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TECHNICAL ASSISTANCE ON SYNTHETIC OILS RENDERED THE JAPANESE BY THE I. G. FARBENINDUSTRIE A.G.

Peck & Jones

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COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

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Report On

TECHNICAL ASSISTANCE ON SYNTHETIC OILS RENDERED THE JAPANESE BY THE I.G. FARBENINDUSTRIE A.G.

Reported by:

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Irvin H. JONES

On Behalf Of

U.S. Technical Industrial Intelligence Committee

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Fuels and Lubricants

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COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
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Sakhalin Island for production annually of 128,000 kiloliters of aviation gasoline. A list of twelve hydrogenation projects considered in 1939 as described in seized documents, is also included.

The Interviews.

There was substantial agreement in all statements made by the interrogated; they all agreed that insufficient information had been given the Japanese by the I.G.Farbenindustrie to have any marked effect on their output of oils from coal, and the like, by way at least of I.G.Farben's processes of direct hydrogenation of such materials. Dr. Ringer's personal opinion is that, in as far as hydrogenation is concerned, there could be little practical synthetic production of gasoline, or of aviation fuel in Japan in the near future; there could, however, be produced some fuel-oil from coal. This situation may possibly result from the fact that the contract-negotiations with the Japanese extended over such long period that there was quite limited contact with the I.G.Farben before the capitulation of Germany, and also from the fact that the Japanese were seemingly desirous of making their own processes operate properly, without disclosing much, if any, of their details to the I.G.Farben.

The contract between the Japanese and the I.G. Farben was signed by the Military Attaché of the Japanese Embassy, and Dr. Ringer believes that the negotiations with the Japanese went so very slowly also largely because of jurisdictional disputes between the Japanese Army and Navy that seemed to be each developing hydrogenation processes competitively. During their negotiations with the I.G.Farben, the Japanese also were trying to circumvent the I.G.Farben and to procure hydrogenation apparatus from probably such concerns as Krupp.

Mr. Matsoka, who was probably Minister of Internal Affairs of Japan, began the negotiations with I.G.Farben in 1941. He however returned to Japan in 1942 and thereafter the negotiations were undertaken by others. The I.G.Farben was attempting to avoid giving exclusive rights for the processes of hydrogenation to the Japanese Army and Navy. However, the German Government gave orders to the Company to reveal to the Japanese the "know how" on hydrogenation processes as they were related to the manufacture of Diesel oil and gasoline, and the I.G.Farben

attempted to limit the disclosed information precisely to these orders. In other words, such processes as are used in the preparation of isooctane and aviation gasoline, or in any hydro-cracking procedure of the DHD (Druck-Wasserstoff-Dehydrierung) process; or in the preliminary hydrogenation process step (Vorhydrierungs Verfahren) and in the complete operations with catalyst 6434, were at no time discussed with any of the Japanese negotiators or their visiting technicians. Neither was information relative to the manufacture of synthetic lubricating oils such as Paraflow inquired of by the Japanese.

Eventually, a contract between the I.G.Farben and the Japanese was ready to be signed in December 1944 and was actually signed in January 1945. The negotiations which actually led to the signed contract included the following negotiators:-

General Komatsu - Military Attaché;

General Atani - who was probably responsible for successful culmination of the negotiations. He was later captured by the American Forces in S.Germany;

Colonel Yoshida - took some part in negotiations but returned to Japan in 1944;

Staff Engineer Mikami (Army) - A glass chemist who bought alkalis in Germany;

Colonel Ishige - who did not understand the processes, and was merely amongst those present;

Major Kinoshita - Army engineer who spoke German and carried on much of the discussions;

Dr. Kani - A salesman from the Mitsubishi Company who joined in the pre-contract discussions;

Dr. Fukao - also a salesman from the Mitsubishi Company who had some experience in a refinery near Tokio where a U.O.P. poly-plant was operated.

Before the above contract was signed, Japanese visitors were frequently in the I.G. plants, but Dr. Donath had the impression that they were either not experts or dissembled well. Both Drs. Ringer and Pier stated that the Japanese technicians who were commissioned to obtain the

hydrogenation information from the I.G.Farben after the signing of the contract were not well-informed or clever technologists and that it is doubtful that they could have accumulated sufficient information to be of practical advantage to Japan.

The exchange of information between the contracting parties started after the preparation of the contract and all real exchange of information took place this year. The Japanese Commission was actually in Heidelberg for this purpose up till eight days before the city was occupied by the American troops.

