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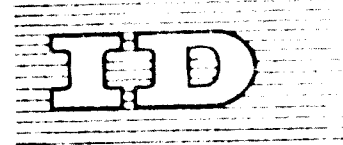
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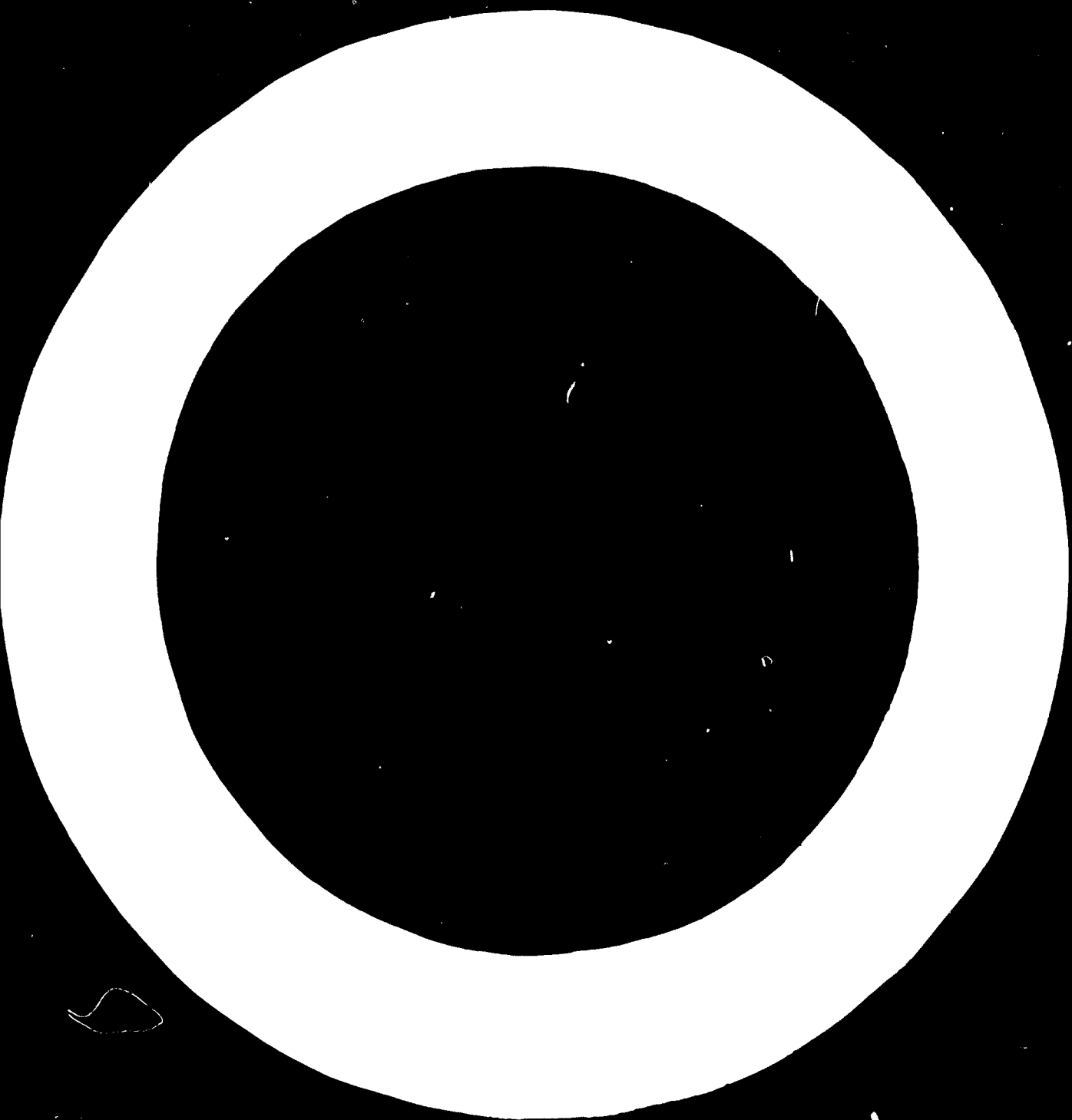
DEVELOPMENT OF THE PETROCHEMICAL INDUSTRY

INCLOSURE^{1/}

by

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The chemical industry in the past period of 23 years, has increased its production value in comparison with that in 1938 more than eighteen times, while the total production value of the whole industry has risen only 13.4 times.

A closer analysis shows that an annual average growth rate in the first ten years period, i.e. from 1946 to 1955, amounted to 24 per cent per annum for the chemical industry and to 12.5 per cent per annum for all industry.

In the next following period 1956 to 1968 the rate for the chemical industry was 15 per cent and for all industry 8.8 per cent.

The annual average growth rate for the ten year period after 1968 would probably decline to 13 per cent and 8 per cent.

By those rates of growth an increase in the production value in 1975, in comparison with the level in 1968, ought to amount for the chemical industry to 138 per cent and for all industry to about 70 per cent.

