		Preparations for return to Japan.
10/9(Mon)	Bappenas	Met with Director Mr. Soegeng Soendjaswadi of Bappenas to make interim report and to hear his opinion.
10/10(Tue)		Left for Japan.

APPENDIX

APPENDIX

CHAPTER 1 ABOUT THE SEA WATER INDUSTRY

More than sixty kinds of elements have been detected from sea water but the most abundantly produced among these is salt. Magnesium and its salts follow it and bromine, gypsum, potassium salts, sulfate of soda and boric acid are also important products from sea water.

The most interesting among these, in view of the present conditions in Indonesia, are bromine, gypsum, magnesium carbonate and magnesium sulfate. Bromine is used as a raw material for agricultural chemicals, especially for fumigators of lumber and as an insecticide against nematodes, gypsum is used as material for cement (this is the only material for cement presently being imported), magnesium carbonate is used as a compound for vulcanized rubber and tooth powder, and magnesium sulfate is used for tanning leather and for fertilizer.

In collecting these useful components from sea water, one way is to do it by direct used of sea water and another is to use bittern which is left after salt has been collected from sea water. There is no quantitative limit when collecting directly, but the quantity will be limited by the quantity of the bittern when collecting from bittern, There will be no problem when the production of salt and that of these useful components balances, but if it does not, direct production from sea water becomes necessary. It is difficult to give an unqualified answer as to which is more advantageous from a business point of view and each corporation is employing its own method in accordance with its own peculiar situation. We will hereunder relate the industrial production method and uses of the major useful components that can be collected from sea water.

CHAPTER 2 ABOUT THE BITTERN INDUSTRY

In Japan also, there are companies that collect bromine and magnesium hydroxide from sea water and those that collect these from bittern.

We took an example from an actual salt plant and showed the flow in Charts Ap-1, Ap-2 and Ap-3. Chart Ap-1 shows an example where salt is collected from sea warer through an ion exchange film and a multiplex purpose evaporator, and gypsum, magnesium hydroxide and magnesia clinker are produced from bittern. Chart Ap-2 shows an example of production of magnesium hydroxide, magnesium sulfate and magnesia from sea water, and Chart Ap-3 that where bromine, gypsum and magnesium carbonate are collected from bittern. The production process of common salt is omitted from both Charts Ap-2 and Ap-3, but this plant produces 175,000 ton/year of common salt and has a capacity for producing 2,500 - 3,000 ton/year of gypsum and 300 - 350 ton/year of bromine, and collects 15,000 ton/year of magnesium hydroxide from sea water.

The number of operators is 80 excluding the salt production process (but includes men for packaging). The purpose for collecting gypsum at this plant is for preventing potassium chloride from mixing with magnesium chloride which is its main product. Collection of bromine and gypsum from bittern is a simple matter and can be done on compact equipment.

2-1 Outline of Bittern

It is needless to say that collection of the above useful components from bittern requires less equipment and can be done at a lower cost except when collecting them from sea water on a large scale.

In planning to undertake the above, a careful research must be made of the components and their quantities contained in the sea water and the bittern discharged from the salt ponds. We surveyed the companies in Japan, but the components and their nature differ a little bit from that of the bittern in Indonesia because the solar evaporation process is no longer employed in Japan, being changed to such methods as the ion exchange film or the vacuum evaporation method. The bittern in the Japanese salt fields of the past differed according to the location and the density was in the range of Be 30 to Be 35 degrees.

The components of bittern are closely related to the material brine, the production method and the evaporating conditions, and we will show the components of bittern in Japan as reference in Table Ap-1.

The density of the bittern discharged from the crystallization pond of P.N. Garam's Madura salt field is estimated to be about Be 28 to Be 29 degrees. According to experience in Japan, an average of 84 litres of bittern (density Be 34 degrees) should be produced from 1 kilolitre of brine in a salt pond (about Be 17 degrees), but actual production is between 70 to 80 litres, since not all of it can be collected due to reasons of equipment and others. Since about 160 kilograms of salt can be produced from the above brine, if we assume that 80 litres can be collected, we can say that 0.5 kilolitre of bittern will be produced while 1 ton of salt is produced. We cannot quote accurate figures because almost no survey of the production of bittern in solar salt production has been made, but we can safely estimate that the amount of bittern collectable for each ton of salt productions at about 0.3 Kilolitre (about 31 Be, "Salt and Magnesia Industries" by N. Fukunaga).

2-2 Cypsum

Gypsum is produced naturally or as a by-product of a chemical plant or collected from sea water, and that collected from sea water comes from either precipitation during the concentration process of sea water or by a chemical reactions. The former is the simplest way, collecting the precipitation which occurs naturally in the salt pond, as it is already being practiced in Indonesia. The latter is produced by treating the concentrated brine or bittern with calcium chloride and is gained as a by-product when bittern is desulfurized for increasing the yield of potassium chloride, and many plants are now treating concentrated brine or bittern for the purpose of obraining high quality gypsum.

Hydrated calcium sulfate is mainly used for controlling the hardening of cement and also for molds of porcelain and china, for plaster boards and for dental and surgical uses as calcinated plaster of Paris. When we consider the fact that Indonesia is lacking in natural resources of gypsum and is importing its gypsum for cement, the collection of gypsum from sea water is absolutely necessary.

In coolecting gypsum, unless it is collected as a by-product of increased potassium chloride production or where high purity is required for dental or surgical uses, there are other methods for producing gypsum in large quantities to satisfy the demand for cement where large quantity rather than high purity is required.

Particularly, since gypsum amounting to two and a half times of the product is produced as a by-product from the phosphate fertilizer plant now being planned by the Indonesian Government, it should be judged whether it would be more advantageous to plan collection of gypsum from sea water or to import until this fertilizer plant enters into operation, considering its construction schedule, because a low priced and stable supply can be expected from this plant.

2-3 Bromine

There are two methods to industrially produce bromine from sea water, namely (1) production of bromine from bittern, and (2) direct method from sea water.

