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DEVELOPMENT OF THE PETROCHEMICAL INDUSTRY IN YUGOSLAVIA<sup>1/</sup>

by

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## 1. Petrochemical Industry

The paper describes the problems of the basic production of the organic chemistry. Although Yugoslavia does not have a significant inorganic petrochemical production (potassium and nitrogen fertilizers, carbon black <sup>II</sup>) we question according to this production will be dealt with in this paper.

The following of the basic organic chemistry production is developed in Yugoslavia:

- plastic: polyethylene l.d., polystyrene, polyvinyl chloride, phenol and aminoplasts, polyacrylonitrile, cellulose acetate, polyvinyl acetate and similar.
- synthetic fibres: polyacrylic and polyamide
- basic organic chemistry products: methanol, formaldehyde, ethylbenzene, styrene, vinyl chloride, acetone, dodecyl benzene, phthalic anhydride, ethylene, propylene, cumene, phenol, plasticizers and similar.

In the growth <sup>1955-65</sup> of the basic organic chemical industry, both models: model forward integration and model backward integration, are engaged in its final integration into the economic structure of the country.

The first of these models developed simultaneously with the final production, the necessary scale of the second and first generation of intermediaries.

In this model is characterized the production of vinyl chloride, vinyl acetate, polystyrene and polyethylene. In this way, and simultaneously with the final production, an entire scale of the preceding phases is developed.

The subject manufacturers was integrated into process complexes owned by enterprises: BECOFIN, OHS and OMI.

OZI - OMIČKA KEMIJSKA INDUSTRIJA, ZAGREB is the first organic petrochemical complex in Yugoslavia. The capacities of the individual units are the following: ethylene 20.000 t/y, polyethylene l.d. 20.000 t/y, polystyrene 10.000 t/y, phenol 1.000 t/y, acetone 1.200 t/y, styrene 10.000 t/y.

In Yugoslavia there are four manufacturers of ammonia and nitrogen fertilizers: "Fabriska azotnih i fosfornih gnojiva" (Petrochemical Product Plant) at Zrenjanin, "Fabriska azotnih i fosfornih gnojiva" (Chemical Industry) at Banjica, "Fabriska azotnih i fosfornih gnojiva" (Nitrogen and Phosphorus Plant) at Borovo, and "Fabriska azotnih i fosfornih gnojiva" (Nitrogen and Phosphorus Plant) at Koprivnica. The first two manufacturers are producing ammonia from natural gas, the third one from coal, and the fourth one uses the coke gas. The total ammonia capacity in Yugoslavia amounts to 360,000 t/y.

The carbon black plant is a unit of the Petrochemical Product Plant at Zrenjanin with 12,000 t/y capacity.

OHIS - CRČINSKO HEMISKI INDUSTRIJA, SKOPLJE manufactures vinyl chloride on the basis of carbide and PVC/capacity 5,000 t/y, polyvinyl acetate 3,000 t/y, polyacrylonitrile fibres on the basis of imported monomers/capacity 6,000 t/y /.

JUGOVINIL, SPLIT manufactures vinyl chloride on the basis of carbide, PVC/capacity 20,000 t/y /.

The second model, however, independently materialized the final production on the basis of imported intermediaries. Under this final production is then the corresponding intermediaries production being built. The phenol, plastic, aminoplasts, polyester, polyurethane etc. from the group of plastics, polyacrylic and polyamide synthetic fibres, and a series of organic chemicals (plasticizers, dodecyl benzene and similar), all of them are developed against this model.

The manufacture materialized against the first model is concentrated in three enterprises (JUGOVINIL, OHIS, OHIS), whereas that against the second model is on the contrary, dispersed and is realized individually in a relative small portion of the overall production of 17 enterprises.

Gross production of the basic organic chemical industry of both the final and the intermediaries products, for the year 1963 and 1964, from 73,000 increased to 222,337 tons. The structural outline of the production, for the period from 1963 - 1964, and its capacities in 1964, are shown in the enclosed table.

