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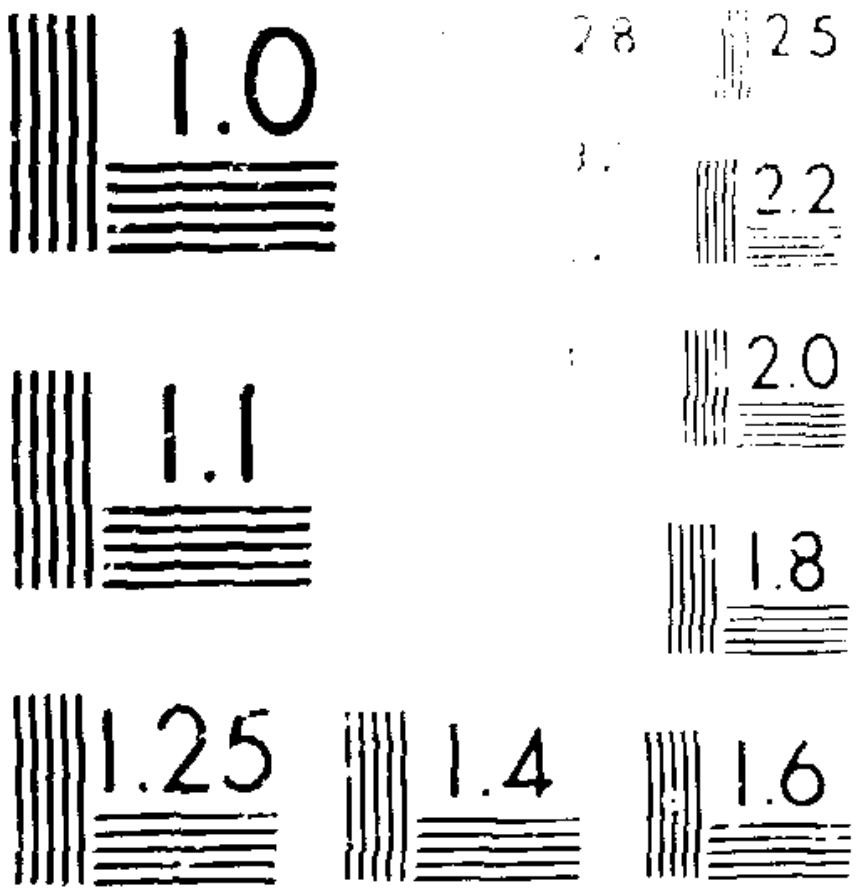
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ON CO-OPERATION AMONG DEVELOPING COUNTRIES IN PETROCHEMICAL INDUSTRIES

Vienna, March 7-9, 1983

UNIDO

The Development of Petrochemical Industries in Developing Countries

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ANNEXES

I. INTRODUCTION

This paper aims at presenting an up-dated view of the world demand and supply of petrochemicals and the ways in which over ten developing countries have established and are operating their petrochemical industry.

The recession and existing over-capacities in developed countries have led to a major restructuring of their petrochemical industry, which has accelerated technical innovations and expansions of the industry elsewhere, in particular in feedstock-endowed countries. Developing countries having faster growing markets and advantageous feedstocks for their industry are better positioned to make a favourable contribution to supplying world markets to the mutual advantage of all concerned.

One of the main problems in preparing this paper concerns the data gathering and the reliability of the information obtained. So far, there is no world-wide authoritative set of data, since no comprehensive statistical reporting system exists. Often, basic data such as production, consumption and trade are not internationally comparable for all countries.

The developed countries have improved in the last years their statistical base including forecasts, but comparable information on Eastern Europe and the developing countries is sorely lacking.

A survey was made on developing countries, in order to improve the data base prepared early in 1982. The replies received from developing countries have been incorporated in this paper.

The abbreviations used in this document are presented in Annex I.

2. THE EVOLUTION OF THE PETROCHEMICAL INDUSTRY

2.1 General

The petrochemical industry took advantage of the changeover from coal to petroleum-based routes assisted by the simultaneous expansion of oil refineries in developed countries to bring about a rapid expansion during the 1950s and 1960s and became a major industrial sector.

The expansion was led by an explosive market growth that substituted petrochemicals for natural products, and by cheap naphtha feedstock and technological developments that gave petrochemicals a cost edge over natural products.

Early in the 1970s, the emergence of new producers in Eastern Europe and in developing countries and declining product substitution growth rates began to highlight the overcapacity build-up in developed countries. The sudden oil price adjustments of 1973 brought the brewing crises into the open.

The maturing of markets in developed countries coupled to inflation, recessions, high interest rates and the increased weight of feedstocks in the production cost of petrochemicals squeezed producers mainly in Western Europe and Japan into rationalization, restructuration and diversification efforts to fend off market inroads by a growing number of outside the region producers having a production cost edge over them.

2.2 Feedstocks

There is a strong market relation between energy resources, petrochemical feedstocks and end petrochemicals.

The rapid growth going on through the 1960's and partly in the 1970's inhibited by the oil price adjustments cannot be seen to continue in developed countries in the 1980's. The continuous hope of recovery of the economies has now been going on for years and yet no signs are visible,

despite positive growth rates calculated from depressed yearly figures showing thus satisfactory levels, but being lower than the peak figures years ago. In these mature markets in developed countries the situation must be seen as likely to continue. Substituting materials like wood, iron, aluminium, paper and others start to be near the equilibrium. House building, water, waste water transportation are also in most cases in mature state and the normal maintenance and renovation are mainly to be anticipated.

The above developments cannot longer support the high market growth rates of the past. The elasticity to GDP which the plastics have had, is substantially reduced, which means in most cases lower growth rates for the main plastics for this decade. Exception makes foremost engineering plastics for various purposes like distant heat networks piping material, car industry plastics and some minor. But these cannot inevitably hold the overall consumption figures high. This all does not mean that the development within the industry would be calm.

There will be major changes and restructuring both due to the already changed feedstock price situation and to the technological innovation which, becoming embodied in an appropriate petrochemical product, will enhance its dominance in the market. However, all these events are likely to affect petrochemicals mostly in the latter part of the decade. One result of these technological innovations is the increased performance of plastics and the increased efficiency in the use of raw materials and energy which would reduce the quantity of polymers and feedstocks required.

The substantial use of non-hydrocarbon energy sources such as nuclear energy, would have an important effect on petrochemical feedstocks, because it would release in many countries valuable middle distillates for ethylene crackers in substantial amounts.

Thus the picture of feedstocks is more complex and at least in the near term very soft. Utilizing more and more natural gas liquids, LPG, flared gas and aromatics (substituted by MTBE) which currently goes to the motor fuel pool, would apparently lessen the formerly tight picture of petrochemical feedstocks. This can be expected to continue throughout the

decade. The exports of petrochemical goods and the barter agreement trade would increase the domestic feedstock requirements of the developing countries.

2.3 Basic Petrochemicals

We will discuss mainly ehtylene here although the role of methanol and aromatics will be more important than it was at the beginning of the decade. The estimates of the last three years have been optimistic due to short term trend biases, using as a starting point peak years and diminishing the impact of longer term trends. Due to this fact a number of projects in the world have been delayed or suspended. Furthermore the longer lead time which is needed in establishing integrated petrochemical complexes shows that brevious time estimates for building new plants have been increased. In developed countries of market economies obsolete and small-scale ethylene plants would be shut down and substituted both by large-scale units based on ethane and by end-products coming from "resource rich" developing countries.

This substitution process may continue in the future when larger plants build in the last five years may become obsolete at the end of this decade, thus lessening the overcapacity situation.

Figure 1 shows the evolution of ethylene demand by regions from 1970 to 1990.

The propylene's main outlet polypropylene which enjoyed a price advantage a time ago has been more and more depressed by higher performance HDPE and LDPE plastic grades in end-uses, which together have to share the market. Due to the continuous improvements in quality and technology in this area, it may take some years to see the final stabilized balance among them.

Generally for propylene in developed countries about 5 per cent growth rate has been estimated for this decade. The expected annual growth rates of the above olefins in the developed countries are about average 2% throughout this decade, provided that the current economic policies are continued.

However, in the developing countries the annual growth rates of olefines are expected to be considerably higher, although at the beginning the process is slow due to the many economic and financial obstacles hindering the growth potential in those countries.

Figure 2 shows the evolution of propylene demand by regions from 1970 to 1990. Figure 9 gives the demand of benzene by regions between 1970 and 1990.

2.4 Fibres and Rubbers

Fibres

Although fibre consumption has suffered from recession and structural changes mentioned in 2.1, estimates made in the past four years have been remarkably consistent. Since minor changes are expected in the developed countries which could affect fiber consumption, the demand should follow the GDP per capita growth rate. The developing countries are expected to have a higher annual growth rate due to unsaturated demand. For the industry in developed countries, it has been astonishing that even after all this first restructuring which has been made after years of work, a further restructuring is still needed.

Table 1 shows the production and consumption of synthetic fibres in 1981 by regions.

Rubbers

Rubbers have suffered from the recession like most petrochemicals. Some time ago also the natural rubber showed better attractiveness probably influenced by the higher feedstock prices, thus reducing the need for synthetic rubbers. The tire business which has faced substantial changes in its polymer use, is expected to hold its position and the share of synthetic rubbers. Better elastomers here also mean less demand.

Table 1 gives world production and consumption of synthetic rubbers in 1981 by regions.

2.5 Thermoplastics

The five thermoplastics account for about 70% of total plastics consumption.

In thermoplastics major changes are taking place due to the technology rivalry among leading petrochemical producers. The most important is the fluidized bed technology emerging in the polymerizing processes like the UNIPOL-process or the new processes where some intermediate phases can be eliminated. The fixed bed processes often released too much catalyst rests to the polymer and they were not so easily controlled like gas phase processes. It appears that the whole previous technology is facing this type of innovation. The two main purposes will be to get low cost products and superior quality in order to beat the competitors. LLDPE is a good example of this. The routes to plastics will be studied carefully possibly to find out improvement possibilities combined to new catalyst technology.

Most of these changes have not affected the scope of the plastics in this decade remarkably except in LLDPE and probably in HDPE. The change of the technology takes time and since there will be low feedstock price premiums and capacity race by those who can afford it, these can be assumed to start to affect mostly in the second part of this decade.

The plastics demand is not expected to show high annual growth rates in the mature markets of the developed countries. In developing countries it does, but is inhibited by a number of obstacles, which have currently slowed down its growth. Figures 3 to 7 give the demand for the five main thermoplastics between 1970 and 1990 by regions. Figure 8 gives the world demand by plastics between 1970 and 1990.

2.6 Investment

In the current economic situation every company has its own strategy concerning investments, which depends largely on its own resources. Generally, the investments are low at the time being, but there is a certain pace of investments influenced by the technological innoviations in the petrochemical field.

Those who have adequate in-house financial resources might dare to take greater risks or can afford to buy the latest technology. In that case, they would have a most favourable position to stay in this business in the long term. That is why investments are expected even in those areas where substantial overcapacity lies - although seldom.

The geographical areas which have potential growth possibilities like developing countries could build up more capacity, however, ethylene units will not be built alone. It will be more or less integrated to downstream plants according to market need and resource availability. Overall investment costs is likely to require billions of dollars. It is not an easy aim to finance this. Generally an integrated petrochemical complex takes almost a decade until the whole complex is running smoothly without any assurance of a favourable business climate at that time.

In developed countries only Canada is likely to build additional capacity in ethylene and derivatives whereby other developed countries would only replace existing capacities that are either obsolete or inefficient by world standard during this decade. Restructuring will be strong in those countries.

Due to the long lead time in building petrochemical complexes in developing countries it is estimated that between 7 and 9 new world scale complexes will be built during this decade. This additional capacity may not be enough to achieve production selfsufficiency in developing countries during this decade.

3. THE PRESENT AND FUTURE OUTLOOK OF THE PETROCHEMICAL INDUSTRY IN THE DEVELOPING COUNTRIES

3.1 General

Data gathering difficulties forced the relying on the latest published information to complement the limited country data obtained from the survey. This information also contains planned capacities for beyond 1985 from which it is difficult to appraise probable implementation schedules. However, those capacities are given for information.

Data of the last few years show steady progress in the expansion of processing industries in developing countries, a major step towards increasing consumption of plastics and other end petrochemicals in those countries. However, new capacity requirements in a number of small and medium size developing countries may still be relatively small by world standards for actual consumption is rather limited.

Concerning the appraisal of future consumption two approaches are applicable. First, the aggregative approach indicates that market potential should be based on unsatisfied needs and is given in terms of kilograms per capita. Second, the distributive approach points out that market potential should be based on effective purchasing power and is given in terms of income per capita over kilograms per capita.

Both approaches tend to become complementary but starting with the growth of effective demand (given by purchasing power) and endeavouring to near in to the level of unsatisfied needs. The latter may be achieved through a faster growth of GDP in relation to population. Calculations of the distributive index by regions show that almost all countries are within the same index range, signifying that countries are already consuming as much petrochemicals as they can afford to pay.

However, the aggregative index by regions show that developing countries have a much larger growth potential than developed countries which are reaching market saturation levels.

This situation poses a good case to further the development of the petrochemical industry through co-operation between developing countries for their mutual benefit.

Tables 1 to 5 give data by regions and countries on capacity, production and consumption for the five main thermoplastics, synthetic fibers, synthetic rubbers, ethylene, propylene and benzene which are the main basic and end petrochemical products for 1980, 1981, 1.. and 1990.

3.2 Regional

Table 1 shows that in developed countries the North American region is currently leasing the per capita consumption of the five main thermoplastics with 45 kg/capita followed by the other regions with an average of 24 kg/capita and the world total around 10 kg/capita respectively.

The same table shows that in developing countries Latin America is currently leading in five main plastics with 6 kg/capita consumption, although in absolute terms Asia consumes twice more plastics than Latin America. The lower figure for Asia, about 2 kg/capita, is due to its very large population comprising about half of the total world population, Africa and the Middle East region consume about half the quantity of plastics in absolute terms and kg/capita terms than Latin America.

In developing countries the five main thermoplastics account over 70% of the ethylene consumption. Further due to substantial imports of end petrochemicals the effective consumption of ethylene lags way behind what it would have been otherwise required by their total consumption of end petrochemicals.

Other basic petrochemicals production, i.e. propylene and benzene and other aromatics are also at low levels compared with that of developed countries, around one-tenth of that in North Africa. If current plans are carried through the above levels of basic petrochemicals production would be substantially increased by 1990.

3.3 Country situation

The present situation of the petrochemical industry in developing countries varies greatly from country to country. Some countries have long experience in basic petrochemical production like Turkey, others have not yet started. All have their different prerequisites, resources, timing, acquisitions, capacities, etc. depending on actual needs. The situation is tabulated in table 5 country by country. While we are compiling production and consumption, data is only available from those countries which have established production. Most countries have only plans. These announcements may be optimistic and in these recessionary conditions many of the planned schedules can be delayed. The encouraging response from the surveyed countries to our questionnaire leads us to hope that a more complete and accurate information may become available in the near future.

Hence, there is so much information in the matrix, only the most interesting can be reviewed. The consumption level in the Middle East and North African countries lies at 3-5 kg/capita, whereas in other African countries it is around 1 kg/capita, which also most of the densely populated areas of Asia do have, exception makes foremost Malaysia and the Republic of Korea having 7.5 and 22 kg/capita consumption. In Latin American countries the consumption nears to 10 kg per capita with a few exceptions. Mexico has a very detailed programme to become a rather fully integrated producer in a very short time span. The same applies in much with Brasil. Some of the smaller countries have also plans of production but are in a very difficult position due to limited markets, which hardly can justify their own production. It remains to see whether they have to be on the buyer's side thus trying to benefit from the long term buyer markets.

However, if we look at the calculated income per capita over thermoplastic consumption per capita, we find that the figure in industrialized and in most developing countries lies about between 200 and 300 US$ per capita/kgs per capita, even in the least developing countries, the exceptions being the Republic of Korea having 69 and high income oil exporters such as Kuwait, reaching 3000. All the industrialized regions appear to be very near each other. This national income consumption value can be a very interesting illustration of momentum development stage in a country or region.

3.4 COMMENTARY BY REGIONS

Latin America

Latin America has achieved recently good progress in petrochemical plant construction. There have been activities in most countries concerning large petrochemical complexes involving large loans and leading recently many of those countries into heavy indebtedness. Thus financing has become again the prime constraining factor for larger countries. The smaller countries have been suffering it along.

Compared with other developing regions, Latin America is about the more advanced one compared with other developing countries. Its nearness to the North American region may have had an influence on this development. These countries do have their own special characteristics regarding problems and stage of development which has been widely discussed in the literature. The sagging markets during this recession will jeopardize continuous plans of production, especially in smaller countries. Some of the larger countries are building highly integrated industries like Mexico, Brazil, Argentina and some have already specialized like Trinidad and Tobago.

Africa and the Middle East

Most of the oil-producing countries in this region have the problem of too small domestic markets compared to economic plant sizes, except Nigeria, Turkey, Egypt and Iran. The consumption in the North-African countries is in good progress almost similar to that in Latin American countries regarding the main plastics. Some of the countries are in phase to start large-scale production and are building their plants. It shows that it could happen in the same phase of economic cycles, which could mean substantive paypack of the plants.Except the net oil exporters generally the net income in most countries in the region is at lower levels than in Latin America, especially in the central African countries thus inhibiting the development. The integration is small in the industry except in Turkey and later in Egypt. Turkey is a good example of what a successful running, even not having large capacity, highly integrated industry can mean for the country's balance of payments. Some of the countries in the area however have the resources to run their specialized industries at world scale level balancing the region's development and supporting the least developed countries in the region.

Asia

Asian countries have the markets which other developing areas are missing. The problem there is that the oil and gas industry has just recently reached the levels to justify earnings for large-scale petrochemical plant commitments. There are more advantageous feedstocks found recently to support even faster development in the petrochemical field in most countries in the area, although some countries have tried to utilize these markets. Despite rapid plant acquisitions the per capita consumption will run only over the central African level in the densely populated countries. Countries like Indonesia, Thailand, Republic of Korea and Malaysia have achieved already a level similar to the more advanced developing countries in the field. The national income in the area is generally lower compared to the other areas as per capita, but as focused on plastics consumption is somewhat higher than in the other developing areas, thus maybe showing unusual development potential. The area is fast developing due its potentials and quite well balanced compared for instance with Africa - Middle East region.

4. EXPERIENCE GAINED FROM THE ESTABLISHMENT AND OPERATION OF THE PETROCHEMICAL INDUSTRY IN SELECTED DEVELOPING COUNTRIES

4.1 General

Developing countries often envisage the petrochemical industry as integrated complexes of large scale plants. However, it is often forgotten that the numerous producers in the processing industry which represent the main market outlet of those petrochemical complexes, are as equally important as the complexes themselves.

In the developing countries there is already a large processing industry. For instance, in plastics processing there are many of the small developing countries 50 or even 100 enterprises in the field, which is encouraging, even if they have no basic petrochemical production at all. For example, if we take countries like Peru or Trinidad and Tobago, both have about 50 or little over plastics processors or Uruguay 80 processors. The same applies to Northern Africa or the Middle East or other parts of the world. In Jordan there are about 75 processors and in Tunisia 120 processors. We can state that the basic core for their further development lies in most of these countries.

4.2 The construction of new plants

Commissioning of a new plant is a very critical phase in the economic life of a petrochemical plant. We have examples showing that delays in construction and cost overruns can push the company into serious financial problems and loss of production. Guarantees should be sought that the plant will run at full capacity and be able to produce products according to specifications.

If a country has been running a petroleum refinery a long time, it has a good basic pool of operational skills for the petrochemical industry. This is the case of most countries nowadays. Then some parts of the oil refinery operators, technicians, managers can be carefully moved into

petrochemical operations like for instance was made in Turkey.

The use of good experienced constructors is very important. There may be cases when lack of qualified personnel during erection and/or commissioning of the plant may require emergency hiring of expatriate personnel at a very high cost.

4.3 Operations

If we review the operations at existing plants in the field of petrochemicals we can see that the operations do not differ remarkably from those in the developed countries. There are problems on both sides and it has been seen for instance in Malaysia that the local people are able to solve most of the problems. Also the machinery is in most cases fairly new or is being renewed continuously. This has been seen in most of the South American countries.

Some of the companies especially those which are joint ventures with multinationals do send their personnel to developed countries regularly and thus are able to maintain a high level of operations and maintenance even in rather complex production and also to improve the facilities. This mainly applies to the end-product industries. Principally running larger plants like ethylene plant need other types of skills by the plant operator, but examples from Turkey for instance show that this is not a problem to overcome when appropriate education and training systems will be applied.

4.4 Ingetration

Integration whether vertical or horizontal has become more popular for petrochemical companies in the last five years being almost the only way to run profitably in some areas of the petrochemical industry, particularly during economic recession. Thus the integration should be carefully studied in order to maximize profits.

Generally, in the petrochemical industry where we have various stages of production starting from one main basic petrochemical like ethylene and leading to intermediates and through polymers to end-products it is advisable to vertically join as much production to the production route as possible to gain maximum value added. If a company has a very advantageous feedstock like in many cases in the developing countries, it probably can produce profitably basics in large quantities and for local needs the main plastics, i.e. PVC, LDPE, LLDPE, HDPE, PP and PS and/or fertilizers depending on choice or market strategy and local factors.

