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(54) **HYDROCARBYL SUCCINIC ACID AND HYDROCARBYLSUCCINIC ACID DERIVATIVES AS FRICTION MODIFIERS**

HYDROCARBYLBERNSTEINSÄURE UND HYDROCARBYLBERNSTEINSÄUREDERIVATE, ALS REIBUNGSMODIFIZIERUNGSMITTEL.

ACIDE HYDROCARBYL SUCCINIQUE ET DÉRIVÉS D'ACIDE HYDROCARBYL SUCCINIQUE COMME MODIFICATEURS DE FRICTION.

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(56) References cited:
EP-A- 0 299 120 EP-A- 1 348 754
WO-A-01/38462 US-A- 2 993 772
US-A- 4 128 403 US-A- 4 214 876
US-A- 4 242 099 US-A- 4 440 545

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Description

[0001] The present invention relates to hydrocarbyl succinic acid and hydrocarbylsuccinic acid derivatives as friction modifiers for gasolines.

Background of the invention

[0002] Carburettors and inlet systems of Otto engines, and also injection systems for fuel proportioning, are subjected to increasing load due to contamination caused by dust particles from the air, unburned hydrocarbon residues from the combustion chamber and crankcase breather gases passed to the carburettor.

[0003] These residues shift the air-to-fuel ratio during idling and in the lower partial load region, so that the mixture becomes leaner and combustion less complete and consequently the content of unburned or partly burned hydrocarbons in the exhaust gas increases and the gasoline consumption rises.

[0004] It is known to avoid these drawbacks by using fuel additives for cleaning the valves and carburettors or injection systems of Otto engines (cf e.g.: M. Rossenbeck in "Katalysatoren, Tenside, Mineralöladditive", edited by J. Falbe, U. Hasserodt, page 223, G. Thieme Verlag, Stuttgart 1978).

[0005] Furthermore, the problem of valve seat recession occurs in the case of Otto engines of less recent design when fuelled with unleaded gasolines. To counteract this, anti-valve seat recession additives based on alkali metal or alkaline earth metal compounds have been developed.

[0006] For trouble-free running, modern Otto engines require automotive fuels having a complex set of properties which can only be guaranteed when use is made of appropriate gasoline additives. Such gasolines usually consist of a complex mixture of chemical compounds and are characterized by physical parameters. The interrelationship between gasolines and appropriate additives in known fuel compositions is still unsatisfactory as regards their detergent action or their pollution-abating properties and their anti-valve seat recession action. Moreover, many of the known additives act as emulsifying agents and thus promote the formation of water/fuel emulsions. Disadvantageously, this promotes engine wear and corrosion and may cause combustion problems.

[0007] WO 03/070860 describes a friction modifier of the formula $R^1-L-N(R^2R^3)$, wherein R^1 is a hydrocarbyl group and L is a linker. Preferred compounds of that formula are polyisobutenylsuccinimides, i.e. R^1 is a polyisobutenyl radical and L is a succinic acid derived group.

[0008] EP-A-1424322 describes polyisobutenylsuccinic acids or derivatives thereof. The compounds are used, inter alia, as detergents or dispersants for lube oil or fuels or as friction modifiers for automatic transmission fluids and continuous variable transmissions.

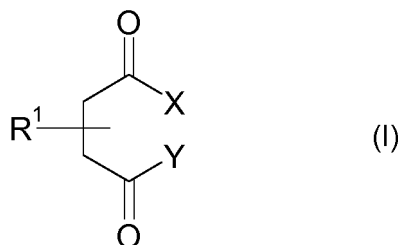
[0009] EP-A-1081208 describes a fuel additive which can be used to improve the lubricity of gasoline and which is obtainable by reacting (i) a hydroxyl group-containing compound, (ii) an amine group-containing compound which is different from (i); and (iii) a hydrocarbyl-substituted succinic acylating agent.

[0010] US 4,242,099 describes the use of a hydrocarbyl succinic acid or anhydride having 12 to 30 carbon atoms, such as tetrapropenyl succinic acid, as anti-wear additive in a diesel fuel.

Summary of the invention

[0011] It is an object of the present invention to provide a more effective fuel/additive formulation. Moreover, the additive shall have no or no significant emulsifying properties.

[0012] The inventors of the present invention found that this object is achieved by the use of at least one hydrocarbyl succinic acid or hydrocarbyl succinic acid derivative of the formula (I)



wherein

R^1 is a linear or branched C_4 - C_{40} -alkenyl or C_4 - C_{40} -alkyl group, wherein at least 95% of the carbon atoms are not quaternary, or R^1 is a C_1 - C_{20} -alkylaryl group;

X and Y are, independently of each other, OR^2 or $\text{O}-(\text{M}^{x+})_{1/x}$ or X and Y together form a group $-\text{O}-$;

R^2 is hydrogen, C_1 - C_8 -alkyl, aryl or C_1 - C_{20} -alkylaryl;

5 $(\text{M}^{x+})_{1/x}$ is a metal equivalent, an ammonium cation $[\text{NH}_4]^+$ or a substituted ammonium cation equivalent; and

x is 1, 2, 3 or 4 in case $(\text{M}^{x+})_{1/x}$ is a metal equivalent, or is 1 in case $(\text{M}^{x+})_{1/x}$ is an ammonium cation $[\text{NH}_4]^+$ or is an integer from 1 to 10 in case $(\text{M}^{x+})_{1/x}$ is a substituted ammonium cation equivalent,

10 **[0013]** as friction modifying additive in a gasoline.

[0014] Preferably, compounds of formula (I) are used as friction reducing agents in gasolines and Otto engines.

Detailed description of the invention

15 **[0015]** The organic moieties mentioned in the above definitions of the variables are - like the term halogen - collective terms for individual listings of the individual group members. The prefix C_n - C_m indicates in each case the possible number of carbon atoms in the group.

[0016] The term "aliphatic hydrocarbyl group containing less than 15% quaternary carbon atoms" denotes a branched or linear aliphatic hydrocarbyl group where less than 15%, preferably less than 10% and more preferably less than 5%,
20 e.g. less than 3% or less than 2 %, of the carbon atoms are quaternary. An aliphatic hydrocarbyl group is an acyclic radical essentially composed of carbon atoms and hydrogen atoms, e.g. an alkyl, alkenyl or alkynyl group. A quaternary carbon atom is a (sp^3) carbon atom carrying four radicals different from hydrogen. Alternatively, the term denotes an araliphatic hydrocarbyl group, i.e. an aliphatic hydrocarbyl group carrying at least one aryl substituent, e.g. an alkenylaryl group or an alkylaryl group, where preferably less than 15%, more preferably less than 10% and even more preferably
25 less than 5%, e.g. less than 3% or less than 2%, of the carbon atoms of the aliphatic moiety are quaternary.

[0017] C_8 - C_{40} -Alkenyl is a singly unsaturated straight-chain or branched aliphatic hydrocarbon radical having from 8 to 40 carbon atoms. Examples include octenyl, nonenyl, decenyl, undecenyl, dodecenyl, tridecenyl, tetradecenyl, pentadecenyl, hexadecenyl, heptadecenyl, octadecenyl, nonadecenyl, eicosenyl, hencosenyl, docosenyl, tricosenyl, tetracosenyl, pentacosenyl, hexacosenyl, heptacosenyl, octacosenyl, nonacosenyl, squalenyl, constitutional isomers thereof,
30 the higher homologs and their constitutional isomers. Examples for constitutional isomers of the aforementioned alkenyl radicals are polyalkenyl radicals derived from oligomers and polymers of α -, β -, γ -, δ -, etc. C_3 - C_8 -olefins, such as propene, 1- or 2-butene, 1- or 2-pentene, 1-, 2- or 3-hexene, 1-, 2- or 3-heptene or 1-, 2-, 3- or 4-octene.

[0018] C_4 - C_{40} -Alkenyl is a singly unsaturated straight-chain or branched aliphatic hydrocarbon radical having from 4 to 40 carbon atoms. Examples include the above-listed examples for C_8 - C_{40} -alkenyl and further butenyl, pentenyl,
35 hexenyl and heptenyl and constitutional isomers thereof.

[0019] C_8 - C_{80} -Alkenyl is a singly unsaturated straight-chain or branched aliphatic hydrocarbon radical having from 8 to 80 carbon atoms. Examples include the aforementioned C_8 - C_{40} -alkenyl radicals, constitutional isomers thereof, the higher homologs and their constitutional isomers.

[0020] C_4 - C_{80} -Alkenyl is a singly unsaturated straight-chain or branched aliphatic hydrocarbon radical having from 4 to 80 carbon atoms. Examples include the aforementioned C_8 - C_{80} -alkenyl radicals and further butenyl, pentenyl, hexenyl
40 and heptenyl and constitutional isomers thereof.

[0021] C_{10} - C_{30} -Alkenyl is a singly unsaturated straight-chain or branched aliphatic hydrocarbon radical having from 10 to 30 carbon atoms. Examples include decenyl, undecenyl, dodecenyl, tridecenyl, tetradecenyl, pentadecenyl, hexadecenyl, heptadecenyl, octadecenyl, nonadecenyl, eicosenyl, hencosenyl, docosenyl, tricosenyl, tetracosenyl, pentacosenyl, hexacosenyl, heptacosenyl, octacosenyl, nonacosenyl, squalenyl, constitutional isomers thereof, the higher
45 homologs and their constitutional isomers.

[0022] C_{12} - C_{16} -Alkyl is a straight-chain or branched alkyl group having from 12 to 16 carbon atoms. Examples include dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl and their constitutional isomers.

[0023] C_{10} - C_{20} -Alkyl is a straight-chain or branched alkyl group having from 10 to 20 carbon atoms. Examples include decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl and their
50 constitutional isomers.

[0024] C_8 - C_{20} -Alkyl is a straight-chain or branched alkyl group having from 8 to 20 carbon atoms. Examples include octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl and their constitutional isomers.

[0025] C_8 - C_{40} -Alkyl is a straight-chain or branched alkyl group having from 8 to 40 carbon atoms. Examples include octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl,
55 eicosyl, hencosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, squalyl, constitutional isomers thereof, the higher homologs and their constitutional isomers.

[0026] C₄-C₄₀-Alkyl is a straight-chain or branched alkyl group having from 4 to 40 carbon atoms. Examples include the aforementioned C₈-C₄₀-alkyl radicals and further butyl, pentyl, hexyl and heptyl and constitutional isomers thereof.

