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AVIATION FUEL

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3 Claims. (Cl. 44-80)

The present invention relates to an aviation fuel.

The average aviation fuel is composed of at least three different hydrocarbon ingredients which normally include an alkylate, an isopentane, and a basic gasoline which may be either straight-run, natural or catalytic gasoline. Tetra-ethyl lead is conventionally added to improve the octane number. There are no set proportions in which each of these ingredients are used and in any given instance the proportion of the ingredients is so adjusted so that the resultant blend will meet the various specifications for aviation gasoline at the lowest possible cost.

The alkylate is the ingredient primarily responsible for the high octane number of the blend but is relatively expensive. Any of the different alkylates can be used and the chemical composition of several useful alkylates is given on pages 472 to 474 of Sachanen, Conversion of Petroleum, Reinhold Publishing Corporation (1948).

The basic gasolines, which may be either straight-run, natural, or catalytically cracked gasolines, are desirable constituents of aviation gasoline because of their low cost but, in the case of catalytically cracked gasoline, it has been found that the gasoline requires a special treatment before it can be used in any significant quantity in an aviation fuel. This is because catalytically cracked gasoline is a notorious gum former and, when used in a significant quantity, produces a blend which does not meet gum specifications. The treatments devised to improve the gum forming tendency of catalytically cracked gasoline are quite cumbersome and fairly costly. They include, for example, sulfuric acid treatment, mild hydrogenation of the catalytic gasoline, and the re cracking of the catalytic gasoline in a catalytic reactor. Because of the disadvantages inherent in any and all of these procedures it is apparent that the art would welcome a simpler method of treating catalytically cracked gasoline in order to render it suitable for inclusion in an aviation fuel in a significant quantity.

One of the basic gasolines which has received prior consideration as a component of aviation fuel is a catalytically cracked distillate boiling in the range of approximately 100 to 430° F. which is obtained from the catalytic cracking of crude petroleum. This distillate can be produced at relatively low cost and is available in large quantities. It is believed that the use of the distillate as a component in aviation gasoline was first considered during the second World War when the heavy demand for aviation fuel necessitated the inclusion of large amounts of catalytic distillate and at one time during the war, it is reported that the total amount of aviation gasoline comprised as much as one-third catalytic distillate.

In the first attempts to employ the catalytic distillate as an ingredient of aviation gasoline it was found as heretofore indicated that the distillate possessed such high gum forming tendencies that it could not be used without a further treatment because aviation gasoline specifications impose much more restrictive stability requirements than do motor gasoline specifications. It was further found that

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not even the most effective oxidation and gum inhibitors were capable of limiting the gum formation in the average catalytically cracked distillate to a sufficient extent to permit the use of the distillate in aviation fuel in any significant quantity. Therefore, it was necessary to subject the distillate to one of the aforementioned treatments. The subjecting of the distillate to any one of the treatments was sufficient to improve the stability sufficiently to permit the inclusion of up to as much as 33% by volume of the catalytic distillate in aviation fuel.

In accordance with the present invention, I have found surprisingly that if the untreated catalytic distillate is subjected to a fractionation to remove the lighter and heavier ends, the resulting heart-cut (approximate boiling point range, 150 to 338° F.) has sufficient stability that it can be incorporated in aviation fuel in a relatively large quantity while still producing an aviation fuel which meets gum specifications. Accordingly, the composition of the present invention comprises an aviation gasoline containing a significant quantity up to about 15% by volume of the total fuel of a heart-cut of a catalytically cracked distillate, said heart-cut having a boiling range of about 150 to 338° F.

It can readily be seen that the invention provides a simplified solution to an existing problem since a simple fractional distillation of the catalytic distillate has inherent advantages both in processing cost and ease of operation over the previously used treatments used to reduce the gum forming tendencies of the catalytic distillate.

The catalytically cracked distillate referred to is one of the products of the catalytic cracking process. It is a well known material made by a well known process. A typical catalytic distillate has the following properties:

ASTM distillation, boiling range:

IBP	-----	° F.	90-100
10%	-----	° F.	120-135
50%	-----	° F.	235-250
90%	-----	° F.	390-405
EP	-----	° F.	420-435
Octane No. F-1 clear	-----		88-92
Bromine No.	-----		35-60
ASTM gum (mgm./100 ml.)	-----		3-5
Gravity (° API)	-----		54-60

A typical hydrocarbon analysis of the catalytic distillate is as follows:

Fraction:	Volume percent
Aromatics	15-30
Olefins	20-35
Saturates	35-55

The heart-cut of the catalytic distillate which is used as an ingredient of aviation fuel in accordance with the present invention is derived from the catalytic distillate by simple fractionation to isolate a material boiling in the approximate range of 150 to 338° F.