This is the way most developing countries will do nowadays with a few exceptions. This normally requires a well-developed plastics processing industry which is a second phase of the main integration. That has been forgotten in many cases, if we disregard the largest developing countries like Mexico which has a well-established integration strategy. A good example in the small countries group is Trinidad and Tobago, which has well established its development of the petrochemical industry in the form of integration and appropriate policies.

4.5 Development of end-uses

Most producers have realized in the developed countries that the end-uses should meet the local needs, expand them and develop new needs to sustain producing capacity.

In the case of Malaysia this has been successfully developed by a local company working together with an international petrochemical producer but often developing countries would like to produce certain products for exports.

Generally, petrochemical production is centered on certain general purpose products where there is adequate internal demand in the country and the rest is being exported.

International petrochemical producers have well realized and established the meaning of development of end-uses. They continuously monitor the market to ascertain what is going on with their product. This information is gathered, processed and analyzed in order to find out in what direction the product should be developed. There are very few products which will sell continuously from year to year. New findings or features or implementation can accelerate the demand.

In the developing countries it is as or even more important to find out most suitable products as in the developed countries. In the beginning of a life cycle of a new production the need is not so important but the sooner this work will be organized the better it will be for the producer as a means of competitiveness

5. THE POTENTIAL FOR THE DEVELOPMENT OF PETROCHEMICALS IN THE DEVELOPING COUNTRIES

5.1 The effect of the economic recession in developed countries

The recessionary situation in developed countries will have a great impact on the development of the petrochemical industries in the developing countries, primarily because of

(i) petrochemical integration in the developed countries has been extensively developed;

(ii) the market linkages established in the developed countries make it very difficult for the producers from developing countries to enter into the market;

(iii) the recession has accelerated the technological innovation being one major element of competitiveness in favour of international petrochemical producers.

However, the exports would be needed by most developing countries starting their petrochemical industry. Fortunately, the lack of advantageously priced feedstocks in developed countries makes it possible for the developing countries' producers to compete with them in world markets and to fend off their inroads into markets of developing countries.

5.2 Local and regional development

The petrochemical development differs greatly among the developing countries' regions. Advanced developing countries have been able to attract a disproportionate high share of the financial resources available internationally. This fact is likely to increase in the long term the differences between regions and countries.

The potentials which primarily lie in developing countries are the cheap, wasted raw materials like flared gas or other easily available feedstocks such as NG or LNG, LPG and the huge potential markets for petrochemical products as can be seen from their per capita consumption.

Also comparatively cheaper labour and management of plants and enterprises can be seen as potential for those countries. Of the five main plastics the per capita consumption is in the developing countries around 3,5 kg per capita compared to 35 kg per capita for developed countries.

When we observe the development of petrochemical industries in developed countries it took about 30 years to accumulate the capital to build that industry to its present stage. To repeat that process in the developing countries in the next ten years, as some countries now intend, there would not be enough capital and other resources to support it. So a carefully planned and implemented programme would be needed to avoid disastrous results no one could bear.

The resources and market potentials of developing countries should be developed in a co-ordinated way so that its actualization would be able to pay in time the huge investments required and bring adequate rewards for its owners, otherwise there would not be enough interest to build petrochemical industries in those countries.

5.3 Integration and co-operation

The experience of the developed countries has shown the value of integration and co-operation. It enabled its petrochemical companies to become competitive, export their products to international markets, obtain adequate profitability, replace unnecessary imports of the same product and to keep market shares as high as possible. The same fully applies to the developing countries.

How this will be done depends case by case on the country and/or company in situation, its feedstocks base, product mix, operations, business relations, agreements, etc. It also depends on the interregional competition and sharing of financial resources available.

Experience has shown that early comers to this industry would be and remain in a stronger position th[illegible] For the latter entry to the market and financing new pl[illegible] ncreasingly difficult.

Co-operation and exchange of experience at company level is important, but often neglected. Among its advantages are the following:

- feedstocks arrangements
- technology developments
- improved maintenance procedures
- catalysts developments
- developments in operations
- training
- enlarged business relations
- suitable product and feedstock pricing
- improved information

Co-operation at country and regional level is presented elsewhere, but it can be stated that co-operation is an important tool when developing integration in the field of petrochemicals.

5.4 Specialization

Specialization is one of the important elements in the international and intra-regional networks of production and trade.

Those countries which have large local markets, sophisticated technology, R and D facilities and advantageous feedstocks and other resources can do almost everything in petrochemicals like now is done in the US and later maybe in Mexico, Brazil, China, India and so on. Smaller countries must carefully apprise their own role and possibilities in this field. The better policies and strategies a country can develop the better it can successfully penetrate in world markets and/or integrate into existing and future networks of production and trade.

When we now look at development of the petrochemical industry in the developing countries we can see that almost everybody wants to produce everything. This situation is bound to lead to conflict and building of overcapacities which will benefit nobody as has actually happend in the developed countries. Since in the petrochemical field there are thousands of products and even almost hundreds of speciality petrochemical groups

there should be room for everyone to utilize its special resources in the right way. If not, then specialization in other fields of industry can give the solution.

In every case soon after this rapid evolution of petrochemical industry which is in more potential development phase than is generally thought, there will be a too crowded situation, which always recalls specialization. How this will be handled, there probably will be special issues concerning this item in the near future.

6. CONCLUSIONS AND RECOMMENDATIONS

The Petrochemical industry has faced serious problems in developed countries, which have built substantial overcapacities for exports. During these recessionary years the industry must face reality and adjust its operations after the demand.

In the developing countries a rather dynamic development and expansion will take place during this decade which is based on advantageous feedstocks and should result also in competitive outlets to world markets.

The experience from some countries shows that there should not be major problems running petrochemical units in the developing countries provided proper actions have been taken.

Yet there are problems like marketing, financing, training, lack of infrastructure and so on hindering the development of this industry in the developing countries.

Outlets of this industry should be ensured by developing processing industries, which are often easy to run and end-uses providing thus growing local markets for petrochemical products in developing countries.

Special attention should be paid to the petrochemical potentials of developing countries mentioned in 5.2 in the petrochemical industry to fully utilize them to enhance the international competitiveness of their production.

ANNEX I

ABBREVIATIONS

DC	DEVELOPING COUNTRIES
HDPE	HIGH DENSITY POLYETHYLENE
IISRP	INTERNATIONAL INSTITUTE OF SYNTHETIC RUBBER PRODUCERS INC
LDPE	LOW DENSITY POLYETHYLENE
LLDPE	LINEAR LOW DENSITY POLYETHYLENE
LNG	LIQUEFIED NATURAL GAS
LPG	LIQUEFIED PETROLEUM GAS
MTPA	MILLION TONS PER ANNUM (SI-system)
NG	NATURAL GAS
PP	POLYPROPYLENE
PVC	POLYVINLYCHLORIDE
PS	POLYSTYRENE
SRI	STANFORD RESEARCH INSTITUTE
TNC	TRANSNATIONAL COMPANY
UF	UREA FORMALDEHYDE

NA	NORTH AMERICA
EE	EASTERN EUROPE
WE	WESTERN EUROPE

LIST OF EXTERNAL REFERENCES

1. IISRP
2. C.H. LINE AND CO.
3. SOCIETY OF THE PLASTICS INDUSTRY
4. S.R.I.
5. FIRST BOSTON GROUP
6. CHEM SYSTEMS INC.
7. JAPAN CHEMICAL INDUSTRY ASSOCIATION
8. ASSOCIATION OF PETROCHEMICAL INDUSTRIES IN JAPAN
9. SHELL
10. DOW
11. EUROPEAN PETROCHEMICAL ASSOCIATION
12. CEFIC
13. ELDID ENGINEERING AND RESEARCH
14. I.C.I.
15. EUROPEAN PLASTICS MANUFACTURERS INDUSTRY ASSOCIATION
16. CHEMICAL MARKETING RESEARCH ASSOCIATION
17. PREDICAST
18. COUNCIL FOR MUTUAL ECONOMIC ASSISTANCE
19. THE CANADIAN CHEMICAL PRODUCERS ASSOCIATION
20. BUREAU OF INDUSTRIAL ECONOMICS, U.S.A.
21. INTERNATIONAL RAYON AND SYNTHETIC FIBRES COMMITTEE
22. MITI
23. TEXTILE ORGANON
24. RUBBER STATISTICAL BULLETIN
25. LITERATURE ARTICLES

