

DESCRIPTION

LIQUID DETERGENT

TECHNICAL FIELD

[0001]

5 The present invention relates to a liquid detergent.

 Priority is claimed on Japanese Patent Application No. 2016-185006, filed September 23, 2016, the contents of which are incorporated herein by reference.

BACKGROUND ART

10 [0002]

 In recent years, it has become more common practice to do washing with a washing machine crammed with clothes and the like (items to be washed) with the increase in capacity of the washing machine or for other factors. In the washing with crammed items to be washed, the proportion of the items to be washed relative to the washing liquid is high, so that the contamination concentration in the washing liquid tends to increase. Therefore, recontamination, in which the dirt removed during washing adheres again to the items to be washed, is likely to occur.

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 In order to improve recontamination prevention ability of a detergent, a liquid detergent blended with an anionic surfactant has been proposed (for example, Patent Documents 1 and 2).

20 Prior Art References

Patent Document

[0003]

Patent Document 1 : Japanese Patent Application Unexamined Publication No. 2014-84432

Patent Document 2 : Japanese Patent Application Unexamined Publication No. 2015-193859

DISCLOSURE OF INVENTION

Problems to be Solved by the Invention

[0004]

Incidentally, when persistent sebum dirt or the like adheres to the items to be washed, the
5 liquid detergent may be applied directly to the dirty portion of the items to be washed.

However, increasing the proportion of the anionic surfactant in the liquid detergent sometimes reduces the direct application cleaning ability of the detergent against persistent dirt such as mineral oil, machine oil, inks of felt tip pen and the like.

[0005]

10 The present invention has been made in view of the above circumstances, and it is an object of the present invention to provide a liquid detergent which is excellent in recontamination prevention ability and has good direct application detergency.

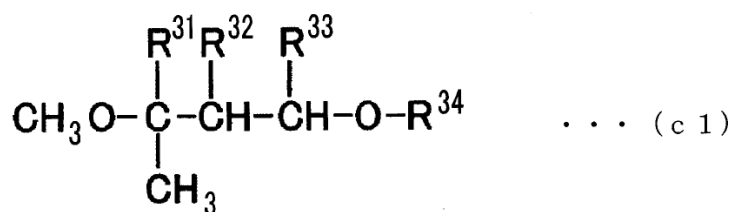
Means to Solve the Problems

15 [0006]

The embodiments of the present invention are as follows.

[1] A liquid detergent comprising: component (A): a nonionic surfactant; component (B): an anionic surfactant exclusive of higher fatty acid salts; and component (C): an organic solvent represented by formula (c1) below, wherein an amount of the component (B) is less than 50 % by mass,
20 and a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0007]



[0008]

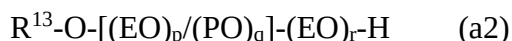
In the formula (c1), each of R^{31} to R^{33} is independently a hydrogen atom or an alkyl group having 1 to 3 carbon atoms, and R^{34} is a hydrogen atom or an acetyl group.

5 [0009]

[2] The liquid detergent according to [1], wherein the component (C) is 3-methoxy-3-methylbutanol.

[3] The liquid detergent according to [1] or [2], wherein the component (A) includes two or more nonionic surfactants, at least one of which is an alkylene oxide adduct of a secondary alcohol
10 or an alkylene oxide adduct of a branched primary alcohol.

[4] The liquid detergent according to [3], wherein the alkylene oxide adduct of the secondary alcohol is a compound represented by the following formula (a2):

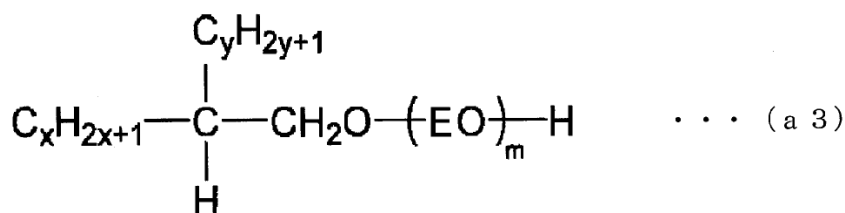


wherein R^{13} is a hydrocarbon group having 6 to 22 carbon atoms, derived from a secondary alcohol,
15 EO represents an oxyethylene group, PO represents an oxypropylene group, p represents an average number of repetitions of EO and is a number of 3 to 20, q represents an average number of repetitions of PO and is a number of 0 to 6, r represents an average number of repetitions of EO and is a number of 0 to 20.

[5] The liquid detergent according to [3] or [4], wherein the amount of the alkylene oxide adduct of the secondary alcohol is 1 to 30 % by mass.
20

[6] The liquid detergent according to [3], wherein the alkylene oxide adduct of the branched primary alcohol is a compound represented by the following formula (a3):

[0010]



[0011]

- 5 In the formula (a3), EO represents an oxyethylene group, m represents an average number of repetitions of EO and is a number of 3 to 10, and x and y are each a number of 1 to 7.

[0012]

- [7] The liquid detergent according to [3] or [6], wherein the amount of the alkylene oxide adduct of the branched primary alcohol is 1 to 30 % by mass.
- 10 [8] The method of any one of [1] to [7], wherein the component (B) comprises at least one member selected from the group consisting of a linear alkylbenzene sulfonic acid or a salt thereof, and a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof.
- [9] The liquid detergent according to [8], wherein the component (B) comprises (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid es-
- 15 ter or a salt thereof, and wherein a mass ratio of (b2) to (b1), (b2)/(b1), is 0.1 to 9.
- [10] The liquid detergent according to any one of [1] to [9], wherein an amount of the component (A) is 10 to 80 % by mass.
- [11] The liquid detergent according to any one of [1] to [10], wherein an amount of the component (C) is 1 to 30 % by mass.
- 20 [12] The liquid detergent according to any one of [1] to [11], wherein a total amount of the component (A) and the component (B) is 15 to 80 % by mass.
- [13] The liquid detergent according to any one of [1] to [12], wherein a mass ratio of the com-

ponent (B) to the component (C), (B)/(C), is 0.1 to 15.

Effect of the Invention

[0013]

5 The liquid detergent of the present invention is excellent in recontamination prevention ability and has good direct application detergency.

DESCRIPTION OF THE EMBODIMENTS

[0014]

10 Hereinbelow, the present invention will be described in detail.

 The liquid detergent of the present invention includes the following components (A), (B) and (C).

 In the present specification, the expression "ordinary washing" means washing of items to be washed with a washing machine or the like using a washing liquid in which a liquid detergent is dispersed in water, and the expression "ordinary detergency" means detergency in the ordinary washing.

 Further, the expression "direct application washing" means washing carried out by directly applying a liquid detergent to items to be washed, and the expression "direct application detergency" means detergency in the direct application washing.

20 The expression "higher fatty acid salt" means a salt of a fatty acid having 8 to 22 carbon atoms.

[0015]

<Component (A)>

 The component (A) is a nonionic surfactant. The component (A) can be produced by a conventional method, and a commercially available product may be used.

