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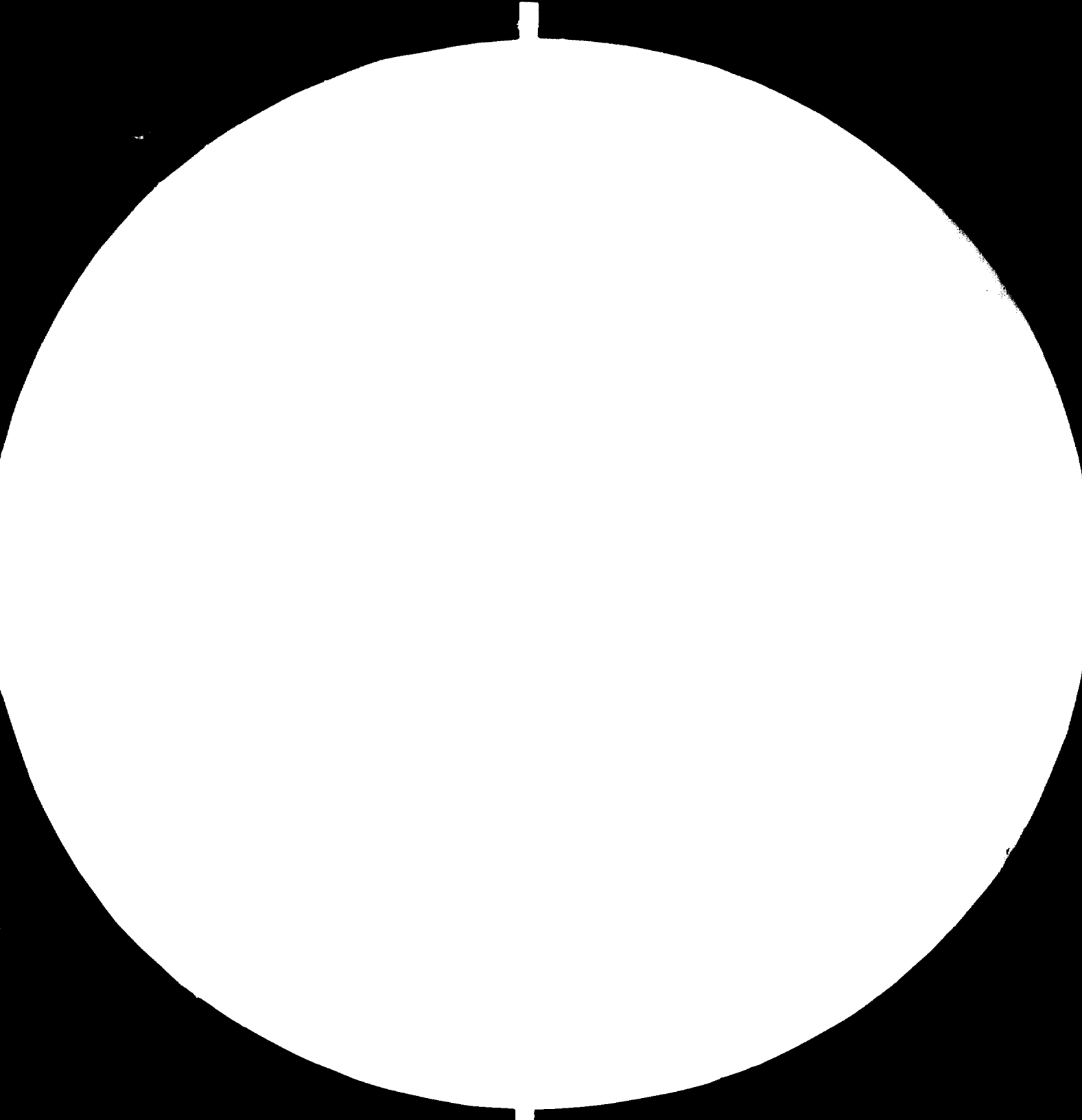

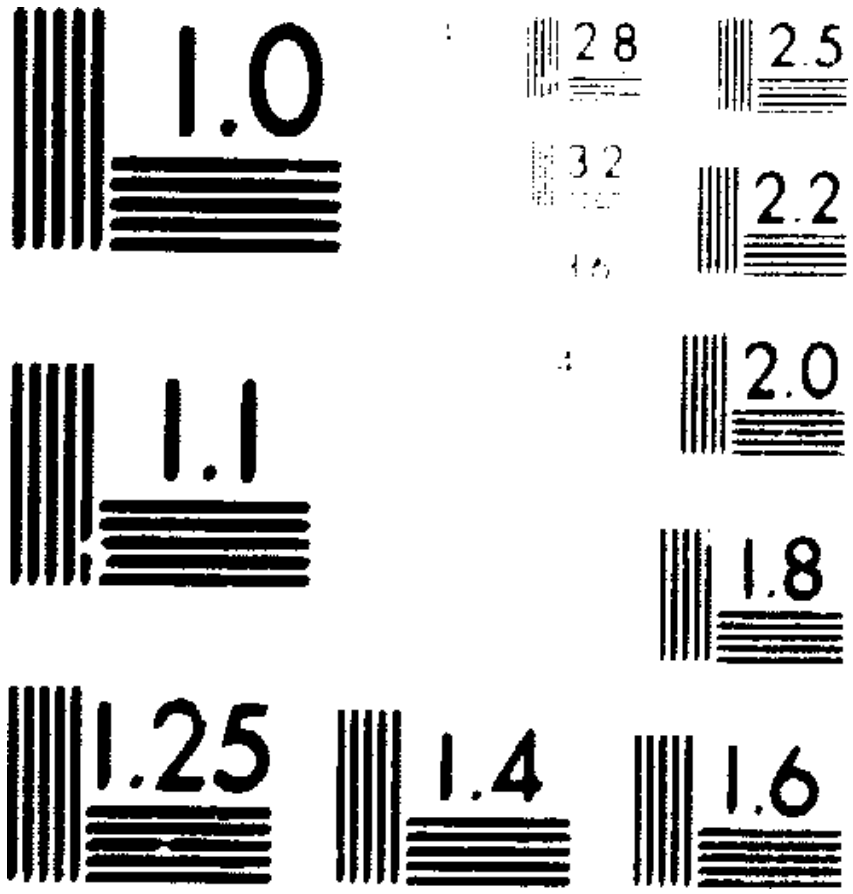

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

11625

Distr.
RESTRICTED
~~UNIDO/IO/R.~~
1 July 1982
ENGLISH

Turkey.

PETKIM - LONG-TERM DEVELOPMENT OF CHEMICAL INDUSTRIES

DP/TUR/79/003

TURKEY

Technical Report*

Prepared for the Government of Turkey
by the United Nations Industrial Development Organization

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~~009075~~

Based on the work of Messrs. L. Sobel and M. Moldovan
within a team of 4 experts

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C O N T E N T S

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SUMMARY

This FINAL REPORT is the closing writing document of the Project DP/TUR/79/003, concerning the Long-term Development of the Turkish Chemical Industry.

For the development of the Project, started in 1980, January 16 and ended in 1982, June 4, seven UNIDO Experts, under the co-ordination of a Chief Technical Advisor(CTA) were involved for different periods of time.

Besides this Final Report, other eight sectorial reports and progress reports were prepared by the experts and the CTA respectively. These reports were already evaluated by the concerned UNIDO bodies.

The Turkish counterpart, following the CTA's recommendations, also prepared twenty three sectorial and special reports, containing important data for the Project. These reports are presented as attachments to the present report.

The Final Report as such is to be considered as the document presenting the results of the examination, processing and interpretation of the data contained by the above-mentioned working papers, as extended parts of this report.

The findings and recommendations given in the final chapter are considered by the author as problems of main importance and of first priority. Consequently, for each detail the related attachment should be consulted and studied.

ACKNOWLEDGMENTS

I am fortunate to have had the help and co-operation of many persons. Even if some of them did not wish to be identified, I am permitted to mention the following names and I do so with grateful thanks :

Mr. S.K. Malik, UNDP Resident Representative in Turkey

Mr. S. Narashimhan, UNIDO-SIDFA in Turkey

Mr. H. Gürsey, National Project Co-ordinator

Dr. A. Tigrel, National Project Manager

Mr. R. Turtin

and

Miss G. Aslan,

main collaborators in the common team.

For the advices and special recommendations concerning my work I like to express my thanks to Mr. M. Youssef, UNIDO's Substantive Officer for the Project and Dr.L.Sobel, the CTA for the Project.

LIST OF ATTACHMENTS

1.-Working plan DP/TUR/79/003/4/01/37

2.-Sectorial studies(list of studied sectors)

3.-The methodology used for sectorial studies

4.-Questionnaire used for sectorial studies

5.-Sectorial reports-volume 1-(Separate volume)

6.-Sectorial reports-volume 2-(Separate voline)

7.-List of major chemicals produced in Turkey

8.-Out-put chart of Turkish Chemical Industry

9.-The on-going investments in the chemical and petrochemical industries -public sector only-

10.-Training programme

11.-List of selected chemicals

12.-Chemicals consumption per sectors

13.-Total chemicals consumption in the Turkish economy

14.-Consumption of chemicals arranged in five groups, based on quantity

15.-Chemicals individual sheets

16.-First output of the computation of disponible data, based on the established mathematical model.-

I. OBJECTIVES AND LOGIC OF THE PROJECT

A. Development objectives

1. To prepare guidelines for the development of the chemical industry.

2. To reach a better balance in foreign currencies concerning the exchange of the chemical products compatible with the investment possibilities in this field and the economics of such investments.

3. To reach a given level of integration in the chemical industry.

4. To develop and formulate a scheme for the production of chemicals on a medium and long term basis.

B. Immediate objectives

1. To conduct a series of surveys of the existing chemical products in the country.

2. To make in-depth studies on a range of chemical products from the above survey including medium term demand projections, export possibilities, choice of technology, raw materials, financial resources, cost of production, energy and environmental impacts.

3. To optimize and finalize these studies to assist the government in making policy decisions pertaining to the future development of the chemical industry.

C. Outputs

Outputs related to the immediate objectives are :

1. A report with recommendations for the development of the chemical industry for a period till 1990 and afterwards.

2. Two special sector development reports, one on pharmaceuticals and the other on dyestuffs with recommendations for their future development.

D. Limitations

1. Despite the fact that the first generation petrochemicals as well as the plastics, synthetic fibres and synthetic rubber have been left out of the scope of this study in the Project Document and bearing in mind a) the repercussions of the petrochemical and downstream industries on the chemical industry as a whole, b) the complex interdependance between various sectors of the Chemical industry with respect to some basic chemical products which can only be classified as petrochemicals, it was regarded appropriate to consider only some of the petrochemicals at a macrolevel in order to arrive at a sound overall view of the Chemical industry*.

2. The fertilizer industry has been excluded from the scope of this study. However, important feedstocks for the fertilizer industry such as ammonia and sulphur have been considered since such materials are also the starting point for a variety of other chemicals**.

3. "The request forms for information on mines, energy and other sectors will be simplified" **

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* See MEL Halfawy (UNIDO): letter to H.Gürsey DP/TUR/79/003 dated November 21, 1979 and his acceptance confirmed by SPO; see also Progress Report January 21, 1960.

** See Yildirim Akturn(SPO): letter to Petkim dated April 21,80

4. The ore extraction and its treatments as defined by State Planning Organization (SPO) have not been studied.

5. The chemical industry related to military use (gun powder, explosives, special chemicals) have been left outside the scope of the project***

E. Logic of the project

1. Taking in account the Project Document, the request of the Turkish Authorities and the general situation in the field, the fulfilling of the following requirements were considered to be important :

a. To establish a homogeneous and efficient team to undertake the work;
b. To organize the collection of data which were not available at the beginning of the work;
c. To elaborate a methodology for data treatment.

2. Taking into account the present stage of development of the Turkish Chemical Industry the following were considered to be essential :

a. To study the establishment of new institutions which will also reach a further stage in the development of the chemical industry;
b. To study the potential of co-operation of the Turkish Chemical Industry with foreign partners.

3. Taking into account the overall economic situation (priorities, finance, power, infrastructure) as well as the fundamental changes in the orientation of the world chemical industry (geographical, structural, direction of development) the preparation of a Master Plan was not envisaged to be realistic since:

*** Oral communication

a. In the present circumstances it would be rapidly absolute, and
b. its performance, due to the specific nature of the chemical industry would not be possible before the undertaking of feasibility studies for a large number of chemicals.