Estimating the position of the chemical industry from the point of view of its percentage share in the total value of the industrial production in the past period, it is necessary to note that the chemical industry - due to the low level of its starting point in 1946 - attained a share of 7.3 per cent only after 16 years, namely in 1961, which made it equal to that in 1938.

This share in 1965 was already 9.6 per cent and in 1968 just 10.2 per cent. The estimated share in the years 1970 and 1975, will be 11.8 per cent and 13.5 per cent respectively.

It shows a continuously growing position and a penetration of the chemical industry into industrial economies of the country. These figures in index form are set out in table I and a growth rate in table II.

Table I

indices	years	1938	1946	1955	1960	1965	1968	1970	1975
		%	%	%	%	%	%	%	%
production value of all industry		1.0	0.73	1.35	6.9	9.15	13.4	14.5	23.1
production value of chemical industry		1.0	1.30	3.07	6.3	12.5	16.2	23.7	42.9
percentage share of chemical industry in total value		1.8	3.0	5.7	6.7	9.6	10.2	11.8	13.5

Table II

indices	period	1946-1955	1956-1965	1966-1975 (estimated)
annual average growth rate of all industry		14.5	7.7	15.0
annual average growth rate of chemical industry		24.0	15.0	18.0

Summarizing table I, it can be concluded that the production value of the chemical industry after the first fifteen years has reached nearly to 30 percent of that in 1948. This means, that during the last eight years the increase was almost twice as high as in the previous fifteen years.

This comparison shows explicitly where the line is crossed between the past and the present.

The past - was a hard way of restoration and reconstruction, and the present - is building of new works and expansion of new material basis in order to create the largest possible foundation for further development of the chemical industry and in particular petrochemical industry.

A lot of reasons can be given to explain the reasons why the development of the chemical industry in the first fifteen years was so slow and what has happened to cause the acceleration to an extraordinary rapid stage in the last eight years.

Certainly such factors as the priority given in the first years to the development of the coal industry, the energy and petrochemical industry, of energy sources as well as a deficiency of raw power, modern production methods and others, played a very important role.

However, the most important factor slowing down the development of the chemical industry was the limited availability of raw materials and the lack of any means of expanding supplies.

The most representative indigenous raw material was coal, the output of which in Poland in 1948 amounted nearly to 1.6 billion metric tons, and which even now is still a main raw material and source of energy for the country.

Besides coal, Poland has very rich resources of rock salt, limestone and

appars, and also newly explored sulphur as well as smaller resources of other minerals.

The resources and output of crude oil were and are small. The same situation applied to natural gas, but in the last few years, this has been radically improved.

Development of the chemical industry has been largely dictated by the raw material available. Therefore, the production of soda ash and sulphuric acid has been developed on a large scale and the traditional organic chemical industry based on raw materials derived from coal tar has been carried out.

The development of synthetic production has been based almost exclusively on the coal basis. Thus, many coke as a raw material, production of ammonia and ethanol have been organized and in addition synthetic gasoline by the Fischer-Tropsch process. Of course, the production of synthetic gasoline could not be economic, so it was stopped after 1932.

The heavy organic synthesis industry operates mainly on acetylene derived from carbide. The production of acetone from acetaldehyde opened the way for further synthesis of acetic acid anhydride, butanol and octanol, as well as of ethanol, from which butadiene has been made according to onester process of Lebedev.

Then, styrene-butadiene synthetic rubber and further also polybutadiene rubber plants have been erected.

Even chlorine needed for production of ethylbenzene was produced from acetylene. Acetylene derived from carbide was also used as an intermediate for the production of vinyl chloride and vinylacetate, trichloroethylene and acrylonitrile.

It was only in recent years that manufacturing process of acetylene by the method of partial combustion of methane with oxygen - together with the production of synthesis gas for ammonia - was developed.

Before 1960, when the rapid world development of petrochemical industry began, it became obvious that the further development of chemical industry on the basis of coal could be economic and must be limited.

Therefore, the production of butadiene from ethanol was stopped and this chemical has been imported till the start up of the production from n-butene by Henry's process. The production of ethylene from acetylene was also stopped. Other units working on an acetylene basis will continue this production,

however their extension is not being considered.

It is assumed that due to the fact that these plants are nearly written off and the manufacturing process was well mastered, the resulting production costs will be maintained at the economic level.

The situation was radically changed at the beginning of 1964, it is then that the utilization of petrochemical raw material started. This was possible due to the supply of natural gas and crude oil from the Soviet Union. Almost simultaneously home resources of natural gas have been discovered. These home resources already in operation should give a steady output in the next years amounting nearly to 6 thousand million cubic meters per annum, and in the farther future up to 30 thousand million cubic meters per annum.

Such a new situation enabled several old plants to be created: nitrogen fertilizer works, refineries and petrochemical plants. Immediate priority was given to nitrogen fertilizer industry. The development of this industry in Poland in recent years, is the most spectacular example of effects which can be obtained by the application of modern chemical engineering and the construction of well designed chemical equipment.

