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REPORT FOR THE PETROCHEMICAL AND FERTILIZER MEETING OF THE INDUSTRIAL CENTRE FOR ARAB STATES - KUWAIT

October 1970

Bureau d'
Etudes
Industrielles et de
Coopération de l'
Institut français du
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REPORT

FOR THE PETROCHEMICAL AND FERTILIZER MEETING

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TABLE OF CONTENTS

—— 0 ——

.../...

III - 3. 8/ Propylene
9/ Butadiene
IO/ Benzene
II/ Paraxylene

4. Fertilizers
I/ Nitrogenous fertilizers
2/ Phosphate fertilizers
3/ Potash and complex fertilizers

5. Sulphur

6. The export question

IV - STRUCTURE OF THE INDUSTRY TO BE ADOPTED

I. Necessity of planning phased and integrated complexes
I/ Phased complexes
2/ Integrated complexes

2. Price of raw materials

3. Capital availability

4. Selling the products

5. Technical limitations

V - HARMONIZATION AND COOPERATION BETWEEN PROJECTS

V I - FEASIBILITY STUDIES and PROJECTED COMPLEXES

I. Recommended development routes

2. Presentation of feasible projects and study of different alternatives

1/ Complex based on olefines production and their derivatives

2/ Complex based on aromatic production and their derivatives

3/ Projects based on export possibilities

3. Analysis of the alternate feasible projects and profitability calculations : basis for the selection of recommended projects

I - INTRODUCTION

In response to a request from the Industrial Development Center for Arab States (I.D.C.A.S.), the United Nations Industrial Development Organization has entrusted to the Bureau d'Etudes Industrielles et de Cooperation de l'Institut Français du Pétrole (B.E.I.C.I.P.) the preparation of a report for the petrochemical and fertilizer meeting that will be held in Kuwait on behalf of IDCAS.

The aim of the report is to present -on the basis of future internal consumption and possibilities for exports in the periods 1971-1975 and 1976-1980-recommendations on the targets of production to be undertaken in the Arab world, on the type, size and location of the projects that could be installed and on the structure of the industry to be established.

The plan of treatment that has been adopted is the following :

In chapter II, a summary of conclusionsand recommandations is given ;

In chapter III the targets of production are indicated for intermediate and finished petrochemical products as well as for fertilizers.

In chapter IV are discussed several aspects to be taken into account at the stage of planning, such as necessity of integrated complexes, price of raw materials, opportunity to obtain or not the participation of foreign partners for financial technical or commercial reasons etc...

In chapter V, are presented the different parameters that must be considered to justify and promote harmonization and co-operation between projects.

In chapter VI, are studied the complexes that appear to be feasible in 1975 and 1980 ; all data regarding process routes, material balances, investments, operating costs and profitability of the projects are given. Whenever possible, precise recommendation on location, type and size of complexes, date of start-up have been given. When precise conclusion was not possible, all the technical and economical bases that are necessary for final decision that can be taken for political or conjonctural reasons- have been forwarded.

This report is based on the data, investigations and findings of the Survey Mission carried out by a team of six Arab experts at the beginning of 1970 in the Arab countries.

Other market information obtained in the course of previous studies performed by BEICIP in this part of the world or supplied by UNIDO have also been taken into account ; the data regarding process routes, investments, operating costs, etc... result from BEICIP's experience, they have been collected through many studies, contacts with process licensors and manufacturing companies and through participation to industrial projects.

.../...

It must be pointed out that the following additional information related to local conditions in the Arab countries, that IDCAS was supposed to provide to BEICIP were not received.

- . price of naphta, petrochemical intermediate and end products
- . cost for transport of raw materials
- . erected plant costs
- . tariffs applicable to petrochemical products and equipment
- . utilities cost
- . cost of man power

Estimates or data already available in BEICIP have had to be used, the authors feel that they are reliable but it can be assumed that they will have to be brought up to date when reaching the stage of final decision for the different complexes that are recommended.

The above described approach to the problem had been discussed and decided in a meeting on july 1st at UNIDO's headquarters in presence of representatives of UNIDO, IDCAS and BEICIP.

A draft of the report has been presented and discussed in September 16th in an other meeting at UNIDO. Very helpful comments and remarks have been made and they have been taken into account in the preparation of the final report.

It is hoped that the present report -although it has not been possible to give final answers to several of the questions that arise due to the lack of some information, to the very short period of time assigned to the work and principally to the fact that political aspects have not been considered- will form a satisfactory working document that contains most of the technical and economical facts and figures necessary for the discussions to be held in the IDCAS meeting.

Thanks must be adressed to UNIDO and IDCAS for their assistance and cooperation to the work conducted by BEICIP.

II - SUMMARY OF CONCLUSIONS AND RECOMMANDATIONS

1°) - SETTING GOALS FOR PETROCHEMICALS AND FERTILIZERS

The targets of production to be undertaken have been estimated in the following way.:

The total quantities than can be produced are equal to the local demand plus the possibilities for exports. The production capacities to be installed should be equal to the difference between quantities to be produced and existing capacities. However, attention must be paid to the existing units if they are not already obsolete ; if the consump increases at a continuous pace, additional capacity has to be gradually installed ; new plants not yet in production are now at the stage of engineering studies or even under construction.

a) - Petrochemical products

The future demand in 1975 and 1980 in the Arab countries has been established for the end products and the corresponding amounts of intermediates that will be necessary have been calculated.

The estimates have been made country by country whenever possible -see chapter III- then they have been assembled according to the usual groups of Arab countries into:North Africa (N.A.), North East Africa (N.E.A.) and Middle East Arab countries (M.E.A.C.). The results for the main end products are given in Table A.

For plastics, the general tendency is that the demand for Polyethylene which is now appreciably below that for PVC will be approximately equal in 1980 (115.000 to 120.000 M.T/Y). At that time, the total polyethylene plus PVC will still represent more than 50 % of the total demand for plastics.

The major consumers for plastics are now U.A.R. and Algeria. Their position will not change in 1980 (23.000 M.T of PE and 28.000 M.T. of PVC in UAR ; 16.600 M.T. of PE and 15.400 M.T. of PVC in Algeria).

Morocco, Syria and Irak are also potential consumers for important quantities. Possibilities for exports may arise in Greece (P.E.) Yougoslavia (PVC) East Africa (P.E. and PVC) and India (P.E.).

For synthetic fibers, polyamides will remain the major product ; nylon 6 being much more important that nylon 66. The total demand for the Arab countries will be 26.000 M.T. of polyamids in 1975 and 41.400 M.T. in 1980. The demand will grow at a very high pace in Algeria, Morocco, and U.A.R.. Algeria will consume 6.700 MT of polyamide, 5.000 T. of polyesters and 2.000 T. of polyacrylics in 1980, Morocco will consume 6.100 T. of polyamides, 4.500 T. of polyesters and 1850 T.of polyacrylics, U.A.R. will consume 7.600 T. of polyamides, and 3.700 of polyesters.

Table A : FUTURE DEMAND FOR PETROCHEMICAL END-PRODUCTS IN THE ARAB COUNTRIES (MT/Y)

	1975				1980			
	North Africa	North East Africa	Middle East Arab Countries	Total	North Africa	North East Africa	Middle East Arab Countries	Total
PLASTICS								
Polyéthylène	18.900	18.800	27.000	64.700	33.500	33.800	47.800	115.100
P. V. C.	22.500	23.600	29.500	75.600	33.300	36.600	52.500	120.400
Polystyrène	4.100	4.000	5.200	13.300	5.750	6.050	7.700	19.500
Polypropylène	1.500	na	na	5.000	na	na	na	15.000
SYNTHETIC FIBRES								
Polyamides	10.900	7.050	8.000	25.950	14.900	11.500	15.000	41.400
Polyesters	6.050	3.000	5.000	14.050	11.000	5.500	10.000	26.500
Polyacrylics	1.800	1.950	2.000	5.750	4.500	4.500	4.000	13.000
SYNTHETIC RUBBER								
S.B.R.	11.050	8.500	8.900	29.000	16.400	14.700	11.900	43.000
Polybutadiène	3.400	2.400	2.500	8.300	6.800	6.100	5.000	17.900
SYNTHETIC DETERGENTS								
(D.D.B.)	14.500	7.100	15.000	36.600	20.500	11.000	22.000	53.500

North Africa: Morocco, Algeria, Tunisia

North East Africa: Libya, U.A.R., Sudan

Middle East Arab Countries: Lebanon, Jordan, Syria, Saudia Arabia, Kuwait, Emirate

In spite of very strong competition from existing suppliers there could be possibility for exports in India (Nylons and polyesters) East Africa (nylon and polyesters) and Iran (polyesters).

For synthetic rubbers, SBR will remain the major product ; polybutadiene coming in second rank. The total demand in the arab world will be 29.000 T. of SBR in I975 and 43.000 T. in I980. U.A.R. (I7.000 T. of synthetics in I980), Algeria (I2.600 T.) and Morocco (I2.600 T) will be the major consumers ; but the total amount per country will remain small and create problems to establish economical plants.

The possibilities for exports are not given in the report.

For synthetic detergents, dodecyl benzene sulphonate will remain the major product. The total consumption of DDB should reach 36.600 in I975 and 53.500 T. in I980 for the total Arab world ; Algeria (I0.000 T. of D.D.B. in I980), U.A.R. (8.000 T.) and Morocco (7.000) will have the largest demand. There will be possibilities for exports in East Africa.

The intermediates (ethylene, propylene, butadiene, benzene and paraxylene) that will be necessary to manufacture the petrochemical end products, have also been studied ; the results are given in table.

Table B - Future demand for petrochemical intermadiates in the Arab countries (M.T/Y)

	I975				I980			
	N.A.	[illegible]	M.E.A.C	Total	N.A.	N.E.A.	M.E.A.C.	Total
Ethylene	35.200	35.300	48.000	II8.500	57.900	59.000	84.300	20[illegible].200
Propylene	20.000	I2.000	22.400	54.4[illegible]	36.000	23.000	36.200	95.200
Butadiene	II.I00	7.900	8.400	27.400	I7.900	I6.000	13.000	46.900
Benzene	25.700	I7.I00	22.900	70.700	35.500	27.300	37.400	I00.200
Paraxylene	5.000	2.500	4.I00	II.800	9.I00	4.500	8.300	2I.950

b) - Fertilizers

The Arab countries are already producers of nitrogen and phosphate fertilizers ; several large units are presently under construction and raw materials (natural gas and phosphate ore) are available in large quantities. It was then advisable to concentrate the survey on these productions.

.../...

The results regarding future demand are presented in table C for nitrogen and phosphate fertilizers.

Table C - Future demand for Nitrogen and Phosphate fertilizers

	1975				1980			
	N.A.	N.E.A.	M.E.A.C.	Total	N.A.	N.E.A.	M.E.A.C.	Total
Nitrogen (N)	135.000	501.000	126.100	762.000	210.000	670.000	230.000	1.110.000
Phosphate (P_2O_5)	148.000	170.000	70.000	388.000	220.000	292.000	150.000	662.000

Still very limited, the consumption in the Arab countries will grow at a high rate, especially in North Africa and U.A.R. The ratio N/P_2O_5 will be approximately 1 in North Africa, it will remain approximately 2 in the whole Arab world. Urea and superphosphate which have a higher content in nutrients will be more commonly used in the future. There will be possibilities for export of Nitrogen fertilizers in India, Pakistan, China and Africa ; for phosphate, present importers such as Western Europe, Asia and even U.S.S.R. will offer large opportunities.

c) - Production capacities

In the case of petrochemicals, there is no plant under production; several units are being built in Morocco, Algeria, U.A.R.; projects have been announced in most of the other Arab countries ; in the report, the plants now being built or firmly decided have been taken into account when presenting the recommendation.

In the case of fertilizers, there are presently several units of large capacity producing Nitrogen and phosphate fertilizers ; the results are summarized in table D.

Table D - Present and future production capacities for Nitrogen and Phosphate fertilizers

(1.000 MT/Y)

	1970				1975				1980			
	NA	NEA	MEAC	total	NA	EA	MEAC	total	NA	NEA	MEAC	total
(N)	0	220	321	841	385	780	1366	2491	n.a.	N.a.	n.a.	n.a.
P_2O_5	335	60	35	430	435	200	260	895	830	330	260	1.420

It must be pointed out that several new phosphate deposits (Irak, Jordan) have been already discovered and will probably be exploited before 1980.

Comparison of tables C and D shows that there will be a large overcapacity and that the production of new plants will be mainly for export . Exceptionnal conditions such as availability of raw materials at low price and plants of large capacities should enable to reach these goals, provided that all necessary steps are taken to guarantee adequate structure of the industry and harmonization between projects.

The conclusions of the market survey are the following :

For petrochemical end products it is recommended that no special provision for export outside the Arab countries should be made when setting the design basis of the units ; Export capacity will automatically exist because newly erected units built to supply the local demand will not produce at full capacity at the beginning.

For petrochemical intermediates, the above is also true but it is necessary to pay attention to a probable gap between production and demand for aromatics in Europe in 1975. Attention must be paid also to the possibilities of producing olefins, at very low price in specific conditions (association of L.N.G. plant with a steam-cracker).

For fertilizers, it has been indicated that most of the new plants to be erected will have to export their production.

2°) - STRUCTURE OF THE INDUSTRY TO BE ADOPTED

Some fundamental conceipts are discussed in this study ; the necessity of having a phased development is emphasized as well as the interest of integrated complexes that will guarantee the best utilization of by products.

The question of raw material prices especially natural gas and naphta is also analysed and the consequences of fixing high prices are outlined.

Capital availability is also an important problem ; should the Arab countries try to finance the foreign exchange part of the projects through loans or through participation of foreign share holders ? Both possibilities are studied from the financial stand point (payment of interest or repatriation of profits) but attention is paid also to the advantages offered by association with foreign partners where looking at the commercialization of the products.

In conclusion it appears that the production of intermediate or of end products whose the productions technics are well known and can be obtained by purchasing of licenses can be undertaken without foreign partnars ; on the contrary for complexe products where complete know-how and permanent research work are necessary, it is advisable to obtain the assistance of a foreign partner who is already in the business in his own country and who has or can create a commercial network with customers assistance and technical sale services.

3°) - HARMONIZATION AND COOPERATION BETWEEN PROJECTS

The recommendations presented in this report are based in the assumption that complete coordination for the development of the industry will be established between the Arab countries. Harmonization must include legal, financial, commercial and technical provisions.

Customs duties and taxes : the policy regarding customs duties for petrochemical products must be decided, exchangas between the Arab countries on the one hand and trade with non-Arab countries on the other hand must be considered ; quotas must be fixed in specific cases and existing bi-lateral agreements have to be taken into account.

The problem of imports duties on machinery,aquipment, spare parts, catalysts etc... must also be investigated in order to decrease the erected cost and operating cost of the plants.

Incentives to encourage foreign investments,when they look advisable- have to be decided. They can cover : simple procedure to obtain the authorization to build projects ; duty and taxes exemption during the first years of production, guarantees for the repatriation of profits. Of course, they have to be balanced by obligations to have local partnars, to employ indigenous man power, to perform the training of local specialists, to guarantee the take-off of certain products, etc...

As regards the commercial aspects, it is advisable for the Arab producers not to act individually when they try to compete with existing suppliars on the export markats.

Interarabic commercial associations should be organised -as they already exist in Europe for example- and be in position to decide on credit facilities to be granted to the customers (especially in Asia), on eventual participation into down-stream investments in the buyars country (for example in plants that could be erected to manufacture finished fertilisers from imported ammonia coming from the Arab countries) and to ensure complete coordination and exchange of information on bilateral agreements between Arab and non-Arab countries (Kuwait, Turkey for instance)

.../...

Many technical factors can make the object of regional cooperation.

The infrastructure (port facilities, land and sea transportation, production and distribution of electricity, etc...) must be established on a region wide scale.

Interregional companies for equipment manufacturing, civil engineering and plant erection, inspection and maintenance of plants can be created.

At the stage of planning and design of the complexes, it would be advisible to have an international body entrusted to coordinate the decisions, to look for potential partners and to make sure that the projects are perfomed according to the best engineering standards. Such entities would also be entrusted to watch over the installation of application laboratories and technical assistance to the customers (plastics, fertilizers etc...), to arrange financing facilities for the Arab customers (fertilizers), to coordinate the installation of the processing equipment that will be necessary to transform the production of the petrochemical units into finished articles (plastic processing, textile fibers spinning and weaving equipment, etc...).

Finally the training at all levels which is now carried out by engineering and construction companies, by manufacturing companies or by special training organizations that have been installed by individual countries (Irak, Kuwait, U.A.R., Algeria etc...) should be organised on a regional scale, taking advantage of the existing facilities and experience that are available in the Arab world or in the rest of the world.

.../...

4°) - RECOMMENDED DEVELOPMENT ROUTES AND PRESENTATION OF FEASIBLE PETROCHEMICAL PROJECTS

Considering the results of the market forecasts reported hereabove either for local consumption of the different Arab Countries or for possible exports, this chapter presents the feasibility study of the different projects which might be envisaged to provide a suitable basis to develop a viable petrochemical program in Arab Countries.

The study of these feasible projects which might be set up in order to meet market requirements and export possibilities has been carried out with the following aims :

4.1.) to utilize the raw materials which are available in the different areas and which constitute the best suitable feed-stocks regarding :

- . their delivery prices
- . quantities available on long term period
- . their characteristics and specifications

4.2.) to group in the same location productions planned by the different countries in petrochemical complexes integrated with already existing complementary plants or with units supplying necessary feed-stocks

4.3.) to select products having sufficient demand in order to implement petrochemical and fertilizer plants with minimum economic size in order to develop a viable program for industrial development

4.4.) to point out the influence of the different technical and economic factors on the profitability of the alternate projects in order to establish priorities in the realization of the program

5°) - PRESENTATION OF ALTERNATE FEASIBLE PROJECTS

1. Complex based on olefins production and their derivatives

Complex A - Plastic and detergent based complex producing :

- . 15,000 MT/year of polyethylene
- . 15,000 MT/year of polyvinylchloride
- . 10,000 MT/year of dodecylbenzene

.../...

a. raw material : propane

b. possible locations : Algeria
UAR
Syria
Irak

c. to supply corresponding 1975 sub-region markets and partly neighbouring countries

d. end-products will be respectively manufactured in the various countries of the sub-regions

Complex A_1 - Plastic and detergent based complex producing

. 30,000 MT/year of polyethylene
. 30,000 MT/year of polyvinylchloride
. 20,000 MT/year of dodecylbenzene

a. raw material : propane

b. possible locations : Algeria or UAR
Syria or Irak

to supply 1975 North Africa and North East Africa markets and 1975 Middle East Arab Countries markets

c. possible locations : Algeria
UAR
Syria
Irak

to supply corresponding 1980 sub-region markets and partly neighbouring countries

d. end-products will be respectively manufactured in the various countries of the sub-regions

Complex B - Plastic and detergent based complex producing

1. Basic products : 80,000 MT/year of ethylene and propylene[a]

2. Monomers and polymers as follows :

Complex B_1 - producing :

. 30,000 MT/year of polyethylene
. 30,000 MT/year of polyvinylchloride
. 20,000 MT/year of dodecylbenzene

a. raw material : naphtha and mixed ethane propane cuts

b. possible locations and markets supplied : see Complex A_1

Note : excess ethylene will be exported to Arab Countries or to possible buyers.

Complexe B_2 - producing :

. 50,000 MT/year of polyethylene
. 50,000 MT/year of polyvinylchloride
. 20,000 MT/year od dodecylbenzene

a. raw material : naphtha and mixed ethane propane cuts

b. possible locations : Algeria or UAR
Irak or Syria

c. to supply 1980 North Africa and North East Africa markets and 1980 Middle East Arab Countries markets

3. End-products will be respectively manufactured in the various countries of the sub-regions.

.../...

a. propylene production will depend upon feed-stocks used in the steam-cracking

Complex C - 150,000 MT/year and 300,000 MT/year
Ethylene production by Ethane steam-cracking

1. to supply ethylene for its derivatives as : polyethylene and PVC to be produced for the local market and for exports to consuming countries

2. possible locations : integrated with large capacity LNG plant under construction or under planning stage in Libya, Algeria and Middle East Arab Countries.

Note : The evaluation of such a project is compared to the production of ethylene by naphtha steam-cracking in units already existing or planned in big ethylene consuming areas.

2. Complex based on aromatic production and their derivatives

Complex D - Aromatic based complex producing :

. 45,000 MT/year of benzene
. 12,500 MT/year of P-xylene
. 18,000 MT/year of O-xylene

a. raw material : gasoline cuts supplied by refineries processing Algerian or Libyan crude oils

b. possible locations : Algeria or Libya

c. to supply major part of the aromatic demand in Arab Countries for 1975

Complex D_1 - Aromatic based complex producing :

. 80,000 MT/year of benzene
. 20,000 MT/year of P-xylene
. 30,000 MT/year of O-xylene

integrated with a coking unit producing :

. 90,000 MT/year of electrodes coke

.../...

a. raw material : gasoline cuts and low sulfur residuum supplied by refineries processing Algerian or Libyan crudes

b. possible locations : Algeria or Libya

c. to supply the aromatic demand in Arab Countries for 1975 and to export the remaining products and electrodes coke to European Countries where deficits will persist for the next years. In 1980, such a complex might supply the whole aromatic demand in Arab Countries

Complex D_2 - Aromatic derivatives based complex producing respectively 15,000 and 30,000 MT/year of caprolactame (for nylon 6 manufacture)

a. raw material : benzene produced in complex D or D_1

b. possible location : taking into account the availability of other raw materials as : ammonia and sulfuric acid which have to be supplied and disposal of by-produced ammonium sulfate, Algeria might be considered as the best location for these productions

c. to supply respectively all the North Africa demand and partly other Arab Countries for 1975 and the major part of the total demand for 1980

Complex D_3 - Aromatic derivatives based complex producing respectively 15,000 and 30,000 MT/year of dimethylterephthalate (for polyesters manufacture)

a. raw material : p-xylene produced in Complex D or D_1

b. possible location : Algeria or UAR (based on p-xylene produced in Algeria)

c. to supply the total demand of Arab Countries respectively for 1975 and 1980

.../...

Complex D_4 - Manufacture of 6,000 MT/year nylons 6 fibers

a. raw material : caprolactame produced in Complex D_2

b. possible location : Morocco, Algeria, UAR, Syria and Irak

c. to supply their local market for 1975 and to export excess products to other Arab Countries, additional units of same size might be provided for 1980

Complex D_5 - Manufacture of 3,000 and 6,000 MT/year polyesters fibers

a. raw material : DMT produced in Complex D_3

b. possible locations and supply :

- one 6,000 MT/year unit for every sub-region located in : Algeria, Irak or Syria and supplying the local market for 1975
- one 3,000 MT/year unit for the following countries : Algeria, Morocco, UAR, Irak and Syria and supplying the local market for 1975
- additional units of capacities included in the same range might be provided for supplying 1980 local markets of the different sub-regions

3. Projects based on export possibilities

The large availability of natural gas in Arab Countries coupled with the growing demand of LNG for peak shaving operation and load gas supply allow natural gas at very attractive prices for ammonia and methanol production.

Large size projects based on these low cost raw material and oriented towards export markets might compete favourably with European or US similar projects.

.../...

Complex E - 1,000 MT/year ammonia based complex

Possible location and supply :

. Middle East Arab Countries for Far East and East Africa markets

. Algeria and Libya for European countries and West Africa and Mediteranean countries

Complex F - 1,000 MT/year methanol based complex

Possible location and supply :

Algeria or Libya for European markets

6°) - ANALYSIS OF THE ALTERNATE FEASIBLE PROJECTS AND PROFITABILITY CALCULATIONS : BASIS FOR THE SELECTION OF RECOMMENDED PROJECTS

For the different complexes presented hereabove, the following technical and economic data have been supplied :

. material balance for the different units and the overall complex

. capital cost for the overall complex

. total product sales

. operating cost of the overall complex

. profitability calculations

The influence of the different technical and economic factors on the profitability of the possible projects will be pointed out in order to allow the participants of the meeting organized by IDCAS to discuss the different alternate feasible projects and to appraise the program of realization for recommended projects.

III - [illegible] OF PRODUCTION TO BE UNDERTAKEN

The first part of this study aims to assess the targets of production to be undertaken in the Arab World and the types of products to be manufactured. This is based on :

The future prospects for the consumption in two periods, namely 1971-1975 and 1975-1980.
The possibilities and potentialities for export in the same two periods

The existing production capacities have to be taken into consideration as well as the projects now being implemented or firmly decided.

When reaching the conclusion of this first part, attention shall be given to the projects that have been announced but have not yet started, in order to check if they can be included in the scope of recommended projects.

III. GENERALITIES.

III.1. The products to be studied

They can be divided into :

- Finished petrochemical products

Polyethylene	Plastics
Polypropylene	
Polystyrene	
Polyvinyl chloride	
Polybutadiene	Rubbers
Styrene-Butadiene	
Polyester	Synthetic fibers
Nylon	
Acrylic	
Synthetic detergents	

- Intermediates

Ethylene
Propylene
Butadiene
B.T.X.
Styrene
Caprolactam
D.M.T. or TPA
Acrylonitrile
Dodecyl Benzene

- Fertilizers

  Nitrogen Fertilizers
  Phosphate Fertilizers
  Compound Fertilizers

- Sulfur (as a recoverable product)

III .1.2. The market to be studied

- Arab countries

  Morocco)
  Algeria) North Africa
  Tunisia)

  Libya)
  UAR) North East Africa
  Sudan)

  Jordan)
  Syria)
  Irak)
  Kuweit) Middle East Arab Countries
  Lebanon)
  Saudi Arabia)
  Emirates)

- Countries offering possibilities for exports

  . Countries along the Mediterranea

    France
    Italy
    Spain
    Yougoslavia
    Greece
    Turkey

  . East Africa

  . Central Africa

  . Asia, namely : India
    Pakistan
    Iran

III.I.3. Methodology

The Market information that appear in this report, have been collected from the most recent studies made by O.N.U.D.I., B.E.I.C.I.P. or specialized organisations; available published data have also been utilised and the report prepared by the arab experts on behalf of I.D.C.A.S. has been of great help.

The main criteria in the selection of basic information has been their homogeneity :

- homogeneity in the sources of information,
- homogeneity in the results and in their presentation.

The forecast for consumption have been based on :

- a comprehensive appraisal of the past and present situation (chronological series)
- a realistic estimate of the marketing possibilites.

Information on the past and present situation have been collected from reliable sources such as :

- national statistics (production,consumption,external trade)
- international statistics
- published information
- previous studies available to BEICIP
- contacts with producers or consumer recently taken by BEICIP in the course of other studies.

The estimate of the market possibilities has been made by using different methods which permit cross-checking of the results :

- extrapolation of chronological series
- using of corelations such as consumption Vs Gross National income
- determining of the rates of growth for the consumption of main products
- breaking down of the consumption into the different types of finish products.

No figure or estimate has been taken into account without being the result of applying several of the above mentioned methods.

The results are presented in the following chapters :

- in chapter III.2the consumption forecast for the main petrochemical products are presented by country or by group of countries ;

- in chapter III.3, based on the future demand for the end products, the forecasts for main intermdediates are presented by country or by group of countries ;

- in chapter III.4 fertilizers are studied ;

- chapter III.5 deals with sulphur.

In each of these chapters, the information are presented, when available, in the following systematic form :

-

- Table A shows the variation of the demand in the Arab countries ;

- Table B shows the production capacities in the Arab countries ;

- Table C shows the variations of the demand in selected countries where there could be possibilities for export ;

- Table D shows the production capacities in these countries.

Since, these report is going to be discussed during the seminary to be held in Kuweit, only very brief comments are given and all efforts have been concentrated on presenting sufficient and reliable figures.

III - 2/ FINISHED PETROCHEMICAL PRODUCTS

III - 2/ I - Plastics

. General characteristics of the market

The rate of growth for consumption of plastic materials is approximately 8 to 10 % in industrialized countries, it is much higher, usually between 10 and 20 % in other countries :

The production of plastic materials (polymers) requires high investments and large capacities ; there is a continuous growth of the "minimum economic sizes" and the oil producing and refining compagnies are now joining the chemical compagnies in the production of plastics intermediates and polymers . On the contrary the processing of plastics into finished products remains usually in the hands of small scale industries.

The present study is concentrated on thermoplastic resins which represent now 60 to 65 % of the demand in Western Europe and approximately 70 to 75 % in the industrializing countries. This is due to the fact that they are cheaper, easy to process and can fulfil most of the requirements of these countries ; on the contrary thermosetting resins such as epoxies, reinforced polyesters which cannot be processed by injection molding have very specific application and are not yet consumed in notable quantities.

The main application of thermoplastics are :

- packaging (fibers, films, blown articles)
- Agriculture (bags, pipes, green houses)
- building (insulating materials, sheets, flooring, pipes, profiles, etc...) .

In Western Europe, where thermoplastics represent 60 to 65 % of the demand, polyethylene, P.V.C. and polysterene represent approximately 50 % of the same ; that means that the share of polypropylene for example, remains very low, approximately 2 % in France and 4 % in Italy in 1969.

For that reason, the market estimates which are given in the following table, if they have been estimated with good accuracy for polyethylene, P.V.C. and polysterene have been roughly evaluated for polypropylene ; no precise figures are available and it can be assumed that the consumption will remain moderate.

In the following paragraphs, the situation for polyethylene, P.V.C., polysterene and polypropylene is presented and illustrated in a series of tables :

In Tables I A, I B, I C, I D, are presented the figures for polyethylene ;
" 2 A to 2 D, are presented the figures for P.V.C. ;
" 3 A to 3 D, are presented the figures for polysterene ;
" 4 A to 4 D, are presented the figures for polypropylene.

III- 2 - I' I- **Polyethylene**

Still inferior to the consumption of P.V.C., the demand for polyethylene is growing at a high rate. This is due to price conditions, multiplicity of uses, and to the development of specific applications such as fertilisers bags.

The general tendency in the Arab countries is that the demand for polyethylene will be in 1980 approximately equal to that for P.V.C. ; that means that the rate of growth will be higher for polyethylene than for P.V.C. (particularly in North Africa).

The share of Polyethylene in the total consumption of thermoplastics is given for some representative countries in the table below :

Polyethylene consumption (in % of total thermoplastics)

	Morocco	Algeria	Tunisia	U.A.R.
1965	22	8,5	37	33
1970	27,5	30	38	33
1975	34	41	40	37
1980	38	43	42	41

All the results regarding demand are presented in table I A to I D.

conclusions : the consumption of Polyethylene in arab countries will be approximately 65,000 T. in 1975 and 115,000 T. in 1980.

