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(54) Fuel additive and fuel compositon containing the same

(57) A fuel additive containing an alkylene-oxide-adducted hydrocarbyl amide is disclosed. The alkylene-oxide-adducted hydrocarbyl amide is surprisingly useful for improving the acceleration response and the driving performance of internal combustion engines when used as fuel additives in hydrocarbon-based fuels, such as gasoline fuel or diesel fuel.

EP 1 273 652 A1

Description

[0001] The present invention relates to a fuel additive containing an alkylene-oxide-adducted hydrocarbyl amide. In a further aspect the present invention relates to the use of the fuel additive in a hydrocarbon-based fuel, such as gasoline fuel or diesel fuel, to enhance the acceleration response and the driving performance of internal combustion engines, such as gasoline or diesel engines.

BACKGROUND OF THE INVENTION

[0002] In order to increase engine output power and acceleration response of spark ignition engines in automobiles, various types of oxygen-containing additives for hydrocarbon-based fuel have been investigated. These hydrocarbon-based fuels include alcohol (e.g. methanol and ethanol), ether (e.g. methyl-t-butyl ether), and ketone (e.g. acetone). In addition, the use of additives, such as hydrazine or nitro compounds (for example nitromethane including nitropropane and nitroparaffin, or nitrobenzene) have been examined for automobile racing. However, the problem with using such additives is that they often have an adverse effect on the durability of the engine and its components.

[0003] It is also known that organometallic compounds (e.g. tetraethyl lead or similar lead alkyls:ferrocene, methyl cyclopentadienyl manganese tricarbonyl), as well as aromatic amine compounds (e.g. aniline, monomethyl aniline, or dimethyl aniline) can be used as anti-knocking agents. However, it has been confirmed that these compounds dramatically reduce the operating efficiency of three-way catalysts due to catalyst poisoning.

[0004] Japanese Patent Application Number (Kokai) 58-104996 (corresponding to US Patent Number 4,409,000) describes the use of an alkyl amine or ethylene-oxide-adducted alkenyl amine as an additive in automobile fuel to clean carburetors and engines.

[0005] According to European Patent Number 0869163 A1 it is possible to reduce friction in gasoline engines by adding N,N-bis(hydroxyalkyl) alkyl amine to gasoline.

[0006] According to PCT Patent Publication 2001-502374 (WO-98/17746), solubility in water as well as the engine performance can be improved by adding fatty acid diethanol amide, fatty acid ethoxylate and alcohol ethoxylate to a liquid fuel such as gasoline or diesel fuel.

SUMMARY OF THE INVENTION

[0007] The present invention relates to a fuel additive containing an alkylene-oxide-adducted hydrocarbyl amide. In a further aspect the present invention relates to the use of the fuel additive in a hydrocarbon-based fuel, such as gasoline fuel or diesel fuel, to enhance the acceleration response and the driving performance of internal combustion engines, such as gasoline or diesel engines.

[0008] In its broadest aspect, the present invention relates to a fuel additive comprising an alkylene-oxide-adducted hydrocarbyl amide having from 3 to 50 moles of alkylene oxide per mole of hydrocarbyl amide.

[0009] In another aspect, the present invention relates to a fuel composition comprising a major amount of a hydrocarbon boiling in the gasoline or diesel range and, from 10 to 10,000 ppm weight per weight of fuel, of the fuel additive of the present invention.

[0010] In still another aspect, the present invention relates to a method of operating an automobile engine with the fuel composition of the present invention.

[0011] In a further aspect, the present invention relates to a method of improving the acceleration performance of a gasoline automobile engine comprising additizing the fuel additive of the present invention to a gasoline and operating the engine with the additized gasoline.

[0012] Among other factors, the present invention is based on the discovery that certain alkylene-oxide-adducted hydrocarbyl amides are surprisingly useful for improving the acceleration response and the driving performance of internal combustion engines when used as fuel additives in hydrocarbon-based fuels, such as gasoline fuel or diesel fuel.

DETAILED DESCRIPTION OF THE INVENTION

[0013] As stated above, the present invention relates to a fuel additive containing an alkylene-oxide-adducted hydrocarbyl amide and its use as a fuel additive in a hydrocarbon-based fuel, such as gasoline fuel or diesel fuel.

[0014] Prior to discussing the present invention in detail, the following terms will have the following meanings unless expressly stated to the contrary.

