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DEPARTMENT OF JUSTICE
WAR DIVISION
ECONOMIC WARFARE SECTION

REPORT ON FUSHUN, PART IV
(REVISED REPORT ON MANSHU KEIKINZOKU)

January 8, 1944

This report supplements and
revises report No. 3005 (CHI-98),
dated June 11, 1943.

Submitted by:
Richard F. Babcock
Kenzie K. Kirkham
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Department of Justice
Chicago, Illinois

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PREFACE

This is the fourth in a series of reports on the industrial area of Fushun, Manchuria. Previous reports have dealt with the shale oil plant, the alumina and aluminum reduction plants (herewith revised) and the coal hydrogenation plant. A further report will discuss the large collieries in Fushun.

Compared with similar installations in Japan itself, some of these industries in Fushun are not very large. (The aluminum plant at Fushun produces only a small portion of the total production of aluminum in the Japanese Empire.) However, the significance of Fushun lies in the fact that it is the most completely industrialized area in Manchuria. Within the small valley of the Hun River, on a branch of the main South Manchurian Railway from Mukden, the Japanese have developed what they like to term "the Pittsburgh of Manchuria."

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Economic Warfare Section
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Washington 25, D. C.

Confidential Report
January 8, 1944
Re: **Fushun**, Part IV (Revised Report on Manshu Keikinzoku)
Submitted by:
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REPORT ON FUSHUN, PART IV
(REVISED REPORT ON MANSHU KEIKINZOKU)

I. INTRODUCTION

Manchurian Light Metals Company (Manshu Keikinzoku K.K.) operates the only known alumina processing plant in Manchuria. Located in Fushun, this alumina plant by the end of 1940 had a capacity of 48,000 metric tons of alumina annually, a quantity more than sufficient to meet the 12,000 metric tons capacity of finished aluminum which was to be produced in the aluminum reduction plant located within the same compound as the alumina plant. In addition to supplying the Fushun aluminum reduction furnaces, the aluminum plants at Antung and Kirin, Manchuria, were to be supplied with alumina by the Manchurian Light Metals Company.[1]

In June 1943 a report was prepared on the Fushun alumina and aluminum plants, based upon information furnished by the Dorr Company, designers of certain materials for the early installations.[2] This present revised report, based upon information supplied by Messrs. John and Asbjorn Sjolie, Norwegian engineers who in 1940 designed and supervised the construction of the extensions to the Fushun plants, may be considered to correct and replace the inadequate and sometimes erroneous information in the earlier report.

II. HISTORY AND ORGANIZATION

As a result of successful experiments with the processing of alumina clay at Fushun, the Manchoukuo Government in 1936 sanctioned the establishment of the Manchurian Light Metals Manufacturing Company. In November 1936 this organization was incorporated, with a capital structure of ¥25,000,000, taken up as follows:

Manchoukuo Government	¥ 10,000,000
S.M.R.	¥ 14,000,000
Sumitomo	¥ 5,000,000
Nippon Denki	¥ 40,000
Japan-Manchoukuo Aluminum Co.	¥ 50,000
Japan Soda Mfg. Co.	¥ 50,000

In December 1937, the Manchoukuo Government, with an eye to rationalizing all heavy industry in Manchuria, formed the Manchurian Industrial Corporation capitalized at ¥ 450,000,000. Under the aegis of the new government corporation,

(OVER)

the original ¥ 10,000,000 of the Light Metals Company held by the Manchoukuo Government and the ¥ 14,000,000 owned by the S.M.R. were transferred to the Manchurian Industrial Corporation, and the nominal capital of the Light Metals Company was increased to ¥ 80,000,000.

The officers of the Manchurian Light Metals Company were as follows:

President - Yoshisuke Aikawa (also Governor of the Manchurian Industrial Corporation)
Chairman - Shinji Yoshino
Managing Directors - Saburoomou Fujimoshi, Nasao Uchino

Exhibit 1 is a photograph of certain of the Japanese engineers at the Fushun plant.