The annual rate of growth for consumption will decrease; now between 15 and 28 % according to the regions in 1965-70 it will go down to 15-17,5 % in 1970-75 and to 12 - 12,5 % in 1975-1980.

In foreign countries the production capacities will grow according to the demand, however there can be possibilities for exports in Greece, India and Africa.

A.R.G. annual rate of growth

I a - DEMAND FOR POLYETHYLENE (M.T/Y.)

	1965		1970		1975		1980
Morocco	I.300		3.I00		6.600		I2.400
Algeria	585		4.000		9.800		I6.600
Tunisia	550		I.300		2.500		4.500
Total North Africa	2.435	a.r.g. 28 %	8.400	a.r.g. I7,5 %	I8.900	a.r.g. I2 %	33.500
Libya	300		900		2.000		4.I00
U.A.R.	4.000		7.700		I5.800		28.000
Sudan	200		500		I.000		I.700
Total N.E. Africa	4.500	a.r.g. I5 %	9.I00	a.r.g. I5,5 %	I8.800	a.r.g. I2,5 %	33.800
Jordan	200	600(1969)	700				
Syria	2.I00	I.900(")	5.500				
Irak	I.000	3.300(")	3.700				
Kuweit	-	200(")	200				
Lebanon	700	2.000(")	2.400				
Saudi Arabia	300	m.a.(")	400				
Total Middle East arab countries.	4.000	a.r.g. (26 %)	I2.900	a.r.g. I6 %	27.000	a.r.g. I2 %	47.800
Total Arab countries	I0.935		30.400		64.700		II5.I00

I - PRODUCTION CAPACITIES (M.T./Y)

Algeria					40.000	(SKIKDA)	
U.A.R.					45.000		
Syria							25.000
Irak					20.000	(BASRAH)	

Ie - FOREIGN COUNTRIES ; CONSUMPTION OF POLYETHYLENE (M.T./Y)

Consumption	1965		1970	1975	1980
East Africa	3.600		I0.700	2I.600	45.900
Central Africa	I.I00		3.300	7.600	I6.000
Sub Total	4.700		I4.000	29.200	6I.900
India	I8.000		45.000	I5.000	2I0.000
Pakistan	3.500	6.500(I968)			26.000
Iran	5.000	I0.000(")			85.000
Sub Total	26.500		85.000	I90.000	32I.000
France	I28.000		300.000	485.000	
Italy	I00.000		200.000	360.000	
Spain	5I.000		90.000	I30.000	
Greece	6.500		I5.000	25.000	
Yougoslavia	I4.000		30.000	55.000	
Turkey	5.000		I2.000	20.000	
Sub Total	304.500		647.000	I.075.000	I.500.000

Id - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES

India	8.500	46.000(I969)	64.000	I[illegible].000	
Pakistan	5.000		5.000	40.000	
Iran			20.000 (abadan)		
	I3.500		89.000		
France	I42.000		460.000		
Italy	I96.000		430.000		
Spain	33.000		I20.000	360.000	
Greece	-		-		
Yougoslavia	5.000		20.000	I20.000	
Turkey	-		I2.000	I00.000	
Sub Total	376.000		859.000		

III- 2/ I . 2 - POLYVINYL CHLORIDE

Presently, P.V.C. is still the most commonly used plastic product ; its share will decrease in the future until P.V.C. and Polyethylene consumption are approximately equal in I980. However, the consumption will continue to grow due to the development of building and packaging industries and also to a large amount of irrigation projects(rigid pipes). As regards agriculture and production of fertilize. bags, there will be a trend to manufacture polyethylène heavy duty bags which are adapted to climatic conditions rather than P.V.C. bags.

The share of P.V.C. in the total consumption of thermoplastics is given below for some selected countries :

P.V.C. consumption (in % of total thermoplastics)

	Morocco	Algeria	Tunisia	U.A.R.
I965	59	78	50	49
I970	55,5	52	45,5	50
I975	44	39	43	45
I980	4I,5	39	39	4I

The results regarding demand of production of P.V.C. are presented in tables 2 A to 2 D.

Conclusion : The consumption of P.V.C. in the arab countries will be approximately 75 000 T. in I975 and I20.000 T. in I980.

The annual rate of growth which is between 9 and I7 % according to the regions will decrease to 8,5 - I4 % in I970-I975 and to 8 - I2 % in I975-I980.

In foreign countries the production capacities will grow according to the demand,with a sensible over capacity in France and Italy, however, there can be small possibilities for exports in Yougoslavia and Africa.

a.r.g. - annual rate of growth

2 A - DEMAND FOR P.V.C. (M.T./Y)

	1965		1970		1975		1980
Morocco	3.500		6.000		9.200		13.800
Algeria	5.400		7.500		10.300		15.400
Tunisia	750		1.550		3.000		4.100
Total North Africa	9.650	a.r.g. 9 %	15.050	a.r.g. 8,5 %	22.500	a.r.g. 8 %	33.300
Libya	500		1.500		3.000		4.600
U.A.R.	6.000		11.500		19.000		28.000
Soudan	600		950		1.400		2.000
Total Nord East Africa	7.100	a.r.g. 14.5%	13.950	a.r.g. 11 %	23.400	a.r.g. 8 %	34.600
Jordan	300	900 (1969)	1.000				
Syria	640	1.800 "	2.000				
Irak	2.000	4.000 "	4.400				
Kuweit	n.a.	300 "	300				
Lebanon	3.500	6.000 "	6.800				
Saudi Arabia	400	700 "	800				
Total Middle East Arab Countries	6.840	a.r.g. 17 %	15.300	a.r.g. 14 %	29.500	a.r.g. 14 %	52.500
Total Arab Countries	23.590		44.300		75.400		120.400

2 B - PRODUCTION CAPACITIES (MT/Y)

Morocco			10.000 (Kenitra)				
Algéria					35.000 (SKIKDA)		
U.A.R.					40.000		
Lybia							5.000
Irak					20.000		
Saudi Arabia							60.000

2 C - FOREIGN COUNRIES CONSUMPTION OF P.V.C. (M.T./Y)

Consumption

	1965		1970	1975	1980
East Africa	6.100		13.200	25.500	48.300
Central Africa	2.600		6.400	12.700	24.400
Sub Total	8.700		19.600	38.200	72.700
India	15.500	1.800 (1967)	35.000		200.000
Pakistan	4.200	5.800 (1967)		13.500	25.000
Iran	6.500	10.000 (1967)			85.000
Sub Total	26.200		70.000	160.000	310.000
France	182.000		340.000	520.000	
Italy	150.000		320.000	500.000	
Spain	54.000		80.000	130.000	
Greece	13.500		25.000	35.000	
Yougoslavia	22.000		40.000	60.000	
Turkey	9.000		16.000	28.000	
Sub Total	430.500		821.000	1.273.000	1.700.000

2 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y.)

India	31.000	19.000 (1969)	56.000	115.000	
Pakistan	-		5.000	30.000	
Iran	4.000		24.000 (AHWAZ, ABADAN)		
France	240.000		420.000		
Italy	299.000		520.000		
Spain	40.000		100.000	250.000	
Greece	-		12.000	18.000	
Yougoslavia	8.000		25.000	125.000	
Turkey	-		32.000	225.000	
Sub Total	587.000		1.109.000		

III. 2 - I- 3. POLYSTYRENE

Presently, polysterene is essentially consumed in molded articles ; for these applications, polysterene is going to be in competition with other thermoplastics (polypropylene, A.B.S.,etc...) but a new outlet will appear in the packaging industry.

The share of polysterene in the total consumption of thermoplastics which is now usually 8,5 to I2 % will decrease until 6,5 to 8 %.

This is illustrated in the table below :

Polystyrene consumption (in % of table thermoplastics)

	Morocco	Algeria	Tunisia	U.A.R.
I965	I2	8,5	5	I0
I970	I0,5	8	6	9,5
I975	I0	7,5	6	7,5
I980	8	6,5	6,5	7,5

The results regarding demand and production of polystyrene are shown in tables 3 A to 3 D.

Conclusion : The consumption of polysterene in the Arab countries, will be approximately I3.500 T in I975 and 20.000 T in I980.

The annual rate of growth for consuption will decrease from approximately I3 % in I965-70 to 9 - I0,5 % in I970-75 and to 6,5 - 8 % in I975-80. It must be noted that the only project for polysterene production is in Algeria and the size and location of this project have not been firmly decided. The future consumption could be higher if any other project was undertaken.

a.r.g. annuel rate of growth

3 a - DEMAND FOR POLYSTYRENE (M.T./Y)

	1965		1970		1975		1980
Morocco	700		I.200		I.900		2.600
Algeria	600		I.I00		I.800		2.500
Tunisia	80		200		400		650
Total North Africa	I.380	a.r.g. I2,8 %	2.500	a.r.g. I0,5 %	4.I00	a.r.g. 6,5 %	5.750
Libya	I00		250		500		800
U.A.R.	I.200		2.I50		3.200		4.800
Sudan	I00	a.r.g. I3,2 %	200	a.r.g. 9 %	300	a.r.g. 8,5 %	450
Total North East Africa	I.400		2.600		4.000		6.050
Jordan	n.a						
Spain	300						
Irak	400						
Kuweit	300						
Lebanon	750						
Saudi Arabia	n.a						
Total middle East Arab Countries.	I.750	a.r.g. I3 %	3.200	a.r.g. I0 %	5.200	a.r.g. 8 %	7.700
Total Arab countries	4.530		8.300		I3.300		I9.500

3 B - PRODUCTION CAPACITIES

Algéria	?

3 C - FOREIGN COUNTRIES - CONSUMPTION OF POLYSTYRENE (M.T./Y)

Consumption

	I965	I970	I975	I980
East Africa	I.I20	2.650	4.660	8.600
Central Africa	430	I.080	2.000	3.700
Sub-Total	I.550	3.730	6.660	I2.300
India	I0.000	7.500 (I967) 20.000		70.000
Pakistan	I.600	3.200 (I967) 5.000		I4.000
Iran	I.800	2.600 (I967) 6.000		2I.000
Sub total	I3.400	3I.000	60.000	I05.000
France	65.000	95.000	I35.000	
Italy	78.000	95.000	I30.000	
Spain	I9.000	30.000	45.000	
Greece	2.500	6.000	9.000	
Yougoslavia	6.000	I2.000	20.000	
Turkey	2.000	4.000	9.000	
Sub Total	I72.500	242.000	348.000	520.000

3 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES

India	I5.000 (I969)	2I.000	60.000
Italy		I70.000	
Spain		46.000	
Greece		6.000	
Yougoslavia		6.500	I0.000
Turkey			45.000

III- 2/ I - 4. POLYPROPYLENE

Information regarding the market of polypropylene is very scarce : the present consumption is pratically zero in the Arab countries. Since the importance of polypropylene varies to a large extend in industrialized countries(small in France, high in Italy) it is difficult to make precise evaluations.

It can be assumed that polypropylene will find its main application in molded articles (building industry, house wares) and in packaging.

It has been estimated that the total demand in arab countries will be approximately 5.000 T. in 1975 and 15.000 T. in 1980.

Possibilities for exports could exist in many countries since the only producing plants in the area that is presently studied are in France, in Italy and in Spain and that projects are being announced in Spain; India, Pakistan, Algeria and U.A.R.

In tables 4 A to 4 D has been collected the small amount of available information.

4 A - DEMAND FOR POLYPROPYLENE (M.T./Y)

	1965	1970	1975	1980
North Africa	n.a.		I.500	
North East Africa	n.a.			
Middle East Arab countries	n.a.			
	n.a.		5.000	I5.000

4 B - PRODUCTION CAPACITIES (M.T/Y)

Algeria	?	(ORAN)
U.A.R.	30.000	

4 C - FOREIGN COUNTRIES - CONSUMPTION OF POLYPROPYLENE (M.T./Y)

	1965	1970	1975	1980
India		I.800 (I968)		25.000
Pakistan		I.900	3.500	
France	5.500	3I.000		
Italy	25.000	50.000		

4 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y.)

India				I5.000
Pakistan				5.000
France	I0.000	20.000		
Italy	44.000	70.000		I74.000
Spain		I2.000	26.000	
Turkey				I5.000

III. 2 - 2. SYNTHETIC FIBERS

To look at the market of synthetic fibers, it is necessary to see what is and will be their position in the entire picture of textile fibers.

The world consumption of textile fibers is growing at a rate of 3,7 % a year ; the demand for wool is pratically constant and the demand for cotton increases at slow rate (approximately I % per year) ; it seems that the consumption of artificial fibers will not grow very much in the future excepting in the non industrialized countries where new plants recently erected are reaching their full capacity. That means that all important changes are going to be supported by synthetics. The following table indicates the breakdown of the demand in I967 and I980.

World consumption of textile fibers (in %)

		I967	I980
natural fibers	cotton	60	48
	wool	8	6
chemical fibers	artificial	I7	I4
	synthetic	I5	32
		I00	I00
		I9.I0^{6}T.	30.I0^{6}T.

This correseponds to an annual growth of I2 % for synthetic fibers.

The manufacturing industry of synthetic fibers (polymerisation and spinning) is characterised by the high value of the product (5 times more expensive than plastic products), small economic capacities (I.000 to 5.000 T. per year). The investments are approximately proportionnal to the size of the units (no economy of scales). However, the major groups are now going to complete integration from the production of intermediate to polymerization and spinning.

The main fields of application of synthetic fibers are :

. clothing (weaved and knitted materials)
. industrial uses (tyre cords, conveying belts, etc...)
. hosiery.

There is a competition between the three major types (nylons, polyesters and acrylics) which represent 90 % of the total synthetic fibers.

. nylon (either 6 or 66) is used in clothing and tyre cords ; it is not very well adapted to tropical conditions.

. polyesters, generally under the form of discontinuous filaments mainly used for clothing in mixture with wool and cotton.

. acrylics are substitute for wool.

The situation in the Arab countries has the following characteristics :

- The demand is growing at a particularly high rate in Algeria, Morocco and U.A.R. where artificial fibers were already consumed in large quantities and are now being replaced by synthetics.

- The importance of the textile industry in several countries (Morocco, Algeria, U.A.R., Tunisia, Lebanon) and the existing or projected production of cotton (North Africa, U.A.R., Soudan) will encourage the consumption of synthetic fibers for the production of mixtures.

In the following paragraphs, the situation for nylons, polyesters and polyacrylics is presented and illustrated in a series of Tables :

- In table 5 A to 5 D are given the figures for nylons ;
- " 6 A to 6 D are given the figures for polyesters ;
- " 7 A to 7 D are given the figures for acrylics .

III- 2/ 2.1. POLYAMIDES (OR NYLONS)

The properties of nylon 6 or 6.6. are approximately similar and their position on a given market depends on the situation of the producers and on the patents and royalties. The trend in the future is a strong advantage to nylon 6 (produced from caprolactam).

The position of nylon in the arab countries remains good due to their adaptability to various end uses and prices inferior to polyesters. But the competition is very strong with polyesters which are better adapted to hot climatical conditions (for clothings).

The results regarding polyamide fibers demand and production are given in table 5 A to 5 D.

. conclusion : The consumption for polyamide fibers in the arab countries will be approximately 26.000 T. in 1975 and 41.000 T. in 1980.

The rate of growth will be higher in the East Arab countries that in African arab countries.

There is a possibility for exports in Asia and Africa but strong competition will be exercised by present suppliers (Japon, China etc...) and, since the minimum economic size are small, most of the industrialising countries will have the possibility to build their own plants.

5 A - DEMAND FOR POLYESTER FIBERS (M.T. Y/)

	1985	1970	1975	1980
[illegible]	1.900	3.200	4.600	6.100
Algeria	1.000	3.000	4.600	6.700
Tunisia	1.200	1.350	1.700	2.100
Sub total North Africa	4.900	7.550	10.900	14.900
Libya	500	700	1.150	2.100
Sudan	800	850	1.200	1.900
U.A.E.	500	2.700	4.700	7.600
Sub Total North East Africa	1.800	4.250	7.050	11.500
Jordan		160 (60)		
Syria	200	500		
Iraq		450		
Kuwait		300		
Lebanon				
Saudi Arabia				
Total Middle East Arab countries	1.500	1.000	8.000	15.000
Total Arab countries	8.200	15.000	25.950	41.400

5 B - PRODUCTION CAPACITIES (M.T/Y.)

U.A.E.	1.000	1.000

4.(60) Alexandrie - Caprolactam

5 C - [illegible] - CONSUMPTION FOR POLYAMIDES

	1965	1970	1975	1980
[illegible]	[illegible]	[illegible]	1.000	1.100
[illegible]	2.300	2.900	3.500	4.200
Sub Total	2.900	3.700	4.500	5.300
[illegible]		3.200 (1967)		70.000
[illegible]		4.[illegible] (")		70.000
[illegible]		8.000 (")		51.000
Sub Total		15.600		191.000

5 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES

[illegible]	60.500	70.000	
Italy	77.000	85.000	145.000
Spain	11.000	19.000	
[illegible]		1.[illegible]	2.500
[illegible]		3.000	
[illegible]	1.000	4.000	10.000
	137.500	199.000	
[illegible]	1.500	2.[illegible]	.000
[illegible]	1.300	12.000	26.000
[illegible]	•	2.000	.000
	2.800	16.500	33.000

III.2 -2. 2. POLYESTERS

The available information and forecasts are given in Tables 6 A to 6D.

The consumption of polyester fibers in the Arab countries will be approximately 14.000 T. in 1975 and 26.500 T. in 1980.

The rate of growth will be particularly high in Libya, UAR and in the Arab countries in Asia.

There could be possibilities of exports in Africa and in Iran, but here again, the competition with present suppliers will be very difficult (Europe, Japan).

III.2.2.3. ACRYLICS

The available information and forecast are given in Tables 7A to 7D.

The consumption of acrylic fibers in the Arab countries will be approximately 6 000 T. in 1975 and 13,000 T. in 1980.

The consumption is now very low, the rate of growth will be approximately equivalent in Morocco, Algeria and UAR. Since there are two projects to produce acrylonitrile in UAR and Syria, their implementation could be an incentive to the consumption.

Possibilities for export are not known.

6 A - DEMAND FOR POLYESTER FIBERS (M.T/Y)

	1965	1970	1975	1980
Morocco	250	800	2.700	4.500
Algéria	250	800	2.400	5.000
Tunisia	150	350	950	1.500
Sub Total North Africa	650	1.950	6.050	11.000
Libya	100	150	500	1.000
U.A.R.	100	650	2.000	3.700
Soudan	100	200	500	800
Sub Total North East Africa	300	1.000	3.000	5.500
Jordan		70 (68)		
Syria	500	2.200		
Irak		20 (69) 50		
Kuweit				
Lebanon				
Saudi Arabia				
Sub Total Middle East Arab countries	1.000	3.000	5.000	10.000
Total Arab countries	1.950	5.950	14.050	26.500

6 B - PRODUCTION CAPACITIES (M.T/Y)

U.A.R.	25.000 (BMT ?)

6 C - FOREIGN COUNTRIES - CONSUMPTION OF POLYESTER FIBERS (M.T./Y)

	1965	1970	1975	1980
Central Africa	400	750	I.450	2.900
East Africa	I.400	2.400	5.000	II.000
Pakistan		I.500 (I967)		4.000
India		3.500 (I967)		76.000
Iran		I.000 (I967)		6.400
				86.400

6 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y)

France	30.000	36.000	
Italy	I4.000	20.000	20.000
Spain	8.000	I5.000	I0.000
Turkey	-	5.000	8.500
Yougoslavia	-		
Pakistan	0	3.000	
India	2.000	7.000	30.000
		24.000 (D.M.T.)	

7 A - DEMAND FOR POLYACRYLIC FIBERS (M.T./Y)

	1965	1970	1975	1980
Morocco	150	400	750	1.850
Algeria	150	400	750	2.000
Tunisia	100	200	300	650
Sub Total North Africa	400	1.000	1.800	4.500
Libya	50	150	350	800
U.A.R.	50	650	1.300	3.000
Soudan	100	200	300	700
Sub total North East Africa	200	1.000	1.950	4.500
Jordan		70 (68)		
Syria				
Irak		100		
Kuweit				
Lebanon				
Saudi Arabia				
Sub Total Middle East Arab Countries	300	1.000	2.000	4.000
Total Arab countries	900	3.000	5.750	13.000

7 B - PRODUCTION CAPACITIES (M.T/Y)

U.A.R.	500	5.000 (Acrylonitrile)	
Syrie			10.000 (Acrylonitrile)

7 C - FOREIGN COUNTRIES - CONSUMPTION OF POLYACRYLIC FIBERS (M.T./Y)

	1965	1970	1975	1980
Pakistan		300 (1967)		4.000
India		300 (1967)		18.000
Iran		1.000 (1967)		6.400

7 D - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y)

A) Fibers

France	12.500	20.000		
Italy	24.000	70.000	115.000	
Spain	0	3.000	15.000	
Yougoslavia	4.500	4.500	35.000	
Spain		20.000		
India	0	13.000	15.000	
Pakistan	0	5.000		

B) Acrylonitrile

France	10.000	60.000		
Italy	15.000	125.000		
Spain	0	3.000		
Yougoslavia				
Egypt			6.000	
Syria				10.000
India			16.000	

III-2.3. SYNTHETIC RUBBERS

The market of synthetic rubber must be investigated taking into account the complete rubber situation (natural synthetic) and the characteristics of all the synthetics.

The rubber market is characterised by a rate of growth of approximately 6,5 % per year which should not vary much before 1980. The annual rate for synthetics will remain above 9 %.

The competition between natural and synthetic will depend on the price of the products, but, if the production cost for synthetic is easily calculated, the production cost for natural rubber which varies from one country to another is difficult to evaluate. The price of natural rubber which has decreased from 34 C/lb. in 1956 to 18 C/lb. in 1968 is now stable at this level and many other facts thant production costs must be taken into account. Synthetic rubber will represent 75 % of the total world consumption in 1975 (82 % in the U.S.A., 65 % in other countries).

The production of synthetic rubbers which requires high investments and large capacities, is in the hands of international groups.

The processing of rubber is similar to plastic processing industry and is usually in the hands of small scale industry, excepting the manufacturing of tyres which is again undertaken by international groups.

The most important synthetic rubbers are : S.B.R., stereospecifics (polyisoprene and polybutadiene), ethylene propylene rubber, butyl, neoprene, nitrile, etc...

The most important are S.B.R. and polybutadiene for general use, butyl for air tubes.

The predominance of S.B.R. (60 % of total synthetics) is now due to large over capacities in the U.S.A. and Canada. Since no new S.B.R. units are being built in these countries, the share of stereospecifics will grow more rapidly. On the contrary, there are still many S.B.R. plants being erected outside the U.S.A.

In table 8A are shown the estimates for synthetic rubbers total demand in the Arab countries :

To estimate the demand in S.B.R. one must consider that :

. The local processing industry will not produce all the articles to be used in the region, and that finished products will have to be imported.

The estimated demand of synthetic rubber for the local industry is indicated below : (table 8 B)

8 - DEMAND FOR SYNTHETIC RUBBERS (M.T./Y)

	1965		1970	1975	1980
Morocco	4.200		5.500	8.700	I2.300
Algeria	5.000		7.I00	I0.I00	I4.800
Tunisia	I.400		?.200	3.400	4.900
Sub Total North Africa	I0.600		I4.800	22.200	32.000
Libya	700		I.500	2.700	5.000
U.A.R.	3.000	4.600 (68)	5.500	II.800	20.000
Sudan	800		I.600	2.400	3.700
Sub Total North East Africa	4.500		8.600	I6.900	28.700
Jordan	I.200		I.800	2.I00	3.000
Syria	2.000		2.500	3.500	5.000
Iraq	2.500	I.000 (69)	3.600	4.800	6.000
Kuwait	600		I.500	2.000	2.600
Lebanon	2.000		2.500	3.200	4.200
Saudi Arabia	3.500		4.500	5.500	7.500
Sub Total Middle East Arab countries	II.800		I6.400	2I.I00	28.300
Total Arab countries	26.900		39.800	60.200	89.000
India	20.000		50.000	II0.000	205.000
Pakistan	3.000				I02.000
Iran	I.000		I0.000		

8B. Estimated demand OF SYNTHETIC RUBBERS (M.T/Y) FOR THE LOCAL INDUSTRY

	1975			1980		
	Total demand of the country	demand of the local industry		Total demand of the country	demand of the local industry	
Morocco	8.700	6.600	(75 %)	I2.300	I0.500	(85 %)
Algeria	I0.I00	7.600	(75 %)	I4.800	I2.600	(85 %)
Tunisia	3.400	2.700	(80 %)	4.900	4.200	(85 %)
Total North Africa	22.200	I6.900		32.000	27.300	
Libya	2.700	I.600	(60 %)	5.000	3.500	(70 %)
U.A.R.	II.800	8.900	(75 %)	20.000	I7.000	(85 %)
Soudan	2.400	I.400	(60 %)	5.700	4.000	(70 %)
Total N.E. Africa	I6.900	II.900		30.700	24.500	
Middle East Arab countries	2I.I00	I2.700	(60 %)	28.300	I9.800	(70 %)
Total Arab Countries	60.200	4I.500		9I.000	7I.600	

A tentative breakdown between S.B.R., polybutadiene and other synthetics is given below (table 9) :

Table 9 - Estimated future demand for SBR, Polybutadiene and other synthetics

	1975			1980		
	S.B.R.	P.B.	Others	S.B.R.	P.B.	Others
North Africa	II.800	3.400	[illegible].700	I6.400	6.800	4.200
North East Africa	8.300	2.400	[illegible].200	I4.[illegible]00	6.I00	3.700
Arab countries in Asia	8.900	2.500	I.300	II.900	5.000	2.900
Total Arab countries	29.000	8.300	4.200	43.000	I7.900	I0.800

Three projects have been announced in U.A.R. : I2.000 T./Y of polybutadiene in 1975
in Algeria : production of S.B.R. and polybutadiene in Oran around 1975. (capacities not indicated).

III- 2/ 4. SYNTHETIC DETERGENTS

. General characteristic

The industry of detergents must be investigated simultaneously with the soap industry. The synthetic detergents represent a growing part of the total detergent + soap, 87 % in the U.S.A., 75 % in Europe, approximately 50 % in industrialising countries.

The most important detergents are the anionics : alkyl benzene sulphonates, linear alkyl sulphonates or alphaolefin sulphonates ; the anionics represent 75 % of synthetic detergents in U.S.A. and much more in industrialising countries. Since pollution problem (biodegradability) are not yet important in most of non industrialised countries, the alky benzene sulphonates (A.B.S.) are consumed in very large quantities.

The production is broken down into :

- Domestic detergents (powders or liquids) with a content of 15 to 20 % of active material,

- Industrial detergents, which are consumed in textile, paper, mining industry, metallurgy, etc... The average content of active product is 40 %.

The industry of synthetic detergents is in the hands of very large industrial international groups and there is a general tendency towards integration, however, the last stage of production (compounding and packaging) can be undertaken by small scale industries.

. Future market

The results are presented in table 10 A to 10 B.

It appears that the average rate of growth in the arab countries will remain superior to 10 % until 1980 (lower in North Africa, due to a large production capacity of soap).

The consumption of dodecyl benzene which is the most important raw material for the production of synthetic detergents should reach approximately 36.500 T. in 1975 and 53.500 T. in 1980.

There will be possibilities of export in Africa but the local consumption could justify by itself the productions of D.D.B.

IO A - DEMAND FOR SYNTHETIC DETERGENTS (M.T./Y OF D.D.B.)

	1965	1970	1975	1980
Morocco	2.500	3.500	5.500	7.000
Algeria	3.000	4.500	7.000	10.000
Tunisia	1.000	1.300		
Sub Total North Africa	6.500	9.300	14.500	20.500
Libya	500	900	1.300	2.000
R.A.U.	1.100	2.000	5.000	8.000
Soudan	200	300	800	1.000
Sub Total North East Africa	1.800	3.200	7.100	11.000
Syria	600	600		
Irak	3.000	6.000		
Koweit		500		
Lebanon	800	1.000		
Sub Total Middle East Arab countries	5.000	10.000	15.000	22.000
Total Arab countries	13.300	22.500	36.000	53.500

IO B_1 - PRODUCTION CAPACITIES (finished products in M.T/Y)

Morocco	13 à 15.000	2 units	
Algeria	22.000	2 units	
Tunisia	5 à 6.000	3 4 units	
Libya	4.600		6.400
R.A.U.	7.500		
Syria	4.000		
Irak	25.000		
Lebanon	?		

IO B_2 - PRODUCTION CAPACITIES (M.T./Y OF D.D.B.)

U.A.R.	6.000
Iraq	10.000
Syria	10.000

[illegible] - [illegible] CONSUMPTION OF SYNTHETICS DETERGENTS (M.T/Y. OF B.D.B.)

	1965	1970	1975	1980
[illegible]	2.000	3.800	7.600	14.900
[illegible]	300	900	1.400	2.100
[illegible]		4.000		30.000
[illegible]		500		10.000
[illegible]				8.000
[illegible]	100.000			
[illegible]	80.000			
[illegible]				
[illegible]				
[illegible]				
[illegible]				

10 B - PRODUCTION CAPACITIES (M.T/Y. OF ALKYL BENZENE)

[illegible]	100.000		
[illegible]	70.000	90.[illegible]	
[illegible]		50.000	[illegible].000
[illegible]		[illegible]0.000	
[illegible]		4.000	
[illegible]			5.000
[illegible]		10.000	10.000

II-3. INTERMEDIATES

The quantities of intermediates to be produced have been calculated starting from the end-products to be manufactured. The yields are those of the most commonly used manufacturing processes.

1 - Vinyl chloride (V.C.)

Vinyl chloride will be used for the manufacture of P.V.C. The results are indicated in table 11 below :

Table 11 - Estimated demand for vinyl chloride (M.T/Y)

Demand	North Africa		North East Africa		Middle East Arab Countries		All Arab countries	
	1975	1980	1975	1980	1975	1980	1975	1980
P.V.C.	22.500	33.300	23.400	35.600	29.500	62.500	52.500	120.400
VINYL CHLORIDE	24.300	35.900	25.200	37.300	[illegible].900	56.700	[illegible].300	29.900

2 - Styrene

Styrene will have to be produced for the manufacture of polystyrene and S.B.R.

The future consumption was indicated in table 8 for polystyrene and table 9 for S.B.R.

