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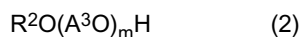
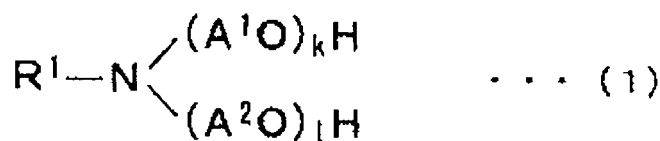
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(54) **Diesel fuel additive composition and scouring method using the same**

(57) A diesel fuel additive composition comprising (a) polyoxyalkylene alkyl amine represented by Formula (1) below, (b) glycol monoalkyl ether represented by Formula (2) below, (c) glycol dialkyl ether represented by Formula (3) below, (d) a heterocyclic compound, and (e) water, wherein the diesel fuel additive composition contains component (a) at 50 to 80% by weight, component (b) at 5 to 20% by weight, component (c) at 5 to 15% by weight, component (d) at 5 to 15% by weight, and component (e) at 1 to 5% by weight;



(wherein R^1 represents an alkyl group with a carbon number from 8 to 25, each of A^1 and A^2 is an alkylene group with a carbon number from 2 to 4, k and l respectively represent a number from 1 to 30, each of R^2 , R^3 and R^4 is an alkyl group with a carbon number from 1 to 8, each of A^3 and A^4 is an alkylene group with a carbon number of 2 or 3, and each of m and n represents a number from 1 to 4).

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DescriptionTECHNICAL FIELD

5 **[0001]** The present invention relates to a diesel fuel additive composition added to diesel fuel, and a scouring method using the same.

BACKGROUND ART

10 **[0002]** Recently, from the viewpoint of environmental issues, reduction in the amount of nitrogen oxides (NO_x), particulate matter (PM), etc. has become a problem. A means to solve this problem is a diesel engine equipped with a common-rail-type fuel injection system.

[0003] A common-rail-type fuel injection system accumulates the fuel pressurized by a fuel injection pump, in a common-rail, which is an accumulator container, and blows the high-pressure fuel accumulated in the common-rail into a cylinder through a fuel injector nozzle.

[0004] The common-rail-type fuel injection system has the problem that the fuel is exposed to high temperature and high pressure and consequently various additives in the fuel are denatured, and therefore, deposits adhere to the injector nozzle.

[0005] In order to use the above injector nozzle adequately, it is necessary to remove the deposits.

20 **[0006]** Thus far, various detergents to remove deposits have been reported (see Japanese unexamined patent publications No. 2008-81626 and No. 2008-81627).

[0007] Specifically, there are detergents comprising polybutene amine, polyether amine, etc., as a main component, which are effective in removing carbon-based deposits.

[0008] Japanese unexamined patent publication No. 2008-81626 describes a detergent composition that can remove water-soluble deposits made of sodium- or potassium-compounds.

[0009] Japanese unexamined patent publication No. 2008-81627 describes a detergent composition that can remove mixed deposits in which water-soluble deposits made of sodium- or potassium-compounds and water-insoluble deposits made of fuel-degraded substance or additives are mixed.

30 SUMMARY OF INVENTION

[0010] However, in addition to the above-mentioned water-soluble deposits and water-insoluble deposits, polymer-substance derived deposits, which are derived from polymer type substances, such as an ethylene-vinyl acetate copolymer, contained in diesel fuel as a low-temperature fluidity improving agent may be mixed in the above deposits.

35 **[0011]** In such a case, the detergent compositions described in Japanese unexamined patent publication No. 2008-81626 or No. 2008-81627 do not have a scouring effect on the polymer-substance derived deposits.

[0012] If various solvents are used to scour the polymer-substance derived deposits, separation and swelling of the deposits occur, and therefore a portion of the fuel piping may become clogged with the separated and swelled deposits, thus resulting in engine stall.

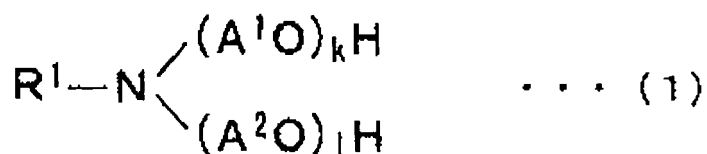
40 **[0013]** In view of the drawbacks of these prior arts, it is an object of the present invention to provide a diesel fuel additive composition that can be stably dispersed in diesel fuel, can remove polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits at once, and does not cause any adverse effect on an object to be scoured, and a scouring method using the diesel fuel additive composition.

[0014] According to a first aspect of the invention, there is provided a diesel fuel additive composition comprising

- 45 (a) polyoxyalkylene alkyl amine represented by Formula (1) below,
 (b) glycol monoalkyl ether represented by Formula (2) below,
 (c) glycol dialkyl ether represented by Formula (3) below,
 (d) a heterocyclic compound, and
 50 (e) water;

wherein the diesel fuel additive composition contains the component (a) at 50 to 80% by weight, the component (b) at 5 to 20% by weight, the component (c) at 5 to 15% by weight, the component (d) at 5 to 15% by weight, and the component (e) at 1 to 5% by weight;

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(wherein R^1 represents an alkyl group with a carbon number from 8 to 25, each of A^1 and A^2 is an alkylene group with a carbon number from 2 to 4, when A^1O and/or A^2O are repeated, each of A^1 and A^2 may be either the same or different alkylene group, and k and l respectively represent a number from 1 to 30),



(wherein R^2 is an alkyl group with a carbon number from 1 to 8, A^3 is an alkylene group with a carbon number of 2 or 3, when A^3O is repeated, A^3 may be either the same or different alkylene group, and m represents a number from 1 to 4), and



(wherein each of R^3 and R^4 is an alkyl group with a carbon number from 1 to 8, A^4 is an alkylene group with a carbon number of 2 or 3, when A^4O is repeated, A^4 may be the same or different alkylene group, and n represents a number from 1 to 4).

[0015] The diesel fuel additive composition of the present invention is added to diesel fuel to scour deposits adhering on an injector nozzle of a diesel engine equipped with a common-rail-type fuel injector.

[0016] The above diesel fuel additive composition is stably dispersed in the diesel fuel due to the presence of the above components (a) to (e) at specific ratios, and therefore it is possible to remove polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits at once, without having any adverse influence on the to-be-scoured object.

[0017] Stability of the above diesel fuel additive composition in the diesel fuel can be ensured by above component (a), polyoxyalkylene alkyl amine. Thus, the above diesel fuel additive composition can be dispersed stably, when it is added to diesel fuel.

[0018] Polymer-substance derived deposits and water-insoluble deposits can be satisfactorily removed due to the presence of the above component (a), polyoxyalkylene alkyl amine, above component (b), glycol monoalkyl ether, above component (c), glycol dialkyl ether, and above component (d), a heterocyclic compound, altogether in the diesel fuel additive composition.

[0019] Water-soluble deposits can be scoured due to the presence of above component (e), water.

[0020] Water tends to corrode the to-be-scoured object, but it is possible to stably disperse the water and to prevent the corrosion of the to-be-scoured object by restricting the amount of above component (e) to be contained and also containing above component (a).

[0021] Thus, the present invention can provide a diesel fuel additive composition that is stably dispersed in diesel fuel, can remove polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits at once, and does not cause any adverse effect on the object to be scoured.

[0022] According to a second aspect of the invention, there is provided a method of scouring and removing a polymer-substance derived deposit, a water-soluble deposit and a water-insoluble deposit adhering to an injector nozzle of a diesel engine equipped with a common-rail type fuel injector, comprising adding the diesel fuel additive composition according to the first aspect of the invention at 0.5 to 2% by weight to diesel fuel.

[0023] The scouring method of the present invention is, as mentioned above, carried out using the diesel fuel additive composition of the first aspect of the invention. Therefore, the above diesel fuel additive composition is stably dispersed in the diesel fuel, and polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits are removed at once, without any adverse effect on the object to be scoured.

DETAILED DESCRIPTION

[0024] The diesel fuel additive composition according to the first aspect of the invention comprises above components (a), (b), (c), (d), and (e) as mentioned above.

[0025] In above Formula (1) which has above component (a), R^1 represents an alkyl group with a carbon number from 8 to 25.

[0026] For the alkyl group with a carbon number from 8 to 25, for example, an octyl group, a nonyl group, a decyl

group, a dodecyl group, a tridecyl group, a tetradecyl group, a hexadecyl group, an octadecyl group, etc., can be provided. A dodecyl group is particularly preferable for above R¹.

[0027] In above Formula (1), each of A¹ and A² represents an alkylene group with a carbon number from 2 to 4.

[0028] For the alkylene group with a carbon number from 2 to 4, for example, an ethylene group, a propylene group, a butylene group, etc., can be provided.

[0029] As mentioned above, when A¹O and/or A²O are repeated, i.e., when k and /or 1 are from 2 to 30, A¹ and/or A² may be either the same or different alkylene groups.

[0030] For above A¹ and A², an ethylene group is preferable.

[0031] When above A¹ or A² is a methylene group, hydrophilicity is high, thus leading to the possible decrease of the solubility of the fuel. On the other hand, when above A¹ or A² is an alkylene group having a carbon number of 5 or more, the lipophilicity is high, and thus water may not be stably dispersed.

[0032] In above Formula (1), each of k and 1 represents a number from 1 to 30.

[0033] When above k or 1 is 31 or more, hydrophilicity is high, thus leading to the possible decrease of the solubility of the fuel.

[0034] It is preferable that the value of K + 1 be from 2 to 4. If the value of k + 1 is above 4, hydrophilicity increases, and thus the solubility of the fuel may be lowered.

[0035] Above component (a) is preferably lauryl diethanolamine.

[0036] In above Formula (2) representing above component (b), R² is an alkyl group with a carbon number from 1 to 8.

[0037] For the alkyl group with a carbon number from 1 to 8, a methyl group, an ethyl group, a propyl group, a butyl group, a pentyl group, a hexyl group, a heptyl group, and an octyl group can be provided.

[0038] If above R² is an alkyl group with a carbon number of 9 or more, the solidifying point thereof is high, and accordingly, the low-temperature fluidity is lowered.

[0039] In above Formula (2), A³ is an alkylene group with a carbon number of 2 or 3.

[0040] For the alkylene group with a carbon number of 2 or 3, an ethylene group, a propylene group, etc., can be provided.

[0041] As mentioned above, when A³O is repeated, i.e., when m is from 2 to 4, above A³ may be either the same or different alkylene group.

[0042] When above A³ is a methylene group, the hydrophilicity is high, thus leading to the possible decrease of the solubility of the fuel. On the other hand, when above A³ is an alkylene group with a carbon number of 4 or more, lipophilicity is high, and thus water may not be stably dispersed.

[0043] In above Formula (2), m represents a number from 1 to 4.

[0044] If m is 5 or more, hydrophilicity is high, and solubility of the fuel is possibly reduced.

[0045] Above component (b) is preferably one, or two or more selected from the group consisting of ethylene glycol monoethyl ether, diethylene glycol monomethyl ether, diethylene glycol monobutyl ether and dipropylene glycol dimethyl ether.

[0046] In above Formula (3) which has above component (c), each of R³ and R⁴ represents an alkyl group with a carbon number from 1 to 8.

[0047] As mentioned above, for the alkyl group with a carbon number from 1 to 8, a methyl group, an ethyl group, a propyl group, a butyl group, a pentyl group, a hexyl group, a heptyl group, and an octyl group can be provided.

[0048] If above R³ or R⁴ is an alkyl group with a carbon number of 9 or more, the solidifying point is high, and the low-temperature fluidity may be reduced.

[0049] In above Formula (3), A⁴ is an alkylene group with a carbon number of 2 or 3.

[0050] For the alkylene group with a carbon number of 2 or 3, an ethylene group, a propylene group, etc., can be provided.

[0051] As mentioned above, when A⁴O is repeated, i.e., when n is from 2 to 4, the above A⁴ may be either the same or different alkylene group.

[0052] When above A⁴ is a methylene group, the hydrophilicity is high, thus leading to the possible decrease of the solubility of the fuel. On other hand, when the above A⁴ is an alkylene group with a carbon number of 4 or more, the lipophilicity is high, and thus water may not be stably dispersed.

[0053] In above Formula (3), n represents a number from 1 to 4.

[0054] When n is 5 or more, the hydrophilicity is high, thus leading to the possible decrease of the solubility of the fuel.

[0055] Above component (c) is preferably one, or two or more selected from the group consisting of diethylene glycol dimethyl ether, diethylene glycol dibutyl ether and dipropylene glycol dimethyl ether.

[0056] A heterocyclic compound, that is above component (d), is a compound containing a nitrogen atom, an oxygen atom, a sulfur atom, etc., as a ring-constructing atom.

[0057] Above component (d) is preferably one, or two or more selected from the group consisting of N-methyl-2-pyrrolidone, 1, 4 dioxane and γ -butyrolactone.

[0058] Above component (a) is contained at 50 to 80% by weight.

[0059] If the content of the above component (a) is less than 50% by weight, water may not be dispersed into the fuel stably. On the other hand, if the content of above component (a) is more than 80% by weight, the stability of the fuel additive at a low temperature occurs.

[0060] More preferably, the content of above component (a) is from 60 to 70% by weight.

[0061] Above component (b) is contained at 5 to 20% by weight.

[0062] If the content of the above component (b) is less than 5% by weight, a sufficient scouring effect is not obtained, and water may not be stably dispersed. On the other hand, if the content of above component (b) is more than 20% by weight, polymer derived deposits among the deposits adhering to the to-be-scoured object become viscous, and the operability of the injector nozzle may be reduced.

[0063] More preferably, the content of the above component (b) is from 10 to 15% by weight.

[0064] Above component (c) is contained at 5 to 15% by weight.

[0065] If the content of above component (c) is less than 5% by weight, a sufficient scouring effect may not be displayed. On the other hand, if the content of above component (c) is more than 15% by weight, polymer derived deposits among the deposits adhering to the to-be-scoured object become viscous, and the operability of the injector nozzle may be reduced.

[0066] More preferably, the content of the above component (c) is from 5 to 10% by weight.

[0067] Above component (d) is contained at 5 to 15% by weight.

[0068] If the content of above component (d) is less than 5% by weight, a sufficient scouring effect cannot be displayed, and water may not be stably dispersed. On the other hand, if the content of above component (d) is more than 15% by weight, polymer derived deposits among the deposits adhering to the to-be-scoured object become viscous, and the operability of the injector nozzle may be reduced.

[0069] More preferably, the content of the above component (d) is from 5 to 10% by weight.

[0070] Above component (e) is contained at 1 to 5% by weight.

[0071] If the content of above component (e) is less than 1% by weight, a scouring effect against water-soluble deposit components may not be displayed. On the other hand, if the content of above component (e) is more than 5% by weight, an adverse effect may be exerted on the system using the above object to be scoured, for example, leading to corrosion of the object to be scoured.

[0072] More preferably, the content of above component (e) is from 2 to 3% by weight.

[0073] It is preferable that the content ratio of above component (e) to above component (a) (content (e)/content (a)) is not higher than 0.1.

[0074] With this content ratio, water, which is component (e), can be stably dispersed.

[0075] If above content (e)/ the content (a) is higher than 0.1, water cannot be stably dispersed, and an adverse effect may be exerted on the system using the above object to be scoured.

[0076] The diesel fuel additive composition of the present invention is a concentrated solution to be added to diesel fuel, and can remain stable by itself.

[0077] It is preferable that the above diesel fuel additive composition is used by being added at 0.5 to 2% by weight to diesel fuel.

[0078] With this amount of diesel fuel additive, good detergency can be obtained.

[0079] If the content of the above fuel additive is less than 0.5% by weight of diesel fuel, sufficient detergency may not be obtained. On the other hand, if the content of the above fuel additive is more than 2% by weight, the water content in the fuel increases, so that an adverse effect may be exerted on the system using the above object to be scoured, for example, leading to corrosion of the object to be scoured.

[0080] More preferably, the content of the above diesel fuel additive composition to diesel fuel is 1% by weight.

[0081] The above fuel additive can be added to diesel fuel by pouring it into a fuel tank of a diesel engine, or diesel fuel blended with the diesel fuel additive composition beforehand may be used.

[0082] To the diesel fuel additive composition of the present invention may be added other components (for example, a cetane number-improving agent such as octyl nitrate and cyclohexyl nitrate, a cleaning agent such as polyether amine and polybutenyl amine, a corrosion inhibitor such as aliphatic amine and alkenyl succinate ester, or an anti-freezing agent such as polyglycol ether) according to various purposes as far as the mode of operation and the effect of the above diesel fuel additive composition are preserved.

[0083] In the scouring method according to the second aspect of the invention, the scouring is, as described above, carried out by adding the diesel fuel additive composition according to the first aspect of the invention at 0.5 to 2% by weight to diesel fuel.

[0084] If the content of the above fuel additive in the diesel fuel is less than 0.5% by weight, sufficient detergency may not be obtained. On the other hand, if the content of the above fuel additive is more than 2% by weight, the water content in the fuel increases, and an adverse effect may be exerted on the system using the above object to be scoured, for example, leading to corrosion of the object to be scoured.

[0085] The above scouring method can be carried out by pouring the diesel fuel additive composition into a fuel tank

of the diesel engine, to thereby add the diesel fuel additive composition to diesel fuel, or by using diesel fuel blended with the diesel fuel additive composition beforehand.

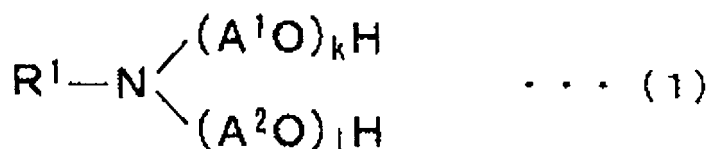
EXAMPLES

Example 1

[0086] This example of the diesel fuel additive composition according to the present invention is explained below, but the present invention is not limited thereto.

[0087] In this example, diesel fuel additive compositions as embodiments of the present invention (Samples E1 to E6), and diesel fuel additive compositions as comparative examples (Samples C1 to C10) were prepared.

[0088] The diesel fuel additive compositions (Samples E1 to E6) as the embodiments of the present invention are comprised of (a) polyoxyalkylene alkyl amine represented by Formula (1) below, (b) glycol monoalkyl ether represented by Formula (2) below, (c) glycol dialkyl ether represented by Formula (3) below, (d) a heterocyclic compound, and (e) water. The compositions contain the component (a) at 50 to 80% by weight, the component (b) at 5 to 20% by weight, the component (c) at 5 to 15% by weight, the component (d) at 5 to 15% by weight, and the component (e) at 1 to 5% by weight.



wherein R^1 represents an alkyl group with a carbon number from 8 to 25, each of A^1 and A^2 is an alkylene group with a carbon number from 2 to 4, when A^1O and/or A^2O are repeated, each of A^1 and A^2 may be either the same or different alkylene group, and k and l respectively represent a number from 1 to 30.



wherein R^2 is an alkyl group with a carbon number from 1 to 8, A^3 is an alkylene group with a carbon number of 2 or 3, when A^3O is repeated, A^3 may be either the same or different alkylene group, and m represents a number from 1 to 4.



wherein each of R^3 and R^4 is an alkyl group with a carbon number from 1 to 8, A^4 is an alkylene group with a carbon number of 2 or 3, when A^4O is repeated, A^4 may be the same or different alkylene group, and n represents a number from 1 to 4.

[0089] In order to produce the above diesel fuel additive compositions (Samples E1 to E6, and Samples C1 to C10), components (a) to (e) as shown in Table 1 were prepared.

[0090] Then, components (a) to (e) shown in Table J. were blended to produce diesel fuel additive compositions (Samples E1 to E6, and Samples C1 to C10) having the compositions shown in Table 2.

(Table 1)

(a)	a	Polyoxyethylene dodecylamine
(b)	b1	Diethyleneglycol monomethyl ether
	b2	Diethyleneglycol monoethyl ether
	b3	Diethyleneglycol monobutyl ether
	b4	Dipropyleneglycol monomethyl ether
	b5	Dipropyleneglycol monobutyl ether
(c)	c1	Diethyleneglycol dibutyl ether
	c2	Diethyleneglycol dimethyl ether

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(continued)

(d)	d	N-methyl-2-pyrrolidone
(e)	e	Water

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Diesel fuel additive composition (Sample No.)	Composition									
	Component (a)		Component (b)		Component (c)		Component (d)		Component (e)	
	Kind	Content (% by weight)	Kind	Content (% by weight)	Kind	Content (% by weight)	Kind	Content (% by weight)	Kind	Content (% by weight)
E1	a	69	b1	10	c1	10	d	8	e	3
E2	a	69	b2	10	c1	10	d	8	e	3
E3	a	69	b3	10	c1	10	d	8	e	3
E4	a	69	b5	10	c1	10	d	8	e	3
E5	a	69	b3	10	c2	10	d	8	e	3
E6	a	69	b3	15	c1	5	d	8	e	3
C1	a	78	b3	1	c1	10	d	8	e	3
C2	a	78	b3	10	c1	1	d	8	e	3
C3	a	78	b3	10	c1	10	d	1	e	1
C4	a	54	b3	25	c1	10	d	8	e	3
C5	a	59	b3	10	c1	20	d	8	e	3
C6	a	61	b3	10	c1	10	d	16	e	3
C7	a	72	b3	10	c1	10	d	8	e	0
C8	a	64	b3	10	c1	10	d	8	e	8
C9	a	84	b3	5	c1	5	d	5	e	1
C10	a	45	b3	20	c1	15	d	15	e	5

[0091] Of the obtained diesel fuel additive compositions, low-temperature fluidity marginal valuation tests were carried out for Samples E1 to E6, and Sample C9, and their low-temperature fluidity margins were evaluated.

[0092] In the low-temperature fluidity marginal valuation tests, the low-temperature fluidity margin was evaluated for each sample by testing whether the samples were flowable at -5°C or not.

[0093] When the sample was flowable at -5°C, the evaluation is represented by "F", and when the sample was not flowable at -5°C, the evaluation is represented by "NF".

[0094] The results are shown in Table 3.

(Table 3)

Diesel fuel additive composition (Sample No.)	Low-temperature fluidity marginal evaluation
E1	F
E2	F
E3	F
E4	F
E5	F
E6	F
C9	NF

[0095] As can be seen in Table 3, Samples E1 to E6 as the embodiments of the present invention are superior in terms of the low-temperature fluidity margin.

[0096] Sample C9 as the comparative example was not flow-movable at -5°C, since the content of the component (a) was more than the upper limit defined in the present invention.

[0097] Then, the diesel fuel compositions (Diesel fuel compositions 1 to 17) shown in Table 4 were prepared by blending the respective diesel fuel additive compositions (Samples E1 to E6, and Samples C1 to C10) at 1% by weight to diesel fuel.

[0098] Diesel fuel composition 7 does not contain any diesel fuel additive composition, and comprises 100% diesel fuel.

(Table 4)

Diesel fuel composition		Base material	Diesel fuel additive composition	Detergency evaluation	Stability evaluation	Corrosivity evaluation
Examples of present invention	Composition 1	Kerosene, JIS class 2	E1	A	G	G
	Composition 2	Kerosene, JIS class 2	E2	A	G	G
	Composition 3	Kerosene, JIS class 2	E3	AA	G	G
	Composition 4	Kerosene, JIS class 2	E4	A	G	G
	Composition 5	Kerosene, JIS class 2	E5	A	G	G
	Composition 6	Kerosene, JIS class 2	E6	AA	G	G
Comparative examples	Composition 7	Kerosene, JIS class 2	-	z	-	G
	Composition 8	Kerosene, JIS class 2	C1	x	u	G
	Composition 9	Kerosene, JIS class 2	C2	x	G	G
	Composition 10	Kerosene, JIS class 2	C3	x	u	G
	Composition 11	Kerosene, JIS class 2	C4	y	G	G
	Composition 12	Kerosene, JIS class 2	C5	y	G	G
	Composition 13	Kerosene, JIS class 2	C6	y	G	G
	Composition 14	Kerosene, JIS class 2	C7	x	G	G
	Composition 15	Kerosene, JIS class 2	C8	z	u	u
	Composition 16	Kerosene, JIS class 2	C9	A	G	G
	Composition 17	Kerosene, JIS class 2	C10	AA	u	u

[0099] Subsequently, evaluations for detergency, stability, and corrosivity were carried out for the obtained diesel fuel compositions (Diesel fuel compositions 1 to 17).

[0100] The results are shown in Table 4.

<Detergency>

[0101] To evaluate detergency, the needle part to which deposits (a mixture of polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits) adhered was removed from the injector of a vehicle equipped with a fuel injecting system. The needle part was then immersed in the individual diesel fuel compositions (Diesel fuel compositions 1 to 17) for 24 hrs, and the extent to which the deposits were removed was evaluated visually.

(Evaluation criteria)

[0102]

AA: Almost all of the deposits were removed.

A: Most of deposits were removed.

x: The amount of the removed deposits was small.

y: The deposits were viscous.

z: The deposits were barely removed.

[0103] It is assumed that the evaluations represented by AA or A were good and acceptable, and the evaluations represented by x, y, or z were bad and unacceptable.

<Stability>

[0104] Stability was evaluated by visually observing the dispersability of the diesel fuel additive compositions, when the above diesel fuel additive compositions (Samples E1 to E6, and Samples C1 to C10) were added to diesel fuel.

[0105] It is assumed that the samples in which no water separation was recognized were good and acceptable (evaluated as G), and the samples in which water separation was recognized were bad and unacceptable (evaluated as u).

<Corrosivity>

[0106] To evaluate corrosivity, filter papers were laid on Petri dishes 6 cm in diameter, and 5 g of swarf of ground cast iron (FC200) was set on the filter papers. The above diesel fuel compositions (Diesel fuel compositions 1 to 17) were introduced in the Petri dishes, followed by a 10 minute immersion of the cast iron swarf therein, and then the test solutions were removed by decantation. Subsequently, the subjects were stored in a container at 20°C at 60% humidity. The state of rust formed on the ground cast iron swarf was observed to evaluate the corrosivity.

[0107] It is assumed that cases in which no rust was recognized were good and acceptable (evaluated as G), and cases in which the formation of rust was recognized were bad and unacceptable (evaluated as u).

[0108] As can be seen in Table 4, Diesel fuel compositions 1 to 6 as the embodiments of the present invention showed a good detergency.

[0109] As may be understood from the foregoing, the present invention can provide a diesel fuel additive composition that is stably dispersed in diesel fuel, removes polymer-substance derived deposits, water-soluble deposits, and water-insoluble deposits at once, and does not cause any adverse effect on the object to be scoured.

[0110] It was found in Table 4 that Diesel fuel composition 7 as a comparative example, which did not contain a diesel fuel additive composition, was bad and unacceptable in terms of detergency.

[0111] Diesel fuel composition 8 as a comparative example, which used Sample C1 of which the content of the component (b) is below the lower limit defined in the present invention as a diesel fuel additive composition, was bad and unacceptable in terms of detergency and stability.

[0112] Diesel fuel composition 9 as a comparative example, which used Sample C2 of which the content of the component (c) is below the lower limit defined in the present invention as a diesel fuel additive composition, was bad and unacceptable in terms of detergency.

[0113] Diesel fuel composition 10 as a comparative example, which used Sample C3 of which the content of the component (d) is below the lower limit defined in the present invention as a diesel fuel additive composition was bad and unacceptable in terms of detergency and stability.

[0114] Diesel fuel composition 11 as a comparative example, which used Sample C4 having the content of the component (b) above the upper limit defined in the present invention as a diesel fuel additive composition so that polymer-

substance derived deposits were rendered viscous, was bad and unacceptable in terms of detergency.

[0115] Diesel fuel composition 12 as a comparative example, which used Sample C5 having the content of the component (c) above the upper limit defined in the present invention as a diesel fuel additive composition so that polymer-substance derived deposits were rendered viscous, was bad and unacceptable in terms of detergency.

[0116] Diesel fuel composition 13 as a comparative example, which used Sample C6 having the content of the component (d) above the upper limit defined in the present invention as a diesel fuel additive composition so that polymer-substance derived deposits were rendered viscous, was bad and unacceptable in terms of detergency.

[0117] Diesel fuel composition 14 as a comparative example, which used Sample C7 of which the content of the component (e) is below the lower limit defined in the present invention as a diesel fuel additive composition, was bad and unacceptable in terms of detergency.

[0118] Diesel fuel composition 15 as a comparative example, which used Sample C8 of which the content of the component (e) is above the upper limit defined in the present invention as a diesel fuel additive composition, was bad and unacceptable in terms of detergency, stability, and corrosivity.

[0119] Diesel fuel composition 16 as a comparative example gave good results in terms of detergency, stability, and corrosivity though it used Sample C9 which had the content of the component (a) above the upper limit defined in the present invention as a diesel fuel additive composition, and which was accordingly considered unacceptable in terms of the low-temperature fluidity margin as mentioned above, because the contents of the other detergent components in Diesel fuel composition 16 were within the ranges defined in the present invention.

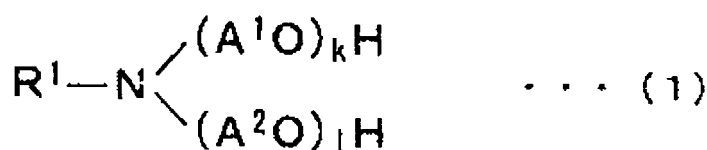
[0120] Diesel fuel composition 17 as a comparative example was bad and unacceptable in terms of stability and corrosivity, for it used Sample C10 having the content of the component (a) below the lower limit defined in the present invention as a diesel fuel additive composition.

Claims

1. A diesel fuel additive composition comprising

- (a) polyoxyalkylene alkyl amine represented by Formula (1) below,
- (b) glycol monoalkyl ether represented by Formula (2) below,
- (c) glycol dialkyl ether represented by Formula (3) below,
- (d) a heterocyclic compound, and
- (e) water;

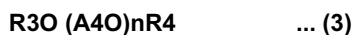
wherein the diesel fuel additive composition contains said component at 50 to 80% by weight, said component (b) at 5 to 20% by weight, said component (c) at 5 to 15% by weight, said component (d) at 5 to 15% by weight, and said component (e) at 1 to 5% by weight;



(wherein R^1 represents an alkyl group with a carbon number from 8 to 25, each of A^1 and A^2 is an alkylene group with a carbon number from 2 to 4, when A^1O and/or A^2O are repeated, each of A^1 and A^2 may be either the same or different alkylene group, and k and l respectively represent a number from 1 to 30),



(wherein R^2 is an alkyl group with a carbon number from 1 to 8, A^3 is an alkylene group with a carbon number of 2 or 3, when A^3O is repeated, A^3 may be either the same or different alkylene group, and m represents a number from 1 to 4), and



(wherein each of R^3 and R^4 is an alkyl group with a carbon number from 1 to 8, A^4 is an alkylene group with a carbon number of 2 or 3, when A^4O is repeated, A^4 may be the same or different alkylene group, and n represents

a number from 1 to 4).

2. The diesel fuel additive composition according to claim 1, wherein said component (a) is lauryl diethanolamine.

5 3. The diesel fuel additive composition according to claim 1 or 2, wherein said component (b) comprises one, or two or more selected from the group consisting of ethylene glycol monoethyl ether, diethylene glycol monomethyl ether, diethylene glycol monobutyl ether and dipropylene glycol dimethyl ether.

10 4. The diesel fuel additive composition according to any one of claims 1 to 3, wherein said component (c) comprises one, or two or more selected from the group consisting of diethylene glycol dimethyl ether, diethylene glycol dibutyl ether and dipropylene glycol dimethyl ether.

15 5. The diesel fuel additive composition according to any one of claims 1 to 4, wherein said component (d) comprises one, or two or more selected from the group consisting of N-methyl-2-pyrrolidone, 1, 4 dioxane and γ -butyrolactone.

6. The diesel fuel additive composition according to any one of claims 1 to 5, wherein a content ratio of said component (e) to said component (a) (content (e)/content (a)) is not higher than 0.1.

20 7. The diesel fuel additive composition according to any one of claims 1 to 6, wherein said diesel fuel additive composition is used by being add at 0.5 to 2% by weight to diesel fuel.

8. A method of scouring and removing a polymer-substance derived deposit, a water-soluble deposit and a water-insoluble deposit adhering to an injector nozzle of a diesel engine equipped with a common-rail type fuel injector, comprising;

25 adding the diesel fuel additive composition according to any one of claims 1 to 7 at 0.5 to 2% by weight to diesel fuel.

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EUROPEAN SEARCH REPORT

Application Number
EP 09 01 3526

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 36 31 225 A1 (TOYOTA MOTOR CO LTD [JP]; SANYO CHEMICAL IND LTD [JP]) 23 April 1987 (1987-04-23) * page 2, line 48 - line 68 * * page 3, line 59 - line 61 * * page 3, line 34 - line 36 * * page 3, line 50 - line 51 * * examples 1,2 * -----	1-8	INV. C10L10/06
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A	DATABASE WPI Week 200221 Thomson Scientific, London, GB; AN 2002-164140 XP002567437 & WO 01/88066 A1 (NIPPON MITSUBISHI OIL CORP) 22 November 2001 (2001-11-22) * abstract * -----	1-8	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 February 2010	Examiner Klaes, Daphne
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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