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MOTOR FUEL

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This invention relates to improved motor fuels and methods of making same and more particularly to motor fuels adapted to reduce or prevent gum troubles in the motor.

The primary feature of the invention is the preparation of motor fuels, preferably light petroleum hydrocarbons, such as gasoline, containing a small amount of a hydrocarbon fraction boiling within the lubricating oil range and having certain preferred characteristics which will be described hereinafter.

Lubricating oil has been added to gasoline in the past but not according to the principles of the present invention. Heretofore it has been used chiefly for the purpose of upper cylinder lubrication in fairly large percentage, or as a mere carrier for other supposedly more essential materials. Many such additions to the gasoline have presented certain disadvantages which more than outweighed their advantages. For example, increased carbon formation and excessive raising of the final boiling point have been observed in most cases and other harmful effects such as increased gum deposition, reduced mileage, irregular distribution to the cylinders and increased knocking tendencies have been reported by persons who have sought to use various so-called "lubricated fuels" known to the art. Attempts to avoid such troubles have been made by using a viscous white oil (made by acid treating lubricating oil stock). White oils have also been mixed with the fuel for use during the breaking-in period of motor cars and for the operation of outboard motors.

It has now been discovered that these disadvantages of the use of lubricating oil in gasoline motor fuel can be eliminated while at the same time attaining certain desirable features not heretofore known in the art.

Although we do not desire to be limited by any theories as to the operation of the invention, the following discussion will present certain pertinent facts and observations.

We have found that gum troubles in the motor as manifested by sticking of the valves, rings, etc., may be prevented or even cured by adding to the motor fuel a petroleum fraction which may be hereafter termed a gum flux. As to the type of material, we have found that it is preferable to use a gum flux having a kauri butanol value above 15 such as naphthenic type lubricating oils containing a substantial percentage of cyclic hydrocarbons including aromatic and hydroaromatic compounds of desirable solvent power. For example, Coastal oils and others originating in the West Texas fields are satisfactory as well as oils derived from the Venezuelan and Peruvian fields. Also, oils obtained by hydrogenation of lubricating oil stocks may be used. In fact, any oil having a sufficiently high fluxing action for the gum comes within the scope of the invention.

Tests made on a number of lubricating oils of various types and origin show that oils of the naphthenic type are far superior in solvent power (as measured by the kauri butanol tests) to oils of a more highly paraffinic nature. The kauri butanol solvency test referred to is described by Circular 378 of February 1931 by the American Paint & Varnish Manufacturers' Association, and the results of such a test give, in comparison to benzol as 100, the amount of liquid being tested which can be mixed with a standard butanol solution of kauri gum without causing turbidity due to insolubility. Table 1 gives the kauri butanol value (K. B.) of two naphthenic oils compared with that of a typical Pennsylvania oil, (tests carried out at 75–80° F.).

Table

Type	Vis. at 210° F.	Solvent power (K. B.)
Naphthenic (A	50	24.4
Naphthenic (B	52	21.4
Paraffinic (Penna.)	50	1.1

The higher the solvent power in general, the better will be the performance of the engine or the less trouble there will be due to sticking of valves, rings, etc. A solvent power above 15.0 shows considerable effect in reducing and preventing gum troubles but we prefer to use an oil having a solvent power above 20.0. Generally the solvent power bears a certain relation to the viscosity of the oil, the higher the viscosity the lower is the solvent power, although this relationship applies more particularly to oils of a paraffinic nature and does not apply as well to those of a naphthenic nature which have a relatively high solvent power even at high viscosities.

several oils of different gum-fluxing characteristics may be blended in order to obtain the desired resultant properties in the blend.

We have found that it is preferable to use an amount of gum flux only sufficient to accomplish the desired gum-fluxing action and this should generally be between 0.5 and 1.5% and preferably about 0.75% although in some cases, depending upon the type of flux and motor fuel being used, as low as 0.1% or even as much as 2% or more may be used. For example, more material of low Conradson carbon could be used than one of high Conradson carbon. There is a considerable difference in the Conradson carbon figure for oils of different types; for example, a Pennsylvania oil treated had a Conradson carbon of .226 whereas a naphthenic oil of the same viscosity range had a Conradson carbon of only .038. In other words, the naphthenic oil shows only about one-sixth as much carbon formation in that test.

The amount of gum-flux to be used also depends to a certain extent on the type of motor fuel with which it is to be used. For instance, for normal low gum gasolines about .5% of oil may in most cases be sufficient whereas with a high gum gasoline the larger percentages may be used.

In carrying out the invention, the preferred gum-fluxing agent may be added to the hydrocarbon motor fuel at any desired stage in the handling of said fuel from its manufacture to final consumption in the motor.

A preferred method is to mix it with the gasoline or other motor fuel immediately after the latter has been refined, and then to pass the mixture to storage where such ageing progresses as may be beneficial. It may however be mixed into the motor fuel by the dealers before dispensing it to the motorists or it may be incorporated in the gasoline by putting it into the gasoline tank or just as the fuel enters the motor itself, such as by feeding it into the feed line going into the carburetor.