In table 12 below, are shown the necessary quantities of styrene :

Table 12 ESTIMATED DEMAND FOR STYRENE

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	1975	1980	1975	1980	1975	1980	1975	1980
Polystyrene	6,300	5,750	4,000	6,050	[illegible],200	7,700	5,300	9,500
S.B.R.	1,000	16,400	8,100	3,700	8,900	11,950	29,000	41,000
Styrene for Polystyrene	4,300	6,000	4,200	6,300	5,400	8,100	13,900	20,400
Styrene for S.B.R.	2,500	3,200	2,650	2,900	1,750	2,900	5,700	8,400
Total in Styrene	[illegible]	9,200	5,850	9,200	7,150	10,400	19,600	28,800

[illegible] Caprolactam

Caprolactam will be used for the manufacture of polyamide fibres. The results are indicated in table [illegible] below; it can be assumed that all local produced [illegible] would be [illegible]

Table [illegible] Estimated demand for caprolactam (M

Demand	South Africa		South East Africa		Middle East and countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
polyamide fibres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Caprolactams	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Dimethyl terephthalate

D.M.T. will be used for the manufacture of polyester fibres. The results are indicated in table [illegible] below

Table [illegible] Estimated demand for DMT [illegible] (M

Demand	South Africa		South East Africa		Middle East and countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
polyester fibres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D.M.T.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Acrylonitrile

Acrylonitrile will be used for the manufacture of acrylic fibres. Table [illegible] shows the results, below

Table [illegible] Estimated demand for acrylonitrile (M [illegible]

Demand	South Africa		South East Africa		Middle East and countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Acrylic fibres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Acrylonitrile	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] - Dodecyl benzene (D.D.B.)

D.D.B. will be used for the production of synthetic detergents. The results have already been indicated in table 10 A. They are summarized in table 16 below:

Table 16 - Estimated demand for DODECYL BENZENE (D.D.B.)

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D.D.B.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] - Ethylene

Ethylene will be used for the manufacture of polyethylene, P.V.C. (vinyl chloride), polystyrene (ethylbenzene) and D.D.T. (ethanol). The results are shown in table 17 below:

Table 17 - Estimated demand for Ethylene.

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
polyethylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
vinyl chloride	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ethylene for polystyrene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ethylene for D.D.T.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ethylene for other	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Ethylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* The quantities necessary for producing ethylene direct, as intermediate into the production of polymers have not been taken into account.

8 - Propylene

Propylene will be used in the manufacture of polypropylene, acrylic fibers (acrylonitrile) and Dodecyl benzene (D.D.B.). The results are shown in table 18, below :

Table 18 Estimated demand for PROPYLENE (M.T.)

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1980	197[illegible]	1980
Polypropylene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	[illegible]	[illegible]
[illegible]	[illegible]	20,[illegible]	[illegible]	[illegible]	[illegible]	22,[illegible]	[illegible]	[illegible]
Acrylonitrile	1,8[illegible]	[illegible]	2,[illegible]	[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]
Propylene for Polypropylene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	[illegible]	[illegible]
Propylene for [illegible]	[illegible]	22,[illegible]	[illegible]	11,[illegible]	[illegible]	2[illegible]	[illegible]	[illegible]
Propylene for Acryl	[illegible]	7,[illegible]	1,2[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21,[illegible]
Total Polypropylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

9 - Butadiene

Butadiene will be used in the manufacture of synthetic rubbers (S.B.R. and polybutadiene). The results are shown in table 19 below :

Table 19 Estimated demand for BUTADIENE (M.T.)

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	197[illegible]	1980	197[illegible]	1980	197[illegible]	1980	197[illegible]	1980
S.B.R.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29,[illegible]	[illegible]
Polybutadiene	[illegible]	[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Butadiene for SBR	[illegible]	10,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10,[illegible]	27,2[illegible]
Butadiene for Polybutadiene	[illegible]	[illegible]	2,[illegible]	[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]
Total butadiene	11,[illegible]	17,[illegible]	7,[illegible]	[illegible]	8,[illegible]	[illegible]	[illegible]	[illegible]

II. 3. 10 - Benzene

Benzene will be used in the manufacture of polystyrene (styrene) S.B.R. (styrene) polyamide fibers (caprolactame) and detergents (D.D.B.). The results are presented in table 20 below :

Table 20 - Estimated demand for BENZENE (M.T/Y)

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	1975	1980	1975	1980	1975	1980	1975	1980
Styrene	.600	9.200	.850	[illegible]	7.100	10.400	19.600	28.800
Caprolactame	12.000	16.400	7.800	12.650	8.800	16.500	33.000	45.500
D.D.B.	14.500	20.300	7.100	11.000	15.000	22.000	56.600	6.500
Benzene for Styr.	6.100	8. 00	5.400	8.500	6.600	9.400	18.100	26.600
Benzene for Caprolactame	13.200	18.000	8.600	14.000	9.700	18.200	36.500	50.200
Benzene for DDB	6.400	9.000	3.100	4.500	6.600	9.600	11.700	23.400
	25.700	37.500	17.100	27.300	22.900	47.400	70.700	100.200

II. 3. 11 - Paraxylene

Paraxylene will be used in the production of polyester fibers (D.M.T.) The results are shown in table 21, below :

Table 21 Estimated demand for PARAXYLENE (M.T/Y)

Demand	North Africa		North East Africa		Middle East Arab countries		All Arab countries	
	1975	1980	1975	1980	1975	1980	1975	1980
D.M.T.	6.650	12.100	1.400	2.050	5.900	11.100	15.450	29.200
Paraxylene	5.000	9.100	2.500	4.500	4.100	8.300	11.600	21.900

III - 4. FERTILIZERS

GENERAL CHARACTERISTICS OF THE MARKET

The fertiliser industry is the most important (in tonnage produced) of the world chemical industry.

The continuous growth of fertiliser consumption and production has not changed since 1950 and the annual rate is approximately 8 %.

- The world population increases by approximately 2 % per year involving a corresponding development of the demand ; since approximately half of the world population still suffers from malnutrition, the needs for agricultural products and fertilisers increase at a higher pace in developing countries.

- The areas of cultivitable lands are now limited and the use of fertilisers is absolutely necessary to increase production and prevent their impoverishment in nutrients.

- The upper limit of nutrients that can be profitably utilised by unit of land is far from being reached even in industrialised countries (excepting Japan, Belgium and Holland).

It is estimated that the local demand for nutrients will be approximately 100 million tons in 1975.

The modern industry is now manufacturing products with a high concentration of nutrients such as :

- Ammonium nitrate (33,5 %) and Urea (46 %)
- Triple superphosphate (45 %) and diammonium phosphate (46 % of P_2O_5)
- Potassium sulphate or chloride (up to 50 or 60 %).

These high analysis products result in large savings in transportation and storage costs.

The newly installed units have large capacities and low production costs.

In developing countries, others factors must be taken into account :

- Although the developing countries represent now 2/3 of the world population (and 3/4 in 1980) the consumption of fertilisers is only 15 to 20 % of the world consumption.

- The fertiliser consumption in developing countries is increasing at approximately 12 % TVA says 16 % per year (10 % in Africa).

In the Arab countries, the consumption of fertilisers is still very limited ; the North African countries and U.A.R. are the largest consumers and their demand will probably continue to grow at a higher rate than in the rest of the Arab world.

Agronomists recommend that the ratio N/P_2O_5 in the industrialised countries should be between 1 and 2 (depending on the types of crops)

...

In North Africa, the proportion of nitrogen fertilisers is approximately 70 % of phosphate fertilisers giving a ratio of 0,7. This ratio will rise and the amount of nitrogen and phosphate fertilisers in 1980 will be approximately equal, giving a ratio of 1.

In other countries, particularly Egypt and Sudan, the ratio N/P_2O_5 is very high (4,3 in 1970 in North East Africa). It will go down to 1,7 in 1980.

In the following chapters, special attention will be given to the following products :

- Nitrogen fertilisers where the nutrient is N
- Phosphate fertilisers where the nutrient is P_2O_5
- Potassic fertilisers where the nutrient is K_2O
- Complex fertilisers which are obtained by the chemical combination of nutrients (N/P_2O_5, K_2O).

III 4. I - <u>Nitrogen fertilisers</u>

In the industry of nitrogen fertilisers, the feedstock (coal, gas and liquid hydrocarbon) is at the same time the raw material and the source of energy.

Ammonia is the fundamental component for nitrogen fertilisers. Ammonia is now produced in plants with a capacity of 600 to 2.000 T day, with low pressure synthesis and centrifugal compressors. This permits large savings in investment, production cost and utility consumption.

The most commonly used raw materials are coal, natural gas and liquid hydrocarbons ; but the importance of coal is decreasing and natural gas is now the most utilised feed-stock, especially in areas where it is available in large quantities (Venezuela, Algeria, Middle-East etc...).

In non-industrialised countries, the growth of nitrogen fertiliser production is much more important than the production of phosphate or potash fertilisers. This is particularly true in the Middle East.

The average annual rate of growth for nitrogen fertiliser consumption is now approximately 12 % a year in the world.

Among the various nitrogen fertilisers (ammonium sulphate, ammonium nitrate, urea) urea is now becoming the most important especially in recently erected plants ; for example in Japan, one of the largest world producers, it represents approximately 50 % of the production.

It must be noted also, that calcium nitrate is highly consumed in U.A.R.

The historical and projected supply and demand for nitrogen are summarised in table 22. Also given are supply and demand data for other countries as an indication of possibilities for export from the Arab countries.

. . . . . .

a.r.g. annual rate of growth

22 A - DEMAND FOR NITROGEN FERTILIZERS (M.T/Y of Nitrogen)

	1965	1970		1975		1980
Morocco	15.000	28.000		50.000		80.000
Algeria	18.000	35.000		65.000		100.000
Tunisia	8.000	13.000		20.000		30.000
Total North Africa	41.000	76.000	17 %	135.000	10 %	210.000
Libya	1.500	3.000		8.000		20.000
U.A.R.	250.000	310.000		420.000		550.000
Sudan	25.000	50.000		73.000		100.000
Total North East Africa	28[illegible]	373.000		501.000		670.000
Jordan	1.000	3.600		7.400		23.000
Syria	12.000	26.000		52.000		89.000
Iraq	2.500	5.000		9.700		25.000
Kuwait	-	-		-		-
Lebanon	10.000	20.000		39.000		68.000
Saudi Arabia	5.000	10.000		18.000		25.000
Total Middle East Arab countries	32.100	64.600		126.100		230.000
Total Arab countries	359.600	513.600		762.100		1.110.000

22 B - PRODUCTION CAPACITIES IN THE ARAB COUNTRIES

Algeria		270.000 (Alger)	350.000 (Arzew)
Tunisia		30.000	[illegible].000
Lebanon		11.000 (imported NH3)	[illegible].000
Syria			165.000
Iraq		50.000 (Basrah)	
Kuwait		110.000	560.000
Saudi Arabia		150.000 (Damman)	390.000
Qatar			240.000
Libya			300.000
U.A.R.	170.000	220.000	440.000
		841.000	2.491.000

22 C - FOREIGN COUNTRIES CONSUMPTION OF NITROGEN FERTILIZERS (M.T./Y)

	1965	1970	1975	1980
[illegible]	20.000	33.000		
India	570.000	1.450.000	3.000.000	
[illegible]	162.000	333.000		
Iran	30.000	60.000		
France	892.000			
Italy	404.000			
Turkey	72.000			

22 B - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y)

India	260.000	1.100.000	2.500.000	5.000.000
[illegible]	84.000	240.000	700.000	1.200.000
Iran	25.000	100.000	450.000	
France	1.070.000			
Italy	840.000	1.700.000	2.500.000	
Spain		1.000.000	1.500.000	
Greece		200.000	500.000	
Yugoslavia		300.000	450.000	
Turkey	32.000	120.000	300.000	

The consumption of nitrogenous fertilizers in the arab countries will be 760,000 T. in 1975 and 1,110,000 T. in 1980. The U.A.R. will remain the main consumer with 400,000 T. in 1975 and 550,000 T. in 1980.

The rate of growth will probably decrease after 1975 in North Africa and U.A.R. It will remain very high in other countries.

There are no possibilities of exports in the Mediterranean countries. The deficit will remain in Asia (particularly in India, Pakistan and China) and Africa, but there will be a very strong competition with the present suppliers (Western Europe, U.S.A., Japan).

[illegible] . 2 - **Phosphate fertilizers**

They are presently consumed in large quantities in U.A.R., Algeria and Morocco ; Since the units now in operation are producing simple superphosphate (excepting Morocco and Tunisia where triple superphosphate and diammonium phosphate are produced), this product is the most commonly used ([illegible] of the total phosphate fertilizers in U.A.R., [illegible] in Morocco, [illegible] in Algeria).

In 1980, with the establishment of modern units, the share of simple superphosphate on the one hand and of triple superphosphate plus diammonium phosphate on the other hand will be about equal in the arab countries.

The result of the market study are shown in table 2[illegible] A to 2[illegible].

The consumption of phosphate fertilizers in the Arab countries should be approximatel [illegible] (P_2O_5) in 19[illegible] and [illegible] (P_2O_5) in 19[illegible]. [illegible], Algeria and Morocco will remain the most important consumers.

The production capacity which is now approximately [illegible] should grow to [illegible] in 1975 and to at least 1.[illegible] T. in 19[illegible]. Several large projects have been announced and new phosphate deposits have not been developed (Syria, Irak, etc ...)

There will be large excesses available for export in 19[illegible] ([illegible] in Morocco, 190,000 T. in Tunisia, 80,000 [illegible] in U.A.R., [illegible] in Algeria), but there will be good possibilities for exports to the countries which are already importers (Western Europe, Asia) and eventually to the U.S.S.R. which is now the second largest consumer in the world.

[illegible] . 3 - **Potash and complex fertilizers**

Potash fertilizers are consumed in very small quantities by developing countries. Europe, North America and U.S.S.R. represent 8[illegible] of the world consumption. This is due to the fact that very few potash units are installed in non industrialized countries and to the specific end uses of potash fertilizers.

Potassium chloride is the most commonly consumed and there is a tendency towards using highly concentrated products.

23 A - DEMAND FOR PHOSPHATE FERTILIZERS (M.T./Y OF P_2O_5)

Sources & bases for projections

	1985	1990	1995	2000
[redacted]	23.000	60.000	60.000	90.000
[redacted]	[illegible]	45.000	60.000	90.000
[redacted]	13.000	20.000	20.000	40.000
[redacted]	71.000	105.000	140.000	220.000
[redacted]	1.500	2.500	[illegible]	12.000
[redacted]	50.000	80.000	150.000	250.000
[redacted]	500	[illegible]	15.000	30.000
[redacted]	[illegible]	87.500	170.000	292.000
[redacted]		3.000		
[redacted]		8.000		
[redacted]		3.000		
[redacted]		14.000		
[redacted]		500		
[redacted]		28.500	70.000	150.000
[redacted]		221.000	380.000	682.000

23 B - PRODUCTION CAPACITIES IN THE ARAB COUNTRIES [illegible]

[redacted]	41.000	150.000 Soft	250.000	450.000
[redacted]	17.000	21.000	27.000	150.000
[redacted]	140.000	160.000	160.000	230.000
[redacted]	35.000	60.000	200.000	330.000
[redacted]			210.000	210.000
[redacted]		35.000	50.000	50.000
		[illegible]	[illegible]	1.420.000

23 C - PRODUCTION CAPACITIES IN FOREIGN COUNTRIES (M.T/Y OF P_2O_5)

	1978	1985
[illegible]	200.000	350.000
[illegible]	100.000	500.000
[illegible]		200.000
[illegible]		150.000
[illegible]		5.000
[illegible]	95.000	800.000
[illegible]	1.600.000	1.700.000
[illegible]		[illegible]

There is no production of potash fertilizers in the arab countries ; studies are being made to develop a deposit significance of potash already discovered in Jordan.

The available information regarding the market in the Arab countries are given in table [illegible], it appears that Algeria, Morocco and U.A.R. will consume moderate quantities of potash fertilizers in [illegible] and 1980.

The question of complex fertilizers is very difficult to study in the industrialising countries where the market is not yet developed for such a sophisticated products.

The most commonly used complex fertilizers are products with 2 nutrients such as :

- Potassium nitrate
- Ammonium phosphates and nitrophosphates
- Potassium phosphate

The complex fertilizers are presently manufactured in industrialized countries and the markets are Europe and North America, but also South America, India and South Korea, because they are receiving international assistance.

In the arab countries, complex fertilizers are consumed in Algeria ([illegible] of phosphatic fertilizers) and Morocco ([illegible] to [illegible]) ; also in Kuwait ([illegible] to [illegible]) but this is not representative since the total amount consumed in the country is very low ([illegible] P_2O_5).

It can be assumed that the installation of modern units producing ammonium phosphate in Morocco, Tunisia and probably Algeria will be an incentive to the consumption of complex fertilizers.

A - [illegible] FERTILIZERS [illegible]

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
Total [illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
U.A.R.	[illegible]	[illegible]	[illegible]	
[illegible]	n.a	n.a.		
[illegible]		[illegible]		
[illegible]		[illegible]		
[illegible]		[illegible]		
[illegible]		[illegible]		
Total [illegible]		> [illegible]	> [illegible]	> [illegible]

III. - SULPHUR

Refined elementary sulphur is consumed mainly in agriculture and in the industry of artificial fibers. The main outlet for sulphur is sulphuric acid (SO_4H_2) which is used in textile industry, metallurgy, chemical industry (pesticides, detergents, dyes, explosives) but mainly in the fertilizers industry.

It is difficult to estimate the future consumption of sulphur starting from the consumption of sulphuric acid since other raw materials than pure sulphur are available (pyrites, gypsum) but it is interesting to see what will be the consumption of sulphuric acid. The available information is given in table 25.

Table 25 - Forecasted demand of sulphuric acid* (t of SO_4H_2)

	1965	1970	1975	1980
Morocco	[illegible]	[illegible]	[illegible]	[illegible]
Algeria	[illegible]	[illegible]	[illegible]	[illegible]
Tunisia	[illegible]	[illegible]	[illegible]	[illegible]
Libya	n.a.	n.a.	n.a.	n.a.
U.A.R.	[illegible]	[illegible]	[illegible]	[illegible]
Sudan	[illegible]	[illegible]	[illegible]	[illegible]
Lebanon	[illegible]	[illegible]		
Syria			[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]

Table 26 - Production capacities of sulphuric acid (t of SO_4H_2)

	1965	1970	1975	1980
Morocco		[illegible]	[illegible]	
Algeria		[illegible]	[illegible]	[illegible]
Tunisia	[illegible]	[illegible]	[illegible]	[illegible]
U.A.R.	[illegible] **	[illegible]	[illegible]	
Syria			[illegible]	
Iraq		[illegible]	[illegible]	
Lebanon		[illegible]	[illegible]	
Kuwait		[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]

* This is [illegible] on the utilisation of the [illegible]

** 70% of the SO_4H_2 is produced from sulphur

[redacted]

[redacted]

[redacted]

[redacted]

IV - 1 [redacted]

1 1 [redacted]

[redacted]

IV - 1 1 [redacted]

[redacted]

IV - 1 [redacted]

[redacted]

In the case of natural gas many factors have to be taken into account

Production cost, price at the well head

Utilization factor (existing reserves, existing or planned [illegible] facilities already committed)

Transportation costs to the coast line including compression, [illegible] removal etc

Location penalities

Some examples of natural gas prices at the coast line are [illegible]

[illegible]

[illegible]

[illegible]

A foreign share holder in a corporation normally brings in his proportionate share of the equity capital usually all in the form of foreign currency. This reduces the total foreign exchange requirements of the projects, and often means that the foreigner's equity payment covers all the foreign exchange requirements up to and even after start up of the plant.

There are some distinct financial advantages. For instance:

a) The loan negotiations which are usually conducted with a foreign bank will be simplified by the intervention of the foreigner, and because of the commercial guarantees that his presence affords.

b) The equity capital brought in means that it is not necessary to find [illegible] the foreign exchange component corresponding to that part of the project.

There are some less attractive aspects as well:

c) Whether the foreign exchange is directly borrowed from a bank, or supplied by a foreign shareholder as his equity, it [illegible] conditions or obligation of the country [illegible]

- In the first case the annual principal and interest payments must be made.
- In the second case, after a given period of time usually [illegible] the foreign shareholder may [illegible] his capital if he so decides.

[illegible]

d) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

A number of commercial networks exist in the arab countries, but these are essentially in the private sector : normally they do not consist of highly trained people in the petrochemical sense. It is usually the foreign companies, experienced in the field abroad, who are capable of creating [illegible] highly trained commercial networks, or strengthening existing ones in arab countries if they choose.

The public sector does not as yet have such commercial networks, though there are some signs in other fields that they are beginning create them.

If the public sector wishes to become involved in the production of the more developed petrochemicals, it will be necessary for it to decide whether, in order to sell the products, it prefers to undertake the considerable efforts necessary to develop an adequate commercial network, or to take advantage of facilities provided by the arab countries private sector, or foreign firms, or both.

3. **Technical limitations**

There are certain practical limitations (in technical considerations), on full freedom of choice as to whether the national sector alone should undertake certain productions.

Broadly speaking, petrochemicals can be divided into two great classes. There is of course some overlap.

In the first class, which we call "Class A", are all those products whose chemical and physical properties are well defined, and whose finished product specifications are clearly established internationally by scientific standards.

In the second class, "Class B", are all those more complex products whose chemical properties are well defined, but whose physical properties and finished product specifications are generally set by the specific use to which they are destined.

A somewhat arbitrary classification is shown in table [illegible] below.

There is full technical freedom of choice [illegible] should operate any production unit belonging under "Class A". [illegible] the same capabilities, whether made locally or imported.

[illegible]

[illegible]

..../...

- Formulation chemistry and
- Customer service network

The Arab countries are not at present equipped to supply either of these two essential items. This is particularly true in the case of the [illegible] sector. Theoretically there is no reason that they could not eventually be built, but it is not believed that such an operation would be feasible until there is a very solid basic petrochemical industry equipped with all its own laboratories.

For plants in "Class 4", there seem to be two essential requirements:

1) A foreign participant, who is already in the business in his own country, who will supply and continue to supply the specialized service and technico-commercial "know how", which continues to evolve very fast.

2) A partner already having [illegible] and able to create a commercial network, which will provide the customer assistance and technical assistance [illegible].

It is therefore recommended that [illegible] technical partner [illegible] in the early stages of the development of the industry at least.

The Arab countries acting alone should not try to realize Class 4 plants without foreign participation. It is desirable where they wish to operate alone, to concentrate their efforts on Class [illegible] plants.

The additional decision of how much of Class 4 plants should be built by foreigners, or what participation Arab countries should have in Class 4 plants, can be in principle based on capital availability, taking into account such prospects as the already [illegible].

[illegible]

[illegible]

International companies for equipment [illegible] [illegible] [illegible] and plant erection, inspection and [illegible] [illegible] [illegible] [illegible] [illegible]

At the stage of planning and design of the complexes it would be advisable to have an international [illegible] [illegible] to [illegible] [illegible] [illegible] to look for potential [illegible] [illegible] [illegible] [illegible] projects are [illegible] according to the best [illegible] standards. [illegible] would also [illegible] [illegible] to [illegible] [illegible] the [illegible] of application [illegible] and technical assistance to the customers (plastics, fertilizers, etc.) [illegible] [illegible] facilities for the [illegible] [illegible] [illegible] [illegible] the [illegible] of the [illegible] [illegible] will [illegible] to [illegible] the production of the [illegible] [illegible] articles (plastic [illegible], [illegible] fibers [illegible] and [illegible] equipment, etc.)

Finally, the training at all levels which is [illegible] [illegible] [illegible] [illegible] and [illegible] companies, [illegible] [illegible] companies [illegible] [illegible] [illegible] organizations that have been [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] should be [illegible] [illegible] [illegible] [illegible] scale [illegible] advantage of the existing facilities and [illegible] [illegible] are available in the [illegible] world and in the rest of the world.

[redacted]

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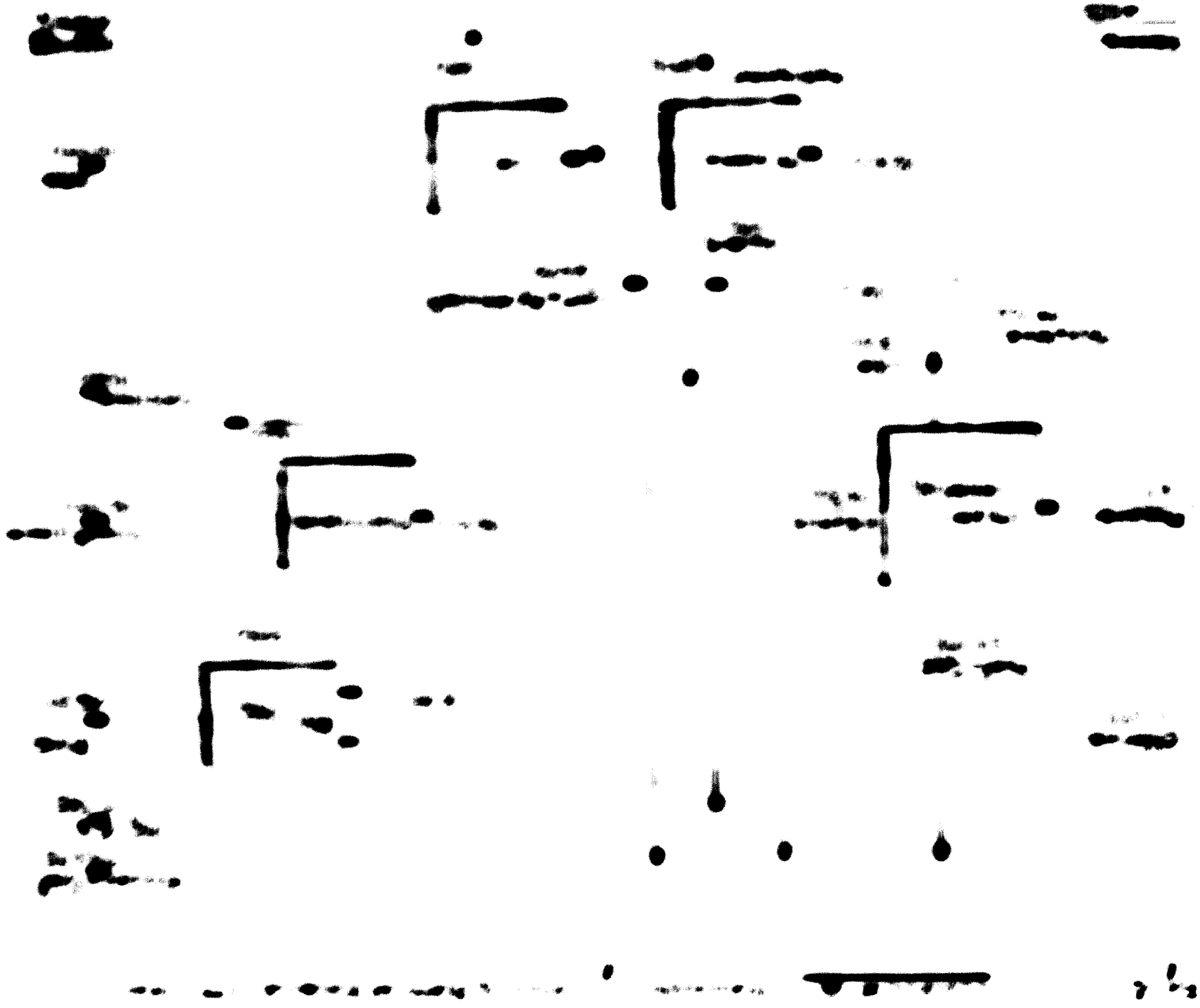

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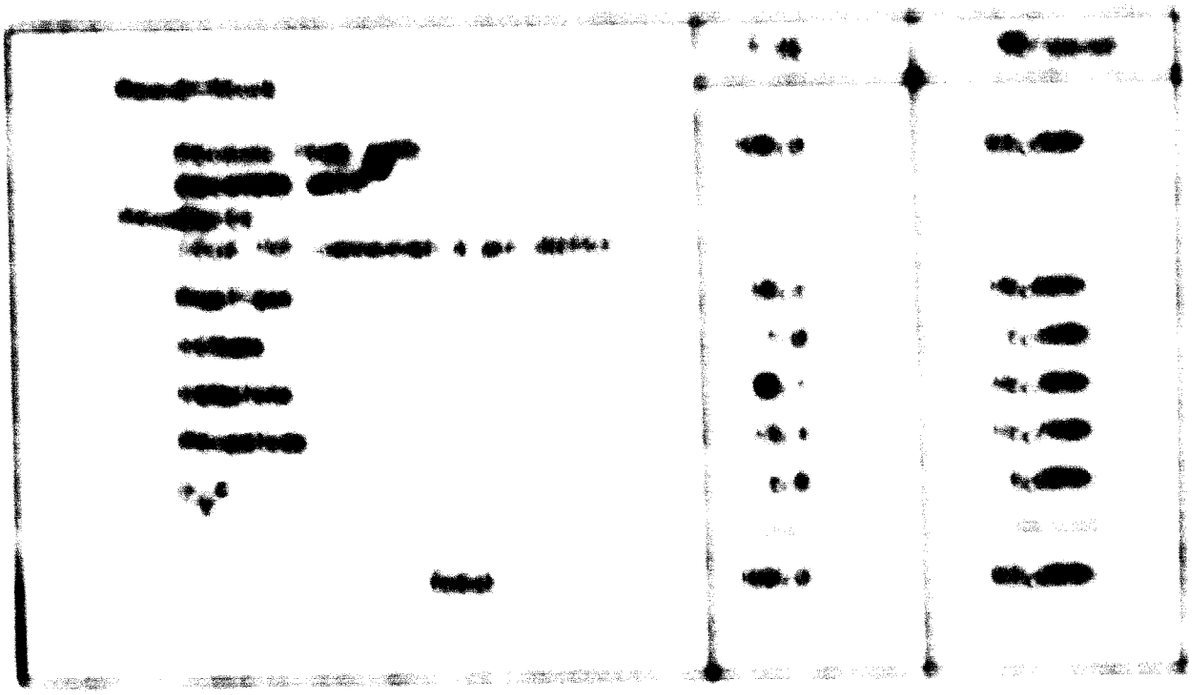

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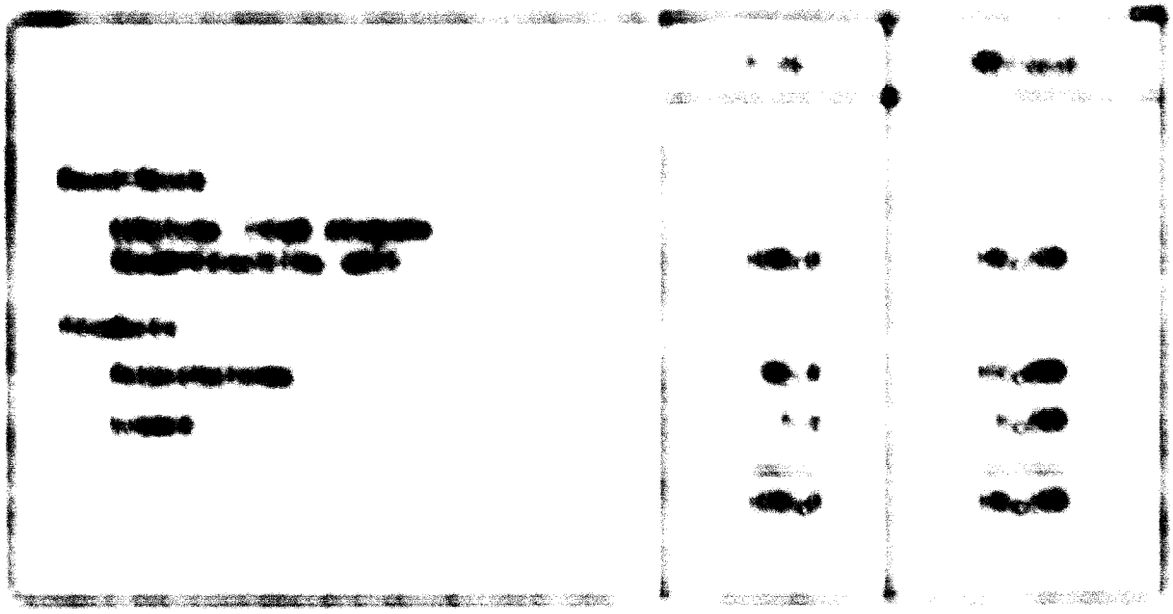

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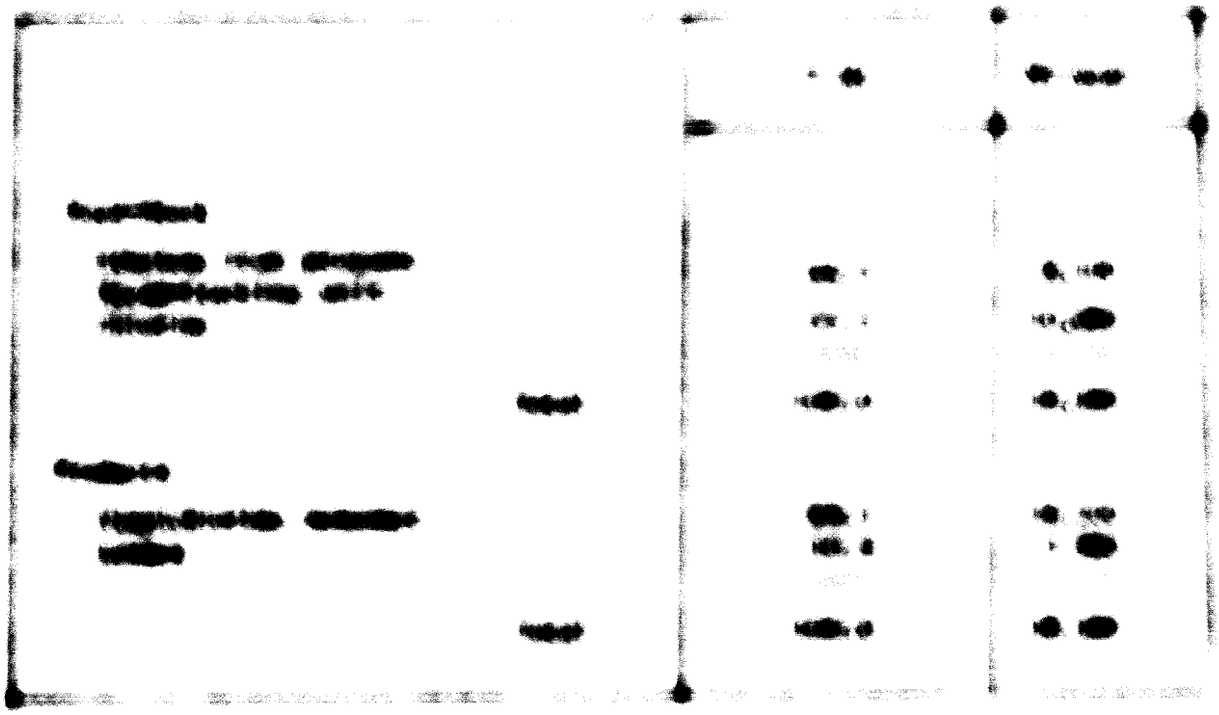

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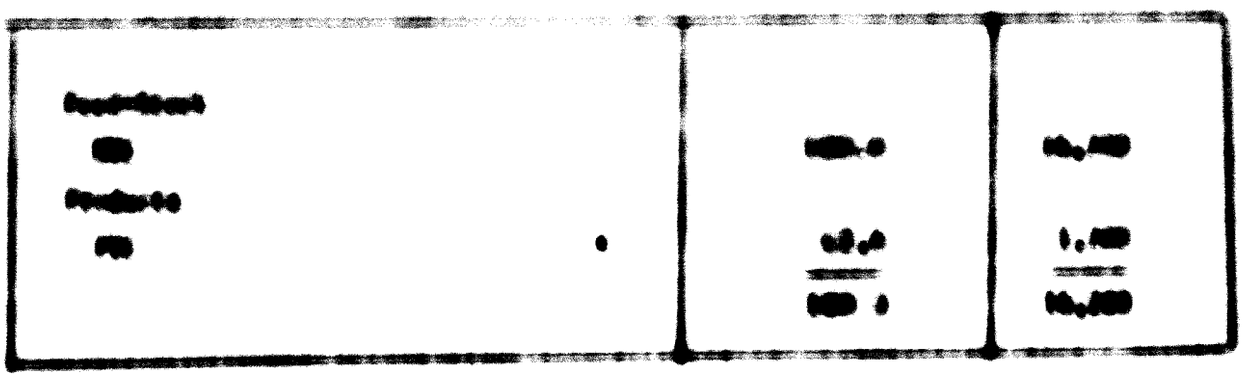

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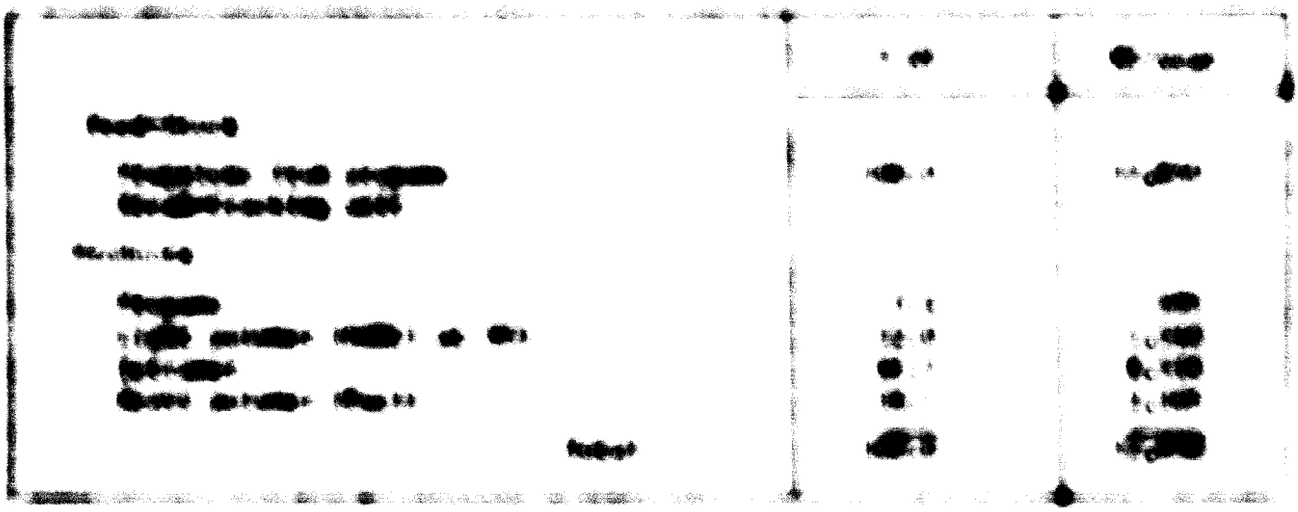

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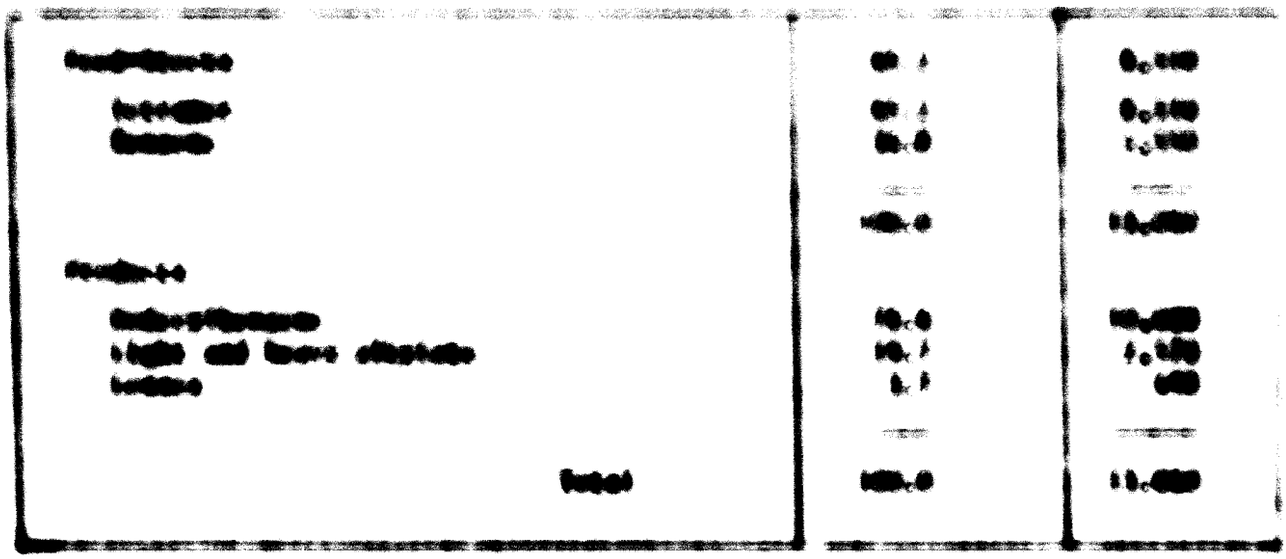

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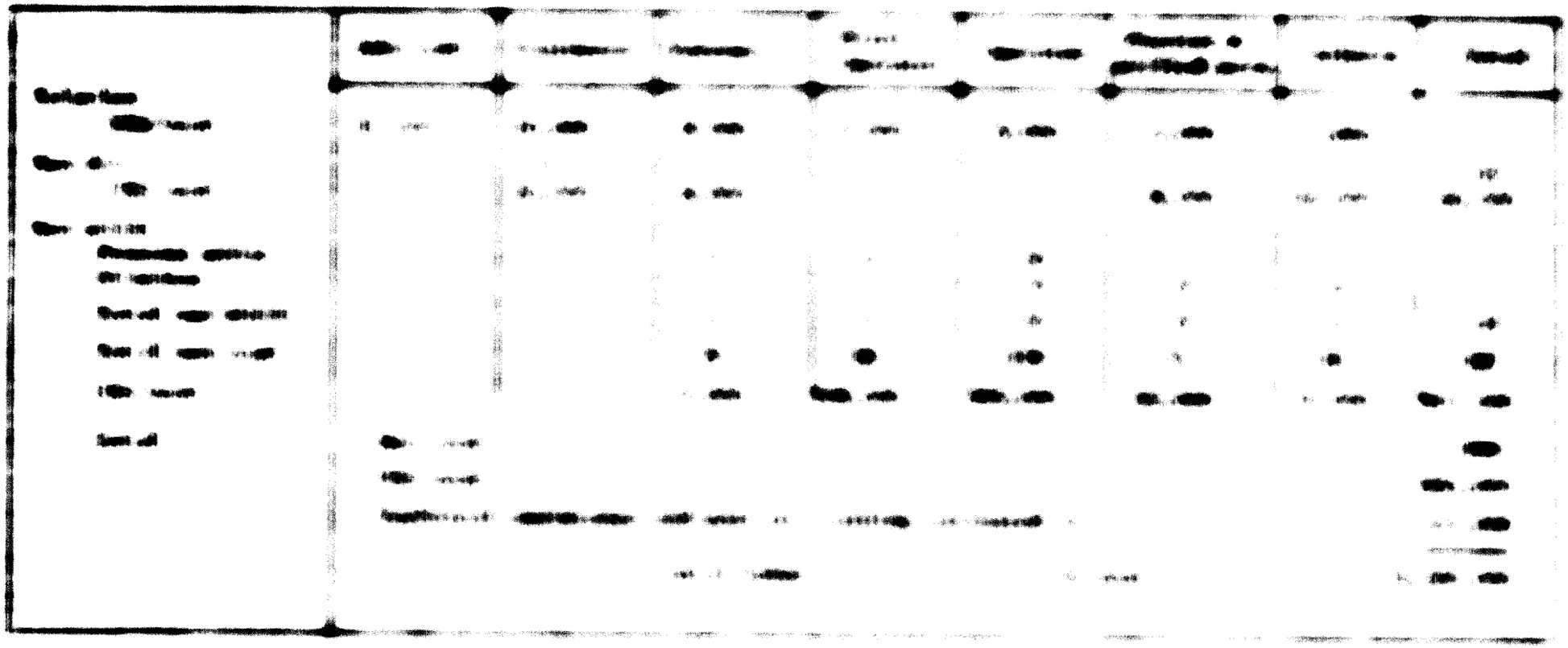

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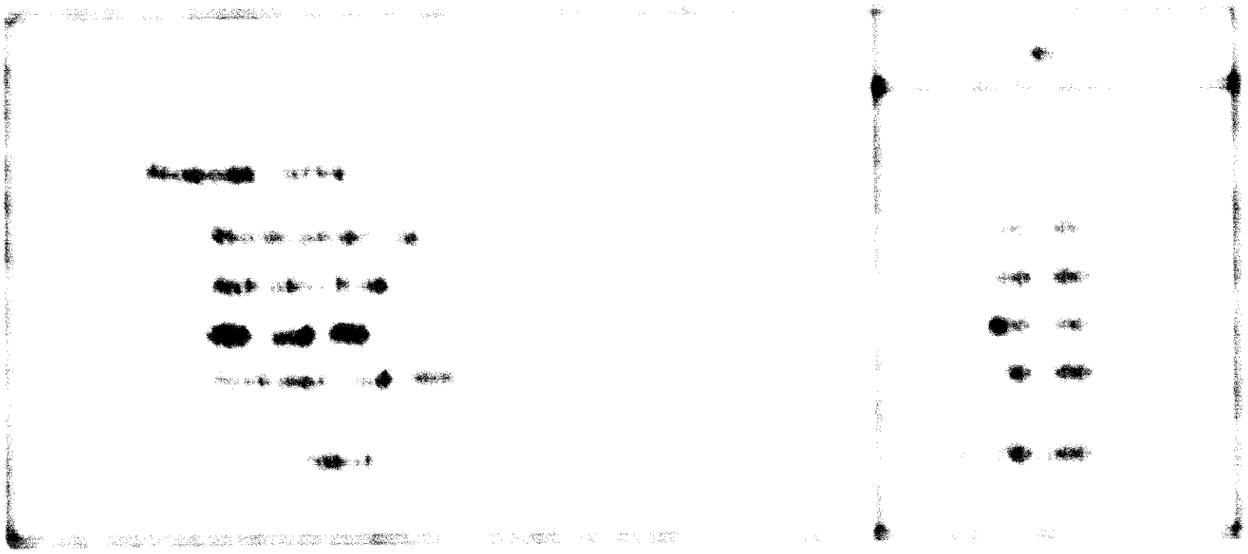

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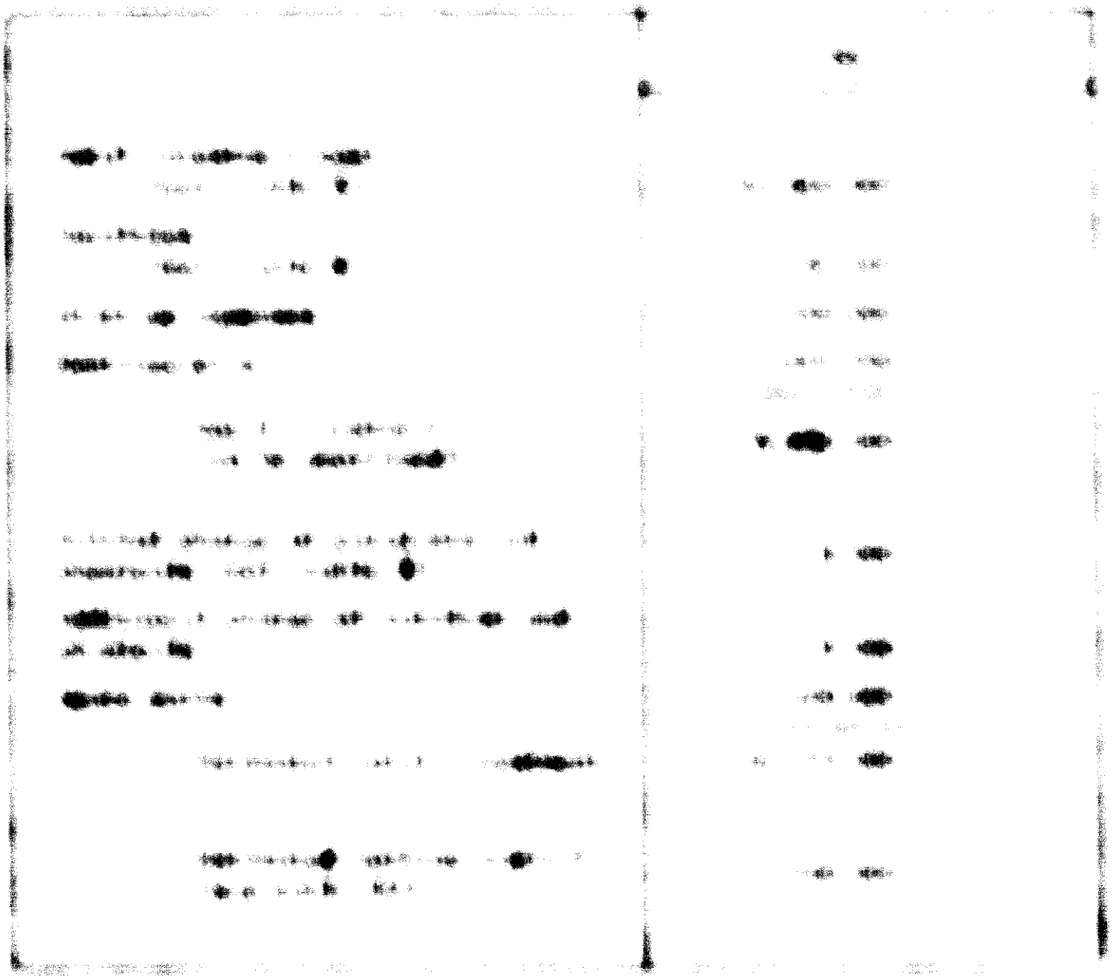

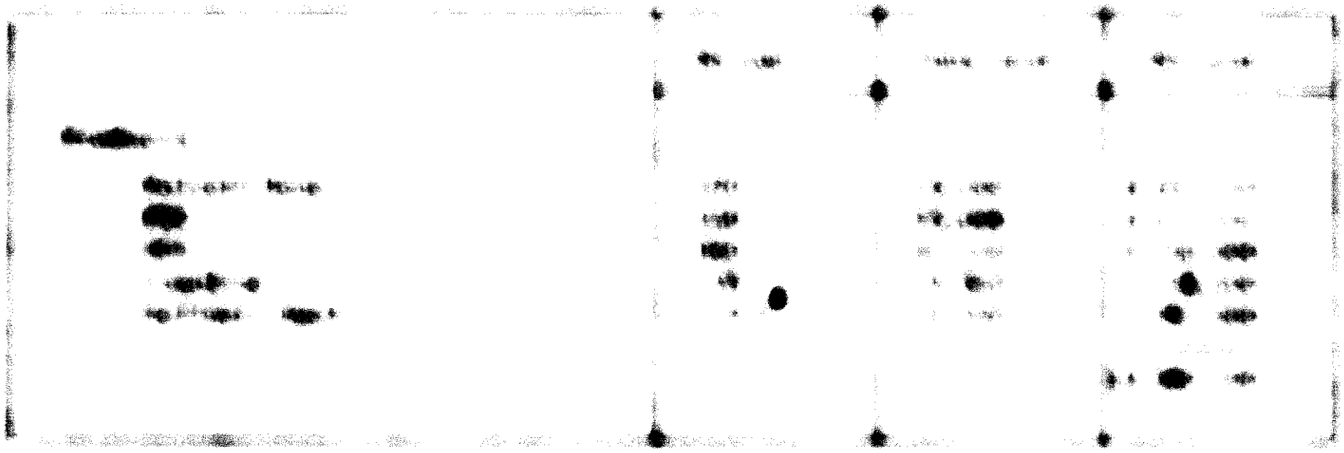

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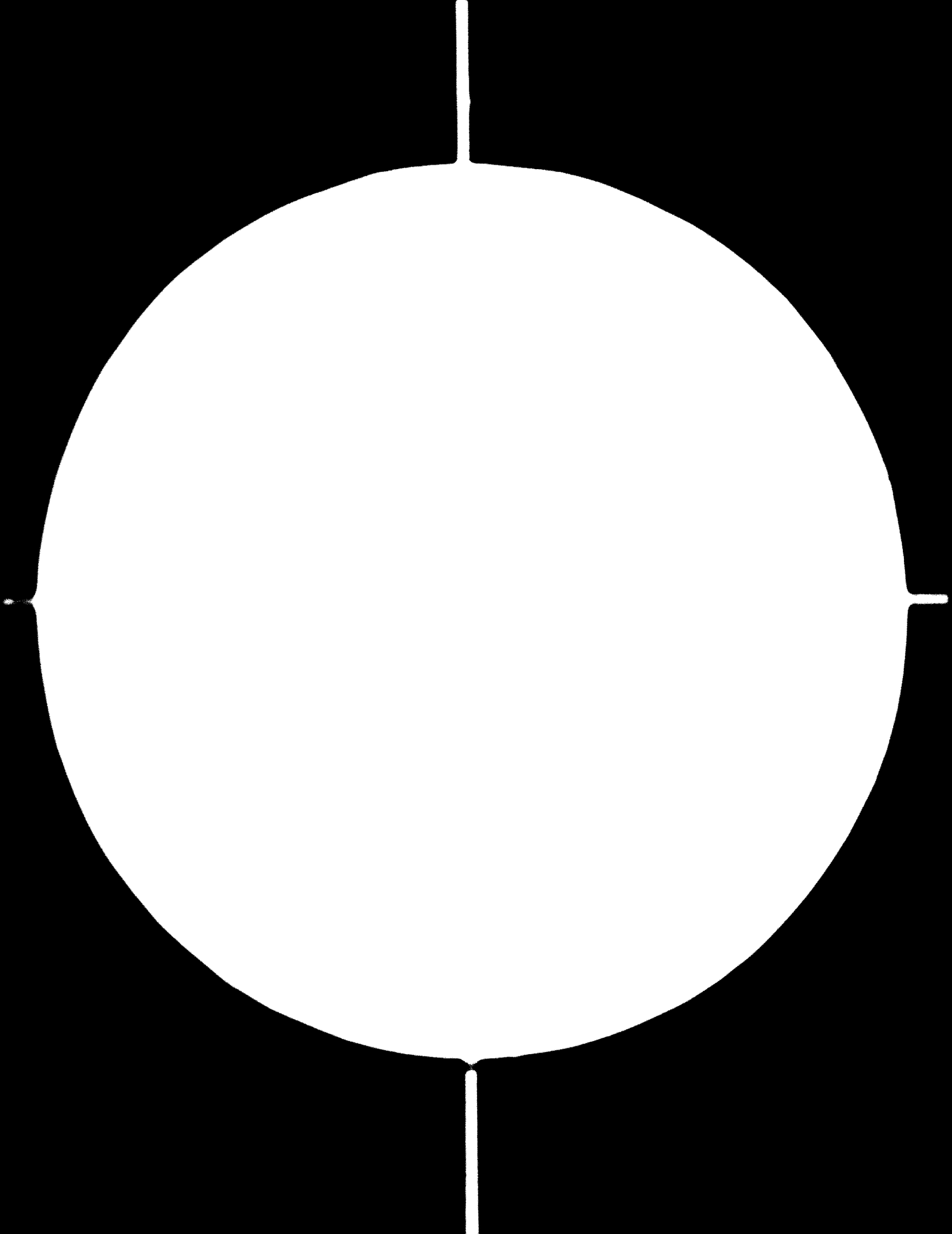


COMPLEX A - PLASTIC AND DETERGENT BASED COMPLEX

Table 12

Estimated operating cost

(US$/year)

Variable charges		
. Utilities	1,495,000	
. Labor	1,200,000	
. Catalysts and chemicals	533,000	
. Miscellaneous	50,000	
Total variable charges		3,278,000
Fixed charges		
. Amortization at 10% of investment	3,637,000	
. Interest at 4% of investment	1,450,000	
. Maintenance at 4% of process units and offsites	1,060,000	
. Interest on working capital at 8%	56,000	
. General plant overhead, taxes and insurance at 1% of investment	363,000	
Total fixed charges		6,566,000
Total operating cost		9,844,000
Estimated working capital		700,000

On the basis of : raw material consumption (benzene and chlorine) during 15 days production of finished products as (PE, PVC, DDB) during 15 days: cost of variable charges during one month.

COMPLEX A - PLASTIC AND DETERGENT BASED COMPLEX

Table 13

Estimated investment profitability

	US$
Credit	
Product sales (see table 11)	12,580,400
Debit	
Operating cost (see table 12)	9,844,000
Raw material cost (see table 11)	2,095,000
Manufacturing cost	11,939,000
Profitability	
Benefits▲ before taxes	641,400
Benefits after taxes at 50%	320,700
Amortization provides	3,637,000
Benefits after taxes plus amortization	3,957,700
Return on capital	11 %
Pay-out time on total investment	9.2 years

▲. calculated as credit less manufacturing cost

Complex A_1 Plastic and Detergent based complex producing

- 30,000 MT/year of PE
- 30,000 MT/year of PVC
- 20,000 MT/year of DDB

a. **Brief description**

The general operation of the plant is illustrated in Figure 2 hereafter with the material balance of the different units.

- raw material : propane
- possible locations : Algeria or UAR
  Syria or Irak

  to supply 1975 North Africa and North East Africa markets and 1975 Middle East Arab Countries markets

- possible locations : Algeria
  UAR
  Syria
  Irak

  to supply corresponding 1980 sub-regions markets and partly neighbouring countries

- end-products will be respectively manufactured in the various countries of the sub-regions

b. **Technical and economic data**

Detailed basic calculations required by the feasibility study are given in the following tables 1, 2, 3, 4 and 5.

c. **Investment**

Estimated investment costs for the overall complex are shown with the Table 6 hereafter.

d. **Operating cost and profitability**

Estimated operating cost and profitability calculations are presented in the tables 7, 8 and 9 hereafter.

e. **Effect of feed-stock price**

The effect of propane value on profitability of the project is illustrated in Figure 3 hereafter.

