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REPORT ON
MIIKE SYNTHETIC OIL COMPANY
OMUTA, KYUSHU

ENCLOSURE (C)

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SUMMARY

This report records and summarizes technical data on the Miike Synthetic Oil Company at OMUTA, Kyushu, obtained by the Petroleum Section of NavTechJap during the period 3-9 October 1945.

The Miike plant utilizes the conventional low-pressure Fischer-Tropsch process, with cobalt-thorium catalyst, for production of oil from Miike coal. The process was licensed from Ruhrchemie and most equipment was constructed by the Koppers Co.

The plant produces gasol (liquefied propane and butane), motor gasoline, diesel fuel, and several grades of paraffin wax. All products were distributed to the Army, Navy or civil government. A plant to produce lubricating oil by aluminum chloride polymerization of paraffin oil, was under construction.

Plant capacity was rated at 30,000 metric tons of total synthetic product per year, but actual production during the peak year 1943 was only 16,000 tons. This was primarily due to decreased production of synthesis gas, the result of water gas generator operating difficulties with the high sulfur, low melting point ash Miike coke. The low production was also due to a low yield of oil per unit of synthesis gas, apparently due to low catalyst activity.

The plant suffered no serious damage from air raids, but due to two explosive bomb hits, one on the main coke conveyor and one on the main synthesis gas line at the desulfurization unit, the entire plant had been shut down since 7 August 1945.

Details on history, ownership and organization of the concern, process flow sheets, plant layout, product quality and output are presented herewith. Also attached are documents pertaining to research work on synthetic lubricating oil, cracking of pine root oil, and iron synthesis catalyst, and copies of original correspondence with German firms.

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I. INTRODUCTION

The Miike Synthetic Oil Company is located in the city of OMUTA, Fukuoka Prefecture, Kyushu, Japan. The center of the plant is located approximately at 33°-01'-14" N, 130°-27'-50" E.

The following Japanese personnel were interviewed and assisted in supplying the information presented herewith:

Mr. Takanaga MITSUI, President
 Mr. Masao TAKEI, Head of Chemical Dept.
 Mr. Heima NAGAHAMA, Head of Mechanical Dept.

II. HISTORY AND ORGANIZATION

Construction of the plant was started in November 1936 by a special construction department in the Mitsui Mining Company. Oil production was started in May 1940. With separation of the chemical department from the Mitsui Mining Company, the plant was transferred in April, 1941, to the newly established Mitsui Chemical Industrial Company. In October 1943, the Independent Miike Synthetic Oil Co. was founded by the joint interests of Mitsui and the TEIKOKU NENRYO KOGYO (Imperial Fuel Industry) Corporation, with a capitalization of 50,000,000 Yen. In October 1944, the following firms were amalgamated to form the NIPPON JINZO SEKIYU (Synthetic Oil) Co., Ltd., with a capitalization of 150,000,000 Yen:

The Miike Synthetic Oil Co. (Capital 50,000,000 Yen)
 The Hokkaido Synthetic Oil Co. (Capital, 70,000,000 Yen)
 The Amagasaki Synthetic Oil Co. (Capital, 30,000,000 Yen)

Of the total capitalization, Mitsui has about 20% and the Imperial Fuel Industrial Corp., an amount greater than 50%. Headquarters of the NIPPON Synthetic Oil Co. are located in TOKYO at 6, Nishi-Ginza, Kyobashiku. This parent concern was established to manufacture and refine synthetic fuel and its derivatives. The top management of this concern is as follows:

Chairman of Board	Mr. Yoshi NISHIKU
President	Mr. Takanaga MITSUI
Managing Director	Mr. Masumi YAMAGUCHI
Directors	Mr. Ryo MITSUI Mr. Tosaki MATSUMOTO Mr. Toshitada KII Mr. Masana KAWAGUCHI Mr. Heima NAGAHAMA Mr. Ryolohi NISHIKAWA Mr. Takashi HOUCHI Mr. Masao TAKEI Mr. Rokuro MIKI Mr. Shuji NISHITERO Mr. Masajiro UCHIDA Mr. Genji IJICHI
Inspectors	Mr. Kaneyoshi SAKAI Mr. Tamesuke OKAMOTO Mr. Norito HIRASAWA

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The following outlines the personnel organization of the Synthetic Oil Plant at Miike:

President	Mr. T. MITSUI
Mechanical Division	Mr. H. HAGAHAMA, Chief
a. Machinery Dept.	Mr. I. HIDAKA
b. Building & Repair Dept.	Mr. K. SAIGO
c. Planning Dept.	Mr. T. MIYAMAYE
d. Electrical Dept.	Mr. Y. KUBOTA
e. Orderly Dept.	Mr. T. UCHIDA
Chemical Division	Mr. M. TAKEI, Chief
a. Gas Dept.	Mr. A. NAKAGAME
b. Synthetic Dept.	Mr. M. SHIBUYA
c. Refining Dept.	Mr. M. ANDO
d. Catalyst Mfg. Dept.	Mr. S. KOJIMA
e. Research Analytical Dept.	Mr. NAKAJIMA
Business Division	Mr. J. KONDO
a. Accounting Dept.	Mr. J. AOKI
b. Sales Purch. Dept.	Mr. AWAZU
c. General Dept.	Mr. M. HIRASHIMA
d. Personnel Dept.	Mr. M. YOSHITAKE
e. Labor Welfare Dept.	Mr. H. KAKURA

The total number of employees at Miike is approximately 1400 and the average daily wage of plant laborers is 2½ Yen.

III. DESCRIPTION OF PROCESS

A. General

The Miike Synthetic Oil Co. operates a conventional low-pressure Fischer-Tropsch process, utilizing a cobalt-thorium catalyst. Synthetic gas, with H₂:CO ratio maintained at 2:1, is obtained by blending water gas and re-formed coke oven gas. Coke oven gas, and coke for the water gas generators, are obtained by high-temperature carbonization of Miike coal in Koppers ovens. Organic and inorganic sulphur are removed from the synthesis gas by use of the iron oxide catalyst, "Luxmasse". Catalysts for sulphur removal and oil synthesis are manufactured in a catalyst plant on the factory grounds. The synthesis reaction is carried on in low-pressure reactors of conventional Ruhrchemie design. The heavier synthesis oil is separated by direct condensation with water, and lighter components are picked by adsorption on activated carbon. Distillation of these products yields liquefied propane-butane, motor gasoline, diesel fuel, and paraffin wax. An outline of the over-all process flow is given in Plate (G).

B. Coke Oven Plant

The coke oven plant was designed, and the equipment manufactured, by the Koppers Co. The plant consists of two batteries of 25 ovens each, and was designed to handle 750 tons of Miike coal per day. Actually, only about 650 tons per day are charged due to the limited coke demand of the water gas generators.