As the nonionic surfactant, any nonionic surfactant conventionally used for a liquid detergent for clothing or the like may be used. Examples of the nonionic surfactant include polyoxyalkylene nonionic surfactants, alkylphenols, alkylene oxide adducts of higher amines etc., polyoxyethylene-polyoxypropylene block copolymers, fatty acid alkanolamines, fatty acid alkanolamides, polyhydric alcohol fatty acid esters or alkylene oxide adducts thereof, polyhydric alcohol fatty acid ethers, alkyl (or alkenyl) amine oxides, cured alkylene oxide adducts of castor oil, sugar esters of fatty acids, N-alkyl polyhydroxy fatty acid amides, alkyl glycosides, and the like. With respect to the nonionic surfactant, a single type thereof may be used individually or two or more types thereof may be used in combination.

10 [0016]

As the nonionic surfactant, a polyoxyalkylene nonionic surfactant is preferable among those exemplified above in terms of viscosity and liquid stability.

Examples of the polyoxyalkylene nonionic surfactant includes a compound represented by the following formula (a1) (hereinafter, also referred to as "compound (a1)"):

15 $R^{11}-X-[(EO)_s/(PO)_t]-R^{12}$ (a1)

[0017]

In the formula (a1), R^{11} is a hydrocarbon group having 6 to 22 carbon atoms, X is a divalent linking group, R^{12} is a hydrogen atom, an alkyl group having 1 to 6 carbon atoms or an alkenyl group having 2 to 6 carbon atoms, EO is an oxyethylene group, PO is an oxypropylene group, s is an average repeating number of EO and is a number of 3 to 20, t represents an average repeating number of PO and is a number of 0 to 6.

[0018]

In the formula (a1), the carbon number of the hydrocarbon group of R^{11} is 6 to 22, preferably from 8 to 22, more preferably 10 to 18. The hydrocarbon group as R^{11} may be linear or branched and may or may not have an unsaturated bond.

25

Examples of -X- include -O-, -COO-, -CONH-, and the like.

The carbon number of the alkyl group as R^{12} is 1 to 6, preferably 1 to 3.

The carbon number of the alkenyl group as R^{12} is 2 to 6, preferably 2 to 3.

[0019]

5 The compound (a1) in which -X- is -O-, -COO- or -CONH- can be prepared from a raw material such as a primary or secondary higher alcohol (R^{11} -OH), a higher fatty acid (R^{11} -COOH) or a higher fatty acid amide (R^{11} -CONH). R^{11} in the materials described above is the same as R^{11} in the formula (a1).

[0020]

10 In the formula (a1), s represents an average repeating number of EO (i.e., average number of moles of added ethylene oxide) and is a number of 3 to 20, preferably 5 to 18. When the number exceeds the above upper limit value, the HLB value becomes too high, which may lower the detergency against sebum. When the number is less than the above lower limit value, the odor of raw materials of the component (A) per se may worsen.

15 In the formula (a1), t represents an average repeating number of PO (i.e., average number of moles of added propylene oxide) and is a number of 0 to 6, preferably 0 to 3. When the number exceeds the above upper limit value, the liquid stability of the liquid detergent at a high temperature tends to decrease.

[0021]

20 When t is 1 or more, that is, when the compound (a1) has EO and PO, the arrangement of EO and PO is not limited, and EO and PO may be present in randomly mixed manner or in block forms. $[(EO)_s/(PO)_t]$ in the formula (a1) indicates that EO and PO coexist randomly or in the form of polymer blocks. The method of adding ethylene oxide and propylene oxide is not particularly limited, and, for example, random addition method or block addition method may be used. Exam-
25 ples of the block addition method include a method including addition of ethylene oxide, which is

followed by addition of propylene oxide, a method including addition of propylene oxide, which is followed by addition of ethylene oxide, a method including addition of ethylene oxide, which is followed by addition of propylene oxide and, then, followed by addition of ethylene oxide.

[0022]

5 The molar distribution of added ethylene oxide or added propylene oxide is not particularly limited.

The molar distribution of addition tends to vary depending on the reaction method employed in production of the nonionic surfactant. For example, when ethylene oxide or propylene oxide is added to a hydrophobic group-containing raw material by using a generally used alkali catalyst such as sodium hydroxide or potassium hydroxide, the molar distribution of added ethylene oxide or added propylene oxide tends to become relatively broad. Further, when ethylene oxide or propylene oxide is added to a hydrophobic group-containing raw material using a specific alkoxylation catalyst as described in Japanese Examined Patent Application Publication No. Hei 6-15038, such as magnesium oxide to which metal ions such as Al^{3+} , Ga^{3+} , In^{3+} , Tl^{3+} , Co^{3+} , Sc^{3+} , La^{3+} and
10 Mn^{2+} are added, the molar distribution of added ethylene oxide or added propylene oxide tends to become relatively narrow.

[0023]

As the compound (a1), especially preferable examples include a compound in which -X- is -O- (for example, an alcohol nonionic surfactant), and a compound (for example, fatty acid alkyl ester or fatty acid alkenyl ester) in which -X- is -COO- and R^{12} is an alkyl group having 1 to 6 carbon atoms or an alkenyl group having 2 to 6 carbon atoms.
20

[0024]

When -X- is -O-, the carbon number of R^{11} is preferably 10 to 22, more preferably 10 to 20, still more preferably 10 to 18. R^{12} is preferably a hydrogen atom.

25 [0025]

When -X- is -COO-, the carbon number of R¹¹ is preferably 9 to 21, more preferably 11 to 21. R¹² is preferably an alkyl group having 1 to 6 carbon atoms or an alkenyl group having 2 to 6 carbon atoms, more preferably an alkyl group having 1 to 3 carbon atoms.

[0026]

5 Examples of the compound (a1) in which -X- is -O- or -COO- include Diadol (trade name, C13 (C represents the number of carbon atoms, the same applies hereinafter) manufactured by Mitsubishi Chemical Corporation, a product obtained by adding 12 moles or 15 moles of ethylene oxide per 1 mole of an alcohol such as Neodol (trade name, a mixture of C12 and C13) manufactured by Shell or Safol 23 (trade name, a mixture of C12 and C13) manufactured by Sasol Co.; a
10 product obtained by adding 12 moles or 15 moles of ethylene oxide per 1 mole of a natural alcohol such as CO-1214 or CO-1270 (trade name) manufactured by Procter & Gamble Co., Ltd.; a product (trade name: Lutensol TO7, manufactured by BASF) obtained by adding 7 moles of ethylene oxide per 1 mol of C13 alcohol obtained by subjecting a C12 alkene obtained by trimerizing butene to an oxo process; a product (trade name: Lutensol XP 90, manufactured by BASF) obtained by adding 9
15 moles of ethylene oxide per 1 mole of C10 alcohol obtained by subjecting pentanol to Guerbet reaction; a product (trade name: Lutensol XL 70, manufactured by BASF) obtained by adding 7 moles of ethylene oxide per 1 mole of C10 alcohol obtained by subjecting pentanol to Guerbet reaction; a product (trade name: Lutensol XA 60, manufactured by BASF) obtained by adding 6 moles of ethylene oxide per 1 mole of C10 alcohol obtained by subjecting pentanol to Guerbet reaction; a prod-
20 uct (trade name: Softanol 90, Softanol 150, manufactured by Nippon Shokubai Co., Ltd.) obtained by adding 9 moles or 15 moles of ethylene oxide per 1 mole of a secondary alcohol having 12 to 14 carbon atoms; and a product (polyoxyethylene coconut fatty acid methyl ester (EO 15 mol)) obtained by adding 15 moles of ethylene oxide per 1 mol of coconut fatty acid methyl ester (lauric acid/myristic acid = 8/2) using an alkoxylation catalyst.