[0027] C₈-C₈₀-Alkyl is a straight-chain or branched hydrocarbon radical having from 8 to 80 carbon atoms. Examples include the aforementioned C₈-C₄₀-alkyl radicals, constitutional isomers thereof, the higher homologs and their constitutional isomers.

[0028] C₄-C₈₀-Alkyl is a straight-chain or branched hydrocarbon radical having from 4 to 80 carbon atoms. Examples include the aforementioned C₈-C₈₀-alkyl radicals and further butyl, pentyl, hexyl and heptyl and constitutional isomers thereof.

[0029] C₁₀-C₃₀-Alkyl is a straight-chain or branched hydrocarbon radical having from 10 to 30 carbon atoms. Examples include decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, hencosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, squalyl, constitutional isomers thereof, the higher homologs and their constitutional isomers.

[0030] C₁-C₄-Alkyl is a straight-chain or branched alkyl group having from 1 to 4 carbon atoms. Examples of an alkyl group are methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-butyl, iso-butyl or *tert*-butyl. C₁-C₂ Alkyl is methyl or ethyl, C₁-C₃ alkyl is additionally n-propyl or isopropyl.

[0031] C₁-C₈-Alkyl is a straight-chain or branched alkyl group having from 1 to 8 carbon atoms. Examples include C₁-C₄ alkyl as mentioned above and also pentyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 2,2-dimethylpropyl, 1-ethylpropyl, hexyl, 1,1-dimethylpropyl, 1,2-dimethylpropyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 1,1-dimethylbutyl, 1,2-dimethylbutyl, 1,3-dimethylbutyl, 2,2-dimethylbutyl, 2,3-dimethylbutyl, 3,3-dimethylbutyl, 1-ethylbutyl, 2-ethylbutyl, 1,1,2-trimethylpropyl, 1,2,2-trimethylpropyl, 1-ethyl-1-methylpropyl, 1-ethyl-2-methylpropyl, heptyl, octyl, and constitutional isomers thereof, such as 2-ethylhexyl.

[0032] C₁-C₁₀-Alkyl is a straight-chain or branched alkyl group having from 1 to 10 carbon atoms. Examples include C₁-C₈-alkyl as mentioned above and also nonyl, decyl, and constitutional isomers thereof.

[0033] C₁-C₂₀-Alkyl is a straight-chain or branched alkyl group having from 1 to 20 carbon atoms. Examples include C₁-C₈-alkyl as mentioned above and also nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl and eicosyl and constitutional isomers thereof.

[0034] C₂-C₈-Hydroxyalkyl is a straight-chain or branched alkyl group having from 2 to 8 carbon atoms, in particular 2 to 4 carbon atoms, wherein at least one, e.g. 1, 2, 3, or 4 of the hydrogen atoms are replaced by a hydroxy group such as in 2-hydroxy-1-ethyl, 2- and 3-hydroxypropyl, 2-,3- and 4-hydroxy-1-butyl, 2-,3-, 4- and 5-hydroxy-1-pentyl, 2-,3-, 4-, 5- and 6-hydroxy-1-hexyl, 2-,3-, 4-, 5-, 6- and 7-hydroxy-1-heptyl, 2-,3-, 4-, 5-, 6-, 7- and 8-hydroxy-1-octyl, 2,3-dihydroxy-1-propyl and the like.

[0035] C₂-C₈-Alkylene is a linear or branched hydrocarbon bridging group having 2, 3, 4, 5, 6, 7 or 8 carbon atoms, like 1,2- ethylene, 1,2- and 1,3-propylene, 1,2-, 1,3-, 2,3- and 1,4-butylene, 2,2-dimethyl-1,2-ethylene, 1,1-dimethyl-1,2-ethylene, 1,5-pentylene, 1,6-hexylene, 1,7-heptylene, 1,8-octylene and constitutional isomers thereof. C₂-C₄-Alkylene is a linear or branched hydrocarbon bridging group having 2, 3 or 4 carbon atoms, like 1,2- ethylene, 1,2- and 1,3-propylene, 1,2-, 1,3-, 2,3- and 1,4-butylene, 2,2-dimethyl-1,2-ethylene, 1,1-dimethyl-1,2-ethylene and the like.

[0036] C₁-C₈-Alkoxy is a straight-chain or branched alkyl group having from 1 to 8, in particular 1 to 4 carbon atoms, which is bound to the remainder of the molecule via an oxygen atom. Examples include methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, 2-butoxy, iso-butoxy, *tert*-butoxy, pentyloxy, 1-methylbutoxy, 2-methylbutoxy, 3-methylbutoxy, 2,2-dimethylpropoxy, 1-ethylpropoxy, hexyloxy, 1,1-dimethylpropoxy, 1,2-dimethylpropoxy, 1-methylpentyloxy, 2-methylpentyloxy, 3-methylpentyloxy, 4-methylpentyloxy, 1,1-dimethylbutyloxy, 1,2-dimethylbutyloxy, 1,3-dimethylbutyloxy, 2,2-dimethylbutyloxy, 2,3-dimethylbutyloxy, 3,3-dimethylbutyloxy, 1-ethylbutyloxy, 2-ethylbutyloxy, 1,1,2-trimethylpropoxy, 1,2,2-trimethylpropoxy, 1-ethyl-1-methylpropoxy, 1-ethyl-2-methylpropoxy, heptyloxy, octyloxy and their constitutional isomers.

[0037] Aryl denotes a carbocyclic C₆-C₁₄-aromatic radical like phenyl, naphthyl, anthracenyl or phenantrenyl, which optionally carries 1 to 3 substituents selected from halogen, OH, C₁-C₈-alkoxy, C₁-C₈-alkyl, nitro, cyano and an aryl radical.

[0038] Alkylaryl is an alkyl group which carries at least one aryl radical and is in particular a C₁-C₂₀-alkylaryl group. C₁-C₂₀-alkylaryl denotes a C₁-C₂₀-alkyl group which carries at least one aryl radical. Examples thereof are benzyl, 1- and 2-phenylethyl, 1-, 2- and 3-phenylpropyl, 1-, 2-, 3- and 4-phenylbutyl, 1-, 2-, 3-, 4- and 5-phenylpentyl, 1-, 2-, 3-, 4-, 5- and 6-phenylhexyl, 1-, 2-, 3-, 4-, 5-, 6- and 7-phenylheptyl, 1-, 2-, 3-, 4-, 5-, 6-, 7- and 8-phenyloctyl, 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8- and 9-phenylnonyl, 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8-, 9- and 10-phenyldecyl, 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8-, 9-, 10 and 11-phenylundecyl, phenyldodecyl, phenyltridecyl, phenyltetradecyl, phenylpentadecyl, phenylhexadecyl, phenylheptadecyl, phenyloctadecyl, phenylnonadecyl and phenyleicosyl and constitutional isomers thereof.

[0039] C₁-C₁₀-alkylaryl denotes a C₁-C₁₀-alkyl group which carries at least one aryl radical. Examples thereof are benzyl, 1- and 2-phenylethyl, 1-, 2- and 3-phenylpropyl, 1-, 2-, 3- and 4-phenylbutyl, 1-, 2-, 3-, 4- and 5-phenylpentyl, 1-, 2-, 3-, 4-, 5- and 6-phenylhexyl, 1-, 2-, 3-, 4-, 5-, 6- and 7-phenylheptyl, 1-, 2-, 3-, 4-, 5-, 6-, 7- and 8-phenyloctyl, 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8- and 9-phenylnonyl, and 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8-, 9- and 10-phenyldecyl, and constitutional

isomers thereof.

[0040] Alkenylaryl is an alkenyl group which carries at least one aryl radical and is in particular a C₁-C₂₀-alkenylaryl group. C₁-C₂₀-alkenylaryl denotes a C₁-C₂₀-alkenyl group which carries at least one aryl radical.

[0041] The metal equivalent (M^{x+})_{1/x} is a metal cation carrying 1, 2, 3 or 4 positive charges and respectively formally equivalating 1, 2, 3 or 4 anions O⁻ (or, more precisely, COO⁻), or (M^{x+})_{1/x} is an ammonium cation NH₄⁺ which formally equivalates 1 anion O⁻ (or, more precisely, COO⁻) or (M^{x+})_{1/x} is a substituted ammonium cation and respectively formally equivalating 1 to 10 anions O⁻ (or, more precisely, COO⁻).

[0042] The term "substituted ammonium cation" denotes a cation derived from a monoamine NR¹⁰R¹¹R¹², where the radicals R¹⁰, R¹¹ and R¹² are, independently of each other, selected from hydrogen, aliphatic hydrocarbyl which is optionally substituted by hydroxyl groups, araliphatic hydrocarbyl and aryl, with the proviso that at least one of the radicals R¹⁰, R¹¹ and R¹² is not hydrogen, or from a diamine or a polyamine, where the amino function(s) may be substituted by aliphatic hydrocarbyl groups which are optionally substituted by hydroxyl groups; araliphatic hydrocarbyl groups and/or aryl groups. The cation generally results from the addition of protons H⁺ to at least part of the basic nitrogen atoms present in the amine.

[0043] The term halogen denotes in each case fluorine, bromine, chlorine or iodine, in particular fluorine, chlorine or bromine.

[0044] With respect to the use according to the invention of the compounds of formula I, preference is given to the following meanings of the substituents and variables (X, Y, R¹, R², R⁶, R⁷, R⁸, R¹⁰, R¹¹, R¹², R¹³, R¹⁴, A, M, y, w, x), in each case on their own or in combination:

Preferably, R¹ is linear or branched C₈-C₄₀-alkyl, in particular C₁₀-C₃₀-alkyl, or is C₈-C₄₀-alkenyl, in particular C₁₀-C₃₀-alkenyl; wherein at least 95% of the carbon atoms are not quaternary.

[0045] Alternatively, R¹ is preferably a C₁-C₂₀-alkylaryl group, more preferably a C₁-C₁₀-alkylaryl group. Suitable alkylaryl groups are listed above.

[0046] However, in a more preferred embodiment, R¹ is a linear or branched alkyl group or an alkenyl group, as defined above.

[0047] In an even more preferred embodiment, R¹ is a linear or branched C₄-C₄₀-alkenyl group, especially a C₈-C₄₀-alkenyl group and in particular a C₁₀-C₃₀-alkenyl group.