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Typical analyses of Miike coal and coke are as follows:

	<u>Coal</u>	<u>Coke</u>	
Water	8.1%	7.8%	
Ash	12.4	19.5	
Volatiles	40.6	2.0	
Sulphur	2.4	2.2	
Fixed Carbon	47.4	78.5	
M.P. of Ash	1060°C	1060°C	
Caking Index	28		
Shatter Test			
		above 50mm	38.1%
		above 40mm	48.4
		above 25mm	63.8
		above 15mm	78.4
		below 15mm	21.6

The coke oven by-products plant contains conventional equipment for production of coal tar and crude benzol, which are shipped to the neighboring Miike Dyestuffs Works, and also ammonium sulphate, which is marketed. Coke oven gas is charged to the Koppers gas re-forming plant. The coke is screened, and particles greater than 25mm in size are charged to the Koppers water gas generators. Coke breeze is charged to five small Koppers producer gas units, yielding about 400 m³/day, which is used for firing the coke ovens.

A process flow chart for the various units of the gas department is given in Plate II(G).

C. Water Gas Plant

The water gas plant consists of five Koppers generators, each with a rated capacity of 100 tons of coke per day. The plant was designed to operate with four generators on stream, and one on standby, producing 444,000 m³/day of water gas. In actual practice, it was usually possible to maintain only three on stream, due to operating difficulties resulting from a lower quality of coke than was expected. The high sulphur content of the coke resulted in severe corrosion; for example, within a period of four years, a 14mm steel wall in the gas scrubber was reduced to 1.5mm. Considerable operating time also was lost due to clinker formation, and breakage of mechanical grates.

Due to the low melting point of the ash, it was necessary to reduce the operating temperature from the 1200°C design optimum to 1100°C, resulting in lower gas production and the rejection of considerable unburned carbon in the ash (about 15%). Actual gas production was only about 1000 cubic meters per ton of coke, compared with the expected 1335. The lower temperature in the reaction zone also resulted in a lower content of CO in the water gas and a higher content of inerts, especially CO₂. This restricted the amount of re-formed gas of high hydrogen content which could be mixed and still maintain a H₂:CO ratio of 2:1 in the synthesis gas. As a result of these difficulties, production of total synthesis gas amounted to only 600,000 m³/day compared with design maximum of 900,000.

No unusual design features or modifications appeared to be incorporated in this plant.

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D. Gas Re-forming Plant

The gas re-forming plant was designed, and the equipment constructed, by the Koppers Co. There are two sets of Cowpers stoves and auxiliary equipment. Design capacity of the plant is 456,000 m³/day. In practice, a mixture of coke oven gas, residual gas from the synthesis, and CO₂ obtained from the neighboring Oriental High Pressure Plant, are re-formed with steam. The CO₂ is added to increase the percentage of CO in re-formed gas to compensate for the reduced percentage of CO in the water gas. Actual re-formed gas production is about 360,000 m³/day, of which, 60,000 m³/day is sent to the Oriental High Pressure Plant.

Water gas and re-formed gas are blended to maintain a H₂:CO ratio of approximately 2:1. In practice, about 300,000 m³/day of water gas are blended with 300,000 m³/day of cracked gas, yielding a synthesis gas mixture of the following composition:

	<u>Actual</u>	<u>Koppers Design</u>
H ₂	55.8%	60%
CO	27.3	30
CO ₂	7.2	5
CH ₄	2.5	1
N ₂	7.2	4
	<u>100.0%</u>	<u>100%</u>

E. Desulfurization

The Klonne desulfurization system is employed, and consists of a "grossreinigung" section for removal of inorganic sulfur, and a "feinreinigung" section to handle organic sulfur. Raw synthesis gas contains approximately 6-10 gm/m³ of total sulfur. After "grossreinigung", the sulfur content is reduced to 0.1 gm/m³, and after "feinreinigung", to 4 mg/m³.

The inorganic removal system consists of two banks of 4 towers each. One tower in each series is ordinarily down for regeneration. Each tower is filled with 600 tons of catalyst, distributed over 16 trays, which has the following composition:

Iron Oxide (Aso Oda)	95%
Soda Ash	5%

The catalyst is manufactured in the Miike plant, but is apparently not as efficient as the German "Luxmasse", requiring an appreciably longer time to regenerate. To shorten the regeneration time, some air is added continuously to the synthesis gas feed. The catalyst is replaced after its sulfur content has risen to 4% by weight.

After leaving the inorganic purifiers, the gas is passed through a two-stage organic sulfur removal plant. The gas is heated to 280°C, and passed through 4 towers in series, each filled with catalyst of the following composition.

Iron Oxide (Aso Oda)	75%
Soda Ash	25%

Spent catalyst is regenerated by air blowing. A process flow chart for the desulfurization section is given Figure 1(O).

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F. Oil Synthesis

Oil synthesis is carried on in reaction chambers of Ruhrochemie design. The reaction occurs at 3-5 lbs/in² and 180-200°C. Originally, 40 reactors were installed, but this number was increased to 56, of which 30 are used in the first reaction stage, 18 in the second stage, and 8 off-stream. Each chamber consists of 550 closely-spaced vertical steel plates, arranged perpendicular to a large bundle of water cooling tubes, 630 in number. About 4½ tons of catalyst is contained in the space between the plates, on the outside of the tubes. A process flow chart for the synthesis section is given in Plate III(G).

The yield expected from the two-stage reaction, according to the Koppers design calculations, was 116 grams of total product per cubic meter of synthesis gas. The actual yield is substantially below this, amounting to 70-85 gm/m³. Reasons given for this lower yield were, that the synthesis gas composition suffers considerable variation and has a higher content of inerts than design, the catalyst activity is lower, (possibly due to the fact that the hydrogen used for reactivation is not pure enough), and also, that water tube leakage reduced the capacity. It is also conceivable that Japanese catalyst-manufacturing technique is not on a par with that of the Germans.

The catalyst is replaced about every 120 days, however, every 20 days, activity is increased by passing hydrogen gas over it at a rate of 800-1000 m³/hr, at a temperature of 205-210°C, for 24 hours. The operation is stopped when exit gases contain less than 1% of methane. The schedule of treatment is as follows:

	<u>Treatment</u>		<u>Days</u>
	<u>Start</u>	<u>Stop</u>	
Fresh Catalyst	180°C	190°C	0-20
#1	180	190	21-40
#2	183	193	41-60
#3	185	195	61-80
#4	187	200	81-100
#5	190	200	101-120

The procedure for replacing old catalyst is as follows: Synthesis gas is displaced with CO₂. The temperature of the catalyst chamber is maintained at 170-180°C, and the catalyst is washed with 35 kls of wash oil (boiling range 180-220°C). The wash period is 15-17 hours. After washing, the temperature of the chamber is raised to 205-210°C, and the catalyst is dried with hydrogen gas. Temperature is dropped gradually to 100°C and hydrogen is displaced with CO₂. The chamber is opened and the spent catalyst discharged into a receiving vessel at the bottom of the chamber. Fresh reduced catalyst is then introduced. Both discharging and charging operations are conducted in a current of CO₂, to protect the catalyst from oxidation. Fresh catalyst is brought on stream at a temperature of 180°C.