1) Manufacture of bromine from bittern (refer to Ap-2, 3 and 4)

Bittern or concentrated bittern preheated to 60 to 80 degrees centigrade is flowed down from the top of a Kubierschky tower made of granite generated steam exist from bottom of tower and chlorine gas is blown in at about 1 to 1.5 meters above the steam exit, causing substitution reaction with chlorine, and the bromine generated thereby is conducted to a coiled cooling tube through the top by a glass or ceramic conduit, whereby crude bromine (of about 75% purity with most of the impurities being chlorine) and bromine solution is gained. Sometimes a small amount of sulfuric acid is added, in the case of bittern, to increase the yield by lowering the pH to 4 or 5, but it is not added to concentrated bittern in most cases. Crude bromine may be used as a product as it is, but generally it is refined by a reflux process, where reflux distillation is repeated in a distillator with a condenser (made of glass) at a temperature slightly higher than the 58.78 degrees centigrade boiling point of bromine, thereby eliminating in gas form most of the chlorine and volatile organic matters. Since there still remain organic compounds, although the purity is raised to 99 to 99.5% through this operation, redistillation is sometimes done using small equipment. At the plant we visited, an annual production of 300 to 350 tons of bromine was manufactured from a production of 175,000 ton/year of salt, using 4 distillation towers of 1 meter square and 6 meters height. Those were cleaned every 20 years at this plant and their method was very compact using only 3 men on a 3 shift basis, which means 1 man for each shift.

2) Direct production of bromine from sea water (Chart Ap-2)

Sulfuric acid is added to sea water, lowering its pH to 3 or 4, and then chlorine gas is added and this is allowed to flow down a packed bromine generator tower made of concrete. Excess air is blown in from the lower part of the generator tower and the air containing bromine is sent to the absorption tower where the bromine is absorbed into a caustic soda solution. This solution is streamed in another distillation tower after adding sulfuric acid and liquid bromine is collected by distillation. The purity of the product reaches 99.5% and there are less impurities, particularly chlorine and organic matters, when compared with the the product from bittern.

The main uses are as a material for such fumigators as methyl bromide and ethyl bromide, as a photographic sensitizer in the form of potassium bromide, as an insecticide for nematodes in the form of ethylene bromide and for such other uses as inorganic chemicals and as material for pharmaceuticals.

2-4 Magnesium Hydroxide (refer to Chart Ap-2)

2-4-1 Magnesium Hydroxide Manufacture from Sea Water

Ther is much difference in the methods of manufacturing magnesium hydroxide from sea water according to the uses. That is, there are such uses as for fire-proof material, for fertilizers, for magnesia cement and raw material for producing magnesium metal. Since the melting point of the calcinated magnesia is lowered, weakening its resistance to high temperature if there is calcium salt in the material magnesium hydroxide, a product without calcium salt is required for fire-proof material. However, it is better to contain a little boron because it is said that a little boron is effective in the formation of Periclase.

Generally, there is not much problem in containing calcium salt and boron compounds for such uses as for fertilizers, for magnesia cement and other uses, but a very active type is required. A product containing a very small amount of boron which is needed for the growth of plants is desired for fertilizer, and in the case of a product for magnesia cement any coloring agents are to be avoided, but there is no particular problem in other components.

Since calcium salt can be removed in the process of making anhydrious magnesium chloride for the manufacture of metal magnesium, the existence of calcium salt in the raw material magnesium hydroxide poses no problem, but, the mixing of boron must be avoided because if boron compounds are mixed in it they will become a great obstacle in the manufacture of metal magnesium by electrolyse.

The boron in sea water tends to attach itself as $B(OH)_3$ to the precipitation of magnesium hydroxide, but this can be prevented by raising the pH with the adding of excessive alkali. The following process, as shown in Ap-2, is required for the collection of magnesium hydroxide from sea water. Advance treatment of sea water - lower the pH to 4 - 5.5 by adding acid to the sea water and then decarbonize by blowing air into it. Main treatment - cause reaction by adding quicklime and carbide residue. Precipitation and separation of magnesium hydroxide - precipitation and separation by Dorr thickener, cyclator and accelerator. Washing and filtering - filtering by vacuum filter. Dehydration and drying - drying by hot air using a rotary drier.

The problems in the above processes are the prevention of mixing of harmful matter into the precipitation and the manufacture of large granules which are easy to filter and wash. One way to make large granules is to form large granular crystals by lessening the reaction speed between the magnesium ion and hydroxide ion in the sea water, and to let these grow further.

2-4-2 Manufacture of Magnesium Hydroxide from Bittern

At the plant that we surveyed, no magnesium hydroxide was being manufactured from bittern. The reason was that a large quantity of magnesium hydroxide was required for fertilizer and because there was not enough bittern for that.

Generally, in collecting magnesium hydroxide from bittern, the bittern is treated by a calcium chloride solution and then it is manufactured by adding lime milk or calcinated dolomite milk to the mother liquor of calcium sulfate which is desulfurized mother liquor, or to bittern. Unlike the manufacture from sea water, if the desulfurization of bittern is incomplete, ther is a risk of calcium sulfate getting mixed into it. Therefore, it is necessary to make the calcium chloride solution as rich as possible in order to make the desulfurization complete. However, since the reaction with a comparatively rich calcium chloride solution tends to result in the formation of fine precipitation, the following steps are takne to gain large granules of magnesium hydroxide which are easy to filter and wash.

A) Continuous Reaction Method

Simultaneously inject desulfurized bittern and lime milk so that always equal amount react and manipulate to keep the reaction density at a minimum.

B) Method of Reaction in Calcium Chloride Solution

Always keep an excessive amount of magnesium chloride in the reacting liquor, when adding lime milk into desulfurized bittern containing large quantities of calcium chloride to cause reaction.

C) Method of Treatment by Calcium Chloride Hydroxide

Either add this double salt to cause reaction or cause its formation in the reaction system.

In other words, both B) and C) are none other than methods to lower the speed of the reaction between magnesium ion and hydroxide ion which react very quickly in a rich solution.
In these methods, it is necessary to elongate the staying time of the seed crystal of magnesium hydroxide as much as possible and to stir the mixture in the reaction tank so that the density in the various parts are equal.

2-5 Magnesium Chloride

The magnesium chloride made from bittern is also called solid bittern and the production method from the old days is still being used with almost no change. That is, bittern is concentrated in a flat cauldron and then the mother liquor, from which the by-product salt and bittern potassic salt which form before reaching the boiling point of 124 - 125 degrees centigrade have been separated, is cooled to normal temperature and the enriched bittern, gained by centrifugal separation from the mixture of sodium chloride and carnallite which is educed, is further enriched by the flat cauldron and when it reaches near the boiling point of 160 degrees centigrade, it is left for a while keeping the temperature, allowing the impurities to precipitate and then the top fluid is poured into a container to let it solidify. (Refer to Chart Ap-7)

Generally speaking, in the manufacture of magnesium chloride from bittern, the coloring is better when bittern after bromine has been collected from it is used because the organic matters contained in the bittern will have been separated.
The amount of magnesium chloride be recovered from bittern is 250 kg/kl.