During this period of exchange of information, Dr.Pier gained the impression that the Japanese Army had 3 hydrogenation plants for Low-Temperature Tar (Urteer) that had a nominal capacity of 50,000 metric tons per year of gasoline. These plants operated with only "Sumpf-phase" and gas-phase steps. The Japanese Navy has a hydrogenation plant for coal at Tokuyama near Tokio. Its capacity is not known, but it is believed to be a small pilot plant producing mainly naval fuel oil and it probably operates at 200-300 atm. pressure. Tungsten and molybdenum catalysts were probably being used in this Navy plant, but long life of catalyst requires special talent in its preparation. Tungsten gives a better catalyst than does molybdenum, but it must be known how to operate it.

The Japanese inquiries suggested that the principal difficulties they had met in developing their own hydrogenation processes were: (1) coking-up of heating coils and heat-exchangers, and (2) operation of the gas-phase step of the hydrogenation for the conversion of Middle Oils to gasolines. It is also known that they were employing chlorine in their processes and were having trouble with corrosion as a result. (Incidentally, Dr. Pier said that 300 atm. hydrogenation operation plus chlorine was the equivalent of 700 atm. operation without it. Operation at 700 atm. is also better with chlorine but, during the war, Dr. Pier never risked its use because of the necessity of keeping all hydrogenation installations at their full capacity in such times)

The difficulties experienced by the Japanese with gas-phase operations were very probably traceable to the employed catalysts and preparation thereof, since Dr.Ringer emphasized that the Japanese wanted especially the "know how" of catalysts manufacture and also to have despatched

two or three experts of the I.G.Farben to Japan to give assistance. It was intended to send these specialists in May of this year by submarine which was an eight weeks' trip. This however was not done. Plant designs and information on catalysts were given the Japanese beginning December 1944, but Dr. Ringer does not know whether they ever reached Japan because they were probably sent by U-boat. It was also thought by Dr. Ringer that the Japanese did not plan to expand their hydrogenation operations until at least the existing Navy plants were brought into successful performance.

A Herr Ruhl, an I.G.Farben representative, is in Japan; he is specialist in nitrogen-fixation plants and does not have the latest information on hydrogenation processes for oil from coal. He also was of the opinion that it was preferable to work with the Japanese Navy rather than with the Army. Herr Ruhl sent no reports and was not in close contact with the I.G.Farben men in Germany; all communications with Germany were direct by wireless telephone every week or ten days. The I.G.Farben heard from Herr Ruhl that the Japanese were not going to build any new plants and he also did not indicate other locations, although Dr. Ringer personally believed them to be in Manchuria. Herr Ruhl was also said not to be the type of man to head a business and his information was limited almost solely to fixed-nitrogen processes, but in this connection he was able to assist the Japanese in ways of producing hydrogen which may be made in Winkler generators.

Dr. Pier said that the Japanese discussed nothing about any Fischer-Tropsch plants or processes they may have had in operation.

The information the Japanese received from the I.G. Farben was the technique of operating hydrogenation plants employing, as primary material, either ordinary high-temperature bituminous coal tar or tars produced by low-temperature distillation of especially brown coals. (It is known that Lurgi, of Frankfurt-am-Main, has assisted the Japanese in building Low-Temperature Distillation plants for coals).

Both Drs. Ringer and Pier were apparently completely cooperative with the interviewers. The former spoke entirely from memory, whereas the latter and his associates had specific information at hand, but they stated

that most of their Japanese files had been evacuated both to Unter Loquitz - a small town south of Erfurt and near Saalfeldt on the main railway line between Munich and Berlin - and to Hassmansheim (Neckar). At Unter Loquitz, the files were stored in a mine-entry of a slate quarry and they were in charge of a Herr Reichler. The files at Unter Loquitz do not however carry all papers that extend up to the conclusion of the contract with the I.G.Farben. Dr. Pier suggested that if these documents could be brought back to Heidelberg, he and his staff would undertake to study them to the end that they could give complete and accurate information in as far as it was in their possession. While it is doubtful that any valuable information could be obtained, it is recommended that these documents of Dr. Pier's be assembled for study at Heidelberg by him and his associates.

Shortly after initiation of the exchange of technical information with the Japanese, I.G.Farben, on 8 February 1945, received from the above-mentioned Major Kinoshita, statements relating to the existence of three Japanese plants for the hydrogenation of tars produced by low-temperature distillation (Urteer); these plants are named as follows:-

(1) Kinsei in Manchuria, located on the Asiatic mainland opposite Koro Island, southwest of Mukden;
(2) Mukden; and

(3) Hokkaido, on the Japanese mainland.

The above three plants were designed by the Japanese for operation at 300 atm. pressure and each for a yearly production of 50,000 tons of gasoline.

A commission of Japanese representatives went to Heidelberg, Germany, in December 1944 to collect full information for the building and operation of a plant for the production of 128,000 kiloliters (93,000 tons) per year of aviation gasoline from Utibuti coal (Sakhalin) (see below). A prior project had been considered for Kinsei (above-mentioned), but was later abandoned for this undertaking on Sakhalin (Karafuto) Island.

