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TREATMENT OF MOTOR FUELS

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This invention relates to the treatment of hydrocarbon motor fuels and more particularly to the incorporation in the motor fuel of substances, known as inhibitors or antioxidants, which act to retard deterioration of the motor fuels.

It is known that hydrocarbon motor fuels produced in the cracking of petroleum have an undesirable tendency to undergo deterioration on storage with loss in such valuable properties as light color, low gum content and antiknock value, the deterioration being due principally to oxidation and being accelerated by the photochemical action of light. Straight run gasolines, on the other hand, do not ordinarily have the same undesirable tendency to deteriorate, although blended stocks containing cracked gasoline and straight-run gasoline usually show the undesirable tendency to deteriorate. Similar fractions of hydrocarbon distillates produced by the distillation of hydrocarbonaceous materials other than petroleum frequently also show a tendency to deteriorate upon storage.

It has been found that such deterioration of hydrocarbon motor fuels can be retarded to a greater or lesser degree by incorporating in the motor fuel certain phenols, aminophenols and/or phenylene diamines. The majority of such inhibitors are solid substances which are not highly soluble in hydrocarbon motor fuels and at best dissolve but slowly in the fuel. Accordingly, it is difficult to obtain a uniform distribution of the inhibitors in the motor fuels without resorting to time-consuming methods of violent agitation of the motor fuel stock being treated. Furthermore, where huge quantities of gasolines are being stabilized with such inhibitors on a commercial scale, any methods involving violent agitation are wholly impractical.

It is essential in large scale operations to be able to blend the inhibitors into the motor fuels in a manner which permits a rapid uniform distribution of the inhibitor throughout the motor fuel. Any uneven distribution of the inhibitors throughout the treated stock is clearly undesirable.

From the practical standpoint of handling motor fuels during the treatment thereof with inhibitors, it is usually most desirable to feed the inhibitors continuously or intermittently into a flow of the fuel. However, the aforesaid solid inhibitors do not ordinarily rapidly dissolve and distribute themselves uniformly throughout the motor fuel when incorporated in this manner. For this reason, it has been proposed to employ mobile solutions of the inhibitors which can be fed into the flow of gasoline.

Among other solvents which have been proposed for this purpose is methyl alcohol. Methyl alcohol is a good solvent for the aforesaid inhibitors and does not have a seriously deleterious effect on the inhibiting potency of the inhibitors. While methyl alcohol is a good solvent for the inhibitors, it does not have an especially good dispersive action on the inhibitors in the gasoline and is not fully satisfactory where water is encountered in the gasoline, such as is ordinarily the case under actual storage conditions. The butyl alcohols are not a particularly good solvent for the aforesaid inhibitors (e. g. the inhibitors tend to separate from solution at lower temperatures) but have a better dispersive action on the inhibitors than does methyl alcohol. However, again, the butyl alcohols are not fully satisfactory where water is encountered in the gasoline.

It has been proposed to employ a combination of methyl alcohol and a butyl alcohol as a solvent. However, such a combination, while serving to combine the good solvent powers of the methyl alcohol with the good dispersive action of the butyl alcohols does not avoid the difficulties encountered when dealing with wet gasolines. Furthermore, in order to arrive at solution which gives a low cold test (i. e. a solution which does not lose mobility, and from which the inhibitors do not tend to separate at low temperatures), it is necessary to employ a major proportion of methyl alcohol in the combination, so that the dispersive action of the butyl alcohols is only utilized to a relatively small extent.

Isopropyl alcohol is a better solvent than the butyls for the aforesaid inhibitors and has a good dispersive action on the inhibitors in the gasoline. Furthermore, isopropyl alcohol solutions are not troublesome when wet gasolines are encountered. However, isopropyl alcohol solutions will not stand low cold tests, i. e. at temperatures of about —40° F., the ispropyl alcohol solutions become troublesomely viscous and there is some tendency for the inhibitors to separate from solution.

I have now found that unlike butyl alcohol solutions, isopropyl alcohol solutions can be made to withstand low cold tests by incorporation therein of, not a major proportion, but a relatively small amount of methyl alcohol, so that the dispersive action of the isopropyl alcohol on the inhibitors is not greatly depleted. I have further found that ethyl alcohol can be em-

ployed in place of methyl alcohol, although less advantageously. Thus, as solvents for phenolic, aminophenolic and phenylenediamine inhibitors, I employ, according to my invention, a mixture of alcohols comprising not more than about 20% by volume of methyl or ethyl alcohol and at least about 80% by volume of isopropyl alcohol. Advantageously at least about 5% by volume of methyl or ethyl alcohols is employed, and most advantageously, a mixture comprising about 10 to about 20% by volume of methyl alcohol and the remainder of isopropyl alcohol is employed. Such solutions readily disperse in hydrocarbon motor fuels and have good cold tests.

The following examples are offered to illustrate typical solutions which I employ in praeticing my invention. These examples are not intended to limit my invention.

Example I

	Grams
Isopropyl alcohol	25
Methyl alcohol	5
N-monomethyl-p-aminophenol	25

Example II

	Grams
Isopropyl alcohol	25
Methyl alcohol	5
N-monobenzyl-p-aminophenol	25

Example III

	Grams
Isopropyl alcohol	25
Methyl alcohol	5
N-monobutyl-p-aminophenol	25

Example IV

	Grams
Isopropyl alcohol	25
Ethyl alcohol	5
N-monbbutyl-p-aminophenol	25

Example V

	Grams
A mixture consisting of about 92% by weight of N-(n-primary-butyl)-p-aminophenol and about 8% by weight of N,N'-di-(n-primary-butyl)-p-phenylenediamine	49.3
Isopropyl alcohol	47.9
Methyl alcohol	5.3

Such a solution, which contains about 10% by volume of methyl alcohol and about 90% by volume of isopropyl alcohol, when cooled to —40° F. did not crystallize. On the other hand the following prior art solution crystallized at about + .5° F.