The main usages are as material for magnesia cement, material for manufacturing metal magnesium, fire extinguishers, water proofing material (for lumber), dust-proofing material (roads and mines), antifreeze, material for the ceramic industry, for the construction of iron furnaces and for the manufacture of parchment paper.

2-6 Magnesium Sulfate

The methods for manufacturing magnesium sulfate are 1) the method of neutralizing magnesium oxides, hydroxides and carbonates by sulfuric acid, changing it to a magnesium sulfate solution, and then condensing this by evaporation and letting it cool and crystallize (Chart 5), or 2) the method of separating and crystalizing from bittern, natural brine or the treated liquid from a potassic industry.

It is mainly used for the tanning of leather, for finishing fabrics, for fillers in paper production and for the production of man -made fibers, besides being used medically as a laxative. Its demand has brown recently as magnesium fertilizer, which, unlike magnesium hydroxide fertilizer, is suited for neutral soil that does not nitrogenous alkaline fertilizers and for mixing with ammonia fertilizers. It is said to be particularly well suited as a fertilizer for the rubber plant.

2-7 Basic Magnesium Carbonate

Basic magnesium carbonate has been used for a long time as a compound for rubber and in tooth powder, pigments, paint and medical drugs. It was originally manufactured by the soda ash process with bittern as the raw material, but the sharp increase in its use as a filler for rubber and as an insulator gave rise to the process of carbonizing magnesium hydroxide and the ammonium carbonate using the waste liquid from an ammonia-soda process plant.

We will hereunder relate about the soda ash process and the ammonium carbonate process, in consideration of the present conditions in Indonesia.

2-7-1 Soda Ash Process (Refer to Chart Ap-8)

2-2.5 kilograms of bleaching powder is added to bittern, as advance treatment, diluting the contents of $MgCl_2$ to about 20%. A roughly 20% solution of soda ash is added to this and reacts at around 70 - 75 degrees centigrade. Since the conditions of the reaction affect the quality, each plant is setting up its own special standards. Then, this is put into a washer and is washed with water or drain until reaction of chloride ion disappears from the washing liquid. After washing is completed, it is cut into a prefixed size by a press, and after dehydration it is placed on a rack drier over a long period and then processed into the product by crushing. Bleaching powder is not added when to collect magnesium carbonate using bittern which bromine collected.. The yield rate is about 200 kilograms from 1 ton of condensed bittern.

2-7-2 Ammonium Carbonate Process (Refer to Chart Ap-9)

2 to 3 kilolitres of waste liquid from an ammonia-soda process plant is mixed with 1 kilogram of raw bittern in a reaction tank and steam is blown into this causing reaction at 60 to 65 degrees centigrade. The formation is filtered through an Oliver filter, heated in an ageing tank by steam, filtered and dehydrated, and dried in a rotary drier after being washed until chloride ion reaction disappears from the washing liquid and then becomes the product by crushing. The yield rate is about 120 kilograms from 1 ton of raw bittern. As the ammonium carbonate which is the waste liquid of an ammonia-soda process plant can be used in this process, the cost is lower compared to the soda ash process.

CHAPTER 3 WRAP UP

In collecting effective components from sea water or bittern, a decision should be made after careful study of the quality, necessary quantity and usage of the material collected. In collecting various materials from sea water, there is an almost unlimited possibility if the equipment can be enlarged, but equipment which is several times larger than that for processing bittern will be required. Also, in the case of collection of usable substances from bittern, when there are 5 salt fields on the island of Madura as is the case with P. N. Garam, considerations should be given to transportation and storage of the bittern so as to enable a year-round operation.

Bromine is the most easily collectable item from sea water in the wide meaning including bittern, and collection of magnesium carbonate and gypsum from the left-over bittern is also comparatively easy. However, gypsum is actually being collected for the purpose of eliminating harmful components in the process of collecting magnesium chloride from bittern. There are plants engaged in direct collection of magnesium hydroxide and bromine from sea water, but a careful study of payability will have to be made since large scale equipment is necessary.

Table Ap-1

Components of Bittern (%)