[0048] In a particularly preferred embodiment, R¹ is derived from a C₄-C₄₀-alkene, e.g. a C₈-C₄₀-alkene, and in particular from a C₁₀-C₃₀-alkene. The alkene may be linear or branched (with the above proviso), and the olefinic double bond may be in a terminal or internal position. Preferred alkenes are α-alkenes (i.e. the olefinic double bond is in a terminal position), e.g. α-C₄-C₄₀-alkenes, e.g. α-C₈-C₄₀-alkenes, and more preferably α-C₁₀-C₃₀-alkenes. In a more preferred embodiment, the alkenes are linear α-alkenes.

[0049] Alternatively, R¹ is derived from a polyalkene, which is obtained by oligo- or polymerization of an alkene. The polyalkene is a C₄-C₄₀-polyalkene, e.g. a C₈-C₄₀-polyalkene, and in particular a C₁₀-C₃₀-polyalkene. The alkene from which the polyalkene is derived may be linear or branched. Preferably, the alkene is selected from C₂-C₈-alkenes, such as ethylene, propene, 1- or 2-butene, 1- or 2-pentene, 1-, 2- or 3-hexene, 1-, 2- or 3-heptene and 1-, 2-, 3- or 4-octene or constitutional or stereochemical isomers thereof. The polyalkene may also be obtained from oligo- or polymerization of an alkene mixture, especially of a technical mixture of olefins such as obtained in industrial processes, e.g. in cracking processes, with the proviso that not more than 20% by weight, preferably not more than 10% by weight, more preferably not more than 5 % by weight, based on the total weight of the alkene mixture, of the alkenes contained in the mixture are alkenes wherein one or both carbon atoms of the olefinic double bond carry two substituents different from hydrogen. A suitable technical mixture is e.g. a C₄-cut comprising 1-butene, 2-butene and isobutene, wherein isobutene is contained in an amount of not more than 20% by weight, preferably not more than 10% by weight, more preferably not more than 5 % by weight, based on the total weight of the composition.

[0050] In a special embodiment, R¹ is derived from dodecene, tridecene, tetradecene, pentadecene, hexadecene, heptadecene, octadecene, nonadecene, eicosene, or the higher homologs. Preferably, the olefinic double bond in said alkenes is in the α-position and/or the alkenes are linear.

[0051] In an alternative special embodiment, R¹ is derived from the tri-, tetra- or pentamers of butene, hexene or octene.

[0052] In an alternative preferred embodiment, the compound of formula (I) is a mixture of compounds of formula (I) with different radicals R¹, where the mixture contains not more than 10% by weight, preferably not more than 5% by weight, more preferably not more than 3% by weight of compounds of formula (I) wherein R¹ is a C₄-C₇-hydrocarbyl group, e.g. a C₄-C₇-alkyl group or a C₄-C₇-alkenyl group.

[0053] In the definition of X and Y, R² is preferably hydrogen or C₁-C₈-alkyl. In a particular embodiment, R² is hydrogen or C₁-C₄-alkyl. Especially, R² is hydrogen.

[0054] Preferably, (M^{x+})_{1/x} is an alkali metal equivalent, an alkaline earth metal equivalent, an ammonium cation NH₄⁺ or a substituted ammonium cation. Correspondingly, x is 1 if M is an alkali metal or an ammonium cation NH₄⁺ and x is

2 if M is an alkaline earth metal. Preferred alkali metals are lithium, sodium and potassium and consequently, preferred alkali metal equivalents are Li^+ , Na^+ and K^+ . Preferred alkaline earth metals are magnesium and calcium and consequently, preferred alkaline earth metal equivalents are $\frac{1}{2} \text{Mg}^{2+}$ and $\frac{1}{2} \text{Ca}^{2+}$.

[0055] In case $(\text{M}^{x+})_{1/x}$ is a substituted ammonium cation, this is preferably derived from a monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, from a diamine of the formula $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NR}^6\text{R}^7$ or from a polyamine of the formula $\text{NR}^{13}\text{R}^{14}\{\text{A-NR}^8\}_w\text{A-NR}^6\text{R}^7$, where

R^{10} , R^{11} , and R^{12} are, independently of each other, hydrogen, $\text{C}_1\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, with the proviso that at least one of the radicals R^{10} , R^{11} , and R^{12} is different from hydrogen;

R^{13} and R^{14} are, independently of each other, hydrogen, $\text{C}_1\text{-C}_8\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$;

R^6 , R^7 and R^8 are, independently of each other, hydrogen, $\text{C}_1\text{-C}_8\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$;

A is a $\text{C}_2\text{-C}_4\text{-alkylene}$ group; and

w is an integer from 1 to 8.

[0056] Suitable and preferred amines from which the cations are derived are listed below.

[0057] Preferably, R^8 is hydrogen or $\text{C}_1\text{-C}_8\text{-alkyl}$. In a more preferred embodiment, R^8 is hydrogen or $\text{C}_1\text{-C}_4\text{-alkyl}$, especially hydrogen, methyl or ethyl and in particular hydrogen.

[0058] In a preferred embodiment, R^6 and R^7 are, independently of each other, hydrogen or $\text{C}_1\text{-C}_4\text{-alkyl}$, especially hydrogen, methyl or ethyl and in particular hydrogen.

[0059] A is preferably 1,2-ethylene $(\text{-CH}_2\text{CH}_2\text{-})$, 1,2-propylene $(\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-}$ or $\text{-CH}(\text{CH}_3)\text{-CH}_2\text{-})$, 1,3-propylene $(\text{-CH}_2\text{CH}_2\text{CH}_2\text{-})$ or 1,4-butylene $(\text{-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{-})$. In particular, A is 1,2-ethylene.

[0060] The ammonium cation derived from the above amines generally results from the addition of a cation, preferably of a proton H^+ to at least part of the basic nitrogen atoms present in the amine. Consequently, the ammonium cation derived from the monoamine preferably has the formula $[\text{NHR}^{10}\text{R}^{11}\text{R}^{12}]^+$; preferably, the ammonium cation derived from the diamine is either a monocation of the formula $[\text{NHR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NR}^6\text{R}^7]^+$ or $[\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NHR}^6\text{R}^7]^+$ or a dication of the formula $[\text{NHR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NHR}^6\text{R}^7]^{2+}$; and preferably, the ammonium cation derived from the polyamine is either a monocation or a polycation having from 2 to $(w+2)$ positive charges, depending on the number of protonated nitrogen atoms in the molecule.

[0061] Preferably, in the monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, R^{10} , R^{11} and R^{12} are, independently of each other, hydrogen, $\text{C}_8\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, more preferably hydrogen, $\text{C}_8\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, even more preferably hydrogen, $\text{C}_{10}\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, in particular hydrogen, $\text{C}_{12}\text{-C}_{16}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, with the proviso that at least one of the radicals R^{10} , R^{11} and R^{12} is not hydrogen.

[0062] Preferred radicals R^{13} and R^{14} are hydrogen, $\text{C}_1\text{-C}_4\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, more preferred being hydrogen and $\text{C}_1\text{-C}_4\text{-alkyl}$. In the cations derived from di- and polyamines, preferably at least 2 of the radicals R^{13} , R^{14} , R^6 and R^7 are hydrogen. More preferably, at least one of the radicals R^{13} and R^{14} and least one of the radicals R^6 and R^7 is hydrogen. In particular, all four radicals R^6 , R^7 , R^{13} and R^{14} are hydrogen. Especially, R^8 is also hydrogen.

[0063] Preferably, M^{x+} is a substituted ammonium cation.

[0064] In a more preferred embodiment, M^{x+} is a substituted ammonium cation derived from a diamine of the formula $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NR}^6\text{R}^7$ or from a polyamine of the formula $\text{NR}^{13}\text{R}^{14}\{\text{A-NR}^8\}_w\text{A-NR}^6\text{R}^7$, where R^6 , R^7 , R^8 , R^{13} , R^{14} , A and w and there preferred embodiments are as defined above.

[0065] In an alternatively more preferred embodiment, M^{x+} is a substituted ammonium cation derived from a monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, where at least one of the radicals R^{10} , R^{11} and R^{12} is $\text{C}_8\text{-C}_{20}\text{-alkyl}$, preferably $\text{C}_{10}\text{-C}_{20}\text{-alkyl}$, more preferably $\text{C}_{12}\text{-C}_{16}\text{-alkyl}$, and the remaining radical(s) is/are hydrogen. In particular, one or two, preferably one, of the radicals R^{10} , R^{11} and R^{12} is $\text{C}_8\text{-C}_{20}\text{-alkyl}$, preferably $\text{C}_{10}\text{-C}_{20}\text{-alkyl}$, more preferably $\text{C}_{12}\text{-C}_{16}\text{-alkyl}$, and the remaining radical(s) are hydrogen.

[0066] In an alternatively more preferred embodiment, M^{x+} is a substituted ammonium cation derived from a monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, where R^{10} is $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, preferably $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, R^{11} is $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, e.g. $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, or $\text{C}_1\text{-C}_8\text{-alkyl}$, e.g. $\text{C}_1\text{-C}_4\text{-alkyl}$, and R^{12} is $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, e.g. $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, $\text{C}_1\text{-C}_8\text{-alkyl}$, e.g. $\text{C}_1\text{-C}_4\text{-alkyl}$, or hydrogen.

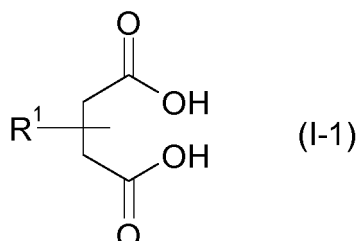
[0067] In case X and Y together form a group -O- , the compound of formula (I) is a hydrocarbyl-substituted succinic acid anhydride.

[0068] In a particularly preferred embodiment, X and Y are, independently of each other, OH or $\text{O}(\text{M}^{x+})_{1/x}$, or X and Y together form a group -O- . Preferably, $(\text{M}^{x+})_{1/x}$ is an alkali or alkaline earth metal cation or more preferably an ammonium

cation NH_4^+ or a substituted ammonium cation as defined above. In an even more preferred embodiment, $(\text{M}^{x+})_{1/x}$ is an ammonium cation derived from substituted amines, preferably from the above-described monoamines, diamines or polyamines and in particular from the above-described diamines or polyamines. Examples of suitable substituted amines are listed below.

