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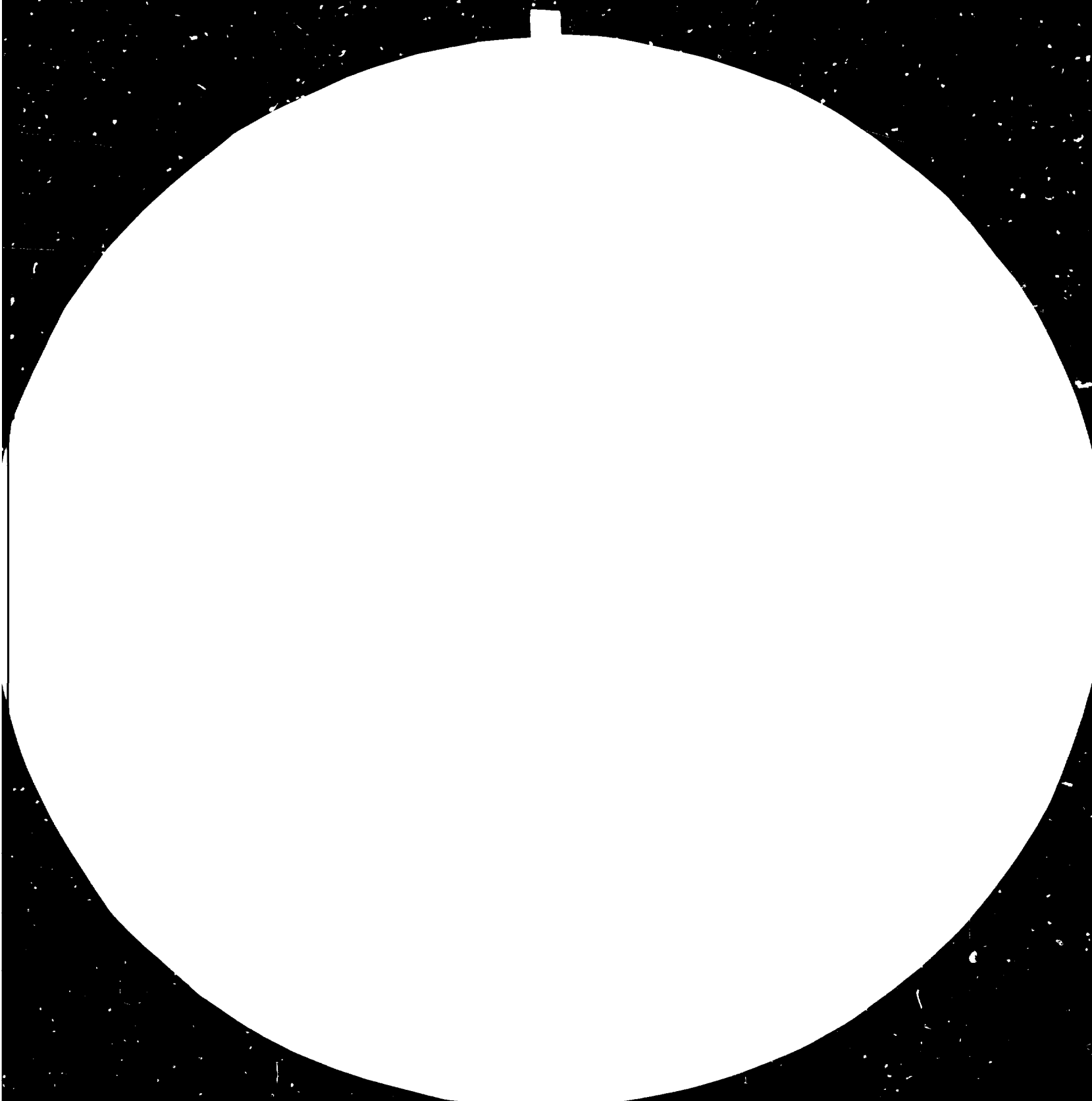