The extent to which a gum flux of high kauri butanol value improves the condition of an engine is shown by the following data.

To determine the relationship between solvency and engine operation, a number of engine tests were made and the amount of carbonaceous gummy deposit was measured both in the intake valves and ports and in the head and block. Example 1 shows the results obtained with an ordinary low gum gasoline with and without an addition of 0.8% of a naphthenic base hydrocarbon fraction having a kauri butanol value of about 25 and a viscosity of 130 seconds at 100° F.

EXAMPLE 1

Engine tests with low gum (5 mgm.) gasoline

	Carbon and gum (grms. (dry) per 100 gals. of fuel)
Gasoline	25.6
Gasoline + 0.8% gum flux (naphthenic base hydrocarbon)	18.6

In other words, the slight addition of gum flux effected a 27% reduction in the amount of gummy deposit.

Although the amount of reduction of the gummy deposit obtained by the addition of a slight amount of gum flux to a low-gum gasoline is quite significant, even more striking results are obtained by the use of a high-gum gasoline, as shown in Example 2.

EXAMPLE 2

Engine tests with high-gum (71 mgm.) gasoline

	Carbon and gum (gms. dry)			
	Intake valves and ports	Head and block	Total	Gals. of fuel consumed
Gasoline	[1] 4.4	[1] 15.6	[1] 20.0	30
Gasoline + 0.8% gum flux (naphthenic base)	2.8	24.0	26.8	100

[1] Engine stuck so tight that the test could not be continued.

In the above examples the expressions "low-gum" and "high-gum" refer to the amount of preformed gum in the gasoline. Here 0.8% of a naphthenic base hydrocarbon distillate having a kauri butanol value of 21.4 and a viscosity of 426 seconds at 100° F. resulted in about a 60% reduction in gummy deposit in the engine. With the straight gasoline the engine operation was so poor that the test had to be stopped after consuming only about 30 gallons of fuel whereas with the gasoline containing the gum flux the engine worked perfectly well after 100 gallons had been consumed, even though a larger total amount of carbon and gum had been deposited during the test (27 grams from 100 gallons of the gasoline containing the naphthenic oil compared to 20 grams from 30 gallons of straight gasoline). In other words, small additions of proper gum-fluxing agents not only reduce the quantity of gummy deposit but also alter the nature of the deposit to such an extent that the engine can operate for a longer period of time in spite of the presence of the gummy deposit.

This gum-fluxing action may also be readily observed by making comparative porcelain dish gum tests. In Example 3 herebelow, the results of such tests are shown, giving the weight in milligrams of gum deposited in the dish upon testing two different gasolines, each alone and with an addition of 1% of a naphthenic base hydrocarbon gum flux.

EXAMPLE 3

Porcelain dish gum tests

Wt. of gum (mgms.) corrected for wt. of gum flux added.

	Gasoline A	Gasoline B
Gasoline	1345	228
Gasoline+1% gum flux (naphthenic base hydrocarbon having K. B. about 22)	409	43

Not only did the presence of the gum flux reduce the quantity of the gum deposited but also in the cases of both gasolines containing the flux the residual gum from these tests was a loose and semi-fluid deposit and was not hard and adherent as was the case with the straight gasolines.

The invention has been found particularly applicable to high-gum gasolines such as those obtained by severe cracking of kerosene, gas oil and other higher boiling petroleum stocks. Such gasolines, unless subjected to considerable refining, have a tendency to deposit large amounts of gum.

The invention also contemplates the use of other materials along with the hydrocarbon mo-

tor fuel, if such are desired. Anti-knock agents such as lead tetraethyl, iron carbonyl, etc., may be used, as well as various blending agents, and likewise the so-called "gum-inhibitors" which are primarily intended to inhibit the deposition of gum during storage, but not in the engine. For example, when a naphthenic hydrocarbon fraction was added in small amounts, according to the invention, to a gasoline containing lead tetraethyl, a favorable gum-fluxing action was noted. Fuels containing benzol, alcohol, etc. may likewise be utilized; for example, to a blend of 90% gasoline and 10% alcohol, 1% of a naphthenic oil was added, and found to effect a reduction in gum deposition (measured by dish test).

Although several properties of the gum flux to be used have been discussed, there are also other characteristics which should be taken into consideration. A relatively low viscosity should be used, such as between the approximate limits of 70 and 450 seconds Saybolt at 100° F. Usually a viscosity below about 150 is satisfactory.

The A. P. I. gravity should be generally within the approximate limits of 18 and 28 (corresponding to specific gravities of .887 and .95), but preferably about 23 (corresponding to .916). The boiling point range will be somewhat controlled by the type of gum flux, viscosity, and gravity, but in any case should be such that the fluxing agent will not be subjected to excessive evaporation losses in the engine.