On the other hand, it also shows that equipment becomes very rapidly out of date even during the period of implementation of projects which was modern when designed. Thus for instance ammonia synthesis units before 1960 had a production capacity of 10 to 100 metric tons per day, while the capacity of units created in 1963, 1964, 1965 and 1966 was 100, 300, 500 and 750 metric tons per day respectively. Due to the investment already finished together with that in course of implementation, the production of ammonia has risen from 1,500 metric tons per day in 1960 to 3,300 metric tons per day in 1967 and is expected to attain nearly 5,500 in 1970 and 7,000 metric tons per day in 1973. It is of interest that the largest single plant will produce 3,000 metric tons per day which is equivalent to 1 million metric tons per annum of ammonia.

The erection of new production capacity for ammonia based on natural gas and the intended introduction of natural gas instead of coke in other plants, will increase the share of natural gas consumption for ammonia production from 13 per cent in 1965 to 75 per cent in 1970. In 1973, this share will approach to 100 per cent.

The whole production of ethanol will be based on natural gas, while a share

of natural gas as raw material for acetylene production will increase from 15 per cent in 1968 to above 30 per cent in 1975.

The crude oil refining industry developed even faster than the fertilizer industry. The capacity was increased from 0.87 million metric tons per annum in 1960 to 3.5 million in 1968 and has attained above 7 million metric tons per annum in 1969. Before 1975, it will attain an anticipated level of 13.5 million metric tons per annum.

Such a great concentration of investment in the extension of fertilizer industry and refineries (leaving aside the important investment carried out in such branches as phosphate and NPK fertilizers, synthetic fibres and other industries) delayed the development of petrochemical industry, which should clear the way for development of modern processes of chemical synthesis.

Therefore, the first small plant for hydrocarbon steam cracking was not put into operation till 1967 and the production of high pressure polyethylene, ethylbenzene, cumene phenol and acetone was then started.

By the beginning of 1971 the total production capacity of petrochemical intermediates will have amounted to about 100,000 metric tons per annum of ethylene, 50,000 to 60,000 metric tons per annum of propylene and 70,000 metric tons per annum of butadiene. These intermediates will be used for production of: polyethylene, ethylenoxide, ethyleneglycol, ethylbenzene, polypropylene, phenol and acetone, as well as synthetic styrene-butadiene and polybutadiene rubbers.

Such a great delay in the development of its most modern branch of chemical industry needs drastic methods to put it right. Therefore, an investment will be concentrated in this branch during the next two five year plans 1971-1975 and 1976-1980. The problem will be very difficult to solve, especially in the first five year plan, because of investments being carried out at the same time in the crude oil refining branch. It is also very difficult to decide the capacities of the new production units, since they are connected by a chain of technological processes leading to end products. It is well known that while raw material prices steadily increase, the prices of final products decrease, while the prices of industrial equipment are steadily going up. The profit that may be obtained by enlarging unit production capacity is also known. Nevertheless, the erection of big production units and especially the concentration of all investment in the technological chain in one place is distinctly risky. That risk

is often caused by delays in the erection cycle as well as by difficulties in bringing on stream large integrated groups of installations, as well as by deficiencies in the operating staff. The latter is particularly the case if an installation is being built in the country for the first time. Further risks of an economic type arise from insufficient utilization of production capacities as well as from losses of production output in case of technical failures in the first basic installation of a technological chain.

All the above mentioned considerations are applicable in the first place to the main petrochemical installation, namely hydrocarbon steam cracking for olefine production. It has not been decided up till ^{now} what production capacities of new cracking plants shall be erected, whether these shall be for 200,000 metric tons per annum or 300,000 metric tons per annum of ethylene or somewhere in between. If the decision in this matter is taken, the plant of a similar production capacity will be erected in the second stage of petrochemical development after 1975. The implementation of these plans will considerably decrease the gap between Polish chemical industry and chemical industries in other countries where the conditions for changing the raw material basis from coal to natural gas and crude oil were more favourable.

To conclude, it must be admitted that only the initial steps have been made in the field of Polish petrochemical industry but as a result of a considerable development of the firm basis for the extension of petrochemical production in the near future has been created. There is a hope that just as in 1960 to 1970, the problem of production of nitrogen fertilizers was solved, after 1970 there will be concentration on the means for development of petrochemical industry.

It will enable the extension of manufacture of products now manufactured on a coal basis to be carried out as well as starting up of production of new products. This should bring about a considerable change in the actual structure of chemical industry and in increasing its share of new products.

In the planned development priority will be given to polyolefine products (polyethylene and polypropylene), ^{to} synthetic fibres (polyester, polyamide and less to polyacrylic), ^{to} polyester-epoxy, polyacrylic-, polyurethane- and polycarbonate resins and new kinds of synthetic rubber. Their annual output will depend on the actual production capacity of olefines which will be brought on

stream.

To finish this short survey of state of chemical industry, it must be emphasized that the future of Polish chemical industry will be firmly based on petrochemistry.

Resumé

Indices of growth of chemical industry and of all industry and percentage share of chemical industry in total industrial production value in 1946 to 1968, as well as probable indices up to 1975 are given.

The current position and development conditions of chemical industry in the past period and the main trends of its development in the future, have been presented.





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