Fig. 2 **CONFIG A1** Manufacturing Scheme & Material Balance (tons/year)

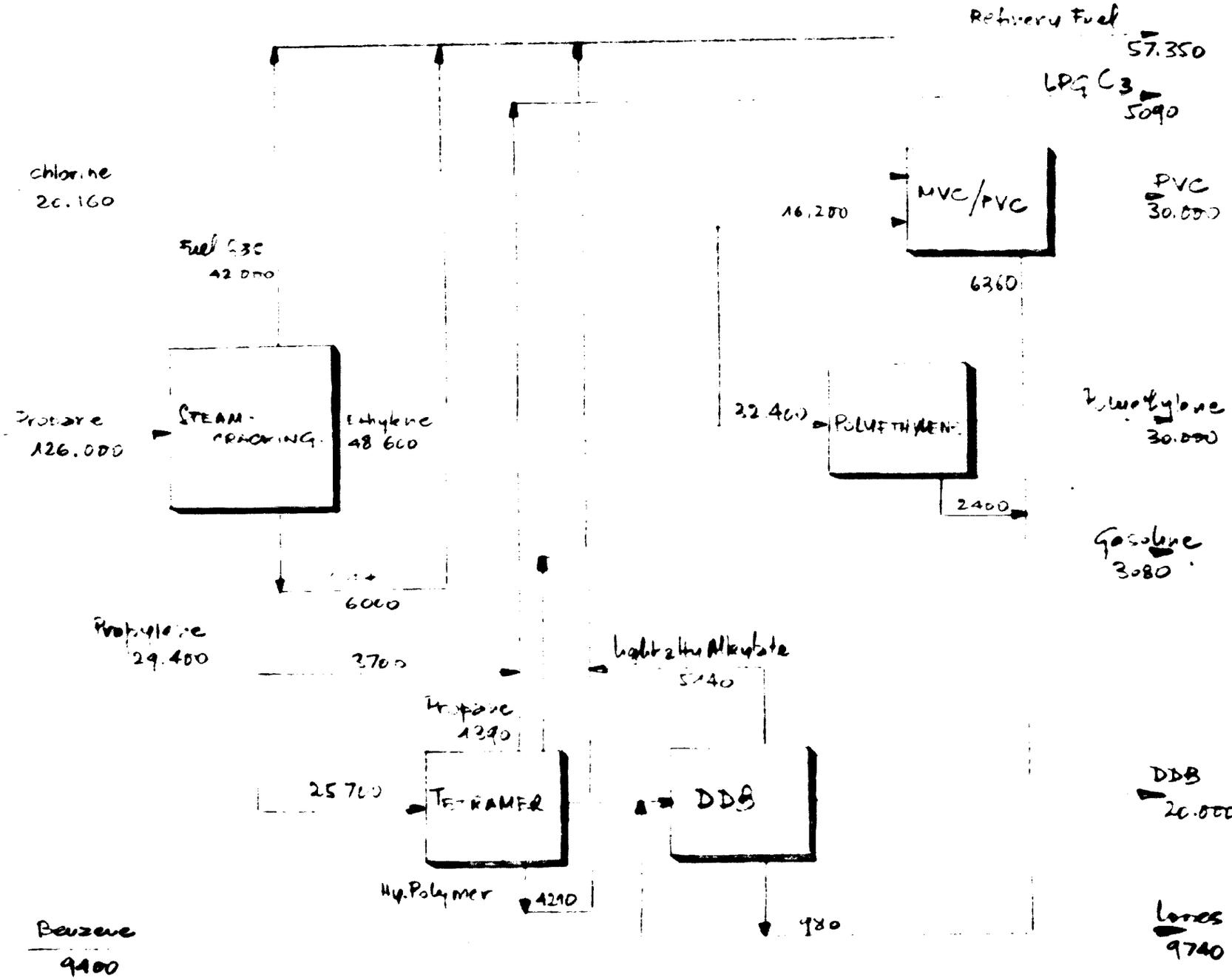
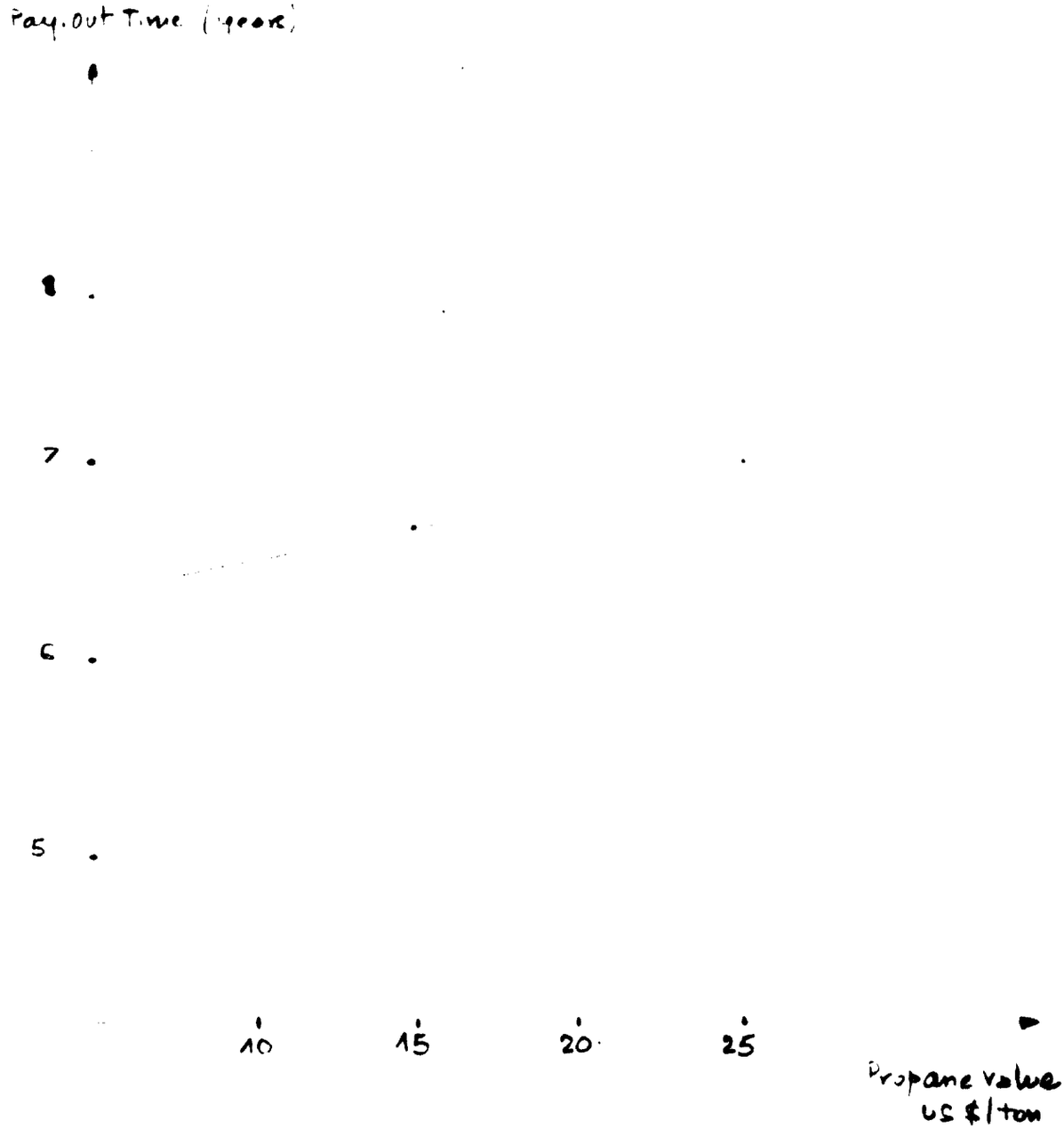


Fig. 3 COMPLEX Aa : Effect of feed stock price on profitability.



COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

producing :

- 30,000 MT/year of polyethylene
- 30,000 MT/year of polyvinylchloride
- 20,000 MT/year of dodecylbenzene

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 1
Estimated investment cost

	US$
Process Units	
Propane steam-cracking	7,900,000
Polyethylene	9,000,000
MVC unit	6,900,000
PVC unit	2,500,000
Tetramer	1,400,000
Dodecylbenzene	1,200,000
Total Process Units (including engineering expenses)	28,900,000
Off-sites	12,100,000
Total investment cost	41,000,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 2

Utility consumption and annual cost

	Electricity kwh/hr	HP steam kg/hr	LP steam kg/hr	Water m^3/hr	Fuel 10^6 kcal/hr
Process Units	26,540	38,074	15,800	5,622	62.0
Off-sites	2,260	-	14,060	1,178	52.0
Total consumption	28,800	38,074	29,860	6,800	114.0

Annual cost of utilities :

	US$/year
Electricity 28,800 x 7920 hr x 0,01 US$/kwh	2,280,000
Fuel 114.0 x 10^6 kcal/hr x 7920 hr x 0.7 US$/$10^6$ kcal	630,000
Demineralised water 41 m^3/hr x 7920 hr x 0.25 US$/$m^3$	80,000
Total	2,990,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 3

Manpower requirements and annual cost

	Administ.	Engineers	Foremen	Chief Operator	Operator	Chemist & skilled pers.	Helpers	Total
Salaries								
US$	12,000	10,000	8,000	6,000	5,000	4,000	2,000	
Men/day	-	2	1	-	-	2	7	12
US$		20,000	8,000			8,000	14,000	50,000
Men/shift								
Process units			3	5	25	-	-	
Off-sites			-	-	8	5	5	
Total men/shift			3	5	31	5	5	49
Total men/year			13	22	140	23	23	221
US$/year			104,000	132,000	700,000	92,000	46,000	1,074,000
Total	Men/year						233	
	US$/year						1,124,000	
	Technical assistance and cost of training estimated at						276,000	
							1,400,000	

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 4

Estimated initial charge and annual consumption

	Initial charge US$	Yearly consumption US$
Process Units		
Steam-cracking	100,000	40,000
Polyethylene		640,000
MVC		80,000
PVC		220,000
Tetramer	22,000	60,000
Dodecylbenzene		16,000
Chemical products		10,000
Total	122,000	1,066,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 5

Estimated royalty cost

(including know-how fee)

	US$
Process Units	
Steam-cracking	300,000
Polyethylène	3,000,000
MVC and PVC	1,000,000
Tetramer and DDB	450,000
Total	4,750,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 6

Estimated total investment

	US$
Total investment cost (ref. table 1)	41,000,000
Royalties (ref. table 5)	4,750,000
Start-up expenses	2,500,000
Contingencies	4,500,000
Total investment (to be amortised)	52,750,000
Initial charge of catalysts and chemicals (ref. table 4)	122,000
Additional charge of catalyst and chemicals	122,000
Spare parts	600,000
Estimated total investment	53,594,000
Estimated working capital (see table)	1,400,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 7

Estimated product sales

	US$/ton	Tons/year	US$/year
Products			
Polyethylene	370	30,000	11,000,000
PVC	340	30,000	10,200,000
HDB	160	20,000	3,200,000
Gasoline	25	3,000	76,800
Refinery fuel[a]	0,7	62,440	384,000
Total product sales			25,160,000

a. 0.7 US$/$10^6$ kcal
Fuel refinery heat value estimated at $13.4.10^6$ kcal/ton

Estimated raw material cost

	Unit cost	Tons/year	US$/year
Raw materials			
Propane	15	126,000	1,890,000
Chlorine	75	20,160	1,620,000
Benzene	75	9,100	680,000
			4,190,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 8

Estimated operating cost

(US$/year)

Variable charges		
. Utilities	2,990,000	
. Labor	1,400,000	
. Catalyst and chemicals	1,066,000	
. Miscellaneous	100,000	
Total variable charges		5,556,000
Fixed charges		
. Amortization at 10% of investment	3,275,000	
. Interest at 4% of investment	2,110,000	
. Maintenance at 4% of Process Units and Offsites	1,640,000	
. Interest on working capital at 8%	112,000	
. General plant overhead, taxes and insurance at 1% of investment	527,000	
Total fixed charges		9,664,300
Total operating cost		15,220,300
Estimated working capital		1,400,000

COMPLEX A_1 - PLASTIC AND DETERGENT BASED COMPLEX

Table 9

Estimated investment profitability

	US$/year
Credit	
Product sales (see table 7)	25,160,800
Debit	
Operating cost (see table)	15,220,500
Raw material cost (see table)	4,190,000
Manufacturing cost	19,410,500
Profitability	
Benefits* before taxes	5,750,300
Benefits after taxes at 50%	2,875,150
Amortisation provides	5,275,000
Benefits after taxes plus amortisation	8,150,000
Return on capital	15.2 %
Pay-out time on total investment	6.6 years

*. calculated as credit less manufacturing cost

Complex B Plastic and Detergent based complex producing :

1. Basic products : 80,000 MT/year of ethylene and propylene

2. Monomers and polymers as follows :

Complex B_1 producing :

. 30,000 MT/year of PE
. 30,000 MT/year of PVC
. 20,000 MT/year of DDB

1. From : Ethane propane cut as feed-stock

a. Brief description

The general operation of the plant is illustrated in Figure 4 hereafter with the material balance of the different units:

. raw material : ethane propane mixed cut
. possible locations and markets supplied : see Complex A_1 with excess ethylene to be exported to Arab Countries or to possible buyers
. end-products will be respectively manufactured in the different countries

b. Investment

Estimated investment cost for the overall complex is shown with the table 1 hereafter.

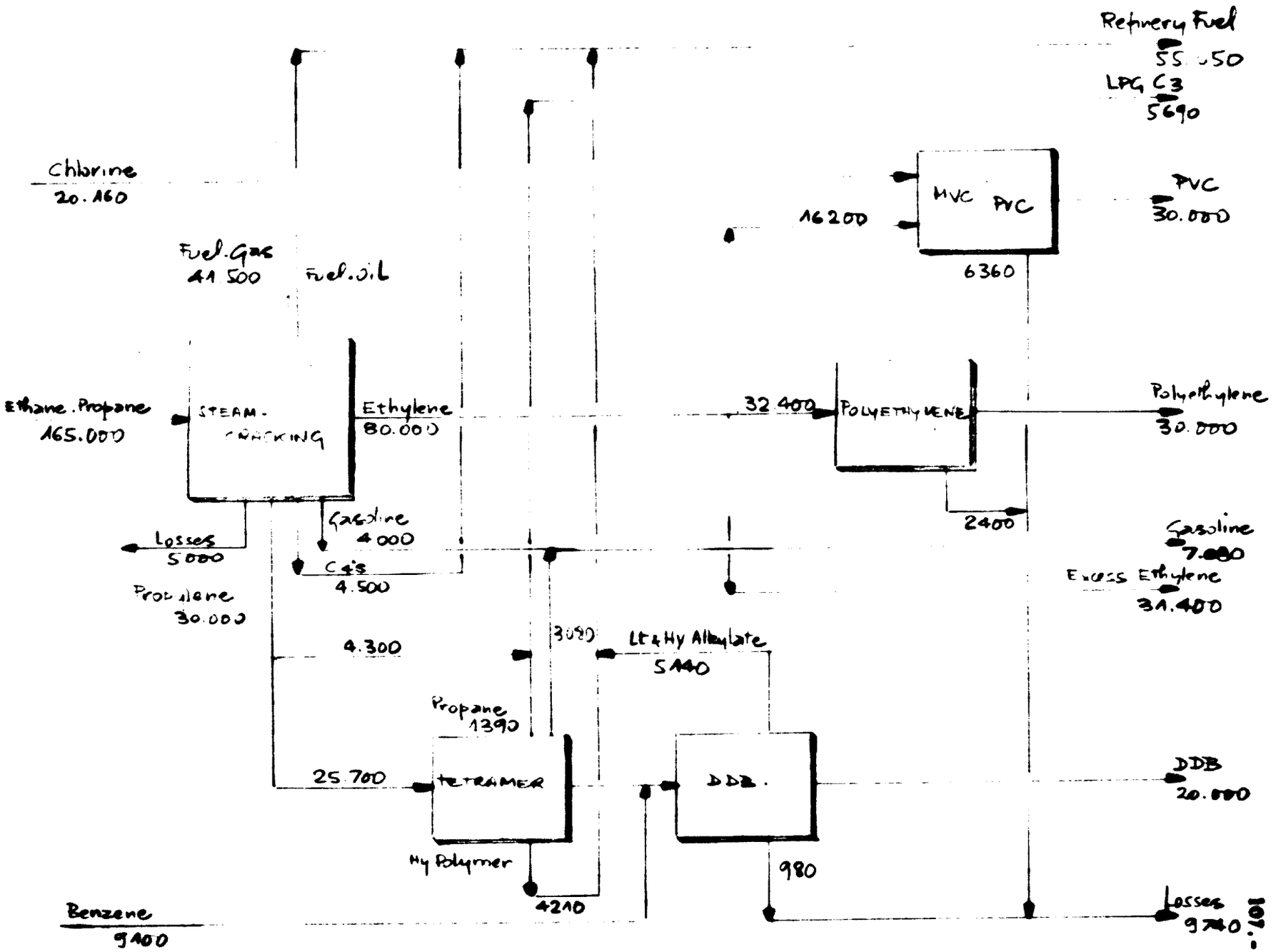
c. Operating cost and profitability

Estimated operating cost and profitability calculations are presented in the following tables 2, 3 and 4.

d. Effect of feed-stock and exported ethylene prices on profitability

The effect of ethane propane mixed charge value and exported ethylene price are respectively shown with the figures 5 and 6.

Fig. 4 COMPLEX B1: Manufacturing Scheme & Material Balance
(Ethane. Propane Steam-Cracking)



COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

producing :

- 30,000 MT/year of polyethylene
- 30,000 MT/year of polyvinylchloride
- 20,000 MT/year of dodecylbenzene

(feed-stock : ethane-propane cut)

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(ethane-propane feed-stock)

Table 1

Estimated Investment Cost

	US$
Process Units	
Ethane - Propane steam-cracking	10,100,000
Polyethylene	9,000,000
MVC unit	6,900,000
PVC unit	2,500,000
Tetramer	1,400,000
Dodecylbenzene	1,200,000
Total Process Units	31,100,000
Off-sites	13,500,000
Royalties	4,750,000
Start-up expenses	3,000,000
Contingencies	4,000,000
Total Investment	56,350,000
Estimated working capital	1,700,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(ethane propane feed-stock)

Table 2

Estimated Product Sales

	Unit Cost US$/ton	Tons/year	US$/year
Products			
Polyethylene	370	30,000	11,100,000
PVC	340	30,000	10,200,000
Dodecylbenzene	160	20,000	3,200,000
Ethylene	70	31,400	2,200,000
Gasoline	25	7,080	176,000
C_3 LPG	20	5,690	113,800
Refinery fuel[a]	0.7	55,350	520,000
Total Product Sales			27,309,800

a. 0.7 US$/$10^6$kcal

Estimated Raw Material Cost

	Unit Cost US$/ton	Tons/year	US$/year
Raw Materials			
Ethane Propane	15	165,000	2,470,000
Chlorine	75	20,160	1,620,000
Benzene	75	9,100	680,000
			4,770,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(ethane propane feed-stock)

Table 3

Estimated Operating Cost

	US$/year
Variable Charges	
. Utilities	3,200,000
. Labor	1,500,000
. Catalyst and chemicals	1,100,000
. Miscellaneous	100,000
Total Variable Charges	5,900,000
Fixed Charges	
. Amortization at 10% of investment	5,635,000
. Interest at 4% of investment	2,250,000
. Maintenance at 4% of Process Units + Offsites	1,750,000
. Interest on working capital at 8%	136,000
. General plant overhead, taxes and insurance at 1% of investment	563,000
Total Fixed Charges	10,334,000
Total Operating Cost	16,234,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(ethane propane feed-stock)

Table 4

Estimated Investment Profitability

	US$/year
Credit	
Product Sales (see table 2)	27,309,800
Debit	
Operating cost (see table 3)	16,234,000
Raw material cost (see table 2)	4,770,000
	21,004,000
Profitability	
Benefits before taxes	6,305,000
Benefits after taxes at 50%	3,252,000
Amortisation provides	5,635,000
Benefits after taxes plus amortisation	8,887,000
Pay-out time on total investment	6.3 years

Fig 5 COMPLEX B1 : Effect of [illegible] on profitability

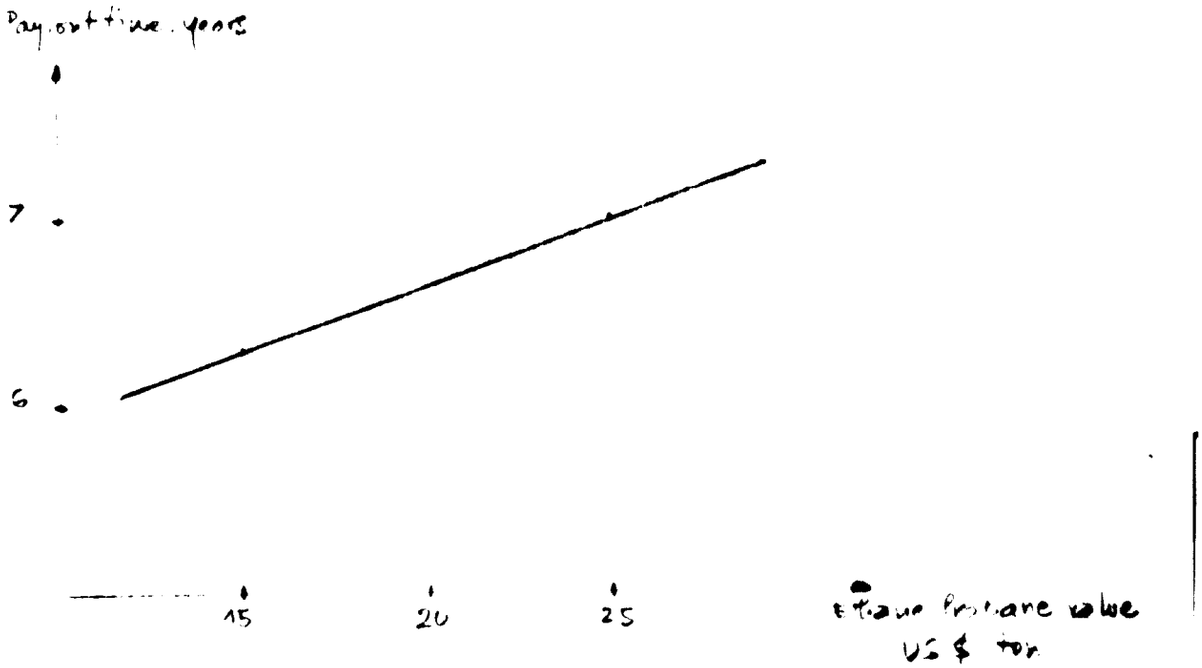
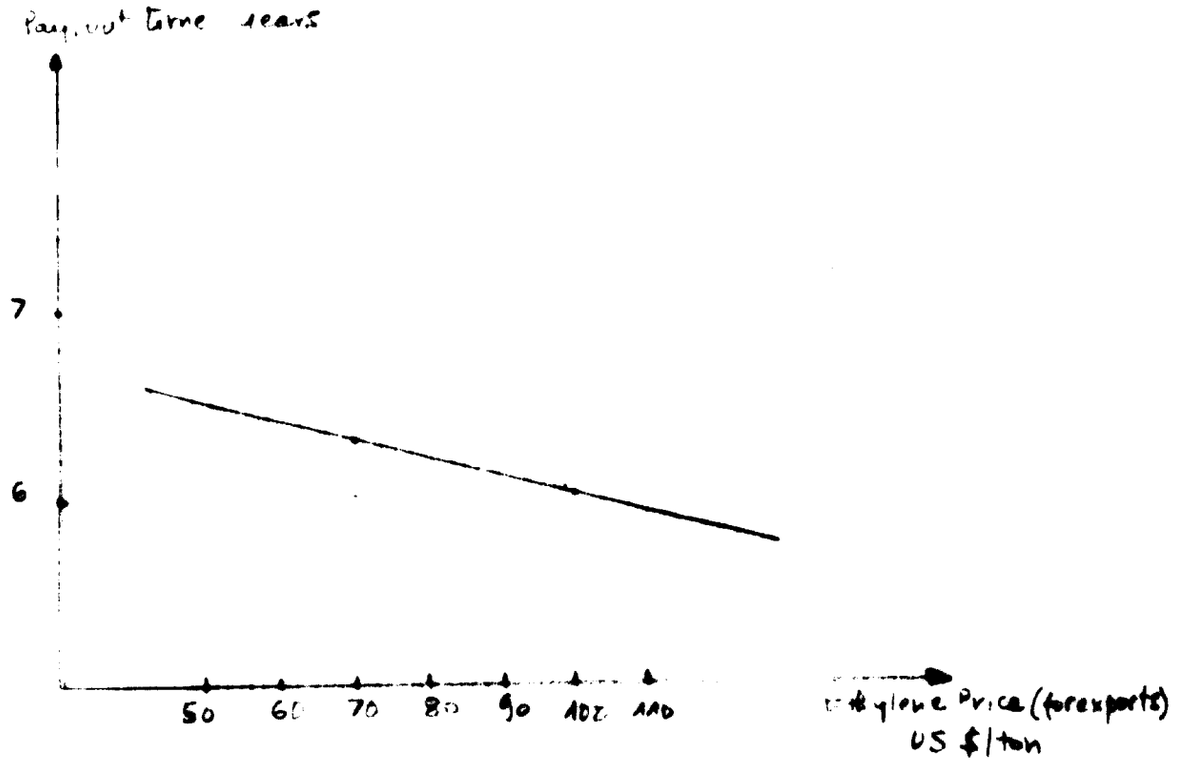


Fig. 6 COMPLEX B1 Effect of escalated ethylene price on profitability



2. from : Naphtha as feed-stock

c. Brief description

The manufacturing scheme of plant is illustrated in figure 7 hereaveve with the material balance of the different units :

. raw material : naphtha
. possible locations and markets supplied : see Complex B based on ethane propane charge
. end-products will be respectively manufactured in the different countries of the sub-region

b. Investment

Estimated investment cost for the overall complex is shown in the table 1 hereafter.

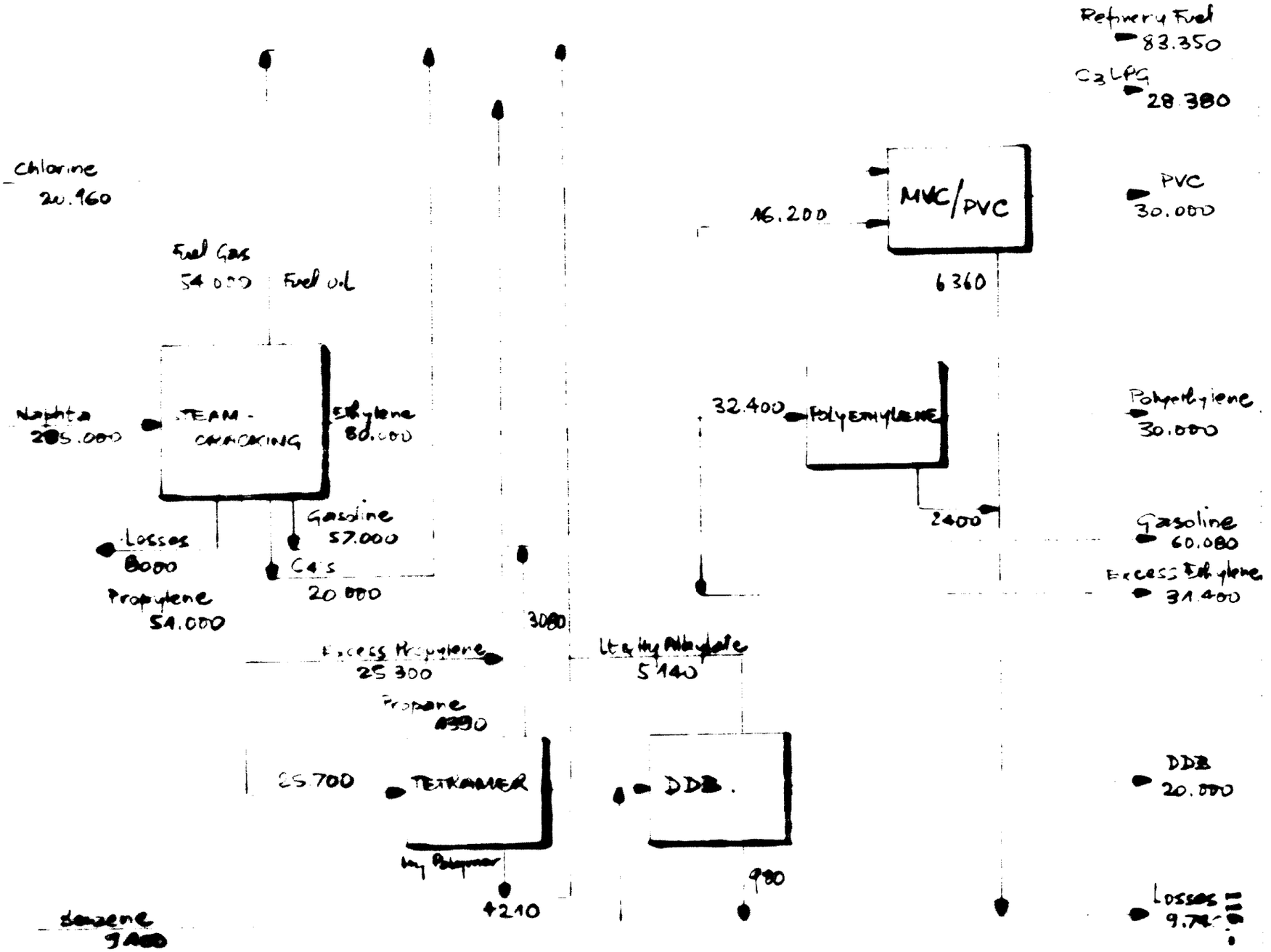
c. Operating cost and profitability

Estimated operating cost and profitability calculations are presented in the following tables 2, 3 and 4.

d. Effect of the feed-stock and exported ethylene prices

The effect of naphtha value and exported ethylene price are respectively shown with the figures 8 and 9.