A preferred distillation range (at 10 mm. pressure) includes the following approximate limits:

	Degrees F.
Initial point	230–306
10 per cent point	276–420
50 per cent point	380–495
90 per cent point	480–554
95 per cent point	502–580

The total range of 230° F. to 580° F. at 10 mm. pressure corresponds approximately to 465° to 875° F. (240° to 470° C.) at atmospheric pressure. The lower limit given for the 10% point (276° F. at 10 mm.) corresponds approximately to 520° F. (270° C.) at atmospheric pressure.

The V. I. (viscosity index), or relation between the viscosity at high and low temperature, has been found to vary inversely with the K. B. value and hence may be used to a certain extent as a guide in selecting the proper gum flux. For example, mineral hydrocarbon distillates of highly paraffinic nature usually have a high V. I., in the neighborhood of 100, and Coastal oils on the other hand or oils of a highly naphthenic nature may have a very low V. I. even considerably below zero. In general, for the present invention, it is preferred to use material having a V. I. less than 30.

Another pertinent characteristic is the aniline point which means the temperature at which the material will dissolve aniline. For purposes of this invention, the aniline point should preferably be less than about 170° F. The flash should also be between the approximate limits of 270 to 375° F.

Other hydrocarbon materials having high solvency or gum-fluxing characteristics may be used instead of or in conjunction with our preferred petroleum fractions. Pure hydrocarbon compounds such as hexa decyl phenyl acetylene and the like, or mixtures thereof, boiling within proper range, may be used. Hydrocarbons having the preferred characteristics may also be prepared from mixed hydrocarbons; for instance, a product of good gum-fluxing properties can be separated from petroleum distillates of lubricating oil viscosity by solvent extraction with liquid sulfur dioxide, phenol and other solvents.

In the appended claims the term "gum flux" is intended to mean a material, liquid at atmospheric temperatures, adapted to soften, loosen and dislodge and/or prevent the deposition of hard carbonaceous gummy deposits on the walls, valves, rings, and other interior parts of an internal combustion engine, said material having a low vapor pressure under the conditions existing in an internal combustion engine during use.

It is not desired to be limited by any of the specific examples hereinabove given for the sake of illustration only nor by any theories advanced as to the operation of the invention and in the following claims it is our intention to claim all inherent novelty in the invention as broadly as the prior art permits.

We claim:

1. A motor fuel consisting essentially of light liquid petroleum hydrocarbons and normally tending to deposit at least a small amount of gum when used for fueling an internal combustion engine, to which has been added about 0.1 to 2.0% of a gum flux consisting chiefly of hydrocarbons liquid at atmospheric temperatures, adapted to soften, loosen and dislodge and/or prevent the deposition of hard carbonaceous gummy deposits on the walls, valves, rings and other interior parts of an internal combustion engine, said material having a kauri butanol solvent value above about 20, a low vapor pressure under the conditions existing in an internal combustion engine during use, and having approximately the following physical characteristics: a "50%" boiling point above about 350° F. at 10 mm. pressure, a 100° F. Saybolt viscosity between the approximate limits of 70 and 450 seconds, an A. P. I. gravity between the approximate limits of 18 and 28 and a flash between the approximate limits of 270° and 375° F.

2. A motor fuel according to claim 1, in which the gum flux is a petroleum hydrocarbon fraction separated by distillation from a naphthenic base crude oil.

3. Motor fuel according to claim 1, containing about 0.75% of a Coastal petroleum fraction having a 100° F. Saybolt viscosity between the approximate limits of 70 and 150 seconds.

4. Motor fuel according to claim 1, in which the gum flux has a viscosity index less than about 30.

5. Motor fuel according to claim 1, in which the gum flux is derived by extraction of petroleum distillates of lubricating oil viscosity with a solvent having a selective solvent action for unsaturated and aromatic compounds.

6. Motor fuel according to claim 1, in which the gum flux is a pure hydrocarbon substance of the nature of hexadecyl-phenyl acetylene.

7. Motor fuel according to claim 1, containing a small amount of an anti-knock agent of the nature of tetraethyl lead.

8. Motor fuel according to claim 1, in which the light liquid petroleum hydrocarbons have a preformed gum content greater than about 5 mg.

9. Motor fuel according to claim 1, in which the gum flux is a hydrocarbon liquid derived from petroleum and has the following physical characteristics: a kauri butanol solvent value of about 25, a 100° F. Saybolt viscosity between the approximate limits of 70 and 150 seconds and an A. P. I. gravity less than 25.

10. The method of preparing motor fuel which comprises adding to light liquid petroleum hydrocarbons normally tending to deposit at least a small amount of gum when used for fueling an internal combustion engine, about 0.1 to 2.0% of a gum flux as defined in claim 1.

11. The method of preparing motor fuel which comprises adding before storage to light liquid petroleum hydrocarbons normally tending to deposit at least a small amount of gum when used for fueling an internal combustion engine, about 0.1 to 2.0% of a gum flux as defined in claim 1.

12. Motor fuel according to claim 1 in which the amount of gum flux is about 0.5 to 1.5%.

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