The plastics represent the central line of the Yugoslav basic organic chemical industry. The largest quantity of the final production falls to plastic. A larger portion of the first and second generation of intermediaries is applied for plastics synthesis, respectively for synthesis of products which are marketably complementary to the plastic (plasticizers). From the gross production as shown for 1963, amounting to about 220,000 tons, about 71,000 tons are the plastics. The rest of 149,000 tons however, are the intermediaries of the first of the second generation, which are exclusively or mostly applied for synthesis of plastics and of complementary products. In this way, the production of plastics in Yugoslavia makes about 32,3 % of

the total organic chemical production. <sup>¶</sup>

The raw material basis of the organic chemical industry determines the origin of the feedstock from which the so called first generation of intermediaries is obtained.

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¶ This highly direct and indirect participation of the plastics is due to the insufficiently diversified production structure of the organic chemical industry.

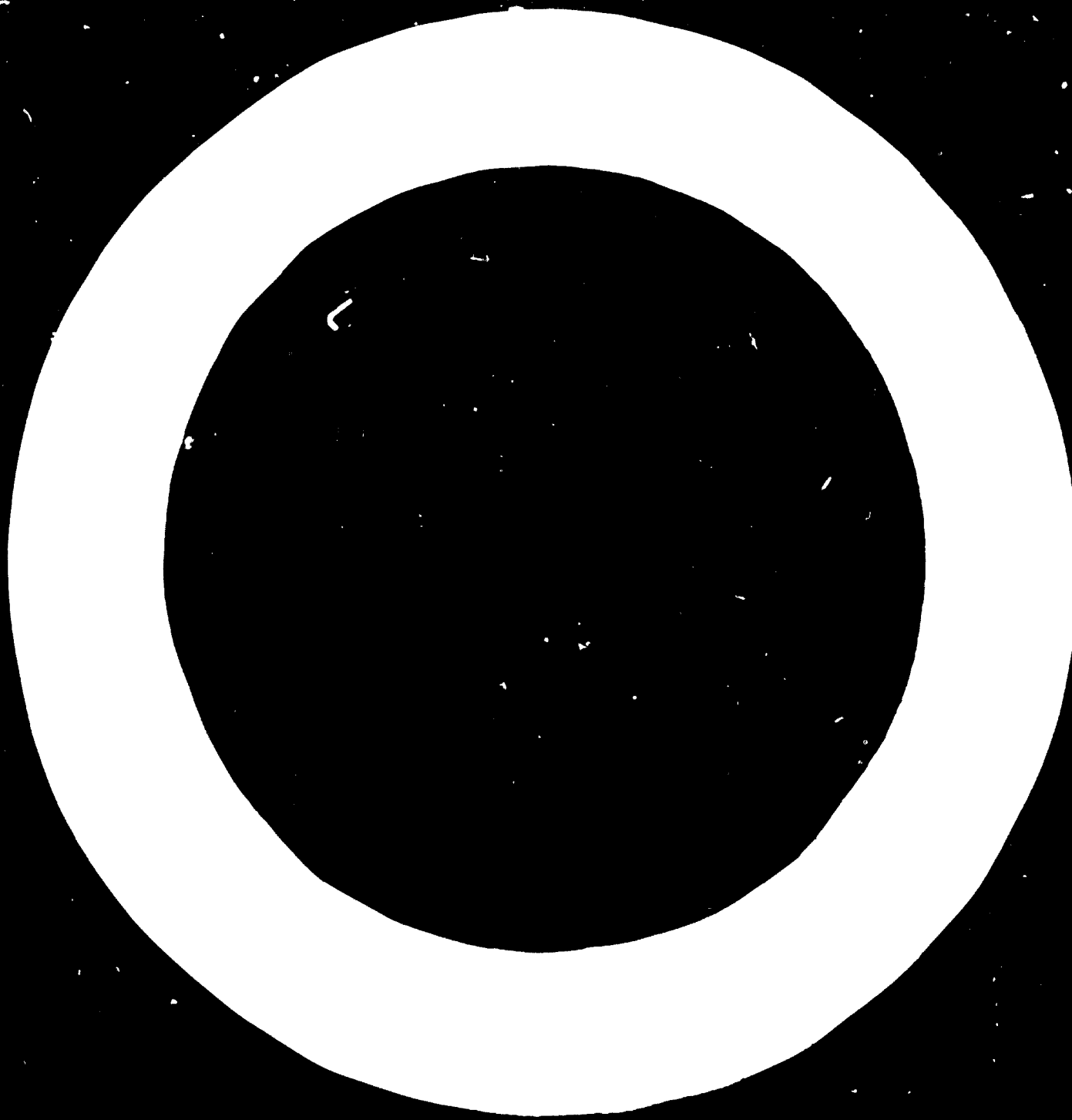
THE PUBLIC HEALTH COMMISSION REPORT FOR THE YEAR 1963 UNTIL 1968

Item	1963	1964	1965	1966	1967	1968	1969
1. <u>Chlorine</u>	17.148	21.111	10.111	1.173	21.501	24.701	21.300
2. <u>Chlorine</u>	2.211	2.211	3.211	1.211	4.211	7.211	10.211