[0069] In an even more preferred embodiment, Y are, independently of each other, OH or $\text{O}^-(\text{M}^{x+})_{1/x}$, where M and x and their preferred embodiments are as defined above. Preferably, $(\text{M}^{x+})_{1/x}$ is an alkali or alkaline earth metal cation or more preferably an ammonium cation NH_4^+ or a substituted ammonium cation as defined above. In an even more preferred embodiment, $(\text{M}^{x+})_{1/x}$ is an ammonium cation derived from substituted amines, preferably from the above-described monoamines, diamines or polyamines and in particular from the above-described diamines or polyamines. Examples of suitable substituted amines are listed below.

[0070] In particular embodiment, the compound of formula (I) is a hydrocarbyl succinic acid of the formula (I-1)



which is at least partially neutralized by a monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$ or a diamine $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NR}^6\text{R}^7$ or a polyamine of the formula $\text{NR}^{13}\text{R}^{14}\{\text{A-NR}^8\}_w\text{A-NR}^6\text{R}^7$, where

R^{10} , R^{11} , and R^{12} are, independently of each other, hydrogen, $\text{C}_1\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$;

R^{13} and R^{14} are, independently of each other, hydrogen, $\text{C}_1\text{-C}_8\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$;

w is an integer from 1 to 8; and

R^1 , R^6 , R^7 , R^8 and A and their preferred embodiments are as defined above.

[0071] In the monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, the radicals R^{10} , R^{11} and R^{12} are, independently of each other, preferably hydrogen, $\text{C}_8\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, more preferably hydrogen, $\text{C}_8\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, even more preferably hydrogen, $\text{C}_{10}\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, in particular hydrogen, $\text{C}_{12}\text{-C}_{16}\text{-alkyl}$ or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$, with the proviso that at least one of the radicals R^{10} , R^{11} and R^{12} is not hydrogen.

[0072] In the diamine or in the polyamine, R^6 , R^7 , R^{13} and R^{14} are, independently of each other, preferably hydrogen, $\text{C}_1\text{-C}_4\text{-alkyl}$, or $\text{C}_2\text{-C}_4\text{-hydroxyalkyl}$. More preferably, R^6 , R^7 , R^{13} and R^{14} are, independently of each other, hydrogen or $\text{C}_1\text{-C}_4\text{-alkyl}$. In an even more preferred embodiment, at least two of the radicals R^{13} , R^{14} , R^6 and R^7 are hydrogen. More preferably, at least one of the radicals R^{13} and R^{14} and least one of the radicals R^6 and R^7 is hydrogen. In particular, all four radicals R^6 , R^7 , R^{13} and R^{14} are hydrogen. Especially, R^8 is also hydrogen.

[0073] Examples for useful monoamines $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, wherein R^{10} , R^{11} and R^{12} are hydrogen, $\text{C}_1\text{-C}_{20}\text{-alkyl}$ or $\text{C}_2\text{-C}_8\text{-hydroxyalkyl}$, are ammonia and primary, secondary or tertiary monoamines, such as methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, ethanolamine, diethanolamine, triethanolamine, ethanolethylamine, ethanoldiethylamine, ethanolpropylamine, ethanoldipropylamine, ethanolbutylamine, ethanoldibutylamine, propylamine, dipropylamine, tripropylamine, propanolamine, dipropanolamine, tripropanolamine, propanolethylamine, propanoldiethylamine, propanolpropylamine, propanoldipropylamine, propanolbutylamine, propanoldibutylamine, isopropylamine, diisopropylamine, triisopropylamine, ethyldiisopropylamine, butylamine, dibutylamine, tributylamine, isobutylamine, diisobutylamine, tert-butylamine, di-tert-butylamine, pentylamine, hexylamine, heptylamine, octylamine, 2-ethylhexylamine, nonylamine, decylamine, undecylamine, dodecylamine, tridecylamine, tetradecylamine, pentadecylamine, hexadecylamine, heptadecylamine, octadecylamine, nonadecylamine, eicosylamine and the like. Mixtures of amines are also suitable. Preferred monoamines are the above alkanolamines and $\text{C}_8\text{-C}_{20}\text{-alkylamines}$, such as octylamine, 2-ethylhexylamine, nonylamine, decylamine, undecylamine, dodecylamine, tridecylamine, tetradecylamine, pentadecylamine, hexadecylamine, heptadecylamine, octadecylamine, nonadecylamine and eicosylamine.

[0074] Examples for diamines of the formula $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-alkylene-NR}^6\text{R}^7$ and for polyamines of the formula $\text{NR}^{13}\text{R}^{14}\{\text{A-NR}^8\}_w\text{A-NR}^6\text{R}^7$ are ethylenediamine, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, pentaethylenhexamine, propylenediamine, dipropylentriamin, tripropylenetetramine, tetrapropylenepentamine, pentapro-

pylenehexamine, butylenediamine, dibutylenetriamine, tributylene-tetramine, tetrabutylene-pentamine, pentabutylene-hexamine, pentylenediamine, hexylenediamine, heptylenediamine, octylenediamine, N,N-dimethylethylene-1,2-diamine, N,N'-dimethylethylene-1,2-diamine, N,N-diethylethylene-1,2-diamine, N,N'-diethylethylene-1,2-diamine, N,N-diethanoethylethylene-1,2-diamine, N,N'-diethanoethylethylene-1,2-diamine, N,N-dipropylethylene-1,2-diamine, N,N'-dipropylethylene-1,2-diamine, N,N-dipropanoethylethylene-1,2-diamine, N,N'-dipropanoethylethylene-1,2-diamine, N,N-dimethylpropylene-1,3-diamine, N,N'-dimethylpropylene-1,3-diamine, N,N-diethylpropylene-1,3-diamine, N,N'-diethylpropylene-1,3-diamine, N,N-diethanolpropylene-1,3-diamine, N,N'-diethanolpropylene-1,3-diamine, N,N-dipropylpropylene-1,3-diamine, N,N'-dipropylpropylene-1,3-diamine, N,N-dipropanolpropylene-1,3-diamine, N,N'-dipropanolpropylene-1,3-diamine, N,N-dimethylbutylene-1,4-diamine, N,N'-dimethylbutylene-1,4-diamine, N,N-diethylbutylene-1,4-diamine, N,N'-diethylbutylene-1,4-diamine, N,N-diethanolbutylene-1,4-diamine, N,N'-diethanolbutylene-1,4-diamine, N,N-dipropylbutylene-1,4-diamine, N,N'-dipropylbutylene-1,4-diamine, N,N-dipropanolbutylene-1,4-diamine, N,N'-dipropanolbutylene-1,4-diamine, N,N-dimethylpentylene-1,5-diamine, N,N'-dimethylpentylene-1,5-diamine, N,N-diethylpentylene-1,5-diamine, N,N'-diethylpentylene-1,5-diamine, N,N-diethanolpentylene-1,5-diamine, N,N'-diethanolpentylene-1,5-diamine, N,N-dipropylpentylene-1,5-diamine, N,N'-dipropylpentylene-1,5-diamine, N,N-dipropanolpentylene-1,5-diamine, N,N'-dipropanolpentylene-1,5-diamine, N,N-dimethylhexylene-1,6-diamine, N,N'-dimethylhexylene-1,6-diamine, N,N-diethylhexylene-1,6-diamine, N,N'-diethylhexylene-1,6-diamine, N,N-diethanolhexylene-1,6-diamine, N,N'-diethanolhexylene-1,6-diamine, N,N-dipropylhexylene-1,6-diamine, N,N'-dipropylhexylene-1,6-diamine, N,N-dipropanolhexylene-1,6-diamine, N,N'-dipropanolhexylene-1,6-diamine, bis[2-(N,N-dimethylamino)ethyl]amine, bis[2-(N,N-diethylamino)ethyl]amine, bis[2-(N,N-dipropylamino)ethyl]amine, bis[3-(N,N-dimethylamino)propyl]amine, bis[3-(N,N-diethylamino)propyl]amine, bis[3-(N,N-dipropylamino)propyl]amine, bis[4-(N,N-dimethylamino)butyl]amine, bis[4-(N,N-diethylamino)butyl]amine, bis[4-(N,N-dipropylamino)butyl]amine, bis[5-(N,N-dimethylamino)pentyl]amine, bis[5-(N,N-diethylamino)pentyl]amine, bis[5-(N,N-dipropylamino)pentyl]amine, bis[6-(N,N-dimethylamino)hexyl]amine, bis[6-(N,N-diethylamino)hexyl]amine, bis[6-(N,N-dipropylamino)hexyl]amine and the like. Such polyamines are described in Kirk-Othmers "Encyclopedia of Chemical Technology", 2nd edition, volume 7, pages 22 to 37, Interscience Publishers, New York (1965, chapter "Ethyleneamines"), which is hereby fully incorporated by reference.

[0075] In an alternative particular embodiment of the invention, the compound of formula (I) is a hydrocarbyl succinic acid of the formula (I-1).

[0076] Processes for preparing hydrocarbyl-substituted succinic acids and their derivatives are well known. For instance, the German patent application DE-A-10123553.4 describes the preparation of a polyalkenyl-substituted carboxylic acid or a derivative thereof by the reaction of a polyalkene with a monounsaturated acid or its derivative, in which the polyalkene adds in an ene reaction to the double bond of the acid component. If desired, the obtained alkenyl-substituted succinic acid derivative may then be converted into the corresponding alkyl-substituted succinic acid derivative by hydrogenating the olefinic double bond by known methods.

[0077] Processes for converting the obtained hydrocarbyl-substituted succinic acid or its derivative into another derivative are also well known. For instance, the acid halide can be prepared by reacting the anhydride with halogenation agents, such as SOCl_2 , PCl_3 or PBr_3 . The acid halide can then be converted into the mono- or diester by reacting with the corresponding amount of an alcohol R^2OH . The acid salts can be prepared e.g. by hydrolyzing the anhydride with a metal hydroxide or by reacting the acid with an amine. The hydrocarbyl succinic amides, i.e. compounds of formula (I), wherein X and/or Y are a group NR^3R^4 and R^3 and/or R^4 are C_1 - C_8 -alkyl, C_2 - C_8 -hydroxyalkyl, a group C_2 - C_8 -alkylene- NR^6R^7 or a group of the formula $\{\text{A}-\text{NR}^8\}_y\text{A}-\text{NR}^6\text{R}^7$, can be prepared by reacting a suitable hydrocarbyl succinic acid derivative with the above-described amines under appropriate conditions known in the art.

[0078] Preferably, the gasoline is additized with the compound of formula (I) in an amount of from 10 to 300, more preferably from 20 to 200, in particular from 25 to 150 mg per kg of the gasoline.

[0079] Preferably, the compound of formula (I) is used in the gasoline in combination with at least one further conventional fuel additive. Conventional fuel additives are, e.g., detergent additives, carrier oils, corrosion inhibitors, antioxidants, antistatics, markers, etc., and mixtures thereof.

A) Detergent additives

[0080] Additives having a detergent action or an anti-valve seat recession action are e.g. compounds which contain at least one hydrophobic hydrocarbon group having a number-average molecular weight (M_n) of from 85 to 20,000 and at least one polar group selected from

(a) monoamino or polyamino groups containing up to 6 nitrogen atoms, of which at least one has alkaline properties,

(b) nitro groups, optionally combined with hydroxyl groups,

(c) hydroxyl groups combined with monoamino or polyamino groups, in which at least one nitrogen atom has alkaline

properties,

(d) carboxylic acid groups or the alkali metal or alkaline earth metal salts thereof,

(e) sulfo groups or the alkali metal or alkaline earth metal salts thereof,

(f) polyoxy-(C₂-C₄ alkylene) groups which are terminated by hydroxyl groups, by monoamino or polyamino groups, in which at least one nitrogen atom has alkaline properties, or by carbamate groups,

(g) carboxylate groups,

(h) groups derived from succinic anhydride and containing hydroxyl and/or amino and/or amido and/or imido groups, which are different from compounds of formula (I); and

(i) groups produced by Mannich reaction of substituted phenols with aldehydes and mono- or poly-amines.

[0081] The hydrophobic hydrocarbon group in the additives, which provides sufficient solubility in the fuel, has a number-average molecular weight (M_n) of from 85 to 20,000, preferably from 113 to 10,000 and more preferably from 300 to 5000. Typical hydrophobic hydrocarbon groups, particularly in conjunction with the polar groups (a), (c), (h) and (i), are polypropenyl, polybutenyl and polyisobutenyl radicals having molecular weights M_n of from 300 to 5000, preferably from 500 to 2500 and more preferably from 750 to 2250.

[0082] The following examples of individual fuel additives having a detergent action or an anti-valve seat recession effect are mentioned by way of example.

[0083] Additives containing monoamino or polyamino groups (a) are preferably polyalkene monoamines or polyalkene polyamines based on polypropylene or highly reactive (*ie* containing predominantly terminal double bonds - mostly in the β - and γ -positions) or conventional (*ie* containing predominantly centered double bonds) polybutylene or polyisobutylene having a molecular weight M_n of from 300 to 5000. Such additives based on highly reactive polyisobutylene which can be prepared from the polyisobutylene containing up to 20 wt% of n-butylene units, by hydroformylation and reductive amination with ammonia, monoamines or polyamines such as dimethylaminopropylamine, ethylenediamine, diethylenetriamine, triethylenetetramine or tetraethylenepentamine, are disclosed, in particular, in EP-A 244,616. If the synthesis of the additives is based on polybutylene or polyisobutylene having predominantly centered double bonds (mostly in the β and γ positions) as starting materials, an obvious choice is the synthesis method involving chlorination and subsequent amination, or oxidation of the double bond with air or ozone to form the carbonyl or carboxyl compound, with subsequent amination under reductive (hydrogenating) conditions. This amination may be carried out using the same amines as mentioned above for the reductive amination of hydroformylated, highly reactive polyisobutylene. Corresponding additives based on polypropylene are described, in particular, in WO-A 94/24231.

[0084] Further preferred additives containing monoamino groups (a) are the hydrogenation products of the reaction products of polyisobutylenes having an average degree of polymerization P of from 5 to 100 with nitrogen oxides or mixtures of nitrogen oxides and oxygen, as described, in particular, in WO-A 97/03946.

[0085] Further preferred additives containing monoamino groups (a) are the compounds produced from polyisobutylene epoxides by reaction with amines followed by dehydration and reduction of the amino alcohols, as described, in particular, in DE-A 196 20 262.

[0086] Additives containing nitro groups, optionally combined with hydroxyl groups (b), are preferably reaction products of polyisobutylenes having an average degree of polymerization P of from 5 to 100 or from 10 to 100 with nitrogen oxides or mixtures of nitrogen oxides and oxygen, as described, in particular, in WO-A 96/03367 and WO-A 96/03479. These reaction products are usually mixtures of pure nitropolyisobutanes (eg α,β -dinitropolyisobutane) and mixed hydroxynitropolyisobutanes (eg α -nitro- β -hydroxypolyisobutane).

[0087] Additives containing hydroxyl groups combined with monoamino or polyamino groups (c) are in particular reaction products of polyisobutylene epoxides, obtainable from polyisobutylene preferably containing predominantly terminal double bonds and having a molecular weight M_n of from 300 to 5000, with ammonia or mono- or polyamines, as described, in particular, in EP-A 476,485.

[0088] Additives containing carboxylic acid groups or the alkali metal or alkaline earth metal salts thereof (d) are preferably copolymers of C₂-C₄₀ olefins with maleic anhydride having a total molecular weight of from 500 to 20,000 whose carboxylic acid groups have been converted entirely or partially to the alkali metal or alkaline earth metal salts and the remainder of the carboxylic acid groups has been caused to react with alcohols or amines. Such additives are disclosed, in particular, in EP-A 307,815. Said additives mainly serve to prevent valve seat recession and can be used, as described in WO-A 87/01126, with advantage combined with conventional fuel detergents such as poly(iso)butylene amines or polyether amines.

[0089] Additives containing sulfo groups or the alkali metal or alkaline earth metal salts thereof (e) are preferably alkali metal or alkaline earth metal salts of an alkyl sulfosuccinate, as described, in particular, in EP-A 639,632. Such additives mainly serve to prevent valve seat recession and can be used with advantage combined with conventional fuel detergents such as poly(iso)butylene amines or polyether amines.

[0090] Additives containing polyoxy-(C₂-C₄ alkylene) groups (f) are preferably polyethers or polyether amines, which are obtained by reaction of C₂-C₆₀ alkanols, C₆-C₃₀ alkanediols, mono- or di-(C₂-C₃₀ alkyl)amines, (C₁-C₃₀ alkyl)cyclohexanols or (C₁-C₃₀ alkyl)phenols with from 1 to 30 mol of ethylene oxide and/or propylene oxide and/or butylene oxide per hydroxyl group or amino group and, in the case of polyether amines, by subsequent reductive amination with ammonia, monoamines or polyamines. Such products are described, in particular, in EP-A 310,875, EP-A 356,725, EP-A 700,985 and US-A 4,877,416. In the case of polyethers such products also have flotation oil characteristics. Typical examples thereof are tridecanol butoxylates or isotridecanol butoxylates, isononylphenol butoxylates, polyisobutenol butoxylates and polyisobutenol propoxylates and the corresponding reaction products with ammonia.

[0091] Additives containing carboxylate groups (g) are preferably esters of mono-, di- or tri-carboxylic acids with long-chain alkanols or polyols, in particular those having a minimum viscosity of 2 mm²/s at 100°C, as described, in particular, in DE-A 3,838,918. The mono-, di- or tri-carboxylic acids used can be aliphatic or aromatic acids, and suitable ester alcohols or ester polyols are primarily long-chain representatives containing, for example, from 6 to 24 carbon atoms. Typical representatives of these esters are adipates, phthalates, isophthalates, terephthalates and trimellitates of isooctanol, isononanol, isodecanol and isotridecanol. Such products also have flotation oil characteristics.

[0092] Additives containing groups derived from succinic anhydride and containing hydroxyl and/or amino and/or amido and/or imido groups (h) are preferably corresponding derivatives of polyisobutenyl succinic anhydride, which are obtained by reaction of conventional or highly reactive polyisobutylene having a molecular weight M_n of from 300 to 5000 with maleic anhydride by thermal treatment or via chlorinated polyisobutylene. Of special interest in this respect are derivatives with aliphatic polyamines such as ethylenediamine, diethylenetriamine, triethylenetetramine or tetrethylenepentamine. Such fuel additives are described, in particular, in US-A 4,849,572.

[0093] Additives containing groups (i) produced by Mannich reaction of substituted phenols with aldehydes and mono- or polyamines are preferably reaction products of polyisobutylene-substituted phenols with formaldehyde and mono- or polyamines such as ethylenediamine, diethylenetriamine, triethylenetetramine, tetrethylenepentamine or dimethylaminopropylamine. The polyisobutenyl-substituted phenols can be derived from conventional or highly reactive polyisobutylene having a molecular weight M_n of from 300 to 5000. Such "polyisobutylene Mannich bases" are described, in particular, in EP-A 831,141.

B) Carrier oils

[0094] Examples of conventional carrier oils are, for example, mineral carrier oils (base oils) and synthetic carrier oils. Examples for suitable mineral carrier oils are in particular those of viscosity class Solvent Neutral (SN) 500 to 2000, as well as aromatic and paraffinic hydrocarbons and alkoxyalkanols. Examples for synthetic carrier oils are olefin polymers with M_N = 400 to 1800 based on poly- α -olefins or poly-internal-olefins, especially those based on polybutene or on polyisobutene (hydrogenated or nonhydrogenated); further polyesters, polyalkoxylates, polyethers, aliphatic polyether amines, and carboxylic acids of long-chain alkanols. Preferably, synthetic carrier oils are used. Preferred synthetic carrier oils are alkanol alkoxyates, in particular alkanol propoxylates and alkanol butoxylates.

C) Further additives

[0095] Further conventional components and assistants are corrosion inhibitors, for example based on ammonium salts of organic carboxylic acids different from compounds I, which salts tend to form films, or on heterocyclic aromatics in the case of corrosion protection of nonferrous metals, antioxidants or stabilizers, for example based on amines, such as p-phenylenediamine, dicyclohexylamine or derivatives thereof and on phenols, such as 2,4-di-tert-butylphenol or 3,5-di-tert-butyl-4-hydroxyphenylpropionic acid, dehazers, demulsifiers, antistatic agents, metallocenes such as ferrocene or methylcyclopentadienyl manganese tricarbonyl, lubricity additives (different from compound (I)), such as certain fatty acids, alkenylsuccinic esters, bis(hydroxyalkyl)fatty amines, hydroxyacetamides and castor oil, antiknock additives, anti-icing additives, octane requirement additives, and also colorants (markers). Sometimes amines are also added for increasing the pH of the fuel.

