ENCLOSURE (B) 16

HYDROCRACKING OHA OIL IN THE SEMICOMMERCIAL HYDROGENATION PILOT PLANT

by

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Part VI

Research Period: 1941-1942

SUMMARY

A study was made of the hydrocracking of Oha gas oil in a semicommercial pilot plant at OFUNA. Special attention was paid to the durability of the MoO_3 catalyst and the control of reaction temperature. It was found that this process was satisfactory for large scale application.

I. INTRODUCTION

A. History of Project

Up to this time many studies had been made in autoclaves and small scale pilot plants, investigating variables such as raw oil, type, reaction pressure, temperature, time, catalyst, purity of fresh H_2 and construction of reaction chamber. This investigation was made to study the process in a large semicommercial scale plant, paying special attention to the distribution of heat in reaction chamber and the durability of the MoO_3 : Ni_2O_3 : clay catalyst.

B. Key Research Personnel Working on Project

Chem. Eng. Lt. Comdr.	K. MITSUI
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II. DETAILED DESCRIPTION

A. Catalyst

The catalyst employed in these experiments was the same as that which gave most satisfactory results in small scale pilot plant tests. It was composed of MoO_3, Ni_2O_3 and acid clay, mixed in the weight ratio of 3:1:3 and dried at 110°C. Physical properties are as follows.

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Properties of Catalyst

Diameter (mm)	6.2
Length (mm)	5.2
Density	2.06
Packed Density (kg/l)	1.34
Free Space (%)	34.9
Porosity (%)	19.3

B. Charge Stocks

The properties of the Oha gas oil used as charge stock are given below.

Properties of Oha Gas Oil

Density ($20^{\circ}/4^{\circ}C$)	0.833
Distillation	
Initial drop	160.5°C
10%	177°C
20%	183°C
30%	192°C
40%	201°C
50%	210°C
60%	221°C
70%	233°C
80%	244°C
90%	268°C
Dry point	315°C
Composition	
Unsaturates	1.0%
Aromatics	24.6%
Naphthenes	11.2%
Paraffins	62.7%
Aniline point	43.8°C

C. Hydrogen

Fresh hydrogen was prepared by electrolysis of water and purity was 99.5%.

D. Apparatus and Procedure

The semicommercial hydrogenation pilot plant was used, (Plate I(B)16) and the conditions of operation had been determined by the small scale pilot plant experiments on hydrocracking of Oha gas oil. The reaction chamber used was 200mm I.D. and 4500mm high and 6 U type heat exchanged pipes (15mm I.D. and 19mm O.D.) were inserted. The volume of catalyst was 160 liters and surface of heat exchanger was $20.8m^2$ per $1m^3$ catalyst for runs 1 to 37 and 110 liters and $24.4m^2/m^3$ resp., for runs 38 to 47.

Raw gas oil was forced into the preheater by a hydraulic feed pump. Fresh hydrogen from the gas-holder was metered and compressed by a five-stage compressor to about 200 kg/cm^2. It was mixed with the raw gas oil and passed over the outside of the hot hydrocracking oil coil in the preheater, and then entered the reaction chamber.

From the reaction chamber the mixture of hydrogenated products and gas passed through the preheater, a cooling coil, and thence to the high pressure separator. Gas and liquid products were separated under full pressure, the liquid oil being withdrawn to the low pressure separator

(about 30 kg/cm^2) from which it passed to storage. The gas from the high pressure separator was recycled by a booster pump. This gas was about 85% hydrogen purity and it was not necessary to wash to avoid H_2S corrosion difficulties in the booster pump. Light oils contained in the low pressure release gases were removed by absorption on active charcoal.

Throughout these experiments the following conditions were maintained as closely as possible:

1. Temperature in the reaction chamber: 350°C, 400°C, and 450°C.
2. Pressure in the plant: 200 kg/cm^2
3. Space velocity: 0.5~2.0

The test was continued for 2040 hours and 47 runs were made. During these runs a special U-type heat exchange system was used to maintain uniform reaction temperature. Details of this system are given in Plate II(B)16. The relation between aviation gasoline yield and reaction temperature is given by Figure 8(B)16.

III. CONCLUSIONS

A. The average oil yield for all runs was 109.6% by volume.

B. It was concluded that the catalyst MoO_3 : Ni_2O_3 : acid clay (3:1:3) was satisfactory for use in large scale hydrocracking plants at the Second and Third Naval Fuel Depots. It was believed that 1.5 space velocity; 410°C and 200 kg/cm^2 were optimum plant operating conditions. A catalyst life up to four months was expected under favorable conditions.

C. Oha gas oil was a satisfactory charge stock for production of aviation gasoline by hydrocracking, giving a good yield of high octane product.

D. The reactor heat exchange system worked satisfactorily and a reaction temperature variation of only 1°C could be maintained.