3. <u>Chlorine</u>	-	-	3.571	-	3.921	1.111	2.000
4. <u>Chlorine</u>	-	-	-	-	3.83	1.111	2.000
5. <u>Chlorine</u>	-	-	1.047	3.701	3.004	3.839	5.000
6. <u>Chlorine</u>	3.042	1.753	7.500	7.263	3.551	5.200	11.000
7. <u>Chlorine</u>	9.380	9.131	12.036	14.471	16.670	22.700	34.000
8. <u>Chlorine</u>	-	-	3.197	13.591	12.591	11.590	13.000
9. <u>Chlorine</u>	9.00	2.030	5.571	9.450	7.054	6.586	13.000
10. <u>Chlorine</u>	-	-	1.112	4.230	1.390	3.100	4.800
11. <u>Chlorine</u>	-	1.382	1.156	-	-	4.248	12.000
12. <u>Chlorine</u>	-	1.177	7.522	6.053	7.810	7.800	10.000
13. <u>Chlorine</u>	-	-	1.093	3.583	633	3.730	10.000
14. <u>Chlorine</u>	5.108	6.207	13.540	10.202	6.414	7.000	25.000

15. Chlorine  
16. Chlorine

17. Chlorine  
18. Chlorine

19. Chlorine





	1	2	3	4	5	6	7	8
<b>First-Generation of Intermediaries</b>								
Acetic acid	-	5.300	7.500	-	16.100	15.925	15.047	27.000
Acetyl chloride	-	-	-	-	1.600	1.075	5.5	2.000
Acetic anhydride	-	-	-	-	-	-	-	-
Acetyl acetate	-	-	-	-	-	-	-	-
Acetyl benzoate	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetamide	-	-	-	-	-	-	-	-
Acetyl acetate	-	-	-	-	-	-	-	-
<b>Total</b>	<b>35.750</b>	<b>57.050</b>	<b>73,025</b>	<b>57,000</b>	<b>81,212</b>	<b>110,824</b>	<b>177,900</b>	
Acetone	5.545	11.285	16,587	1,573	4,322	4,322	4,322	4,322
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
Acetyl acetone	-	-	-	-	-	-	-	-
<b>Total</b>	<b>10,000</b>	<b>22,000</b>	<b>35,000</b>	<b>1,573</b>	<b>17,322</b>	<b>17,322</b>	<b>17,322</b>	