4. Therefore it is decided to elaborate a FINAL REPORT which :

a. Will include in particular a list of products produceable in Turkey under economic conditions;
b. Will contain guidelines concerning the directions of the development and the necessary steps to be taken for reaching this aim;
c. Will also contain order of magnitude, investment requirements and general guidelines on technological aspects, economic capacities and selection of product mix. These considerations were also motivated by the limitations described under the previous paragraph.

5. The present situation of the Turkish Chemical Industry was considered in relation to the general economic situation in the country.

a. It has been less than two years since Turkey embarked on its new economic program, Progress has been impressive, but there is still time and distance to go before the Turkish Economy is out of the critical zone. The introduction of tight monetary and fiscal policies has succeeded in bringing inflation down to 30 percent. Reducing it further will depend on the effects of the structural changes planned for the economy, the impact of which may not be felt for some time.
b. Bringing the balance of payments into equilibrium will not be easy either. Turkey still has a large foreign debt to repay. It also faces a rising import bill as domestic demand recovers and as the expanding export sector imports more capital goods and materials, which is certainly true of the Chemical industry, as well.
c. Despite the fact that the current general appearance of

the Turkish Economy is certainly much better than two years ago, and there are indications of further improvement, the Economy still has serious problems to overcome such as unemployment and a general shortage of foreign currency. Moreover inflation is still to be pulled down further.

d. The interaction of the status of the Chemical Industry with the general economic situation outlined above is inevitable. Rising production costs, shortage of some critical raw materials and a heavy dependance on imported technology are some of the more immediate weaknesses of the Turkish Chemical Industry which can be regarded as a relatively new industry in the country. The evolution of a modern chemical industry in Turkey really coincides with the 1960's. Since that time rapid progress has been observed in many branches of the industry. Nevertheless, for the healthy growth and development of the industry in the future much remains to be achieved in the way of infrastructural integration and a better utilisation of locally available resources. It is also to be noted that the present economic policy has cut down considerably on investments.

e. For more information on Turkey and Turkish economy and particularly the industry, the following publications will be of interest :

- The Turkish Economy 1980 (edited by Tusiad)
- Marketing in Turkey (U.S. Chamber of Commerce, Oct.1979)
- Turkey (OECD Economic Survey, end 1978)

These publications give useful information, trade regulations, distributions and sales channels, transportation, communication, advertising and market research in the Turkish industry.

f. The Chemical Industry is owned partly by the state and partly by private capital in the following ratio :

	PERCENTAGE			
	PRODUCTION		EMPLOYMENT	
	PUBLIC	PRIVATE	PUBLIC	PRIVATE
Basic chemical industry	42.3	55.7	50.3	49.7
Other chemical industry	3.9	96.1	10.7	89.3

g. Many of the state economic enterprises (SEE) have required state subsidies to cover the operating losses which are caused usually by the following :

- intentions to encourage the development of backward regions
- over-emp'oyment partly caused by the efforts to decrease unemployment
- sales of essential goods and services at low costs

h. The private sector is more heavily engaged than the SEE in the more profitable sectors (light manufacturing, consumer products) of the chemical industry.

i. Turkey's development strategy has been fixed by the successive five year plans which are prepared by the State Planning Organization and which are obligatory for the public sector.

j. As for the production of the chemical industry, expressed in current TL x 10^9 :

	dollars value of T.L.	Annual increase %	TARGET	FULFILMENT
1st plan(1963-67)	9.08	14.5	3887	3563
2nd plan(1968-72)	14.30	18.8	8813	8412
3rd plan(1973-77)	15.81	10.1	30302	32458
Program 1978	25.50	10.0	60400	57024

F. Activities

The following activities were considered essential to achieve the project outputs :

1. Organization of a study group in PETKIM for carrying out the surveys.

2. Review of past studies carried out in Turkey.Preparation and dispach of questionnaries to the manufacturers and users.

3. Analysis of the results of the above survey and of the data available to evaluate the priorities and determine the guidelines.

4. Supplying available technical literature and arranging contacts with competent organizations abroad for PETKIM personnel.

5. Assistance of two consultants to PETKIM in conducting in-depth study on pharmaceuticals and dyestuffs and preparing demand projections.

6. Identification of the type of pharmaceuticals, dyestuffs and dyestuffs intermediates in current and future demand which can be conveniently and economically manufactured from available domestic raw materials or imported intermediates; study of the suitability and adaptability of the existing and planned plants for these chemicals.

7. Preparation of a priority list for the production of those chemicals produceable at economic scales in Turkey giving recommendations with regard to their implementation.

8. Determination of general guidelines on technological aspects, economic capacities and selection of product unit.

9. Furnishing order - of - magnitude investment requirements.

10. Giving recommendations to carry out studies in other chemical sectors.

11. Preparation and submission of Final Report.

* * *

II. ACTIVITIES CARRIED OUT AND OUTPUT PRODUCED

A working plan was elaborated (Attachment 1) and approved by the Turkish authorities as well as by UNIDO. The execution of this plan was initiated in January 1980. Consequently, the data for the years 1978 and 1979 are taken as reference.

A. Activities carried out

1. During the execution of the project, a study group within the Project and Study Department of PETKIM was organized.

2. Very few studies were made on the chemical industry and those attempted were rather limited. The data collected by the Turkish Chamber of Industry and Commerce in their "Industry Inventory Study" were found to be very limited in value and not in a suitable form for use in the Project.

3. The Industrial Development Bank's (TSKB) Survey of the Chemical Industry completed in 1981 could be considered as an exhaustive study. But it was available only in 1981 and it only gave a detailed analysis of the situation for the year 1977. However some useful data on existing and foreseeable capacities as well as the demand levels up to 1983 could be extracted from this study. In fact a major effort of the project personnel was focussed on the collection, checking and treatment of data.

4. It can be considered that for the first time the Turkish chemical industry has now acquired a data basis. Although there is still some room for improvement, completion and updating of this data, it nevertheless constitutes an instrument of high quality for the development of the Chemical industry.

5. The extrapolation of past data on production, imports and consumption by taking into account the GNP or similar parameters will not necessarily give a correct view of the future development.

That is particularly true for Turkey where the chemical industry is young and it can be presumed that in the future the real values will most probably deviate considerably from any extrapolated values not only quantitatively but also qualitatively. Therefore it was concluded that it would be more realistic to estimate the future consumption of chemicals in Turkey through a feedback system based on individual studies on different sectors of the economy using chemicals. These studies are to be referred to as sectorial reports, see :

- th list of sectorial studies (attachment 2)
- the methodology used (attachment 3)
- a model of the questionnaire used (attachment 4)
- an abbreviated form of the sectorial reports in English* (attachments 5 and 6)

6. A list of 472 major chemicals produced in Turkey has been established, indicating for some of them the capacity, the location of the plant, the name of the company and the owner (attachment 7).

7. A basic input-output chart of the Turkish chemical industry has been prepared giving an overall view of the interrelations between the different sectors (attachment 8).

8. The following table relates the imports and exports of the Turkish Chemical industry (by chapters), in volume and value, by years for the period 1970-1979. (see pages 9A and 9B)
A closer look at this table reveals the following important facts :

(a) In 1979, fertilizers in finished form accounted for 41% of the total imports of chemicals;
(b) Again in 1979, if the imported raw materials for the domestic fertilizer production are considered as well, the above given figure would increase up to 48%.

* for the study on ores and minerals only the table of contents and for the study on pesticides only the table of contents and the summary

TURKEY'S CHEMICAL INDUSTRY - FOREIGN TRADE (In M Ton)

Chapter	1970		1975		1977		1978		1979	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
28. Inorganics	232.4	19.2	748.9	55.4	562.3	129.5	566.2	57.4	629165	31442
29. Organics	155.1	0.2	277.1	2.6	580.8	8.2	341.9	3.4	499388	2284
30. Pharmaceuticals	0.1	0.1	0.1	0.1	0.3	-	-	-	59	98
31. Fertilizers	658.0	-	261.0	-	2033.6	-	1757.7	-	2099252	-
32. Colors	10.0	4.0	19.8	3.0	27.7	1.6	19.4	1.2	16381	970
33. Parfumery	0.1	0.0	0.2	-	0.4	-	0.4	-	319	49
34. Soap and det.	3.1	0.0	5.6	-	9.8	-	5.9	-	4322	1537
35. Adhesives	1.1	0.0	0.6	-	0.5	-	0.5	-	394	30
36. Explosives	0.5	-	1.3	0.6	0.6	-	0.1	-	299	52
37. Photographic	1.1	0.0	2.1	-	2.4	-	2.5	-	1949	2
38. Miscellaneous	38.4	0.2	47.1	6.4	70.5	1.0	45.2	2.7	51109	589
TOTAL :	1099.9	23.7	1363.8	68.1	3288.9	140.3	2739.8	64.7	3302637	37053
39. Resins	60.4	0.1	117.0	1.9	220.5	2.2	102.5	1.3	95097	870
40. Rubber	34.5	1.3	59.9	1.1	71.5	-	54.8	-	37049	788
51. Man made fibers cont.	9.9	0.4	16.2	0.3	10.6	-	8.9	1.1	7114	1726
56. Man made fibers disc.	15.6	0.4		0.9	10.6	3.0	1.9	9.2	14143	7778
GRAND TOTAL:	1220.3	25.9	.1	72.3	3372.1	145.5	2907.9	76.3	3456040	48315
Fertilizers/total x 100										

It is clear that the fertilizer industry is responsible for nearly half of the total chemical imports.

9. On the other hand, the first generation petrochemicals (benzene, toluene, xilenes, styrene, etc.) imported as given in the chapter on organic chemicals represent another significant part of the total imports of chemicals.

10. The following table shows the on-going investments as furnished by the State Planning Organization for the Public Sector (Official Gazette dated March 8, 1982, No. 17627 Prime Ministry) - (See Attachment 9).

11. The comparison of capacities to the consumption for the corresponding years was one of the major aims of the study.

12. Certain activities of the Chemical Industry exist only at a limited scale in the country. To develop these activities, a training programme was elaborated (attachment 10)(See Dr. Sobel's Progress Report, April 18, 1981) with the aim of forming specialists in these fields.

13. An important quantity of technical literature* was furnished by the experts, concerning the world situation in the field studied as well as by the Turkish counterparts concerning the situation in the country.

14. Personnel contacts with competent organizations abroad for PETKIM as well as the visit of the plants was limited due to the lack of continuity in the official channels. Nevertheless, the minimum necessary contacts took place.

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* have not been attached to the Report, due to their volume (they refer to surface active agents, water treatment, chlorine and caustic soda, chemicals for the food industry, and fermentation chemical industry)

15. Two consultants assisted PETKIM and worked together with the experts team in conducting study on pharmaceuticals, dyestuffs and dyestuffs intermediates. The output of these studies is given in three corresponding reports which are to be considered as attachments to the final report. The results of these studies have been evaluated and the conclusions have been given in the chapter "Findings and recommendations".

B. Output produced

After the treatment of collected data, a list of about 50 chemical products or groups of chemicals was established as chemicals produceable at economic scales in Turkey (attachment 11). A priority order has been established for the implementation of projects for the production of these chemical products. The results obtained in the aforementioned treatment and further considerations made it possible to give general guidelines on technological aspects, economic capacities and selection of product mix. However an accurate picture pertaining to the implementation of such projects could not be furnished because this would not be realistic before the feasibility studies are completed, describing the economic parameters at the moment of implementation. Nevertheless some of the items have already been included in PETKIM's long range plans.

III. ACHIEVEMENT OF IMMEDIATE OBJECTIVES

A. As it was mentioned in Chapter 2, considerable time had to be devoted to collect data on the Chemical Industry and the related sectors of the Turkish Economy in order to establish the status of each of the 472 chemicals in relation to their production and consumption, giving special consideration to those which constitute the critical chemical inputs to the more important sectors of the Economy.

B. The interpretation of the collected data, albeit in a rather rough form, allowed a general evaluation of the growth potential of the Turkish Chemical Industry. The dyestuffs and the pharmaceuticals constituted the subject matter of two separate and detailed studies which resulted in two different reports, the one on dyestuffs and dyestuff intermediates comprising two volumes.

C. Apart from the work of the project team, various sectorial reports investigating in particular the flow of chemical materials were prepared with thehelp of the specialists from the sectors concerned.
Furthermore, individual reports on certain groups of chemicals as well as on such topics as natural resources and feedstocks, energy and manpower were prepared (see attachment 6)

D. The collected data on the 472 chemicals encompassed within the sectorial studies and the reports on individual groups of industrial chemicals were also sorted by means of a computer program which not only listed the past consumption statistics and future demand projections for the chemicals in alphabetical order, but also gave the consumption pattern for each chemical (for details see attachments 12, 13 and 14).

E. After a detailed review of the demand projections for the 472 chemicals or groups of chemicals encompassed in the study, about 100 individual sheets concerning the main chemicals were draw up in view of a more detailed study based on the level of their projected consumption in the year 1990, chosen as the pivot for development and giving due consideration to their importance in the overall development of the industry. The data pertaining to the production, consumption imports and exports, if any, of these chemicals were subsequently treated in more detail and commented upon in the form of recommendations with respect to their production in the context of the medium and long term development of the Turkish Chemical Industry (attachment 15).

F. A noteworthy effort was spent in the last part of the project on the processing of the collected data by the computer in the form of a material balance distribution mathematical model. A starting point in the process of the application of mathematical models to the medium and long term planning of the chemical industry was established. It is hoped that this idea will be pursued and further developed (attachment 16).

G. In addition to the draw up of the 100 individual chemicals sheets, as a previous work for the detailed study of the 50 selected chemicals given in the attachment 11, the available raw materials and feedstocks for the Turkish chemical industry were examined.

1. Minerals and ores. Turkey's natural resources have only been partly surveyed and are not yet fully developed. Turkey does have abundant or satisfactory reserves of salt, some minerals and ores, which are important for basic chemical production and special chemicals.

2. Crude oil. The most important raw materials for the chemical industry, crude oil as well as natural gases, are available in limited quantities only. It is true that explorations have not been very intensive and therefore there is wide-spread hope that future drillings will be more successful. The petrochemical industry, including the ammonia production is totally based on naphta. Currently petrochemicals represent 60% of the chemical industry's output but in reality their influence is even wider. Over 90% of organic chemicals are derived from oil and gas as is 95% of ammonia, one of the most important inorganic chemicals.
Turkey's crude oil reserves are estimated at 14 million tons. In 1980, production of crude oil amounted to 2-3 million tons. The domestic production accounted for only 16% of the country's total consumption of oil products and it accounted for 18.5% of the crude oil refined in Turkish refineries.

In 1981 Turkey imported 11.6 million tons of crude oil. Nearly half of the oil came from Iraq, 23% from Kuweit, 15% from Iran and 13% from Saudi Arabia respectively. The Turkish refinery capacity amounts to 18 million TPA. In the last two years capacity utilization has been 70% on the average.
It is planned to increase the capacity of the two largest refineries by 10 million tons. One of the two, namely the Izmir Refinery will play an important role in the Turkish petrochemical industry, since supplies feedstocks to the Aliaga Petrochemical Complex.
In addition, under construction, there is a new refinery located in Ankara Region with an annual capacity of 5 million tons to be commissioned in 1986.

3. Natural gases. Turkey's reserves of natural gases are estimated at around 10 million standard cubic meters (SCM). (Data were furnished by the Turkish Petroleum Corporation in April 1982). Six different reserves have been discovered up to this date, five of which are located in the South-Eastern Part of Anatolia. The other reserve is in the Thrace region (European part of the country). The total recoverable reserves are estimated to be around 18 billion SCM, corresponding to an average daily production of about 20 million SCM.
The estimated daily production potential is about 1.0 million SCM. In 1980 only about 24 million SCM were produced and supplied to a neighbouring cement plant for use as fuel.

4. Coal reserves of Turkey are estimated at 1452 million tons. The production of coal in 1980 amounted to 4.0 million tons. On the other hand lignite reserves are estimated at 5931 million tons and the production in 1980 amounted to 14.1 million tons. (Source: Ministry of Energy and Natural Resources-Report on the Project for Large Range Exploration of Energy Feedstocks, 1980).

The forecasts for coal and lignite production envisage a moderate growth of coal and a very rapid increase of lignite. The production of coal in 1988 will reach 5.0 million tons, while the production of lignite is expected to reach 95.4 million tons, 6.8 times more than in 1980. In spite of some delays in the realization of this program , the production target for lignite clearly demonstrates a decisiveness of the Turkish Government to develop and exploit its great lignite potential. This attitude should be strengthened and wide-spread among all consumers, including the chemical industry which uses oil energy quite extensively.
At the moment, there is no study or project in Turkey aiming to introduce carbohydrates instead of hydrocarbons. It is true that the chemical industry of Turkey is already in position to make some use of carbonization in the production of coke. In fact, for the present, the coke industry is the only producer of benzene in Turkey. There is a program for an enlargement of the production of benzene, but it is tied up with an expansion of the coke production. This expansion has been delayed because of general investment restrictions in the country.

5. Biomass. The use of biomass as a feedstock for chemicals and petrochemicals has not been deeply studied in Turkey. Biomass includes wide range of materials such as forest residues, wood wastes, agricultural crops, agricultural residues, municipal wastes and potential energy crops. These materials are used for food, fertilizers, soil conditioning, structural materials, oils, paper and wood products, for fibers, source of energy and for chemical manufacture. Any use of biomass in a large scale for petrochemicals, as well as for energy, has to be balanced with the present uses.
In the SRI - Stanford Research Institute study "Chemical Feedstocks at the Crossroads", volume I, the total production of biomass in Turkey in 1990 is estimated at 110 200 000 dry metric tons, and out of that the total usable biomass is estimated at 75 500 000 dry metric tons. The total usable

biomass of Turkey for the basic year 1980 is estimated at 14 600 000 dry metric tons. The usable biomass represents the quantity of the material in excess of normal food and fiber requirement and which is produced and available at competitive market price. These estimates ignore the economics of processing or converting biomass to energy forms in competition with conventional resources or sunfuel . The estimated amount of Turkey's usable biomass in 1980 is equivalent to 5.8 million tons of crude oil, and the corresponding figure for 1990 is approaching 30 million tons of crude oil. Two of the raw materials accounted with biomass, starch and molasses, already used for the production of some chemicals, were separately considered.

6. Starch. For 1980, the starch from the surplus production of wheat in Turkey is estimated at 900 000 metric tons. The amount of ethanol that could be produced out of this production amounts to 150 million gallons.

7. Molasses, as a by-product of the sugar industry is produced in high quantities in Turkey. The production in 1981 was of 466 000 tons and it is projected an increasing to 680 000 in 1990, a large quantity beeing considered for export (about 150 000 tons). As molasses is one of the selected products, a more detailed consideration will be given in the next chapter.

H. Other important elements were used for the examination as well as considerations concerning the selected chemicals, as for example the structure of the national economy, the structure of the population and the growth of the population. Special attention was given to the impact of the chemical industry on the agriculture, having in view the problems of fertilizers, pesticides and other special chemicals necessary for a modern agriculture and the possibilities of such a modern agriculture to provide the chemical industry with some raw materials able to substitute partly the imported crude.

I. Based on the aforementioned working documents and with the mentioned principles in view, the 50 selected chemicals and groups of chemicals were examined and considered as follows:

1. Acetic acid. Acetic acid is already produced in Turkey by the fermentation of molasses via ethanol. As a by-product, ethyl-acetate, one of the most used solvents in the coatings industry, is obtained.
The existing capacity of 3300 TPA will be extended to 4700 tons/year until 1990, when the demand will be aprox. 10 200 TPA. For the difference of aprox. 5 500 TPA only a further extension of the capacity based on the same technology could be considered, because :

- petrochemical technologies (from acetaldehyde by carbonization of methanol or from butane by liquid-phase oxidation), as well as the necessary raw materials are not available;
- the economic capacities for these processes are more than ten times greater than the needs of Turkey;
- the experience of the Turkish Producer is based on the fermentation technology;
- the costs and duration of the extension works are more convenient for the fermentation technology;
- the actual sales price of the product for the domestic market could be improved after a new extension;
- the product is absolutely necessary for the petrochemical and textile industries and the only way to avoid imports is through such an extension.

2. Acetone. Acetone is not produced in Turkey at present. A first capacity of 1250 TPA is expected to come on stream in 1983. This production could cover approx. 15 percent of the projected demand in 1990 (8300 TPA) which is expected to further increase during the years after 1990.

Considerations for the installation of a new plant heavily depend on two other products, namely phenol and buthyl alcohol, since acetone is a by-product from the production of either chemical:

- acetone could be obtained as a by-product in the production of phenol within the petrochemical sector;
- acetone could also be obtained as a by-product in the production of buthyl alcohol via a fermentation based process using raw materials of vegetable origin.

Technical information describing the latter technology and giving operating data from a factory in Romania, have already been given to PETKIM. This technology appears as appropriate for Turkey for acetone it-self but because of the phenol required by the development of the industry, both technologies are to be considered within the framework of a feasibility study.
A further point must be underlined here: the acetone-buthyl alcohol process is more flexible. The proportion between the two products could be changed by modifying the operating conditions.
As for the other process, for each ton of phenol 0.600 tons of acetone will be obtained. A suitable phenol capacity for Turkey would be around 40 000 TPA, which would correspond to a production of 24 000 TPA acetone. Of course, the excess quantity could be exported to neighbouring countries.

3. Acethylene and calcium carbide. Production of acethylene in the local conditions as a basic raw material for some petrochemicals, is not economically justified because:

- carbide is produced only in limited quantity (30 000 TPA in 1990);
- carbide is one of the intensive energy consumers and for this reason an extension of capacity is to be avoided;
- the technology and the necessary raw material (natural gas at a cheap price) for a large industrial plant in Turkey

are not available;
- the existing capacity for producing calcium carbide will cover the demand of 1990 and will be beyond the production of acethylene as an "industrial gas".

4. Acethylene black with a total demand of 4500 tons in 1990 and a corresponding value of dollars 18 millions, used only by the Electrotechnical industry, could be displaced by another carbon black already produced in Turkey and adapted for this purpose. The structure of the carbon black particle, its activity as well as dielectric constant figure could be obtained by a corresponding modification of the operating conditions of the carbon black plant. The plant could be operated in these conditions a period of time in accordance with the demand of product for a whole year (i.e. 4 500 tons) and than rearranged for the usual types of carbon black. A close collaboration between the producer and the consumer is necessary to solve this problem in the suggested way.

5. Acrylonitrile. There is no production of acrylonitrile for the time being. A first plant with a 70 000 TPA capacity will come on stream in 1984 at PETKIM's Aliaga Petrochemical Complex. For the beginning the plant will be operated at only 50% of its full capacity. Even with full capacity (70 000 TPA) this plant can not cover the demand of 1990, by a difference of 12 000 TPA.
Assuming that the demand for this important synthetic fiber raw material will continue to increase after 1990 an additional domestic capacity might be necessary. This could be obtained either by installing a new unit within the scope of a possible Third Petrochemical Complex or by revamping the unit at the Aliaga Complex. However a detailed feasibility study would be required to justify such an investment. Detailed investment data for this chemical in local conditions are available from PETKIM.

6. Alkylbenzene sulphonate. A capacity of 13 000 TPA dodecilbenzene (DDB) is operated by PETKIM in its Yarimca Complex. The capacity will be of 20 000 TPA in 1990, as a result of some improvements envisaged by PETKIM.
Sodium - DDB - sulphonate is a typical alkyl aryl sulphonate and synthetic detergent. Also, in Turkey the total produced DDB is used by the concerned sector to produce detergents.
Sodium - DDB - sulphonate has lost some of its importance because of its unsatisfactory biodegradability. A Government restriction was already imposed on the use of DDB in Turkey and consequently PETKIM carried out a feasibility study for the production of linear-alkyl-benzene (LAB) that meets ecology requirements much better than DDB does. In 1990 the estimated demand of DDB is of 20 000 tons and LAB 28 000 tons. In the aforementioned study a plant with a capacity of 50 000 TPA was proposed. For such a plant 18 550 TPA of benzene and 158 450 TPA of kerosene are needed but in the balance of the Aliaga's benzene plant there is no room for this consumption, unless other benzene consumer project is forsaken.
For this reason it is highly recommended to reconsider the study and to include the possibility of partly producing the necessary detergents by using alkane-sulphonate. This is a very promising way to solve the problem.
Basic raw materials for alkane-sulphonate of say 24 000 TPA capacity are n-paraffins and liquid sulphur dioxide in quantities of 17 000 TPA and 10 000 TPA respectively.

7. Ammonia. The main producer and consumer of ammonia is the fertilizers sector. Besides big quantities of ammonia used for fertilizers, quite important ones are used by some other sectors of the economy, first of all by petrochemicals. Because of the restrictions concerning the fertilizers this product was not balanced by the team. The only information concerning the future is about a new plant to be installed in the Marmara area. No information about the capacity and the time it will come on stream were received.

As for the necessary quantities in the period considered, there are increasing figures from 23 000 tons in 1980 to 80 000 tons in 1990. From the projected consumption of 80 000 TPA, 76 000 TPA will be used by the petrochemical sector and the remaining 4 000 TPA by other eight small consumers. For the time being as well as until 1990, some supplementary quantities could be imported in reasonable conditions from Kuweit or USSR, two of the big exporters from the neighbouring countries. The possibility of a long term arrangement with Kuweit in barter conditions with an exceeding chemical product of Turkey is recommended for study.

As for the far future, taking into account the development of the lignite extraction, it is highly recommended to follow in the specialized literature the new process under development i.e. the production of ammonia directly from lignite. The method could be of high interest for the development of the Turkish chemical industry, because it is supposed that this new process will be competitive in energy consumption with the other processes.

8. Antimony and antimony oxide. Antimony, as a metal, is already produced in Turkey and even exported in some important quantities. Antimony oxide and other antimony compounds are not produced.

The antimony oxide is known as a very good flame retardant, used in plastics and rubber processing.

The total demand of flame retardants is estimated to be of 700 TPA in 1990. In this figure some chlorinated paraffins and aluminium hydroxide are included as well as brominated phosphorous compounds and boron compounds.

Because of the big consumption of antimony oxide in the plastic processing allover the world, it is strongly recommended to study the possibility of transforming the exported antimony in antimony oxide at least partially to cover the domestic and export demands. The economic capacity could be established on the basis of a detailed market study. The present price of the product is of dollars 3100/ton.

9. Benzene. For the present in Turkey benzene is being produced as a by-product from the coke ovens in the steel industry. This production can not meet the country's demand, 80% of which is accounted for by the Yarimca Petrochemical Complex (P.C.). More than half of the demand for benzene in Turkey is covered by imports. A very ambitious plan for the development of steel and coke production served as a basis for a programmed enlargement of the coal/coke based production of benzene*. The first naphta based benzene producing facility in Turkey will be the Aromatics Unit of the Aliaga Petrochemical sector expected to come on stream in 1984. This unit will fully meet the requirements of the Yarimca Petrochemical Complex and will have a considerable surplus of benzene available for use as feedstock to new projects or for export.

Table 1

Production Targets and Demand Estimates for Benzene
(Thousand Tons)

	1981	1985	1990
DEMAND :	55	75	84
PRODUCTION :	21	154	286
Iron and Steel Industry	21	(61)*	(162)*
Aliaga P.C.	-	93	124

At present, the consumption pattern of benzene is the following: 35% cyclohexane, 2790 styrene, 13% DDB and 25% for other users among which the most significant one is the leather industry. The demand for cyclohexane (caprolactame) by 1990 will probably not exceed today's production capacity i.e. of 28650 tons.

* The stabilization policy for the national economy, introduced in January 24, 1980, is causing a delay in this plan.

Therefore this end user would not produce a significant claim for additional benzene. Special considerations for other main consumers of benzene, namely styrene and phenol will be given in the individual sheets.
From the summary of all considered quantities and consumers, it appears that, conditionally speaking, 15 000-20 000 TPA of the Aliaga benzene would be available either for other projects or for export.
Recommendations for the use of this exceeding quantity are made for each respective product separately.

10. Borax and other boron compounds. The boron compounds have a big importance for special alloys in metallurgy, for the production of high quality glasses (optical glass) and crystals, in the textile industry as fire retardants and rust inhibitors as well as for high quality abrasives.
The most important in the family of boron compounds is the sodium borate (borax). At present plants of 35 000 TPA boric acid and 60 000 TPA borax (55 000 decahydrate and 5 000 pentahydrate) are under operation. Extension of both decahydrate and pentahydrate capacities is in view until 1990, when the production figures will be 72 000 TPA and 165 000 TPA respectively.
Only approx. 17% of the production of borax will be used in Turkey, the largest part being destined for export.
Boric acid will be produced 135 000 TPA in 1990 of which approx. 30 000 tons will be consumed in Turkey. Also a capacity of 20 000 TPA sodium perborate is operated by ETIBANK. This capacity will cover the projected demand in 1990. The good development of borax and boric acid production and the eventual development of oxides and alloys, could give ETIBANK the possibility of long-term market arrangements to support the efforts for development of the chemical industry as a whole (compensations in the balance of payments).

11. Calcium formate. Calcium formate as well as formic acid are important chemicals for the leather industry w. is one

of the most developed sectors of the Turkish national economy. A capacity of 2 600 TPA formic acid is actually on stream. The technology is based on the processing of imported sodium formate. This capacity will cover only approx. 30% of the projected demand in 1990.
The forecasted value of the imports of formic acid is of dollars 11.2 mill. and dollars 5.4 mill. respectively. The consumption is expected to increase continuously. Due to the value of imports, an enlargement of the existing capacity including the production of sodium formate for the formic acid (and oxalic acid, if necessary) as well as the required calcium formate, is recommended.
The process can start from calcium hydroxide and charcoal (or coke) to produce carbon monoxide by incomplete combustion. The capacities of 10 000 TPA calcium formate as final product and 10 000 TPA acetic acid are considered appropriate for Turkey to cover its domestic market consumption needs.
UNIDO could provide PETKIM with technical information concerning this technology.

12. Calcium oxide. The actual production capacity of calcium oxide in Turkey is enough to cover the local demands. In spite of the increase of the consumption from 40 000 tons in 1980 to 87 000 tons in 1990, the existing capacities will cover and even exceed the demands in 1990.

13. Chlorine and caustic soda. PETKIM is the largest producer of chlorine and sodium hydroxide in Turkey with installed capacities of 32 400 TPA and 36 540 TPA respectively. The second significant producer is KORUMA TARIM, a major producer of pesticides and agricultural chemicals, with 13 000 TPA chlorine and 14 700 TPA sodium hydroxide. The third producer is SEKA, the state owned paper and cellulose company, with 12 800TPA of chlorine and 14 500 TPA of caustic soda respectively. There is also some production of chlorine and caustic soda produced by other small companies at capacities of 1330 TPA and 7140 respectively.

The chlor/alkali unit within the Aliaga Petrochemical Complex will come on stream after 1983 with capacities of 75 000 TPA chlorine and 84 600 TPA caustic soda.
It is projected that the total capacities in 1990 will be approximately 146 000 TPA for chlorine and 170 000 TPA for caustic soda. On the other hand the projected demand levels for the same year are about 158 000 tons of chlorine and 215 000 tons of caustic soda.
Considering the production deficits projected for 1990, it is apparent that unless more outlets for chlorine are created by 1990, the required additional production of caustic soda (about 5 000 tons) via electrolysis of salt, will not be viable. It is therefore highly recommended to affect the production of this additional amount of caustic soda through other processes, such as Le Blanche process, using sodium carbonate as feedstock.

14. Copper sulphate. The production of copper sulphate in Turkey started in 1980 only, and the actual operated capacity (3 000 TPA) represents only 30 percent of the projected demand in 1990. No other capacity is expected to be built until 1990.
It is to be mentioned that copper sulphate is remaining again an important chemical for the agriculture even in developed countries like USA. For the treatment of some plants no other new product has occupied the same place as pesticide as the copper sulphate.
Due to the value of imports (dollars 6.3 million in 1990), the experience achieved by operating the existing capacity in Turkey as well as the existance of the necessary raw material, a corresponding extension of copper sulphate production to cover all demands is recommended.

15. Caprolactame. Caprolactame is already produced in Turkey. A plant with a capacity of 25 000 TPA is operated by PETKIM in its Yarimca Petrochemical Complex. The installed plant is based on Inventa process, using as principal feedstocks

benzene, phenol or cyclohexane.
The total production of caprolactame is destined to the textile sector. The installed capacity will cover the demands projected for 1990 to 22 500 tons. The domestic consumption in 1982 is projected to only 14 250 tons. The remaining quantities are exported each year until 1990 and beyond. Caprolactame was considered for the beginning in the balance of the benzene produced by PETKIM.

16. Dimethyl terephtalate and terephtalic acid. A capacity of 60 000 TPA dimethylterephtalate is operated at present by SASA. The process is based on the treatment of paraxylene with methanol (Hercules-Witten catalytic process). SASA is planning to increase the production capacity to 145 000 TPA (in 1985).
The total production of SASA is destined to the Textile sector for the polyester fibers.
Also, a capacity of 70 000 TPA terephtalic acid will be installed in the PETKIM's Aliaga Petrochemical Complex. From these 70 000 TPA terephtalic acid a quantity of approximately 60 000 TPA - dimethyl/terephtalate will be obtained by esterification.
Inspite of the fact that the textile industry in Turkey is very developed, the projected capacities represent a good stage of development of the syntetic fibers industry in this country. For the year 1990 an export of 60 000 tons is projected. Nevertheless important quantities are projected for export even earlier (15 000 tons were exported in 1981).

17. Dyestuffs. In the framework of the Turkish chemical industry as a whole, dyestuffs production represents a major problem. The importance of the problem is deeply connected with the position of textile industry and leather industry, as the main dyestuff consumers in the economy of Turkey.
The existing Turkish dyestuffs industry as well as the development possibilities have already been studied by an expert of UNIDO. The two reports given by this expert are considered as attachments to this final report.

The technical parts of both these reports have been rechecked in the final part of the Project DP/TUR/79/003 (February-March 1982) and it has been concluded that they are well done and appropriate for the purpose. As for the economic considerations and recommendations, these parts are to be reviewed and reconsidered in the framework of a feasibility study. In fact this industry is technically a very complicated one, much more sophisticated than it appears to be at a first glance as it needs highly trained personnel and know-how transfer that cannot be obtained in a short time. For these reasons a successively staged development is recommended, starting with some of the intermediates which are also of interest for other branches of the chemical industry. Such an intermediate could be aniline, which is also of big interest for rubber and pesticides as well as for the production of isocyanates.

18. Etanolamines. Mono-, Di-, and Triethanolamine are usually produced from ethylene oxide and ammonia. The ratio of the three products depends on the reaction conditions.
None of these three chemicals is produced in Turkey at present. Triethanolamine is mostly used in the soap industry. The projected consumption in 1990 will be of about 2 300 tons. The other two ethanolamines could also be used in the soap and detergents industry and in the production of other surface active agents for the textile industry.
The necessary ethylene-oxide to produce amines will be available from the Aliaga Complex. It is to be mentioned that the process for the production of amines is not a complicated one, but most of the equipment should be made of stainless steel due to corrosion problems.
It is recommended to conduct a feasibility study on the production of ethanolamines from ethylene oxide and ammonia within the petrochemical sector.

19. Fats and fatty acids. Regarding fats and fatty acids, a total projected demand of about 110 000 tons in 1990 has been established after considering the consumption level envisaged

in various sectors. Despite the fact that fats and fatty acids respectively are two different groups of products, the total projected demand figure of 110 000 tons in 1990 could not be divided due to the lack of data into two separate figures representing the demand level for each group.

It is believed that Turkey should not have problems in the case of fats.

As for the fatty acids, through extrapolation of other data and a consideration of per capita consumption levels in other countries, it has been concluded that a quantity in the order of 10 000 tons of fatty acids would meet the domestic market requirements in 1990.

It must be underlined that no synthetic fatty acids production is necessary for Turkey. It is advisable to consider raw materials of animal origin only. A detailed study of the relative amounts of soap, detergents and other surface active agents to be produced in Turkey could give a more realistic view of fats and fatty acids production.

20. Ferro alloys. In this group of products, ferrochromium, ferromanganese, ferrosilicium and ferro-molybdenium are considered.

Two of the products i.e. ferrochromium and ferrosilicium ar produced by ETIBANK, a state company specialized in fine metallurgy. The other two products are imported and no capacity is forseen to be installed during the concerned period. The import value of these products in 1990 is estimated to be more than dollars 200 million. As for the ferrosilicium, the capacity of 5 000 TPA represents only 10 percent of the projected demand in 1990, whose import value is forecasted to be approx. dollars 85 million. Ferrochromium is produced on a large scale (60 000 TPA) mainly for export (75%).

The high value of the imports forecasted for 1990 as well as the local availability of raw materials justify a special study (market, technical and economic) for this family of products, examining the creation of new capacities

to produce more ferrosilicium and even ferrochromium to compensate the imports by exports.

21. Formaldehyde. Three companies in Turkey are producing formaldehyde from methanol: POLISAN and BASF, using silver catalyst and DERBY with ferric-molybdate catalyst. The actually total installed capacity is of 70 000 TPA. A growth to 88 000 TPA is projected for 1990.
The domestic consumption does not need the whole of the produced formaldehyde at the time being or in 1990. The remaining product will be exported. The quantity for export in 1990 is projected to 13 000 tons.
The main consumer is the petrochemical sector, (95%) for the formaldehyde resins.
Because of the proportion of formaldehyde and other ingredients (phenol or urea), considerations about formaldehyde resins are given within the phenolic resins paragraph.