ENCLOSURE (B)16

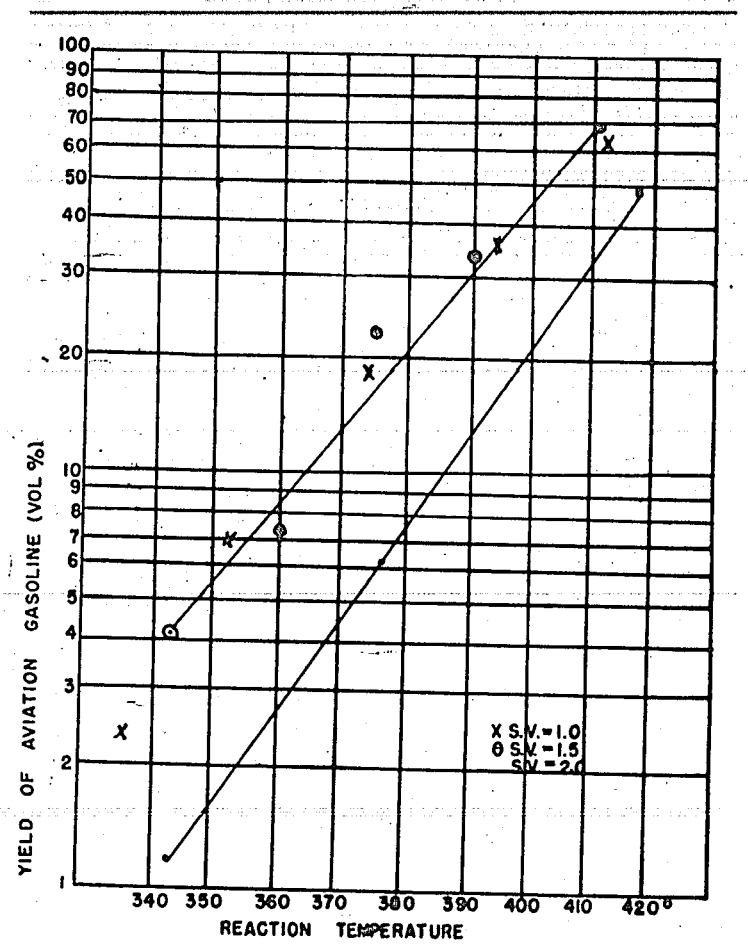
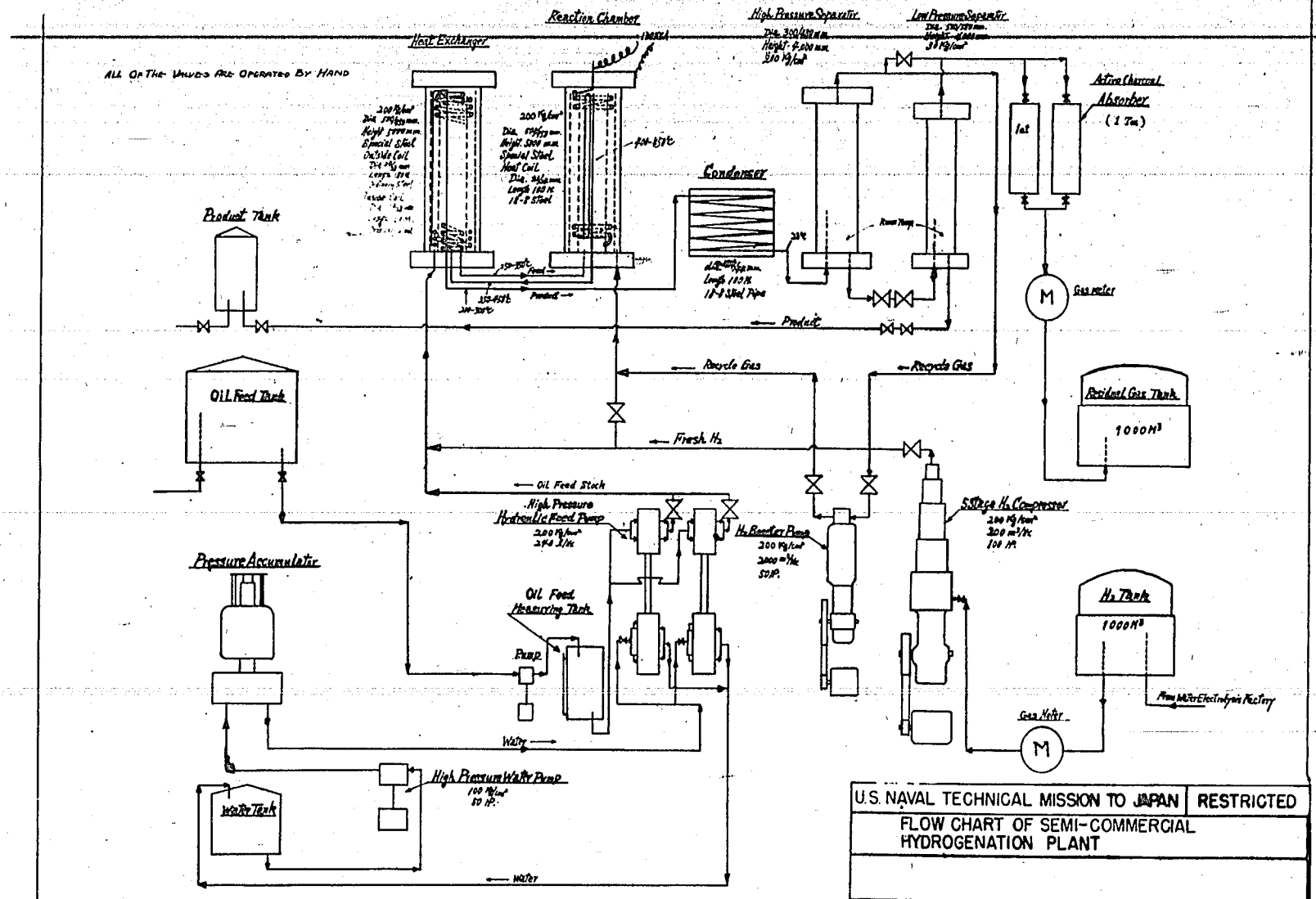
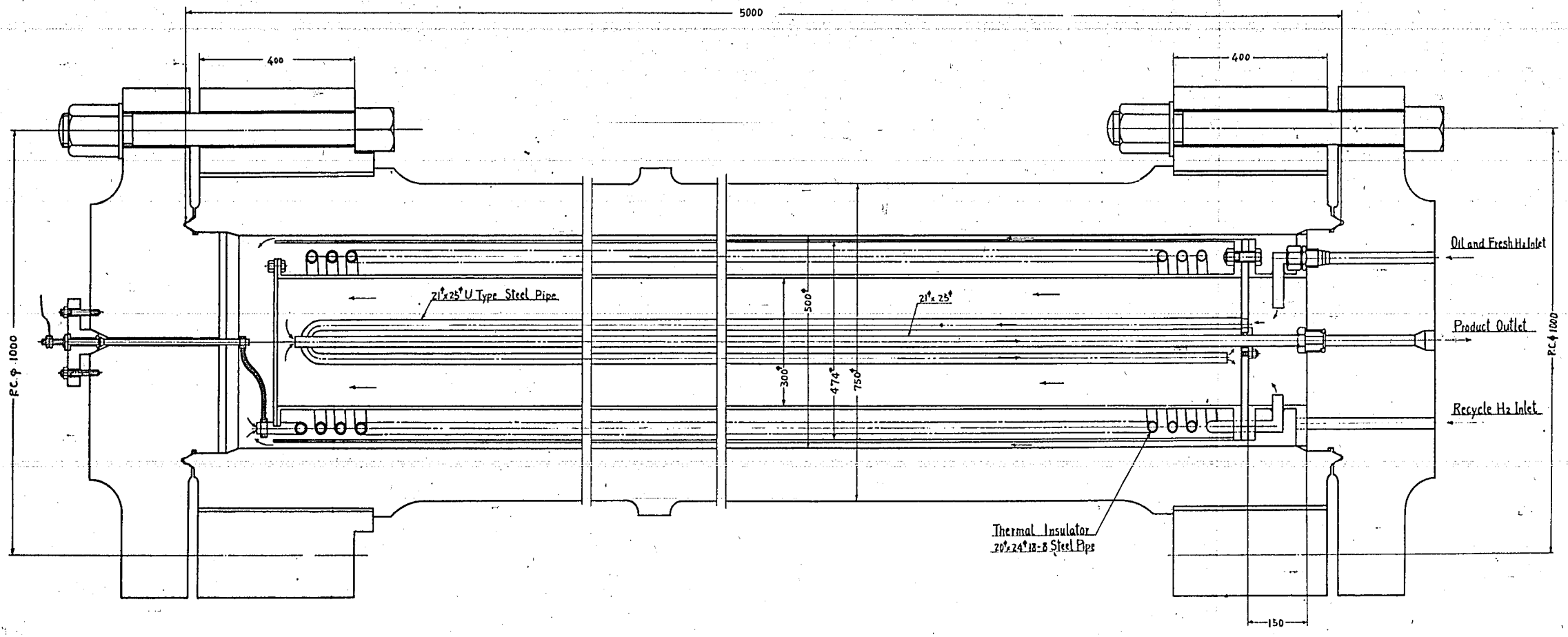


Figure 8(B)16

ELD OF AVIATION GASOLINE



U.S. NAVAL TECHNICAL MISSION TO JAPAN		RESTRICTED
FLOW CHART OF SEMI-COMMERCIAL HYDROGENATION PLANT		
	PLATE I (B) 16	X-38(N)-2



U.S. NAVAL TECHNICAL MISSION TO JAPAN	RESTRICTED
THE CONSTRUCTION OF REACTION CHAMBER	
27 DEC. 45	PLATE II(B)16 X-38(N)-2