Fig. 7 Case B1 Manufacturing process & Material balance
(Nafta Steam Cracking)



COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

producing :

- 30,000 MT/year of polyethylene
- 30,000 MT/year of polyvinylchloride
- 20,000 MT/year of dodecylbenzene

(feed-stock : naphtha)

[redacted] - PLASTIC AND FERTILIZER BASED COMPLEX

(naphtha feed-stock)

Table 1

[redacted]

	US$
Process Units	
Naphtha steam-cracking	11,000,000
Polyethylene	9,000,000
[redacted] unit	6,000,000
[redacted] unit	2,500,000
Reformer	1,600,000
[redacted]	1,200,000
Total Process Units	31,000,000
Off-sites	14,000,000
Royalties	4,750,000
Start-up expenses	3,000,000
Contingencies	4,250,000
Total Investment	57,000,000
Estimated Working Capital	1,700,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(naphtha feed-stock)

Table 2

Estimated Product Sales

	Unit Cost US$/ton	Tons/year	US$/year
Products			
Polyethylene	370	30,000	11,100,000
PVC	340	30,000	10,200,000
DDB	160	20,000	3,200,000
Ethylene	70	31,400	2,200,000
Gasoline	25	60,000	1,520,000
C_3 LPG	20	28,380	570,000
Refinery fuel[a]	0.7	85,390	780,000
Total Product Sales			29,570,000

a. 0.7 US$/$10^6$kcal - Fuel refinery heat value estimated at 13.4.10^6kcal/ton

Estimated Raw Material Cost

	Unit Cost US$/year	Tons/year	US$/year
Raw Materials			
Naphtha	10	288,000	3,140,000
Chlorine	75	20,100	1,620,000
Benzene	75	9,100	680,000
Total Raw Material Cost			7,440,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(naphtha feed-stock)

Table 3

Estimated Operating Cost

	US$/year	
Variable Charges		
. Utilities	3,400,000	
. Labor	1,500,000	
. Catalysts and chemicals	1,100,000	
. Miscellaneous	100,000	
Total Variable Charges		6,100,000
Fixed Charges		
. Amortization at 10% of investment	5,795,000	
. Interest at 4%	2,310,000	
. Maintenance at 4% of Process Units + Offsites	1,810,000	
. Interest on working capital at 8%	136,000	
. General plant overhead, taxes and insurance at 1%	579,000	
Total Fixed Charges		10,630,000
Total Operating Cost		16,730,000

COMPLEX B_1 - PLASTIC AND DETERGENT BASED COMPLEX

(naphtha feed-stock)

Table 4

Estimated Investment Profitability

	US$/year
Credit	
Product Sales (see table 2)	29,570,000
Debit	
Operating cost (see table 3)	16,730,000
Raw material cost (see table 2)	7,440,000
Total Debit	24,170,000
Profitability	
Benefits before taxes	5,400,000
Benefits after taxes at 50%	2,700,000
Amortization provides	5,795,000
Benefits after taxes plus amortization	8,495,000
Pay-out time on total investment	7 years

Fig. 8 COMPLEX B1 : Effect of feed stock price on profitability

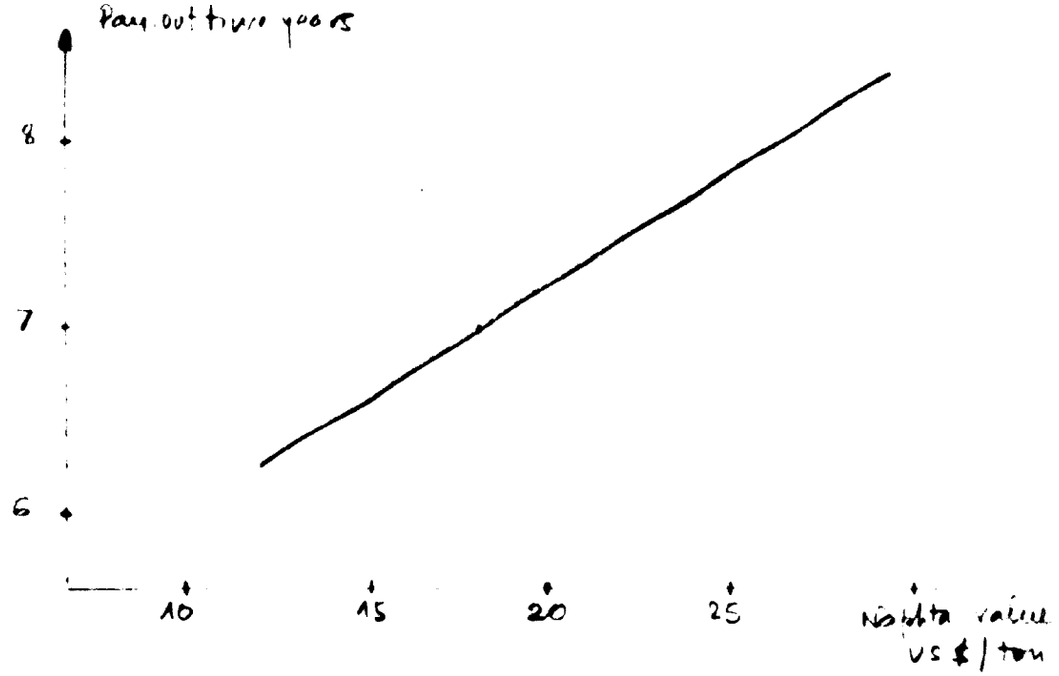
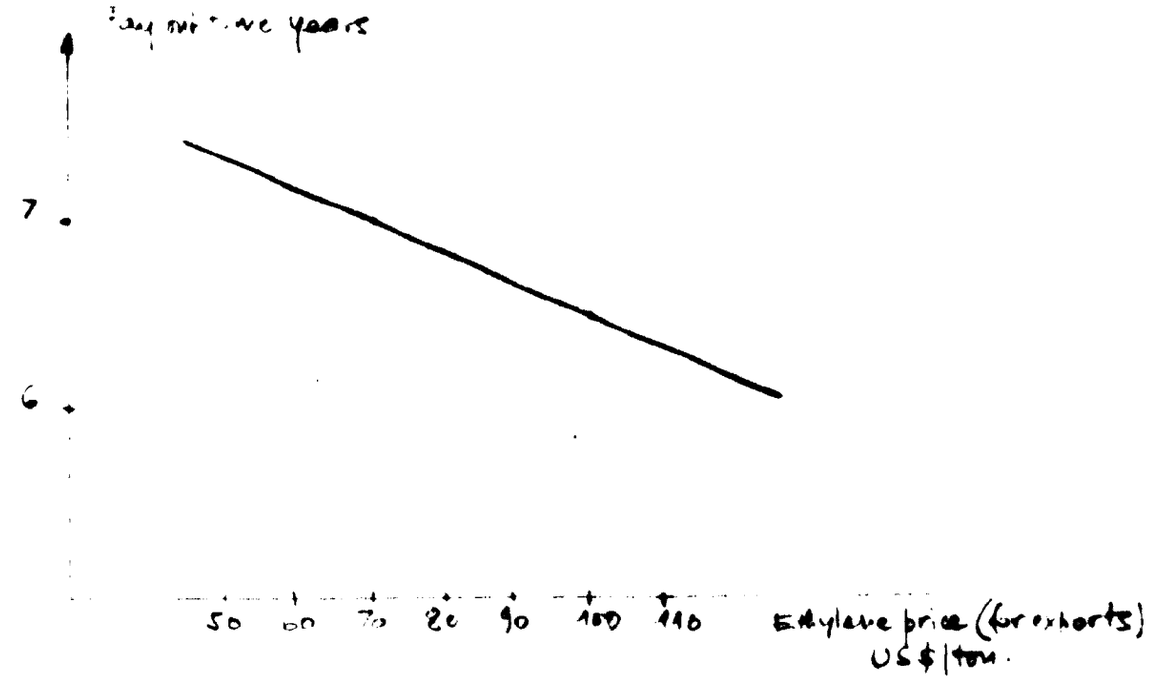


Fig 9. COMPLEX B1 Effect of ethylene price on profitability



Complex B_2 producing :

- 30,000 MT/year of PE
- 30,000 MT/year of PVC
- 20,000 MT/year of DDB

a. Brief description

The manufacturing scheme of the plant is illustrated in Figure 10 hereafter with the relevant material balance of the different units.

- raw material : naphtha and mixed ethane propane cuts
- possible locations : Algeria or UAR
  Irak or Syria
- to supply 1980 North Africa and North East Africa markets and 1980 Middle East Arab Countries markets.
- end-products will be respectively manufactured in the different countries of the sub-regions.

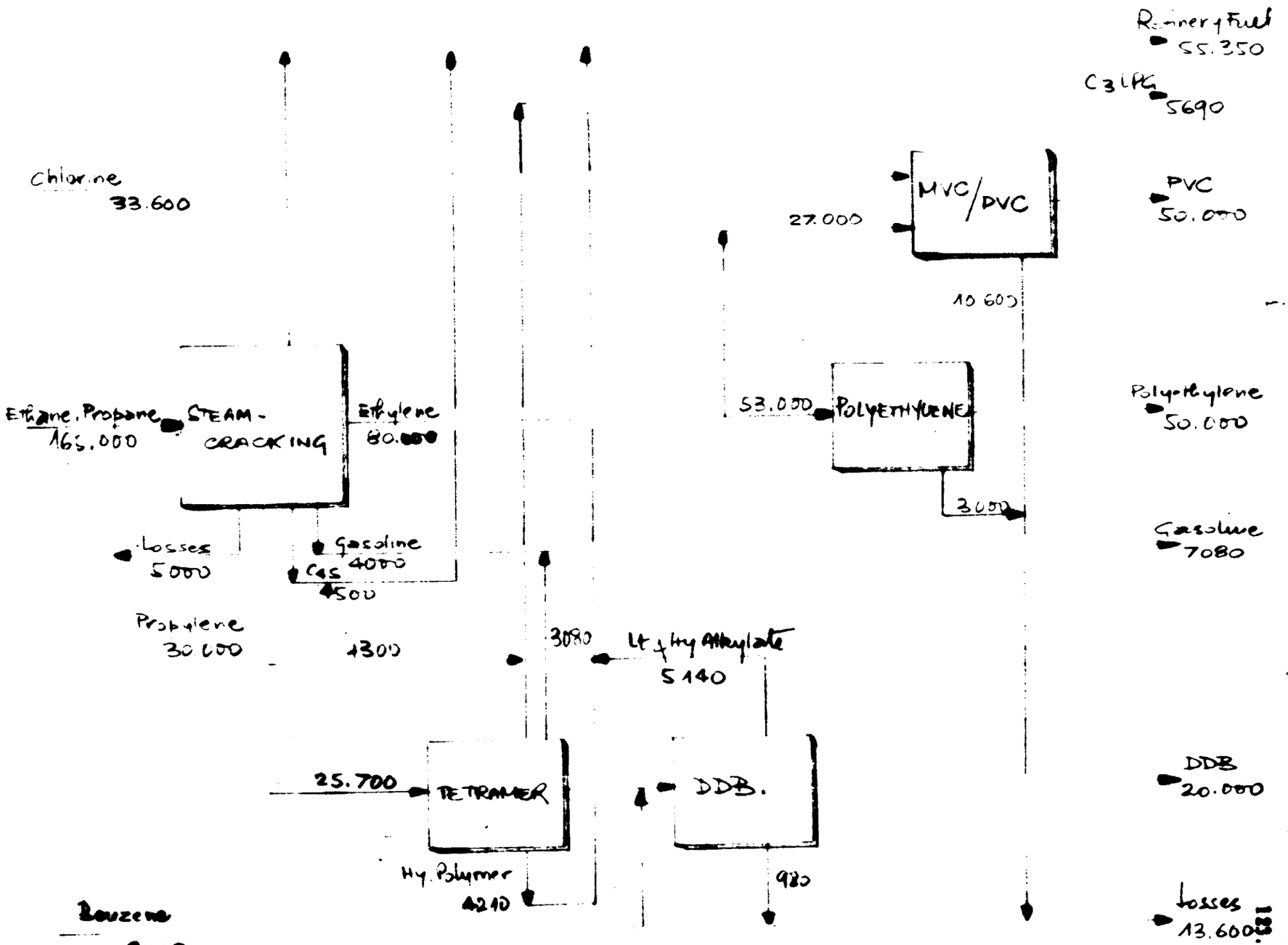
b. Investment

Estimated investment cost for the overall complex is shown in the table 1 hereafter.

c. Operating cost and profitability

Estimated operating cost and profitability calculations are presented in the following tables 2, 3 and 4.

Fig. 10 CHEM x B2. Manufacturing Scheme & Material Balance
(Ethane & Propane Steam Cracking)



COMPLEX B_2 - PLASTIC AND DETERGENT BASED COMPLEX

producing :

- 50,000 MT/year of polyethylene
- 50,000 MT/year of polyvinylchloride
- 20,000 MT/year of dodecylbenzene

(feed-stock : ethane propane cut)

COMPLEX B_2 - PLASTIC AND DETERGENT BASED COMPLEX

Table 1

Estimated Investment Cost

	US$
Process Units	
Ethane Propane steam-cracking	10,100,000
Polyethylene unit	14,000,000
MVC unit	10,200,000
PVC unit	4,100,000
Tetramer	1,400,000
DDB	1,200,000
Total Process Units	41,000,000
Offsites	17,000,000
Royalties	6,000,000
Start-up expenses	4,000,000
Contingencies	5,000,000
Total Investment	73,000,000
Working Capital	2,800,000

COMPLEX B_2 - PLASTIC AND DETERGENT BASED COMPLEX

Table 2

Estimated Product Sales

	US$/ton	Tons/year	US$/year
Products			
Polyethylene	370	50,000	18,500,000
PVC	340	50,000	17,000,000
Dodecylbenzene	160	20,000	3,200,000
Gasoline	25	7,080	176,000
C_3 LPG	20	5,690	113,000
Refinery fuel	0.7	55,350	520,000
Total Product Sales			39,509,000

Estimated Raw Material Cost

	US$/ton	Tons/year	US$/year
Raw Materials			
Ethane Propane	15	165,000	2,470,000
Chlorine	75	20,160	1,620,000
Benzene	75	9,100	680,000
			4,770,000

COMPLEX B_2 - PLASTIC AND DETERGENT BASED COMPLEX

Table 3
Estimated Operating Cost

	US$/year
Variable Charges	
. Utilities	4,500,000
. Labor	2,100,000
. Catalysts and chemicals	2,000,000
. Miscellaneous	200,000
Total Variable Charges	8,800,000
Fixed Charges	
. Amortization at 10% of investment	7,300,000
. Interest at 4% of investment	2,920,000
. Maintenance at 4% of Process Units + Offsites	2,320,000
. Interest on working capital at 8%	224,000
. General plant overhead, taxes and insurance at 1% of investment	730,000
Total Fixed Charges	13,494,000
Total Operating Cost	22,294,000

COMPLEX B_2 - PLASTIC AND DETERGENT BASED COMPLEX

Table 4

Estimated Investment Profitability

	US$/year
Credit	
Product Sales (see table 2)	39,509,000
Debit	
Operating Cost (see table 3)	22,894,000
Raw material cost (see table 2)	4,770,000
Total Debit	
Profitability	
Benefits before taxes	12,445,000
Benefits after taxes at 50%	6,223,000
Amortization provided	7,300,000
Benefits after taxes plus amortization	13,523,000
Pay-out time on total investment	5.4 years

Example 6 150.000 and 300.000 MT/year ethylene production by ethane steam-cracking

a. Brief description

That production is intended to supply ethylene :

. for its derivatives as : polyethylene and PVC to be produced for the local market
. for exports to consuming countries

These ethane steam cracking plants should be located closely or integrated with large capacity LNG plant under construction or under planning stage from which ethane could be recovered at low cost and in sufficient quantities.

Possible locations are : Libya, Algeria and Middle East Arab Countries where LNG plants are foreseen.

b. Economics

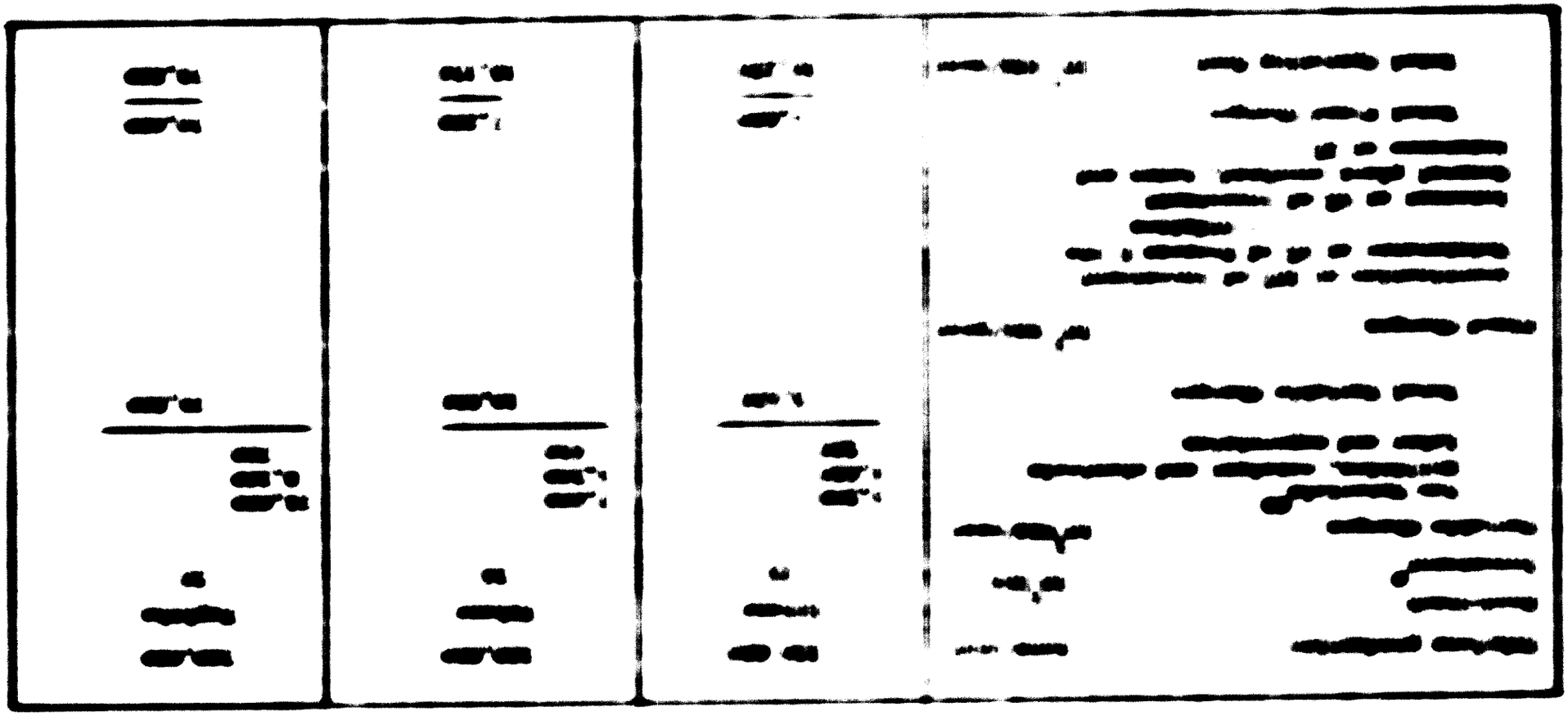
Elements of operating cost, investment cost, estimated manufacturing cost and ethylene selling prices are summarized in the tables 1 and 2.

The economies that large steam cracking has to offer is presented in the table 3.

The economics of such a project is compared to the production of ethylene by naphtha steam-cracking in units already existing or planned in big ethylene consuming areas.

[redacted]

[redacted]



[redacted]

[redacted]

[redacted]

[redacted]				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]		[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

VI.2.2. Complex based on aromatic production and their derivatives

Complex [illegible] Aromatic based complex producing :

. 45,000 MT/year of benzene
. 19,500 MT/year of P-xylene
. 17 000 MT/year of O-xylene

a. Brief description

The manufacturing scheme of the plant integrated in an existing or projected refinery is illustrated in Figure 11 hereafter with the material balance of the different units.

. raw material : gasoline cuts or reformate supplied by refineries processing Algerian or Libyan crude oils

. possible locations : Algeria or Libya

. markets : to supply major part of the aromatic demand in Arab Countries for 1975

b. Yields and consumption

Estimated yields, material balance are shown with the following tables 1, 2 and 3.

c. Investment

Estimated investment cost including royalties and initial catalyst cost are given in the tables 4, 7, 8 and 9.

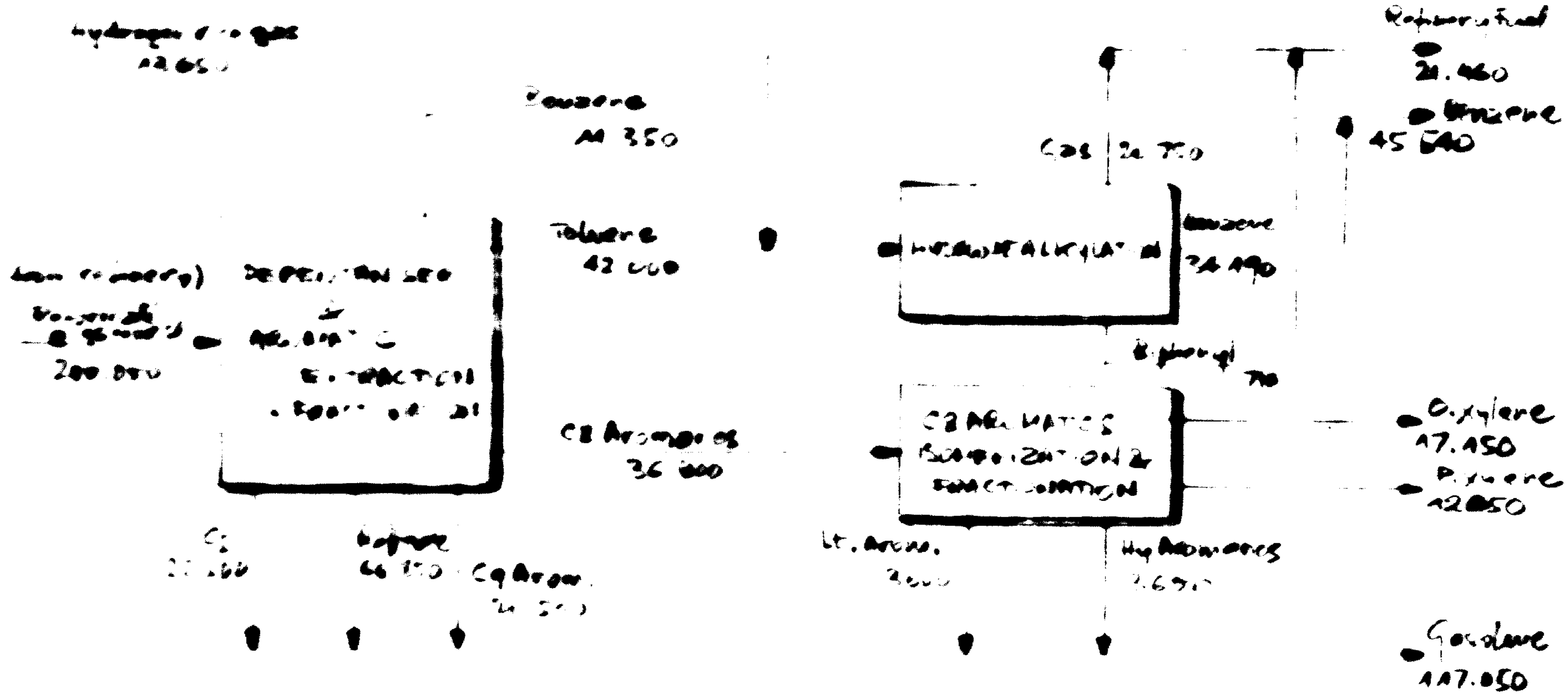
d. Operating requirements

Estimated utility, catalyst and chemicals, labor requirements are set forth in the tables 5, 6 and 7.

e. Operating cost and profitability

Estimated operating cost and profitability calculations are presented in the tables 10, 11 and 12.

Fig. 10 CASE D Aromatics ... Material Balance (tons/year)



COMPLEX D - AROMATIC BASED COMPLEX

COMPLEX D - AROMATIC BASED COMPLEX

Table 1

Aromatic extraction - Material balance

	% wt	Tons/year
Feed-Stock		
Reformate C_5^+	100.0	200,000
Benzene	5.7	11,400
Toluene	21.4	42,800
C_8 aromatics	20.9	41,800
C_9 aromatics	17.1	34,000
Total aromatics	65.1	130,200
Products		
Benzene		11,390
Toluene		42,000
C_8 aromatics		36,800
C_9 aromatics		20,500
Total aromatics (a)		110,690
Raffinate (included pentanes)		89,390
Total		200,000

a. % aromatic recovery

Benzene	99.5 %
Toluene	98 %
C_8 aromatics	88 %
C_9 aromatics	60 %

COMPLEX D - AROMATIC BASED COMPLEX

Table 2

Toluene Hydrodealkylation

Material Balance

	% wt	Tons/year
Feed-Stock		
Toluene from aromatic extraction	100	42,000
H_2 rich gas from catalytic reforming[a]	32.5	13,650
Total	132.5	55,650
Products		
Fuel-gas	49.4	20,790
Benzene	81.4	34,190
Biphenyl	1.7	710
Total	132.5	55,690

a. Absorber-stripper has to be planned in the hydrodealkylation unit to increase the H_2 content in the gases coming from catalytic reforming

COMPLEX D - AROMATIC BASED COMPLEX

Table 3

Fractionation and Isomerisation of C_8 Aromatics

Material Balance

	% wt	Tons/year
Feed-Stock		
C_8 aromatics from aromatic extraction	100.0	36,000
Ethylbenzene	20	7,360
Ortho-xylene	16	5,900
Meta-xylene	45	16,240
Para-xylene	19	7,000
Products		
Ortho-xylene	46.6	17,150
Para-xylene	33.8	12,490
Light aromatics	9.8	3,600
Heavy aromatics	9.8	3,600
Total	100.0	36,800

COMPLEX A - AROMATIC BASED COMPLEX

Table 4
Estimated Investment Cost

	US$
Process Units	
Depentaniser	300,000
Aromatic extraction	1,800,000
Toluene hydrodealkylation	1,400,000
Absorber-stripper	180,000
Ortho-xylene fractionator	900,000
P-xylene cristallisation	1,800,000
Isomerisation of C_8 aromatics	1,100,000
Total Process Units (engineering included)	7,480,000
Off-sites	3,000,000
Total investment cost	10,480,000

COMPLEX D - AROMATIC BASED COMPLEX

Table 5

Utility consumption and annual cost

	Electric Power kwh/hr	MP steam kg/hr	LP steam kg/hr	Cooling Water m^3/hr	Fuel 10^6 kcal/hr
Process Units					
Depentanizer	35			91	2.9
Aromatic extraction	135	13,450		377	
Hydrodealkylation	60	2,550		196	3.5
Absorber-stripper	30			26	0.6
O-xylene fractionator	300			41	13.0
P-xylene cristallization	600	200	600	150	
Isomerization of aromatics	115			44	5.8
Total Process Units	1,445	16,200	600	925	25.8
Off-sites	525		3,510	200	15.6
Total Consumption	1,970	16,200	4,190	1,125	41.4

Annual cost of utilities	US$/year
Electric power 1,970 kwh/hr x 7920 hr/year x 0.01 US$/kwh	156,000
Fuel 41.4 10^6 kcal/hr x 7920 hr/year x 0.7 US$/$10^6$ kcal	230,000
Demineralized water 18.2 m^3/hr x 7920 hr/year x 0.25 US$/$m^3$	24,000
Total	410,000

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Table 6

[illegible]

	Administr.	Engineers	Foremen	Chief Operator	Operator	Chemist & skilled pers.	Helpers	Total
Salaries								
PHP/year	12,000	10,000	8,000	6,000	5,000	4,000	2,000	
Man/day		2			2	6	4	14
PHP/year		20,000			10,000	24,000	8,000	62,000
Man/shift								
Persons under supervision			1	3	10			14
Additional					5	7	2	14
Total man/shift			1	3	15	7	2	28
Total man/year			5	14	68	32	9	128
PHP/year			40,000	84,000	340,000	128,000	36,000	628,000
Grand total	Man/year							142
	PHP/year							672,000
	Technical assistance and cost of training estimated at							178,000
	Total labor cost PHP/year							850,000

COMPLEX B - AROMATIC BASED COMPLEX

Table 1

Catalysts and Chemicals

Estimated initial charge and annual consumption

	Initial Charge US$	Yearly Consumption US$
Aromatic extraction	[illegible]	[illegible]
Toluene hydrodealkylation	[illegible]	[illegible]
C_8 isomerization	[illegible]	[illegible]
Chemical products	-	[illegible]
Total cost of catalysts and chemicals	[illegible]	[illegible]

COMPLEX D - AROMATICS BASED COMPLEX

Table 8

Estimated annual costs

(including know-how fee)

	US$
Aromatic extraction	[illegible]
Toluene hydrodealkylation	[illegible]
C8-xylene fractionation	[illegible]
Para-xylene recrystallization	[illegible]
C_9 conversion	[illegible]
Total	1,[illegible]

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Complex [illegible], Aromatic based complex [illegible] :

. [illegible],000 MT/year of benzene
. [illegible],000 MT/year of P-xylene
. 30,000 MT/year of O-xylene

Integrated with a coking unit producing :

. [illegible],000 MT/year of electrode coke

a. **Brief description**

The manufacturing scheme of the different projected plants integrated in an existing or projected refinery is illustrated in Figure 12 hereafter, with the material balance of the different units

. raw material : gasoline cuts and low sulfur residuum supplied by refineries processing Algerian or Libyan crudes

. possible locations : Algeria or Libya

. to supply the aromatic demand in Arab Countries for 19[illegible] and to export the remaining products and electrode coke to European Countries where deficits will persist for the next years. In 19[illegible], such a complex might supply the whole aromatic demand in Arab Countries.

b. **Yields and production**

Estimated yields, material balances are shown with the following tables 1, 2, 3, 4, 5 and 6.

c. [redacted]

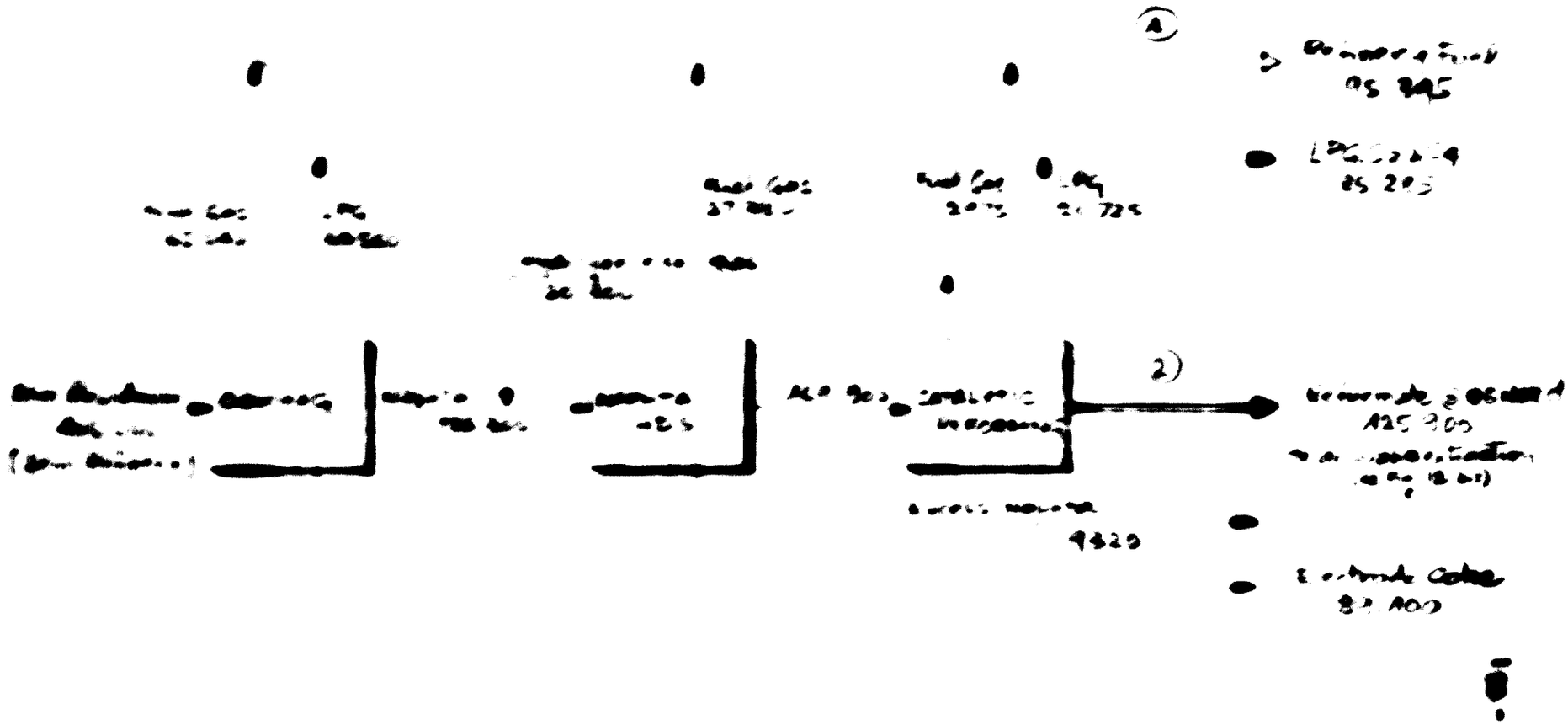
Estimated investment cost including process units and offsites, royalties and initial charge of catalysts and chemicals are given in the tables 7, 10, 11 and 12.

d. [redacted]

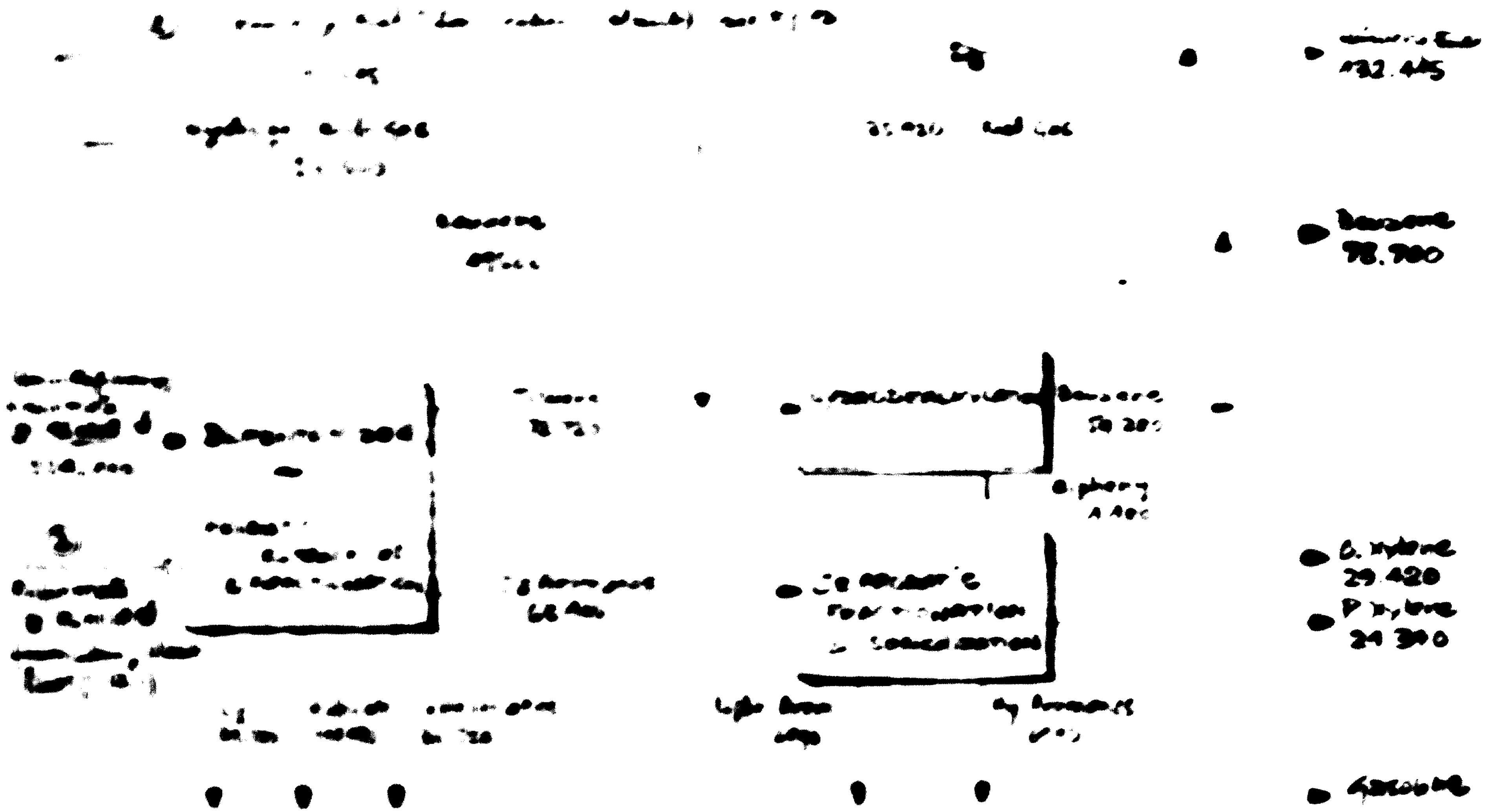
Estimated utility, catalysts and chemicals, labor requirements are set forth in the tables 8, 9 and 10.

e. [redacted]

Estimated operating cost and profitability calculations are presented in the tables 13, 14 and 15.



