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DEPARTMENT OF JUSTICE
WAR DIVISION
ECONOMIC WARFARE SECTION

REPORT ON FUSHUN, PART III

COAL HYDROGENATION PLANT

December 16, 1943

Submitted by:
Kenzie K. Kirkham and
Richard F. Babcock
Economic Warfare Section
Department of Justice
Chicago 4, Illinois

P R E F A C E

This is the third in a series of reports about the industrial area of Fushun, the "Ruhr of Manchuria." This report deals with the coal hydrogenation plant of the South Manchuria Railway Company. The first in this series of reports (Part I, Report No. 3004 (Chi-97) dated June 11, 1943) discussed the Shale Oil Plant. The second (Part II, Report No. 3005 (Chi-98) dated June 11, 1943) discussed the Aluminum Plant--Manshu Keikinzoku.

Other reports will follow on the coal mining operations, power plants, and the "model" Japanese community for the workers in the aluminum and coal hydrogenation plants.

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Economic Warfare Section
War Division
Department of Justice
Washington 25, D. C.

Confidential Report
December 16, 1943
Re: Fushun, Part III
Coal Hydrogenation Plant
Submitted by: Kenzie K. Kirkham
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REPORT ON FUSHUN, PART III
COAL HYDROGENATION PLANT

INTRODUCTION

On July 33, 1939, the Japanese navy and the South Manchuria Railway Company announced simultaneously that, after years of reseach, a new method had been discovered of obtaining oil from coal by direct hydrogenation. They claimed that this process had been industrialized at a new plant in Fushun, Manchuria, and by 1941 this plant would be producing 360,000 metric tons of crude oil annually. The Japanese claims to the discovery of improved techniques in the direct hydrogenation process, which was invented by Dr. Bergius in 1913, and has been exploited commercially by the Germans and English, are open to question. Likewise, there is considerable suspicion of their claims of large production. Nevertheless, the Fushun plant represents one of the most significant developments in the efforts of the Japanese to exploit and expand their synthetic oil industry. The importance of the Fushun coal hydrogenation plant lies in its proximity to the largest and most thoroughly exploited bituminous coal mine in Manchuria, the years of research by the Japanese which have gone into the Fushun plant, and the superiority of the direct hydrogenation process to any other known means of extracting oil from coal.

The first part of this report outlines briefly the direct hydrogenation process. The second part discusses the history of Japanese research and experimentation leading up to the construction of the Fushun plant and, following a brief statement regarding the Japanese synthetic oil industry, the report concludes with what information is available on the location, description, and productive capacity of the Fushun plant, and a consideration of the claims to the development of an improved process at Fushun.

I. COAL LIQUEFACTION

The essential chemical difference between petroleum and coal is that the former contains about twice as much hydrogen as coal. All experiments designed to improve and perfect the extraction of oil from coal require the addition of hydrogen to the coal, either directly at high temperature and pressure, or by first gasifying the coal and then adding hydrogen at a low temperature. Among the hundreds of experiments conducted by many nations since Dr. Berthelot in 1868 first discovered that oil could be produced from coal, two processes have been developed commercially by nations to whom synthetic oil supply is a prime factor of national policy.(1) One of these processes was perfected by two German chemists in 1925-- Dr. Fischer and Dr. Tropsch. The Fischer-Tropsch process requires the complete gasification of the raw material, followed by a reconversion into the liquid product.

(OVER)

In order to obtain oil from the Fischer-Tropsch patent, at least one-half dozen different processes are necessary, which are not required in the direct hydrogenation process.

In 1913, the German scientist, Dr. Bergius, discovered that by the application of hydrogen under high pressure and at high temperature, and with the aid of a catalyst, as much as 97 per cent of the coal consumed might be directly converted into oil. This process may be briefly described as follows: The raw coal is crushed to a fine powder, and cleansed to eliminate most of the ash content. The coal is then mixed with heavy oils, previously extracted in the process, to make a paste. This paste is injected by pumps into narrow cylindrical converters, where it comes into contact with hydrogen gas under pressure of approximately 250 atmospheres and the temperature of approximately 450 degrees centigrade. In the presence of organic catalysts, the paste is converted into oil. From this point, most of the oil is transformed into heavy and light motor fuel in liquid phase converters and into a high grade gasoline by means of vapor phase converters with the aid of various catalysts. (Exhibit One) A small heavy oil fraction, containing unconverted coal and ash, may be treated for oil recovery, and the coke residue may be used for fuel. Raw gas is practically the only by-product, and it may be utilized in the process by conversion to hydrogen in the hydrogen manufacturing plant, which usually forms an integral part of any coal hydrogenation process. There are numerous advantages to this direct hydrogenation process:

(1) It is possible to regulate to a great extent the type of finished product desired, such as fuel oil, Diesel oil, illuminating oil, or gasoline;

(2) This process permits the production of far higher octane number gasoline than is true with the Fischer-Tropsch process. The latter is believed to produce only 20 to 40 octane gas;

(3) The original character of the raw material is retained in the products, permitting such valuable properties as ready ignitability and good lubricating value;

(4) Because it does not pass through the gasification state, this process does not depend on the market demand for coke, which would be the product of carbonizing the coal.

It is this process, (2) in the perfecting and adapting of which the Japanese have spent years of research and millions of yen, that has been industrialized at Fushun, Manchuria.

II. JAPANESE SYNTHETIC OIL INDUSTRY

The Japanese interest in the direct hydrogenation of coal has been, of course, only one phase of the great concern of the Japanese government

over the development of a synthetic oil industry.(3) Spurred by large government subsidies, tax exemptions and laws designed to encourage private investment,(4) Mitsui, Mitsubishi, Nippon Oil, South Manchuria Railway Company and other large industrial concerns have tried to establish plants using the Fischer-Tropsch process(5) and low temperature coal carbonization.(6) The history of Japanese attempts to obtain the Fischer-Tropsch equipment from Germany and the grandiose plans for production of synthetic oil by all methods are beyond the immediate scope of this report. The successful development of the shale oil plant at Fushun, a source of fuel for the Japanese army in Manchuria, has already been presented in Report 1 on Fushun.(7) The direct hydrogenation process employed at Fushun differs from other Japanese synthetic oil developments in the fact that it is the only synthetic oil process which the Japanese claim to have industrialized through their own efforts.

III. DEVELOPMENTS LEADING TO CONSTRUCTION OF FUSHUN COAL HYDROGENATION PLANT

The liquefaction of coal by the direct hydrogenation process has been the subject of intense research and experiment during the past 25 years by many scientific institutions in Japan. Among these have been the Fuel Research Institute of the Ministry of Commerce and Industry, the Tokyo Industrial Experimental Laboratory of the same Ministry, the Institute for Physical and Chemical Research, the Tokuyama Fuel Depot of the Imperial Navy, and the South Manchuria Railway. However, it was the experiments conducted by the Naval Depot and the SIR which were primarily responsible for the successful development of the coal hydrogenation plant in Fushun, about which the Japanese trumpeted their claims of revolutionary techniques in 1939.(8)

A. Experiments Conducted by Tokuyama Fuel Depot

Immediately following the last war, the Naval Depot began its experiments in coal hydrogenation based upon the principles of Dr. Bergius. Japanese coal was sent to Germany, where Naval scientists witnessed the failure of these early trials, when the quantity of fuel extracted from the coal was only 30 to 35 per cent of the coal consumed. The Depot thereupon abandoned both the German laboratories and Japanese coal, and decided to apply its own principles to the bituminous coal mined at Fushun, Manchuria. Following three years of experiments, the Naval Depot designed an experimental plant of three reaction towers, each having a separate agitator and a capacity of 130 litres. In 1932 this experimental plant was substantially improved in order to obtain a finer coal powder and to permit more careful utilization of exhaust heat. The Japanese did permit publication of the results of operation in this trial plant. In 1934 the navy was able to liquefy 67 per cent of the Fushun coal by consuming 1,065 cubic meters of gas and 1554 tons of bituminous coal. The oil and gasoline had the following characteristics:(9)

	Gasoline	
Octane number	For Airplanes 69%	For Automobiles 67%
Olefin hydrocarbons	5.3	5.0
Naphthene hydrocarbons	29.3	22.5
Paraffin hydrocarbons	31.2	31.6
Aromatic hydrocarbons	24.2	40.9

	Heavy Oil
Specific gravity	0.9291
Moisture, per cent	0.3
Impurities, per cent	0.02
Flash point, Pensky-Martens, degrees C.	115.
Viscosity, Redwood No. 3, seconds	12.6
Calorific value, calories per gram	10.269
	%
Carbon	87.10
Hydrogen	10.80
Sulfur	0.22
Nitrogen	0.48

The plant which was constructed at Fushun was originally based upon these experiments conducted by the Naval Depot but was later altered to include new findings made by the South Manchuria Railway.