III. RAW MATERIALS AND POWER

The alumina is extracted from a clay which has about 45 percent Al_2O_3 content, found in large quantities near Fuchow, Yentai, Chunchow, Penhsihu, and other districts along the Antung Mukden Railway. The 1940 Japan Manchoukuo Yearbook lists the reserves of "alumina shale" as follows:

	Quantity (M. tons)	Grade (%)
Yentai	1,034,000	45--41.3
Penhsihu	3,202,000	40--47.3
Niusintai	9,382,000	46.4--52.5
Shaoshin	5,930,000	45.3--55
Others	5,770,900	37.2--55
Total	25,318,900	

In addition to the alumina clay, coke, limestone, and iron ore are employed in the extraction of alumina. All the coke is produced in Fushun. The limestone is found in large quantities at Fushun, Penhsihu, and other areas in Manchuria. The iron ore comes from Anzan and Penhsihu. In the aluminum plant two more materials are added to the process which, while not strictly "raw materials," may be mentioned here. One is cryolite, a solvent used to dissolve the alumina in the bath. The Manchurian Light Metals Company uses a synthetic cryolite made at Fushun. The reduction process requires from 70-100 pounds of cryolite per ton of aluminum produced.

Further important elements in the electrolytic phase of the production of the metal from its oxides are the carbon electrodes. Technically speaking, the electrodes are a part of the reduction cell but they may be classed with raw materials in that they are consumed during the process of electrolysis.

The aluminum reduction furnaces are not dependent upon independent manufacture of carbon electrodes, since they employ the Soderberg process whereby the electrodes

are made by the addition of carbon and pitch in the electrolytic cell or furnace.

In the opinion of the Sjolies, there was no such thing as a bottleneck as far as raw materials were concerned.

The new 300,000 kilowatt power plant at Fushun, which utilizes pulverized local coal, supplies comparatively cheap and abundant electric power to operate all the electrolytic furnaces in the aluminum plant. The approximate location of this plant is shown on Exhibit 3.

IV. PRODUCTION AND CAPACITY

The construction of the alumina and the aluminum reduction plants at Fushun has taken place in two stages. The so-called No. 1 plant was constructed in 1938 and 1939. The expansion of these installations to gain increased capacity was undertaken in 1940.

Alumina Plant

The equipment for the first alumina plant which was constructed at Fushun in 1938 was designed for a daily capacity of 45 metric tons of alumina (Al_2O_3). The production for the first year of operation was about 15,000 tons of alumina. The equipment for the expansion of the alumina plant which was installed in 1940 was designed to increase the capacity to 135 metric tons daily. Thus, on completion of the 1940 additions, the Fushun plant was supposed to be turning out about 48,000 metric tons of alumina annually. No figures are available on the actual production after the expansion. The chief engineer told Mr. Ford of the Dorr Company that in February 1940 the original alumina plant was operating at only 80 percent of efficiency.[3]

Aluminum Plant

The equipment for the first aluminum reduction plant was designed to produce 6,000 tons of aluminum annually by the operation of 100 electrolytic furnaces or cells. Actually the production was about 4,000 tons during the first year of operation. In 1940 another electrolytic pot house was constructed, which added 100 more furnaces and increased the capacity of the plant to 12,000 tons of aluminum per year.[4]

V. PROCESSES AND EQUIPMENT

Alumina Plant

The alumina plants in Japan proper employ the conventional Bayer process for extracting alumina from high-grade bauxite imported from the Dutch East Indies. However, the alumina clay or "shale" used at Fushun has a much higher silica content and is of a lower grade than the bauxite, a condition which renders inefficient the Bayer process. T. B. Ford of the Dorr Company stated the Japanese were using, in 1938, a process at Fushun very similar to the Pederson process. A flow chart of the Pederson process used at Fushun was prepared by Mr. Ford and is attached as Exhibit 2. From this chart it would appear that the

only change at Fushun is in the original charge. Usually the Pederson process is used with bauxite; at Fushun it was a low-grade clay. However, Asbjorn Sjolie states, "As far as I can remember, the plant at Fushun is not following this (Pederson) process exactly. They have made a few changes themselves and have called it their own process. We do not recall the name of it as they kept it very secret and the same is true regarding the changes they made."5

