



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

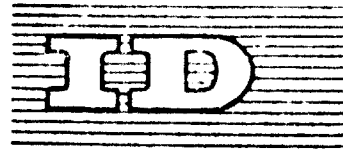
## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)



United Nations Industrial Development Organization

Distr.  
LIMITED

ID/WG.27/10  
31 October 1968

ORIGINAL: ENGLISH

Expert Group Meeting on the Development of the Plastics  
Industry in Developing Countries

Vienna, Austria, 11 - 15 November 1968

PROBLEMS AND EXPERIENCES IN TECHNICAL ASSISTANCE  
IN PETROCHEMICALS AND PLASTICS IN DEVELOPING COUNTRIES<sup>1/</sup>

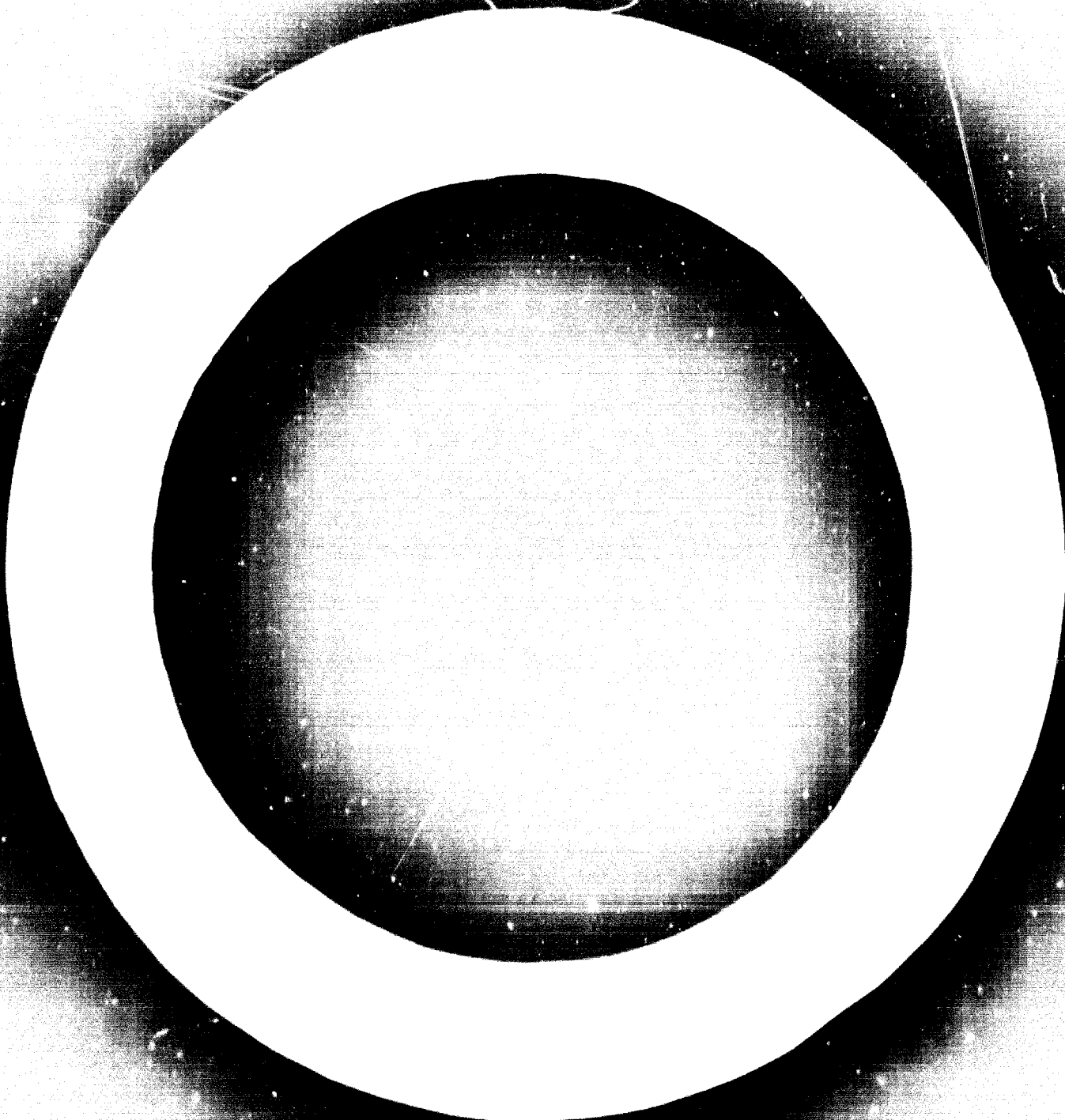
by

J. Skarka  
Chemoprojekt  
Czechoslovak Socialist Republic

D 00015

<sup>1/</sup> The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.