25 [0027]

Preferred examples of the compound (a1) include those in which -X- is -COO-, R^{12} is an alkyl group having 1 to 6 carbon atoms, and t is 0, that is, polyoxyethylene fatty acid alkyl esters, among which polyoxyethylene fatty acid methyl esters (hereinafter, also referred to as "MEE") in which R^{12} is a methyl group are especially preferable.

5 The use of polyoxyethylene fatty acid alkyl ester as a nonionic surfactant increases the solubility of the liquid detergent in water to thereby improve the detergency. In addition, even when the amount of the component (B) in the liquid detergent is increased, a remarkable increase in viscosity (gelation) is unlikely to occur so that a concentrated liquid detergent having good fluidity can be obtained.

10 Polyoxyethylene fatty acid alkyl esters, especially MEE, are nonionic surfactants showing weak regularity in molecular orientation in an aqueous solution system, and micelles thereof are unstable. It is speculated that due to the above characteristic, gelation of the polyoxyethylene fatty acid alkyl ester does not occur at a high concentration, and the solubility thereof in water can be increased even if a single type of polyoxyethylene fatty acid alkyl ester is blended in a large amount
15 in the liquid detergent. Therefore, it is considered that, when the liquid detergent containing the polyoxyethylene fatty acid alkyl ester is dispersed in water, the concentration of the polyoxyethylene fatty acid alkyl ester in the resulting washing solution quickly becomes uniform, whereby the polyoxyethylene fatty acid alkyl ester is allowed to contact the items to be washed with an intended concentration so that the liquid detergent exerts high detergency even from the initial stage of
20 washing.

[0028]

In the polyoxyethylene fatty acid alkyl ester, the narrow rate indicating the distribution ratio of the compounds with different number of moles of added ethylene oxide is preferably 20 % by mass or more. The upper limit of the narrow rate is preferably substantially 80 % by mass. The
25 narrow rate is more preferably 20 to 60 % by mass. The higher the narrow rate, the more favora-

ble the detergency becomes. However, since the liquid stability at low temperatures may decline when the narrow rate is too high, the narrow rate of 30 to 45 % by mass is still more preferable.

[0029]

The narrow rate of the polyoxyalkylene nonionic surfactant such as polyoxyethylene fatty acid alkyl ester is a value determined by the following equation (S).

[0030]

$$\text{Narrow rate} = \sum_{i=s_{\max}-2}^{i=s_{\max}+2} Y_i \quad \cdot \cdot \cdot \quad (S)$$

10 [0031]

In the equation (S), $S_{\max}$ is the number of moles of added alkylene oxide in the alkylene oxide adduct most abundant in the polyoxyalkylene nonionic surfactant (i.e., the value of $s + t$ in the formula (a1));

i represents the number moles of added alkylene oxide; and

15 Y_i represents a ratio (% by mass) of the alkylene oxide adduct with i moles of added alkylene oxide, which is present in the entire component (a1), relative to the total mass of the compound (a1).

[0032]

For example, the narrow rate can be controlled by the method used to produce the polyoxyethylene fatty acid alkyl ester.

A method for producing the polyoxyethylene fatty acid alkyl ester is not particularly limited. One example of such method is an addition polymerization of an ethylene oxide to a fatty acid alkyl ester using a surface-modified composite metal oxide catalyst (see Japanese Unexamined Patent Application Publication No. 2000-144179).

25 Preferable examples of the surface-modified composite metal oxide catalyst include a

composite metal oxide catalyst such as magnesium oxide having metal ions (such as Al^{3+} , Ga^{3+} , In^{3+} , Tl^{3+} , Co^{3+} , Sc^{3+} , La^{3+} , Mn^{2+} and the like) added thereto, which is surface-modified with metal hydroxides and the like; and a calcined product catalyst of hydrotalcite surface-modified with a metal hydroxide and/or a metal alkoxide.

5 In the surface modification of the composite metal oxide catalyst, the proportion of the metal hydroxide and/or metal alkoxide relative to 100 parts by mass of the complex metal oxide is preferably 0.5 to 10 parts by mass, more preferably 1 to 5 parts by mass.

[0033]

10 The method for producing the polyoxyethylene fatty acid alkyl ester is not limited to the above-mentioned method. For example, the polyoxyethylene fatty acid alkyl ester can be also produced by a method in which an alkylene oxide is added to a fatty acid alkyl ester in the presence of an alkoxylation catalyst prepared from a mixture of an alkaline earth metal compound and an oxyacid or the like. The above-mentioned alkoxylation catalyst is disclosed in Japanese Patent No. 04977609, International Patent Application Publication No. 1993/004030, International Patent Ap-
15 plication Publication No. 2002/038269, International Patent Application Publication No. 2012/028435 and the like, and examples thereof include an alkoxylation catalyst prepared from a mixture of an alkaline earth metal salt of a carboxylic acid and/or an alkaline earth metal salt of a hydroxycarboxylic acid with sulfuric acid and the like.

[0034]

20 By increasing the amount of the component (A) in the liquid detergent, advantages are obtained, such as being able to wash items with less amount of the liquid detergent, and to reduce the size of the container for the liquid detergent. When the amount of the component (A) in the liquid detergent is increased, the component (A) to be used is preferably a secondary alcohol ethoxylate obtained by adding ethylene oxide to a secondary alcohol (for example, Softanol series products
25 manufactured by Nippon Shokubai Co., Ltd.) or MEE since these compounds have a small gelation

region even at a high concentration and hence are easy to blend. Since these compounds have a small gelation region even at a high concentration, gelation is unlikely to occur even if the amount thereof in the liquid detergent is increased.

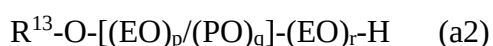
[0035]

5 With respect to the component (A), a single type thereof may be used individually or two or more types thereof may be used in combination.

When the component (A) includes two or more nonionic surfactants, it is preferable that at least one of the nonionic surfactants is an alkylene oxide adduct of a secondary alcohol or an alkylene oxide adduct of a branched primary alcohol from the viewpoint of further improving the re-
10 contamination prevention ability and the direct application detergency. Especially, a combination of the adducts and a compound with R^{11} in the formula (a1) being a linear hydrocarbon group is preferable, a combination of the adducts and a polyoxyethylene fatty acid alkyl ester is more preferable, and a combination of the adducts and MEE is still more preferable.

[0036]

15 Examples of the alkylene oxide adduct of the secondary alcohol include a compound represented by the following formula (a2) (hereinafter, also referred to as "compound (a2)"):



[0037]

In the formula (a2), R^{13} is a hydrocarbon group having 6 to 22 carbon atoms, derived from
20 a secondary alcohol, EO represents an oxyethylene group, PO represents an oxypropylene group, p represents an average number of repetitions of EO and is a number of 3 to 20, q represents an average number of repetitions of PO and is a number of 0 to 6, r represents an average number of repetitions of EO and is a number of 0 to 20.

[0038]

25 In the formula (a2), the carbon number of the hydrocarbon group of R^{13} is 6 to 22, prefera-

bly from 8 to 22, more preferably 10 to 18.

R^{13} is derived from an alcohol (R^{13} -OH) used as a raw material, which is a secondary alcohol.

[0039]

5 In the formula (a2), p represents an average repeating number of EO (i.e., average number of moles of added ethylene oxide) and is a number of 3 to 20, preferably 5 to 18.

In the formula (a2), q represents an average repeating number of PO (i.e., average number of moles of added propylene oxide) and is a number of 0 to 6, preferably 0 to 3.

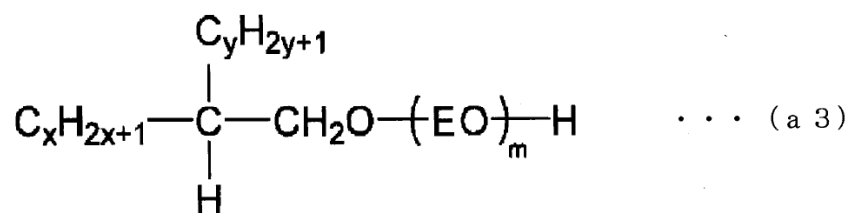
10 In the formula (a2), r represents an average repeating number of EO (i.e., average number of moles of added ethylene oxide) and is a number of 0 to 20, preferably 2 to 15.

When q is 1 or more, that is, when the compound (a2) has EO and PO, the arrangement of EO and PO is not limited, and EO and PO may be present in randomly mixed manner or in block forms. $[(EO)_p/(PO)_q]$ in the formula (a2) indicates that EO and PO coexist randomly or in the form of polymer blocks. The method for adding ethylene oxide and propylene oxide is not particularly limited, and examples thereof include the methods exemplified above in the description of the compound (a1).

[0040]

20 Examples of the alkylene oxide adduct of the branched primary alcohol include a compound represented by the following general formula (a3) (hereinafter, also referred to as "compound (a3)"):

[0041]



[0042]

In the formula (a3), EO represents an oxyethylene group, m represents an average number of repetitions of EO and is a number of 3 to 10, and x and y are each a number of 1 to 7.

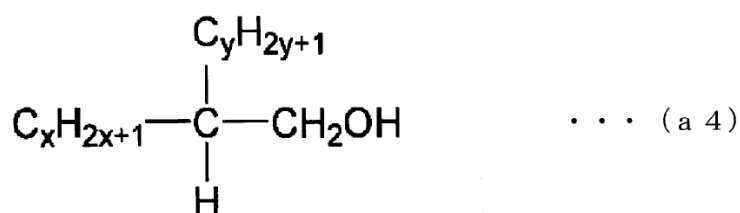
[0043]

5 As examples of C_xH_{2x+1} and C_yH_{2y+1} in the formula (a3), a linear or branched alkyl group can be mentioned, and it is preferable that both of C_xH_{2x+1} and C_yH_{2y+1} are linear alkyl groups. Preferable examples of C_xH_{2x+1} and C_yH_{2y+1} include a methyl group, an ethyl group, a propyl group, a butyl group, a pentyl group, and a hexyl group. In particular, the combination of C_xH_{2x+1} and C_yH_{2y+1} is preferably a combination of an ethyl group and a butyl group or a combination of a pro-
10 pyl group and a pentyl group (either of the two groups in each combination may be C_xH_{2x+1} or C_yH_{2y+1}).

[0044]

As the compound (a3), for example, one obtained by adding ethylene oxide to an alcohol (Guerbet alcohol) obtained by the Guerbet reaction can be used. As the Guerbet alcohol, for ex-
15 ample, a branched primary alcohol obtained by treating a primary alcohol with a Guerbet reaction can be used. Hereinafter, the expression "Guerbet alcohol" means an alcohol obtained by the Guerbet reaction. Here, the "Guerbet reaction" refers to a reaction in which "when a primary alcohol is heated in the presence of metallic sodium or metallic potassium, a bimolecular condensation is caused to generate a primary alcohol branched to the β position" (see "Dai Yuki Kagaku
20 (Comprehensive Organic Chemistry), Vol. 2, Shibouzoku Kagoubutsu (Aliphatic Compounds) I", supervised by Nobuo Kotake, published by Asakura Shoten 1957). Specifically, the alcohol obtained by the Guerbet reaction is represented by the following formula (a4).

[0045]



[0046]

In the formula (a4), each of x and y is a number of 1 to 7.

[0047]

5 The Guerbet alcohol is preferably a branched primary alcohol having 8 to 12 carbon atoms. The Guerbet alcohol may be a synthesized product, or a commercially available product. Examples of the commercially available product include "ISOVOL 12" (12 carbon atoms, x = 4 and y = 6 in the formula (a4)) manufactured by CONDEA.

[0048]

10 The amount of the component (A) is preferably 10 to 80 % by mass, more preferably 20 to 70 % by mass, still more preferably 25 to 50% by mass, especially preferably 25 to 40% by mass, based on the total mass of the liquid detergent. When the amount of the component (A) is within the above range, it becomes easy to obtain a liquid detergent excellent in detergency against oily stains and excellent in liquid stability. Especially when the amount of the component (A) is not
15 less than the lower limit value, it is possible to impart high detergency to the liquid detergent. On the other hand, when the amount of the component (A) is not more than the above upper limit value, occurrence of gelation is suppressed and the stability of the liquid detergent improves.

[0049]

20 When the component (A) contains a polyoxyethylene fatty acid alkyl ester, the amount of the polyoxyethylene fatty acid alkyl ester is preferably from 10 to 50 % by mass, more preferably from 15 to 50 % by mass, still more preferably from 20 to 40 % by mass, based on the total mass of the liquid detergent. When the amount of the polyoxyethylene fatty acid alkyl ester is not less than

the above lower limit value, high detergency can be achieved. On the other hand, when the amount of the polyoxyethylene fatty acid alkyl ester is not more than the above upper limit value, film formation and gelation can be suppressed.