B. Experiments by the South Manchuria Railway

While the Naval Fuel Station at Tokuyama has the longest history of experiments with coal hydrogenation, it was the research conducted by the SMR which culminated in the supposedly revolutionary techniques employed at the Fushun plant. In 1928 a special laboratory was created at the SMR Central Research Laboratory to conduct experiments in coal hydrogenation. At about the same time, the president of SMR, Lotaro Yamamoto, inaugurated the policy of close cooperation with the Naval Depot which has marked Japanese development of coal hydrogenation during the 1930's.

About 1931, the SMR purchased 100,000 yen worth of coal hydrogenation equipment from Germany for experimental purposes in spite of the failure of the Naval experiments with Dr. Bergius and Japanese coal. This German machinery was installed in the Central Research Laboratory, and the experiments were conducted during 1933 and 1934.

C. Decision to Construct Plant at Fushun

In 1935, experiments conducted by the SMR and the navy had progressed to such an extent that a formally set-up Coal Liquefaction Committee headed by Dr. Yamanishi decided to industrialize the enterprise. Japanese scientists were again dispatched to Germany to study the developments in that country.

On August 4, 1936, President Yosuka Matsuoka of SMR established an office at Fushun to supervise the construction of a coal hydrogenation plant costing 14,000,000 yen, after obtaining a license from the Japanese government.(10) On June 7 and 8, 1937, a joint conference was held at Tokuyama Naval Fuel Station between the representatives of the SMR and the Japanese Navy. It was decided at this time that the experiments conducted by the SMR should be put into practice at the proposed Fushun plant. Construction of the plant continued during the years of the China Incident, and in April of 1939 the plant was officially named the Fushun Coal Liquefaction Plant, two months after its completion. On July 22, 1939, the SMR and the Ministry of the Navy simultaneously announced

> "the successful discovery of the direct liquefaction process and caused no little wonderment among the oil industrialists of the world. Up to this time, practically all important Japanese chemical industries, such as ammonium sulphate and rayon, were industrializations in existing foreign patents, but the coal liquefaction process at Fushun was industrialized after it was discovered in a Japanese scientific laboratory." (11)

The Japanese have practiced their usual secrecy about this "revolution in fuel technology." The possible meanings of this cryptic announcement are considered in Section V.

IV. DIRECT HYDROGENATION OF COAL AT FUSHUN, MANCHURIA

A. Raw Materials

The Fushun coal field lies about 22 miles east of Mukden on the South Manchuria Railway line between Mukden and Fushun. The field covers about 16,500 acres in the narrow Hun River valley, and extends about 10 miles east to west, parallel to and about 2 miles south of the river. The field is about 2 1/2 miles in width from north to south. The entire Fushun deposit has been estimated to contain 1,200,000,000 tons of 12,000 B.T.U. bituminous coal. The estimated coal production for 1941 at Fushun under the revised Manchurian Five Year Plan was to be 19,600,000 metric tons of coal. This has been said to represent more than 70 per cent of the total coal output in Manchuria.(12) A subsequent report will discuss in detail the Fushun collieries and their mining methods and equipment. It is sufficient for this report to note the almost inexhaustible supply of the one raw material needed for obtaining synthetic oil by this process.

B. Location of the Fushun Plant

From what information is available on the Fushun coal hydrogenation plant, the site of the plant is about five or six miles west of the SMR main station at Fushun. All of the buildings and installations cover several acres in the area just south of the SMR double track line and a few hundred yards west of the Kojoshi River, a small tributary of the Hun. This hydrogenation plant is just east of the aluminum plant known as the Manchuria Light Metals Company, on which construction was begun in 1938. Mr. Asbjorn Sjolie, Norwegian engineer who was hired by the Japanese to construct the aluminum plant in 1938, recalls that a dirt road ran along the north side of the railway from the aluminum plant to the Kojoshi River. At a point a few hundred yards from the northeast corner of the aluminum plant, this road crossed under the railway to the south side of the tracks and then went over the river by means of a small bridge. It was while walking along this road just east of the aluminum plant that Mr. Sjolie was able to see the coal hydrogenation plant to the south. Exhibit 2 shows the location of the coal plant in relation to the other industries in Fushun.(13) Directly across the railroad from the aluminum plant (northwest from the coal hydrogenation