Definitions

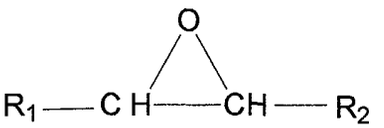
[0015] The term "hydrocarbyl" refers to an organic radical primarily composed of carbon and hydrogen which may be aliphatic, alicyclic, aromatic or combinations thereof, e.g., aralkyl or alkaryl. Such hydrocarbyl groups may also contain aliphatic unsaturation, i.e., olefinic or acetylenic unsaturation, and may contain minor amounts of heteroatoms, such as oxygen or nitrogen, or halogens, such as chlorine. When used in conjunction with carboxylic fatty acids, hydrocarbyl will also include olefinic unsaturation.

[0016] The term "alkyl" refers to both straight- and branched-chain alkyl groups.

[0017] The term "lower alkyl" refers to alkyl groups having 1 to about 6 carbon atoms and includes primary, secondary and tertiary alkyl groups. Typical lower alkyl groups include, for example, methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, t-butyl, n-pentyl, n-hexyl and the like.

[0018] The term "alkenyl" refers to an alkyl group with unsaturation.

[0019] The term "alkylene oxide" refers to a compound having the formula:



wherein R_1 and R_2 are each independently hydrogen or lower alkyl having from 1 to 6 carbon atoms.

[0020] The term "fuel" or "hydrocarbon-based fuel" refers to normally liquid hydrocarbons having boiling points in the range of gasoline and diesel fuels.

[0021] In its broadest aspect, the present invention involves a fuel additive comprising an alkylene-oxide-adducted hydrocarbyl amide having from 3 to 50 moles, preferably from 3 to 20 moles, more preferably from 4 to 15 moles, of alkylene oxide per mole of hydrocarbyl amide.

[0022] The alkylene-oxide-adducted hydrocarbyl amide of the present invention is derived from an alkyl amide having from 4 to 75, preferably from 8 to 22, carbon atoms or alkenyl amide with at least one or two points of unsaturation having from 4 to 75, preferably from 8 to 22, carbon atoms. Examples of desirable alkyl amides suitable for the present invention include, but are not limited to, octyl amide (capryl amide), nonyl amide, decyl amide (caprin amide), undecyl amide dodecyl amide (lauryl amide), tridecyl amide, teradecyl amide (myristyl amide), pentadecyl amide, hexadecyl amide (palmityl amide), heptadecyl amide, octadecyl amide (stearyl amide), nonadecyl amide, eicosyl amide (alkyl amide), or docosyl amide (behenyl amide). Examples of desirable alkenyl amides include, but are not limited to, palmitoolein amide, oleyl amide, isooleyl amide, elaidyl amide, linolyl amide, linoleyl amide. Preferably, the alkyl or alkenyl amide is a coconut oil fatty acid amide.

[0023] The alkylene oxide adducted to the hydrocarbyl amide of the present invention is derived from an alkylene group having from 2 to 5 carbon atoms. Preferably, the alkylene oxide is selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, and pentylene oxide. Ethylene oxide and propylene oxide are particularly preferred. In addition, mixtures of alkylene oxides are desirable in which, for example, a mixture of ethylene oxide and propylene oxide may be used to form the alkylene-oxide-adducted hydrocarbyl amide of the present invention. A respective molar ratio of from 1:5 to 5:1 may be used in the case of a mixture of ethylene oxide and propylene oxide.

[0024] A desirable number of moles of the alkylene oxide to be adducted to the hydrocarbyl amide will be in the range of from 3 to 50 moles of alkylene oxide per 1 mole of hydrocarbyl amide. More preferably, the range of from 3 to 20 moles is particularly desirable. Most preferably, the range of from 4 to 15 moles is most preferable as a molar range of the additive.

[0025] Preferably, the alkylene-oxide adducted hydrocarbon amide is derived from an alkylene-oxide-adduction reaction involving a coconut oil fatty acid amide with ethylene oxide and propylene oxide. However, the alkylene-oxide adducted hydrocarbyl amides useful as fuel additives in the present invention can be also a mixed product wherein various types and different moles of alkylene oxide and can be adducted to various types of hydrocarbyl amides.

[0026] The present invention provides for a method of operating gasoline engine automobiles wherein an automobile equipped with a gasoline engine is operated with the fuel composition of the present invention. The method of operating gasoline engine automobiles is preferred when the amount of alkylene oxide is from 3 to 20 moles per mole of hydrocarbyl amide and the alkylene oxide is selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, pentylene oxide, or mixtures thereof.

[0027] The present invention further provides for a method of improving the driving and acceleration performance of internal combustion engines, such as a gasoline or diesel engines in automobiles, by using the fuel additive described herein.

[0028] The fuel additive of the present invention improves acceleration performance of internal combustion engines when the fuel additive is added to a low boiling point hydrocarbon-based fuel like gasoline, and the driving performance is also improved when the additive is added to other hydrocarbon-based fuel like a diesel fuel, alcohol fuel or ether fuel. The method of improving acceleration performance in gasoline engine automobiles is preferred when the amount of alkylene oxide is from 3 to 20 moles per mole of hydrocarbyl amide and the alkylene oxide is selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, pentylene oxide, or mixtures thereof.

