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CHEMICAL PRODUCT AND PROCESS OF PRODUCING SAME

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The present invention relates to improvements in the manufacture of moter fuel.

It is an object of this invention to produce a motor fuel having an improved octane rating as determined in actual road tests as distinguished from laboratory determinations such as the A. S. T. M. octane rating test.

It is a further object of this invention to produce a motor fuel having an improved octane rating as determined by an actual road test in automobiles which involves reforming the intermediate fractions of cracked stocks boiling within the gasoline range, preferably catalytically and in the presence of hydrogen, and thereafter blending the proper light, the reformed intermediate, and the proper heavy fractions to produce a gasoline of improved octane rating.

It is a further object of this invention to reform a virgin naphtha fraction boiling below about 325° F. in order to improve its octane rating and to blend this naphtha fraction with other relatively heavier hydrocarbons to produce a gasoline having an end point of about 405° F. or thereabouts.

At the present time, many motor fuels, particularly those containing addition agents, such as tetraethyl lead, are deficient in anti-knock quality in certain fractions, approximately those distilling between 192° F. and 325° F. It has been found that the road performance of a motor fuel is more directly related to the first 80% distilling off the fuel than to octane rating of the fuel as a whole as determined by the standard A. S. T. M. procedure. In a gasoline base, therefore, having a distillation end point of about 405° F. with about 40% distilling off at 212° F., the fraction boiling between about 192° F. and 325° F., in the case of a cracked gasoline or the entire product distilling below about 325° F., is the fraction whose A. S. T. M. octane number is most directly related to the road octane number of the entire fuel. The following tests have been carried out with two fuels in order to demonstrate this fact:

	Fuel A	Fuel B
A. S. T. M. rating	71.7	71.7
Road rating—Average 4 automobiles made by 4 different manufacturers	78.3	73.1
Difference	6.6	1.4

	Boiling range, °F.	A. S. T. M. Octane	Boiling range, °F.	A. S. T. M. octane
Rating of individual fractions—				
0–35%	99–216	76	99–216	76
35–55%	208–257	79	209–266	60
55–70%	248–304	91	255–302	49
70–90%	302–344	60	304–356	80
90–100%	354–412	25	343–409	90

It will be observed that the octane rating of the fractions boiling above about 325° F. apparently have little bearing on the road performance, fuel B (having the higher octane rating in this range) giving the poorer road performance, whereas fuel A (having the lower octane rating in this range) gives the better road performance. The octane rating, therefore, either in the mid-boiling fraction or in the total light fraction (up to 325° F.) is directly related to the road performance.

In carrying out this invention, therefore, high octane fractions are concentrated in the mid-boiling range of a motor fuel, such as gasoline in the case where the gasoline contains cracked products, or the octane rating of the whole portion of the motor fuel boiling up to 325° F. is elevated in the case where the fuel contains virgin naphtha in this fraction.

It is well known that normal thermal cracking processes when used for producing high octane motor fuel cause an excessive conversion of the higher boiling fractions to normally gaseous products including a considerable quantity of butane, which butane cannot be included in the motor gasoline due to its adverse effect on vapor pressure. It is also known that the product from a thermal cracking process usually has a high octane number in the low boiling range which tapers off to a relatively low octane rating in the higher boiling fractions. It is common practice, therefore, to reform or recrack products boiling within the motor gasoline range in order to raise the octane rating of the higher boiling fractions. This process, however, not only consumes cracking capacity, but leads to a reduction in the yield of motor gasoline due to the formation of normally gaseous fractions and heavy polymers.

In order to avoid the necessity of increasing the octane rating of motor fuel as a whole, as well as to avoid the above-mentioned defects in prior practice, to produce a product which will have a high octane rating as determined by road tests as distinguished from A. S. T. M. laboratory tests, the present invention includes preferably reforming the fraction of the motor fuel boiling below about 325° F. catalytically and in the presence of hydrogen. Since the very low boiling fractions from a cracking operation are produced at a relatively high octane level, the hydrocarbons boiling approximately up to 200° F. and also those boiling from about 325° F. to the end point need not be reformed. Naphthas, however, distilled directly from crude petroleum oil up to distillation temperatures of about 325° F. must be reformed for best results. The 200° F. to 325° F. fraction from some cracking source or the 0 to 325° F. fraction from crude oil are subjected to reforming in the presence of a catalyst, such as alumina admixed with 3 to 35% of Cr_2O_3, MoO_3 or Fe_2O_3 in order to

increase the octane rating to the desired level but with considerably less formation of the permanent gases, such as butane and heavy polymers than would be possible by the usual thermal reforming means.