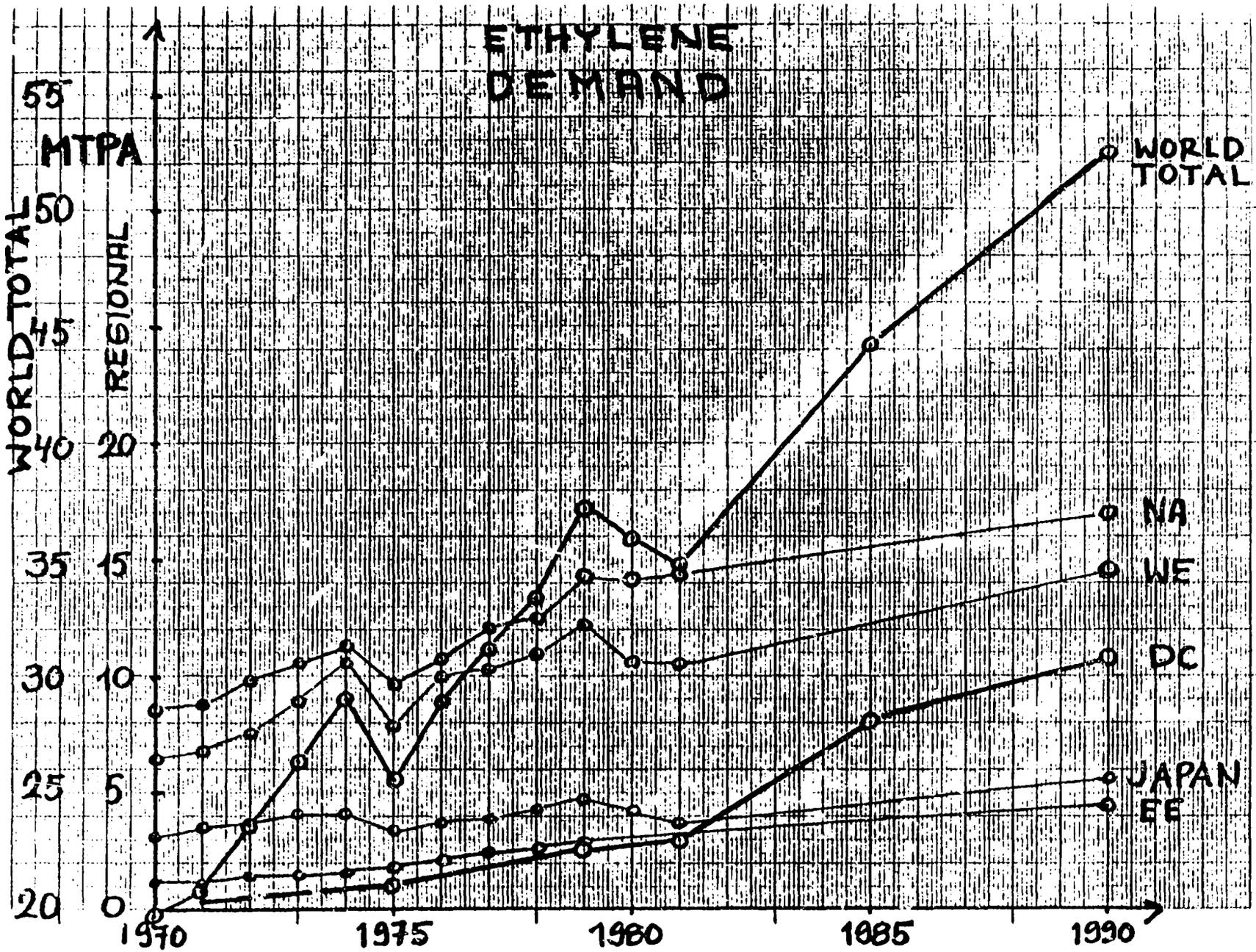
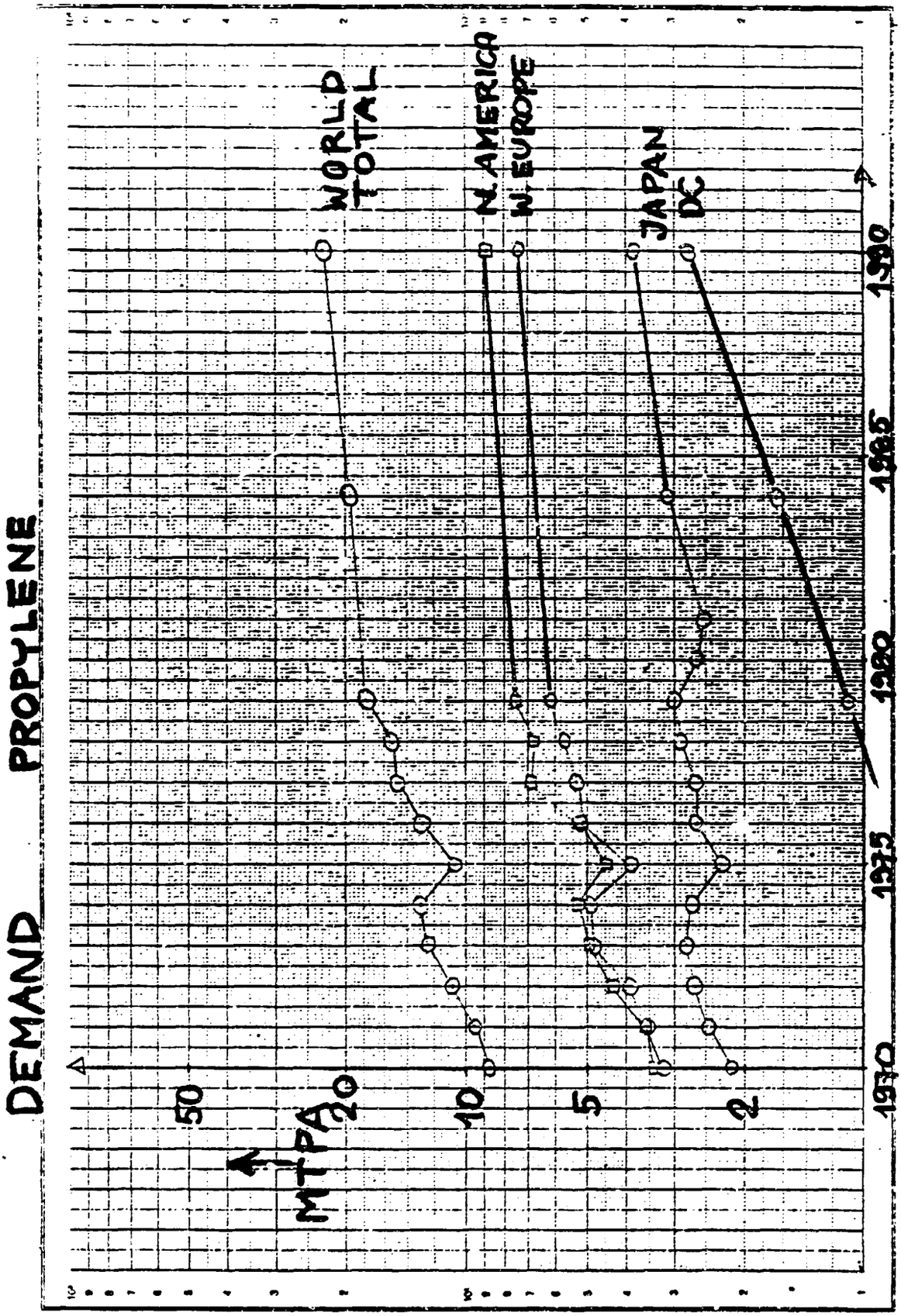
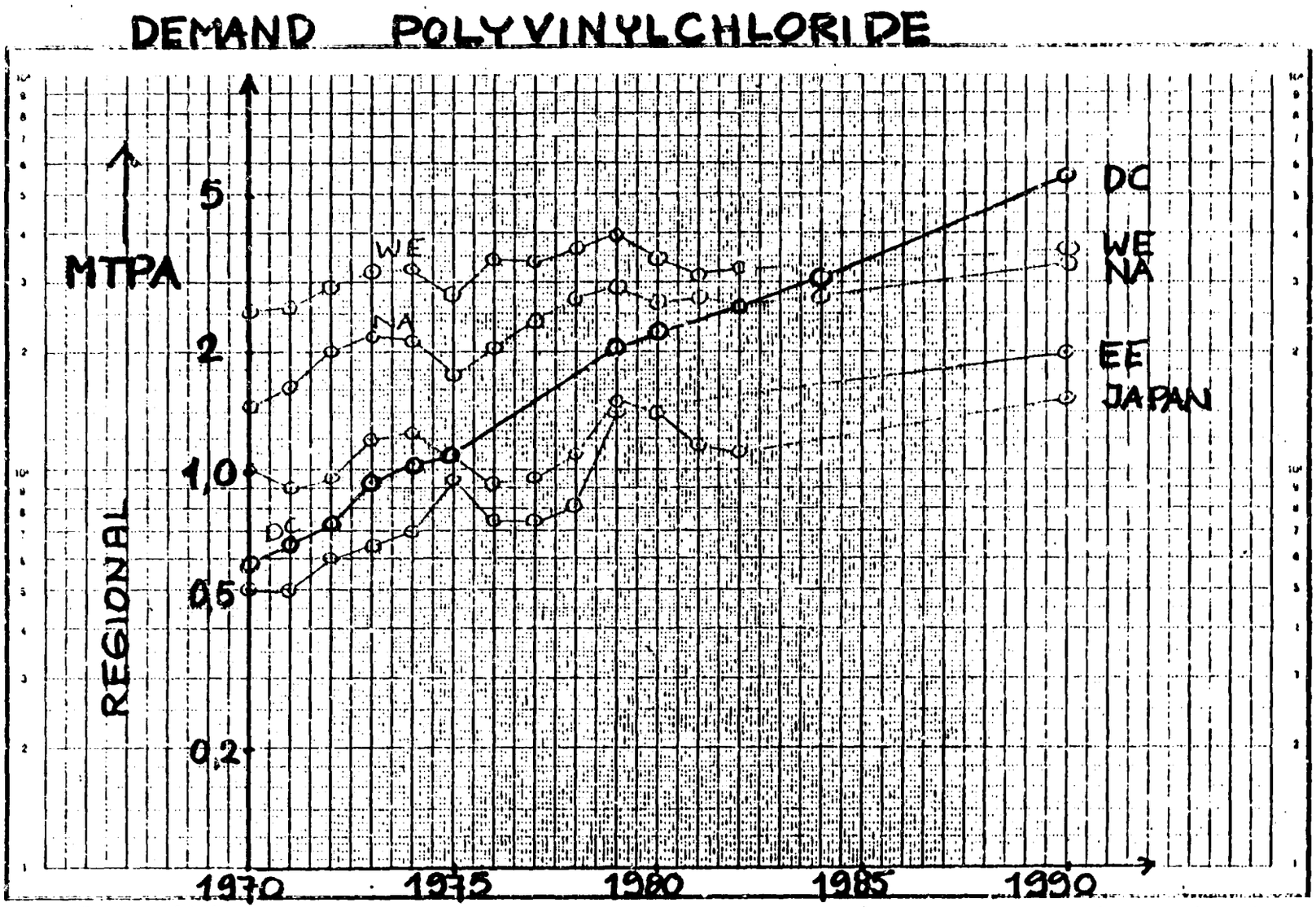

ETHYLENE DEMAND
WORLD TOTAL
MTPA
REGIONAL
55
50
45
40
35
30
25
20
20
15
10
5
0
1970
1975
1980
1985
1990
WORLD TOTAL
NA
WE
DC
JAPAN
EE