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plant), a new communal settlement has been constructed to house Japanese workers employed in the Fushun aluminum plant and coal liquefaction plant. This project is supposed to cover about 100 acres, and, as may be seen from Exhibits 3, 4, and 5, would serve as a good landmark in attempting to locate the coal liquefaction plant.

Directly north from the site of the coal liquefaction plant, and just east of the communal settlement, a new power plant has been constructed, which is known as "Fushun new electric power plant." The hydrogenation plant, the aluminum plant, the new power plant, and the community are all three or four miles west of the shale oil plant, the open pit mines, and Power Plants No. 1, 2, and 3.

C. Units Comprising the Fushun Hydrogenation Plant

There are no blueprints or specifications available which would give clues as to the exact layout of this plant. All informants have stressed the great care which the Japanese took to prevent any foreigner from gaining even a superficial idea as to the structure of the plant. About all that is known about the buildings is that they were constructed of red brick and reinforced concrete, and to this extent were similar in appearance to the buildings comprising the aluminum plant directly west.

In 1939 the Japanese did permit publication of some innocuous information about the installation of this plant, which proves no more than that the Fushun plant differed little in its mechanical structure from such coal hydrogenation plants as the one in Billingham, England.

> "The Fushun coal liquefaction plant is composed of the hydrogenation manufacturing plant, the compression plant, coal mixing plant, reaction plant, gas separation plant, and distillation plant. (1) The hydrogenation manufacturing plant is composed of the liquid gas plant and the transforming plant where hydrogen is manufactured from steam by using coke; (2) the compression plant compresses the transformed gas coming from the hydrogen plant, removes carbonic acid within the gas, and compresses hydrogen to the pressure required in coal liquefaction; (3) the functions of the coal mixing plant consists [sic] of arranging coal for liquefaction use, making of catalysers and paste, and sending them to the reaction plant; (4) the reaction plant turns the high pressure hydrogen and the paste received from the coal mixing plant into oil; [It is this part of a direct hydrogenation plant which has the readily recognizable rows of tall converters such as are shown in Exhibit 6.] (5) the gas separation plant disposes of discarded gases after liquefaction reaction, and manufactures hydrogen from discarded gas to be used again in liquefaction; (6) the distillation plant is composed of a crude oil distillation plant, oil refining plant, and cresol plant." (11)

These are the standard units of any coal liquefaction plant using the direct hydrogenation process. The Japanese-controlled Manchuria, Volume 3, page 825, 1938, published a photograph of what they termed a "coal liquefaction plant at Fushun." One American engineer insists that this photograph of Exhibit 7 is a 750 ton Dermag blast furnace, and an outstanding American chemist, while not willing to state that this is a blast furnace, is unable to identify it conclusively as a coal hydrogenation unit.(14)

D. Production and Capacity

There are no reliable figures on the estimated or actual production at the Fushun plant. What estimates are available range from figures of 30,000 metric tons to 360,000 metric tons of crude oil annually. The following bits of information relative to the capacity of this plant which have appeared in various Japanese or Far Eastern publications are included for the purpose of showing the uncertainty relative to this point.

1. "All the present liquefaction enterprises, both governmental and private, however, are small and experimental in scale, the plant operated by the South Manchurian Railway Company being limited to an annual production of 30,000 metric tons." Page 361, October 1937, Far Eastern Review.

2. "Early plans called for the production during 1937 of 21,000 metric tons of benzine and the same quantity of heavy oil from plants using a direct hydrogenation method alone, but as a matter of fact, not a drop of oil has been obtained." Page 466, December 1938, Far Eastern Review.

These statements were made approximately two years before the announced completion of the Fushun plant.

3. In the Japan Manchuria Year Book for 1940, the capacity of the Fushun plant was said to be 33,000 metric tons of crude oil annually or about 630 barrels daily. For 1939, the first year of operation using the S.M.R. process, the production was only to be 22,000 metric tons.