The Japanese negotiated with the Dorr Company for agitating and settling equipment to be used in the original alumina plant, and by contract agreement the Dorr Company designed and supervised the installation of the following equipment:

3 Turbo mixers and tanks, 10 ft. in diameter, 9 ft. deep
1 washing thickener, 40 ft. in diameter, 32 ft. deep, with pumps
1 thickener, 30 ft. in diameter, 10 ft. deep
3 thickeners, 30 ft. in diameter, 12 ft. deep

The equipment was manufactured by Tokyo-Babcock K.K., Isogo-Machi, Isogo-Ku, Yokohama, a subsidiary of Babcock-Wilcox, Ltd., England, and affiliated with Mitsui interests.

In January 1939 the Dorr Company received the following order for additional equipment:

6 Turbo mixers and tanks, 10 ft. diameter, 9 ft. deep
2 washing thickeners, 40 ft. diameter, 32 ft. deep, with pumps
2 thickeners, 30 ft. diameter, 10 ft. deep.

This order, intended for the new expansion of the plant, was manufactured in America and shipped by the Dorr Company to Japan in the fall of 1939. These later installations were completed in 1940.

Aluminum Plant

All electrolytic cells for the reduction plant were purchased from the Norwegian firm of Soderberg. The cell walls are rectangular, 6 ft. by 8 ft., and were designed for 24,000 amperes capacity.

The most important and vital part of the aluminum plant is the rectifying plant which transforms the alternating current from the main power plant into direct current. The alternating current, at suitable voltage, is transmitted to the reduction plant where it passes through transformers that reduce the voltage to the proper point for the rotary converters. These machines rotate in synchronism with the generators at the power plant and convert the alternating current into direct currents of large voltage. A number of the rotary converters operate in parallel on a bus system, and the long lines of the electrolytic cells are likewise operated in parallel from this bus system. The parallel arrangements permit the shutting down of any machine or a single cell at any time for inspection and repairs, without interfering with the operation of the plant. This is highly important since the power supply must be continuous or the cell contents will solidify in a few hours.

VI. LOCATION OF THE PLANT AND DESCRIPTION OF THE BUILDINGS

The Manchurian Light[illegible]tals Manufacturing Company's compound is located about six miles west of the main railroad station of Fushun. This approximate location is shown in Exhibit 3. The plant is bordered on the north by the double-track South Manchurian Railway going west to Mukden. The compound is about four to five miles south of the Hun River, and two to two-and-one-half miles west of the Kojoshi River, a tributary of the Hun. Across the S.M.R. tracks to the north of the aluminum compound is a "model community" for the Japanese workers. Between the aluminum plant compound and the Kojoshi River is the coal hydrogenation plant discussed in Report on Fushun, III.[6]

The entire compound of the aluminum plant area is surrounded by a red brick wall eight feet high, and all the buildings inside this compound are constructed with red brick and reinforced with steel. All the buildings have corrugated iron roofs. A general layout plan of the principal buildings is shown in Exhibit 4.

The alumina processing plant is 500 ft. by 100 ft. and about 50 ft. high. It contains all of the equipment for processing the calcium aluminate slag which comes from the raw material after it has been smelted in the large, three way, primary electric furnace. This latter installation is immediately west of the alumina building. The two buildings are connected by mechanical conveyors which transport the slag into the alumina building.

The calcining building, 500 by 100 ft., is just south of the alumina building. It houses the rotary dryers and the long calcine kilns. There is a tall stack at the west end of this building.

The electrolytic pot or cell buildings are 500 ft. by 100 ft. and between 50 and 75 ft. high. The cells, 100 to a building, are arranged in long rows the entire length of each building.

West of the two pot rooms is the rectifier building. It is this plant which transforms the alternating current from the main power plant in Fushun into direct current for use in the reduction plant. This is the most important and vulnerable installation of the entire reduction plant.

The remelt building is just east of the two pot rooms. It contains the furnaces which remelt all the aluminum to form a certain standard of purity.

Across the road west from this main group of buildings are the carbon paste plant, an electric substation, a large office building, and the guardhouse. There are likewise several auxiliary buildings such as shops and storehouses, which have not been marked in Exhibit 4 because of the uncertainty of their exact location.