**Acetyl acetone**

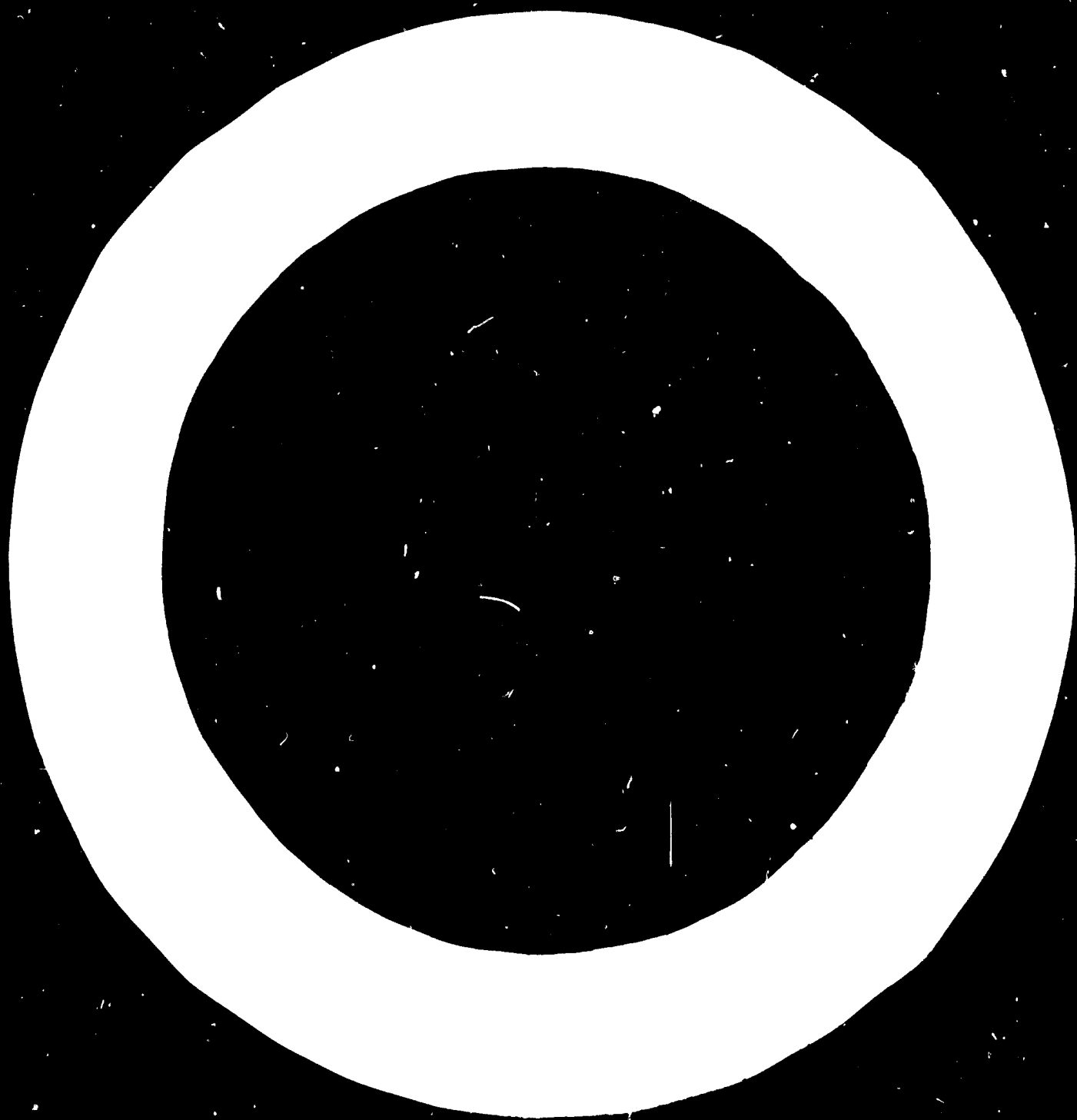
Acetyl acetone is the acetyl derivative of acetone, formed by the reaction of acetyl chloride with acetone. It is a colorless, odorless liquid, soluble in organic solvents. It is used in the synthesis of various chemical compounds, including acetone derivatives, and as a reagent in analytical chemistry.

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Accordingly, the raw material basis can properly be defined only for the group of organic chemical products where the final production materializes the first generation of intermediaries (methane, ethylene, propylene, benzene and synthesis gas). The overall ethylene and propylene production, and the portion of the synthetic gas production required for methanol synthesis are based on hydrocarbons from petroleum (petroleum or light naphtha gas), whereas the entire production of methane, that of benzene and a part of synthesis gas for methanol are based on carbon derived from coal.

As shown by the carbon content (C), the fugitive production of the first generation of intermediaries, was based on:

- hydrocarbons from petroleum	27,200 tons or 92 %
- coal	2,800 " " 48 %
RTM:	29,000 tons or 100 %

For that intermediate and final products derived from the intermediate products of the large production phase, the raw material basis cannot precisely be defined, but having in view the nature of the targeted product, it can safely be said that the greatest portion is derived from methane by transformations.

The value of fixed capital in the basic organic chemistry in Yugoslavia at the end of 1968, amounted to about 1.7 milliard D.D. (about 130 million dollars), which makes about 27% of the total fixed assets of chemical industry.

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If in the first phase plants at Rijeka and at Ploče are completed, and assuming that the present production relations in the 1960s, the origin of carbon for the production of the first generation of intermediaries, will and probably be changed to the advantage of hydrocarbons from petroleum. With the full utilization of the gas available in 1970, the relation between coal- and organic chemistry would be the following:

- petroleum (organic chemical)	163,000 or 89 %
- coal (organic chemical)	19,000 or 11 %
	182,000 or 100 %

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### 1. Expanding Starts

The problems of the initial development of the basic organic chemical industry in Yugoslavia arise from the fact that the prices of the organic chemical products are considerably higher than those found by the developed countries on the world market. This difference in significance after the economic reforms in 1961 when the transfer of the Yugoslav economy from the open type to a system of self-discipline along with the system protection which in a number of cases was for the same products as those in West European countries, did not lead to a complete balance of the domestic production and only at the world market level of the domestic market too.

