OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

D03658

IID

Distribution
LIMITED

ID/WG.123/10
6 June 1972

Original: ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting on Transfer of Know-how
in Production and Use of Catalysts

Bucharest, Romania, 26 - 30 June 1972

HYDRODESULPHURIZATION OF FUEL OIL USING CO-MO CATALYSTS[1]

by

Manoochehr Shahab

National Iranian Oil Company
Research Centre

Iran

1/ 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.

id.72-3756

Rapid technological advancements have created great concern in human's environmental surroundings. One of the major causes of these alarms is burning of fossil fuels containing hazardous sulfur containing compounds which give off sulfur dioxide upon burning. SO_2 a major pollutant of today's industrial comunities is not only determintal to health but also costly to industrial installations. To remedy this problem many institutions have set this as a major goal to implement a mechanism to remove sulfur from petroleum crudes or petroleum products.

Researchers from the young catalytic unit of the National Iranian Oil Company's research center in conjunction with scientists from other disciplines from analytical and engineering groups have made up a team to investigate the hydrodesulfurization of an Iranian Fuel Oil. The reasons for the choice of this particular challenging subject have been summarized as follows :

1. To examine sulfur removal process of a particular Iranian fuel oil containing 2.4% sulfur by weight.

2. To investigate economics of a desulfurization process in Iran where raw materials are abundant and labor is relatively cheap compared to many other countries abroad.

3. To gain an insight in the process of desulfurization which can have valuable applications in the removal of sulfur from less problematic crude oils. This latter can pave the road for marketing low sulfur crudes to world's markets and to abide with some country's strict pollution laws and regulations and to be able to compete in international crude market.

To this end the following stages have been approved for the successful completion of the project.

1. Identification of various types of sulfur containing compounds in the fuel oil.

2. Preparation of a hydrodesulfurization catalyst.

3. Determination of physical properties of catalysts such as surface area and porosity measurements.

4. Propane deasphalting of the fuel oil for removal of asphalt and heavy metals such as vanadium.

5. Hydrodesulfurization of the propane deasphalted fuel and identification of products.

6. Determination of optimum process conditions.

7. Economic calculation of the process.

8. Implementation of the process on an industrial scale.

A commerical activated alumina having a specific surface area of 200 meters/g was used as a support. Three catalyst samples were prepared. In all cases the alumina support was inprognated with solutions of cobalt actate and ammonium molybdate and the salt molecules, embodied on the support surface were then reduced to the metals by heating in a stream of hydrogen. The technics of impregnation varried from one to another case. An examination was made of the surface area, pore size surface activity of the catalysts and they have been subjected to small laboratory bench experiments and pilot plant test.

A fuel oil having 144.6 cs viscosity/at 30°C was pretreated in a liquid liquid extraction pilot scale. L.P.G. was used as extraction solvent to remove asphalt and heavy metals. The deasphalted fuel was pumped into the top of a reactor equipped with several thermocouples. Hydrogen was fed through a drying tube to the reactors. The reactors were operated to maintain isothermal conditions throughout the catalyst bed. The temperature distribution was kept within an error of ± 2°C. The pressure drop did not exceed more than 1% of the operating pressure.

The reactor was warmed gradually and then feed was introduced under steady conditions. The reactor products were cooled by a water cooler and then passed to a high pressure separator, where hydrogen rich gas was flushed from the liquid product and the products were measured and identified.

Results and Discussion :

1. In our experimental work, sulfur removal increased with an increase in the reaction temperature when liquid hourly space velocity was fixed.

2. Rate of sulfur removal increased with increasing hydrogen pressure at fixed temperatures.

3. Vanadium and other heavy metals can be effectively removed from the fuel oil to elongate the life of hydrodesulfurization catalyst.

4. The rate of sulfur removed is decreased with the ageing of catalyst.

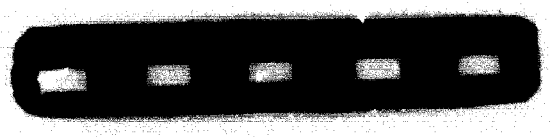
5. Improved desulfurization will result with increasing total pressure or increasing hydrogen partial pressure.

The economic feasibility study is under investigation.

In conclusion, it should be mentioned that Iran with its expending oil and petrochemical industries may be considered as one of the biggest future consumers of a variety of industrial catalysts. The country should follow an active line in catalytic research work which should, one day, lead to the establishment of a manufacturing body of most industrial catalysts.

Acknowledgment :

The work done by M. Hashemi, S. Salajeghe, F. Behbahani in the actual work and compilation of this work is greatly appreciated.



IG. 7. 74