Of the various proposals made by the I.G.Farben to the Japanese, the one decided upon projected the consumption of 600,000 tons of Utibuti coal to produce the 128,000 kiloliters of gasoline per year. Considering capital investment and coal consumption, the most economical operation was to be achieved by direct hydrogenation of a portion of the above amount of coal in combination with low-temperature carbonization of the remainder coupled with hydrogenation of the thereby-formed low-temperature tars. The hydrogenation was to be performed at 300 atmospheres pressure following the same procedure used at Scholven in the Ruhr. Thus, the Japanese received from the I.G.Farben actually only substantially the Scholven plant and its operation along with data on the hydrogenation catalysts 3510, 5058 and 6434; as aforementioned, Dr. Donath states his doubts that the Japanese know how to operate with catalyst 6434 which is adapted to provide a gasoline product having an octane number of 91 when admixed with Tetraethyl lead.

The Utibuti coal is a young bituminous coal that had not been tested by the I.G.; however, the Japanese submitted the following information:

1. Analysis of Raw Coal (Japanese analysis).

Water	-	8.17% by wt.
Ash	-	15.9% " "
Volatile matter		34.54% " "
Fixed carbon		41.39% " "
Total		100.00
Heating value		6655 Kcal/kg.

Ultimate Analysis

Carbon	-	60.69% by wt.
Hydrogen	-	5.18% " "
Oxygen	-	16.78% " "
Nitrogen	-	1.32% " "
Sulphur	-	0.46% " " (combustible 0.14; non-combustible 0.32.
MeltingPoint of ash		- 1230°C.
Sintering Point		- 1160°C.

In 1943, data were submitted by the Japanese on another coal, as follows:

2. Analysis of Raw Coal

Source	-	Not given
Water	-	6.05% by wt.
Ash	-	11.5% " "
Volatile matter	-	41.0% " "
Fixed carbon	-	41.0% " "
Sulphur	-	0.5% " "
Total		100.0%
Heating value	-	6655 Kcal/kg.

Ultimate Analysis

Carbon	-	74.0% by wt.
Hydrogen	-	5.5% " "
Oxygen	-	13.5% " "
Nitrogen	-	1.5% " "
Combustible Sulphur		0.4% " "
Ash		5.0% " "
Total		99.9%

Yield from the above coal by its low-temperature carbonization:

Semicoke	-	62% by wt.
Tar	-	18% " "
Water	-	13% " "
Ash in coke	-	8% " "

The above (2) coal has been washed with 80% yield of a coal product having the following composition; this washed coal was intended for use in the direct hydrogenation:

Water	-	6.0%
Ash	-	5.05%
Carbon (amf)	-	72.0%
Volatile matter	-	45.0%

"amf" = ash and moisture-free coal or "reinkohle".

The hydrogen consumption for converting the coal to aviation gasoline is estimated to be 3000 Nm^3 per ton of gasoline, and the product would have an octane number of 70-72 clear and of 88-90 with 0.1% vol. of T.E.L.

The best washing tests gave an 83% yield of washed coal with 2.1% ash.

Low-temperature carbonization of the Raw Coal (2) by the Lurgi process was reported by the Japanese to yield:

Semicoke	-	63.0% by wt.
Tar (Urteer)	-	12.25% " "
Gasoline	-	1.50% " "
Gas	-	9.00% " "
Water	-	14.30% " "
Total		100.05% " "

Fischer-Hempel assay shows 16.4% by weight of the coal as tar.

Hydrogenation of coal (2) gave the following results, as reported by the Japanese:

Yield	?
H_2 consumption	?

Assay of oil:

First drop	40°C.
Off at 180°C.	8.05% by vol.
Off at 320°C.	52.92% " " (53.92)

Analysis of the Light Oil shows:

Sp.gr./20°C.		0.8633
Off at 180°C.		38.9% vol.
Off at 280°C.		97.4% vol.
Phenols	23.0%	
Unsaturateds	14.8%	
Aromatics	16.3%	
Saturateds	45.9%	
Total	100.0%	

It is believed that the Japanese Navy process operates under conditions that give much less Middle Oil than is shown by the above results, and produces mostly fuel oil. These conditions are reported to be operations at 220 atm. pressure and 425°C.

According to Dr. Pier, no new coals from Japan were recently tested by I.G.Farben. He said that he was not acquainted with the Japanese method of producing hydrogen, but suspected that Winkler generators were employed.

In so far as the manufacture of Tetraethyl Lead is concerned, both Drs. Ringer and Pier said that the I.G. Farben gave the Japanese representatives no information on Tetraethyl lead, nor did the Japanese ever visit any plants for its manufacture.