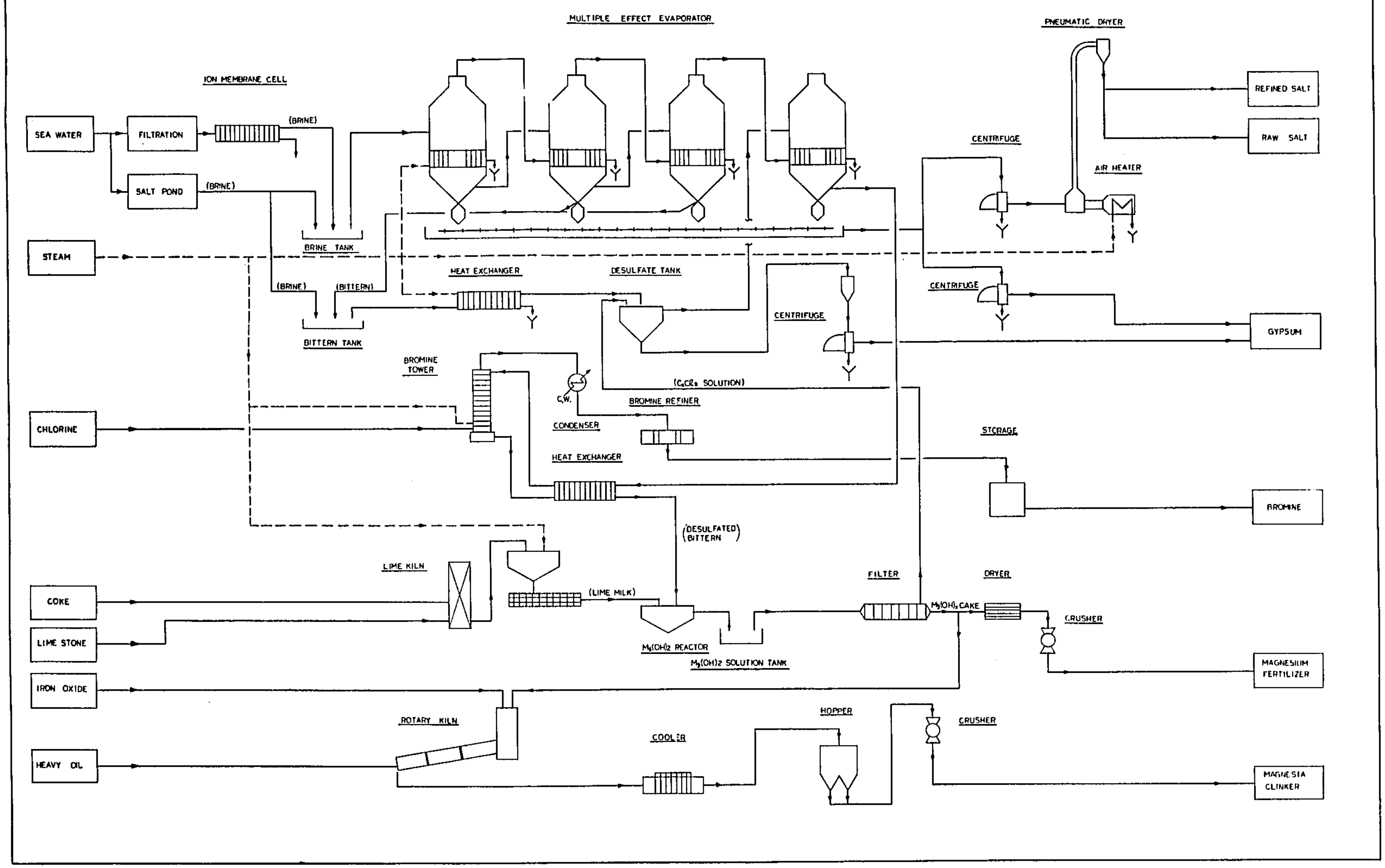
Production	Location	Be Density	Temp	CaSO4	MgSO4	MgBr2	MgCl	KCl	NaCl	Total
ST Type Flat Cauldron	Akoh, Hygo	35.7	36.1		9.456	0.364	17.623	3,441	3.896	34.780
"	Takamatsu, Kagawa	31.5	7.5		3.743	0.395	18.656	3.254	4.897	30.945
"	Setoda, Hiroshima	31.5	26.0		6.580	not measured	17.460	2.630	6.170	32.840
"	Akibo, Yamaguchi	35.0	57.0		9.670	not measured	17.360	3.330	4.200	34.560
Steam type	Yorishima, Okayama	33.2	10.0		3.784	0.424	20.463	2.993	4.182	31.846
"	Hayashida, Kagawa	34.0	30.0		8.198	0.313	15.53	3.229	5.171	32.464
"	Okayama (b)	34.8	25.0		9.588	not measured	17,209	3.302	3.503	33.602
Vacuum type	Akoh, Hyogo	34.1	21.0		7.407	0.348	16.708	3.566	4.870	32.899