Fig. 1

Fig.2


DEMAND PROPYLENE
MTPA
50
20
10
5
2
1970
1975
1980
1985
1990
WORLD TOTAL
N. AMERICA
W EUROPE
JAPAN
DC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REGIONAL
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0,2
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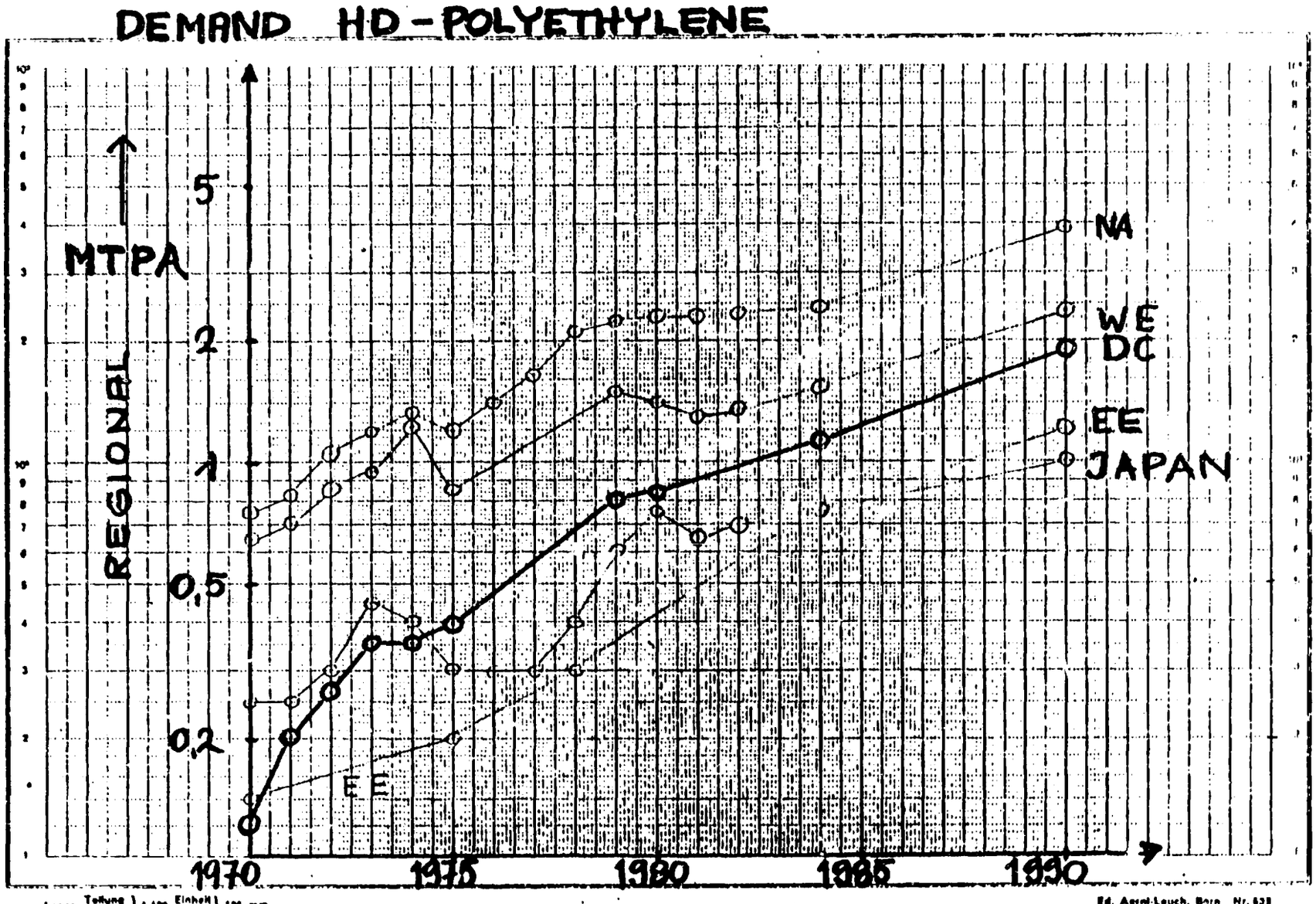
DC
1970
1975
1980
1985
1990
DC
WE
NA
EE
JAPAN

Fig. 3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0,2
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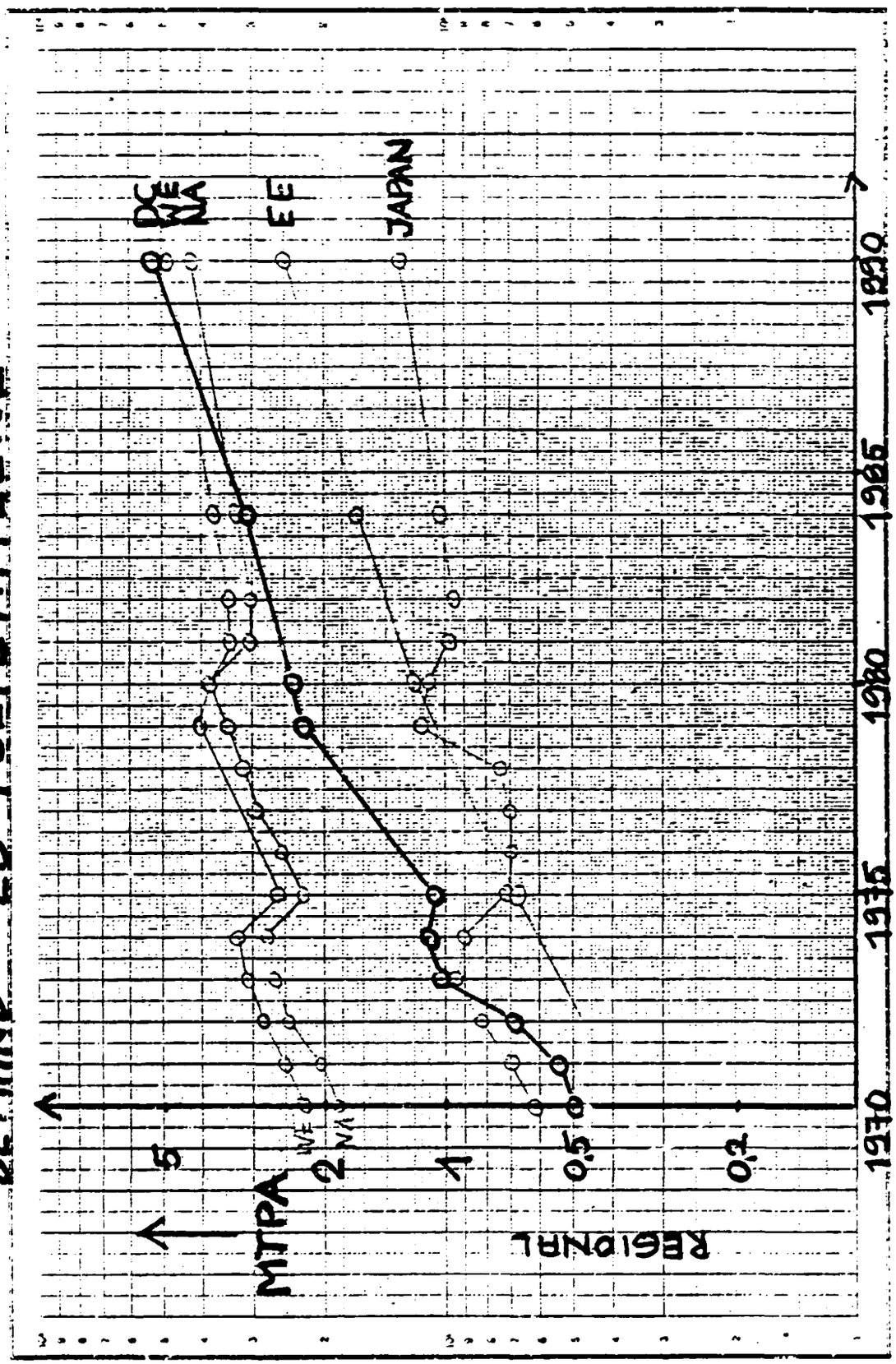
DC
EE
JAPAN
FE
1970
1975
1980
1985
1990

Fig. 4

Fig. 5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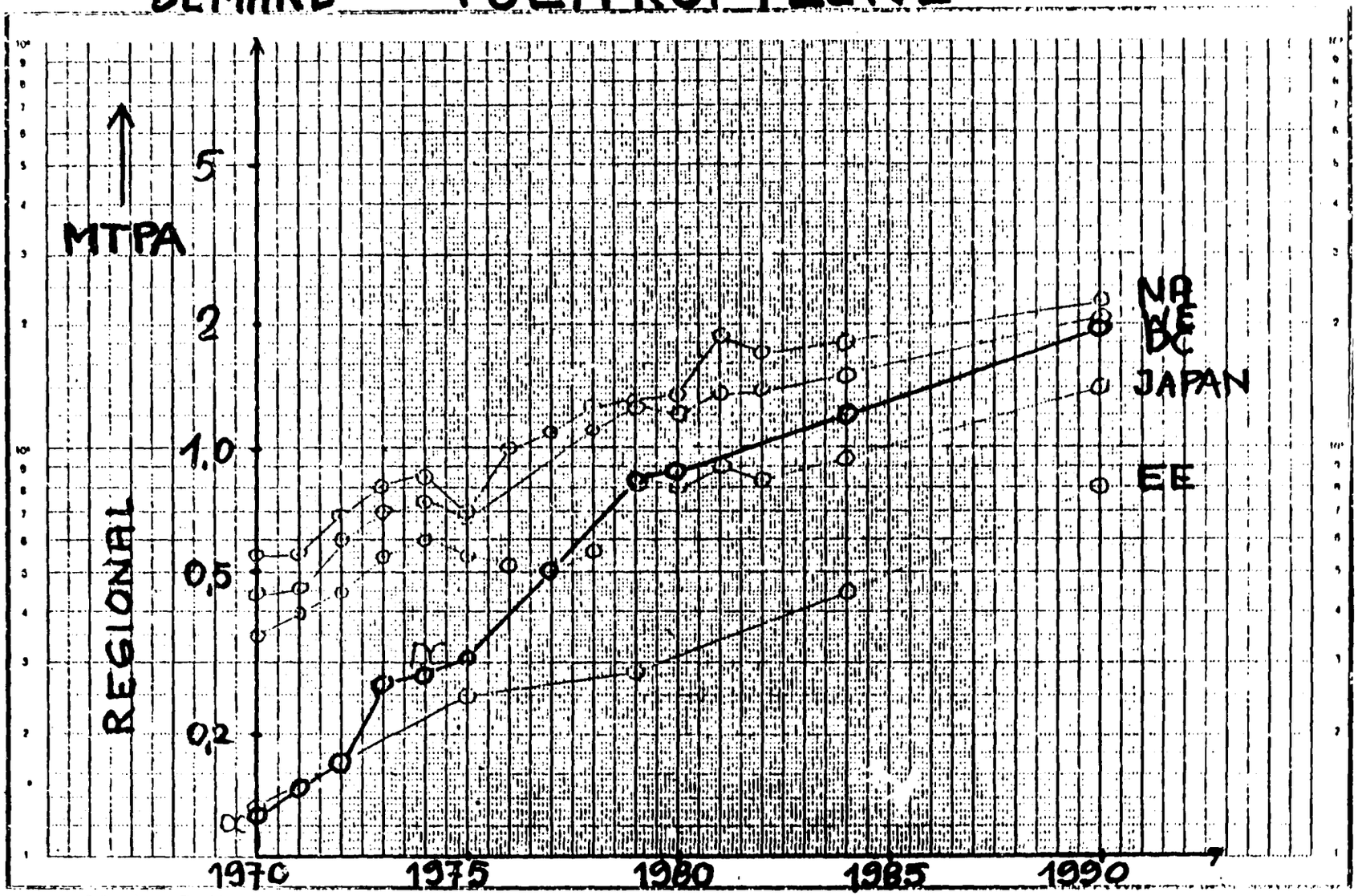
0.2
1970
1975
1980
1985
1990
JAPAN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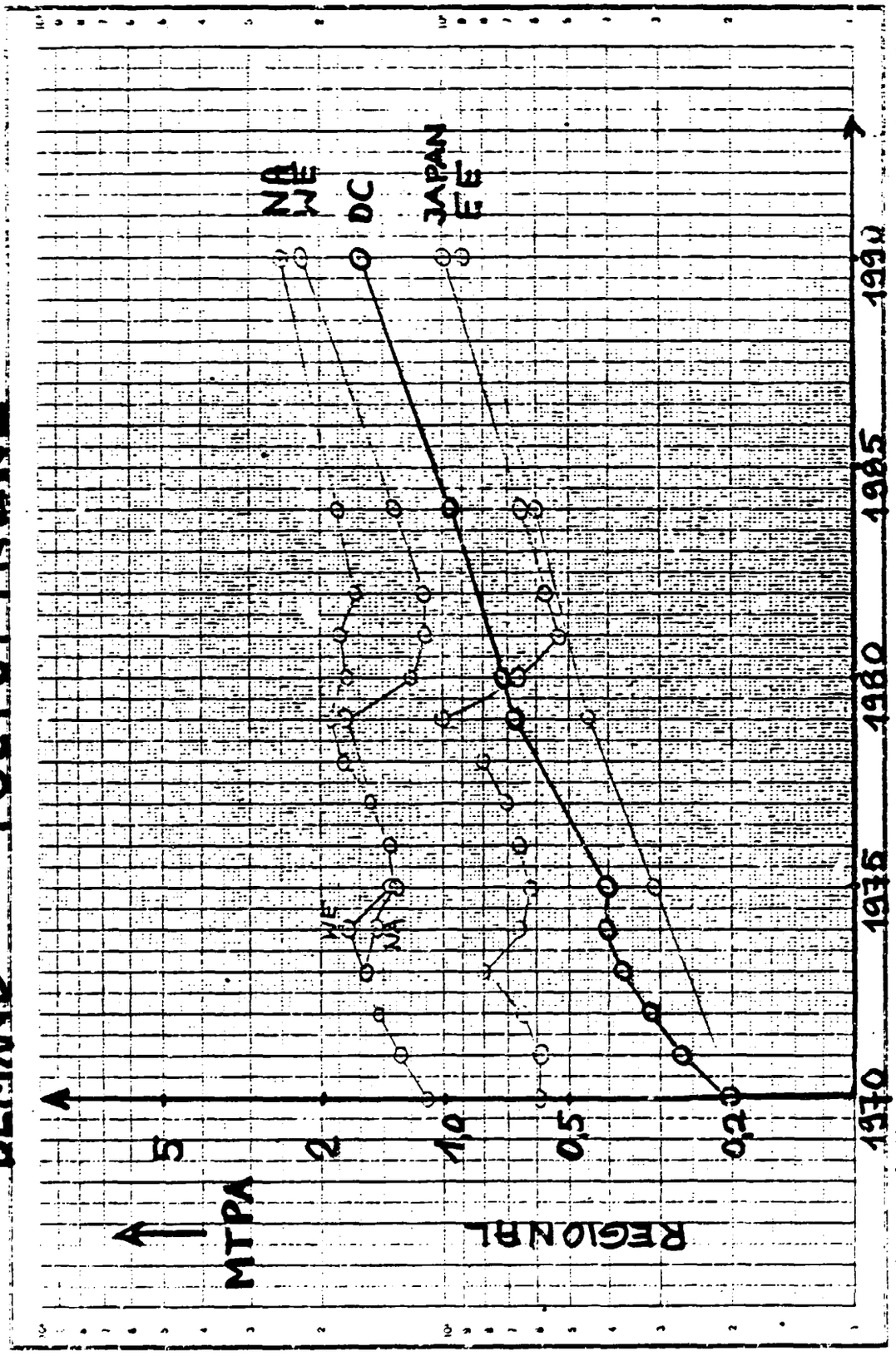
MTPA
REGIONAL
5
2
1.0
0,5
0,2
NA
WE
DC
JAPAN
EE
1970
1975
1980
1985
1990