22. Formic acid. There is only a small capacity of 2 600 TPA installed and operated in Turkey by Cukorova Kimya and Forsan to produce a part of the formic acid necessary for the leather sector. It is the only capacity to be operated until 1990.
Even now, part of the necessary formic acid is imported, but imports are continously increasing until 1990, when the projected consumption will be of 8 900 tons, the import representing dollars 11.2 million.
Taking into account the importance of the leather industry in the framework of the Turkish national economy as well as the existing possibilities to install a new capacity of 10 000 TPA, such a recommendation was already made within calcium and sodium formate (sec. 11).

23. Furfural and related products. Furfural is produced in Turkey in a small plant. The capacity of 2 000 TPA in 1990 represents only 66% of the projected demand. The actual consumer in Turkey is the Refineries sector.

No tetrahydrofuran is produced, despite that fact that both products are much used as solvents for phenolic resins and PVC as well as dispersants in the finishing of textiles.
Because of the existance of raw materials in Turkey and the consumers' interest abroad, the extension of furfural and related products production in Turkey is recommended, based on the detailed information given in Dr. Sobel's Progress Report, May 1980, page 18.
Nevertheless, a detailed feasibility study on the subject is fully justified. Prior to such a study it is recommended to enquire about the long term arrangement possibilities pertaining to the marketing of furfural and related products both in Turkey and abroad.

24. Glycerine. The actual production capacity of glycerine in Turkey is 2 500 TPA and it will increase until 1990 to 7 000 TPA. This capacity represents more than twice the projected demand in 1990. The glycerine is in fact a by-product from the soap industry and a further increase in the production capacity will be dictated by the development of the soap industry.
Even after 1990 no spectacular increase in domestic demand is expected to justify an investment in a petrochemical glycerine plant.

25. Hydrogen peroxide. There is no hydrogen peroxide production in Turkey at present, but a plant with a capacity of 15 000 TPA will come on stream in 1983, to cover the demand of Turkish market and to create some export possibilities. The exports in 1990 are forecasted to be 5 000 TPA. The domestic consumption will increase by some 200 tons each year. With such a target the existing capacity will be sufficient to cover the needs for the next twenty years and even longer.

26. Lubricants and additives for lubricants. A special study concerning the lubricants was carried out by PETKIM.

The quantity of lubricants (luboil and grease)to be consumed in Turkey in 1990 is estimated to be 320 000 TPA. Also, to produce this quantity of lubricants approxim. 22 000 TPA different additives will be necessary. The value of the import of additives projected for the same year (1990) is of dollars 110 million.
Because of the high value of imports the mentioned study was carried out.
The manner in which the problem was treated by PETKIM, gives us the right to consider as realistic the possibility to produce the largest part of additives gradually.
In fact the preparation of lubricants needs a good base of oil and also a large number of additives to obtain a high quality of the end product . There are additives for different purposes: oxydation inhibitors, corrosion inhibitors, erosion inhibitors, dispersants, alkali additives, rust inhibitors, lubricators and extreme pressure additives.
The principal types of additives used in formulating engine oil are as follows:

- organo-metallic detergent (as calcium or magnesium sulphonates or phenates) with the role to keep the hot parts of the engine clean;
- dispersants (as for example alkenyl succinimides) with the role to avoid the formation of sludge;
- antioxydants (as the diaryldithiophosphates);
- viscosity index improvers (as for example polymethaacrylate or other similar polymers of the polyolefin) used to confer "multigrade" quality to the lubricants.

For the time being only two products are produced in Turkey (two dispersants) the remainder being imported.
The solution of this problem is deeply depending on a good collaboration and co-ordinaticn between the Refining and Petrochemical sectors focussed on the common effort to minimize the imports.

27. Maleic anhydride. There is no production of maleic anhydride at present. The demand in 1990 is estimated to be about 2 400 TPA. The product is consumed mainly for the

production of polyester resins. It is also consumed by pulp and paper industry and by glass industry. In the developed countries approx. 50% of maleic anhydride is consumed in unsaturated polyester resins (about three-quarters of these go into reinforced plastics applications, that is building panels, marine craft and accessories and automobiles. The remainder are used in casting resins, putty resins, and clay pipe seals).
Maleic anhydride is also used in manufacture of agricultural chemicals: malathion, captan and maleic hydroxide. Some quantities are also used for alkyde resins.
From these considerations, the demand figure seams to be underestimated. New consumers will probably ask for additional quantities even in the near future.
An in-depth examination of the problem within the framework of a feasibility study for the installation of a plant in Turkey is recommended. A capacity of 10 000 TPA could be considered as economic. Both processes, starting from benzene or from n-butane, are to be studied and compared under the local conditions.
Maleic anhydride could also be produced as a by-product within the process based on naphtalene to produce phtalic-anhydride, but for this product another process is recommended for the local conditions (see phtalic-anhydride).

28. Methanol. Methanol is one of the basic intermediates required for the production of a large number of other chemicals and due to the forecasted problems in the availability of conventional raw materials in the future, its importance will increase more and more.
Many consumers and producers are now involved in studies to establish the future pivot position of methanol in the chemical industry. New raw materials to produce methanol are being considered.
As for the Turkish chemical industry, about 70 000 TPA will be required in 1990, according to the projected demand figures. At a first glance, this figure could justify an investment but a market study will demonstrate the possibility

to avoid investment efforts at least for the next 10-15 years because of the existance of big capacities, all around the world, giving possibility to obtain the necessary methanol at a reasonable price through imports.
However, during the course of time, this situation will presumably change and because methanol will probably become a pivot for the development of the heavy organic chemical industry in Turkey, a study to establish the viability of methanol production at a large scale in Turkey will certainly be of interest. PETKIM is now able to carry-out such a work, using the methods developed in the common work with UNIDO team.
According to the information received from the Turkish Petroleum Company, there is a known national gas reserve of about 10^{10} Nm^3 at Hamidakat within the province of Kirklareli (Thrace).
The analysis of this gas which is virtually sulphur free, has indicated a C_1-content of 94.6% which is ideal as a methanol feedstock. It has been estimated that the annual production of methanol from the aforementioned reserve could be of the order of 250 000 TPA. Consequently, the said reserve would be sufficient for a large capacity methanol plant. It is therefore strongly recommended to arrange for the necessary co-ordination between the parties involved for the use of this gas reserve as a chemical feedstock for the future, and not as a fuel as used now.

29. Methy-ethyl-ketone and other oxygenated solvents. There is no production of methyl-ethyl-ketone (MEK) in Turkey and the demand in 1990 is forecasted to 1 700 tons.
As a special space was reserved for industrial solvents in this chapter (see 39), MEK production is considered there (group C).

30. Molasses. Molasses could be considered within the framework of biomass, because of their origin, as a by-product of the sugar industry. The quantity of molasses to be produced

in 1990 is estimated to be about 680 000 tons and for the same year the projected demand of the Turkish market is only 450 000 tons. Approximatelly 70 000 tons are considered to be used as animal food and the difference of approx. 150 000 tons should be available for export.
70 000 tons destined for animal breeding could not really be considered available for an potential chemical transformation, since breeding livestock is an important sector of the National Economy. On the other hand the important quantity of 150 000 tons foreseen for exportation could be considered as a suitable raw material for the production by fermentation of ethanol and its derivatives through chemical means.
With a specific consumption of 4.3 tons molasses per ton of ethanol, from 150 000 tons of molasses, about 35 000 tons of alcohol could be obtained. Part of the available molasses could also be transformed into acetic acid to cover the domestic needs. For a quantity of about 12 000 tons acetic acid, with a specific consumption of 5 tons molasses per ton of acetic acid, about 60 000 tons of molasses as raw material input, the remaining 90 000 tons are sufficient to produce about 21 000 tons of alcohol. Ethanol could be the starting point for a wide spectrum of chemical products, including acetaldehyde, acetic acid, chloral, ethyl ether, di-ethyl amine, ethyl acetate, glycol ethers as well as other more sophisticated products. Because starch is also considered as a raw material for ethanol, it would be worthwhile to carry out a detailed feasibility research program on the fermentation industry using raw materials of agricultural origin.

31. Phenol. Big quantities of phenol are imported to meet the demand of domestic market in Turkey because only a quantity of 445 TPA is obtained as a by-product in the iron and steel sector. This represents 3.56% of the projected demand in 1982 and only 1.59% in 1990. The main consumer of phenol is the petrochemical sector (97.2% in 1990).

Within the acetone paragraph (point 2) it was already suggested a comparative study between the cumene process to produce phenol-acetone and starch fermentation to produce acetone-butanol-ethanol. A capacity of 40 000 TPA phenol could be considered suitable for Turkey, at the economic limit.

Because of the by-product that will by far exceed the domestic demand within the cumene process, it seems more appropriate to adopt for the phenol the chlorobenzene process and for acetone the fermentation of starch because butanol and ethanol are necessary on the market, as well.

As for the chlorobenzene process for phenol production some advantages for the local conditions are to be noticed i.e. a reduced consumption of caustic soda and an important consumption of chlorine under the form of chlorobenzene (1.250 ton/ton) and as hydrochloric acid (0.513 ton/ton).

There are two modifications in the hydrolysis process by which phenol is made from chlorobenzene, but only one is used commercially, namely the one which uses caustic soda as hydrolysis agent. The carbonate process (with sodium carbonate solution) theoretically has an advantage over the caustic process as the phenol is present in the reactor efluent rather than sodium phenate.

The substitution of caustic soda by sodium carbonate appears very attractive for the local conditions in Turkey but only a detailed study, combining the problem of phenol-acetone as well as the comparison between cumene process and chlorobenzene process to produce phenol could give full arguments for future investments.

These problems should be considered as integrated with the chlorine and caustic soda, the substitution of caustic by sodium carbonate, the use of the chlorine in chlorobenzene-phenol diphenilidene process and with mono-di- and trichlor-benzene, to 2,4-D.

This is a good item for the linkage and the integrated production and it is recommended to conduct this study in a very attentive manner, in order to become a model for integration in the chemical field.

32. Phenolic resins and other thermosetting resins. In this group the following products are considered : urea formaldehyde resin, phenol-formaldehyde resin, melaminformaldehyde resin, phenol-formaldehyde moulding powder and urea-formaldehyde moulding powder. The production of 1979 which is considered a pivot year for the past, and the projected production in 1990, as pivot for the future are given below in metric tons :

	1 9 7 9		1 9 9 0	
	Production	Demand	Production	Demand
Urea formaldehyde resin	43 885	43 885	88 113	88 113
Phenol-formaldehyde resin	9 827	9 827	35 016	35 016
Melamine-formaldehyde resin	3 521	3 521	9 810	9 810
Phenol-formaldehyde moulding powder	1 363	1 363	2 170	2 170
Urea-formaldehyde moulding powder	6 831	7 396	7 220	25 424

a. Urea-formaldehyde resins. There are six different companies in Turkey producing urea formaldehyde resins. The total installed capacity (1982) is of 68 000 TPA. To cover the demand in 1990, extensions of the existing capacities are in view.
As for the consumers, there are a lot of small companies that process the resins to produce different goods. An important user of this resins is the textile sector for the finishing of fabrics. The projected figure of consumption for this purpose is of 10% from the total production.
There are no special problems concerning the production in the future.

b. Phenol-formaldehyde resins. A total installed capacity of 31 300 TPA is owned by five Turkish companies. The difference of some thousand tons between this capacity and

the actual demand makes the subject of the extension of one or more production plants without arising any technical or technologic problems.
The only problem is to meet the necessary quantity of phenol by imports. The growth in consumption is quite spectacular in comparison with other products of this group. The main consumer is the food industry for packaging boxes. This aspect will be considered again within polystyrene (see 41).

c. Melamine-formaldehyde resin. There is no production of melamine in Turkey. The demand in 1979 was 3211 tons and the forecasted figure for 1990 is 5403. The total of melamine is absorbed by the melamine-formaldehyde resins producers. Melamine-formaldehyde resins are produced currently in Turkey. A total installed capacity of 7 500 TPA is divided between DERBY, ALTINEL and POLISAN companies.
For the difference of about 2300 TPA in 1990, corresponding extensions of the existing capacities will be made. The main consumers of resins are the electric and electronic sectors for special equipment production.

d. Phenol-formaldehyde moulding powders are also produced by DERBY and another company in small quantities (1363 tons in 1979 and 2170 in 1990) for the same electric and electronic sectors. There will be no special problems for its production even for a higher demand if the phenol problem is solved.

e. Urea-formaldehyde moulding powder. There is only a 7 200 TPA installed capacity to produce this powder that is owned by three companies. No enlargement of the production is expected until 1990 when the demand will be probably of 25-26 000 tons. This is the only real problem for this group of products. Because the user is again the electric-electronic sector, to avoid the import it is recommended to conduct an in-depth study having in view the existing experience (know-how) of each of these companies and the possibility to extend the capacity for the period after 1990, as well.