	Grams
A mixture consisting of about 92% by weight of N-(n-primarybutyl)-p-aminophenol and about 8% by weight of N,N'-di-(n-primarybutyl)-p-phenylenediamine	71.4
Isobutyl alcohol	15.4
Methyl alcohol	61.7

Ordinarily, I have found it advantageous to make up the solutions of inhibitors in my new solvents, employing about one part by weight of the inhibitor to one by weight of the solvent. Other ratios of solvent to inhibitor can be employed.

Sufficient of the solution of the inhibitor should be incorporated in the gasoline to give a concentration of inhibitor in the gasoline which will substantially retard deterioration of the gasoline. Ordinarily a concentration of inhibitor of from about 0.01 g. to about 1.0 g. per 1,000 g. of motor fuel, i. e. from about 0.001% to about 0.1% by weight will suffice. The most useful and economical concentration of inhibitor will, of course, vary from inhibitor to inhibitor and motor fuel to motor fuel. The most advantageous concentration of inhibitor is, of course, readily determined by making the ordinary tests and observations customarily employed in the art.

As phenol inhibitors, which are especially useful in conjunction with my new solvent, hydroquinone, diamyl-hydroquinone and catechol may be mentioned. As aminophenolic inhibitors, N-alkyl-p-aminophenols, e. g. N-methyl-, N-benzyl-, N-n-primarybutyl, N-isobutyl-, N-isoamyl-, N-n-primaryamyl, N-hexyl-, N-heptyl-, N-octyl-, and N-cetyl-p-aminophenols, are especially useful in conjunction with my new solvent. As phenylenediamine inhibitors, N,N'-dialkyl-p-phenylenediamines, e. g. N,N'-di-(n-primarybutyl) and N,N'-diisoamyl-p-phenylenediamines, are especially useful in conjunction with my new solvent. Mixtures of N-alkyl-p-aminophenols and N,N'-dialkyl-P-phenylenediamines, particularly those containing a majority of N-alkyl-p-aminophenols, are especially useful in conjunction with my new solvents. Mixtures of N-alkyl-p-aminophenols and N,N'-dialkyl-p-phenylenediamine are described for example in the copending application of Harold Von Bramer and Albert C. Ruggles, Serial No. 96,467, filed August 17, 1936 (now U. S. Patent No. 2,163,640, dated June 27, 1939).

What I claim as my invention and desire to be secured by Letters Patent of the United States is:

1. A deterioration inhibitor for a hydrocarbon motor fuel comprising a solution of an inhibitor capable of inhibiting deterioration of hydrocarbon motor fuels and selected from the group consisting of phenols, aminophenols and phenylenediamines, the solvent of said solution comprising not more than about 20% by volume of an alcohol selected from the group consisting of methyl and ethyl alcohols, and at least about 80% by volume of isopropyl alcohol.

2. A deterioration inhibitor for a cracked gasoline comprising a solution of an inhibitor capable of inhibiting deterioration of cracked gasoline selected from the group consisting of phenols, aminophenols and phenylenediamines, the solvent of said solution comprising not more than about 20% by volume of an alcohol selected from the group consisting of methyl and ethyl alcohols and at least about 80% by volume of isopropyl alcohol.

3. A deterioration inhibitor for a cracked gasoline comprising a solution of an inhibitor capable of inhibiting deterioration of cracked gasoline selected from the group consisting of phenol, amino phenol and phenylenediamine inhibitors, the solvent of said solution comprising not more than about 20% by volume of methyl alcohol and at least about 80% by volume of isopropyl alcohol.

4. A deterioration inhibitor for cracked gasoline comprising a solution of a N-alkyl-p-aminophenol inhibitor the solvent of said solution comprising about 10 to about 20% by volume of methyl alcohol and about 90 to about 80% by volume of isopropyl alcohol.

5. A deterioration inhibitor for a cracked gasoline comprising a solution of a N,N'-dialkyl-p-

phenylenediamine inhibitor, the solvent of said solution comprising about 10 to 20% by volume of methyl alcohol and about 90 to about 80% by volume of isopropyl alcohol.

6. A deterioration inhibitor for a cracked gasoline comprising a solution of a N-alkyl-p-amino-phenol capable of inhibiting deterioration of cracked gasoline and in which aminophenol the alkyl group contains at least four carbon atoms, and a substantial proportion, based on the amount of the aminophenol, of a N,N'-dialkyl-p-phenylenediamine in which each alkyl group contains at least four carbon atoms, the solvent of said solution comprising about 10 to 20% by volume of methyl alcohol and from about 90 to about 80% by volume of isopropyl alcohol.

7. A method for stabilizing cracked gasoline against deterioration which comprises adding to the gasoline a solution of an inhibitor capable of inhibiting deterioration of hydrocarbon motor fuels and selected from the group consisting of phenols, aminophenols and phenylenediamines, the solvent of said solution comprising not more than about 20% by volume of an alcohol selected from the group consisting of methyl and ethyl alcohols, and at least 80% by volume of isopropyl alcohol.

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