Category D4 : Manufacturing Scheme & Material Balance



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Feed-stock		
Atmospheric residue of North African crude oil	100.0	[redacted]
Products		
Fuel gas	10.0	[redacted]
$C_3^=$	2.0	[redacted]
C_3	4.5	[redacted]
$C_4^=$'s	3.0	[redacted]
iC_5	1.0	[redacted]
nC_5	1.0	[redacted]
Total LPG	[redacted]	[redacted]
C_5 - 140°C gasoline	[redacted]	[redacted]
Jet	[redacted]	[redacted]
Total	[redacted]	[redacted]

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	% wt	Tons/year
Feed-stock		
C_3 - 140°F [redacted]	100.0	100,000
[redacted]	1.1	1,000
Total	101.1	101,000
Products		
H_2O	nil	-
C_1	0.1	100
C_2	0.8	1,000
C_3	1.5	2,000
C_4	2.4	4,000
Total gas	4.8	8,100
C_5	5.0	5,000
C_6 - 140°F [redacted]	91.1	100,000
Total	101.1	101,000

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	Sp. Gravity	% wt	Tons/year
Feed-Stock			
[redacted][a]	0.798	100.0	100,000
Products			
Fuel			
[redacted]		11.00	20,300
[redacted]		1.75	2,075
LPG			
C_3		4.75	8,000
C_4		7.40	13,000
Reformate C_5^+	0.798	74.10	135,000
		100.00	100,000
Characteristics of reformate C_5^+			
[redacted]	96		
[redacted]	102		

a. After hydrocracking

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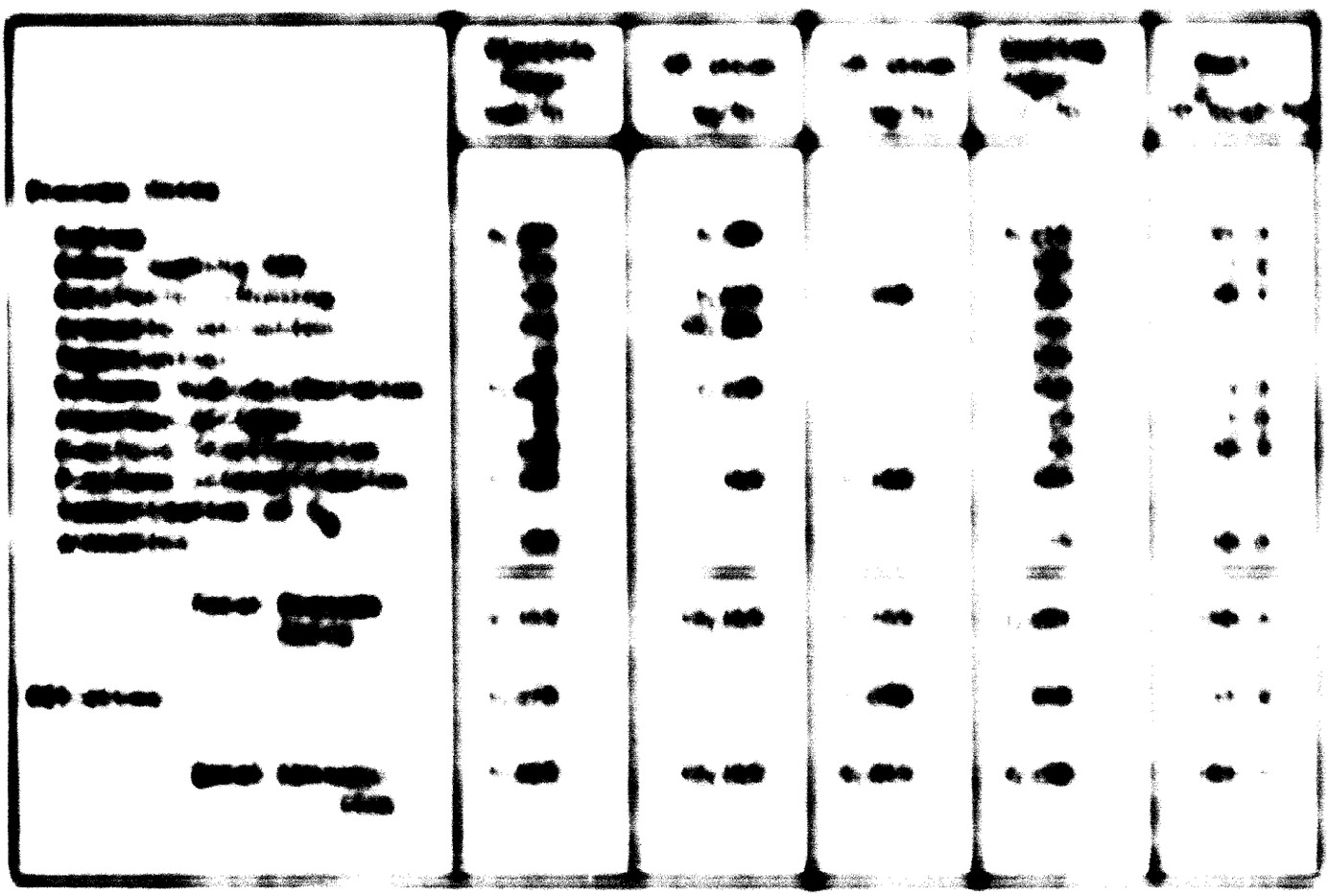

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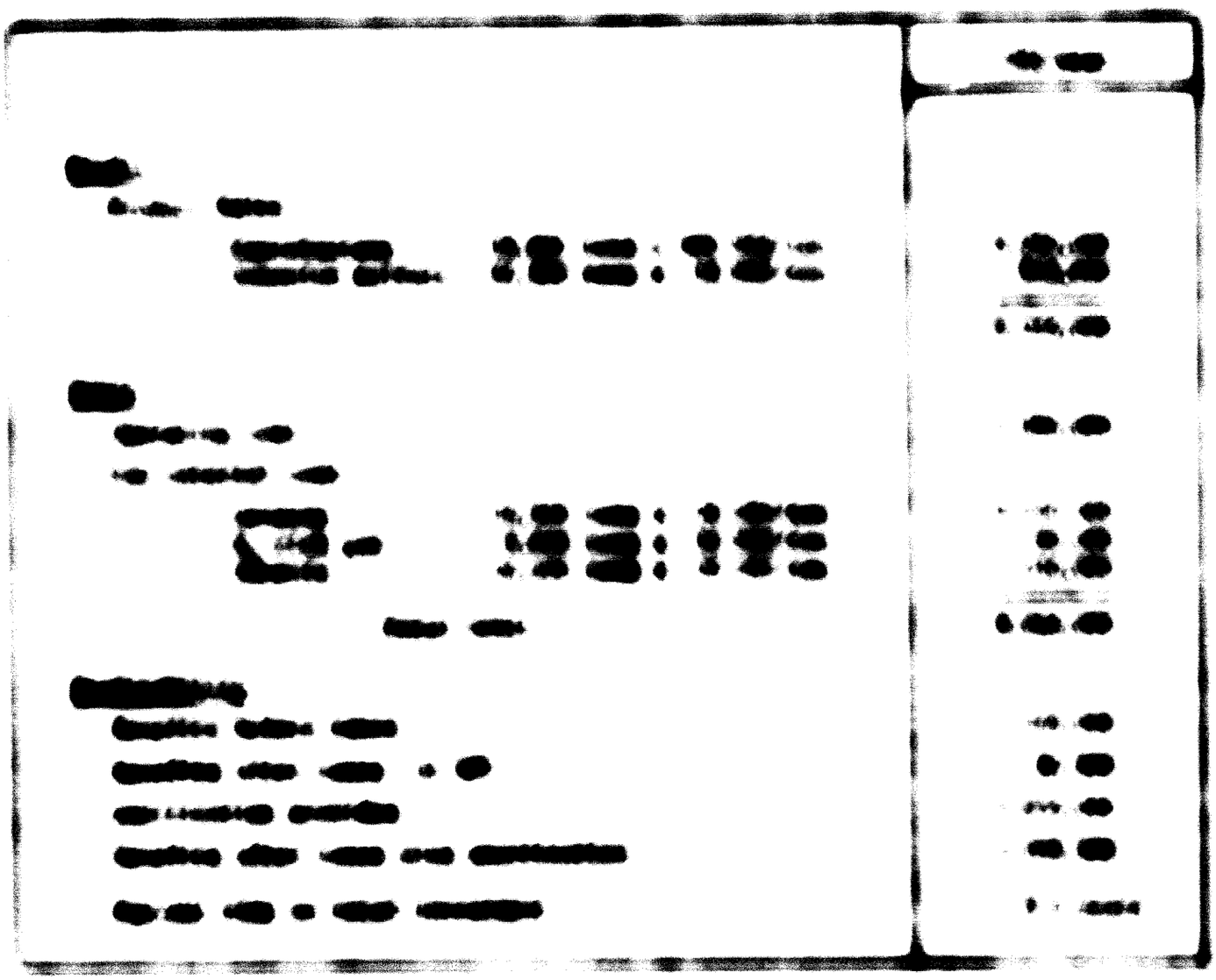

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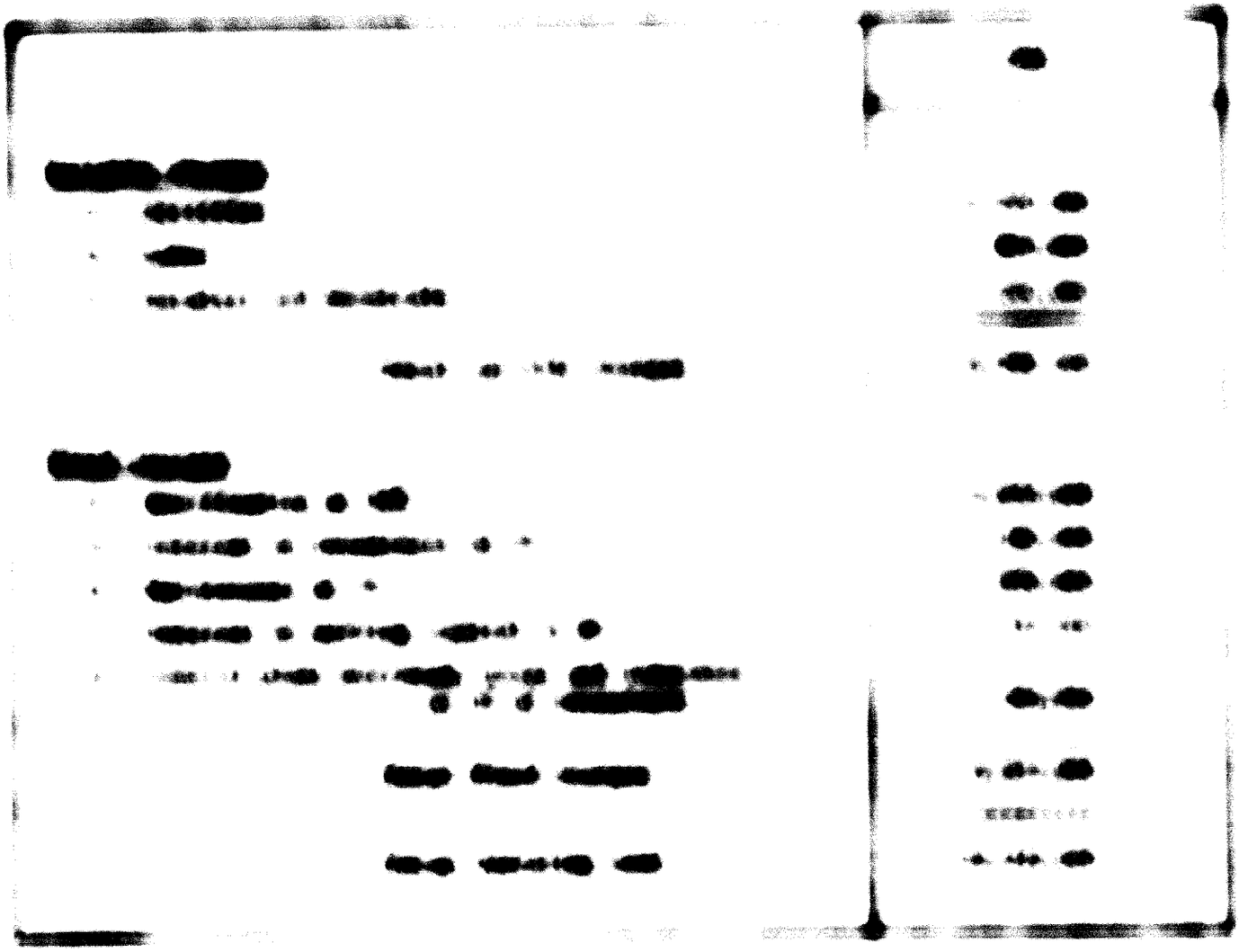

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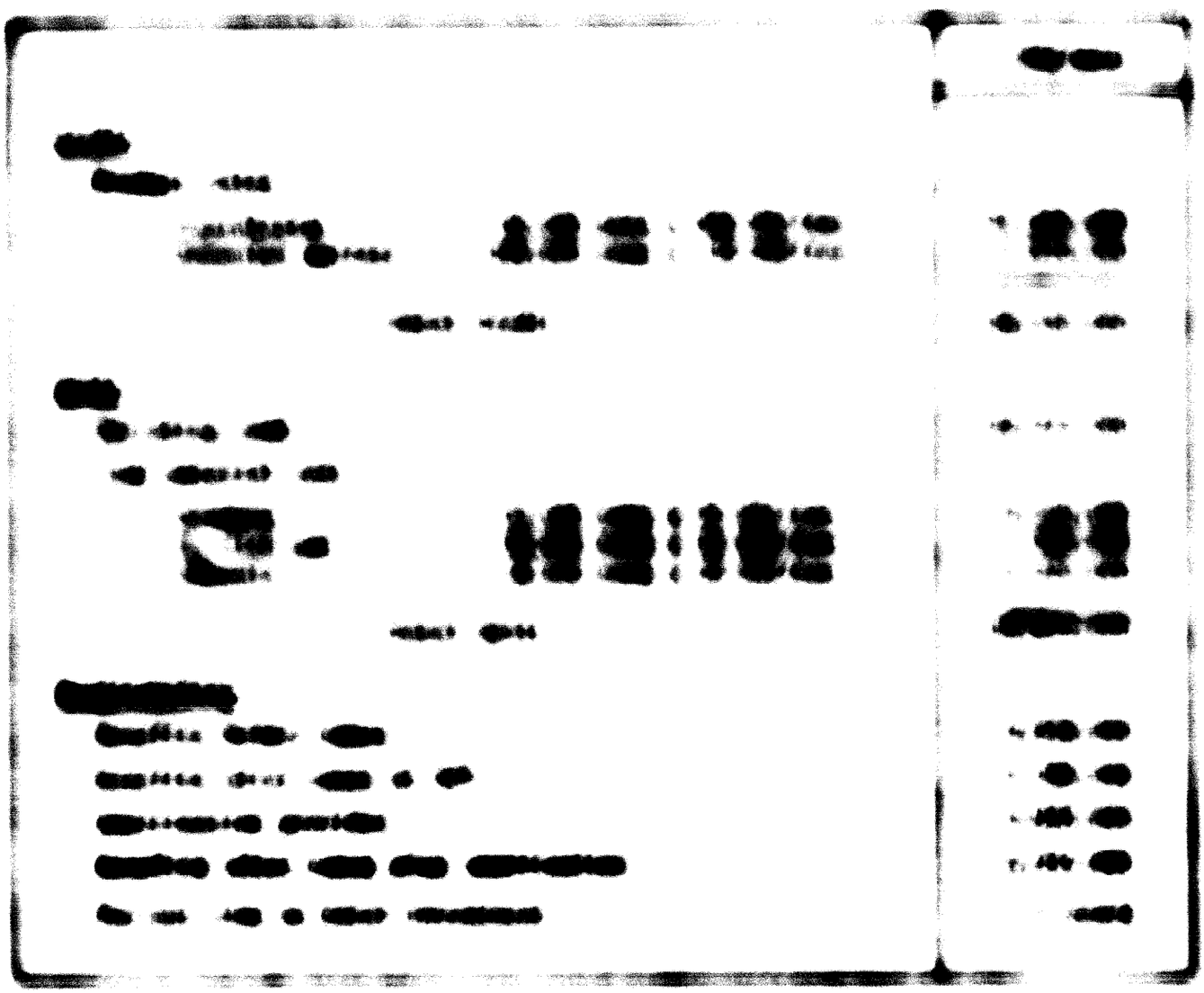

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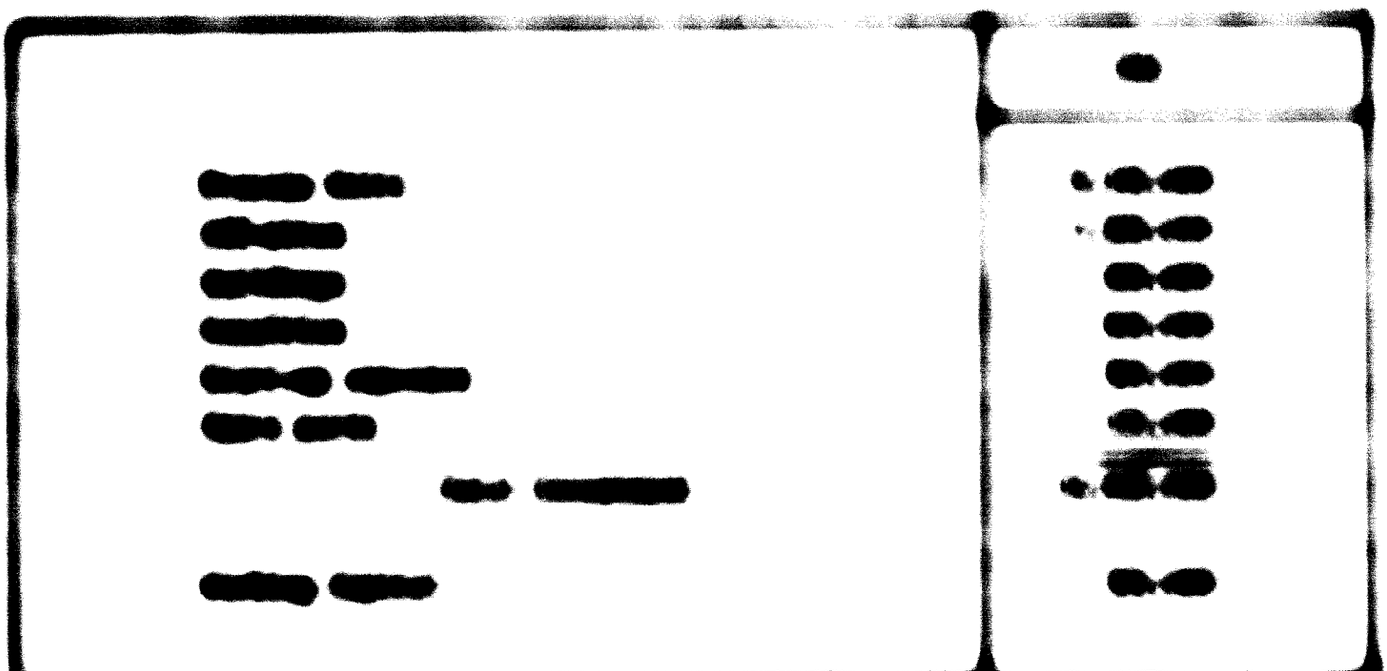

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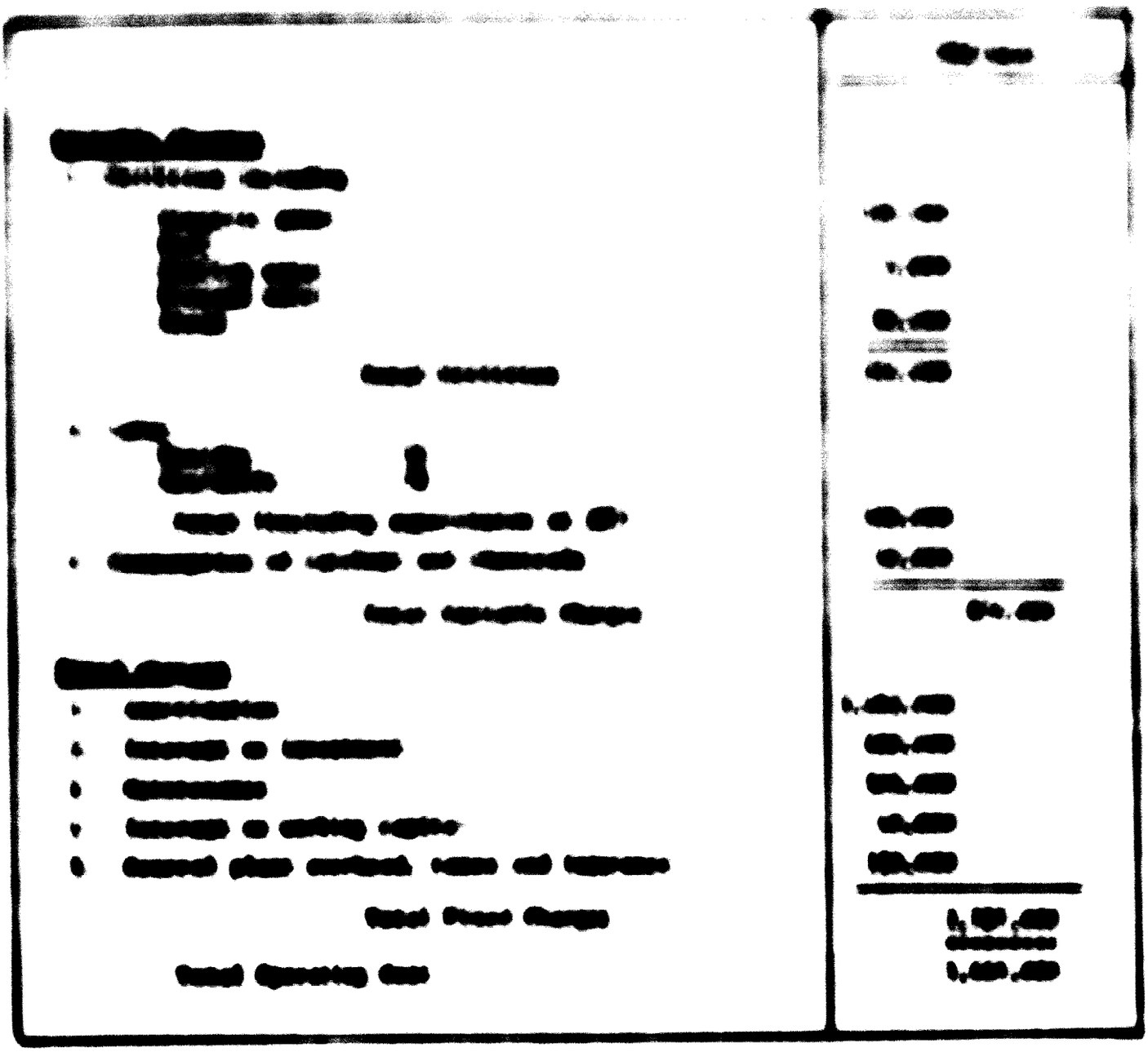

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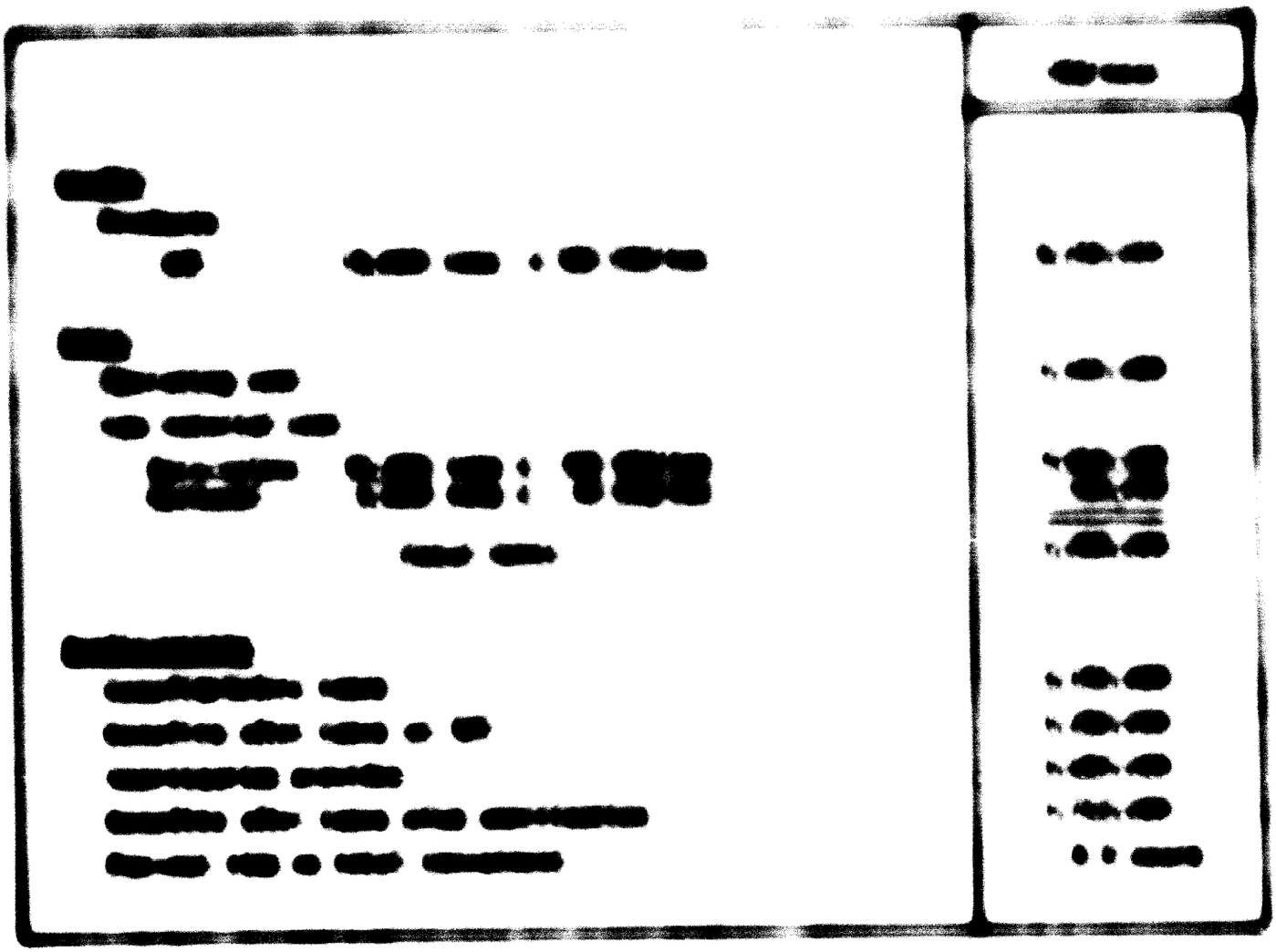