33. Phtalic anhydride, plasticizers unsaturated polyester

and alhydic resins. The production of phtalic anhydride in Turkey first started in 1966. The existing capacity is of about 18 000 TPA and it belongs to two private firms. One of these firms stopped the production activity in 1977 on economic grounds.
The existing capacity in operation is estimated to be of 11 000 TPA. A new unit with a capacity of 30 000 TPA within the Aliaga Petrochemical Complex is expected to be on stream in 1984. With a total domestic capacity of over 40 000 TPA, the local market will probably be just covered up till the end of the '80s.
The projected demand for 1990 is around 50 000 TPA.
The worldwide consumption pattern for phthalic anhydride is given as follows:

- plasticizers %50
- alkyd resins %20
- unsaturated polyesters %25
- dyestuffs and others % 5

In Turkey it has been estimated* that 85% of the consumption of this important chemical was in the production of plasticizers (phthalates). Most of the remaining 15% are consumed for the production of alkyd and unsaturated polyester resins. Since phthalic anhydride is a vital intermediate for the production of many important classes of dyestuffs and pigments, after the startup of the Aliaga Plant, a significant development in the field of dyestuffs started.

34. Polyols, isocianates, polyurethanes.

a). The polyurethanes are actually produced in Turkey by a number of small companies in the private sector using imported raw materials and intermediates. The projected consumption for the year 1982 is of about 25 500 tons. This figure has been estimated backwards on the basis of the local demand

* Dr.A.Tigrel, "Phtalic Anhydride", Petkim Journal, to be published in June 1982.

for tolylene di-isocyanate (TDI), which is totally supplied through imports. On the same basis, a quantity of 29 000 is forecasted for 1990.

b). Polyfunctional isocyanates are essential for the production of polyurethanes, the most widely used being tolylene diisocyanate (TDI) and methyl di-phenil di-isocyanate (MDI). For the production of these iso-cyanates both the short and medium-term prospects are not bright since the aromatic amines and phosgene required for their production are not available locally and have to be imported.

c). The other essential group of raw materials for the production of polyurethanes are polyether polyols.
Polyols are produceable from propylene oxide. The problem of the production of propylene oxide is closely interrelated to the propylene balance in the petrochemical sector which, at present, does not appear to be suitable since as in 1985 all the available propylene will be allocated for the production of polypropylene, acrylonitrile and DDB, the remainder being directed to the LPG-pool.
On the basis of the above given considerations it would be more appropriate to review the status of the polyurethanes industry with respect to feedstocks and intermediates at a later stage.

35. Potassium salts. Three of the potassium compounds are significant in Turkey, these being the silicate, bichromate and carbonate.

a). An installed capacity of 6 700 TPA potassium silicate operated by EGE KIMYA cover the demand even beyond 1990, since the projected consumption in 1990 is only 3 700 tons. The demand of the domestic market was 1 000 tons in 1979. The decreasing difference of production between the nominated capacity and the domestic consumption in the period 1979-1990 is forecasted as exportable.

b). The current production level of potassium bichromate corresponds only 40 percent to the level of the projected demand in 1990. The existing capacity is of 450 TPA. The product is required for the textile industry. Because of the importance of textile products in the total volume of Turkish exports, the potassium salt is very significant, too.

The import value for 1990 is projected to be around 1.6 million.

c). Potassium carbonate, necessary for seven different sectors and mainly for glass industry, is not yet produced in Turkey. The import costs for the projected demand of 3 800 tons of this product in 1990 are estimated as dollars 3.5 million.
Since a total of over dollars 5 million will be required for the importation of these chemicals in 1990, a separate feasibility study, to indicate the viability of installing additional capacity for the bichromate and a new plant for the production of potassium carbonate, are strongly recommended.

36. Pesticides. For the production of pesticides in Turkey a special study has been carried out by the Pesticides Research Directorate.

The presentation of the interdependency between petrochemistry and organic chemistry would not be complete without paying due attention to the problem of pesticides.
Agriculture in Turkey still emerges as the most important sector of the economy. It is vital that agricultural output be greater to feed the ever increasing population and, at the same time, to increase foreign exchange earnings through the exportation of agricultural products.
Among the pesticides used by agriculture in Turkey there are about two hundred different active ingredients.

Of these only DDT, BHC, TMTD, Eystone (copper sulphate), 2-4-D ester, Mineral oil, Sulphur and DDVP are being produced locally. However, the local production of some of these chemicals (as f.e. 2-4-D ester) is virtually completely based on imported raw materials or intermediates. Of course, it is impossible to consider the production of all the necessary active ingredients in Turkey. Even in some of the developed western countries, all this chemicals are not being manufactured.

Of the active chemicals produced in Turkey, sulphur and copper sulphate are not produced in sufficient quantities and consequently the deficit of these materials is covered through imports. The most used active chemicals that require a high level of foreign exchange expenditures are in fact 33 individual products. The current value of the import of these 33 products is approximately dollars 46 mill. From this group of active ingredients the following fifteen are suitable for production in Turkey: 2-4-D acid, trifluoralin, propanil, PCNB, parathion methyl, methamidophos, dimethoate, dialifos, malathion, diazinon, fenthion, trichlorphon, dicofol, zineb, maneb, manezeb and methylzineb*.

The production of these chemicals should not be considered as a problem of the immediate future since most of the raw materials required for their production are not available locally and therefore have to be imported.

The problem should be pursued within a development scheme for a properly organised intermediate chemicals industry which would provide the infrastructural network for the production of a number of chemicals required as inputs in not only the pesticides industry but also in the production of dyestuffs and the chemicals for the rubber, plastics, leather and textile sectors respectively.

37. Sodium salts. The group of sodium compounds is dominated by sodium carbonate and caustic soda. As caustic soda

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* Report on Pesticides, Pesticides Research Directorate, Ankara (1981).

has already been considered together with chlorine, only the other compounds of sodium are considered in this section. In the available statistical data on the consumption levels in Turkey as many as 19 products, including caustic, are mentioned. For example:

a) Sodium carbonate. The existing installed capacity is 150 000 TPA operated by MERSIN SODA. A new capacity of 150 000 TPA is expected to come on-stream in 1982. No other capacity is provided until 1990. Important quanitites of sodium carbonate remain for export after the second plant comes on-stream since the domestic market will only absorb 100 percent production in 1987. The problem of the production of sodium carbonate could not be considered as clear or solved in Turkey since, in 1988, some thousand tons will have to be imported to meet the demand. For the years after 1988 import will increase again. On the other hand, some substitution of caustic soda in the textile sector and even in the chemical industry should be examined more thoroughly as already recommended.

b) Sodium bicarbonate

and

c) Sodium bichromate are already produced and even exported to a certain extent.

d) Sodium silicate is produced sufficiently for domestic needs.

e) Sodium bisulphite - very necessary for the leather industry which is an important sector of the economy - is currently imported and will continue to be imported in the future. For 1990 the value of imports is estimated at $3.3 million.

f) Sodium hydrosulphite is also imported and for the imports $7.0 million will be spent in 1990. For some of the remaining products the existing capacities are insufficient. As for the rest there are no producers in Turkey and the necessary quantities are only met by imports.

Therefore it is highly recommended to conduct a detailed study on sodium salts used in the Turkish chemical industry, with a view to establishing the significant level of their consumption in a number of different sectors of the industry.

38) Starch. The available information on this product is not edifying with regard to its real potential for the development of the chemical industry in the country.

The production of starch is statistically considered within flour and flour products in the framework of the food industry. There is no separate figure for the starch in this group. The only certain information consists in the existance of a capacity of 28 000 TPA operated at present. The product of this factory is mainly used in the textile sector for the finishing of fabrics.

A remaining quantity of 5 000 TPA in 1990 will not be sufficient as feedstock for an acetone-butane-ethanol plant, in the case that the result of the comparative study with phenol-acetone is favorable for the fermentation pr ocess to obtain acetone. Because the chlorobenzene process to produce phenol seems to be more appropriate for Turkey than the cumene based process, the fermentation process for producing acetone will become attractive.

It is necessary to pay more attention to the fermentation chemical industry in Turkey because of its potential development on the whole.
For this reason, starch must be considered within molasses as basic raw material for the future and consequently treated in the framework of the recommended feasibility study for agricultural raw materials (see 30 - Molasses).

39. Stearine, stearic acid and salts. Inspite of the fact that Turkey has a good source of stearine, it was not possible to obtain some information concerning the actual production or the projected data for the future.
As it was mentioned before (point 19), under the common name of fats and fatty acids, lots of products are summated in the statistics. The quantity of 110 000 tons in 1990 includes, of course, the stearine and stearic acid as it results from the food industry sectorial study.
Some figures for 1990 concerning the demands of plastic and rubber processing sector in stabilizers, are referring to four stearic acid compounds. These are: 7.43 tons of monobasic lead stearate ; 263 tons of dibasic stearate; 22 tons of zinc stearate and 9 tons of cobalt stearate.
It is supposed that some other products are used by consumers under trade names unidentified as pertaining to this family.
Because of the lack of information it was impossible to give right consideration to this group of products.

40. Solvents (industrial solvents). This general name covers a large number of chemicals and petrochemicals. The group of industrial solvents could be divided as follows:

a). Alcohols, used for cosmetics, coatings, adhesives, inks, photographic films, pharmaceuticals and as fuel additives. The main individual products of the group are: amylalcohols, buthyl alcohols, ethyl alcohol(ethanol), isopropanol and methanol;

b). Esters, mainly represented by amyl acetate, buthyl acetate and ethyl acetate and used for adhesives, coatings, inks and pharmaceuticals.

c). Glycol ethers, for example tetrahydrofurane used for adhesives, coatings, textile, lubricants and pharmaceuticals. Three members of this group are particulary important as solvents: acetone, methylethylketone (MEK) and methylisobuthylketone (MIBK).
Since it does not create problems with respect to the air pollution and has quick drying action, MEK can be considered as a serious competitor for many other solvents.

d). Hydrocarbons (from petroleum) known as BTX group (Benzene, Toluene and Xylenes) are used for additives, coatings and inks, pharmaceuticals and fuel additives.

e). Chlorinated hydrocarbons, main products in this group being carbon tetrachloride, chloroform, ethylchloride, ethylene chloride, perchlorethylene and trichlorethylene, used as fuel additives as well as for dry cleaning (perchlorethylene).

f). Carbon disulfide, used in rubber industry and manmade fibers.
Many of the above mentioned chemicals and petrochemicals have been individually considered in the experts' report and even in this final report because some of them are also used for other purposes than solvents. Basic information concerning the technologies and economics related to the production of different solvents are given in Dr. Sobel's Progress Report from May 1980.
The total projected demand of solvents,as it appears in the working papers of our team, will be of about 90 000 TPA in 1990.
During the course of data collection within the framework of this study, great difficulties were encountered in obtaining

consumption figures for specific solvents, since many small private sector firms simply quoted figures under the heading "solvents", without specifying anything on the nature of chemicals in question. It is highly probable that a significant proportion of the "solvents" considered as special products could be substituted by other chemicals some of which could already be manufactured in Turkey. Consequently, it is strongly recommended to carry out a detailed study on the problem of solvents in Turkey. Such a study will no doubt be of great assistance to many small companies utilizing solvents for a variety of purposes, and in general terms will be of great value to the economy of the chemical industry as a whole.
In the framework of this study the problem of the chlorinated Paraffines, as pointed out in the Dr. SOBEL's PROGRESS REPORT, May 1980, page 165-175, must be in-depth studied for the local conditions and adoption of the necessary proposals.