[0096] The term "gasoline" includes blends of distillate hydrocarbon fuels with oxygenated compounds such as ethanol, as well as the distillate fuels themselves.

[0097] Suitable gasolines are e.g. those described in Ullmann's Encyclopedia of Industrial Chemistry, 5th edition, 1990, volume A16, page 719 ff.

[0098] Suitable gasolines are e.g. those having an aromatics content of not more than 60% by volume, e.g. not more than 42% by volume or not more than 35% by volume and/or a sulfur content of not more than 2000 ppm by weight,

e.g. not more than 150 ppm by weight or not more than 10 ppm by weight.

[0099] In a preferred embodiment, the aromatics content of the gasoline is e.g. from 10 to 50% by volume, e.g. from 30 to 42% by volume, in particular from 32 to 40% by volume or not more than 35% by volume.

[0100] In another preferred embodiment, the sulfur content is e.g. of from 2 to 500 ppm by weight, e.g. of from 5 to 100 or not more than 10 ppm by weight.

[0101] In another preferred embodiment, the olefin content of the gasoline can be up to 50% by volume, e.g. from 6 to 21% by volume, in particular from 7 to 18% by volume.

[0102] In another preferred embodiment, the gasoline has a benzene content of not more than 5% by volume, e.g. from 0.5 to 1.0% by volume, in particular from 0.6 to 0.9% by volume.

[0103] In another preferred embodiment, the gasoline has an oxygen content of not more than 25% by weight, e.g. up to 10% by weight or from 1.0 to 2.7% by weight, and in particular from 1.2 to 2.0% by weight.

[0104] Particular preference is given to a gasoline which has an aromatics content of not more than 38% by volume or preferably not more than 35% by volume, and at the same time an olefin content of not more than 21% by volume, a sulfur content of not more than 50 or 10 ppm by weight, a benzene content of not more than 1.0% by volume and an oxygen content of from 1.0 to 2.7% by weight.

[0105] The amount of alcohols and ethers contained in the gasoline may vary over wide ranges. Typical maximum contents are e.g. methanol 15% by volume, ethanol 65% by volume, isopropanol 20% by volume, tert-butanol 15% by volume, isobutanol 20% by volume and ethers containing 5 or more carbon atoms in the molecule 30% by volume.

[0106] The summer vapor pressure of the gasoline (at 37°C) is usually not more than 70kPa, in particular not more than 60kPa.

[0107] The research octane number (RON) of the gasoline is usually from 75 to 105. A usual range for the corresponding motor octane number (MON) is from 65 to 95.

[0108] The above characteristics are determined by conventional methods (DIN EN 228).

[0109] Moreover, an additive concentrate can be used, comprising at least one compound of the formula (I) as defined above and at least one diluent and optionally at least one further additive. Suitable additional additives are those mentioned above.

[0110] Preferably, the additive concentrate contains at least one further additive selected from carrier oils, detergents, corrosion inhibitors, demulsifiers, conductivity improvers, odorants, markers, dyes, solvents, anti-valve seat recession additives and octane requirement additives. More preferably, the additive concentrate of the invention contains at least one carrier oil and optionally at least one further additive selected from detergents, corrosion inhibitors, demulsifiers, conductivity improvers, odorants, markers, dyes, solvents, anti-valve seat recession additives and octane requirement additives. Even more preferably, the additive concentrate of the invention contains at least one carrier oil, at least one detergent and/or corrosion inhibitor and optionally at least one further additive selected from demulsifiers, conductivity improvers, odorants, markers, dyes, solvents, anti-valve seat recession additives and octane requirement additives.

[0111] Preferably, the detergent is selected from detergents of the above group (a), in particular polyisobutene monoamines, and detergents of the above group (i), in particular polyisobutyl Mannich bases.

[0112] In the additive concentrate, the compound(s) of formula I are preferably present in an amount of from 0.1 to 95 % by weight, more preferably from 1 to 80 % by weight, even more preferably from 5 to 70 % by weight, in particular from 10 to 70 % by weight, based on the total weight of the concentrate. If the additive concentrate contains a further additive, the compounds of formula I are preferably present in an amount of from 0.1 to 80 % by weight, more preferably from 1 to 70 % by weight, even more preferably from 5 to 50 % by weight, in particular from 5 to 30 % by weight, based on the total weight of the concentrate.

Suitable diluents are e.g. aromatic and aliphatic hydrocarbons, such as benzene, toluene, the xylenes, solvent naphtha, and alkanols with 3 to 8 carbon atoms, e.g. propanol, isopropanol, n-butanol, sec-butanol, isobutanol and the like, in combination with hydrocarbon solvents, and alkoxyalkanols.

[0113] Finally, a gasoline composition with improved friction properties can be obtained, where a gasoline or a commercial gasoline composition is additized with at least one compound of the formula (I) as defined above or with the additive concentrate as defined above.

[0114] The compound(s) of formula (I) and optionally said additional additives are metered into the gasoline or gasoline composition, where they become effective. The compounds (I) and optionally the additional additives can be added to the gasoline or to gasoline fuel composition individually or as a previously prepared additive concentrate (additive package).

[0115] The compounds of formula (I) exhibit, in addition to their good friction modifying characteristics, a good compatibility with other additives and solvents in the additive concentrates and a good solubility in the fuel. Moreover, they do not adversely affect the properties of other additives present in the fuel or in the additive concentrate. In particular, they do not promote the formation of water/fuel emulsions, which is a serious problem in regard of corrosion, filter plugging, accumulation of contaminants in the engine and engine wear. Furthermore, they exhibit an additional corrosion protection for metals, especially for aluminium, magnesium, tin, lead, copper, iron, zinc, chromium, manganese and

silver, and for alloys containing at least one of these metals.

[0116] The invention is illustrated by, but not restricted to, the following examples.

Examples:

1. Preparation examples

1.1 Preparation of octadecenyl-substituted succinic anhydride

[0117] 126 g of octadec-1-ene and 0.37 g of HQME (hydroquinone monomethyl ether) were heated to 180°C and 49 g of maleic anhydride were added. The reactive mixture was stirred at 200°C until a product mixture containing 10.2% octadec-1-ene, 74.6% of the monomaleinated product and 15.1% of the bismaleinated product was obtained. Unreacted maleic anhydride was removed under high-vacuum conditions.

1.2 Preparation of octadecenyl-substituted succinic acid

[0118] 50 g of the product obtained in example 1.1 were stirred in the presence of 20 g water at 100-130°C. Excessive water was removed at 70°C under reduced pressure. The obtained product had an acid number of 6.2 mmol/g.

1.3 Preparation of oligohexenyl-substituted succinic acid

[0119] An oligohexene containing 80% trimer of hexene (and 20% tetramer and higher hexene oligomers; obtained by oligomerization of 3-hexene according to the procedure described in WO 00/39058), was reacted with maleic anhydride as described in example 1.1. 6.5 g of the resulting product were dissolved in 100 ml tetrahydrofurane and hydrolyzed with 1.625 g of KOH at room temperature. 10 g of a strong acidic ion exchanger were added and the mixture was stirred for 30 minutes. After filtration, the solvent was evaporated under reduced pressure to yield a product having an acid number of 3.8 mmol/g.

1.4 Preparation of dodecenyl-substituted succinic acid

[0120] 13.3 g of 2-dodecen-1-yl succinic anhydride were reacted as described in example 1.3 to yield a product having an acid number of 7.0 mmol/g.

2. Preparation of the fuel compositions

[0121] Keropur® 3458N (commercial product of BASF containing polyisobutene amine with $M_n = 1000$ and tridecanolpolypropoxylate (tridecanol 15×PO) and also a dimeric fatty acid as corrosion protection)) was heated to 60°C. To this was added a compound of formula (I) (additive of table 1 below) and the mixture was stirred at that temperature for one hour.

3. Application examples - High Frequency Reciprocating Rig (HFFR)-Test

[0122] For evaluating the lubricity/wear of gasolines, a High Frequency Reciprocating Rig (HFFR)-test - a standard procedure for evaluating diesel fuel lubricity - was carried out using a HFFR-apparatus from PCS instruments, London. The test conditions (according to CEC F-06-A-96) were modified to suit the use of gasolines (temperature: 25°C; load: 720 g). The applicability of the HFFR-test to gasolines is proved by D. Margaroni, Industrial Lubrication and Tribology, Vol. 50, No. 3, May/June 1998, pp. 108-118, and W. D. Ping, S. Korcek, H. Spikes, SAE Techn. Paper 962010, pp. 51-59 (1996).

[0123] Prior to testing, the gasolines (gasolines according to EN 228) were gently concentrated to 50 vol.-% using the distillation apparatus MP 628 from Herzog, Lauda-Königshofen, Germany. The lubricity of the unadditized concentrated gasoline (control) was tested according to the above-described HFFR-test and compared with the lubricity observed when the concentrated gasoline was additized as shown in table 1. The resulting wear scar diameters are also listed in table 1. The lower the value of the wear scar diameter, the better the performance of the additive in the fuel composition.

Table 1: Wear Scar Diameters in Gasoline

Example	Additive	Treat Rate [mg/kg]	Wear Scar Diameter [μm]
3.1	control	-	919

(continued)

Example	Additive	Treat Rate [mg/kg]	Wear Scar Diameter [μm]
3.2	Keropur 3458 N	500	874
3.3	Keropur 3458 N + product of example 1.3	500 + 50	732
3.4	Keropur 3458 N + product of example 1.3	500 + 100	650
3.5	Keropur 3458 N + product of example 1.4	500 + 50	827

4. Emulsification behavior according to DIN 51415

[0124] The test was carried out with 500 mg/kg Keropur 3458 N and 50 mg/kg tetrapropenylsuccinic acid in a gasoline according to EN 228 (RON 95; pH 7). The results are shown in table 2 below.

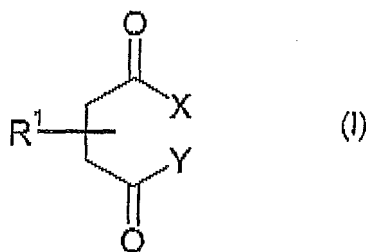
Table 2: Emulsification

minutes	rating
1	1B
5	1
30	1
60	1

[0125] As the results show, no emulsion is formed.