Following these first cautious estimates, the Japanese began to make very sanguine claims about the production of synthetic oil at Fushun.

4. "The Shorben plant of Germany, which had a productive capacity of 150,000 metric tons in 1936, and [was] believed to have made no expansion since then, is the only liquefaction plant that measures favorably with the Fushun plant of the S.M.R." Contemporary Manchuria, January 1940. (Publication of the South Manchuria Railroad.)

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5. Under the impetus of the Five Year Plan for Manchuria, annual production of 360,000 metric tons of crude oil was expected at the Fushun plant during the last year of the revised Five Year Plan, which was to be 1941. This plan called for the production of 1,700,000 metric tons of crude oil from all types of coal liquefaction in Manchuria.

Then, in 1940, after such enthusiastic estimates, the Japanese again became cautious regarding their synthetic oil capacities.

6. "Several years more and further technical experimentation, however, are still necessary before the liquefaction industry, which has just passed through the experimental stage, can be developed economically." Far Eastern Review, July 1940, page 248.

7. "The coal liquefaction plant at Fushun still remains an experimental one so far as size is concerned, but in producing oil of such fine quality, the plant has succeeded in establishing the foundation of regular industrialization of coal liquefaction, thus marking an epic in the annals of liquid fuel in Japan." Contemporary Manchuria, April 1940, page 10.

One possible clue as to the production in the Fushun plant may be drawn from the Japanese government's requirement of a guarantee of at least 50,000 metric tons annual production before a license would be issued for the construction of a coal liquefaction plant. The South Manchuria Railway received such a license from the government in 1936.(4)

E. Employes

As of 1939, the 2,000 employes at the coal hydrogenation plant were only a small part of the 43,000 laborers employed in the Fushun area. Again the figures are misleading, representing as they do the first year of operation of the coal plant. The increased labor demanded by the new coal hydrogenation plant and the aluminum plant was resulting in the construction of a new community settlement directly across the railroad tracks from the aluminum plant. Information on this settlement and the institutions established for the welfare of the employes is sufficient to merit a separate report.

F. Transportation

The main line of the S.M.R. branches off at Suchiatan, 9.7 miles south of Mukden, and one line extends east and slightly north about 30 miles to the heart of Fushun. This line is double track, and as noted above, passes along the north side of the coal liquefaction plant. Tracks belonging to the former North Manchurian Railroad running from Mukden northeast to Kirin pass along the north side of the Hun River, but there is no known railroad bridge connecting this with the S.M.R. line which services the industries in Fushun. An entirely new line has been constructed from Fushun straight south to

Penhsihu to speed up transportation of heavy goods, such as coal and by-products, from the mines in the Fushun area.(15) All the railways in the industrial area of Fushun, including all spurs to the plants, are now completely electrified.

G. Power

All the electric power for the various plants that make the group of the coal liquefaction compound comes from the new 300,000 kilowatt electric power plant. This new plant, the third built at Fushun, is housed in a very large building constructed of red brick and reinforced concrete, and has a corrugated iron roof. There are many auxiliary buildings of the same material, and the tall concrete smokestacks stand out very prominently in this area. The approximate location of the power plant is north of the liquefaction plant across the South Manchuria Railway tracks and just west of Kojoshi River.

H. Water Supply

The water supply for the liquefaction plant is obtained in adequate quantities from pumping stations on the Hun River. Nearly all the industrial plants in Fushun have their own reserve water power and auxiliary pumps, and the city of Fushun is supplied by a modern and efficient water works system.

V. JAPANESE CLAIMS TO A NEW DEVELOPMENT AT THE FUSHUN COAL HYDROGENATION PLANT

In 1939 the Japanese announced that

> "[The Fushun] plant was adapted to the Imperial Navy process at first, but with the progress made at the Central Research Laboratory [of the South Manchurian Railway] appropriate expansion was carried out for the purpose of incorporating the new findings. The new changes include equipment and operations methods of the reaction and coal mixing plant which evolved from the experiments carried on over a number of years at the Central Research Laboratory and characterizes the Fushun plant as one based on a unique process and on a number of S.M.R. patents."(11)

Whatever may be the scope of these "new techniques" claimed to have been industrialized at Fushun, the structural design of the plant, as outlined above in section IV.-C, has remained similar to the standard coal direct hydrogenation plants in England and Germany. An acquaintance with readily identifiable features of such plants (viz., the long rows of tall narrow 160 ton converters, the large cranes, and the distillation tanks) would permit easy identification of this plant at Fushun.