The aviation fuel of the present invention preferably comprises from about 68% to about 73% of an alkylate, from about 4 to about 9% of isopentane, from about 7 to about 12% of a straight-run gasoline, and from about 5 to about 15% of the aforementioned heart-cut.

In order to illustrate the invention, the following examples are presented. In the examples, the performance rating data were obtained according to ASTM tests D614-49T and D909-49T.

Example 1

There was blended together 82 barrels of a light alkylate having a boiling range of 95 to 325° F. which had been prepared by the alkylation of isobutane with butylene, using a sulfuric acid catalyst, 5 barrels of isopentane, and

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13 barrels of a straight-run gasoline having a boiling range of 120 to 290° F. The blend was found to have a performance rating of 106/130 by knock test methods. In order to dilute the blend to a 100/130 rating, there was added 17 barrels of a heart-cut of a catalytic distillate having a boiling range of about 100 to 435° F., the heart-cut having a boiling range of about 150 to 338° F.

In the ASTM gum test, the blend left a residue of only 2 mgm. per hundred ml. which is sufficient to pass the gum specifications for aviation fuel.

Example 1A

When 17 barrels of the untreated catalytic distillate was substituted for the 17 barrels of heart-cut used in Example 1, the resultant blend had a very poor gum rating and in the ASTM gum test left a residue of about 15 mgm. per hundred ml. which exceeds gum specifications for aviation gasoline.

The two examples taken in comparison show that the untreated catalytic distillate cannot be incorporated in aviation fuel in any quantity without resulting in a blend that fails to meet gum specifications. However, the heart-cut can be used in a significant quantity and when the octane rating of the blend permits, up to about 15% by volume of the heart-cut can be utilized based on the weight of gasoline.

In theory, the success of the invention can be explained in retrospect by the postulation that the diolefins of the catalytic distillate are predominantly in the lighter and heavier ends. Since the diolefins are known to be gum formers, their removal by fractionation renders the resulting heart-cut relatively free from gum-forming components. Hence, the heart-cut can be used in relatively large amounts in aviation fuel.

I claim:

1. An aviation fuel containing a significant amount up to about 15% by volume of the total fuel of a heart-cut boiling in the range of 150° F. to 380° F., fractionated from a catalytically cracked distillate having the following inspection:

IBP	° F.	90-100
10% over	° F.	120-135
50% over	° F.	235-250
90% over	° F.	390-405
EP	° F.	420-435
Octane No. F-1 clear		88-92
Bromine No.		35-60
ASTM gum (mgm./100 ml.)		3-5
Gravity (° API)		54-60
Aromatics	percent	15-30
Olefins	do	20-35
Saturates	do	35-55

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2. An aviation fuel containing from about 68% to about 73% of alkylate, from about 4% to about 9% isopentane, from about 7% to about 12% of a straight-run gasoline, and from about 5% to about 15% of the heart-cut boiling in the range of 150° F. to 380° F., fractionated from a catalytically cracked distillate having the following inspection:

IBP	° F.	90-100
10% over	° F.	120-135
50% over	° F.	235-250
90% over	° F.	390-405
EP	° F.	420-435
Octane No. F-1 clear		88-92
Bromine No.		35-60
ASTM gum (mgm./100 ml.)		3-5
Gravity (° API)		54-60
Aromatics	percent	15-30
Olefins	do	20-35
Saturates	do	35-55

3. An aviation fuel containing 82 parts of a light alkylate boiling in the range of 95° F. to 350° F. obtained by the alkylation of isobutane with butylenes, 5 parts of isopentane, 13 parts of straight-run gasoline boiling in the range of 120° F. to 290° F. and 17 parts of a heart-cut boiling in the range of 150° F. to 380° F., fractionated from a catalytically cracked distillate having the following inspection:

IBP	° F.	90-100
10% over	° F.	120-135
50% over	° F.	235-250
90% over	° F.	390-405
EP	° F.	420-435
Octane No. F-1 clear		88-92
Bromine No.		35-60
ASTM gum (mgm./100 ml.)		3-5
Gravity (° API)		54-60
Aromatics	percent	15-30
Olefins	do	20-35
Saturates	do	35-55

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,852,356

September 16, 1958

Fred Lee Lichtenfels

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 12, after "90%" insert -- over --.

Signed and sealed this 25th day of November 1958.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents