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PROCESS FOR REMOVING DEPOSITS FROM INTERNAL-COMBUSTION ENGINES AND COMPOSITION THEREFOR

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This invention relates to the removal of deposits of carbon and other substances, and particularly to improved compositions of matter for loosening these deposits and to a process for effecting the removal thereof.

The principal object of the invention is to provide a liquid mixture which may be employed to effectively loosen the carbon and other adherent deposits from the surfaces of metal parts, such as combustion chambers, pistons, cylinder heads and valves of internal combustion engines. A further object of the invention is to provide such a composition which is inexpensive, efficient and has no detrimental effects upon the metal parts or crankcase lubricant with which it comes into contact.

It is well known that solid deposits, consisting principally of carbon and other products of combustion of the fuel mixture and lubricating oil, adhere to the piston faces and other interior parts of internal combustion engines to the detriment of efficient engine operation. These deposits usually decrease the life of the exhaust valves, lower the efficiency of heat transfer to the cooling jacket, reduce the capacity of the engine to take in a full charge of air and fuel and, in the case of the Otto cycle engines, increase the tendency of the fuel to detonate or "knock." It follows, therefore, that a means of easy and effective removal of such deposits is of great value, particularly if such means can be employed without disassembling the engine as is customarily required. Moreover, it appears likely that if engine manufacturers could be assured that an easy and inexpensive method of removing combustion chamber deposits were available to the public, they would feel more free to build engines having higher compression ratios and therefore of higher efficiency, with consequent great benefit to engine users in the future.

In general, this invention materially facilitates deposit removal by providing a liquid composition comprising a mixture of one or more lower-alkyl substituted benzenes and dimethyl formamide. The lower-alkyl substituted benzenes which I found to be of particular value are toluene and homologues thereof having a total of 7 to 10 carbon atoms, xylene and aromatic high-flash naphthas being examples of these homologues which are highly satisfactory. All of the aforementioned materials readily combine to form a homogeneous mixture which is ready for immediate use.

When only one of these lower-alkyl substituted benzenes is mixed with dimethyl formamide to form a two-component mixture, the former may be added in amounts up to 75% by volume of the total mixture. Thus a mixture containing 25% to 75% by volume of dimethyl formamide and 25% to 75% by volume of a lower-alkyl substituted benzene is an effective decarbonizer. However, superior results are obtained when both xylene and a high-flash aromatic naphtha are mixed with dimethyl formamide. This mixture is particularly effective in the removal of carbon and other adherent deposits from the interior surfaces of internal combustion engines when the xylene and the high-flash aromatic naphtha are used in approximately equal proportions by volume. The high-flash aromatic naphtha employed is a coal tar distillate boiling between 250° F. and 400° F. and is less volatile than either xylene or dimethyl formamide.

The application of highly volatile solvents to hot surfaces tends to vaporize and disperse them before they can exert much solvent effect. Less volatile solvents, on the other hand, although having less tendency to immediately vaporize, normally do not have as great a solvent power for the resinous binder in the carbonaceous de-

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posits as do the more volatile compounds. Dimethyl formamide, however, although relatively high boiling, provides the high degree of solvent action normally associated only with many of the more volatile organic solvents. Accordingly, it will be noted that I have provided a unique and efficient mixture of high-boiling and low-boiling solvents which is particularly suited for the removal of the objectionable carbon deposits. In this mixture the advantages of high solvent power possessed by the lower-boiling low molecular weight solvents are almost entirely retained and, at the same time, the tendency of these components to be lost through rapid vaporization is materially decreased by the presence of the high-boiling solvents.

In accordance with these findings, I have obtained commercially practical results with a mixture comprising approximately 10% to 45% by volume of xylene, 15% to 55% by volume of high-flash aromatic naphtha and 25% to 75% by volume of dimethyl formamide. Thus a mixture of 33⅓% by volume of xylene, 33⅓% by volume of high-flash aromatic naphtha, and 33⅓% by volume of dimethyl formamide has proved especially satisfactory and has excellent deposit-loosening properties.

For particular applications, however, I have found that the carbon-removing properties of the aforementioned mixtures are further improved by the addition of a surface-active agent. Accordingly, the addition of only a relatively minor amount of a quaternary ammonium surface-active agent even further increases the solvent action of these mixtures because of the wetting action thereby provided. Among the quaternary ammonium surface-active agents which I found to be of particular utility are salts of amines which have at least one high molecular weight hydrocarbon radical attached to the nitrogen atom, such as salts of benzyl-substituted dimethyl amines wherein the benzyl ring is substituted or unsubstituted. More particularly, excellent results were obtained with substituted ammonium chlorides having at least two methyl substituents and a substituted or unsubstituted benzyl substituent, examples of these salts being stearyl dimethyl benzyl ammonium chloride and methyl dodecyl benzyl trimethyl ammonium chloride. The former surface-active agent is currently commercially available under the trade name Triton K-12 and the latter under the trade name Hyamine 2389. Although both of these compounds are methyl-substituted ammonium chlorides, it will be understood that the surface-active agents which may be added in accordance with this invention need not necessarily be chlorides, other quaternaries also being beneficial because of their wetting or penetrating properties.

Only a relatively small amount of one of these surface-active salts need be added to enhance the deposit removing qualities of the aforementioned decarbonizing mixtures. I have found these surface-active agents to be effective within the practical addition limits of 0.1% to 5.0% by volume of these mixtures, approximately 1% by volume being the optimum amount to be added. The addition of these agents to the above mixtures in quantities greater than 5% by volume appears to create no further beneficial results.

For example, outstanding results are achieved with a mixture having approximately equal proportions of the three major constituents, or a mixture in which the proportions of these constituents are varied within relatively restricted limits, to which mixture is added 0.1% to 5.0% by volume of one of the aforementioned quaternary ammonium surface-active salts. Accordingly, a decarbonizer fluid comprising 10% to 45%, by volume of xylene, 15% to 55% by volume of a high-flash aromatic naphtha, 25% to 75% by volume of dimethyl formamide and 0.1% to 5.0% of either stearyl dimethyl benzyl ammonium chloride or methyl dodecyl benzyl trimethyl ammonium chloride has proved to be particularly effective.

Ordinarily, the best method of using the aforementioned deposit-removing mixture is to apply it to the coated parts without disassembling the engine and after these parts have become heated by the actual operation of the engine. Thus, in water-cooled engines the tem-

perature of the coolant in the cooling jacket should be above 150° F.

By way of example, we may form a mixture of 33⅓% by volume of xylene, 33⅓% by volume of the aromatic high-flash solvent naphtha, 33⅓% by volume of dimethyl formamide, which components are mutually soluble, and then inject 30 to 90 milliliters of this composition into the combustion chamber of each cylinder. This is preferably done after the engine has been operated for a sufficient period of time to heat the coated metal parts. Specifically, one of the best methods for applying the mixture to the engine is to slowly introduce a suitable quantity of it into the carburetor air intake tube while the engine is idling, the last one-sixth to one-fourth of the liquid being added at such an increased rate as to stall the engine. The mixture is then permitted to act on the deposit for a suitable period of time, depending upon the nature of the coating to be removed. In most cases I have found that from about one to six hours is a sufficient length of time to obtain excellent results. The engine is then started, and the loosened carbon and other deposited particles are blown out through the exhaust pipe.

As an alternative, the coated parts may be removed from the engine and heated over a flame or by other appropriate means, the carbon-removing composition applied by immersion, spraying, painting or other suitable means, and the loosened deposit wiped, brushed or blown from the metal surfaces. Although heating accelerates the solvent action and thereby reduces the necessary period of solvent activity, the mixture may be applied to the coated parts at ordinary temperatures.

It is to be understood that while the invention has been described in conjunction with certain specific examples, the scope of the invention is not to be limited thereby except as defined in the appended claims.

I claim:

1. A composition for removing adherent deposits from internal combustion engines consisting essentially of, by volume, 10% to 45% of xylene, 15% to 55% of an aromatic high-flash naphtha boiling in the range between 250° F. and 400° F., and 25% to 75% of dimethyl formamide.

2. A composition for removing adherent deposits from internal combustion engines consisting of approximately 33⅓% by volume of xylene, 33⅓% by volume of a high-flash aromatic naphtha boiling between 250° F. and 400° F. and 33⅓% by volume dimethyl formamide.

3. A composition for removing adherent deposits from internal combustion engines consisting essentially of, by

volume, 10% to 45% of xylene, 15% to 55% of an aromatic high-flash naphtha boiling in the range between 250° F. and 400° F., 25% to 75% of dimethyl formamide, and 0.1% to 5% of a cationic surface-active agent.

4. A composition for removing carbonaceous deposits from surfaces of internal combustion engines consisting, by volume, of approximately 33% of xylene, 33% of a high-flash aromatic naphtha boiling between 250° F. and 400° F., 33% of dimethyl formamide, and 1% of a quaternary ammonium surface-active salt selected from the group consisting of stearyl dimethyl benzyl ammonium chloride and methyl dodecyl benzyl trimethyl ammonium chloride.

5. A composition for removing carbon and like deposits from metallic surfaces consisting essentially of 10% to 45% by volume of xylene, 15% to 55% by volume of a high-flash aromatic naphtha boiling between 250° F. and 450° F., 25% to 75% by volume of dimethyl formamide, and 0.1% to 5% of a cationic surface-active agent selected from the group consisting of stearyl dimethyl benzyl ammonium chloride and methyl dodecyl benzyl trimethyl ammonium chloride.

6. A method of removing organic deposits from combustion chambers of an internal combustion engine which comprises heating the coated parts, applying to the deposits a mixture consisting, by volume, of 10% to 45% of xylene, 15% to 55% of a high-flash aromatic naphtha boiling between 250° F. and 400° F., 25% to 75% of dimethyl formamide, and 0.1% to 5% of a cationic surface-active agent, and removing the loosened deposits.

7. The process of removing deposits from combustion chambers of internal combustion engines which comprises heating the coated parts to a temperature above 150° F., applying to the deposits a solution consisting of approximately 33⅓% by volume of xylene, 33⅓% by volume of high-flash aromatic naphtha boiling between 250° F. and 400° F., and 33⅓% by volume of dimethyl formamide, and removing the loosened deposits.

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