Information on the quality of the gasoline or oil produced at Fushun is very unsatisfactory. If it is true that the S.M.R. laboratories did improve the naval station's techniques, the 1933 naval experiments noted above in section II.-A gives small clue to the present status of coal hydrogenation at Fushun.

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As far as can be learned, the S.M.R. announcement in July 1939 caused little excitement among American engineering and chemical circles. No technical or trade magazines carried any remarks relative to the Japanese claims.(16)

From what information is available, it would appear that the Japanese had developed at Fushun a process whereby the primary liquefaction of the coal paste was carried on at lower temperatures and the secondary hydrogenation of the heavy oil was done at lower pressures than is the case, for example, in the Billingham plant which is likewise using bituminous coal. (The Germans up to 1939 had little experience in the hydrogenation of bituminous coal.) Sacrificing efficiency in the time yield of oil, this solved problems which had haunted the English for a long while. Suggesting the nature of the possible developments at Fushun, the following statements have been made by Mr. H. H. Storch, Supervising Physical Chemist, Experimental Station, U. S. Bureau of Mines, Pittsburgh, in two letters of December 1 and 8, 1943 to the Chicago office of the Department of Justice.

> ". . .From my first-hand knowledge of conditions at the Billingham (England) coal hydrogenation plant and from conversation with Professor Oshima [Japanese oil expert] who visited us in 1937, I can make the following statements:
>
> "(1) The Germans up to 1939 had little experience in the hydrogenation of bituminous coal.
>
> "(2) The British in 1935-1937 encountered some severe difficulties in the hydrogenation of bituminous coal. These difficulties centered about the necessity for purging a certain amount of asphaltic-like materials formed in the primary liquefaction of bituminous coal. These materials hydrogenate relatively slowly and as their concentration in the recycle heavy oil builds up, the recycle becomes more viscous. This results in difficulties if it is used in a vehicle for powdered coal and if the asphaltic content gets high enough, 'choking' of the converters with coke-like deposits occurs.
>
> "No entirely satisfactory asphaltic purge has been developed at Billingham. A compromise solution of the problem was instituted which made possible fairly satisfactory operation, but which reduced the gasoline yield from the expected 65 per cent to about 52 per cent of the coal used for hydrogenation. Development and research work at Billingham indicated that the problem could be solved by decreasing the primary liquefaction temperatures (at the expense of decreased space-time yield) combined with the new process for hydrogenation of the primary heavy oil.
>
> "(3) Oshima in 1937 was aware of this difficulty and of its possible solution." (Letter of December 1st.) (Italics added.)

The Japanese in 1940 published the figures on the temperature in the primary coal liquefaction converters and the pressure in the primary heavy oil hydrogenation converters. Ir. Storch has stated (letter of December 8):

> "The most significant (to me) item in this article [11] is given at the top of the second column of page 246, viz., that the operating temperature was 400° C. [in the Fushun plant]. This is 60°-70° C. lower than the operating temperature used at Billingham and this comparison helps to substantiate my guess that the Japanese process differs from the British mainly in having a lower operating temperature and longer contact time. . .
>
> "You will also note that the operating pressure is given as 200 atmospheres. This indicates that the Japanese process does not involve operation at 700 atmospheres plus a 'fixed' catalyst (i.e., catalyst fixed in place in the converter in the shape of granules or pellets) for heavy oil hydrogenation. The latter operation is one of the alternatives to operation at lower temperatures and longer contact time."

That the Japanese improvements were along lines similar to those studied at Billingham, may be inferred from the Japanese chortle in 1939 that

> "Furthermore, the Fushun process was perfected after only 6 months of experimentation, whereas the Billingham plant in England spent two years before the production stage was reached." (11)

Both the British and Japanese were using bituminous coal. The British had difficulty with eliminating the asphalt in the primary converter and were convinced this required a lower temperature. Japanese oil experts were aware of this difficulty as early as 1937. In 1940 the Japanese announced the use of a lower temperature and gloated over their victory over the British. This information lends substance to the belief that the Japanese "improvements" involved a slowing down of production per unit of time in order to secure a higher quality of oil and a greater yield of oil per unit of bituminous coal.