In my communication I would like to discuss some possibilities of technical assistance to developing countries in the erection of the petrochemical and plastics industry. I would like to mention some experiences and problems which can arise in such an activity. Also I would like to say something about the development and the tradition of chemical industry in Czechoslovakia, so that you could make an idea on what basis can the help from Czechoslovakia be realized.

The development of the chemical and petrochemical industry in Czechoslovakia

Already before the Second World War the Czechoslovak chemical industry had an important place in the national economy and has a fairly long tradition.

After the Second World War there was a very rapid expansion of this industry. In the last 20 years the production increased 7-fold.

The greatest expansion was achieved in crude oil refining and in petrochemistry. Before the Second World War Czechoslovakia had only five small refineries. During the war a big chemical factory was built for the production of fuels by the carbonization of lignite and hydrogenation of tars in the North Bohemia in Záluží. In the second decade after the war the large capacity refinery Slovnaft in Slovakia was built in connection with the starting import of crude oil in a large scale. These two refineries produce fuels and lubricants.

The older factory in North Bohemia in Záluží has gradually reduced the production from lignite and it is being reconstructed to a high capacity refinery, as well producing fuels from crude oil. In both of these refineries considerable capacities of various petrochemical productions have been erected in past years. Both factories produce ethylene from refinery gases and straight run naphtha. The petrochemical complex in Záluží is producing synthetic alcohol by direct hydration of ethylene and ethylbenzene by alkylation of benzene. These intermediates are used for the production of synthetic rubber in a new factory in Middle Bohemia. From propylene higher alcohols for plasticizers will be produced by oxosynthesis.

In the refinery Slovnaft in Slovakia the petrochemical production includes mostly the production of plastics like high-pressure polyethylene, polypropylene and the intermediate for fibres like phenol, glycols and DMT.

Soon after the war other units of the petrochemical type were built like caprolactam, PVC and polyvinylacetate, aromatics and of course methanol, formaldehyde, ammonia and generally nitrogen fertilizers. At the beginning some of these productions were based on other than petroleum sources and only in later stages of development they were changed or will be reconstructed on a petrochemical basis. Future projects will continue in the field of typical petrochemical units based on ethylene and propylene. In both main above mentioned factories with existing petrochemical processes based on ethylene and propylene new ethylene units are being designed for further production of intermediates based on ethylene and propylene, mostly plastics and intermediates for fibres and rubber production and other chemicals.

#### The creation of chemical industry in Czechoslovakia

The chemical industry before and also after the Second World War was built mainly by our own know-how, engineering and also the chemical machinery and equipment was of our own production. This applies to all branches of chemistry, including crude oil refining, classical organic and inorganic technologies, fertilizers, synthetic rubber and plastics material, coal tar refining, pharmaceuticals and nuclear chemistry. In the petrochemical industry the pyrolysis of hydrocarbons were engineered, as was the gas separation, the extraction of aromatics, synthetic alcohol, ethylbenzene, phenol, formaldehyde, methanol, caprolactam, PVC, ammonia and nitrogen fertilizers.

Some new processes were, however, bought from abroad, for example one unit of gas separation, extraction of aromatics, paraxylene, high-pressure polyethylene, ethylenoxide, and oxosynthesis.

The engineering for most of the new plants built after the war was done by the engineering organization Chemoprojekt which was founded in 1950. The engineering activity of Chemoprojekt is based on the results of research and development institutes in laboratory and pilot plant scales, on the experience and evaluation of existing commercial units and eventually on licenced processes from abroad, and lastly on direct co-operation with foreign engineering companies.

The main advantage of the engineering organization Chemoprojekt is that it concerns itself with all the various fields of chemical industry and belongs to one of the greatest organizations of this kind in Europe. Complete engineering service is being provided, as required by the customers, containing elaboration

of feasibility studies, surveys, preparation of tenders, all sorts of consulting and designing, field engineering and supervision of start-up operations, technical assessment of existing processes by testing and measuring methods, designs of individual chemical processes and auxiliary facilities are carried out by Chemoprojekt engineers and technical staff.

The equipment is delivered by the leading Czechoslovak machinery manufacturers. The chemical equipment by Škoda or Královopolská - united in CHEPOS, or by Vítkovice steel. All kinds of turbo and reciprocating compressors and blowers by ČKD, the pumps by Sigma, steam turbines and boilers by I. Brno, the instrumentation by ZPA, electric motors and equipment by ČKD, EZ and other companies.