Dr. Ringer who, as aforesaid, handled all negotiations with the Japanese, stated that they obtained no information on the manufacture of Oppanol.

From the I.G.Farben, the Japanese got no data on fuels for jet-planes, but they may have obtained such information from the Reichsministerium or outside firms. Both Drs. Ringer and Pier said that they were not aware that the Japanese secured any advice or data on motors for jet-planes although they had contact with such firms as Junkers and also Messerschmidt. The Japanese General Otani, who was involved in the contract negotiations, was much out of Berlin on aviation business. Incidentally, in this connection, Dr. Pier stated that brown-coal middle oil was the fuel used for the jet-planes; such fuel should have a low pour-point (stock punkt) and neither too many aromatics nor phenols. The best fuels for planes of this type were never completely developed because the models changed so frequently.

Survey of captured documents of the I.G.Farben stored in the Library at Heidelberg under guard of the American Army disclosed the following statements which are of importance in this connection:

a. In the last paragraph of the minutes of a meeting in Ludwigshafen on 3 November 1941 between the Japanese and Dr. Pier, there stands the following statement:
"The production in Sakhalin amounts to about half a million tons. The Japanese hydrogenation plant in Tokuyama (Navy) is in production; it is small and still giving trouble".

b. A document dated 3 May 1939 mentioned the following hydrogenation projects under consideration:

(1) Ogura Sekiyu
200 tons/day anthracene-gas oil (200-300°C) to a special gasoline having an End Point of 150°C. This should give a gasoline that, in admixture with 0.09% tetraethyl lead has an octane number of 90 or above. This was a Japanese Army project.

(2) Project North China

Under the leadership of Admiral Godo, there was requested a bid on plants for the production of 50,000 and 100,000 tons per year of gasoline from bituminous coal.

(3) Project Nissan Kagaku (Dr. Endo)

This company closed a contract with Lurgi of Frankfurt-am-Main for the low-temperature distillation of 100,000 tons per year of bituminous coal. The plant was projected for operation in the summer of 1940. Herr Ruhl (I.G.Farben) gave a cost estimate on a hydrogenation plant for 13,500 tons of the low-temperature tar per year to 10,000 tons of gasoline.

(4) Japan Gasoline K.K.

a) Production of isooctane. At the same time a licence for cracking of CH_4 was declined because the project was too small;
b) Hydrogenation of 100,000 tons/year of crack-gasoline to aviation motor fuel having an octane number of 82;
c) Hydrogenation of 41,000 tons/year of "lube stock" (360-385°C) to aviation motor fuel.

(5) Project Nippon Yuka

Mr. Haga, of New York, requested a plant for the recovery of 10,000 tons/year of gasoline from bituminous coal. Ovens for the NH_3 synthesis at Showa Hiryo were let to the Bethlehem Steel Co.

(6) Project Uba Chisso

Uba Chisso was interested in tar and coal hydrogenation. In 1937 a bid was submitted by the I.G. Farben for treating 20,000 tons/year. In December 1938, new projects were bid upon for the hydrogenation of 40,000 tons/year of tar to gasoline for automobiles, and to 28,400 tons year of aviation gasoline.

(7) Project Tokio Gas

This company contemplated a plant for hydrogenation of 20,000 tons/year tar to about 16,000 tons automobile gasoline.

(8) Sumitomo Kagaku

Messrs. Nakao, Kodama, and Shioya in contact with Messrs. Patrick & Tillman in London.

(9) Showa Seiko

Costs were submitted on the following projects:

a) Production of 125,000 tons/year of gasoline from Fushun coal;
b) Production 80,000 tons/year gasoline from 100,000 tons/year of coke-plant tar;
c) Production of Synthesis Gas from coal in Winkler generators for the Fischer-Tropsch reaction.

(10) Manshu Yuka

The Manshu Yuka has a plant for low-temperature distillation of bituminous coal. The tar is hydrogenated according to its own process (Kuroi). Mr. Hama, during a visit to Berlin, said on 31 October 1938, that his company would produce in Manchuria 1,000,000 tons of which he would take over the production of 350,000 tons and that, of the latter amount, one-third would be produced according to the Fischer-Tropsch process, and another one-third would be according to the SMR (Navy) process. It is planned by Manshu Yuka to increase the present production of 10,000 tons/year gasoline to 50,000 tons.

(11) Project Manshu Tanko

Coal samples (six) submitted by this organization can be easily hydrogenated.

(12) On 23 June 1942, the Japanese asked the Krupp organization for a bid to supply them with: 18 ovens, 18 m. long and 1 m. in diameter; 12 vessels 6 m. long and 0.8 m. in diameter; all adapted respectively for operation at 300 atm. and 450 atm. pressure operation.

These project data are here included because, since the writing of the letter wherein they were described, many, if not all, of the projects may have developed into producing plants.