[0050]

5 When the component (A) contains an alkylene oxide adduct of a secondary alcohol, the amount of the alkylene oxide adduct of the secondary alcohol is preferably from 1 to 30 % by mass, more preferably from 2 to 20 % by mass, still more preferably from 3 to 10 % by mass, based on the total mass of the liquid detergent. When the amount of the alkylene oxide adduct of the secondary alcohol is not less than the lower limit value, higher direct application detergency can be
10 imparted to the liquid detergent. On the other hand, when the amount of the alkylene oxide adduct of the secondary alcohol is not more than the above upper limit value, the viscosity increase of the liquid detergent can be further suppressed.

[0051]

 When the component (A) contains an alkylene oxide adduct of a branched primary alcohol,
15 the amount of the alkylene oxide adduct of the branched primary alcohol is preferably 1 to 30 % by mass, more preferably from 2 to 20 % by mass, still more preferably from 3 to 10 % by mass, based on the total mass of the liquid detergent. When the amount of the alkylene oxide adduct of the branched primary alcohol is not less than the lower limit value, higher direct application detergency can be imparted to the liquid detergent. On the other hand, when the amount of the alkylene oxide
20 adduct of the branched primary alcohol is not more than the above upper limit value, the viscosity increase of the liquid detergent can be further suppressed.

[0052]

<Component (B)>

 The component (B) is an anionic surfactant exclusive of higher fatty acid salts. The
25 component (B) can be produced by a conventional method, and a commercially available product

may be used.

As the anionic surfactant, any anionic surfactant conventionally used in a liquid detergent for clothing or the like may be used, and examples thereof include a linear alkylbenzene sulfonic acid or a salt thereof; an α -olefin sulfonic acid or a salt thereof; a linear or branched alkyl sulfuric acid ester or a salt thereof; a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof; a polyoxyalkylene alkenyl ether sulfuric acid ester or a salt thereof; an alkane sulfonate having an alkyl group or a salt thereof; an α -sulfo fatty acid ester or a salt thereof; a carboxylic acid type anionic surfactant, such as an alkyl ether carboxylic acid or a salt thereof; a polyoxyalkylene ether carboxylic acid or a salt thereof, an alkylamido ether carboxylic acid or a salt thereof, an alkenyl amido ether carboxylic acid or a salt thereof, and an acyl aminocarboxylic acid or a salt thereof; a phosphate type anionic surfactant, such as an alkyl phosphate ester or a salt thereof, a polyoxyalkylene alkyl phosphate ester or a salt thereof, a polyoxyalkylene alkyl phenyl phosphate ester or a salt thereof, and a glycerin fatty acid ester monophosphate ester or a salt thereof, and the like.

Examples of the salt form of these anionic surfactants include alkali metal salts such as a sodium salt and a potassium salt; alkaline earth metal salts such as a magnesium salt; and alkanolamine salts such as a monoethanolammonium salt and a diethanolammonium salt.

[0053]

Among these, the linear alkylbenzene sulfonic acid or a salt thereof is preferably a linear alkylbenzene sulfonic acid having a linear alkyl group having 8 to 16 carbon atoms or a salt thereof, and especially preferably a linear alkylbenzene sulfonic acid having a linear alkyl group having 10 to 14 carbon atoms or a salt thereof.

When the number of carbon atoms of the alkyl group is within the above range, the recontamination prevention ability can be improved. Examples of the alkyl group include a decyl group, an undecyl group, a dodecyl group, a tridecyl group, and a tetradecyl group.

The linear alkylbenzene sulfonic acid or a salt thereof may be a commercially available

product or may be produced by a known synthesis method. As the known synthesis method, the linear alkylbenzene sulfonic acid or a salt thereof can be produced by a method including sulfonating an alkylbenzene with sulfuric anhydride.

[0054]

5 As the α -olefin sulfonate or a salt thereof, an α -olefin sulfonate having 10 to 20 carbon atoms or a salt thereof is preferable.

As the alkyl sulfate or a salt thereof, an alkyl sulfate having 10 to 20 carbon atoms or a salt thereof is preferable.

[0055]

10 As the polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof, an alkyl ether sulfuric acid ester having a linear or branched alkyl group having 8 to 20 carbon atoms and having 1 to 10 moles on average of ethylene oxide added thereto or a salt thereof (that is, a polyoxyethylene alkyl ether sulfuric acid ester or a salt thereof) is preferable. Further, it is also preferable to use an alkyl ether sulfuric acid ester having a linear or branched alkyl group having 8 to 20 carbon atoms
15 which is obtained by adding 0.5 to 10 moles on average of any of alkylene oxides having 2 to 4 carbon atoms, or a combination of ethylene oxide and propylene oxide (molar ratio of ethylene oxide/propylene oxide = 0.1/9.9 to 9.9/0.1), or a salt thereof.

For example, the polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof has a structure represented by the following formula (b2).

20
$$R^{21}-O-[(EO)_v/(PO)_w]-SO_3^-M^+ \quad (b2)$$

[0056]

In the formula (b2), R^{21} is a linear or branched alkyl group having 8 to 20 carbon atoms, EO is an oxyethylene group, PO is an oxypropylene group, v represents an average repeating number of EO and is a number of 0 or more, w represents an average repeating number of PO and is a
25 number of 0 to 6, and $0 < v + w$. M^+ is a counter ion.

[0057]

The carbon number of R^{21} is 8 to 20, preferably 10 to 20, more preferably 12 to 14. Examples of R^{21} include a dodecyl group, a tridecyl group, a tetradecyl group and the like. Among these, a dodecyl group is preferable.

5 The average repeating number v of EO is 0 or more, preferably 0.5 or more, more preferably 1 or more. The average repeating number v is preferably 10 or less, more preferably 5 or less, still more preferably 3 or less, particularly preferably 1.5 or less.

The average repeating number w of PO is preferably 0 to 3, more preferably 0.

10 Examples of M^+ include alkali metal ions such as sodium ion and potassium ion, alkaline earth metal ions such as magnesium ions, and cations derived from alkanol amines such as monoethanol amine and diethanol amine.

15 When v and w are each 1 or more, that is, in the case where the compound represented by the formula (b2) has EO and PO, the arrangement of EO and PO is not limited, and EO and PO may be present in randomly mixed manner or in block forms. $[EO]_v/(PO)_w$ in the formula (b2) indicates that EO and PO coexist randomly or in the form of polymer blocks. The method for adding ethylene oxide and propylene oxide is not particularly limited, and examples thereof include the methods exemplified above in the description of the compound (a1).

[0058]

20 Among the compounds represented by the formula (b2), the polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof is especially preferably a product having a linear or branched alkyl group having 10 to 20 carbon atoms and having 1 to 10 moles on average (more preferably 1 to 5 moles on average) of an alkylene oxide added thereto.

25 The polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof used as the component (B) enables suppression of denaturation of the enzyme by the anionic surfactant in the liquid detergent.

The polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof may be a commercially available product or may be produced by a known synthesis method. As the known production method, the polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof can be produced by a method including reacting a polyoxyalkylene alkyl ether with sulfuric anhydride or with chlorosulfonic acid.