Fig. 6

Fig. 7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MTPA
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2
1,0
0,5
0,2
REGIONAL
1970
1975
1980
1985
1990
NA
WE
DC
JAPAN
EE
WE
NA

THERMOPLASTICS WORLD DEMAND

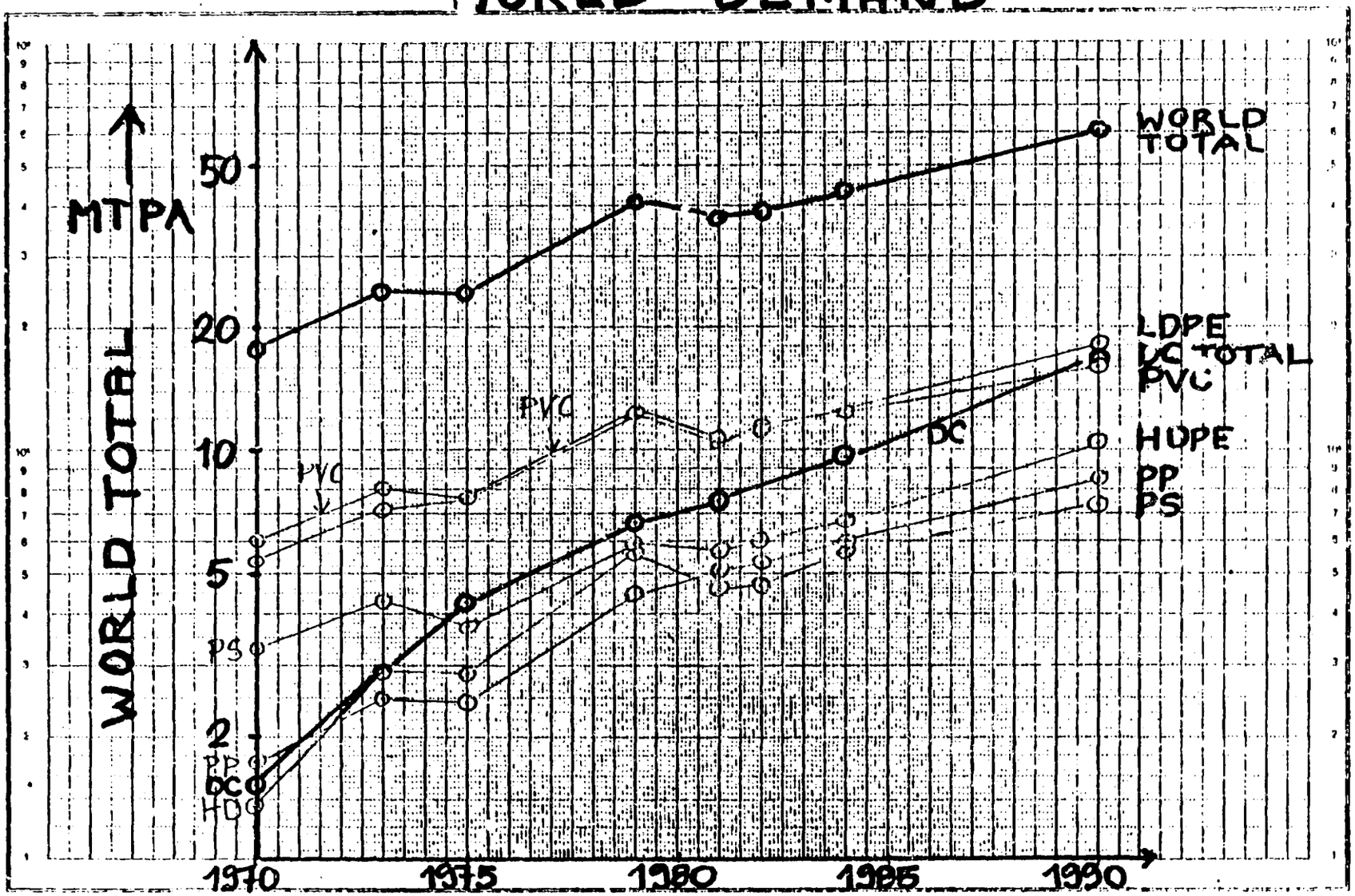

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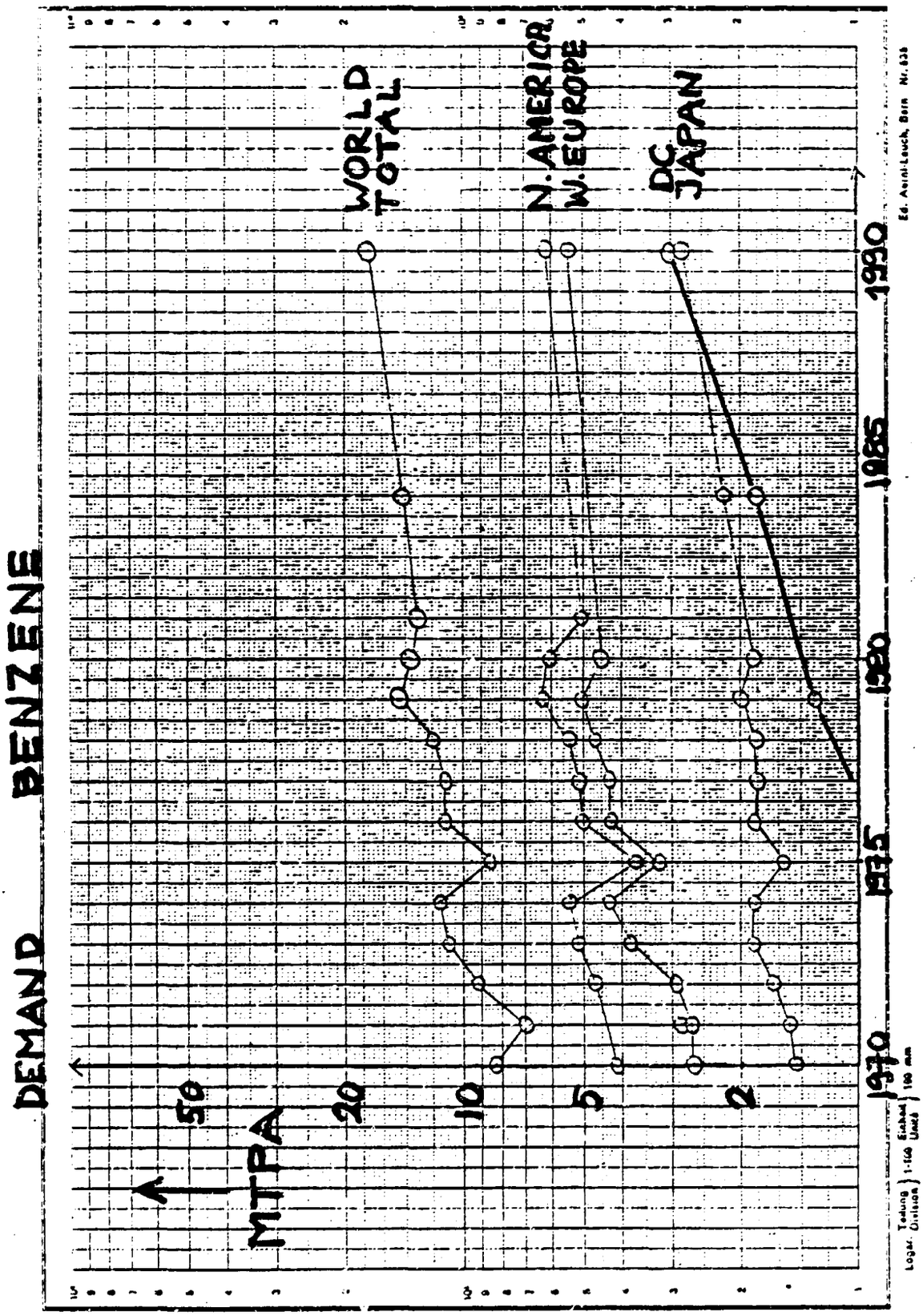
Fig. 8

