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TECHNIQUES OF DIRECT COAL LIQUEFACTION

DP/CPR/83/002

Technical report: Upgrading of Coal Liquids*

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

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Vienna

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Post title : Consultant on upgrading of coal liquids

Duration : 12 days

Date : October 2 - 13, 1986

Duty station : Beijing, China

Purpose of project :

To strengthen and support the Government's on-going R&D programme on techniques of direct coal liquefaction carried out at the Central Coal Mining Research Institute (CCMRI), Beijing.

Duties :

The consultant will be assigned to CCMRI and, in consultation with research workers from CCMRI, review thier work programme including practical laboratory work and give lectures and advice on the following topics :

1)Upgrading route of coal liquids and economic analysis;
2)The hydro-denitrogenation and hydro-desulfurization of coal liquids;
3)The hydrocracking of coal liquids;
4)The mechanism of colour change of coal liquids and the method of protecting coal liquids from colour change;

Report of results

During my stay at CCMRI in Beijing, I executed the following activities :

1.Visit to facilites

1.1 Coal liquefaction plant(0.1t/d continuous flow reactor type development unit) and small ones.

1.2 Upgrading units of coal-derived liquids.

1.3 Analytical instrumentation for coals and for liquefaction products.

I visited the coal liquefaction plant, upgrading facilities and analysis section for coal liquids to join the upgrading experiments and to pick up the problems and discuss about how to operate the plants, experimental methods and analytical methods.

2. Lectures and discussions

I gave following lectures on upgrading of coal liquids.

2.1 Catalysts for upgrading of coal liquids

2.2 Effects of upgrading reaction conditions on the behavior of product components, especially aromatics and oxygen compounds

2.3 Effects of upgrading reaction conditions on the properties of product oils

2.4 Hydrotreating of the mixed oils of coal liquids and petroleum distillates

2.5 Evaluation of the properties of kerosene and diesel fuel fractions from coal liquids,and its' problems as fuel oils

2.6 Sludge formation from the mixed oils of coal liquids and petroleum distillates

2.7 Storage stability of coal liquids caused by oxydation, lighting and heating

Above lectures were made by slides and overhead projector for researchers and engineers belonging to the research works of coal liquefaction and upgrading of coal liquids.

During and after my lectures, I had deep discussions of the matters relevant to my lectures with the attendees, and exchanged detail informations.

Besides upgrading of coal liquids, we discussed about many topics, especially coal liquefaction studies in Japan, utilization of coal(for example, commercial posibility of chemicals or carbon materials), development of oil shale, coal mine safty, effect of development of coal mine on environment, etc.

3. My recomendations to UNIDO and activities in my area are as follows :

At present, China has been producing 850million t/y of coal, and plans to expand to 1200 million t/y in the early 2100's. Coal reserves in place in China is 700,700 million tonnes and about 65% of coal reserves has a good quality as the feedstocks of coal liquefaction. In China, coal occupies 72% of total energy consumption, and will be 77% in the early 2100's.

On the other hand, production of Chinese crude oil is steadily incresing, but it seems to be fairly difficult to hit a big oil field any more.

Moreover, population of China is more than one billion. When the modernization policy will be successful, domestic demand for liquid fuels will grow up rapidly.

From these surroundings, development of coal liquefaction techniques is necessary for China. As the development of coal liquefaction technique needs a long lead time, steady fundamental research work should be important.

Studies of coal liquefaction by 0.1 t/d plants (two units) and a small experimental apparatus are going well.

Studies of upgrading of coal liquids have been just started by a small reactor. For upgrading research work. at least 100 - 200 ml/hr continuous flow reactor will be needed to evaluate the quality of hydrotreated oils.

It depends on Chinese government policy to decide which will be better, to use neat coal liquid or to use the mixture of coal liquid and petroleum distillate as commercial fuels. Any way, it is neccessary to solve the technical problems of both usage of neat coal liquid and the mixture.

As coal liquids contain lots of heteroatoms as compaired to petroleum distillates, detail fundamental research works on stability against oxidation, lighting and heating, are important.

CCMRI has many kinds of analitical instruments, but some of them are already fairly old. New analitical instruments are needed for evaluation studies of product oils.

Coal liquids will be important as liquid fuels, and also will be important as a chemical source because it contains lots of nitrogen compounds and oxygen compounds which have a big posibility of new chemicals. So, studies on separation of hetero-compounds from hydrocarbons should be done.

Researchers and engineers of CCMRI are young and excellent, but informations which they can obtain now are poor. To catch up with the top level of the world, getting more informations is very important for them. Therefore, more interchange of researchers is neccessary between CCMRI and Japan, the United States, Germany etc.

I, myself, as Director-General of National Research Institute of Pollution and Resources(NRIPR), am willing to exchange researchers and informations between CCMRI and NRIPR.