G. Oil Recovery

The heavier oil is recovered from the reaction exit gas by direct condensation with water, and then, by passage through charcoal adsorbers to recover the lighter gasoline components. Two recovery stages are employed, one after the first synthesis stage and the other after the second stage. Each recovery stage consists of a packed condenser, tower, wherein reaction gases are passed counter-current in direct contact with cold, recirculated water. Oil condensed by this operation is

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separated and sent to the distillation plant. The overhead gas from the condenser tower is passed through an absorber containing about 15 tons of activated carbon. The exit gas from the first absorption stage is sent to the second synthesis stage, and the exit gas from the second absorption stage ("rest" gas), is recycled to the gas re-former unit, or utilized as fuel gas. The light hydrocarbons absorbed on the carbon are periodically stripped off with steam, condensed, and sent to a "gasol" storage tank.

The raw gasol is compressed to 4-5kg/cm² and passed into a packed absorber tower, counter-current to circulated oil. The lean exit gas is sent to fuel, and the rich absorber oil is charged to a stabilizer, where finished gasol is taken-overhead. This product consists mainly of butanes and is marketed in steel bottles for use as motor fuel. Since the capacity of the absorption plant is 500 m³/hr, and only about 3600 m³/day are received from the synthetic plant, the absorption plant is only operated about 6-7 hours per day.

H. Oil Distillation

The condensed oil from the synthetic plant is charged to a pipe still of Wilke design, and separated into a light benzine overhead out, which is charged to the gasoline stabilization plant, diesel oil fractions, and a paraffin oil fraction.

Condensed light gasoline, from the activated carbon units and from the condensed oil distillation plant, is charged to a Wilke stabilization column, wherein stabilized motor gasoline is produced, together with a gasol overhead which is mixed with the product from the gasol absorber. No chemical treatment is given to either the gasol, gasoline, or diesel oil.

I. Paraffin Plant

The paraffin plant was installed to recover paraffin from the catalyst wash oil. The plant produces recovered wash oil, diesel oil, and three grades of wax.

J. Catalyst Manufacturing Plant

Complete facilities are installed for manufacture of fresh synthesis catalyst, and for the recovery of cobalt and thorium from spent catalyst. All cobalt used in the manufacture was obtained before the war from Katanga, Africa, via Ruhrchemie. Thorium was obtained from U. S. sources. No supplies of these metals have been shipped to Japan since the start of the war. Design capacity of the plant is 4½ tons of non-reduced catalyst per day. Normal production, however, is about 3 tons per day. Facilities for reducing the catalyst are available, and reduced catalyst is shipped in closed metal containers in 1 atmosphere of CO₂. Mr. MITSUI advised that this plant was the only cobalt manufacturing unit in Japan. It was stated that no innovations or departures from the original Ruhrchemie manufacturing technique had been introduced in this plant.

A flow chart for the catalyst manufacturing plant is given in Plate IV(G).

Further details on the plant layout are given in detail drawings listed in Appendix IV.

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K. Miscellaneous

Plans were purchased in 1939 from the Universal Oil Products Co. for a Dubbs-Kogasin cracking unit and a non-selective gas polymerization unit. Construction work had not yet started on the polymerization unit. Work was in progress on the cracking unit, but was being held up due to lack of furnace tubes and hot oil pumps. This unit was stated to have a capacity of 2kls per hour. At the direction of the government, it was planned to utilize the cracking unit to lightly crack paraffin oil to make charge stock for an $AlCl_3$ lubricating oil plant.

Construction work also was in progress on the lubricating oil polymerization reactors and clay filtration units. In the polymerization section it was planned to mix 3-5% of $AlCl_3$ with the cracked paraffin oil and react at 60-90°C for 8-12 hours. The reaction mix was to be drawn off, settled, filtered through activated clay, and vacuum distilled. It is understood that the NIPPON Oil Co. near YOKOHAMA has a similar process in production.

L. Plant Layout

Plate V(G) gives the layout of the entire plant, showing location of all major units and buildings. Also indicated on this layout, is the bomb damage suffered during three air raids on the plant. The plant was not seriously damaged as a result of these raids, although the rupturing of the main synthesis gas line at the "feinreinigung" plant and also the main belt conveyor at the coke plant due to explosive bomb hits on 7 August, 1945, resulted in complete stoppage of oil production. The damage was still being repaired at the time of this inspection.

IV. PRODUCTION

The plant production capacity, according to Koppers design calculations, was as follows:

<u>Basis</u>	<u>Vol. of Synthesis Gas - (m³/day)</u>	<u>Annual Production Total Product</u>
Design Maximum	900,000	38,100 met. tons
Design Normal	770,000	32,600
"Rated" Capacity		30,000

Actual production was considerably less than this, due to the lower volume and quality of synthesis gas produced. Low synthesis gas production was a result of operating difficulties in the water gas plant caused by a poorer quality of Miike coke than was expected. The conversion of gas to oil, in the synthesis step, was also much lower than expected.

Actual annual production figures are given in Table I(G) and II(G). It will be noted that the peak monthly production rate, in March 1944, was about 1500 tons, corresponding to an annual production of 18,000 tons. Actual production for the peak year of 1943 was roughly 16,000 tons.

During the period 1943-45, inclusive, about 25% of the motor gasoline output went to the Army and the remainder went to the Civil Government. About 18% of the diesel oil went to the Army and the balance to the Navy.

An inventory of products in storage at the Miike Plant as of 8 October 1945, follows:

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<u>Stock</u>	<u>Amount</u>
Motor Gasoline	4.0 kl
Diesel Oil	
Light No. 1	1.3 kl
Light No. 3	110.8 kl
Heavy Oil	85.8 kl
Paraffin Oil	4587.9 kl
Solid Paraffin	7.0 tons

Paraffin oil was being accumulated in storage to serve as feed stock for the lubricating oil plant under construction.

V. QUALITY OF PRODUCTS

Actual inspections of the several types of products made at Miike are given in Table III(G). These inspections are well in line with Fischer-Tropsch cobalt catalyst data reported from other sources. In addition to the products listed, Miike produced paraffin wax in the following grades:

Paraffin No. 4	Melting point higher than 50°C
Paraffin No. 6	Melting point higher than 60
Paraffin No. 8	Melting point higher than 70

Samples of all Miike products and catalysts were obtained and shipped to the Ordnance Investigating Laboratory, Indian Head, Md., for forwarding to the Naval Research Laboratory, Anacostia, Md. NavTechJap serial numbers assigned to this shipment are JE-26-0001 to 0006 inclusive.