Dr. Gustav Egloff, President of the American Chemical Society and Chief Chemist of the Universal Oil Products Corporation, is of the opinion that if the Japanese have made new improvement, it would be in the nature of a new type of catalyst designed to secure a more efficient production of oil from bituminous coal.(17) Dr. Egloff points out that the Japanese study of German methods which were based upon the hydrogenation of lignite coal would still have left unsolved the perfecting of the hydrogenation of bituminous coal. However, Dr. Egloff is inclined to dismiss the Japanese claims as just another example of Japanese industrial boasts without foundation.

SOURCES

1. Mr. H. H. Storch
Chief Chemist, Central Experimental Station
United States Bureau of Mines
Pittsburgh, Pennsylvania

2. Mr. A. C. Fieldner
Chief, Fuels and Explosives Service
Bureau of Mines
United States Department of Interior
Washington, D. C.

3. Dr. Gustav Egloff
Chief Chemist
Universal Oil Products Company
310 So. Michigan Blvd.
Chicago, Illinois

4. Mr. Ralph Vaill, former Technical Adviser
Iron and Steel Section
Manchurian Heavy Industries Development Company,
now employed with Open Hearth Combustion Co., Chicago
For complete data on Vaill, see Report Chi-58--
Report on Showa Steel Works, Anzan, Manchuria,
by Leo Kuhn, Antitrust Division, Department of Justice,
Chicago, Illinois, March 15, 1943

5. Mr. Asbjorn Sjolie and Mr. John Sjolie
2623 N. 29th Street
Tacoma, Washington
Now with Olin Corporation
3400 Taylor Way,
Tacoma, Washington

These two men, father and son, were hired by Japanese to supervise construction of aluminum plant at Fushun in 1940.

Periodicals used in this report are cited in the notes.

NOTES

1. This does not include the low pressure coal carbonization process by which crude oil and low grade gasoline are obtained as a by-product of coke manufacture.

2. This description of the direct hydrogenation process and the reasons for its superiority over the Fischer-Tropsch process are given as a condensation of numerous articles on the subject. These opinions have been confirmed by Dr. Gustav Egloff, Chief Chemist, Universal Oil Products Company, and President of the American Chemical Society. According to Dr. Egloff, about the only advantage of the Fischer-Tropsch process over direct hydrogenation is the high quality Diesel fuel obtained from the former process. A coal hydrogenation plant is easily adapted to the use of crude oil in place of powdered coal, and the cresol plant may be used to produce plastics.

3. Figures on Japanese production of synthetic oil (exclusive of oil from coal shale) vary from 4,000,000 barrels to 22,100,000 barrels annually. For a bibliography of various estimates, see "Substitute Fuels as a War Economy," by Gustav Egloff and P. M. Van Arsdell, in Chemical and Engineering News, Volume 20, page 649, May 25, 1942. Lacking comprehensive information from fresh sources on this subject, no attempt has been made to discuss Japanese synthetic oil production, except as it directly pertained to the Fushun plant. Some new information gained through a search of the files of Japanese trading companies in New York is set out in the Report on Synthetic Oil and Gasoline Industry - Japan (Japanese File Research Project), #3179 (NY-200), August 6, 1943 by Fred S. Auty. A contemplated search of the Japanese files of Universal Oil Products Company, Chicago, may reveal hitherto unknown information on this subject.

4. In 1936, the Japanese government planned the establishment of a giant holding company with an eventual capital of yen 500,000,000 to spur the development of a synthetic oil industry. It was to be a semi-government corporation with large private investments. The government would guarantee an annual dividend of 5 per cent on the investment to encourage the development of synthetic oil by private industry. The Japanese "Diet" exempted synthetic oil plants from the income tax, the business profits tax, and most provincial taxes, for a period of ten years. Subsidies were granted to cover the difference between the costs of natural and synthetic petroleum for seven years. In order to qualify for these rights and exemptions, a company had to guarantee a capacity of at least 50,000 metric tons of crude oil annually in any one plant. Far Eastern Review, Volume 34, page 466, December 1938.

5. According to an article in Far Eastern Review, April 1940, Mitsui purchased and received a complete Fischer-Tropsch plant from Germany in 1939, to be installed at Ohmuta, Kyushu Island, Japan. Mitsui planned another plant using the Fischer-Tropsch process for installation in Hokkaido.