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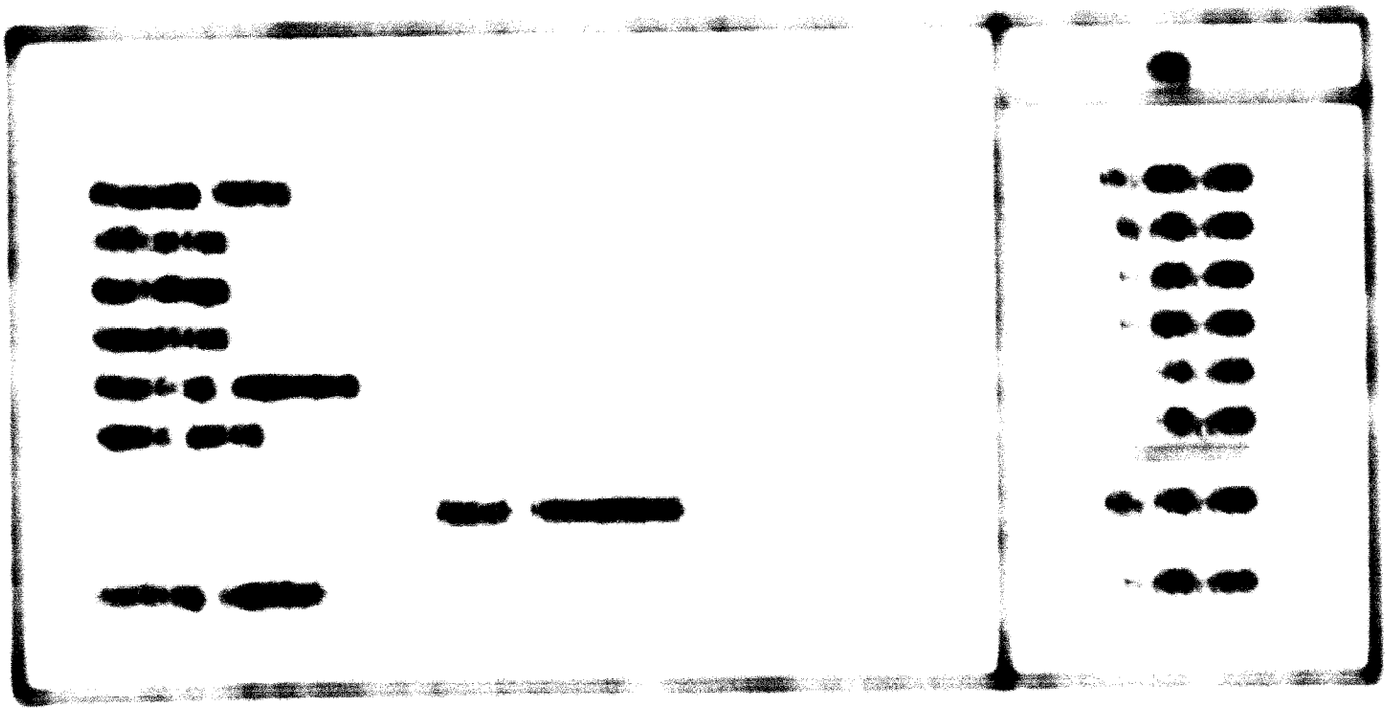

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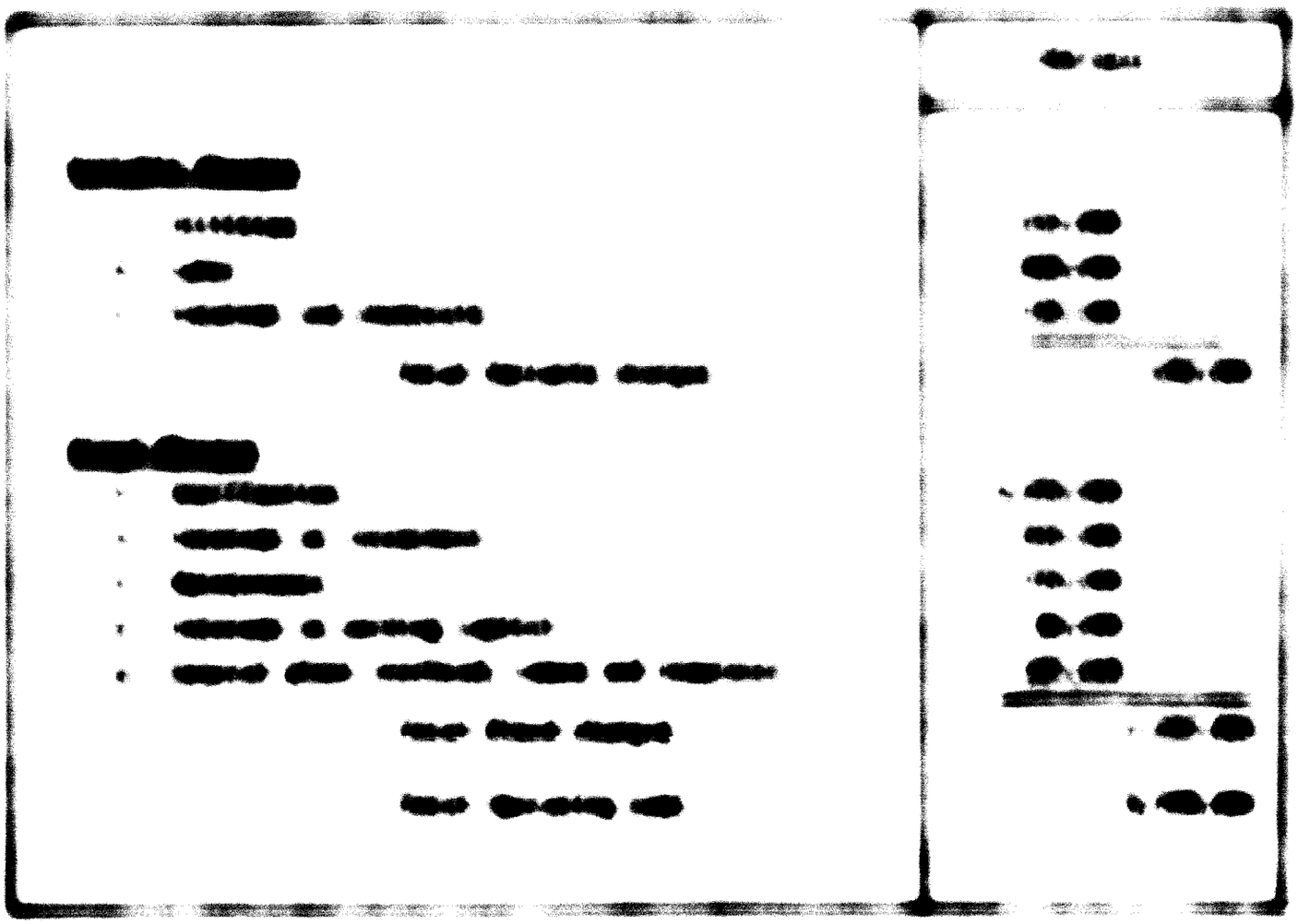

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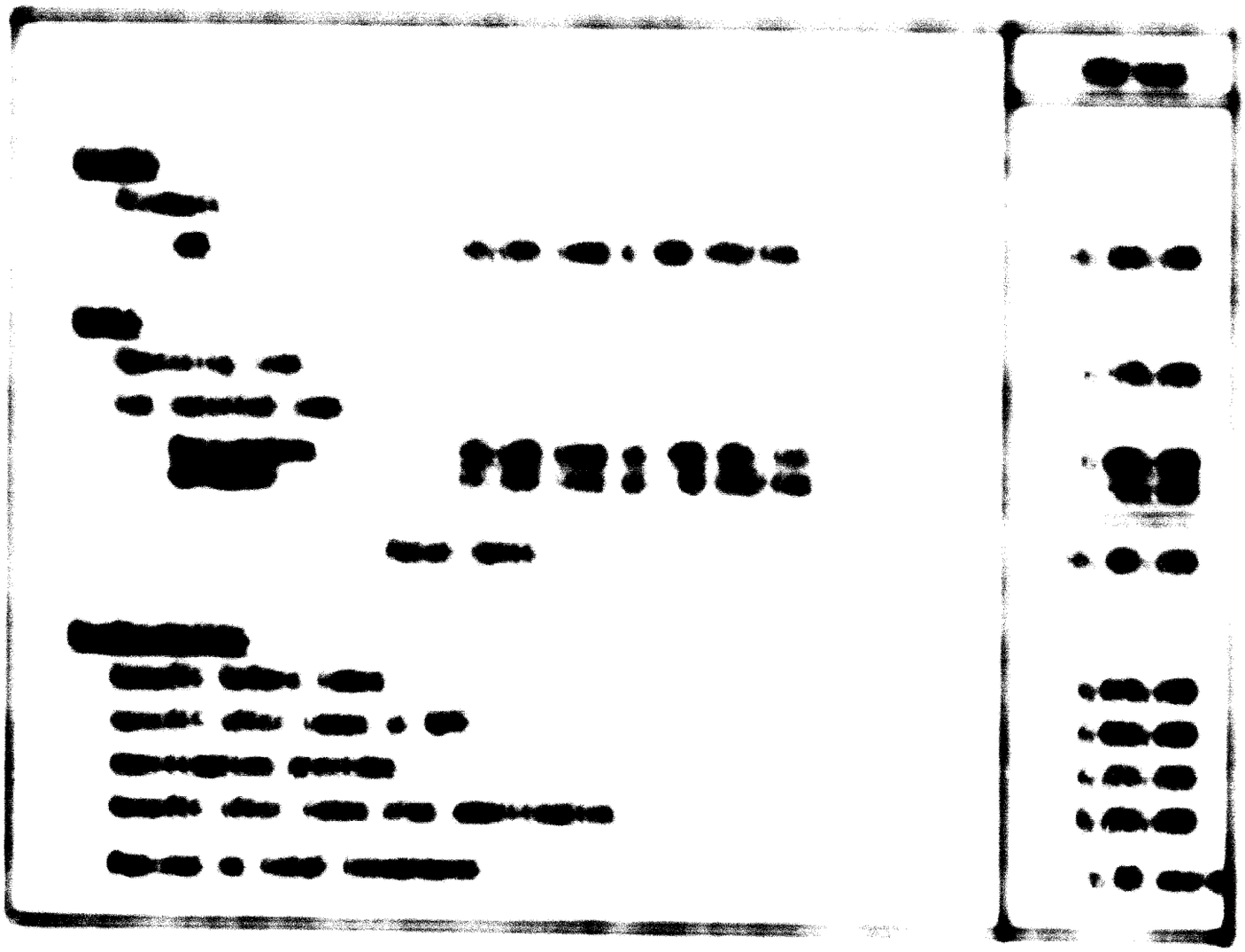

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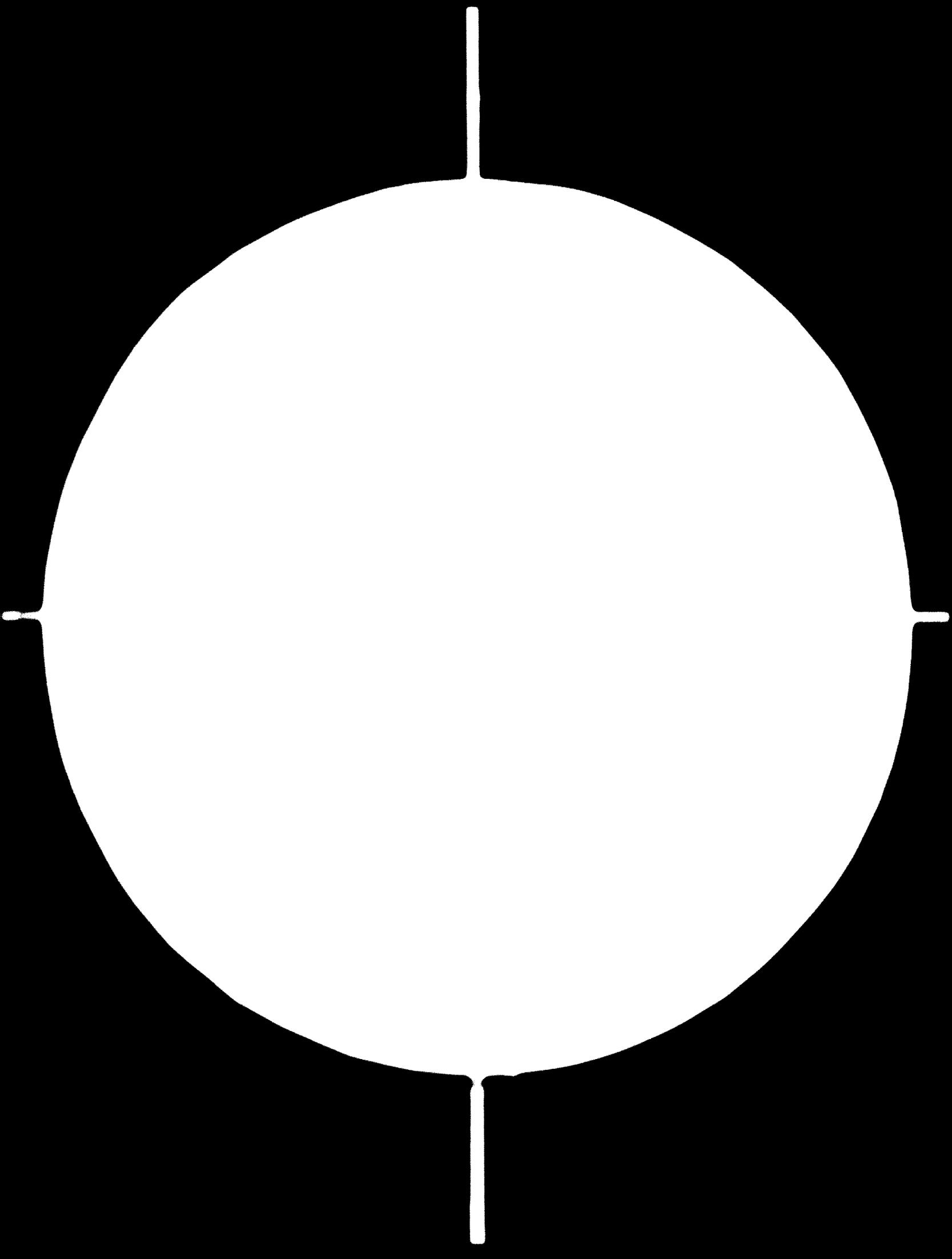

COMPLEXE D_4 - MANUFACTURE OF 6,000 MT/YEAR NYLON 6 FIBRES

producing :

. Nylon 6 filaments : 5000 MT/year

. Nylon 6 polyester (tyre cords) : 1,000 MT/year

COMPLEX D_4 - MANUFACTURE OF 6,000 MT/YEAR NYLON 6 FIBRES

Table 1
Estimated Investment Cost

	US$
Process Units	9,650,000
Off-sites	3,100,000
Buildings	1,100,000
Royalties	300,000
Start-up expenses	800,000
Spare parts	150,000
Total	15,100,000
Working capital	950,000

COMPLEX D_4 - MANUFACTURE OF 6,000 MT/YEAR NYLON 6 FIBRES

Table 2

Estimated Operating Cost

			US$/year
Variable Charges			
1. Utilities			
Electric power	kwh/hr	2,850	
Cooling water	m^3/hr	207	
Inert gas	m^3/hr	198	
Process water	m^3/hr	3.5	
Steam	t/hr	2.06	
Refrigeration	10^3kcal/hr	420	
Total utility consumption			300,000
2. Labor			
Men/day	10		
Men/shift	460		
Total (including supervision at 25%)			2,850,000
3. Consumption of catalyst and chemicals			90,000
Total variable charges			3,240,000
Fixed charges			
1. Amortization at 10%			1,510,000
2. Interest on investment at 4%			640,000
3. Maintenance			550,000
4. Interest on working capital			75,000
5. General plant overhead, taxes, insurance			151,000
Total fixed charges			2,926,000
Total operating cost			6,166,000

COMPLEX D_4 - MANUFACTURE OF 6,000 MT/YEAR NYLON 6 FIBRES

Table 3

Estimated Investment Profitability

		US$/year
Credit		
Product sales		
Nylon 6 filaments	5,000 MT x 1,900 US$/ton	9,500,000
Nylon 6 polymers	1,000 MT x 1,000 US$/ton	1,000,000
Total Credit		10,500,000
Debit		
Operating cost		6,166,000
Raw material cost		
Caprolactam	6,500 MT x 550 US$/ton	3,580,000
Total Debit		9,746,000
Profitability		
Benefit before taxes		754,000
Benefit after taxes at 50%		377,000
Amortization provides		1,510,000
Benefit after taxes plus amortization		1,887,000
Pay-out time on total investment		8 years

Complex D_5 Manufacture of 3,000 and 6,000 MT/year polyesters fibres

a. raw materials : DMT produced in Complex D_3

b. possible locations and supply :

. 6,000 MT/year unit for the corresponding sub-region located in : Algeria (North Africa and North East Africa); Irak or Syria (Middle East Arab Countries) and supplying local market for 1975.

Economics of such a project are presented in the following tables 1, 2 and 3.

. 3,000 MT/year unit for the following countries : Algeria, Morocco, UAR, Irak and Syria and supplying the local market for 1975.

c. extension of polyester fiber manufacture

Additionnal units of capacities included in the same range might be provided for supplying 1980 local markets of the different sub-regions.

COMPLEX D_5 - MANUFACTURE OF 6,000 MT/YEAR POLYESTER FIBRES

COMPLEX D_5 - MANUFACTURE OF 6,000 MT/YEAR POLYESTER FIBRES

Table 1

Estimated Investment Cost

	US$
Process Units	4,200,000
Off-sites	2,200,000
Buildings	800,000
Royalties	1,000,000
Start-up expenses	400,000
Spare parts	80,000
Total	8,680,000
Working capital	650,000

COMPLEX D_5 - MANUFACTURE OF 6,000 MT/YEAR POLYESTER FIBRES

Table 2

Estimated Operating Cost

			US$/year	
Variable Charges				
1. Utility consumption				
Electric power	kwh/hr	1055		
Fuel	10^6 kcal/hr	1.25		
Cooling water	m^3/hr	110		
Inert gas	m^3/hr	46		
Process water	m^3/hr	3.8		
Compressed air	nm^3/hr	510		
Steam	tons/hr	6.7		
Refrigeration	10^3kcal/hr	146		
Total consumption			190,000	
2. Labor				
Men/day		10		
Men/shift		184		
Total labor (including supervision at 25%)			1,200,000	
3. Catalyst and chemicals			185,000	
Total variable charges				1,575,000
Fixed charges				
1. Amortization			868,000	
2. Interest on investment			350,000	
3. Maintenance			258,000	
4. Interest on working capital			52,000	
5. General plant overhead, taxes and insurance			87,000	
Total fixed charges				1,615,000
Total operating cost				3,190,000

COMPLEX D_5 - MANUFACTURE OF 6,000 MT/YEAR POLYESTER FIBRES

Table 3

Estimated Investment Profitability

		US$/year
Credit		
Product Sales		
Polyester fibres	6,000 tons x 1,500 US$/ton	9,000,000
Methanol (low quality)	2,100 tons x 50 US$/ton	105,000
Total Credit		9,105,000
Debit		
Operating cost		3,190,000
Raw material cost		
DMT	7,000 tons x 550 US$/ton	3,850,000
Ethylene glycol	2,700 tons x 150 US$/ton	405,000
Total Debit		7,445,000
Profitability		
Benefit before taxes		1,660,000
Benefit after taxes at 50%		830,000
Amortisation provided		868,000
Benefit after taxes plus amortisation		1,698,000
Pay-out time on total investment		5.1 years

COMPLEX D_1 - MANUFACTURE OF 3,000 MT/YEAR POLYESTER FIBRES

COMPLEX D_5 - MANUFACTURE OF 3,000 MT/YEAR FIBRES

Table 1

Estimated Investment Cost

	US$
Process Units	3,050,000
Off-sites	1,600,000
Buildings	500,000
Royalties	600,000
Start-up expenses	300,000
Total	6,110,000
Working capital	325,000

COMPLEX D_2 - MANUFACTURE OF 1,000 MT/YEAR POLYESTER FIBRES

Table 2

Estimated Operating Cost

	US$/year
Variable Charges	
1. Utility consumption	95,000
2. Labor	700,000
3. Catalyst and chemicals	92,000
Total variable charges	887,000
Fixed charges	
1. Amortization	611,000
2. Interest on investment	264,000
3. Maintenance	190,000
4. Interest on working capital	26,000
5. General plant overhead, taxes and insurance	61,000
Total fixed charges	1,132,000
Total operating cost	2,019,000

COMPLEX D_5 - MANUFACTURE OF 3,000 MT/YEAR POLYESTER FIBRES

Table 1

Estimated Investment Profitability

			US$/year
Credit			
Product sales			
Polyester fibres	3,000 tons	x 1,500 US$/ton	4,500,000
Methanol (low quality)	1,050 tons	x 50 US$/ton	52,500
Total credit			4,552,500
Debit			
Operating cost			2,019,000
Raw material cost			
DMT	3,500 tons	x 550 US$/ton	1,925,000
Ethylene glycol	1,350 tons	x 150 US$/ton	202,000
Total debit			4,146,000
Profitability			
Benefit before taxes			406,500
Benefit after taxes at 50%			203,000
Amortisation provided			611,000
Benefit after taxes plus amortisation			814,000
Pay-out time on total investment			7.5 years

VI.2.3. Projects based on export possibilities

The large availability of natural gas in Arab Countries coupled with the growing demand of LNG for peak shaving operation and load gas supply allow to supply natural gas at very attractive prices for ammonia and methanol production.

Large size projects based on these low cost raw material and oriented towards export markets might compete favourably with European or US similar projects.

Complex E 1,000 MT/day Ammonia based complex

a. possible location and supply :

- . Middle East Arab Countries for Far East and East Africa market
- . Algeria and Libya for European Countries and West Africa and Mediteranean Countries

b. economics

Technical and economic data, estimated operating cost and ammonia selling prices are summarised in the following tables 1 and 2.

COMPLEX E - 1,000 MT/DAY AMMONIA BASED COMPLEX

COMPLEX E - 1,000 MT/DAY AMMONIA BASED COMPLEX

(330,000 MT/year)

Table 1

Technical and Economic Data

1. Estimated Investment Cost (Grass roots plant)[a]	10^6 US$		
Process Units including royalties and initial catalyst charge		18.8	
Offsites including utilities production and storage		8.4	
Start-up expenses		1.8	
Spare parts		0.8	
Total Investment			29.8
Working capital			0.8
2. Imputs			
. Raw material and utility requirements			
Natural gas (process and fuel)	10^6 m^3/year		384
Boiler feed water	10^6 m^3/year		1.12
. Chemicals and catalyst consumption	US$		430,000
. Labor			
Men/shift			15

a. Units producing their own electricity and ready to start production
Natural gas is used as feed-stock and for power generation

COMPLEX E - 1,000 MT/DAY AMMONIA COMPLEX

(330,000 MT/year)

Table 2

Economics of Ammonia Production

		10^3 US$/year
1. Operating cost		
A. Variable Charges		
Raw materials and utilities		
Natural gas	384. $10^6 m^3$ x 0.2 ¢/m^3	768
Boiler feed-stock water	1.12 $10^6 m^3$ x 0.25 $/$m^3$	280
Chemicals and catalysts		430
Labor		
Manpower salaries and wages	60 x 5,000 $/year	300
Supervision		75
Total variable charges		1,853
B. Fixed Charges		
Amortization at 10% of investment		2,980
Interest at 4% of investment		1,190
Maintenance at 4% of Process Units + Offsites		1,100
General plant overhead, taxes and insurance		298
Interest on working capital		64
Total fixed charges		5,632
Total operating cost		7,485
Unit operating cost	US$/ton	23
2. Estimated selling price (for a five years pay-out with taxes on benefit at 50%)		
Net income before taxes		5,960
Total sales		13,445
Ammonia selling price in US$/ton		41

Complex F 1,000 MT/day methanol based complex

a. possible locations and supply : Algeria or Libya for European markets

b. economics

Technical and economic data, estimated operating cost and methanol selling prices are summarized in the following tables 1 and 2.

COMPLEX F - 1,000 MT/DAY METHANOL BASED COMPLEX

COMPLEX F - 1,000 MT/DAY METHANOL BASED COMPLEX

(330,000 MT/year)

Table 1

Technical and Economic Data[a]

1. Estimated Investment Cost (Grass roots plant)			10^6 US$
Process Units (including royalties)			13.0
Offsites (including utilities production and storage)			5.0
Start-up expenses			0.9
Initial chemical and catalyst charges			1.0
Spare parts			0.3
Total Investment			20.2
Working capital			0.8
2. Inputs			
. Raw materials and utility requirements			
Natural gas feed/ton of methanol			5.10^6 kcal
Natural gas fuel/ton of methanol			3.10^6 kcal
. Electricity/ton of methanol			50 kwh
. Boiler feedwater	m^3/hr		40
. Cooling wer (recirculating)	m^3/ton		2
. Synthesis catalyst /ton of methanol		US$	0.7
. Other catalyst and chemicals / ton of methanol		US$	0.4

a. Based on LP methanol process using centrifugal compressors

COMPLEX F - 1,000 MT/DAY METHANOL BASED COMPLEX

(330,000 MT/year)

Table 2

Economics of Methanol Production

		US$/year
1. Operating cost		
A. Variable charges		
a. raw materials and utilities		
. natural gas : 8.10^6 kcal x 330,000 x 70 US¢/10^6kcal	1,850,000	
. electricity : 50 kwh x 330,000 x 0.01 US$/kwh	165,000	
. boiler feed-water : 40 m^3/hr x 8,000 x 0.25 US$/$m^3$	80,000	
. cooling water : 2 m^3/ton x 330,000 x 6 $/$10^3 m^3$	4,000	
b. synthesis catalyst 0.7 US$ x 330,000	231,000	
other catalysts and chemicals 0.4 US$ x 330,000	132,000	
c. labor : manpower salaries and wages : 50 x 5,000 $/year	250,000	
supervision	60,000	
Total variable charges		2,772,000
B. Fixed charges		
a. amortization at 10% of investment	2,020,000	
b. interest at 4% of investment	800,000	
c. maintenance at 4% of Process Units + Offsites	720,000	
d. general plant overhead, taxes and insurance	200,000	
e. interest on working capital	64,000	
Total fixed charges		3,804,000
Total operating cost		6,576,000
Unit operating cost US$/ton	20	
2. Estimated selling price (for a five years pay-out with t taxes on benefit at 50%)		
C Net income before taxes		4,040,000
Total Sales		10,616,000
Methanol selling price in US$/ton	32	

VI.3. ANALYSIS OF THE ALTERNATE FEASIBLE PROJECTS AND PROFITABILITY CALCULATIONS : BASIS FOR THE SELECTION OF RECOMMENDED PROJECTS

It has been possible to examine in the hereabove paragraph the economics of producing petrochemicals which might reasonably find outlets on the local market of the Arab Countries or for exports.

The feasibility studies which have been carried out show that conditions in Arab Countries are such that a petrochemical industry designed to satisfy a large part of the internal market in 1975 and 1980 and based on harmonization and cooperation between the Arab Countries can be a profitable venture.

Different alternates related to : process routes, size of projected plants, locations and schedule for realization have been presented and the influence of the different technical andeeconomic factors on the profitability of the possible projects have been outlined in order to allow the participants of the meeting organized by IDCAS to evaluate the different alternates and to appraise the program of execution for recommended projects.

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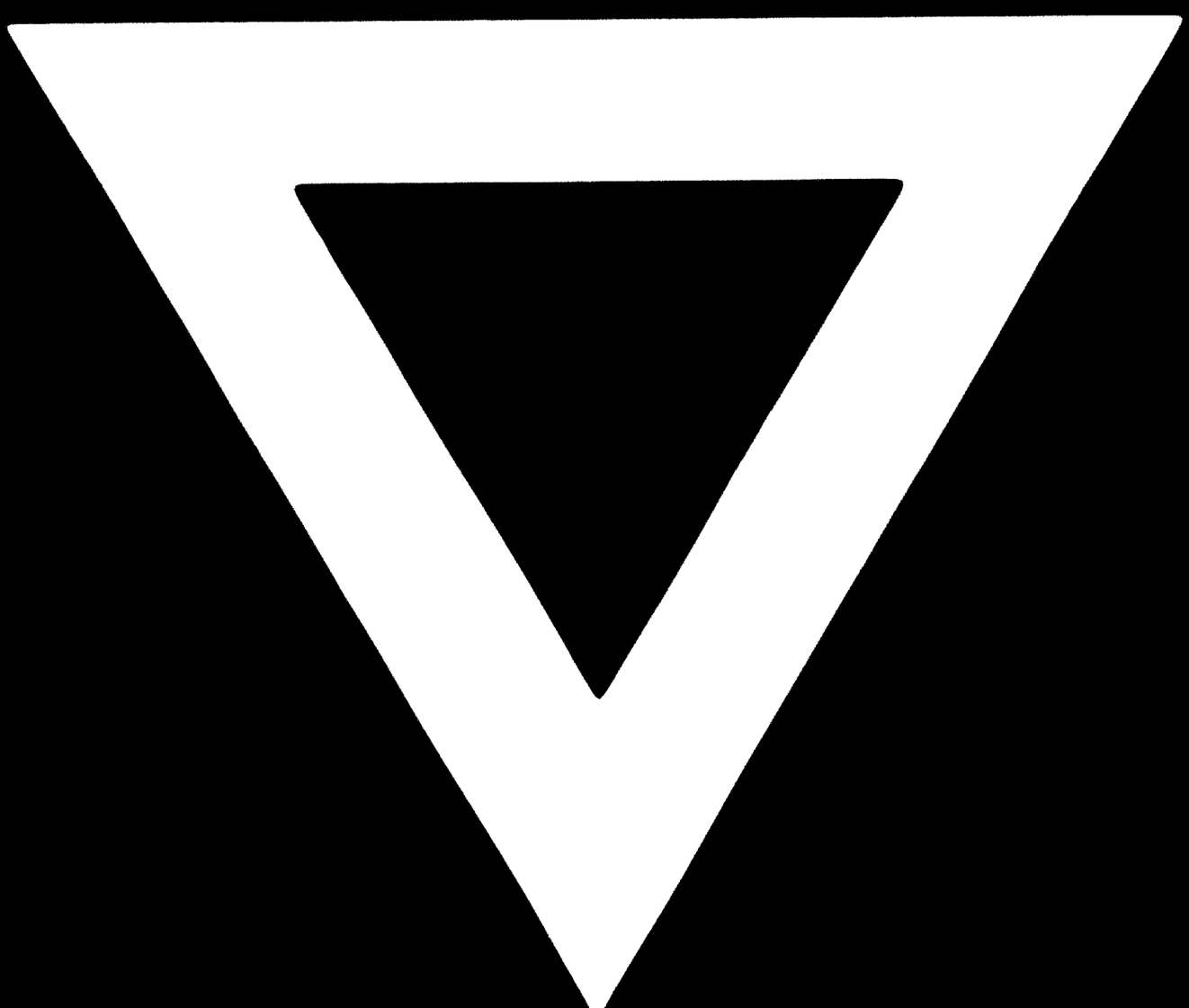

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