41. Styrene and polystyrene.

a). A plant with a nominatal capacity of 25 000 TPA styrene, based on U.O.P. licence is operated by PETKIM in its Yarimca P.C. (Petrochemical Complex). In 1981, only 19 450 tons were produced. This is in fact the real capacity of the plant, based on 300 days of operation per year.
For 1990, to meet the demand of the domestic market, an import of about 6 000 tons is forecasted.
The raw materials for styrene are supplied by Yarimca Petrochemical Complex (the ethylene) and Turkish Steel Industry and by the import of benzene.
PETKIM estimated the demand for styrene to be 23 600 tons in 1985 and 25 800 tons in 1990. In fact these estimates are derived from the production targets for polystyrene and SBR for these years.
No enlargement of the existing styrene capacity is envisaged in the concerned period.

b).Polystyrene PS) and styrene-butadiene rubber (SBR) are the only consumers of styrene, both being produced in Yarimca P.C.
Polystyrene production was 12 300 tons in 1981. The forecasted production in 1990 is 13 500 tons.
In PETKIM's study on plastics and rubber sector of Turkey, it is recorded that polystyrene processing industry has a capacity of 45 800 tons and that this industry will consume 22 000 tons of PS in 1985 and 35 000 tons in 1990. In addition to this, the study forsees that consumption of PS in those years by the Electricity and electronics sector will reach 20 000 tons and 33 400 tons respectively.

From the above facts it is possible to conclude :

1. present level of polystyrene used in Turkey is low and depressed probably due to the lack of styrene;
2. forecasts for PS consumption show a widening gap between planned production and demands which could be solved either by a new production or through imports.

The above figures and the analysis of Turkish market bring arguments for the installation of a new polystyrene capacity of about 40 000 TPA, in order to have optimal economic results from its operation. It is still necessary to carry out a detailed marketing study, breaking the polystyrene into four markets :

- expandable PS, which is the substance of hot beverage cups, protective packaging and picknick coolers, PS sheets for insulation of houses and protected vegetable breedings (green houses);
- foamed PS, which is the material for sandwich containers, meat trays and egg cartons;
- medium and high impact rubber-modified materials;
- crystaline material for transparent boxes, drinking glasses and other breakable plastic goods.

For sure, the study will not only show importance of PS

for the domestic market but also its significant role for packaging exports of Turkish agricultural and industrial products.
This kind of packaging is more appropriate for agricultural (foods) than other products - which is the case of PVC or phenol-formaldehyde resins, as it was commented before.

c). The SBR production in Yarimca PC is the second large consumer of styrene and the last one to be counted for in today's consumption pattern of styrene in Turkey. In 1980 the production was about 18 000 tons, and with no imports it covered the needs of the domestic market. For 1990 the demand for SBR is expected to reach 48 000 tons while the production target for the same year is 38 000 tons. This will increase consumption of styrene but will not produce great pressure on the product line.

d). Any future marketing analysis of styrene situation in Turkey has to give due consideration to the copolymers ABS and SAN and the unsaturated polyester resins. These products have not received due attention from the policy makers of this sector, despite the fact that they play a very important role in energy conservation. The importance of these products may be well illustrated by their 18 per cent share of the monomers produced in the USA.

To conclude the open problem of styrene and polystyrene it will be necessary to carry out a complex thorough study (market, technical and economic) having in view to establish the conditions for the recommended new capacities of polystyrene.
Apparently a similar proposal should be made for the styrene, because of the linkage of these products and the lack of styrene in the next years. Such a recommendation was avoided for the following two reasons :

- to diminish the investment effort by difference of a simultaneously investment for both styrene and polystyrene new plants;

- the existance of an exceeding capacity for styrene in the world and the reasonable conditions to import the necessary quantities for some years after the new polystyrene plant will come on stream.
  Nevertheless the import of styrene should not be considered a solution for ever although, of course, in the framework of the study styrene should also be examined under all aspects. It is recommended for instance to conduct a comparison study between dehydrogenation processes and oxidation-epoxidation processes (Oxirane, Shell International) in the Turkish local conditions. In the meantime experiments of an industrial plant operation in Yarimca will be very usefull for the decisions that should be made in this respect. The unsatisfactory results of the starting operation of this plant should determine an objective comparison of the processes.

42. Sulphur and sulphuric acid.

a). As a basic raw material for the chemical industry sulphur is used in large quantities. The expected consumption of sulphur in 1982 is of 234 000 tons. The main consumer is the fertilizers industry with 190 000 tons and petrochemical sector with 30 000 tons. The difference of about 14 000 tons is used in other five sectors of the economy. The domestic production in this year will be of 72 000 tons and will remain the same until 1990. For 1990 the projected consumption is 434 000 tons, 90% of which will be in the fertilizers industry, the remainder being required for the production of other chemicals. Because only 72 000 TPA could be provided from domestic sources, the difference will be met by importation. In fact there are very few countries self-sufficient in sulphur.
The consumption pattern of sulphur outside the fertilizers industry as projected for the year 1990 is given bellow:

- Petrochemicals	33 600 tons
- Plastic and rubber	6 900 tons
- Mining	3 000 tons
- Pulp and paper	1 900 tons
- Dyes, varnishes	500 tons
- Petroleum products	400 tons
TOTAL	46 300 tons

b). Sulphuric acid. The greatest part of sulphur is used to produce sulphuric acid for the fertilizers industry. The projected figures for the consumption of sulphuric acid outside the fertilizers sector are the following :

- Mining	240 000
- Leather	20 000
- Pulp and paper	17 600
- Food	16 200
- Textile	13 000
- Petrochemicals	12 250
- Fermentation sector	10 400
- Electricity	6 800
- Petroleum products	600
TOTAL	336 802

With a specific consumption of 0.328 tons sulphur per ton of sulphuric acid (obtained by double absorbtion process and V_2O_5 - catalyst) the necessary sulphur to produce the above given quantity of sulphuric acid is of about 111 000 TPA. The biggest capacities to produce sulphuric acid are integrated with the fertilizers. The total capacity of the installed sulphuric acid plants in Turkey is 1 754 000 TPA. The production in 1980 was of only 360 000 tons. As the total consumption target in 1990 is of the order of 1250000 TPA, the existing capacities in Turkey will be sufficient to meet the domestic demand.

However some remarks and recommendations could be made. Because of the high import quantities of sulphur, an extension of the national production must be undertaken in the mining sector and the chemical industry. The lignite rich in sulphur could become an important source of sulphur in the future. The removal of the sulphur will improve firstly the ecology (see pollution in Ankara) and it will also contribute to cover the sulphur needs. This is a problem of national interest and should be treated as such taking into account the forecasted development of the lignite exploitation in the concerned period.

This proposal could not be considered as a utopia, a demonstrative example being the removal of the sulphur from natural gases in the South of France. The developed method permitted to the involved companies to produce a very important quantity of high quality sulphur at competitive prices.

It is also recommended to organize a team of specialists in sulphuric acid technology entitled to carry out a systematic expertise of the installed plants in order to identify unacceptable consumption of sulphur, pollution aspects, and of course, to give technical assistance in the related improvements. This action could be organized under the auspices of the authority involved in sulphur imports.

43. Synthetic tannins and related resins. Among the chemicals demanded by leather industry, synthetic tannins and related resins occupy an important place. The total projected demand of these products in 1990 will be cf about 14 000 tons.

The value of the 1981 imports was not available but by extrapolation of 1979 figures for these products, the 14 000 tons to import in 1990 will cost more than dollars 50 million.

A study of the conditions for the partial production of such products in Turkey was not possible due to lack of data. Nevertheless, there are a lot of products known under the general name of SYNTANS given by their inventor many

years ago. The number of products and trade names is continously increasing.
The synthetic tanning materials are in fact the products resulting from the condensation of formaldehyde with one of the following chemicals: naphtalene, sulphonic acids, various phenols and sulphonated phenols, diarylsulphones, urea, melamine or dicyanamide. There also are other materials resulting by condensation without formaldehyde, as for example styrene-maleic anhydride or lignine sulphonates.
The main important related resins are: nitrogen resins syntans, lignin sulphonates syntans, dialdehyde resins tannage and formaldehyde with resorcinol (forming syntans in the skin).
From among the main filling agent resins synthetic rubber, polystyrene, acrylates, polyvinyls and silicones can be mentioned.
Taking into account the importance of the leather industry as well as the importance of this group of products for the leather industry it is highly recommended to perform a special and detailed study on the auxiliary chemicals required in the leather industry including, of course, the synthetic tanning and filling materials.

44. Silicon dioxide. The production of silicon dioxide in 1982, as projected by the Ministry of Energy, will be 21 000 tons, from which over 15 000 tons are projected for the export. The production in 1990 is expected to grow to 46 000 tons, with an export forecasted to 34 000 tons.
The main user on the domestic market is the soap and detergent sector, with over 99%.
The above given figures are convincing: there is no problem with silicon dioxide for the Turkish market even beyond 1990.

45. Titanium dioxide. Seven different sectors of the Turkish economy are using titanium dioxide. The quantity demanded in 1990 is projected to be about 53 000 tons and the corresponding import value about dollars 83 million.

Based on these figures, a special study is recommended. No reliable data concerning the availability of ilmenite or rutile ores in Turkey have been obtained, and the technology is not a very simple one as well. Nevertheless there are very few producers in the world and titanium dioxide has a good market.
For these reasons if one of the mentioned raw materials is available in Turkey, such a study would appear fully justified.

46. Zinc chloride. The product is necessary mainly for the electronic and electrotechnical sectors (99%) at a projected quantity of 4 400 tons in 1990.
The import value of this quantity is estimated to be of about dollars 7 million. The product is not difficult to produce, yet there is no production capacity in Turkey.
It is highly recommended to conduct a feasibility survey for the production of this chemical in Turkey. It is however advisable that the production of zinc chloride be either integrated with chlorine producing facilities or even with the production of zinc oxide.

47. Zinc oxide. Zinc oxide, one of the two mostly used white pigments, is also used in big quantities in Turkey. A capacity of 7 200 TPA is under operation now and will remain the only one until 1990. This is not able to meet the projected demand for that year and even now there are some imports to cover the local consumption.
As for the pivot year 1990, the projected demand will only be met by importing about 6 500 tons in addition to the domestic production representing more than dollars 12 million.
In view of the status of the product outlined above it is highly recommended to prepare a feasibility study to indicate the viability of increasing the local production capacity either by revamping the existing unit or by installing a new plant.

48. Catalysts,activators, stabilizers, corrosion inhibitors and other special products. Lots of chemical products needed by different sectors in large or small quantities are considered as "auxiliaries" and act in different technologies as mentioned above.
The importance of these "auxiliaries" could only appear from summation of the imported quantities and there value.
An example could be considered the group of stabilizers needed by the plastic and rubber processing sectors in a total quantity of 12 000 TPA.Some of these stabilizers were commented within stearine family.
Another kind of special products are the catalysts. Some of them are difficult to be produced because of the technology, the patents or other reasons but from them a lot remain that could be produced.
Coming back to the additives example, it is highly recommended to involve a team in carrying out a similar study for the above categories of products to be produced in Turkey with second priority.

IV. UTILISATION OF PROJECT RESULTS

A. This Final Report should not be confused with a thorough feasibility study for the Chemical industry in general, even if completed by all the said attachments.
Needless to say, a separate in-depth feasibility study for each of the chemicals, mentioned or recommended for production within the context of this report, will be required prior to any investment decision. However, this work which is to be regarded as the outcome of a fruitful collaboration between UNIDO and the Turkish counterpart, does provide an overall synopsis of the Turkish Chemical Industry pin-pointing its infra-structural weaknesses and recommending strategies to assure sound growth in the future.

B. The Final Report and its Attachments constitute an inventory of the main problems of the chemical industry in Turkey but this must not be mistaken for an exhaustive inventory. Many aspects were not tackled. These problems

should be re-appraised as soon as the time and other priorities will permit it.

C. The Final Report constitutes also an exemplified method of work for the elaboration of a study of such a large amplitude as the development of chemical industry in Turkey should be.
The selected chemicals and related treatments within the common work with the representatives of the counterpart are to be considered as examplifying and reference elements for the further developement of this important work. The remaining chemicals (to 472 individuals) are of high interest for the national economy,too. The used selection was done only for reasons of priority, available time and data.

D. The sectorial reports gathered in the Attachments 5 and 6 could be used not only for the next part of the work but also as a compass for the orientation of the development of chemical industry in interdependence with the concerned sectors and for the desired integration of the production.

E. As a result of the project and an immediate possible utilisation of its evaluations, the experience achieved by the Turkish members of our team, now able to get involved independently in the follow-up of the project, is of utmost importance.
The permanent contact with UNIDO experts has given the Turkish counterpart the possibility of taking over the necessary know how under the best conditions.

V. FINDINGS AND RECOMMENDATIONS

The project on the Long Term Development of the Turkish Chemical Industry (DP/TUR/79/003) has now been finalized in the form of a Final Report based on a large number of studies covering the entire Chemical Industry.

