ENCLOSURE (B) 22

ENGINE TESTS OF AROMATIC HYDROCARBONS FOR AVIATION FUEL

by

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LIST OF TABLES AND ILLUSTRATIONS

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SUMMARY

To examine the performance of aromatic hydrocarbons as aviation fuel and to utilize the new source of fuel, aromatic hydrocarbons such as benzene (C_6H_6), toluene, xylene, solvent naphtha, Benzex (from SO_2 extraction of East Indie topped gasoline), and dry distilled oil of caoutchouc were subjected to the engine tests. It was necessary that the aviation fuel contain less than 20% of benzene, as the benzene readily caused detonation. Toluene had the best performance as an aviation fuel and equalled or surpassed iso-Octane. Xylene and higher aromatics also had good antiknock properties, but it was necessary to improve the fuel supply apparatus, as these aromatics had poor volatility. It should be possible to obtain a good antiknock aviation gasoline by blending over 70% of aromatics, excepting benzene, with natural gasoline.

I. INTRODUCTION

A. History of project

Research was carried on from December 1942 to March 1944.

B. Key research personnel working on project: Eng. Lt. Comdr. Tatsuo NAKAYAMA.

II. DETAILED DESCRIPTION

A. Description of test apparatus and test procedure

It was the same as that of Enc.(B)11 of Article 3 of this series, "Engine Test of Alcohol as Aviation Fuel."

B. Experimental results

The properties of the samples and their allowable maximum engine performances are given in Table I(B)22. The occurrence of detonation was detected by cylinder temperature and change in exhaust gas color. For each set of operating conditions, the engine was operated continuously for a period of three minutes.

Samples No. three, four, five (containing benzene) had higher octane numbers than samples No. six, seven, eight, nine, and ten (benzex contains higher aromatics), but the allowable maximum performances of the former are lower than those of the latter. Samples No. one and twelve (toluene and xylene) had much higher antiknock properties and allowable maximum performances than those of benzene.

III. CONCLUSIONS

Benzene is not satisfactory, even if blended with natural gasoline. The blends have higher octane numbers, but their engine performances are not good.

Toluene showed the best performances and its volatility was good enough to use in carburetor engines. Xylene and higher aromatics and their mixtures also have good antiknock properties, but their volatilities are very low, and hence in order to use them, it was necessary to attach an apparatus to the fuel supply or to mix these heavy aromatics with natural light gasoline.

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The aromatics actually used in aviation gasoline consisted of 20-30% of benzex (Sample No. 6) in natural gasoline manufactured in East Borneo (B.P.M. Oil Product Factory).

Table I(B)22
PROPERTIES OF SAMPLES AND ALLOWABLE MAXIMUM ENGINE PERFORMANCE

Sample No.	Name	Composition (by volume)	Octane Number	Test Engine	RPM	Max. HP	Max. Boost (mmHg)	Reference Fuel Data		
								Fuel	Max. HP	Max. Boost
1	Toluene	Industrial pure toluene 100%	More than 100	"Kinsei" 4 type mono-cylinder	2000	80	600	iso-Octane 0.2% leaded	70	450
2	Mixture of toluene	Toluene 80% gasoline 20%	90	"Sakae" 4 type 14-cylinders	2700	1200	450	A 100 G	1100	350
3	Benzene	Pure benzene 100%		"Kinsei" 4 type mono-cylinder	2500	60	150	A 91 G	65	200
4	Mixture of benzene-1	Benzene 10% A 92 G 90%	93	"Kinsei" 4 type mono-cylinder	2500	60	150	A 91 G	65	200
5	Mixture of benzene-2	Benzene 20% A 92 G 80%	93	"Kinsei" 4 type mono-cylinder	2500	60	150	A 91 G	65	200
6	Benzex	Benzex 100%	90	"Kinsei" 4 type mono-cylinder	2400	85	350	A 91 G A 95 G	65 85	200 450
7	Mixture of Benzex-1	Benzex 90% gasoline 10%	85	"Kinsei" 4 type mono-cylinder	2400	85	350	A 91 G A 95 G	65 85	200 450
8	Mixture of Benzex-2	Benzex 80% gasoline 20%	85	"Kinsei" 4 type mono-cylinder	2400	80	300	A 91 G A 95 G	65 85	200 450
9	Mixture of Benzex-3	Benzex 60% gasoline 40%	80	"Kinsei" 4 type mono-cylinder	2400	70	250	A 91 G A 95 G	65 85	200 450
10	Mixture of Benzex-4	Benzex 50% gasoline 50%	80	"Kinsei" 4 type mono-cylinder	2400	65	200	A 91 G A 95 G	65 85	200 450
11	Solvent Naphtha	Solvent naphtha 100%	98	"Kinsei" 4 type mono-cylinder	2500	85	450	A 91 G	75	300
12	Xylene	Industrial pure xylene 100%	More than 100	"Kinsei" 4 type mono-cylinder	2000	80	600	iso-Octane 0.2% leaded	70	450
13	Dry Distillate of caoutchouc	Aromatics 75% leaded 0.15%	95	"Kinsei" 4 type mono-cylinder	2200	75	500	A 95 G	75	500

A 100 G, A 95 G and etc. are aviation gasolines whose octane number are 100, 95 and etc.