[0059]

As the polyoxyalkylene alkenyl ether sulfuric acid ester or a salt thereof, an alkenyl ether sulfuric acid ester having a linear or branched alkenyl group having 8 to 20 carbon atoms and having 1 to 10 moles on average of ethylene oxide added thereto or a salt thereof (that is, a polyoxyethylene alkenyl ether sulfuric acid ester or a salt thereof) is preferable. Further, it is also preferable to use an alkenylether sulfuric acid ester having a linear or branched alkenyl group having 8 to 20 carbon atoms which is obtained by adding 0.5 to 10 moles on average of any of alkylene oxides having 2 to 4 carbon atoms, or a combination of ethylene oxide and propylene oxide (molar ratio of ethylene oxide/propylene oxide = 0.1/9.9 to 9.9/0.1), or a salt thereof.

Examples of the alkanesulfonic acid or a salt thereof include alkanesulfonic acids having 10 to 20 carbon atoms or salts thereof, of which an alkanesulfonic acid having 14 to 17 carbon atoms or a salt thereof is preferable, and a secondary alkanesulfonic acid or a salt thereof is particularly preferable.

The α -sulfo fatty acid ester or a salt thereof is preferably an α -sulfo fatty acid ester salt having 10 to 20 carbon atoms.

[0060]

These anionic surfactants are readily available on the market. Further, a compound synthesized by a known method may be used as well.

With respect to the anionic surfactant, a single type thereof may be used individually or two or more types thereof may be used in combination.

[0061]

The anionic surfactant is at least one compound selected from the group consisting of a linear alkylbenzene sulfonic acid or a salt thereof, an alkane sulfonate or a salt thereof, a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof (especially, an alkylether sulfuric acid ester salt having a linear or branched alkyl group having 8 to 20 carbon atoms which is obtained by adding 0.5 to 10 moles on average of any of alkylene oxides having 2 to 4 carbon atoms, or a combination of ethylene oxide and propylene oxide (molar ratio of ethylene oxide/propylene oxide = 0.1/9.9 to 9.9/0.1)), a polyoxyalkylene alkenyl ether sulfuric acid ester or a salt thereof (especially, an alkenylether sulfuric acid ester having a linear or branched alkenyl group having 8 to 20 carbon atoms which is obtained by adding 0.5 to 10 moles on average of any of alkylene oxides having 2 to 4 carbon atoms, or a combination of ethylene oxide and propylene oxide (molar ratio of ethylene oxide/propylene oxide = 0.1/9.9 to 9.9/0.1)), and an α -olefin sulfonic acid or a salt thereof. Among these, at least one selected from the group consisting of a linear alkylbenzene sulfonic acid or a salt thereof and a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof are more preferable.

[0062]

The amount of the component (B) is less than 50 % by mass, preferably 1 to 35 % by mass, more preferably 3 to 25 % by mass, still more preferably 5 to 20 % by mass, still more preferably 10 to 20 % by mass, based on the total mass of the liquid detergent. When the amount of the component (B) is not less than the above lower limit value, the detergency, especially the direct application detergency, is further improved. On the other hand, when the amount of the component (B) is less than the upper limit value, the stability of the liquid detergent improves.

[0063]

When the component (B) includes (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof, the mass ratio of (b2) to

(b1), (hereinbelow, also referred to as "b2/b1 ratio") is preferably 0.1 to 9, more preferably 0.5 to 9, still more preferably 1.5 to 9, particularly preferably 1 to 5. When the b2/b1 ratio is not less than the above lower limit value, the stability of the liquid detergent further improves. On the other hand, when the b2/b1 ratio is not more than the above upper limit value, the recontamination prevention ability further improves.

[0064]

Further, the mass ratio of the component (A) to the component (B), (hereinafter also referred to as "A/B ratio") is less than 3, preferably 0.5 or more and less than 3, more preferably 1 to 2.5, and still more preferably 1.5 to 2.5. When the A/B ratio is not less than the above lower limit value, the direct application detergency of the liquid detergent further improves. On the other hand, when the A/B ratio is less than the above upper limit value, the recontamination prevention ability and the ordinary detergency improve.

[0065]

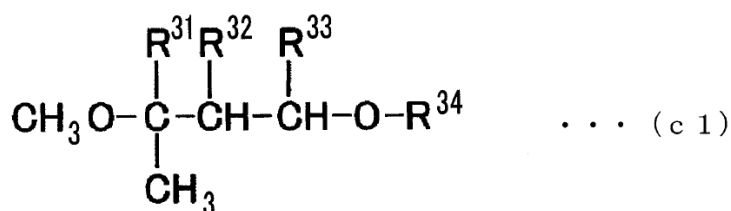
Further, the total amount of the component (A) and the component (B) is preferably from 15 to 80 % by mass, more preferably from 30 to 70 % by mass, even more preferably from 40 to 60 % by mass, based on the total mass of the liquid detergent. When the total amount of the component (A) and the component (B) is not less than the above lower limit value, the liquid detergent exhibits high direct application detergency. On the other hand, when the total amount of the component (A) and the component (B) is less than the above upper limit value, film formation and gelation can be suppressed.

[0066]

<Component (C)>

The component (C) is an organic solvent represented by the formula (c1) below. The component (C) can be produced by a conventional method, and a commercially available product may be used.

[0067]



[0068]

In the formula (c1), each of R³¹ to R³³ is independently a hydrogen atom or an alkyl group
 5 having 1 to 3 carbon atoms, and R³⁴ is a hydrogen atom or an acetyl group.

[0069]

Examples of the component (C) include 3-methoxybutanol, 3-methoxy-3-methylbutanol,
 3-methoxy-3-ethylbutanol, 3-methoxy-3-propylbutanol, 3-methoxy-2-methylbutanol,
 3-methoxy-2-ethylbutanol, 3-methoxy-2-propylbutanol, 3-methoxy-1-methylbutanol,
 10 3-methoxy-1-ethylbutanol, 3-methoxy-1-propylbutanol, 3-methoxybutyl acetate,
 3-methoxy-3-methylbutyl acetate, 3-methoxy-3-ethylbutyl acetate, 3-methoxy-3-propylbutyl acetate,
 3-methoxy-2-methylbutyl acetate, 3-methoxy-2-ethylbutyl acetate, 3-methoxy-2-propylbutyl acetate,
 3-methoxy-1-methylbutyl acetate, 3-methoxy-1-ethylbutyl acetate, and 3-methoxy-1-propylbutyl
 acetate. Among these, 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2 methylbuta-
 15 nol, 3-methoxy-1-methylbutanol and 3-methoxy-3-methylbutyl acetate are preferable, and
 3-methoxy-3-methylbutanol is more preferable.

With respect to the component (C), a single type thereof may be used individually or two
 or more types thereof may be used in combination.