It is to be clear that the findings of any research project cannot be ultimate evaluations in themselves. Consequently, within the context of the Chemical Industry, there is still a lot of work to be done in the light of the ideas developed in this project, in order to make it possible that the problems lieing ahead should be overcome and the industry given the necessary infrastructure and development impetus.

A. Structure of the chemical industry in Turkey. The present available information concerning the chemical industry in Turkey reveal the fact that this industry is divided in two sectors : Public sector and Private sector.

1. A critical evaluation of the chemical industry in Turkey shows that with the exception of some of the recent large scale projects (Aliaga Complex in the Public sector and SASA's dimethylterephtalate plant in the Private sector for example), many production units are rather small in capacity, thus being inefficient in operation. Some of the producers in the private sector operate plants with capacities much below the sizes encountered in modern practice and in the majority of cases they use imported feedstock .

2. With regard to the development of the industry in general terms, an immediate impression was that many plants owned by small private sector companies were built or revamped on the basis of ad hoc criteria. Quite a number of projects were apparently carried out without paying attention to long term domestic market developments or potential, no consideration whatsoever being paid to export promotion. Even during the development of those sectors of the economy which are good foreign exchange earners, no consideration was attributed to the chemicals absolutely necessary to ensure better quality of the products. This is particularly true for the textile and leather industries, two of the most significant exporting

sectors, which require the importation of a large number of dyestuffs and auxiliary chemicals.
The conclusion is that there must be a general lack of co-ordination or inter-connection between the respective sectors. Also, some products made in small plants are different in price and quality in spite of the fact that the expensive imported raw materials are the same.This is a rather unhealthy state of affairs which needs to be changed to secure the viability of chemical operations in the Private sector on a long term basis. The Private sector will also have an important role in the development of the chemical industry and must be supported to continue to play it by the Public sector.

3. It is also obvious that despite some of the drawbacks and limitations imposed upon them by the general administrative and economic conditions in the country, the public sector Chemical companies seem to be more aware of the latest techno-economic considerations. This can easily be checked by an analysis of some of the recent public sector investments from a techno-economic viewpoint.

4. It is important that the chemical industry is urgently studied in-depth to guide it towards current techno-economic developments. Furthermore, the recommendations already given in chapter 3 of this report as well as in the concerned chapters of the previous reports on the dyestuffs and pharmaceuticals and in the progress reports of the CTA, should be given serious considerations as they are closely relevant to the sound growth of the industry.

B. Available Raw Materials and Feedstocks for the Turkish Chemical Industry

1. It must be emphasized that Turkey is by no means a poor country with respect to the raw materials for the chemical industry. It is also obvious that the indigenous resources of the country have not been exploited to the full in the development of the chemical industry.

A number of recommendations on this problem have already been given in earlier sections of this report. A notable development potential exists in the fields of ferro-alloys and the boron compounds, respectively. It has been observed that this potential is being developed by ETIBANK.
In fact, a proper evaluation of the indigenuous resources would no doubt have indicated a number of investment opportunities which would have secured a stronger infrastructure for the industry on the whole.

2. Because of the lack of conventional raw materials in general, it is absolutely necessary to seek other materials available for further developments. In fact, it is unusual to develop a national heavy industry based on imported raw materials only.
For this reason it was already recommended to carry out some special studies to this end. Even for the development of the petrochemical sector which can be considered as the most modern sector, not only crude oil should be considered. Methanol and ethanol as feedstocks for the corresponding family of products are to be studied in detail.

a. The natural gas reserves in Southern Eastern Anatolia are known to have a very high carbon dioxide content which renders them unsuitable as chemical feedstock. The natural gas reserve in the Thrace region, however, is very significant in relation to the feedstock requirements of a large scale methanol plant. The estimated daily production potential is about 1.0 million standard cubic meters. As the gas is virtually free of sulphur and contains as much as 93.4% C1-fraction it would be a suitable feedstock to a very large scale methanol plant. Since methanol is a very valuable feedstock for a wide spectrum of petrochemical products this idea should be given a serious consideration.
As an alternative for producing methanol the viability of the production of methanol based on biomass should

be investigated in the local conditions of Turkey, having in view future developments.

b. Sulphur needs are also an unsolved problem for the time being and it will remain so for the development of the sector. For this reason we recommend to include in the study the removal of the sulphur from lignite and, of course, the extension of the exploration and production of the mining sector.

c. A very promising source of raw materials for the future development consists in the agricultural products and food industry by-products.
This problem will be commented in details in the next C position.

d. A special problem in the field of feedstocks is represented by naphta. A high quantity is used at present for producing ammonia (220 thousand tons in 1980 and four times more in 1990). It is recommended to re-study this problem because it seems to be more convenient to import ammonia as such instead of transforming the imported crude in naphta and then, with high consumption of energy, this into ammonia. The big installed plants in USSR and KUWEIT could probably ensure some of the necessary ammonia by imports.

C. Impact of the Development of the Chemical Industry on the Modernization of the Turkish Agriculture.

1. Because the agriculture is still the most important sector of the Economy, representing as much as 60% of the Gross National Product, special attention should be paid to the development and modernization of this vital sector within the context of the overall development strategy for the chemical industry. This inherently means that not only should there be a properly planned local production of fertilizers

and pesticides, but also an efficient programme for the training of the users of these chemicals. Particularly in the case of fertilizers it is presumed that there is a considerable amount of wastes in the form of over-application per unit of land, arising mostly from the ignorance of the farmers with respect to the relationship between the fertilizer quantity and the fertility of the land. Therefore it is highly recommended to organize within the state enterprises producing fertilizers a specialized body for training as assistance in the benefit of the said users.

2. The further development of agriculture is regarded as a pre-requisite for the sound development and general viability of the chemical industry on a long term basis since some of the agricultural products exhibit the potential of becoming important feedstocks for the chemical industry and are the subject matter of recent techno-economic considerations all over the world. It is therefore recommended that the fermentation industry in Turkey based on agricultural products such as molasses, starch, sugar-beets, corn or wheat should be given special consideration. In this way, the production of a large number of important chemicals could be obtained in Turkey covering a significant part of the infrastructural gaps.
As a starting point in the development of fermentation based processes, it is highly recommended to conduct an in-depth feasibility study for the production of furfural and related products, ethanol, acetic acid, acetone and butanol from agricultural feedstocks.

3. As a special recommendation we mention here the possibility of carrying out a study with the object of appraising the transformation of the forecasted 150 000 TPA (starting from 1990) molasses for export into ethanol for gasohol. The quantity would be sufficient for a plant of ethanol with a capacity of 40 000 TPA.

This solution has at least the following advantages :

- saving of crude for the benefit of petrochemical sector;
- improvement of ecology in Ankara, by substitution of conventional gasoline with alcohol.

This problem is considered as an important one even for cities with lower pollution levels than that of Ankara. For the time being not only Brasil is directed towards this solution.

4. Turkey has a flourishing food industry with a very high export potential to the neighbouring countries. In this context, the packaging industry as well as the chemicals required in the industry for mostly preservation purposes carry a lot of significance. It is therefore recommended to pay special consideration to the requirements of the food industry in the long range planning of the chemical industry.

D. Impact of the Development of the Dyestuffs Sector on Leather and Textile Industries.

1. The problem of dyestuffs and dyestuffs intermediates has already been tackled by a separate study on this important field conducted and finalized in the form of two reports. However, it is to be emphasized once again that this is a vital field for the Turkish Economy from the viewpoint of two of the most important exporting sectors, namely the textile and the leather industries.
It has been mentioned in the report on dyestuffs that there is a department of dyestuffs technology recently established within the framework of the Aegean University at Izmir and that some research on dyestuffs has already started in the said department. Since training starting from the University level is very important for the development of the dyestuffs industry in any country, this development is considered to be highly supported. On the other hand it is believed that the problem of the synthesis of dyestuffs for industrial utilization should be interlinked with a well organized technical assistance scheme. In most cases, the consumers

are not really interested in how the dyestuffs are synthesized; yet, they are very interested in the conditions of application and the results to be evaluated with reference to the quality of the products in question (textiles or leather products). Therefore, it is highly recommended to establish a Central Laboratory for the dyestuffs to provide the necessary technical assistance to the consumers as well as to control the quality of the dyed products to be exported.

2. In the field of fine organic synthesis (pharmaceuticals, dyestuffs and related chemicals) the transfer of know-how cannot be too rapid. The know-how is something more than a technical documentation which could be obtained from any experienced company. The know-how must be transferred in the real sense through scientists who are disposed of to be involved in long-term work in order to become familiar with the specific conditions in the field.
On this account, it is highly advisable to send young engineers in the framework of long term arrangements with specialized companies to receive extensive training and specializations in the fields in question for periods of one or two years.

E. Establishment of an Informational Centre for the Chemical Industry.

1. It should be noted that there is no Central Institute or any other suitable type of organization responsible for technical documentation and marketing data related to the chemical industry.
Once this project is realized work should be continued on the above subject:
a) for studying in depth the chemical industry and adopting it to the present technical and economical situation;
b) for studying in depth the recommendations given in the outputs of this report.
To begin, further studies on particular sectors of the chemical industry not yet practiced in Turkey (or only on a very limited scale) should be undertaken, perhaps with assistance from UNIDO.

2. The development guide from the modern Turkish chemical industry, which is only 15 years old, used to require a type of executive work based on quick dicisions on a qualitative basis (since data was not available). The executive had at his disposal in many cases a monopoly and he determined the position of the market.

The situation has now changed. The previous work has created a chemical industry which has reached a step where a new type of management is necessary. The activities have to be chosen carefully in correlation with the other sectors of the chemical industry and in strong linkage with the different activities of this industry while also considering the overall economy of the country. Since decisions have to be taken on a quantitative basis, it is important to have quantitative data not only on home activities but also on regional and world activities. The management has to be able to treat and analyse this data quickly in function of multiple and different parameters.

These are conditions which will allow the creation of the needed linkages between the different branches of the chemical industry while also taking decisions in conformity with the needs of the home economy, in a given international environment concerning the studied item.

To be able to practice this new type of management, the technical level of chemical industry in Turkey is certainly high enough. The commercial and managerial levels (planning and operational analysis) have to be improved. A major improvement would be the creation of a Central Documentation Service with its own data banks, computing equipment, and relations between the existing foreign data banks and its staff members, part of which should be economists maintaining direct contacts with the foreign chemical companies. Of course, such a Service has to be built up step by step. A study would have to be made, perhaps with assistance from UNIDO, on the choice of the appropriate documentation system and its implementation.

F. Engineering Services in Turkey for the Chemical Industry.

1. There are several private engineering and consulting firms in Turkey, not properly organized or equipped to

undertake the complete process and design engineering of chemical plants. They are, in most cases, affiliated with large foreign companies and work as sub-contractors of such companies. It is important, from long term considerations, that these firms develop into efficient organizations capable of performing the complete design of process plants.

2. The sound growth and development of the chemical industry is deeply connected with the level of local engineering activities. For this reason, it would be worthwhile to establish a well equipped engineering organization. Such an organization could be established as a subsidiary of a big chemical company. This recommendation is supported by the fact that there is quite a number of suitably qualified and talented engineers in Turkey who could be oriented to the process and design engineering of chemical plants. On the other hand, the existance of an efficient engineering department within the organization of large companies which are heavily dependant on modern technologies would no doubt contribute to the accumulation of local engineering know-how and expertise and through a well organized co-ordination with the research department would make the development and commercialization of local process technology possible.

G. Problems of General Interest for the Chemical Industry in Turkey

1. There are also problems of general interest for the Industry such as air and water pollution. Ecological considerations are already emerging to the front and any long term development plan for the chemical industry should pay the necessary attention to them.

2. The problem of the water treatment, chemical industry wastes and air pollution in the area is the problem of each plant, of each owner. It is wrong to consider that this will be solved by the officials.

The role of officials is only to establish a systematical control in this respect.

3. It is recommended to involve in this field of research the Turkish high schools and universities. This will contribute to the introduction of the future engineers in the field of industrial discipline.

4. An important field of special activity within the framework of the Chemical Industry is the "protection against corrosion". It is certainly not sufficient to have some prescriptions in the know-how documentation. Unless the necessary precautions are taken, some very expensive imported or locally manufactured equipment could be destroyed by corrosion even before the recovery of the invested money.
This is also an activity appropriate for the universities, at least in the beggining.

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We have once again the opportunity to repeat that all Attachments of this study are considered as parts of the Final Report including the recommendations given in the sectorial reports, special reports and the progress reports of the CTA.