"	Yamada, Okayama	33.0	35.0		8.866	0.276	12.947	3.035	7.102	32.226
"	Nio, Kagawa	34.0	45.0		10.386	0.288	13.920	3.548	6.941	35,083
"	Marugame, Kagawa	35.0	32.7		10.432	not measured	15.311	3.393	4.363	33.499
Pressure type	Salt Institute	31.7	34.5		6.271	not measured	18.557	2.942	4.843	32.613
Electric Heater	Unknown	30.4	15.0		8.260	not measured	14.340	2.980	9.230	34,810
Solar Syatem	Manchuria	30.7	15.0		5.160	not measured	10.460	2.050	11.620	29.290
"	Korea	31.5	15.0	0.107	8.050	not measured	10.267	2.000	10.185	30.623
"	Taiwan	32.9	21.0	0.005	12.251	0.328	16.079	3;452	9.373	41.533

Table Ap-2

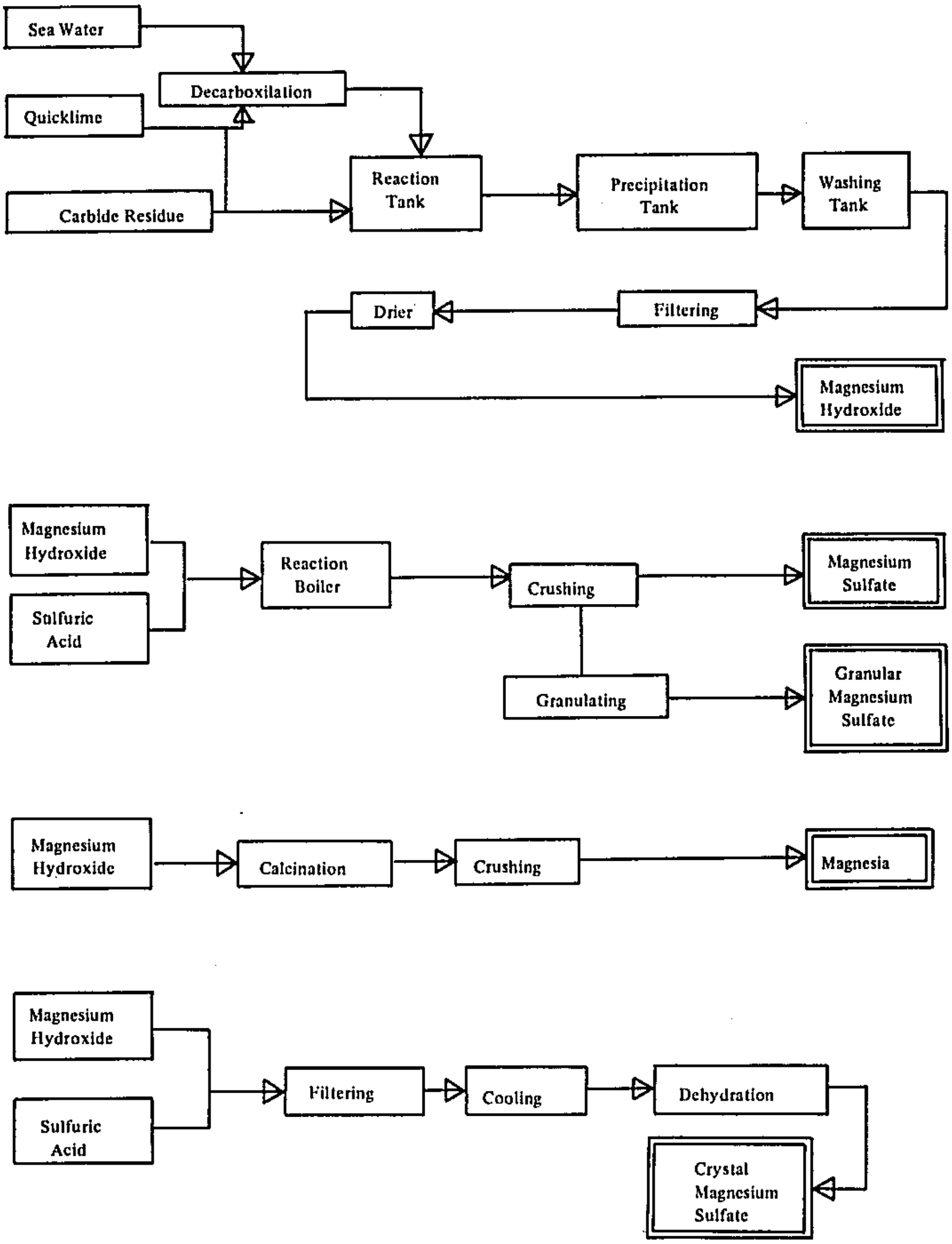
Variation in Composition
Average Composition of Bittern (%)