[0029] The amount of fuel additive of the present invention added in a hydrocarbon-based fuel will typically be in a range of from 10 to 10,000 ppm weight per weight (active component ratio). More preferably, the desired range is from 10 to 5,000 ppm weight per weight, while a range of from 10 to 1,000 ppm weight per weight is most preferable.

[0030] The fuel additive of the present invention is normally supplied as an organic solvent solution with an effective fuel additive content of at least 30 weight %, based on the amount of the fuel additive and organic solvent solution.

[0031] Although no particular limitations are imposed on the method used to add a fuel additive of the present invention to a hydrocarbon-based fuel, a concentrated fuel additive product may be prepared which contained at least 30 weight % of the active component. This product can be added according to any selected method including adding it into the fuel tank of a fuel station or into the fuel tank of a passenger car.

[0032] The fuel additive of the present invention can also be combined with one, two, or more other additives publicly known to be used in hydrocarbon-based fuels. Such additives include, but are not limited to, deposit control additives such as detergents or dispersants, corrosion inhibitors, oxidation inhibitors, metal deactivators, corrosion inhibitors, demulsifiers, static electricity preventing agents, anti-coagulation agents, anti-knock agents, oxygenates, flow improvers, pour point depressants, cetane improvers and auxiliary-solution agents.

EXAMPLES

[0033] The invention will be further illustrated by the following examples, which set forth particularly advantageous method embodiments. While the examples are provided to illustrate the present invention, they are not intended to limit it. The present invention has been described with reference to specific embodiments and it is intended to cover those various changes and substitutions that may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

Example 1

[0034] A Toyota Camry 1800cc, 5MT (Type E-SV40, provided with Knock Sensor, type 4S-FE engine), mounted on a chassis dynamometer, was operated at a constant speed of 20 km/hr. The acceleration measurement was initiated by fully opening the throttle and measuring the amount of time required for the vehicle speed to reach 110 km/hr with the transmission locked in fourth gear. This measurement was repeated 10 times using the same fuel and the median value obtained from these 10 measurements was determined as the acceleration time period. In addition, in order to minimize the influence of ambient conditions (temperature, pressure, etc.) on engine performance, the entire test procedure was executed within a single day.

[0035] The gasoline used have the following specifications: density (at 15°C): 0.7389 g/cm^3, Reid vapor pressure: 60.5 Kpa, octane number: 90.2 (RON), 82.3 (MON), aromatics (volume %): 29.9, olefin (volume %): 15.6, 10% distillation temperature (°C): 50.0, 50% distillation temperature (°C): 92.0, 90% distillation temperature (°C): 169.5. The fuel composition was adjusted by adding 100mg/L of 5 moles of oleyl amide-ethylene oxide (fuel additive) to this gasoline.

[0036] Gasoline containing the above described fuel additive and gasoline without the fuel additive (same as the above) were then tested in accordance with the test procedures described herein above. Table 1 shows the results.

Table 1

Test Fuel Oil	Acceleration Time Period (20-110km/hours)
Gasoline with No Additive (Comparative Example)	24.91 seconds
Fuel Composition containing Additive	24.69 seconds

[0037] From the different acceleration time periods shown in Table 1, it is clear that the acceleration performance was improved by the fuel additive of the present invention. Although the difference in the acceleration time period indicated in Table 1 is not dramatic (less than 1%) with the fuel additive of the present invention, this is a distinct

difference, particularly in case of cars needing to attain a high speed, such as racing cars, etc. Furthermore, in addition to the importance of acceleration for racing cars, even a small improvement in acceleration performance can be very important for passenger cars driving on public roads where it may be necessary to suddenly accelerate in order to avoid an accident, etc., as a result of a sudden event.

Example 2

[0038] The test was carried out as described in Example 1, using four moles of propylene oxide adducted coconut oil fatty acid di-ethanol amide (fuel additive) was added at a concentration of 100 mg/L to this gasoline in order to prepare a fuel composition containing the fuel additive.

[0039] Gasoline containing the above described fuel additive and gasoline without the fuel additive (same as the above) were then tested in the acceleration evaluation test in accordance with the test procedures described in Example 1. Table 2 shows the results of the test.

Table 2

Test Fuel Oil	Acceleration Time Period (20-110km/hours)
Gasoline with No Additive (Comparative Example)	24.51 seconds
Fuel Composition containing Additive	24.38 seconds

[0040] As shown by the results in Table 2, the acceleration performance was clearly improved when the fuel additive of the present invention was employed in the fuel.