[0070]

20 The amount of the component (C) is preferably 1 to 30 % by mass, more preferably 2 to
 20 % by mass, still more preferably 3 to 10% by mass, based on the total mass of the liquid deter-
 gent. When the amount of the component (C) is not less than the above lower limit value, gelation

is suppressed and the fluidity of the liquid detergent is more easily maintained. In addition, the detergency against ink stain improves as well. On the other hand, even if the component (C) is used in an amount exceeding the above upper limit value, no further effect of improving fluidity is obtained despite of the use of larger amount of the component (C), which is economically disadvantageous.

[0071]

The mass ratio of the component (B) to the component (C), (hereinafter also referred to as "B/C ratio") is preferably 0.1 to 15, more preferably 1 to 10, and still more preferably 2 to 5. When the B/C ratio is not less than the above lower limit value, high recontamination prevention ability can be achieved. On the other hand, when the B/C ratio is not more than the above upper limit value, high direct application detergency can be achieved.

[0072]

<Optional Component>

The liquid detergent may contain components (optional components) other than the components (A), (B) and (C) as long as the effects of the present invention are not impaired.

Examples of the optional components include those generally used in liquid detergents. Examples thereof include water, higher fatty acids or salts thereof, cationic surfactants, amphoteric surfactants, solvents other than the component (C) and water (other solvents), chelating agents, enzymes, hydrotropic agents (for example, polyethylene glycol, an aromatic sulfonic acid or a salt thereof), detergency builders, stabilizers, alkaline agents (for example, alkanol amines such as monoethanolamine, diethanolamine, and triethanolamine), metal ion scavengers, texture improvers such as silicone, antiseptics, fluorescent agents, dye transfer inhibitors, pearl agents, antioxidants, antibacterial agents, pigments including those that are generally used as a colorant, emulsifier, perfumes, pH adjusters, and the like.

[0073]

(Water)

The liquid detergent of the present invention preferably contains water as a solvent other than the component (C) from the viewpoints of ease of handling during production of the detergent, solubility of the detergent in water at the time of use, and the like.

5 The amount of water is preferably from 5 to 45 % by mass, more preferably from 10 to 40 % by mass, based on the total mass of the liquid detergent. When the amount of water is not less than the above lower limit value, fluidity and stability can be satisfactorily maintained. On the other hand, when the amount of water is not more than the above upper limit value, it is possible to allow the components (A), (B) and (C) to be contained in the liquid detergent in amounts within
10 optimal ranges.

[0074]

(Higher Fatty Acid or Salt thereof)

The higher fatty acid or a salt thereof is preferably a higher fatty acid having 10 to 20 carbon atoms or a salt thereof, and examples thereof include a single fatty acid such as caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, isostearic acid, hydroxystearic acid,
15 oleic acid and behenic acid, or a salt thereof; and a mixed fatty acid such as coconut oil fatty acid, beef tallow fatty acid or the like, or a salt thereof.

Examples of the salt form of the higher fatty acid include alkali metal salts such as a sodium salt and a potassium salt; alkaline earth metal salts such as a magnesium salt; and alkanolamine salts such as a monoethanolammonium salt and a diethanolammonium salt.
20

With respect to each of these fatty acids and salts thereof, a single type thereof may be used individually or two or more types thereof may be used in combination.

[0075]

(Cationic Surfactant)

25 As the cationic surfactant, any cationic surfactant conventionally used in a liquid detergent

for clothing or the like may be used. Examples of the cationic surfactant include long-chain aliphatic amide alkyl tertiary amines or salts thereof such as caprylic acid dimethylaminopropylamide, capric acid dimethylaminopropylamide, lauric acid dimethylaminopropylamide, myristic acid dimethylaminopropylamide, palmitic acid dimethylaminopropylamide, stearic acid dimethylaminopropylamide, behenic acid dimethylaminopropylamide, and oleic acid dimethylaminopropylamide; aliphatic ester alkyl tertiary amines or salts thereof such as palmitate ester propyl dimethylamine, and stearate ester propyl dimethyl amine; palmitic acid diethanol aminopropyl amide, stearic acid diethanol aminopropyl amide; quaternized products such as an alkyl trimethyl ammonium salt, a dialkyl dimethyl ammonium salt, an alkyl benzyl dimethyl ammonium salt, and an alkyl pyridinium salt.

Among these, long-chain aliphatic amide alkyl tertiary amines or salts thereof are preferable, and caprylic acid dimethylaminopropylamide, capric acid dimethylaminopropylamide, lauric acid dimethylaminopropylamide, myristic acid dimethylaminopropylamide, palmitic acid dimethylaminopropylamide, stearic acid dimethylaminopropylamide, behenic acid dimethylaminopropylamide, oleic acid dimethylaminopropylamide or salts thereof are more preferable.

With respect to each of the cationic surfactants, a single type thereof may be used individually or two or more types thereof may be used in combination.

[0076]

(Amphoteric Surfactant)

The amphoteric surfactant may be any amphoteric surfactant conventionally used in liquid detergents for clothing and the like, and examples thereof include those of an alkyl betaine type, an alkylamide betain type, an imidazoline type, an alkyl aminosulfonic acid type, an alkyl aminocarboxylic acid type, an alkyl amidocarboxylic acid type, an amide amino acid type, or a phosphoric acid type.

With respect to each of the amphoteric surfactants, a single type thereof may be used indi-

vidually or two or more types thereof may be used in combination.

[0077]

(Other Solvent)

As other solvents, any solvents conventionally used for liquid detergents for clothing etc.
5 may be used, and examples thereof include monohydric alcohols having 2 to 4 carbon atoms, polyhydric alcohols having 2 to 4 carbon atoms, and glycol ether-based solvents.

Examples of the monohydric alcohol having 2 to 4 carbon atoms include ethanol, 1-propanol, 2-propanol, 1-butanol and the like.

Examples of the polyhydric alcohol having 2 to 4 carbon atoms include ethylene glycol,
10 propylene glycol, butylene glycol, glycerin and the like.

The glycol ether-based solvent is preferably a compound represented by the formula: $R^{41}-(OR^{42})_uOH$ (wherein R^{41} is an alkyl group having 1 to 6 carbon atoms or a phenyl group, R^{42} is an alkylene group having 2 to 4 carbon atoms, and u represents an average number of repetitions of OR^{42} and is a number 1 to 5), and examples thereof include ethylene glycol monobutyl ether,
15 ethylene glycol monohexyl ether, ethylene glycol monophenyl ether, propylene glycol monophenyl ether, diethylene glycol monomethyl ether, diethylene glycol monobutyl ether, and the like.

[0078]

(Chelating Agent)

The liquid detergent of the present invention may contain a chelating agent capable of che-
20 lating metal ions.