Claims

1. The use of at least one hydrocarbyl succinic acid or hydrocarbyl succinic acid derivative of the formula (I)



wherein

R¹ is a linear or branched C₄-C₄₀-alkenyl or C₄-C₄₀-alkyl group, wherein at least 95% of the carbon atoms are not quaternary, or R¹ is a C₁-C₂₀-alkylaryl group;

X and Y are, independently of each other, OR² or O⁻(M^{x+})_{1/x} or X and Y together form a group -O-;

R² is hydrogen, C₁-C₈-alkyl, aryl or C₁-C₂₀-alkylaryl;

(M^{x+})_{1/x} is a metal equivalent, an ammonium cation [NH₄]⁺ or a substituted ammonium cation equivalent; and

x is 1, 2, 3 or 4 in case (M^{x+})_{1/x} is a metal equivalent, or is 1 in case (M^{x+})_{1/x} is an ammonium cation [NH₄]⁺ or is an integer from 1 to 10 in case (M^{x+})_{1/x} is a substituted ammonium cation equivalent,

as friction modifying additive in a gasoline.

2. The use as claimed in claim 1, where R¹ is derived from an α -alkene.
3. The use as claimed in claim 1, where R¹ is derived from a polyalkene obtained by oligo- or polymerization of at least one C₂-C₈-alkene.

4. The use as claimed in any of the preceding claims, where R^2 is hydrogen or C_1 - C_8 -alkyl.

5. The use as claimed in any of the preceding claims, where

(M^{x+})_{1/x} is an alkali metal cation, an alkaline earth metal equivalent, an ammonium cation $[NH_4]^+$ or a substituted ammonium cation equivalent;

x is 1 or 2 in case (M^{x+})_{1/x} is an alkali metal or alkaline earth metal equivalent, or is 1 in case (M^{x+})_{1/x} is an ammonium cation $[NH_4]^+$ or is an integer from 1 to 10 in case (M^{x+})_{1/x} is a substituted ammonium cation equivalent.

6. The use as claimed in any of the preceding claims, where X and Y are, independently of each other, OH or O-(M^{x+})_{1/x}, or together form a group -O-.

7. The use as claimed in claim 6, where X and Y are, independently of each other, OH or O-(M^{x+})_{1/x}.

8. The use as claimed in any of the preceding claims, where the substituted ammonium cation equivalent is derived from a monoamine $NR^{10}R^{11}R^{12}$, from a diamine of the formula $NR^{13}R^{14}$ - C_2 - C_8 -alkylene- NR^6R^7 , or from a polyamine of the formula $NR^{13}R^{14}\{A-NR^8\}_wA-NR^6R^7$, where

R^6 , R^7 and R^8 are, independently of each other, hydrogen, G_1 - C_8 -alkyl or C_2 - C_8 -hydroxyalkyl;

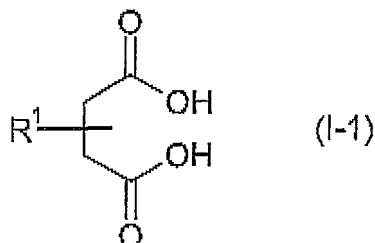
R^{10} , R^{11} and R^{12} are, independently of each other, hydrogen, C_1 - C_{20} -alkyl or C_2 - C_8 -hydroxyalkyl, with the proviso that at least one of the radicals R^{10} , R^{11} , and R^{12} is different from hydrogen;

R^{13} and R^{14} are, independently of each other, hydrogen, C_1 - C_8 -alkyl or C_2 - C_8 -hydroxyalkyl;

A is a C_2 - C_4 -alkylene group; and

w is an integer from 1 to 8.

9. The use as claimed in any of the preceding claims, where the compound of formula (1) is a hydrocarbyl succinic acid of the formula (I-1)



which is at least partially neutralized by a monoamine $NR^{10}R^{11}R^{12}$ or a diamine $NR^{13}R^{14}$ - C_2 - C_8 -alkylene- NR^6R^7 or a polyamine of the formula $NR^{13}R^{14}\{A-NR^8\}_wA-NR^6R^7$, where

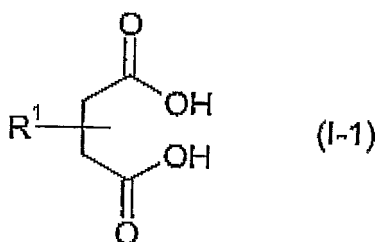
R^{10} , R^{11} and R^{12} are, independently of each other, hydrogen, C_1 - C_{20} -alkyl or C_2 - C_6 -hydroxyalkyl, with the proviso that at least one of the radicals R^{10} , R^{11} , and R^{12} is different from hydrogen

R^{13} and R^{14} are, independently of each other, hydrogen, C_1 - C_8 -alkyl or C_2 - C_8 -hydroxyalkyl;

w is an integer from 1 to 8; and

R^1 , R^6 , R^7 , R^8 and A are as defined in any of claims 1 to 3 and 8.

10. The use as claimed in any of the preceding claims, where the compound of formula (I) is a hydrocarbyl succinic acid of the formula (I-1)



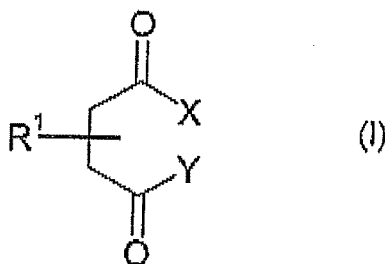
where R^1 is as defined in any of claims 1 to 3.

11. The use as claimed in any of the preceding claims, where the gasoline is additized with the compound of formula (I) in an amount of from 10 to 300 mg per kg of the gasoline.

12. The use as claimed in any of the preceding claims, in combination with at least one further conventional fuel additive.

Patentansprüche

1. Verwendung von mindestens einer Hydrocarbylbernsteinsäure oder einem Hydrocarbylbernsteinsäurederivat der Formel (I)



in der

R^1 für eine lineare oder verzweigte C_4 - C_{40} -Alkenyl- oder C_4 - C_{40} -Alkylgruppe steht, wobei mindestens 95% der Kohlenstoffatome nicht quaternär sind, oder R^1 für eine C_1 - C_{20} -Alkylarylgruppe steht;

X und Y unabhängig voneinander für OR^2 oder $O-(M^{x+})_{1/x}$ stehen oder X und Y zusammen eine Gruppe -O- bilden;

R^2 für Wasserstoff, C_1 - C_8 -Alkyl, Aryl oder C_1 - C_{20} -Alkylaryl steht;

$(M^{x+})_{1/x}$ für ein Metalläquivalent, ein Ammoniumkation $[NH_4]^+$ oder ein substituiertes Ammoniumkationäquivalent steht; und

x für 1, 2, 3 oder 4 steht, wenn $(M^{x+})_{1/x}$ für ein Metalläquivalent steht, oder für 1 steht, wenn

$(M^{x+})_{1/x}$ für ein Ammoniumkation $[NH_4]^+$ steht, oder für eine ganze Zahl von 1 bis 10 steht, wenn

$(M^{x+})_{1/x}$ für ein substituiertes Ammoniumkation-äquivalent steht,

als reibungsverminderndes Additiv in einem Benzin.

2. Verwendung nach Anspruch 1, wobei sich R^1 von einem α -Alken ableitet.

3. Verwendung nach Anspruch 1, wobei sich R^1 von einem durch Oligo- oder Polymerisation mindestens eines C_2 - C_8 -Alkens erhaltenen Polyalken ableitet.

4. Verwendung nach einem der vorhergehenden Ansprüche, wobei R^2 für Wasserstoff oder C_1 - C_8 -Alkyl steht.

5. Verwendung nach einem der vorhergehenden Ansprüche, wobei

$(M^{x+})_{1/x}$ für ein Alkalimetallkation, ein Erdalkalimetalläquivalent, ein Ammoniumkation $[NH_4]^+$ oder ein substituiertes Ammoniumkationäquivalent steht;

x für 1 oder 2 steht, wenn $(M^{x+})_{1/x}$ für ein Alkalimetall oder ein Erdalkalimetalläquivalent steht, oder für 1 steht, wenn $(M^{x+})_{1/x}$ für ein Ammoniumkation $[NH_4]^+$ steht, oder für eine ganze Zahl von 1 bis 10 steht, wenn $(M^{x+})_{1/x}$ für ein substituiertes Ammoniumkationäquivalent steht.

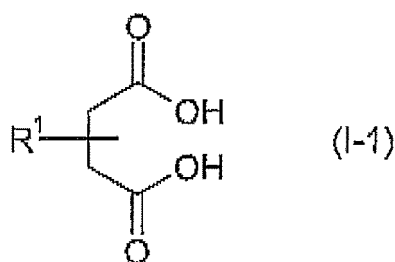
6. Verwendung nach einem der vorhergehenden Ansprüche, wobei X und Y unabhängig voneinander für OH oder $O-(M^{x+})_{1/x}$ stehen oder X und Y zusammen eine Gruppe -O- bilden.

7. Verwendung nach Anspruch 6, wobei X und Y unabhängig voneinander für OH oder $O-(M^{x+})_{1/x}$ stehen.

8. Verwendung nach einem der vorhergehenden Ansprüche, wobei sich das substituierte Ammoniumkationäquivalent von einem Monoamin der Formel $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$, von einem Diamin der Formel $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-Alkylen-NR}^6\text{R}^7$ oder von einem Polyamin der Formel $\text{NR}^{13}\text{R}^{14}[\text{A-NR}^8]_w\text{A-NR}^6\text{R}^7$ ableitet, wobei

R^6 , R^7 und R^8 unabhängig voneinander für Wasserstoff, $\text{C}_1\text{-C}_8\text{-Alkyl}$ oder $\text{C}_2\text{-C}_8\text{-Hydroxyalkyl}$ stehen;
 R^{10} , R^{11} und R^{12} unabhängig voneinander für Wasserstoff, $\text{C}_1\text{-C}_{20}\text{-Alkyl}$ oder $\text{C}_2\text{-C}_8\text{-Hydroxyalkyl}$ stehen, mit der Maßgabe, dass mindestens einer der Reste R^{10} , R^{11} und R^{12} von Wasserstoff verschieden ist;
 R^{13} und R^{14} unabhängig voneinander für Wasserstoff, $\text{C}_1\text{-C}_8\text{-Alkyl}$ oder $\text{C}_2\text{-C}_8\text{-Hydroxyalkyl}$ stehen;
 A für eine $\text{C}_2\text{-C}_4\text{-Alkylengruppe}$ steht; und
 w für eine ganze Zahl von 1 bis 8 steht.