6. Mitsubishi had been operating low temperature coal carbonization plants for some time. See Confidential Report on Japanese Coal Carbonization

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Industry (2746) by Allan Trumbull, Economic Warfare Section, Seattle, April 30, 1943.

7. Confidential Report No. 3004 (Chi-97) on Fushun, Manchuria, Part I, Oil Shale Refinery and Dubbs Cracking Plant, June 6, 1943, by Kenzie K. Kirkham and Robert A. Nitschke, Economic Warfare Section, Department of Justice, Chicago.

8. Information on the developments leading to the construction of the Fushun plant has been obtained from the following periodicals: Contemporary Manchuria, January 1940, pages 17-27; Industrial and Engineering Chemistry, Volume 15, No. 17, September 1937, page 382; Far Eastern Review, July 1940, page 247.

9. Industrial and Engineering Chemistry, Volume 15, No. 17, page 382, September 10, 1937.

10. This figure does not appear sufficiently large to cover much more than the cost of a trial plant. However, with the introduction of the revised Manchukuo Five-Year Plan of 1937, the Japanese government expected to pour in yen 1,000,000,000 for the construction of coal liquefaction plants in Manchuria, and it may be assumed that the Fushun plant received a good portion of this subsidy, permitting an expansion of their original construction plans.

11. "Coal Liquefaction and the South Manchurian Railway," Far Eastern Review, July 1940, page 247.

12. The geological age of the coal has been placed in the tertiary period, and the Fushun Mine laboratory has made the following analysis of the coal: Specific gravity 1.28, moisture 3.7 per cent, volatile matter 43.7 per cent, fine carbon 45.9 per cent, ash 6.7 per cent, nitrogen 1.6 per cent, sulphur 0.6 per cent, calorific value 6.960. This analysis and the estimates of coal production at Fushun were given in a speech by Mr. Ralph Vaill before the Eastern States Blast Furnace and Coke Association in Chicago, on November 18, 1938.

The estimated coal demand in 1941, if the so-called Five-Year Plan which was drawn up in 1937 was realized, was to be approximately 27,000,000 metric tons. Of this amount, the heavy industries of Manchuria were to consume 8,335,000 metric tons, the railways 3,000,000 metric tons, and other industries 8,810,000 metric tons. (Japan Manchuria Year Book, 1940, page 755) Statement of estimated coal deposit has been taken from Commerce Report dated June 30, 1930, by J. W. Furness, Chief, Minerals Division, United States Department of Commerce.

13. This location for the liquefaction plant is confirmed by the statement of Reverend Patrick J. Herrity, missionary in Fushun from 1932-1940. See Confidential Report on Manchukuo, Steel Works at Anshan, Electric Power and Shale Oil Works at Fushun, and Munitions and Coal Liquefaction Plant Near Fushun, by A. F. Machanus, Antitrust Division, Department of Justice, New York, September 16, 1942.

14. Ralph Vaill (see sources) stated that this photograph showed a blast furnace and four stoves at Honkeiko (Pensihu) Manchuria. Gustav Egloff (see sources) questions whether this is a blast furnace, but could not state unequivocally that it was even a trial coal liquefaction plant. If this is a blast furnace, the caption may either be a mistake of a lay magazine or a naive attempt to confuse outsiders regarding coal hydrogenation developments at Fushun.

15. Father Charles Burns, missionary in North China and Manchuria from 1934-1940, now residing in Mary Knoll, New York

16. The Japanese believed that this announcement caused quite a furor. "On July 22, 1939, the S.M.R. and the Ministry of Navy simultaneously announced the successful discovery of the direct liquefaction process and caused no little wonderment among the oil industrialists of the world . . . It is said that the surprise of the Germans at the success of the process was greater than that of the Japanese themselves, even though Germany was the first to develop the coal liquefaction industry, while there is no doubt that Americans, British, and Russians, who control the greater part of the oil output, were somewhat astonished, though perhaps in a different sense." Page 248 of article cited in Note 11.

17. Mr. Storch, however, in his letter of December 1 to the Department of Justice, Chicago, stated, "It is unlikely that any better catalysts than tin compounds plus volatile chlorine compounds for primary coal liquefaction, have been developed by the Japanese."