Baume Density (15 C)		MgSO4	MgCl2	KCl	MgBr2	NaCl	Total
27	1.2291	2.80	4.70	0.75	0.06	19.25	27.56
28	1.2397	3.70	5.85	1.14	0.09	17.54	28.34
29	1.2505	4.60	7.05	1.46	0.12	15.64	28.87
30	1.2613	5.42	8.30	1.68	0.16	13.85	29.41
31	1.2726	6.42	9.66	1.97	0.20	12.00	30.25
32	1.2839	7.30	11.20	2.20	0.24	10.35	31.29
33	1.2955	7.95	12.85	2.44	0.28	8.62	32.14
34	1.3072	8.50	14.35	2.72	0.31	7.20	33.08
35	1.3191	9.20	15.85	2.96	0.34	5.42	33.76
36	1.3312	9.60	17.38	3.12	0.37	4.82	35.28

FLOW SHEET OF SALT AND ITS DERIVATIVES' PLANT

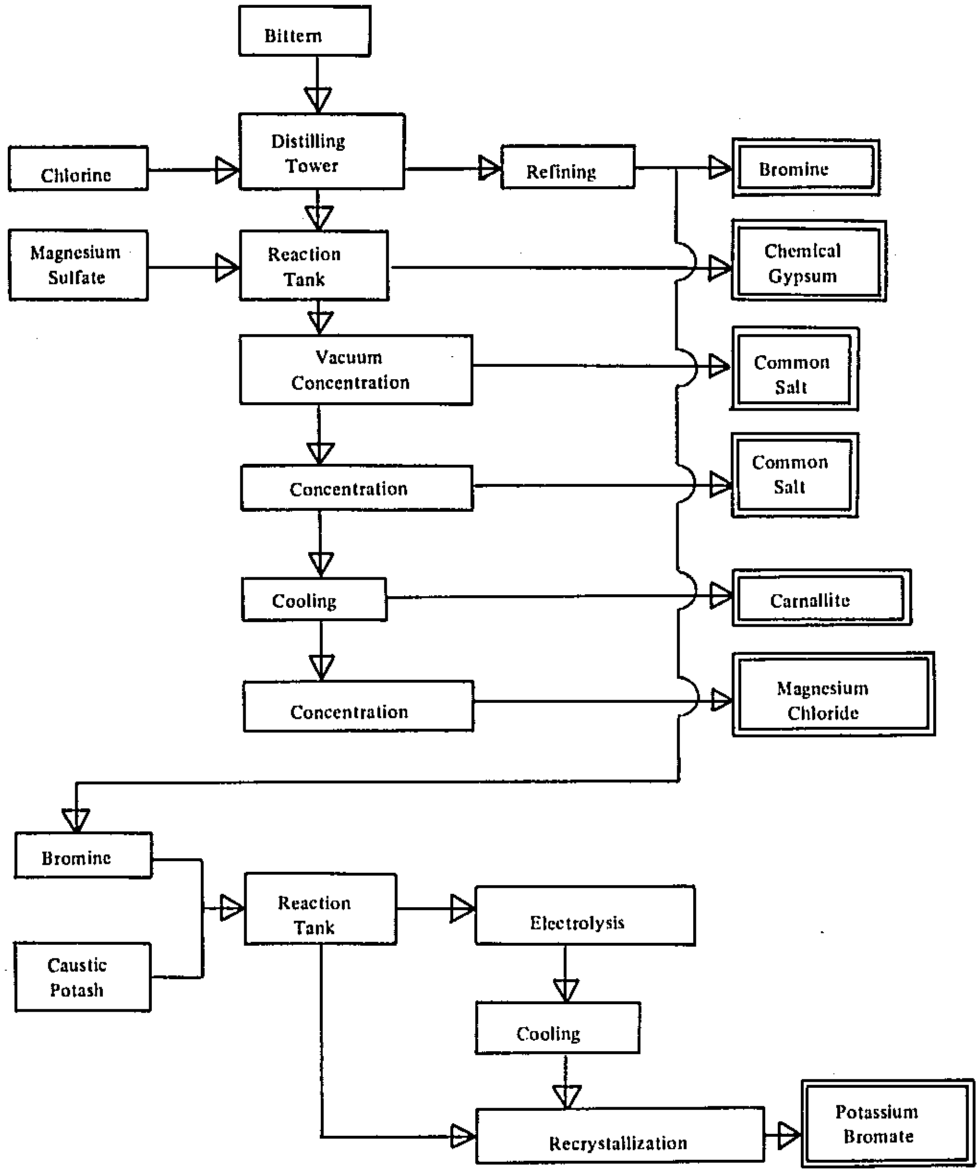


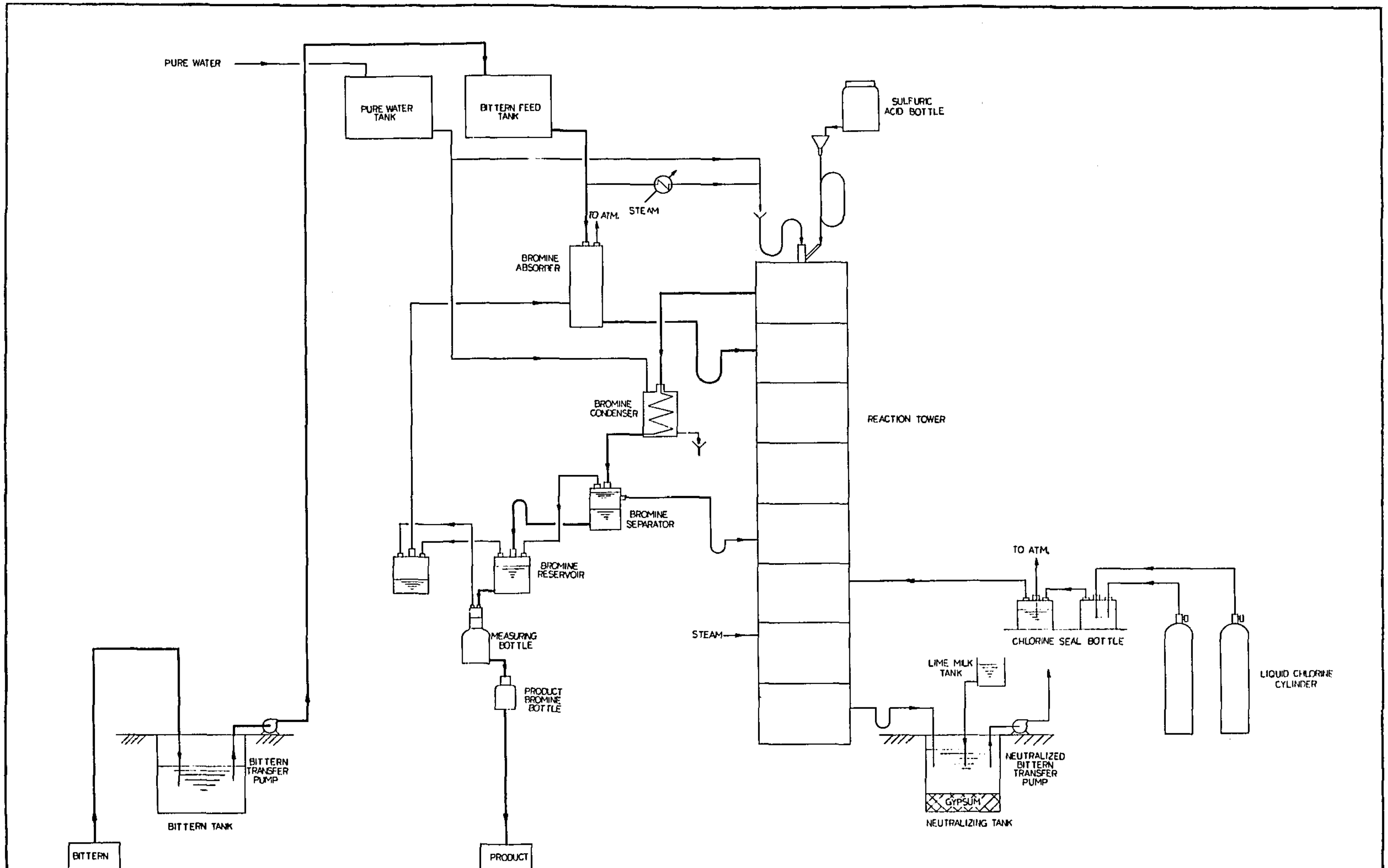
(Chart Ap-2) One Example of Sea Water Industry



(Chart Ap-3)