The development of petrochemical industry in developing countries

A number of developing countries has exceptionally favourable conditions for the development of the petrochemical and plastics industries. Let us notice first of all some data: The following table shows the amounts of natural gas, produced with crude oil in the Arab countries in 1965. The amount of the produced gas utilized and percentage flared are shown. The data are given in billions cu.ft./year.

<u>Country</u>	<u>Produced</u>	<u>Utilized</u>	<u>Flared</u>	<u>% Flared</u>
Abu Dhabi	50	n.a.	50	100
Algeria	140	66	74	53
Bahrain	10	n.a.	n.a.	n.a.
Iraq	187	19	168	90
Kuwait	398	68	330	83
Libya	304	-	304	100
Neutral Zone	65	n.a.	n.a.	n.a.
Quatar	90	27	63	70
Saudi Arabia	379	109	270	71
UAR	n.a.	n.a.	n.a.	n.a.
<b>Total</b>	<b>1 623</b>	<b>289</b>	<b>1 300</b>	<b>80%</b>

From the table it can be noted that the great quantities of natural gas are destroyed by flaring. The utilized part does not exceed in the average 20%. These burnt hydrocarbon gases represent an ideal petrochemical raw

material. Similarly it is very difficult to find utilization for a part of refinery products like straight run naphtha or LPG.

For example, in the Iraqi refineries surpluses in the region of 150,000 to 200,000 t/year of straight run naphtha are expected, and from 50 to 75,000 t/year of LPG.

In Iran the export of refinery products in 1964 and 1965 amounted to an average of 69.5% of the annual production. The export of gasoline was 73% and of fuel oils as much as 82%. These figures illustrate the existence of a very large petrochemical raw material basis in the Middle East and in many other developing countries.

On the other hand in the developing countries of Asia, Africa and South America there is 60% of cultivated land but these countries consume only 20% of the world production of fertilizers. This disproportion between raw material basis on one hand and great need for fertilizers, plastics and other products on the other, creates considerable pressure for the development of petrochemical industry in countries which have very favourable raw material basis.

The development of petrochemical industries in these countries have, however, many obstacles. The main one is the low degree of economic development and in connection with this a low financial reserve which has to be divided between all the public and economical fields.

Another problem is that the developing countries are relatively small and this causes difficulties in the marketing of products.

Other difficulties arise from the side of chemical and engineering companies from developed countries who possess the process know-how and licences. For certain jobs it can be difficult to obtain a process licence or it is possible under not acceptable conditions. The reasons for this can be different, various questions of competition, political or other.

Another problem is a shortage of leading experienced technicians and skilled personnel.

#### Role of UN Organizations to developing countries

The organizations of the UN can play an important role, and it depends on the developing countries to accept this help in the best way. The organizations of the UN responsible for the help must, however, carefully



select the most important regions where there are favourable conditions for this help and for the development of the petrochemical industry. Another important factor is to select capable experts for all the necessary activities who would participate in this help. In the branch of petrochemistry the necessary feasibility studies are relatively difficult in respect to the complexity of the problem. One of the most important factors is the co-ordination of marketing. This is the only way to erect economical capacities capable of competition with large units in developed countries.

A typical example is the production of ethylene where the capacities of units in developed countries reached 500,000 t/year, whilst in developing countries capacities of 50 - 100,000 t/year ethylene will be probably the acceptable maximum.

It is recommendable that the feasibility studies should be prepared in several stages since the tasks are complicated, the investment costs are very large and the problems require step by step processing.

Another form of direct help of the UN Organizations to the developing countries should be the initiation of research and development centres for petroleum, petrochemistry and plastics which are completely missing in these countries. The same applies to university education in these fields for many countries.

#### Experience with the technical assistance to developing countries

It has been mentioned that the engineering corporation Chemoprojekt, as well as chemical equipment and machinery manufacturers have a long experience and tradition. In the course of time domestic activity expanded to international contract.

Our first international job was relatively large. It was the complex erection of a petroleum refinery in Homs in Syria, based on Iraqi crude. This was the first case of turn-key job including know-how engineering, delivery of equipment, erection, commissioning, technical help. The first negotiations started after an inquiry in February 1956. The negotiations took part under strong competition of other experienced engineering companies.

The contract was signed in March 1957. The complete delivery time was 27 months. The first civil works on site were started in September 1957.

Needless to say that the first turn-key job for a foreign country was connected with various difficulties connected with the application of different standards, lack of experience with the erection in a climatically different country. Some difficulties originated from the side of the buyer. At the time of the signing of the contract there was no definite selection of the site, that means there was no clear data about soil conditions on time for civil engineering, design and also the climatic data was not complete. Later it was discovered that the analysis of water from the river Oronto was not representative, so that water demineralization process for the power station had to be changed during the design period.