Business conditions in Yugoslavia covered by the six prices forming the price list of the basic organic chemical products are different. These differences are the result of the following factors:

- the limitations of the Yugoslav economy at the time of the construction of large capacity plants and a very concentration of production in industrial complexes;
- the relative economic potential of the chemical companies in Yugoslavia are on the level of the leading members of the chemical industry in West European states. Contrary to the position of these companies, including in their long range development plans, with the basis and the processing relations of the chemical industry, the economic position of the principal companies of the Yugoslav chemical industry in the world is almost exclusively dependent on the world position of the basic production.
- the construction of the field basic organic chemical industry was financed by local and foreign loans which for the most part potential of these companies, high installation and capital costs which in price policy. The construction materialized by foreign loans increased the capital expenditure due to the cost of manufacturing (interest on interest), bank expenses and limited production of equipment supplies. All these extra costs along with customs duties now collected for a plant (except, with the investment into the basic organic chemical plant in large scale (i.e. Clavin plant), about 40% higher than for the West European countries.

- The initial development of the basic organic chemical industry is dependant on the purchase of licences, of know-how and engages substantial amount of foreign currency. For example, from the total foreign currency expenditure for erection of OMI Plants - Zagreb, amounting to 35 million dollars, some about 2 million dollars was used for paying licence and know-how fee.
- The plant maintenance is not easy in the developed countries owing to inadequate machine building industry in Yugoslavia. For the most specialized professional repair for maintenance of individual complexes have to be formed and excessive quantities of spare parts available in stores. In developed countries the supplier of a equipment (generators and similar), as a rule, maintains himself the equipment he supplied.
- So far in Yugoslavia there was neither a serious long term development programme, nor an adequate economic policy aiming to simplify the transfer of the complex chemical technology from the developed countries to the specific Yugoslav economic and social structure. The contrast of interest between the basic and processing sectors of the chemical industry is intensified by the lack of long term development strategy and practical economic policy supporting it. The difference between domestic and international prices of the basic organic products makes this contrast even greater, which prevents both the integration process and the transformation of the present into the new organizational structure aimed to the countries determining the world prices.
- A relatively small home market is an unfavorable factor which cannot be neutralized by the export orientation of the basic organic chemical industry. All these factors mentioned above, together with the shortage of capital, and the fact that Yugoslavia is not holding a share of the existing economic blocks, limit the export possibilities.
- At the time of the investment decisions for the construction of plants and basic organic chemical plants / OMI and OMI / with selected technology and capacity, it was possible to sell these products without losses at approximately the same price level as in the West European countries. However, the erection was not yet finished and the prices of the products on the world market were already so much lower that Yugoslav plants could not operate

... In that case and even later it was impossible to make al-  
lowed to conduct new conditions. Product delays in progress of  
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termine the optimum capacity. These selected prices should be taken into consideration in all economic policy decisions (rate of exchange, customs duties, foreign trade regime, etc.).

### 3. Future level of output

It is expected that the rate of restriction of the industrial sector will be low. It is anticipated that the industrial production per capita will be increased from about 1,000 in 1970 to 1,700 in 1975, and almost 2,000 in 1980. The improved development of the industrial branches which responded for an industrial sector for the first time in the country is expected. In this way, the growth of the petroleum industry is expected. Among the most important are the following products:

- plastics, especially PVC, polyethylene and polystyrene. It is expected that the plastic consumption per capita would increase from 2.71 kg in 1970 to 12.5 kg in 1980.\*
- synthetic fibres - especially manufacture of polyethylene and polypropylene, the production of which should be added.
- synthetic rubber
- organic and inorganic chemicals from which the other essential products are derived.

Chemical industry for oil and mineral manufacture will be restricted to the existing capacity of new oil and other products. The future will be concentrated on the new industrial plants (20,000 m<sup>3</sup> ethylene capacity).

In the program of the long-term development strategy, the development of the national chemical industry will be a priority. It is expected that the basic organic chemical industry.

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