NOTES

1. The aluminum reduction plant at Antung had not been completed by the end of 1940. This plant was to be an exact duplicate of the Fushun aluminum reduction plant. Mr. Asbjorn Sjolie was designing the Antung plant in 1940 when work was arrested because of the lack of materials. At the end of 1940 the Japanese offered Sjolie $100,000. to remain in Manchuria for six months and complete the plant, on the assumption that the materials would be forthcoming. He declined the offer. Both Asbjorn Sjolie and his son John believe that the Japanese have completed the Antung plant.

2. Report on Fushun, Part II--Manshu Keikinzoku, submitted by Robert A. Nitschke and Kenzie K. Kirkham, Economic Warfare Section, Department of Justice, Chicago, Illinois, June 11, 1943. Report No. 3005 (CHI-98).

3. Mr. Bartow Ford supervised the installation of the equipment in the original alumina plant in 1938. On his return to Fushun in February of 1940 he was not permitted inside the plant compound.

4. Two tons of alumina are required to produce one ton of finished aluminum. With the production of 48,000 tons of alumina and 12,000 tons of aluminum at Fushun, there was a sufficient balance of alumina to supply the aluminum plant at Antung.

5. Letter from J. E. Sjolie to Daniel B. Britt, Department of Justice, Chicago, Illinois, December 15, 1943.

6. Report on Fushun, Part III--Coal Hydrogenation Plant, submitted by Richard F. Babcock and Kenzie K. Kirkham, Economic Warfare Section, Department of Justice, Chicago, Illinois, December 16, 1943. Report No. 3302 (CHI-137).

SOURCES

1. Asbjorn Sjolie and John Sjolie, father and son, the two Norwegian engineers who designed and supervised the construction of the Fushun aluminum plant. Present address: 2623 North 29th Street, Tacoma, Washington. They are employed in the offices of the Olin Corporation, 3400 Taylor Way, Tacoma. They are Norwegian citizens in this country on a visitors' visa. Mr. Asbjorn Sjolie has been a consulting engineer for the following firms: (a) Manfred-Weiss, Budapest, Hungary, 1935; (b) Societe d'Electrochimie, Paris, France; (c) Nippon Aluminum Company, Formosa, Japan--this aluminum reduction plant was built in 1937. The factory was to be increased to 12,000 metric tons annual production under Sjolie's supervision; (d) Japan Light Metal Company, Cambra, Japan, 1940-41. Sjolie built a factory in Niigata, Japan, for the same company; (e) Fabrika Aluminia, Jugoslavia. This factory was constructed in 1938 under Sjolie's supervision. Mr. Sjolie is probably one of the outstanding authorities on aluminum reduction furnaces in the country today.

2. T. B. Ford, of the Dorr Company, Chicago, Illinois, was the Dorr Company's foreign representative in Japan. He designed the thickening and settling equipment for the Fushun alumina plant.

3. Father Clarence Burns, 1421 North Astor Street, Chicago, Illinois. Missionary in North China and Manchuria from 1934 to 1940. Was stationed in Fushun from 1938 to part of 1940. Now at Mary Knoll, New York.

Publications

4. Nippon Today and Tomorrow, 1941.

5. The Aluminum Industry, Chemical Engineering Series 1930, by Edward, Frary and Jeffries.

6. Volume 3, The Light Metal Industries. Aluminum and Magnesium. George S. Armstrong & Co., Inc., Industrial Engineers and Management Consultants, 52 Wall Street, New York.

7. Chemical and Metallurgical Engineering, May 1943.

8. Japan-Manchoukuo Year Book, 1940.

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INDEX OF EXHIBITS

1. Photograph of the Norwegian and Japanese engineers who designed and constructed the 1940 additions to the aluminum plant in Fushun (original photograph property of Mr. Asbjorn Sjolie).

2. Diagram of Pederson process which, with slight changes, is used at Fushun (prepared by Mr. Bartow Ford, Dorr Company).

3. Map and sketch of Fushun area showing location of Manchurian Light Metals Company plants.

4. Sketch of the Manchurian Light Metals Company's plant compound, (prepared from description by Mr. Asbjorn Sjolie).