Other difficulties were connected with the choice of a civil engineering sub-contractor, which would be capable of finishing the work in scheduled time and in the prescribed quality.

Certain difficulties occurred on the delivered equipment from our side, caused in the production or during transportation, but they were all removed during erection or starting period. The successful erection of the refinery in Homs was a good propagation for the engineering organization Chemoprojekt, as well as for the chemical equipment manufacturers and erection organizations. These facts led to another contract with Czechoslovakia for a second stage of the Homs refinery, where the capacity is to be more than doubled. The erection works are at present in progress. At the same time we are participating in the erection of an ammonium nitrate unit in the Homs fertilizer complex.

Approximately at the time of erection of the Homs refinery two other contracts were closed for know-how, engineering and equipment deliveries, including erections for crude distillation units in the refineries in Suez and Alexandria. Both units have been a long time in successful operation.

In 1961 the erection of a new crude oil refinery in Iraq began to be pressing. Various groups worked in Iraq as well as in Czechoslovakia on the feasibility study, taking into account the local conditions and marketing possibilities.

The prospective sites were considered in the neighbourhood of Basrah. At the same time first considerations and studies were made for the eventual erection of a petrochemical complex in connection with the unlimited raw material sources in Basrah, Daura and at the Kirkuk area.

The erection of a new refinery in Basrah has been somewhat postponed because of the enlargement of the Daura refinery, now under way. But the tendering procedure for the new Basrah refinery is now again under way, as are the considerations for eventual petrochemical development.

Between the first feasibility study and present state a long time elapsed which was caused by different factors. However, this period enabled the development and correction of prospective capacity of refined crude, products quality and distribution and other technical questions, including site selection, utility supply etc.

On the basis of an agreement last year the engineering organization Chemoprojekt prepared a feasibility study for a tire plant and carbon black production in Iraq. The detailed study included variations of the location of the plant. During marketing studies special problems occurred in connection with the capacity selection. It was found that a lot of other countries are planning tire plants of small capacities which are not able to reach the economy of huge plants. Similarly it is possible to say that the capacity problem of the carbon black plant was more pressing. The domestic use did not exceed 20% of the capacity, generally considered as economical. After considering export to other countries a total requirement of 70-80% of a minimum economic capacity was reached. Another complication occurred in connection with the necessary licensing by a third party because the licensors requested special conditions. This work is continuing to the further stages of tendering.

Czechoslovakia was asked to send experts in connection with the planned petrochemical industrialization in other countries. Thus our group of experts studied in 1965 the local conditions of the petrochemical development in UAR in Alexandria. The experts studied the possibilities of participation in a new petrochemical complex by delivering individual process plants, utility and other units.

Another complex group studied this year the possibilities of further industrialization of chemical and petrochemical industry in Syria. It is obvious that the engineering organization Chemoprojekt has contacts with other engineering companies with the aim to concentrate and co-ordinate the experience and capacity in offering the individual petrochemical plants, respectively the whole complexes for third parties. This is the way of participation in Yugoslavia.

Such a co-operation of several engineering manufacturing and financing companies is now a common way to realize more easily big jobs. It is very difficult to find only one company convenient for such a purpose from all points of view.

### Conclusions

I tried to show in my communication the tradition and development of chemical and machinery industry in Czechoslovakia and to explain the experience and tradition on which the work of engineering organization Chemoprojekt is based.

I tried to indicate here the possibilities of our participation in the erection of the petrochemical industry for domestic companies as well as for foreign countries, with special view for developing countries. The scope of help for some countries finished or under way was shown.

It is possible to say that the activity includes all kinds of help, it means erection of units by turn-key system or usual engineering activity with equipment delivery, feasibility, economical or territorial studies and activity of individual experts, which are very important steps in the industrial development.

Concerning United Nations and its Organizations for industrial development, that means mainly UNIDO, it is possible to say that they have all possibilities to play an important role in helping developing countries:

UNIDO can send not only individual experts, but expert groups from different companies and countries, so that maximum objectivity can be guaranteed.

UNIDO can influence and support the technical and economical co-operation between small developing countries with the aim of erecting large petrochemical complexes for several small countries together.

On the other hand, UNIDO, and eventually other UN Organizations, can influence and demand from chemical and engineering companies as well as from manufacturers of chemical equipment in economically developed countries a more convenient licensing policy and better delivery and financing conditions for developing countries.

It is a matter of fact that with the increasing influence of UNIDO and experience of its representatives the help to the developing countries will be more effective in all fields of activity, that means including the very important petrochemical and plastics industry.



24 . 1 . 12