ENCLOSURE (B) 8

STUDIES ON THE MANUFACTURE OF AVIATION GASOLINE BY HIGH PRESSURE HYDROCRACKING OF PINE RESIN

by

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Research Period: May - Aug. 1945

Prepared for and Reviewed with Authors by
the U. S. Naval Technical Mission to Japan

December 1945

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LIST OF TABLES AND ILLUSTRATIONS

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SUMMARY

The object of this study was to find the optimum operating conditions for the manufacture of aviation gasoline, by high pressure hydro-cracking of pine resin. The semi-solid fraction of pine resin distilling above 300°C was hydro-cracked in an autoclave using Molybdenum Sulphide (MoS_3) catalyst and a 70% yield of cracked oil was obtained containing 40% of aviation gasoline with an octane number of 93-95 (0.15% lead).

I. INTRODUCTION

A. History of Project

Very recently, in response to the urgent demands of the war, pine resin was investigated as a source of aviation gasoline. No previous data were available on this subject. The key point of this research was to select proper reaction conditions for hydro-cracking the very stable pine resin, with high content of acidic matter (phenolic acid and abietic acid), so that high octane aviation gasoline could be obtained.

B. Key Research Personnel Working on Project

Chem. Eng. Lt. S. INABA

II. DETAILED DESCRIPTION

A rotating autoclave of 2-5 liters capacity was used for these tests. Continuous pilot plant experiments were not made.

Properties of the raw pine resin are given below. The fraction boiling above 300°C. (about 50% of the raw pine resin), was used in these experiments. This fraction at room temperature was a hard solid of brownish color. Upon heating to 80-90°C, it became a viscous liquid.

Specific Gravity, d_4^{15}	1.023
Initial Boiling point (°C)	95
10%	155
20%	169
30%	228
40%	309
50%	318
60%	333
70%	346
80%	346
F.B.P.	354
Acid Value	122
Saponification Value	135

Physical and chemical properties of products are tabulated in Tables I(B)8 and II(B)8.

III. CONCLUSIONS

As the result of the autoclave tests, it was found that by high pressure hydrocracking of pine resin under the conditions of 200 kg/cm^2 hydrogen pressure, 430-450°C temperature, 2 hours reaction period, and using Molybdenum.

Sulphide catalyst, a good quality gasoline with 93-94 octane number (0.15% lead) could be produced in yield of 28%. This work was cut short due to the end of the war. It was planned to investigate this process on pilot plant scale, particularly to develop methods for handling the high viscosity melted pine resin in continuous operation. Further work to develop stronger and more active catalysts also was planned.

Table I(B)8
CONDITIONS OF REACTION AND PROPERTIES OF PRODUCTS
(Autoclave Test)

	Exp. No.	
	1	2
Catalyst	MoS_3	MoS_3
Reaction Conditions		
Reaction Temperature, °C	430	450
First Reaction Pressure, kg/cm^2	100	95
Final Reaction Pressure, kg/cm^2	65	63
Highest Reaction Pressure, kg/cm^2	220	225
Reaction Time, hours	2	2
Products		
Absorbed Hydrogen wt. % of Raw Oil	4.3	4.6
Yield of Cracked Oil wt. % of Raw Oil	68	70
Water wt. % of Raw Oil	12.5	13.5
Acidic Matter vol. % in Cracked Oil	1.0	0.5
Specific Gravity of Cracked Oil	0.7869	0.7800
I. B. P. of Cracked Oil °C	39	38
10% Boiling Point of Cracked Oil °C	72	68
20% Boiling Point of Cracked Oil °C	94	89
30% Boiling Point of Cracked Oil °C	105	104
40% Boiling Point of Cracked Oil °C	118	116
50% Boiling Point of Cracked Oil °C	137	133
60% Boiling Point of Cracked Oil °C	153	150
70% Boiling Point of Cracked Oil °C	186	182
80% Boiling Point of Cracked Oil °C	199	192
90% Boiling Point of Cracked Oil °C	210	203
97% Boiling Point of Cracked Oil °C	233	220
Final Boiling Point of Cracked Oil °C	263	252
Total Distillate (vol %)	95	98
Residue (vol %)	2	1
Loss (vol %)	2	1
Residual Gas Composition (vol %)		
CO_2	0.2	0.3
O_2	0.3	0.4
C_nH_{2n}	0.9	0.5
CO	0.4	0.3
C_nH_{2n+2}	16.5	17.5
H_2	78.2	76.2
N_2	3.5	4.8
n. (Carbon number)	0.9	0.6
Yield of Aviation Gasoline from Cracked Oil vol %	37	40

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Table II(B)8
PROPERTIES OF AVIATION GASOLINE
(Autoclave Test)

	Exp. No.	
	1	2
Reaction Temperature, °C	430	450
Specific Gravity D_4^{15}	0.7778	0.7614
Acidic Substance in Aviation Gasoline, vol. %	0.2	0
Fractional Distillation, °C		
Initial Boiling Point	42	33.4
10% Boiling Point	84	63.8
20% Boiling Point	94	80.2
30% Boiling Point	101	97.4
40% Boiling Point	108	105.6
50% Boiling Point	110.4	108.6
60% Boiling Point	120.5	118.5
70% Boiling Point	132	130.8
80% Boiling Point	147	147
90% Boiling Point	160	162
97% Boiling Point	170.4	168.5
Final Boiling Point	172.5	171.5
Total Distillate vol. %	95	98
Residue	3	1
Loss	2	1
Composition vol. %		
Unsaturated Hydrocarbon	3.0	0
Aromatic Hydrocarbon	21.3	24
Naphthenic Hydrocarbon	24.3	30.4
Paraffinic Hydrocarbon	51.4	45.6
Aniline Point	60.7	1.2
Octane Number		
Clear	78.0	79.0
With 0.15% of Lead	93.6	94.2