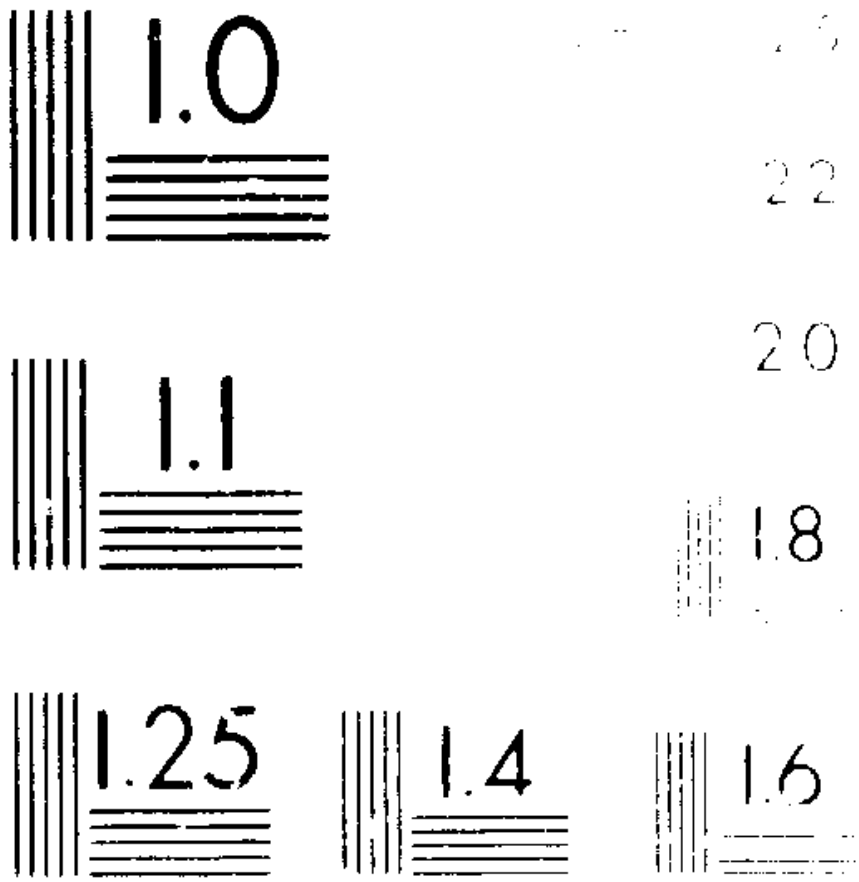
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DPR Korea

CATALYST RESEARCH AND DEVELOPMENT FOR INDUSTRIAL APPLICATIONS

DP/DRK/81/013/A/01/37

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Final Report

Based on the work of Dr. Raissa Tschesnokova, Expert for Catalytic Oxydation and Dr. Aiez Efendiev, Expert for Catalytic Reactions

United Nations Industrial Development Organization, Vienna

S U M M A R Y

Experts of UNIDO Dr. R.V. Tcheshokova and Dr.A.A.Efendiev visited the Institute of Organic Chemistry of DPRK Academy of Sciences and found that the researches on catalytic chemistry are industrial oriented and are carrying out on reasonable level. However to increase the efficiency of research in order to use the results in industry the Institute needs a modern equipment. The experts also recommend to train the personnel of catalytic laboratories through study-tour, fellowship and expertize. It is advisable to change the structure of the catalytic laboratories and to develop new progressive directions in catalysis. The experts together with Institute specialists worked out a perspective programme. Places for the study-tour and fellowship were suggested and recommendation on development of research were given. Realization of the project by UNIDO and UNDP will result in bringing about the programme and increase the efficiency of research. This will lead to an improving of existing and a foundation of new technological processes, which in turn will improve the economics of the country.

INTRODUCTION

Experts of UNIDO Dr. R.V.Tcheshokova and Dr.A.A.Efendiev acted in accordance with the job description (see Appendix 1,2) and the work programme (see Appendix 3). By the end of their mission in DPRK the work programme has been completely fulfilled.