Example 3

[0041] The test was carried out as described in Example 1, using ten moles of propylene oxide adducted coconut oil fatty acid di-ethanol amide (fuel additive) was added to provide a concentration of 100 mg/L in this gasoline in order to prepare a fuel composition containing the fuel additive.

[0042] Gasoline containing the above described fuel additive and gasoline without fuel additive (same as the above) were then tested in accordance with the test procedures described previously. Table 3 shows the results of the test.

Table 3

Test Fuel Oil	Acceleration Time Period (20-110km/hours)
Gasoline with No Additive (Comparative Example)	24.85 seconds
Fuel Composition containing Additive	24.74 seconds

[0043] As shown by the results in Table 3, the acceleration performance was clearly improved when the fuel additive of the present invention was employed in the fuel.

Example 4

[0044] The test was carried out as described in Example 1 except the gasoline used had the following specifications: density 9 at 15°C: 0.7303 g/cm^3, Reid vapor pressure: 60.2Kpa, octane number: 92.1 (RON), aromatics (volume %): 23.19, olefin (volume %) 19, 10% distillation temperature (°C): 54.3, 50% distillation temperature (°C): 86.2, 90% distillation temperature (°C): 158.1 and using four moles of propylene oxide and two moles of ethylene oxide adducted coconut oil fatty acid di-ethanol amide (fuel additive) were added to provide a concentration of 100 mg/L in this gasoline.

[0045] Gasoline containing the above described fuel additive and gasoline without fuel additive (same as the above) were then tested in accordance with the test procedures described previously. Table 4 shows the results of the test.

Table 4.

Test Fuel Oil	Acceleration Time Period (20-110km/hours)
Gasoline with No Additive (Comparative Example)	23.96 seconds
Fuel Composition containing Additive	23.75 seconds

[0046] As shown by the results in Table 4, the acceleration performance was clearly improved when the fuel additive of the present invention was employed in the fuel.

Claims

1. A fuel additive comprising an alkylene-oxide-adducted hydrocarbyl amide having from 3 to 50 moles of alkylene oxide per mole of hydrocarbyl amide.

2. The fuel additive according to Claim 1, wherein the alkylene-oxide-adducted hydrocarbyl amide has from 3 to 20 moles of alkylene oxide per mole of hydrocarbyl amide.

3. The fuel additive according to Claim 2, wherein the alkylene-oxide-adducted hydrocarbyl amide has from 4 to 15 moles of alkylene oxide per mole of hydrocarbyl amide.

4. A fuel additive according to Claim 1, wherein the alkylene-oxide-adducted hydrocarbyl amide is derived from an alkyl or alkenyl amide having from 4 to 75 carbon atoms.

5. A fuel additive according to Claim 4, wherein the alkylene-oxide-adducted hydrocarbyl amide is derived from an alkyl or alkenyl amide having from 8 to 22 carbon atoms.

6. A fuel additive according to Claim 5, wherein the alkyl or alkenyl amide is a coconut oil fatty acid amide.

7. A fuel additive according to Claim 1, wherein the alkylene oxide is selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, pentylene oxide, or mixtures thereof.

8. A fuel additive according to Claim 7, wherein the alkylene oxide is elected from the group consisting of ethylene oxide, propylene oxide, or a mixture thereof.

9. A fuel additive according to Claim 1, wherein the alkylene-oxide-adducted hydrocarbyl amide is derived from an alkylene-oxide-adduction reaction involving a coconut oil fatty acid amide with ethylene oxide and propylene oxide.

10. A fuel additive according to claim 1, wherein the amount of alkylene oxide is from 3 to 20 moles per mole of hydrocarbyl amide and said alkylene oxide is selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, pentylene oxide, or mixtures thereof.

11. A fuel composition for automotive fuels comprising a major amount of hydrocarbon boiling in the gasoline or diesel range and, from 10 to 10,000 ppm weight per weight of fuel, of a fuel additive as claimed in any preceding claim.

12. The fuel composition according to Claim 10, wherein the alkylene-oxide-adducted hydrocarbyl amide is in the range of from 10 to 5,000 ppm weight per weight of fuel.

13. The fuel composition according to Claim 12, wherein the alkylene-oxide-adducted hydrocarbyl amide is in the range of from 10 to 10,000 ppm weight per weight of fuel.

14. A method of operating gasoline automobile engines comprising operating said engine with the fuel composition according to Claim 11, 12 or 13.

15. A method of improving the acceleration performance of gasoline automobile engines comprising additizing the fuel additive of any one of claims 1 to 10 to a gasoline and operating said engine with said gasoline.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 25 4662

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 November 2002	de La Morinerie, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 25 4662

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-11-2002

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