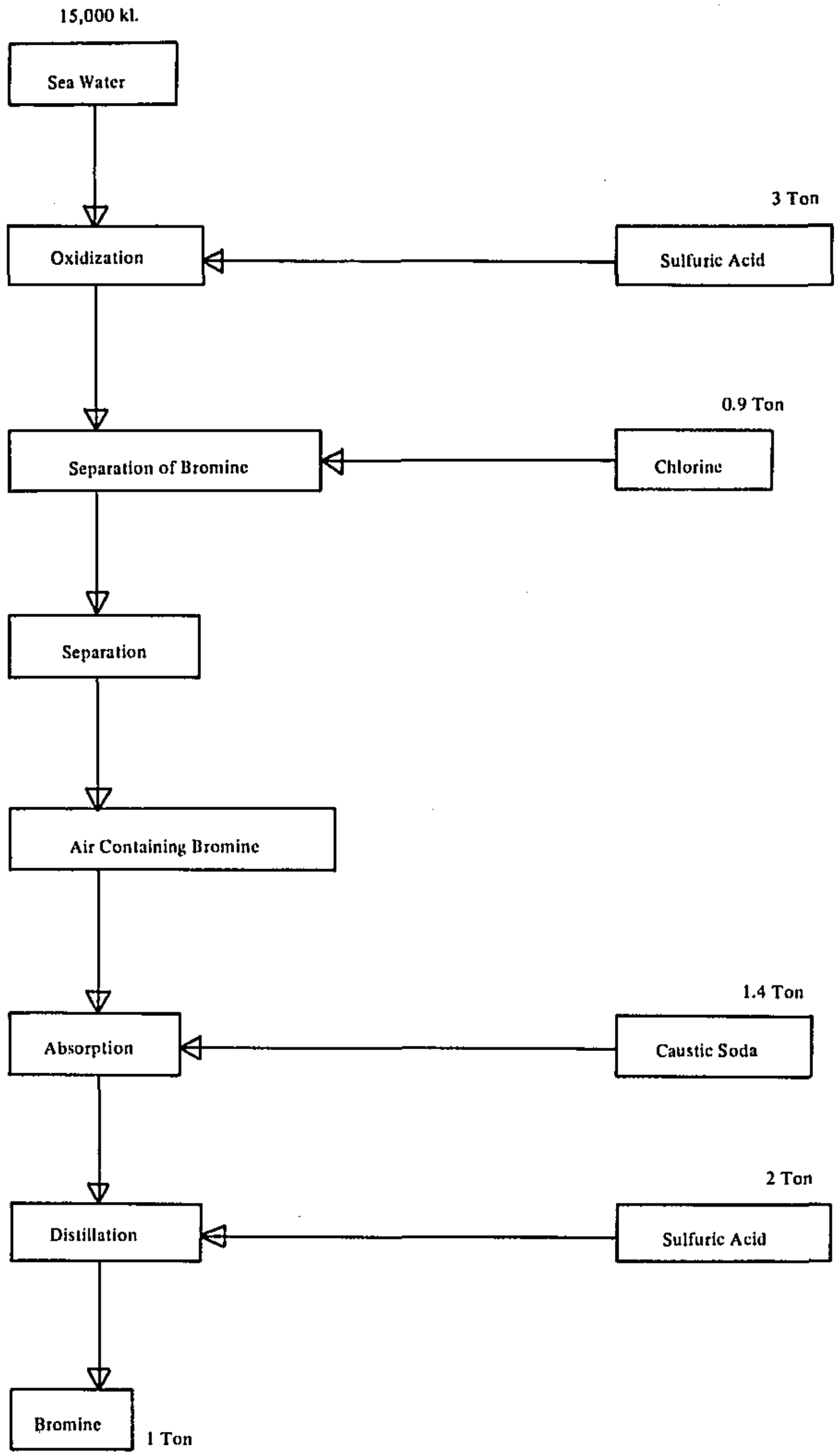
Process Chart



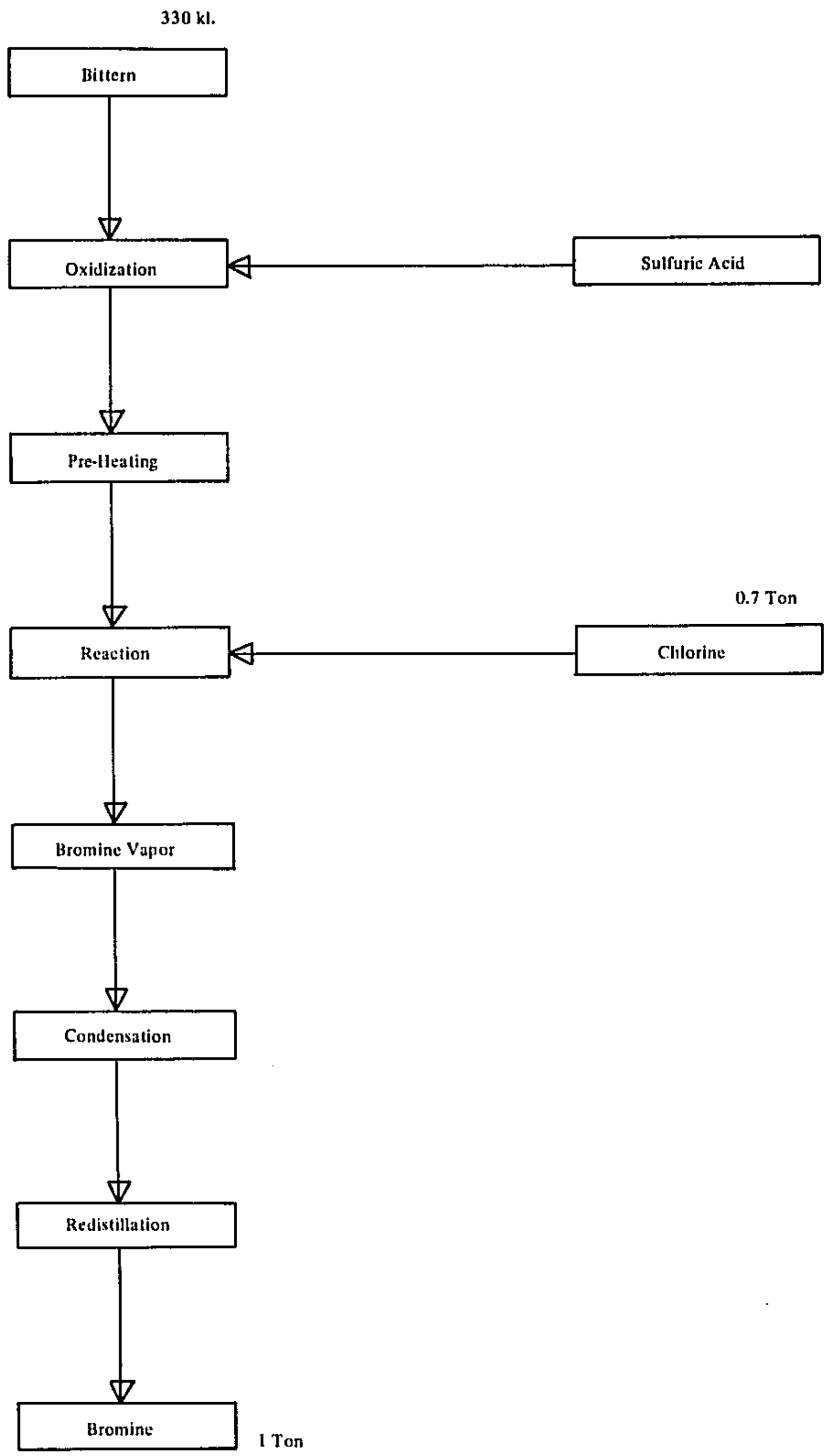


FLOW SHEET OF BROMINE PLANT

(Chart Ap-5) Manufacture of Bromine from Sea Water

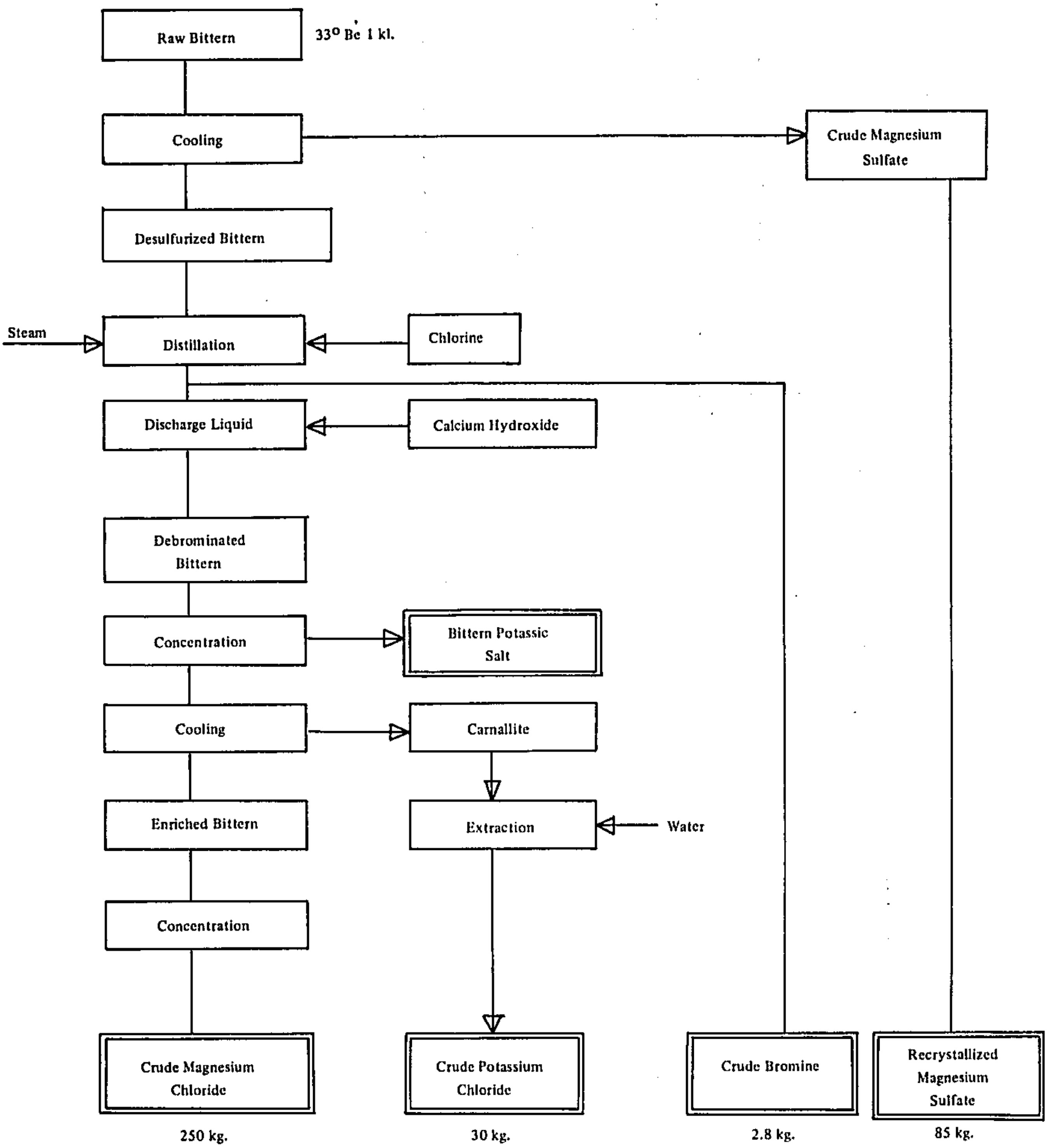


(Chart Ap-6) Manufacture of Bromine from Bittern