On February 13 we had a briefing in Cairo, Hyangsang, where

we met Mr.S.Ristic, the Resident Representative and Mr.R.Miller, the Deputy Resident Representative.

On February 14 during the first visit to the Institute of Organic Chemistry, Hamhung, the experts were given a general information by Dr. Kim Sung Bai, the Deputy Director of the Institute. The obtained information relates to the organization of catalytic laboratories, their personnel, main directions of research and plans for future activity. There have also been obtained the information about catalyst production in DPRK, main fields of industry based on the catalytic processes, their general characteristics. A detailed information on this subject was also given by the members of the Institute staff.

The authorities of the Institute of Organic Chemistry have arranged visits to the catalytic laboratories, a workshop, a science library and an analytical laboratory of the Institute of analytical chemistry. Meetings with the representatives of Sungri Petroleum Refinery (engineer Sin Sen Gi) and Hamhung Petrochemical factory (engineer O Won Sok) were organized. The experts visited Vinalon factory for production of synthetic fibres.

Finding

In the Institute of Organic Chemistry there are 3 laboratories dealing with catalysis. There is also an analytical group, consisting of 10 people and a special workshop which serve the catalytic laboratories. All together 36 people are involved in catalytic research.

Laboratory No 1 is headed by Dr.Hyon Byong Sop. There are [illegible] people in the laboratory, among them [illegible] with a higher

education including I doctor and I master of science.

The main direction of laboratory research is gasification of coal and the use of the obtained gas for production of defines aromatic hydrocarbons and synthetic gasolines.

There is no oil in DPRK and it is imported from USSR, China and Iran. But still the majority of hydrocarbons are produced from oil. Only 20% of hydrocarbons are produced from coal through methanol. The laboratory faces the problem - to help the industry to increase the production of hydrocarbons through methanol up to 40-50%. To achieve this one should increase the methanol production more than twice. Therefore one of the important problem is an essential increase in catalysts activity and selectivity. Another problem is working out the domestic catalysts. At present mainly the imported zeolites are used as catalysts.

Copper oxide, vanadium oxide, chromnickel and some other catalysts have been studying in the Institute for the last 7-8 years.

Laboratory N 2 is headed by Dr. Kim Hyong Gi. There are 22 people in the laboratory, among them 11 people with a higher education including I doctor and 3 master of science. The main directions of research are:

- oxydation of ethylene and propylene to produce ethylene oxide and acrylic acid. Silver catalyst and the new Bi-Mo-Fe-Ti catalysts are used for these processes. The latter one is being tested now in semiplant scale. The test results show that the catalyst needs to be improved.

- oxydation ammonolysis of propylene to produce acrylonitrile. Industrial Bi-Sb catalyst and a new developed Bi-Mo

catalyst are used for this process. The aim of research is to improve the catalysts in order to increase their activity and selectivity and to work out the new improved catalysts.

- oxydation of isobuthylene to produce methylmethacrylate. This work is only at the beginning and the researchers are trying to work out new catalysts in laboratory scale.

Laboratory N 3 is headed by Master of Science Kim Song Tack. There are 20 people in the laboratory, among them 13 people with a higher education including 2 master of science.

The main direction of research is dealkylation of toluene and xylene to produce benzene. For this purpose chrom oxide catalysts supported on alumina are used. At present benbene is obtained from crude oil and the dealkylation processes are not yet in industrial scale. Platinum containing catalysts are also studied for platforming process.

On the base of the obtained information it might be noted that the Institute of Organic Chemistry personnel has a good understanding of industrial catalysis problems. There is a large collection in the science library especially of periodicals. The personnel knowledge of literature is quite reasonable.

The Institute has good linkages with industry and the most of researches carried out are industrial oriented. The factory we have visited and the factories, the representatives of which we have met, work in close cooperation with the catalytic laboratories of the Institute.