Fig. 9


DEMAND BENZENE
MTPA
50
20
10
5
2
1970
1975
1980
1985
1990
WORLD TOTAL
N.AMERICA W.EUROPE
DC JAPAN

ANNEX IV

TABLE 1

WORLD PRODUCTION AND CONSUMPTION OF PETROCHEMICALS BY REGIONS IN 1981

1000 metric tons

REGION	THERMO-PLASTICS	SYNTH. FIBERS	SYNTH. RUBBERS	ETHYLENE	THERMOPLASTICS	
					INCOME/CAPITA ($) KGS CAPITA	KGS/ CAPITA
PRODUCTION						
Developed countries						
North America	12,651	4,567	2,511	14,400		50.2
Western Europe	11,411	2,841	1,731	10,499		34.8
Japan	4,349	1,281	1,010	3,644		37.2
Eastern Europe 1/	3,480	1,000	2,519	3,000		9.3
Other developed countries	1,030	70	80	700		19.8
Developing countries 1/						
Africa and Middle East	290	80	20	210		0.8
Asia	2,690	1,730	267	1,600		1.3
Latin America	1,535	500	356	1,200		4.3
World total	37,436	12,069	8,494	35,253		9.4
CONSUMPTION						
Developed countries						
North America	11,346	3,921	2,232	14,400	250	45.0
Western Europe	10,470	2,893	1,734	10,499	321	31.9
Japan	3,876	1,315	851	3,644	269	33.1
Eastern Europe 1/	3,340	1,030	2,450	3,000	na	8.9
Other developed countries	1,060	140	155	700	247	20.4
Developing countries 1/						
Africa and Middle East	1,030	220	60	210	545	2.9
Asia	3,960	1,950	450	1,600	182	1.9
Latin America	2,180	600	495	1,200	323	6.1
World total	37,262	12,069	8,427	35,253	280	9.4
SHARE OF THE DEVELOPING COUNTRIES IN WORLD TOTAL (%)						
Production	12.1	14.8	7.6	8.5		
Consumption	19.2	16.8	11.9	8.5		

1/ Estimates

TABLE 2

WORLD PRODUCTION AND CONSUMPTION OF THERMOPLASTICS BY REGIONS IN 1981

1,000 metric tons

REGION	PVC	HDPE	LDPE	PP	PS	TOTAL
PRODUCTION						
Developed countries						
North America	2,746	2,400	3,868	1,884	1,753	12,651
Western Europe	3,215	1,557	3,764	1,655	1,220	11,411
Japan	1,151	670	977	1,018	529	4,349
Eastern Europe 1/	1,300	370	1,120	280	410	3,480
Other developed countries	450	140	260	100	80	1,030
Developing countries 1/						
Africa and Middle East	100	-	180	-	10	290
Asia	1,220	220	660	350	240	2,690
Latin America	535	250	410	100	240	1,535
World total	10,717	5,607	11,239	5,387	4,482	37,436
CONSUMPTION						
Developed countries						
North America	2,552	2,157	3,338	1,594	1,705	11,346
Western Europe	3,192	1,363	3,417	1,403	1,095	10,470
Japan	1,110	523	824	932	487	3,876
Eastern Europe 1/	1,150	350	1,100	330	410	3,340
Other developed countries	430	170	260	120	80	1,060
Developing countries 1/						
Africa and Middle East	350	145	340	100	95	1,030
Asia	1,300	520	1,220	600	320	3,560
Latin America	630	320	700	250	280	2,180
World total	10,714	5,548	11,194	5,329	4,472	37,262
SHARE OF THE DEVELOPING COUNTRIES IN WORLD TOTAL in %						
Production	17.3	8.4	11.1	8.4	10.9	12.1
Consumption	21.3	17.8	20.2	17.8	15.5	19.2

1/ Estimates

TABLE 3

PLANT CAPACITY OF PETROCHEMICALS BY DEVELOPING COUNTRIES REGIONS

1000 metric tons

REGION	THERMO-PLASTICS	FIBERS	RUBBERS	ETHYLENE
1980				
Africa and Middle East	377	129	46	375
Asia	3,149	1,906	410	1,823
Latin America	1,805	624	382	1,399
TOTAL	5,331	2,659	838	3,597
1985				
Africa and Middle East	2,282	395	168	3,273
Asia	4,573	2,329	465	3,253
Latin America	3,442	812	574	3,157
TOTAL	10,297	3,536	1,207	9,683

Source: Based on the UNIDO country survey, 1982 and other published sources.

TABLE 4

FORECASTED CONSUMPTION OF PETROCHEMICALS FOR DEVELOPING COUNTRIES REGIONS BY 1985 and 1990

1000 metric tor

1 9 8 5				
REGION	THERMOPLASTICS	SYNTH. FIBERS	SYNTH. RUBBERS	ETHYLENE 1/
Africa and Middle East	1,525	335	85	1,200
Asia	5,800	2,725	585	2,800
Latin America	3,350	840	625	2,400
TOTAL	10,675	3,900	1,295	6,400
1 9 9 0				
Africa	2,500	530	125	2,500
Asia	8,700	3,900	770	5,500
Latin America	5,150	1,230	870	3,600
TOTAL	16,350	5,660	1,765	11,600

ANNUAL GROWTH RATE IN %						
REGION	THERMOPLASTICS		SYNTH. FIBERS		SYNTH. RUBBERS	
	1980-85	1985-90	1980-85	1985-90	1980-85	1985-90
Africa and Middle East	9.7	10.4	9.8	9.6	8.3	8.0
Asia	9.3	8.5	8.4	7.4	6.7	5.7
Latin America	6.9	9.0	7.0	7.9	5.9	6.8
TOTAL	8.6	8.9	8.2	7.7	6.4	6.4

1/ Estimates based on existing, under construction and planned capacities of ethylene-derived intermediates and end petrochemicals in each region.

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
AFRICA AND MIDDLE EAST	PVC	HD	LD	PP	PS	TOTAL						INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
ALGERIA [1]													
Capacity 1980	35	na	48	na	na	83	na	na	120	na	na	na	na
Capacity 1985	35	48	48	-	-	131	17	44	120	na	95		(10.9)
Capacity 1986+	135	80	148	70	38	471	24	115	120	235	95		(21.4)
EGYPT [1]													
Demand 1980	25	25	35	10	12	107	15	6	na	10	12	213	2.7
Capacity 1985	80	na	na	na	na	80	30	54	140	75	17		(6.1)
Capacity 1986+	80	60	100	40	45	325	60	54	300	na	na		(7.2)
IRAN [1]													
Demand 1980	70	19	28	12	12	141	16	57	na	na	na	356	3.6
Capacity 1986+	40	60	100	50	-	250	40	101	525	180	360		(6.4)
IRAQ [3]													
Capacity 1986+	80	30	60	60	na	230	na	na	160	na	na	(170)	(17.6)
JORDAN [3]													
Demand 1980	8	2	7	0.5	0,5	18	na	na	na	na	na	122	5.6
KENYA [2]													
Demand 1980	na	na	na	na	na	na	3	2/13	na	na	na	na	na
KUWAIT [1]													
Demand 1980	2.5	1	3	2	0.6	9	na	na	na	na	na	3,000	6.5
Capacity 1986+	na	na	160	na	na	160	na	na	350	na	280		(114)

[1] From country survey

[2] From published information

[3] UNIDO country paper

TABLE 5

COUNTRY SITUATION ON PETROCHEMICALS cont.

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
AFRICA AND MIDDLE EAST	PVC	HD	LD	PP	PS	TOTAL						INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
LIBYA 2/ 4/													
Capacity 1980	60	na	na	na	na	60	na	na	na	na	na	na	20
Capacity 1985	60	130	135	68	na	393	70	na	330	171	na		(131)
MOROCCO 3/													
Demand 1980	13	6	20	1	1	41	9	na	na	na	na	427	2.1
Capacity 1986+	25	na	60	na	na	85	na	na	na	na	na	na	(4.3)
NIGERIA 2/													
Capacity 1985	na	na	na	35	2	37	na	8	na	35	15	na	
Capacity 1986+	145	70	110	60	na	385	na	na	580	75	na		(4.5)
QATAR 1/													
Demand 1980	na	0.4	0.3	na	na	1	na	na	na	na	na	na	na
Capacity 1981	na	na	140	na	na	140	na	na	200	na	ra		(233)
Capacity 1985	na	na	140	na	na	140	na	na	280	na	na		(233)
SAUDI ARABIA 1/													
Demand 1980	74	18	25	5.2	13.9	136	na	na	na	na	na	849	15.1
Capacity 1985	-	181	580	na	na	761	na	na	1,736	na	na	(121)	(84,5)
Capacity 1986+	100+	195	670	na	95	1,060+	na	na	1,736	na	na	(109)	(117.7)

1/ From country survey

2/ From published information

3/ UNIDO country paper

4/ European Chemical News of 28 June 1982 (declaration of Mr. R. Kawafi, General Manager of the Lybian petrochemical complex)

COUNTRY SITUATION ON PETROCHEMICALS cont.