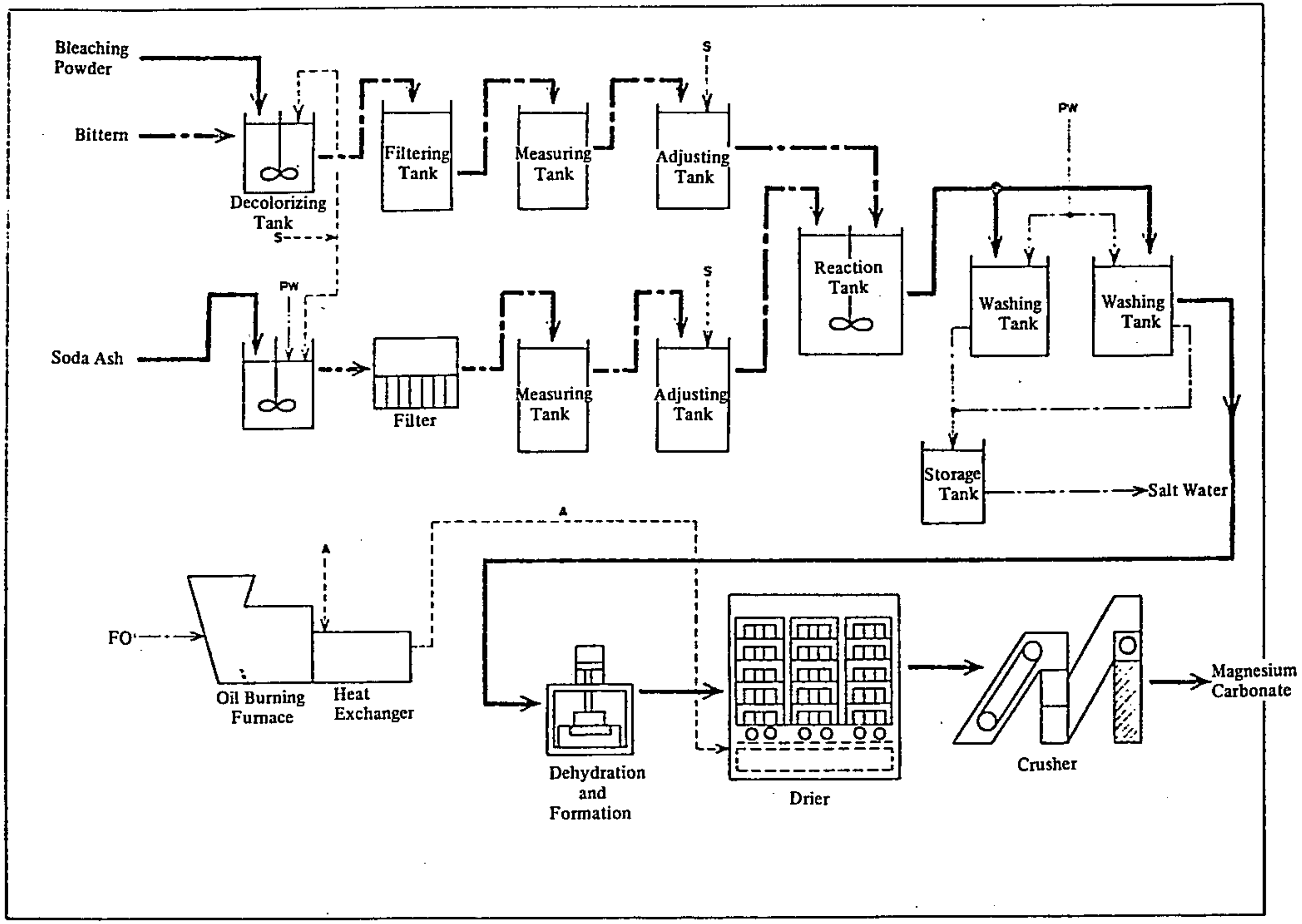
(Chart Ap-7)

One Example of Use of Bittern



(Chart Ap-8)

Production Process of Magnesium Carvonata (Soda Ash Process)



(Chart Ap-9)

Production Process of Magnesium Carbonate (Ammonium Carbonate Process)