The personnel knows the modern directions in catalysis,

realize the necessity of testing the catalysts by using the contemporary methods. However the Institute does not have the suitable equipment and those available are obsolete. The Institute needs help and the people of catalytic laboratories are quite ready to accept help. At present situation it is impossible to carry out many of the investigations of the catalysts on a proper level.

The experts paid much attention to a preparation of a project document. The purposes and the programmes of study-tour (see Appendix 4) and fellowship (See Appendix 5) were discussed. The modern directions in catalysis, especially industrial oriented processes were given special attention.

High level research centres with modern equipment and skilled personnel were recommended for both study-tour and fellowship.

The experts had several technical talkings to the Institute specialists. The following problems have been discussed:

a) oxydation of olefines

b) physical-chemical investigation of the catalysts for ammonia production

c) homogenious and supported metal complex catalysts: their use and investigations of structure and properties

d) liquid-phase oxydation processes.

Some consultation on equipment purchase has been given.

The experts presented the following lectures:

"The main directions of physical-chemical investigations

of the catalysts forming processes" (Dr.R.V.Tschesnokova)

"The use of homogeneous and supported metal complex catalysts in industrial processes: present state and future perspectives" (Dr.A.A.Efendiev).

About 20 members of the Institute staff attended the lectures. There were several discussions after the lectures. There were also underlined the routes for the development of those directions.

Recommendations

I. The Institute needs a modern equipment for analytical control of a composition and a quality of industrial catalysts, investigation of the catalysts forming processes, physical-chemical investigations of volume and surface properties of the catalysts, analysis of starting materials and reaction products.

2. It is recommended to expand the researches on investigations of catalysts characteristics especially the ones undergoing changes during the catalytic process, investigations of properties of catalysts after using them in industrial reactors, investigations of technological stability of the processes.

3. It is recommended to develop research on study of deactivation of catalysts due to temperature, reaction media, etc.

4. It is advisable to change the structure of catalytic laboratories. The department of catalysis is recommended to establish. The department should consist of the following laboratories: for preparation of catalysts, for investigation of processes and for physical-chemical methods. For this purpose

it would be highly desirable to increase the personnel of catalytic laboratories.

5. It is recommended to train the catalytic laboratories specialists through study-tour and fellowship in high level research centres (the programmes for study-tour and fellowship are given in Appendix 4,5). It is also desirable the experts consult the staff periodically, i.e. 1,5-2 months per year.

6. It is recommended to develop new progressive direction in catalysis that is the catalysis by homogenious and solid supported metal complexes. Such catalysts are of greater activity and selectivity compared with traditional heterogenious catalysts. It is also advisable to expand the research of liquid-phase oxydation processes.

The Institute have already started researches on liquid-phase oxydation of alkylaromatic hydrocarbons in a presence of cobalt acetate. To increase the stability of catalyst and to avoid its loss during the process it is recommended to support the catalyst on solid porous carrier. Another progressive direction is the use of metal-polymer complex catalysts.

Acknowledgement

The experts would like to thank the Government of DRV, the leadership especially Deputy Director Dr.Hoa Sung Bai and the staff of the Institute of Organic Chemistry for their helps which were essential to achieve the objective of this mission. We would like to express our thanks to Mr. Slobodan Kistic, Resident Representative of UNDP in DRV and his staff for the assistance and valuable advices.

Mr. Robert Gumen of UNIDO Chemical Industries Branch took active participation in the mission and we find his help very valuable. We also would like to mention a good cooperation with our colleagues Dr. Carlos E.Gigola, expert in catalytic hydrogenation and Dr. Radko Komers, expert in R&D equipment for catalytic chemistry. We also acknowledge Mr. Pak Yong Son of the Institute of Analytical Chemistry and Mr. Pek Rak Bon of the Institute of Organic Chemistry for their good work providing the interpreting service. The warm hospitality of all our Korean hosts is gratefully appreciated.