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
AFRICA AND MIDDLE EAST	PVC	HD	LD	PP	PS	TOTAL						INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
SUDAN [2]													
Demand 1980	7	4	4	0.7	0.3	16	na	na	na	na	na	479	0.6
TANZANIA [2]													
Demand 1980	na	na	na	na	na	na	4	5	na	na	na	na	na
TUNISIA [3]													
Demand 1980	7	3	10	4	4	28	2	na	na	na	na	259	4.4
TURKEY [1]													
Demand 1980	47	10	40	20	13	130	28	82	42	16	48	412	2.9
Capacity 1980	52	na	27	na	15	94	46	129	55	40	24		
Capacity 1985	147	40	174	60	14	435	51	276	367	199	154		(9.6)
Capacity 1986+	147	40	174	60	14	435	51	278	367	199	286		(9.5)

[1] From country survey

[2] From published information

[3] UNIDO country paper

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
ASIA	PVC	HD	LD	PP	PS	TOTAL						INCOME/CAPITA. ($) / KGS/CAPITA	KGS/ CAPITA
BANGLADESH [1]													
Demand 1980	8	0.3	5	0.2	0,2	14	0,2	2	na	na	0.5	626	0.2
Capacity 1986+	30	na	na	na	na	30	0,2	13	na	na	na		
CHINA [2]													
Demand 1980	360	54	265	91	30	800	116	447	480	205	340	323	0.8
Capacity 1980	400	183	264	133	60	1,040	160	527	540	230	400		
Capacity 1985	600	463	324	133	60	1,580	190	527	1,285	480	550		(1.6)
Capacity 1986+	1,080	603	1,080	230	60	3,053	190	527	2,940	480	550		(3.0)
HONG KONG [2]													
Capacity 1980	na	na	na	na	75	75	na	na	na	na	na	na	na
Capacity 1985	na	na	na	na	153	153	na	na	na	na	na		(31)
INDIA [1]													
Demand 1980	82	63	74	20	13	252	48	88	126	66	26	528	0.4
Capacity 1980	87	30	110	30	24	281	50	89	210	119	139		(0.4)
Capacity 1985	142	30	110	30	24	336	50	151	210	119	237		(0.5)
Capacity 1986+	376	170	270	115	49	980	130	408	770	374	502		(1.5)
INDONESIA [1]													
Demand 1980	92	64	77	50	12	295	15	109	na	na	na	237	2.0
Capacity 1980	54	na	na	37	na	91	na	124	na	na	na		(0.6)
Capacity 1985	72	na	na	37	na	109	na	191	na	na	na		(0.7)
Capacity 1986+	150	100	150	37	na	437	40	235	340	na	421		(3.0)

[1] From country survey
[2] From published information

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION / ASIA	PVC	HD	LD	PP	PS	TOTAL	RUBBERS	FIBERS	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
												INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
KOREA, Rep. of [1]													
Demand 1980	179	71	136	148	43	577	127	320	369	241	110	102	15.1
Capacity 1980	300	140	150	185	117	892	100	400	505	268	155		(23.5)
Capacity 1985	350	140	150	185	167	992	125	658	505	268	183		(26.1)
Capacity 1986+	350	140	150	185	167	992	180	658	505	268	250		(26.0)
MALAYSIA [1]													
Demand 1980	22	21	30	24	8	105	6	17	na	na	na	225	7.5
Capacity 1985	53	na	na	na	10	63	na	36	na	na	na		(4.5)
Capacity 1986+	53	80	135	80	10	358	na	45	250	84	na		(25.6)
PAKISTAN [2]													
Demand 1980	5	- 73 -		25	na	103	5	34	100	na	na	201	1.3
Capacity 1986+	na	na	120	70	na	190	na	48	na	na	na		
PHILIPPINES [2]													
Demand 1980	25	na	na	na	13	38	13	47	na	na	na	na	na
Capacity 1986+	240	60	120	100	100	620	na	58	350	190	na		(12.7)
SINGAPORE [2]													
Demand 1980	16	na	na	na	na	16	3	na	na	na	na	na	na
Capacity 1985	na	80	120	100	na	300	na	na	300	165	na		(12.5)

[1] From country survey

[2] From published information

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION	PVC	HD	LD	PP	PS	TOTAL	RUBBERS	FIBERS	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
ASIA												INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
THAILAND 2/													
Demand 1980	18	- 50 -		na	15	83	9	71	na	na	na	395	1.8
Capacity 1986+	80	120	144	60	23	427	na	87	300	60	na		(9.1)
OTHER ASIA 2/													
Demand 1980	300	50	140	50	50	590	80	687	443	204	137	na	33.1
Capacity 1980	400	50	215	50	55	770	100	766	568	230	200		
Capacity 1985	400	200	215	125	100	1,040	100	766	953	478	450		
Capacity 1986+	600	200	460	170	120	1,550	140	766	953	478	450		

2/ From published information

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
LATIN AMERICA	PVC	HD	LD	PP	PS	TOTAL						INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
ARGENTINA 2/ 3/													
Demand 1980	23	na	na	14	31	68	na	24	90	30	10	na	na
Capacity 1980	33	na	32	na	na	65	40	77	na	na	na		
Capacity 1985	120	na	190	na	na	310	na	77	251	76	128		(10.3)
Capacity 1986+	160	100	310	60	50	680	na	na	840	336	na		
BOLIVIA 3/													
Capacity 1985	31	20	45	18	12	126	na	3	60	40	87	na	(22.7)
Capacity 1986+	31	80	80	30	19	240	na	na	150	80	100		(57.4)
BRAZIL 1/													
Demand 1980	364	123	331	109	117	1,044	212	249	728	401	335	227	8.8
Capacity 1980	335	110	328	100	194	1.067	245	237	792	460	330		
Capacity 1985	370	170	543	166	212	1,461	325	243	1,344	683	567		(12.3)
CHILE 2/													
Capacity 1985	15	na	24	na	5	44	11	8	na	na	2		
Capacity 1986+	15	na	24	35	5	79	na	15	60	40	na	na	(7.2)
COLOMBIA 3/													
Demand 1980	na	na	na	na	na	na	na	31	15	3	43	na	na
Capacity 1980	48	na	15	na	13	76	na	na	20	10	43		(2.8)
Capacity 1985	77	na	65	na	13	155	40	na	215	10	43		(5.7)
Capacity 1986+	77	na	65	na	15	157	40	57	496	na	50		
COSTA RICA 3/													
Demand 1980	15	16	na	na	na	31	na	3/6.5	na	na	na	na	(14.1)

1/ From country survey

2/ From published information

3/ UNIDO country paper

COUNTRY SITUATION ON PETROCHEMICALS cont.

1000 metric tons

REGION	THERMOPLASTICS						RUBBERS SYNTH.	FIBERS SYNTH.	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
LATIN AMERICA	PVC	[illegible]	LD	PP	PS	TOTAL						INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
ECUADOR 5/													
Demand 1980	na	na	na	na	na	na	na	3,5	na	na	na	na	na
Capacity 1980	na	na	na	na	na	na	na	5	na	na	na	na	
Capacity 1986+	30	63	70	73	na	236	na	na	140	155	140		(29.5)
MEXICO 1/													
Demand 1980	127	109	235	69	85	625	109	184	366	157	94	268	8.9
Capacity 1980	136	100	69	na	114	419	97	232	432	324	124		
Capacity 1985	300	200	309	100	201	1,110	158	403	932	401	124		(14.8)
Capacity 1986+	440	300	549	200	300	1,789	220	516	2,832	531	598		(22.4)
NICARAGUA 5/													
Capacity 1980	30	na	na	na	na	30	na	na	na	na	na	na	11.5
PARAGUAY 5/													
Demand 1980	5	5	10	5	5	38	na	na	na	na	na	148	10
PERU 3/													
Demand 1980	11	na	na	na	na	na	na	35	na	na	na	na	na
Capacity 1980	7	na	na	na	na	7	na	40	5	na	na		
Capacity 1986+	75	25	90	25	15	230	40	40	255	147	125		(12.8)
TRINIDAD AND TOBAGO													
Demand 1980 5/	6	6	na	na	2,2	14	na	0,3	na	na	na	na	11.8
URUGUAY 5/													
Demand 1980	12	na	20	1,5	5	38,5	na	3/4,5	na	na	na	220	12.8

1/ From country survey

3/ UNIDO country paper

5/ From Petrochemical Week, Porto Alegre, 17-21.5.1982, country paper

COUNTRY SITUATION ON PETROCHEMICALS

1000 metric tons

REGION	PVC	HD	LD	PP	PS	TOTAL	RUBBERS	FIBERS	ETHY-LENE	PROPY-LENE	BENZE-NE	THERMOPLASTICS	
LATIN AMERICA												INCOME/CAPITA ($) / KGS/CAPITA	KGS/ CAPITA
VENEZUELA [3/]													
Demand 1980	23	na	na	14	31	68	na	17	90	30	10	na	na
Capacity 1980	42	na	59	na	40	141	na	22	150	94	10		(9.4)
Capacity 1985	40	60	59	na	40	199	na	22	150	94	100		(13.3)
Capacity 1986+	55	70	90	na	40	255	40	na	430	94	100		(17.0)

[3/] UNIDO country paper

ANNEX V

METHODOLOGICAL NOTES

In the first world-wide study on the petrochemical industry published in December 1978, both a macroeconomic forecasting and a world petrochemical model were prepared, since the data base for an statistical trend extrapolation was inadequate.

The macroeconomic forecasting approach was used in this report. The best correlation coefficients are found in equations of the form $y = a \log x + b$; where y represents consumption in kilos per capita and x represents GDP per capita. Individual equations were prepared for each region.

In this report, the data and forecasts of developed countries were taken as given by their respective country or regional associations, except for Eastern Europe that were estimated.

For developing countries, forecasts of GDP and population growth rates 1980-1990 were obtained from the UNIDO-UNCTAD (UNITAD) world model. The data reflects the global trend scenario 1975-1990 adjusted for the historical data 1975-1980. It assumes that a substantial economic recovery in developed countries should take place by mid 1983, followed by a recovery in developing countries.

The elasticity per caput coefficients were assumed based on those derived from the world petrochemical model, adjusted according to experience and future expectations.

In the whole, the macroeconomic assumptions may yield optimistic forecasts since until mid 1983 it may not be feasible to ascertain if the economic depression that set in late 1979 in developed countries and late 1980 in developing countries, is structural or not.

The detailed macroeconomic assumptions are as follows:

A. GDP and population in 1980 and annual growth rates 1980-1990

Region	GDP		Population	
	in 10^9 constant dollars of 1975	Growth rate (%)	10^6 inhabitants	Growth rate (%)
Developed countries	5,833.5	3.35	1,212.9	0.78
Africa and Middle East	403.5	4.10	526.4	3.02
Asia	508.6	4.52	2,276.3	1.74
Latin America	483.6	5.86	364.1	2.67

Source: UNITAD global model, January 1983

B. Elasticity per caput coefficients for developing countries by regions

Region	Thermoplastics		Synth. Fibers		Synth. Rubbers	
	1980-85	1985-90	1980-85	1985-90	1980-85	1985-90
Africa and Middle East	1.30	1.35	1.30	1.30	1.20	1.20
Asia	1.25	1.20	1.20	1.15	1.10	1.05
Latin America	1.05	1.15	1.05	1.10	1.00	1.05

Source: First world-wide study on petrochemicals 1975-2000, world petrochemical model, adjusted according to the following assumptions in the light of experience:

Africa: Several major petrochemical complexes are expected on stream between 1985-1990. The learning curve of consumption has shown historically a period of fast growth lasting about 3-4 years, upon local availability of petrochemical products.

Asia: reflects the diminishing competitiveness of production in the main exporting countries, and the partial counterbalance by the dynamism of ASEAN countries.

Latin America: reflects the actual drop in consumption in 1981 and the still depressed levels in 1982, chiefly due to heavy financial burdens in the largest consuming countries.