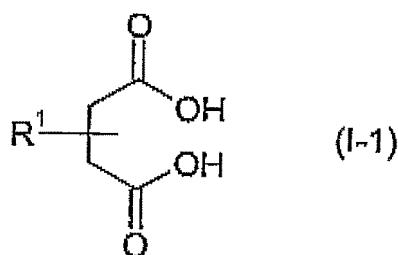
9. Verwendung nach einem der vorhergehenden Ansprüche, wobei es sich bei der Verbindung der Formel (I) um eine Hydrocarbylbernsteinsäure der Formel (I-1)



die mindestens teilweise durch ein Monoamin der Formel $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$ oder ein Diamin der Formel $\text{NR}^{13}\text{R}^{14}\text{-C}_2\text{-C}_8\text{-Alkylen-NR}^6\text{R}^7$ oder ein Polyamin der Formel $\text{NR}^{13}\text{R}^{14}[\text{A-NR}^8]_w\text{A-NR}^6\text{R}^7$ neutralisiert ist, handelt, wobei

R^{10} , R^{11} und R^{12} unabhängig voneinander für Wasserstoff, $\text{C}_1\text{-C}_{20}\text{-Alkyl}$ oder $\text{C}_2\text{-C}_8\text{-Hydroxyalkyl}$ stehen, mit der Maßgabe, dass mindestens einer der Reste R^{10} , R^{11} und R^{12} von Wasserstoff verschieden ist;
 R^{13} und R^{14} unabhängig voneinander für Wasserstoff, $\text{C}_1\text{-C}_8\text{-Alkyl}$ oder $\text{C}_2\text{-C}_8\text{-Hydroxyalkyl}$ stehen;
 w für eine ganze Zahl von 1 bis 8 steht; und
 R^1 , R^6 , R^7 , R^8 und A wie in einem der Ansprüche 1 bis 3 und 8 definiert sind.

10. Verwendung nach einem der vorhergehenden Ansprüche, wobei es sich bei der Verbindung der Formel (I) um eine Hydrocarbylbernsteinsäure der Formel (I-1)

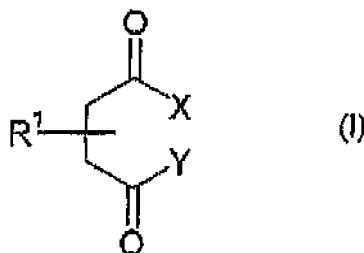


handelt, wobei R^1 wie in einem der Ansprüche 1 bis 3 definiert ist.

11. Verwendung nach einem der vorhergehenden Ansprüche, wobei das Benzin in einer Menge von 10 bis 300 mg pro kg des Benzins mit der Verbindung der Formel (I) additiviert wird.
12. Verwendung nach einem der vorhergehenden Ansprüche in Kombination mit mindestens einem weiteren herkömmlichen Kraftstoffadditiv.

Revendications

1. Utilisation d'au moins un acide hydrocarbylsuccinique ou dérivé d'acide hydrocarbylsuccinique de formule (I)



dans laquelle

R¹ est un groupe alcényle en C₄-C₄₀ ou alkyle en C₄-C₄₀ linéaire ou ramifié, dans lequel au moins 95 % des atomes de carbone ne sont pas quaternaires, ou R¹ est un groupe alkylaryle en C₁-C₂₀ ;

X et Y sont, indépendamment l'un de l'autre, OR² ou O-(M^{x+})_{1/x} ou X et Y forment conjointement un groupe -O- ; R² est hydrogène, alkyle en C₁-C₈, aryle ou alkylaryle en C₁-C₂₀ ;

(M^{x+})_{1/x} est un équivalent de métal, un cation ammonium [NH₄⁺] ou un équivalent de cation ammonium substitué ; et

x est 1, 2, 3 ou 4 dans le cas où (M^{x+})_{1/x} est un équivalent de métal, ou est 1 dans le cas où (M^{x+})_{1/x} est un cation ammonium [NH₄⁺] ou est un entier de 1 à 10 dans le cas où (M^{x+})_{1/x} est un équivalent de cation ammonium substitué, en tant qu'agent de modification de frottement dans une essence.

2. Utilisation selon la revendication 1, où R¹ est dérivé d'un α-alcène.

3. Utilisation selon la revendication 1, où R¹ est dérivé d'un polyalcène obtenu par oligo- ou polymérisation d'au moins un alcène en C₂-C₈.

4. Utilisation selon l'une quelconque des revendications précédentes, où R² est hydrogène ou alkyle en C₁-C₈.

5. Utilisation selon l'une quelconque des revendications précédentes, où (M^{x+})_{1/x} est un cation de métal alcalin, un équivalent de métal alcalino-terreux, un cation ammonium [NH₄⁺] ou un équivalent de cation ammonium substitué ; x est 1 ou 2 dans le cas où (M^{x+})_{1/x} est un équivalent de métal alcalin ou de métal alcalino-terreux, ou est 1 dans le cas où (M^{x+})_{1/x} est un cation ammonium [NH₄⁺] ou est un entier de 1 à 10 dans le cas où (M^{x+})_{1/x} est un équivalent de cation ammonium substitué.

6. Utilisation selon l'une quelconque des revendications précédentes, où X et Y sont, indépendamment l'un de l'autre, OH ou O-(M^{x+})_{1/x}, ou forment conjointement un groupe -O-.

7. Utilisation selon la revendication 6, où X et Y sont, indépendamment l'un de l'autre, OH ou O-(M^{x+})_{1/x}.

8. Utilisation selon l'une quelconque des revendications précédentes, où l'équivalent de cation ammonium substitué est dérivé d'une monoamine NR¹⁰R¹¹R¹² à partir d'une diamine de formule NR¹³R¹⁴-(alkylène en C₂-C₈)-NR⁶R⁷, ou d'une polyamine de formule NR¹³R¹⁴-[A-NR⁸]_wA-NR⁶R⁷,

où

R⁶, R⁷ et R⁸ sont, indépendamment les uns des autres, hydrogène, alkyle en C₁-C₈ ou hydroxyalkyle en C₂-C₈ ; R¹⁰, R¹¹, et R¹² sont, indépendamment les uns des autres, hydrogène, alkyle en C₁-C₂₀ ou hydroxyalkyle en C₂-C₈, à condition qu'au moins un des radicaux R¹⁰, R¹¹ et R¹² soit différent d'hydrogène ;

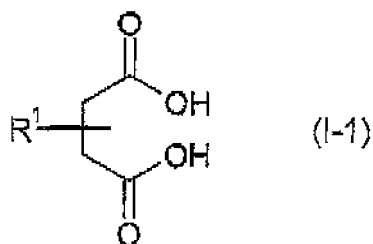
R¹³ et R¹⁴ sont, indépendamment l'un de l'autre, hydrogène, alkyle en C₁-C₈ ou hydroxyalkyle en C₂-C₈ ;

A est un groupe alkylène en C₂-C₄ ; et

w est un entier de 1 à 8.

9. Utilisation selon l'une quelconque des revendications précédentes, dans laquelle le composé de formule (I) est un

acide hydrocarbylsuccinique de formule (I-1)



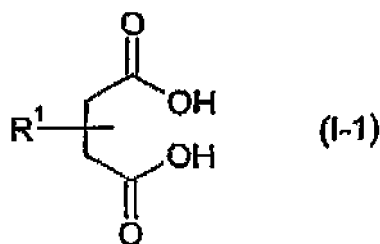
qui est au moins partiellement neutralisé par une monoamine $\text{NR}^{10}\text{R}^{11}\text{R}^{12}$ ou une diamine $\text{NR}^{13}\text{R}^{14}$ -(alkylène en C_2 - C_8)- NR^6R^7 ou une polyamine de formule $\text{NR}^{13}\text{R}^{14}$ -[A- NR^8]_wA- NR^6R^7 ,
où

R^{10} , R^{11} , et R^{12} sont, indépendamment l'un de l'autre, hydrogène, alkyle en C_1 - C_{20} ou hydroxyalkyle en C_2 - C_8 , à condition qu'au moins l'un des radicaux R^{10} , R^{11} , et R^{12} soit différent d'hydrogène

R^{13} et R^{14} sont, indépendamment l'un de l'autre, hydrogène, alkyle en C_1 - C_8 ou hydroxyalkyle en C_2 - C_8 ; w est un entier de 1 à 8; et

R^1 , R^6 , R^7 , R^8 et A sont tels que définis dans l'une quelconque des revendications 1 à 3 et 8.

10. Utilisation selon l'une quelconque des revendications précédentes, où le composé de formule (I) est un acide hydrocarbylsuccinique de formule (I-1)



où R^1 est tel que défini dans l'une quelconque des revendications 1 à 3.

11. Utilisation selon l'une quelconque des revendications précédentes, dans laquelle le composé de formule (I) est ajouté à l'essence en une quantité de 10 à 300 mg par kg d'essence.
12. Utilisation selon l'une quelconque des revendications précédentes, en combinaison avec au moins un additif de carburant conventionnel supplémentaire.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 03070860 A [0007]
- EP 1424322 A [0008]
- EP 1081208 A [0009]
- US 4242099 A [0010]
- DE 10123553 A [0076]
- EP 244616 A [0083]
- WO 9424231 A [0083]
- WO 9703946 A [0084]
- DE 19620262 A [0085]
- WO 9603367 A [0086]
- WO 9603479 A [0086]
- EP 476485 A [0087]
- EP 307815 A [0088]
- WO 8701126 A [0088]
- EP 639632 A [0089]
- EP 310875 A [0090]
- EP 356725 A [0090]
- EP 700985 A [0090]
- US 4877416 A [0090]
- DE 3838918 A [0091]
- US 4849572 A [0092]
- EP 831141 A [0093]
- WO 0039058 A [0119]

Non-patent literature cited in the description

- **M. ROSSENBECK.** Katalysatoren, Tenside, Mineralöladditive. G. Thieme Verlag, 1978, 223 [0004]
- Ethyleneamines. **KIRK-OTTMERS.** Encyclopedia of Chemical Technology. Interscience Publishers, 1965, vol. 7, 22-37 [0074]
- Ullmann's Encyclopedia of Industrial Chemistry. 1990, vol. A16, 719 ff [0097]
- **D. MARGARONI.** Industrial Lubrication and Tribology, May 1998, vol. 50 (3), 108-118 [0122]
- **W. D. PING ; S. KORCEK ; H. SPIKES.** SAE Techn. Paper 962010, 1996, 51-59 [0122]