In order to illustrate the invention more fully, the following specific examples are given with the understanding that the said examples are purely illustrative and do not impose any limitation on the invention.

Example 1

A naphtha cut obtained directly by distillation from an East Texas crude and which had an end point of about 325° F. was subjected to a catalytic reforming operation in the presence of hydrogen and an alumina catalyst containing about 97% Al_2O_3 and 3% Cr_2O_3 at a temperature of about 920° F. and under a pressure of 200 pounds per square inch gauge pressure while feeding the naphtha through the catalyst bed at a rate of ½ volume of cold oil per volume of catalyst per hour, the amount of hydrogen being about 60 molal percent, based on the average molecular weight of the oil.

Example 2

An East Texas crude was topped to remove fractions boiling up to about 410° F. A gas oil cut boiling from 470° F. to 800° F. was subjected to thermal cracking in any known process. The cracked fraction produced by this operation, boiling within the range of 200–325° F. was mixed with an equal quantity of a virgin naphtha boiling up to about 325° F. and the mixture was subjected to a catalytic reforming operation in the presence of hydrogen and a catalyst, such as a mixture of oxides containing 70% alumina and 30% MoO_3 at a temperature of 950° F. and a pressure of 300 pounds per square inch at a feed rate of 1 volume of cold oil per volume of catalyst per hour, the amount of hydrogen present being 50 molar percent of hydrogen based on the average molecular weight of the oil.

In carrying out the present reforming operation, pressures from 50 pounds per square inch to 400 pounds per square inch gauge may be employed while temperatures within the range of from about 925° F. to 1000° F. may be used, and the rate at which the naphtha is fed to the catalyst zone may vary within the range of from 0.5 to 2 volumes of cold oil per volume of catalyst per hour. The range of hydrogen concentration employed in this process may vary from 30 to 85 molal percent hydrogen with respect to the average molecular weight of the oil. Of course, hydrogen need not be employed, but its use is preferred.

While catalytic reforming in the presence of hydrogen gives superior results, it is, of course, possible to reform the intermediate fractions thermally as follows:

Example 3

A naphtha obtained by distillation from a Muskegon crude petroleum boiling up to 325° F. was thermally reformed by heating in a coil to a temperature of 700 to 1000° F. under a gauge pressure of 700 pounds per square inch, at a feed rate of 15 volumes of cold oil per volume of reaction zone per hour.

The intermediate or light and intermediate fractions reformed according to the previous examples are blended with relatively heavier and lighter fractions to produce a motor fuel. For example, the product produced according to Example 1 may be blended with heavier and lighter fractions to give a final product in which 17% to 21% is boiled off by heating the blend to 158° F., 40% boils off at 212° F., 60–67% boils off at 257° F., 80% boils off at 356° F. and the final end point is about 405° F. This motor fuel would normally be for spring or fall use, the winter grades would be more volatile, while the summer would be less volatile.

To recapitulate, the present invention proposes to improve a fuel such as gasoline by reforming the fraction boiling from 0° to 325° F. where this fraction is not a cracked stock but is virgin naphtha, or by reforming the fraction boiling from 200° F. to 325° F. where the gasoline or this fraction thereof is produced in a cracking operation.

It is obvious that many modifications of this invention falling within the spirit of the same will readily occur to those skilled in this art.

I claim:

1. The method of improving the road octane rating of a given body of gasoline which comprises separating from said body fractions boiling between about 192° F. and 325° F., catalytically reforming said fractions by the aid of heat and pressure and then blending said fractions with the untreated fractions of said body.

2. The method of making gasoline of improved road octane number which comprises separately reforming in the presence of a catalyst with the aid of heat and pressure gasoline fractions boiling between about 192° F. and 325° F. and then blending said fractions with fractions not so treated and of different boiling range to form a gasoline of proper volatility and boiling range.

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