VI. RESEARCH WORK

The Miike plant has only a small research group containing five people. Most attention was devoted to the study of plant operating problems. Some basic research work on oil synthesis was carried on at the Meguro Laboratory in TOKYO. At Miike, most attention was concentrated on a pilot plant study of lubricating oil production, by $AlCl_3$ polymerization of lightly cracked paraffin oil, and the production of gasoline from pine root oil. Investigation of the latter process was undertaken upon orders from the Army.

Documents pertaining to these projects, together with miscellaneous reports from Miike and other laboratories, were obtained and are listed in Appendix II(G). Several papers on iron synthesis catalyst and studies of paraffin oxidation products are of special interest.

VII. PATENTS

Appendix I contains a list of all Japanese patents held by the Miike Company. Copies of the same were not available at Miike.

VIII. NEGOTIATIONS WITH GERMANS

Selected copies of correspondence between Mitsui Bussan, (Mitsui Trading Co.) and German firms during the years 1936-37, together with an index and abstract of the same, were obtained and are listed in Appendix III. Correspondence for other years is held in the Tokyo Company Headquarters. This correspondence mainly concerns licensing agreements with Ruhrohemie, and negotiations with Heinrich Koppers, regarding design and construction of equipment.

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Table I(G)
ACTUAL PRODUCTION FIGURES

	June-Dec. 1940	1941	1942	1943	1944	Jan.-July 1945
Coal Charged (tons)	136,706	227,179	208,203	234,807	218,781	101,913
Water Gas (1000 m ³)	23,745	24,368	52,793	86,628	78,478	26,143
Cracked Gas (1000 m ³)	17,685	104,411	78,926	103,503	82,617	33,877
Synthesis Gas (1000 m ³)	29,444	103,670	136,123	198,024	163,890	57,370
Synthetic Oil (kl)	3,787	7,787	10,063	15,258	14,323	3,079
No. of Chambers Operated	2,036	5,625	6,231	13,170	9,077	2,532
No. of Working Days	204	322	293	350	293	91

Table II(G)
ACTUAL PRODUCTION OF FINISHED PRODUCTS

	April-Dec. 1940-1942	1942	1943	1944	Jan.-July 1945
Motor Gasoline (kl)	5,556	6,743	10,142	5,938	1,038
Light Diesel Oil (kl)	3,772	2,559	3,815	3,472	662
Diesel Oil (kl)				343	16
Liquefied Petroleum Gases (tons)	128	278	468	226	48
Paraffin Oil (kl)	204	1,366	1,817	1,086	119
Paraffin Wax (tons)			82	56	10
Ammonium Sulphate (tons)	1,708	1,856	1,749	1,162	235
Carbon Black (tons)			959	946	172
Coke (tons)	152,859	150,811	135,997	138,321	35,132
Tar (tons)	13,573	13,189	12,635	12,812	3,394

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Table III(G)
TYPICAL INSPECTIONS OF OIL PRODUCTS

Test	Condensed Oil	Active Carbon Oil	Motor Gaso.	Diesel Oil	Paraffin Oil	Washing Oil
ASTM Distillation						
T.B.P.	136.9	24.7	36.9	170.7	290.1	127.4
10%	168.6	37.2	56.2	195.0	349.7	158.8
50%	239.8	77.1	97.3	243.2	387.2	190.3
90%	313.3	139.5	145.4	286.1	399.1	204.4
97%	333.2	159.1	158.6	307.3	413.3	210.6
T.P.	350.6	173.5	171.2	316.5		226.2
Specific Gravity	0.7658	0.6729	0.7079	0.7685	0.7980	0.7456
Flash Point, °C				58.8		
Solid Point, °C				-3.9	22.2	
Octane No.			About 40			
Octane No.				About 85		
Fluc. Red, at 30°C				28.3		
Acid Value	0.06					
Vapor Press. kg/cm ²		0.78	0.52			
Carbon Residue				0.03		
Ash, %				0.001		

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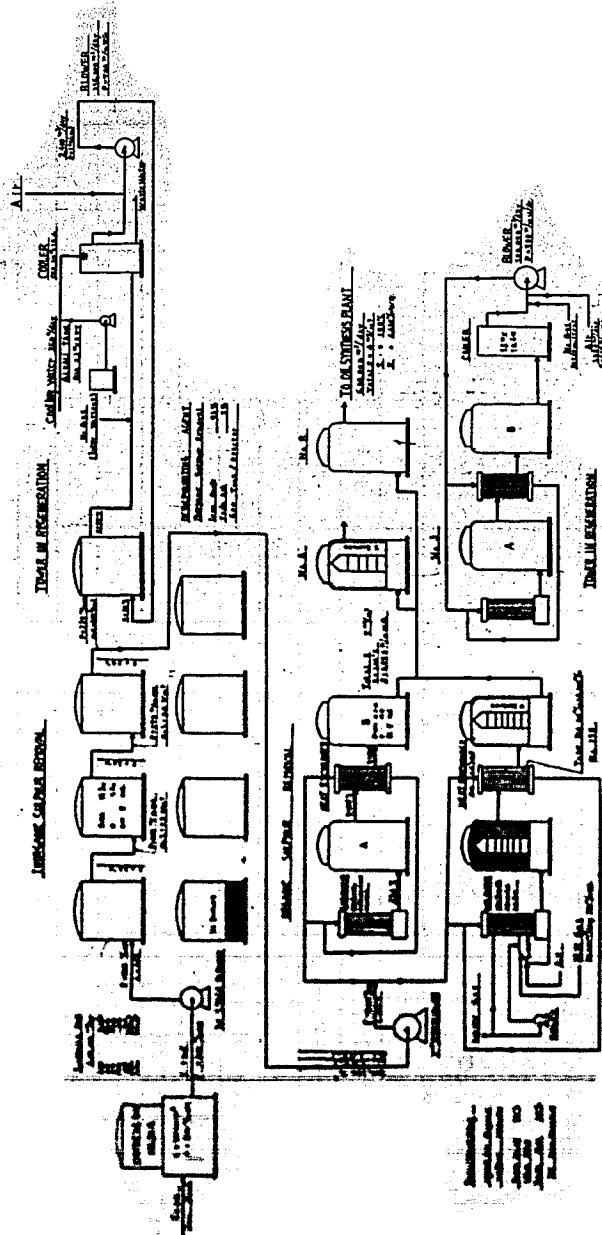


Figure 1(G)
DESULFURIZATION PLANT
MILNE SYNTHETIC OIL CO.

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LIST OF PATENTSPatents Held by Miike Synthetic Oil Co.

<u>Patent No.</u>	<u>Title and Inventor</u>
128,550 133,888	"The Preparation of Sulfur Purifier of Gas" by Y. NIKAIDO
139,563	"Thermostat Apparatus in Gas Reaction Chamber Using Catalyst" by S. KOIZUMI
157,995	"Synthetic Oil Apparatus" by Y. NIKAIDO
161,655	"Liquefied Gas Charging Method" by H. YANAI
163,776	"Treatment Preliminary to Fractional Rectification of Hydrocarbons" by H. YANAI
287,840	"A New Design for Catalyst Tube of Gas Reaction Chamber" by T. KII

Patents Pending in Showa 18 (1943)

3,299	"The Preparation of Gas for Oil Synthesis" Unknown
11,102	"Double Distillation Apparatus" by H. YANAI
12,406	"Absorption Pipette for Gas Analysis" by M. YASUDA
13,312 (12 July '43)	"Method of Grease Making from Oxidized Products of Paraffin Hydrocarbons" by KIYOHISA
14,186	"Method of Soap Making by Oxidation of Paraffin Hydrocarbons" by KIYOHISA

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APPENDIX II
 LIST OF RESEARCH DOCUMENTS OBTAINED
 FROM MILKE SYNTHETIC OIL CO.

ATIS No. 4587

<u>NavTechJap Document No.</u>	<u>Title LUBRICATING OILS</u>	<u>Date</u>
ND26-0016.1	Report concerning synthetic oil produced from Gishin coal.	9 November 1939
ND26-0016.2	Description of lubricating oil plant including flow chart.	no date
ND26-0016.3	The process of manufacturing grease from oxidation products of paraffin hydrocarbons.	24 July 1943
ND26-0016.4	(copy of above)	
ND26-0016.5	Stability of lubricating oils produced by polymerization of olefins.	15 November 1943
ND26-0016.6	Report on attempt to improve the synthetic polymerized oil, whose index of viscosity is too low for use in aircraft engines, by making a cut at the lower boiling point.	3 August 1944
ND26-0016.7	Comparison of properties of various lubricating oils.	April 1937
ND26-0016.8	Research on polymerization of synthetic lubricating oils using $AlCl_3$ catalyst.	no date
ND26-0016.9	Research on the manufacture of olefins by normal pressure cracking.	15 October 1943
ND26-0016.10	Translation into Japanese of final Fischer Method contract.	no date

ATIS No. 4588

CATALYSTS

ND26-0017.1	Study on lowering of reaction temperature of gasoline synthesis using iron catalyst.	December 1939
ND26-0017.2	Data on iron catalysts.	June 1944
ND26-0017.3	Report on raw iron catalysts used in the production of synthetic gasoline.	December 1938
ND26-0017.4	Report on synthesis catalyst production at Holten.	March 1942

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ATIS No. 4589

<u>NavTechJap Document No.</u>	<u>Title</u> <u>PINE OIL</u>	<u>Date</u>
ND26-0018.1	Report of laboratory and pilot plant results in processing pine root oil for production of aviation gasoline.	1945
ND26-0018.2	(copy of above)	

ATIS No. 4590

MISCELLANEOUS

ND26-0019.1	Results of cracking a mixture of coke oven gas and rest gas (containing CO ₂).	October 1942
ND26-0019.2	Research on alkylation of synthetic gasoline produced with an iron catalyst (or gasoline produced by cracking).	February 1945
ND26-0019.3	A discussion of metal-organic compounds, chiefly Al, Zn, Fe, salts of fatty acids. (TM: compounds formed during Fischer process.)	December 1937
ND26-0019.4	"Research on Antioxidants of Gasoline" by K. MORIKAWA.	1944
ND26-0019.5	Desulfurization and oxidation with inorganic desulfurization agent.	February 1943
ND26-0019.6	Studies in the use of rest gas as the reduction gas in the hydrogen generator in the Iron Contact Process.	June 1943
ND26-0019.7	Analysis of Manchurian coal.	no date
ND26-0 19.8	Heat decomposition of coke oven gas with Cowper equipment.	December 1942
ND26-0019.9	Tables of fuel specifications.	May 1944
ND26-0019.10	Specifications for fuels used by Army and Navy.	no date
ND26-0019.11	The process of manufacturing soap by oxidation of paraffin hydrocarbons.	August 1943
ND26-0019.12	(copy of above)	
ND26-0019.13	(copy of above)	

ENCLOSURE (G)

ATIS No. 4590

NavTechJap
Document No.Title
MISCELLANEOUSDate

ND26-0019.14

The process of manufacturing grease from oxidation products of paraffin.

July 1943

ND26-0019.15

Comparison of two batteries; one operated on producer gas and one operated on coal gas.

March 1941

ND26-0019.16

Research (Oil Synthetic Plant)

October 1945

ND26-0019.17

The Manufacture of Catalyst.

October 1945

ND26-0019.18

The Fischer Method of petroleum synthesis.

July 1938

ND26-0019.19

Paraffin with high melting point from synthesis process.

April 1943

ENCLOSURE (G)

APPENDIX III
 LIST OF SELECTED CORRESPONDENCE BETWEEN
 GERMANY AND MITSUI BUSSAN

ATIS No. 4575

<u>NavTechJap Document No.</u>	<u>Description</u>	<u>Date</u>
ND26-0004.1	Telegrams from Deutsche Bussan advising on progress of negotiations for Fischer process, interest of other countries in the process, development of Fischer plants in Germany, etc.	2/6-12/36
ND26-0004.2	Confirmation by Mitsui Bussan Co. of telegram received from Deutsche Bussan. (Context in 1)	2/10/36
ND26-0004.3	Confirmation by Mitsui Bussan Co. of telegram received from Deutsche Bussan. (Context in 1)	2/13/36
ND26-0004.4	Confirmation by Mitsui Bussan Co. of telegram received from Deutsche Bussan regarding negotiations for general license for Fischer process.	2/18/36
ND26-0004.5	Telegram from Essen announcing signing of contract for Fischer process and giving various details.	2/20-21/36
ND26-0004.6	Deutsche Bussan Purchase Report on license for Fischer process made to the account of the Mitsui Bussan Co. Ltd.	2/20/36
ND26-0004.7	Letter regarding proposed contract for Fischer process sent from Ruhrchemie to Deutsche Bussan. contains power of attorney for Mitsui Bussan Co's agent in Germany, and Proposed contract.	2/20/36
ND26-0004.8	Confirmation of telegram sent by Deutsche Bussan describing new Fischer water gas unit.	3/3/36
ND26-0004.9	Telegram from Berlin representative recommending second payment as Fischer process investigated and thought to be a success in Japan.	2/28/36
ND26-0004.10	Telegram to Berlin representative regarding proposed Hokkaido Fischer plant and suitable personnel for the new set up.	3/5/36
ND26-0004.11	Telegram from Berlin representative recommending contract for exclusive license for Fischer process in view of its undoubted success in Japan and so that Mitsui will be in strong position to control proposed new combine.	4/14/36

ENCLOSURE (G)

ATIS No. 4575

<u>NavTechJap Document No.</u>	<u>Description</u>	<u>Date</u>
ND26-0004.12	Letter from Heinrich Koppers to Deutsche Bussan regarding tests on Japanese coal to be used in production of synthetic gas, and a proposal to build benzine synthesis plant for them.	5/20/36
ND26-0004.13	Letter from Heinrich Koppers to Deutsche Bussan clarifying their proposal to supply diagrams, blueprints, and technical information for the construction of a benzine synthesis plant for the Japanese.	6/18/36
ND26-0004.14	Letter from Fried. Krupp to Deutsche Bussan regarding offer to deliver works blue prints and provide a foreman for the construction of contact ovens for a Fischer Benzine Synthesis Plant.	7/20/36
ND26-0004.15	Letter from Krupp defining terms under which a foreman will be sent to Japan to supervise building of contact ovens.	7/20/36
ND26-0004.16	Telegram from Deutsche Bussan regarding report on comparison of German plants observed and agreement of Krupp to send an engineer to supervise construction of contact ovens.	7/27/36
ND26-0004.17	Letter from Heinrich Koppers to Deutsche Bussan regarding their offer to contract for the building of the synthetic plant.	7/27/36
ND26-0004.18	Letter from Gutehoffnungshutte to Deutsche Bussan regarding offer to supply certain machines and tools for construction of contact ovens for Fischer Benzine Synthesis Plant.	8/4/36
ND26-0004.19	Letter from Ruhrchemie to Deutsche Bussan giving list of material sent.	8/5/36
ND26-0004.20	Contract between Mitsui Bussan and Ruhrchemie for the Fischer Process.	11/27/36
ND26-0004.21	Proposed option contract between Ruhrchemie and Mitsui Bussan regarding the use of the Schmieroel Process, also final copy of contract regarding Schmieroel Process.	11/27/36
ND26-0004.22	Specifications of Catalyst Fabrick Design.	12/17/36
ND26-0004.23	Letter from Koppers giving the basic calculations of benzine synthesis by the Fischer-Tropsch method for Mitsui Bussan.	12/18/36

ENCLOSURE (G)

ATIS No. 4575

NavTechJap
Document No.

Description

Date

NavTechJap Document No.	Description	Date
ND26-0004.24	Letter from Vergasungs-Industrie to Deutsche Bussan concerning the production of synthesis gas from Fushun coal for the petrol synthesis according to the Fischer-Tropsch method. Letter contains offer to construct synthesis gas plant.	9/15/37
ND26-0004.25	Telegram from Berlin representative to Mitsui Bussan regarding shipment of various equipment.	12/31/37
ND26-0004.26	Telegram from Mitsui Bussan to Berlin requesting that certain drawings be sent.	12/31/37
ND26-0004.27	Letter from Deutsche Bussan to Mitsui Bussan regarding progress of negotiations for getting patent rights for producing synthetic fatty acid.	1/5/38
ND26-0004.28	Letter from administrative head of Miike Factory to main office requesting return of certain documents in order to have complete file for Allied inspection.	9/27/45
ND26-0004.29	Portion of telegram (sender and addressee not given) regarding advisability of investing in new company in Japan to manufacture anhydrous alcohol with the Scholler patent. Telegram of the 29th states Scholler better than Bergins for manufacture of alcohol.	7/25-29/?
ND26-0004.30	Portion of telegram (sender and addressee not given) regarding information on the Fischer process and terms of agent's authorization for prepayment.	no date
ND26-0004.31	Report on the meeting of the German Society for Oil Investigation held in Berlin. Report consists of notes on talks given at the meeting concerning: methods to increase German mineral oil production; outline of German industrial and economical policy in respect to motor fuel production and consumption; difficulties and advantages of the Fischer Hydrogenation Process.	9/28/?

ENCLOSURE (G)

APPENDIX IV
LIST OF MISCELLANEOUS DETAIL DRAWINGS OBTAINED FROM
MIKE SYNTHETIC OIL CO.

ATIS No. 4586

<u>NavTechJap Document No.</u>	<u>Subject</u>
ND26-0015.1	Flow Sheet of Fischer-Tropsch Benzine Synthetic Process.
ND26-0015.2	General Arrangement.
ND26-0015.3	Coke Oven for Synthetic Plant.
ND26-0015.4	Flow Sheet of H ₂ SO ₄ Mother Liquor and Ammonia Plant.
ND26-0015.5	Flow Sheet of Tar Plant.
ND26-0015.6	Flow Sheet of Benzol Absorption and Crude Benzol Distillation Plant.
ND26-0015.7	General Arrangement of By-Product Plant.
ND26-0015.8	General Arrangement of Producer Gas Plant.
ND26-0015.9	Arrangement for Producer Gas Generator of Producer Plant.
ND26-0015.10	Arrangement of Apparatus of Water Gas Plant.
ND26-0015.11	Gas Producer Washer and Ignition Chamber Arrangement.
ND26-0015.12	General Arrangement of Cracking Plant.
ND26-0015.13	800IΦ Revolving Gas Piping from Turbo Blower to Grob Reiniger.
ND26-0015.14	Arrangement of Organic Desulphurizing Apparatus.
ND26-0015.15	General Arrangement of apparatus of Organic De-Sulphurizing Plant.
ND26-0015.16	General Arrangement of Synthesis Plant.
ND26-0015.17	Construction of New Type Contact Furnace of Synthesis Plant.
ND26-0015.18	Flow Sheet of Condensation Plant.
ND26-0015.19	Layout of a Benzine Absorption Plant of the Carbo Union Process (Sheet 1)
ND26-0015.20	(Sheet 2)
ND26-0015.21	(Sheet 3)

ENCLOSURE (G)

ATIS No. 4586

Subject

NavTechJap.
Document No.

ND26-0015.22

(Sheet 4)

ND26-0015.23

Distillation Plant.

ND26-0015.24

Arrangement of Paraffin Purifying Apparatus.

ND26-0015.25

Arrangement of Lubricant Plant.

ND26-0015.26

General Flow Sheet of Extension Plan of Catalyst Plant.

ND26-0015.27

General Arrangement of Apparatus for Extension of Catalyst Plant.

ND26-0015.28

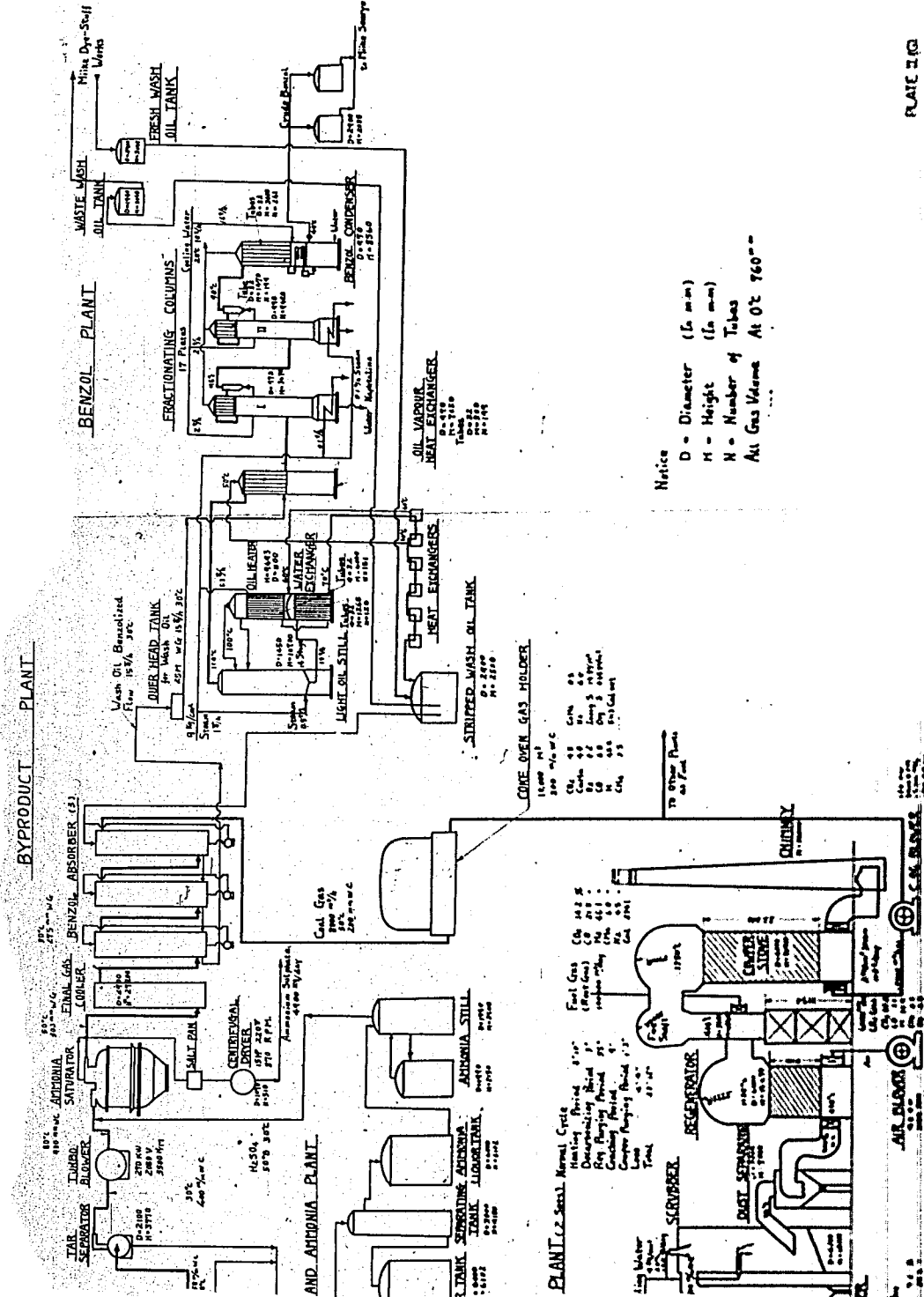
Flow Sheet of Reduction Plant of Catalyser.

ND26-0015.29

Machine Arrangement of the Reduction Plant of Catalyst.

ND26-0015.30

General Arrangement of Luxemass Plant.



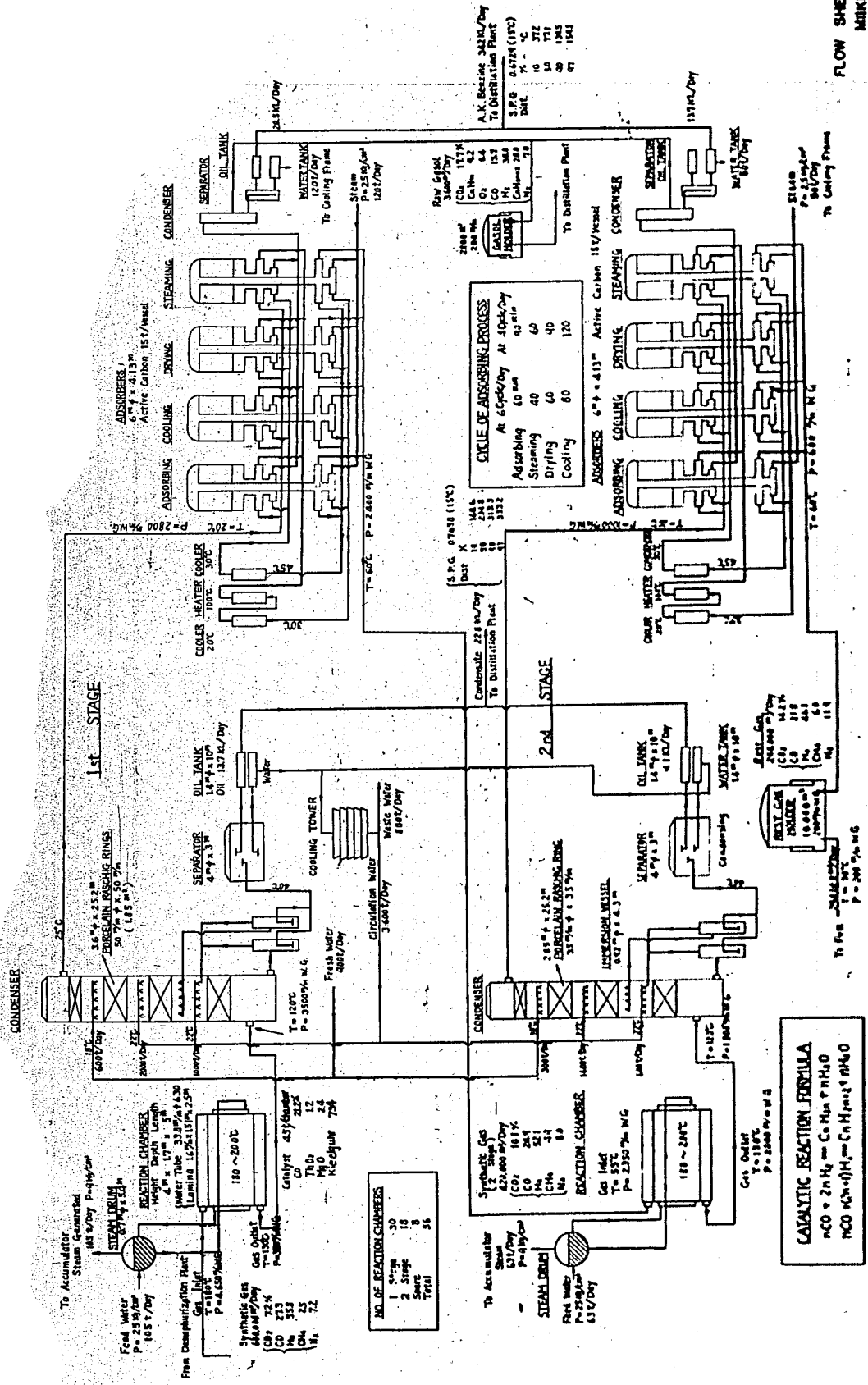
COKE OVEN GAS HOLDER

16,000 cu ft	CO	18.0
100 cu ft	H ₂	1.0
100 cu ft	CH ₄	1.0
100 cu ft	C ₂ H ₆	1.0
100 cu ft	C ₂ H ₄	1.0
100 cu ft	C ₂ H ₂	1.0
100 cu ft	N ₂	1.0
100 cu ft	O ₂	1.0
100 cu ft	Ar	1.0
100 cu ft	H ₂ O	1.0
100 cu ft	SO ₂	1.0
100 cu ft	H ₂ S	1.0
100 cu ft	HCN	1.0
100 cu ft	Other	1.0

PLANT (L.P. STAGE)

Normal	CO	18.0
Normal	H ₂	1.0
Normal	CH ₄	1.0
Normal	C ₂ H ₆	1.0
Normal	C ₂ H ₄	1.0
Normal	C ₂ H ₂	1.0
Normal	N ₂	1.0
Normal	O ₂	1.0
Normal	Ar	1.0
Normal	H ₂ O	1.0
Normal	SO ₂	1.0
Normal	H ₂ S	1.0
Normal	HCN	1.0
Normal	Other	1.0

Notice
 D = Diameter (L. in.)
 H = Height (L. in.)
 N = Number of Tubes
 All Gas Volume At 0° 760 mm



ADSORBERS!
6" x 4.13"
Active Carbon 157/week

CYCLE OF ADSORBING PROCESS
At 6°C/Day At 10°C/Day

Adsorbing	40	60
Steaming	40	40
Drying	60	60
Cooling	60	120

S.P.G. 0.7538 (15°C)
Dist. 18 14.4
19 13.8
20 13.2
21 12.6

CONDENSATE 22.8 cu/Day
To Distribution Plant

CONDENSER
T=120°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

NO. OF REACTION CHAMBERS

1 Stage	30
2 Stage	18
Start	6
Total	54

CATALYTIC REACTION FERROX
NiCO + 2n H₂ = C_nH_{2n} + n H₂O
NiCO + 2n H₂ = C_nH_{2n+2} + n H₂O

Raw Feed
3460 cu/Day
CO 11.71%
C₂H₆ 4.2
O₂ 1.4
CO₂ 3.8
CH₄ 3.8
N₂ 1.8

A.K. Bedding 34210/Day
To Distribution Plant
S.P.G. 0.6724 (15°C)
Dist. 10 37.2
15 37.1
20 14.5
25 14.1

Raw Feed
2100 cu/Day
CO 11.71%
C₂H₆ 4.2
O₂ 1.4
CO₂ 3.8
CH₄ 3.8
N₂ 1.8

CONDENSATE 22.8 cu/Day
To Distribution Plant

CONDENSER
T=120°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

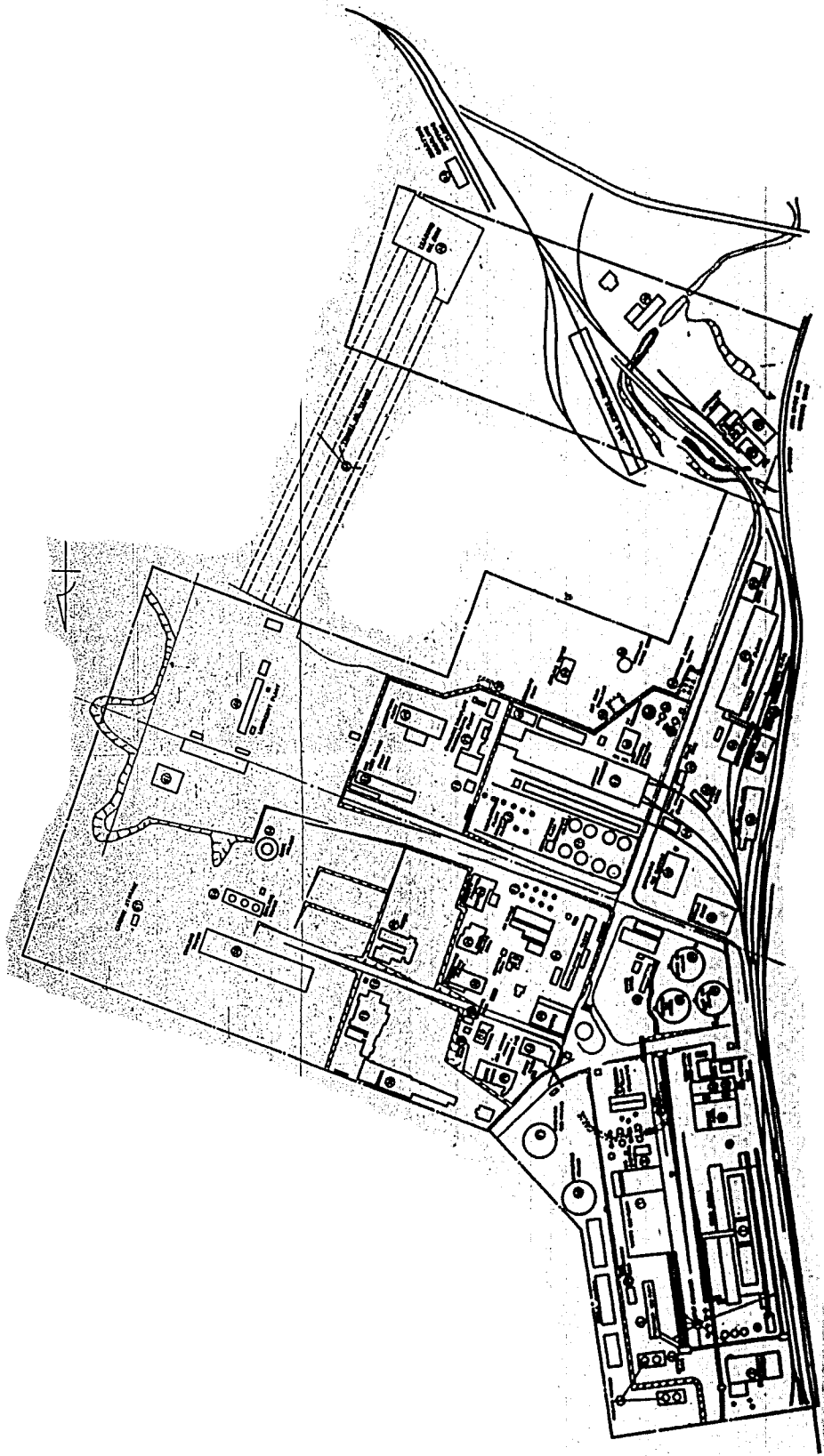
CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.

CONDENSER
T=110°C
P=2350% M.G.



U.S. NAVAL TECHNICAL ASSISTANCE TO JAPAN | RESTRICTED
PLANT LAYOUT MAP
MINE SYNTHESIS CO. CO.
5233A1948 | PLATE 130 | 1-34497