As the chelating agent, organic chelating agents can be mentioned. Specific examples thereof include citric acid, lactic acid, tartaric acid, oxalic acid, malic acid, gluconic acid, nitrilotriacetic acid, iminodiacetic acid, ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, glycol ether diaminetetraacetic acid, hydroxyethyliminodiacetic acid, triethylenetetraaminehexaac-
25 etate, organophosphonic acid derivatives such as ethane-1,1-diphosphonic acid,

ethane-1,1,2-triphosphonic acid, 1-hydroxyethane-1,1-diphosphonic acid, ethanehydroxy-1,1,2-triphosphonic acid, ethane-1,2-dicarboxy-1,2-diphosphonic acid, methane hydroxyphosphonic acid, aminotrimethylene phosphonic acid, ethylenediaminetetra methylene phosphonic acid, and salts thereof. Among these, 1-hydroxyethane-1,1-diphosphonic acid and ethylenediaminetetraoxymethylenesulfonic acid are more preferable, and 1-hydroxyethane-1,1-diphosphonic acid is particularly preferable.

[0079]

(Enzyme)

The presence of an enzyme in the liquid detergent improves the direct application detergency in washing by directly applying the liquid detergent to items to be washed.

Examples of the enzyme include protease, amylase, lipase, cellulase, mannanase and the like.

[0080]

As the protease, a protease having serine, histidine and aspartic acid in its molecule, such as serine protease, is preferable.

Generally, a preparation containing a protease (protease preparation) is commercially available. When preparing the liquid detergent, the protease is usually blended using such a protease preparation.

Examples of the protease preparation include products with tradenames Savinase 16L, Savinase Ultra 16L, Savinase Ultra 16XL, Everlase 16L Type EX, Everlase Ultra 16L, Esperase 8L, Alcalase 2.5L, Alcalase Ultra 2.5L, Liquanase 2.5 L, Liquanase Ultra 2.5 L, Liquanase Ultra 2.5 X L, and Coronase 48 L, each available from Novozymes; and products with tradenames Purafect L, Purafect OX, and Properase L, each available from Genencor.

[0081]

Examples of the amylase preparation include products with tradenames Termamyl 300L, Termamyl Ultra 300L, Duramyl 300L, Stainzyme 12L, and Stainzyme Plus 12L, each available

from Novozymes; a product with a tradename Maxamyl, available from Genencor; a product with a tradename Pullulanase Amano, available from Amano Enzyme Inc.; and a product with a tradename DB-250, available from Seikagaku Corporation.

Examples of the lipase preparation include products with tradenames Lipex 100L and
5 Lipolase 100L, available from Novozymes.

Examples of the cellulase preparation include Carezyme 4500L (tradename, manufactured by Novozymes), Carezyme Premium 4500L (tradename, manufactured by Novozymes), Endolase 5000L (tradename, manufactured by Novozymes), Celclean 4500T (tradename, manufactured by Novozymes) and the like.

10 Examples of the mannanase preparation include a product with a tradename Mannaway 4L, available from Novozymes.

With respect to the enzyme, a single type thereof may be used individually or two or more types thereof may be used in combination.

[0082]

15 The amount of the enzyme is preferably 0.1 to 3 % by mass in terms of the amount of an enzyme preparation, based on the total mass of the liquid detergent.

[0083]

With respect to the amounts of the components (A), (B) and (C) contained in the liquid detergent, the total thereof does not exceed 100 % by mass, based on the total mass of the liquid detergent. When the liquid detergent contains water and optional component(s), the total amount of
20 the components (A), (B) and (C), water and the optional component(s) does not exceed 100 % by mass, based on the total mass of the liquid detergent.

Further, the total of the amounts of all components contained in the liquid detergent equals 100 % by mass.

25 [0084]

<Production Method>

The liquid detergent of the present invention can be prepared, for example, by dissolving the above-mentioned components (A), (B) and (C) and, if necessary, optional components in water, and adjusting the pH of the resulting mixture to a predetermined value using, if necessary, a pH ad-
5 juster such as monoethanolamine, diethanolamine, triethanolamine, sodium hydroxide, potassium hydroxide, etc.

[0085]

<pH>

The pH of the liquid detergent of the present invention at 25 °C is preferably 5 to 9, more
10 preferably 6 to 8.

When the pH of the liquid detergent at 25 °C is within the above range, the storage stability of the liquid detergent is more favorably maintained.

In the present invention, the pH of the liquid detergent is a value measured by a pH meter or the like while adjusting the temperature of the liquid detergent to 25 °C.

15 [0086]

<Effects>

In the liquid detergent of the present invention described above, excellent recontamination prevention ability and good direct application detergency are achieved by the combination of the component (A) and the component (B) used in a specific mass ratio with the component (C). In
20 addition, the liquid detergent of the present invention also has good ordinary detergency.

The liquid detergent of the present invention is suitable as a liquid detergent for clothing.

[0087]

Examples of the method of using the liquid detergent include a method in which the liquid detergent is charged into water together with the items to be washed at the time of washing (ordi-
25 nary washing), and a method in which the items to be washed is soaked in an aqueous liquid deter-

gent solution prepared by dissolving the liquid detergent in water in advance. Alternatively, the liquid detergent may be directly applied to the items to be washed, and left to stand for a certain period of time, followed by ordinary washing (direct application washing).

Examples of the items to be washed include textile products such as clothing, dish towels,
5 towels, sheets and the like.

When the liquid detergent is dissolved in water for use, it is preferable to dilute the liquid detergent, for example, 5 to 5000 times (volume basis).

[0088]

The liquid detergent of the present invention in still another embodiment includes:

10 component (A): a nonionic surfactant containing the compound represented by the formula (a1) below, and the compound represented by the formula (a2) below or the compound represented by the formula (a3) below;

component (B): an anionic surfactant exclusive of higher fatty acid salts; and

component (C): an organic solvent represented by formula (c1) below,

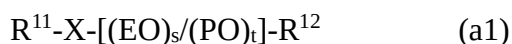
15 water; and

an optional component acceptable as a liquid detergent,

wherein:

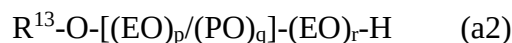
an amount of the component (B) is less than 50 % by mass, based on the total mass of the liquid detergent; and

20 a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.



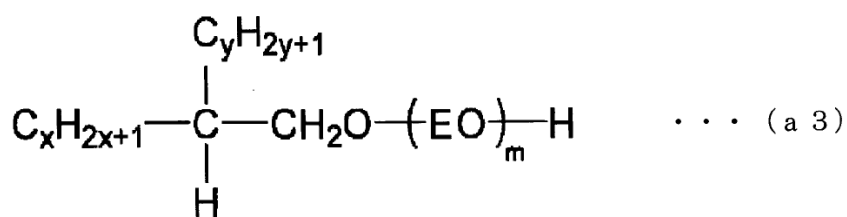
wherein R^{11} is a hydrocarbon group having 6 to 22 carbon atoms, X is a divalent linking group, R^{12} is a hydrogen atom, an alkyl group having 1 to 6 carbon atoms or an alkenyl group having 2 to 6 carbon atoms, EO is an oxyethylene group, PO is an oxypropylene group, s is an average repeating
25 number of EO and is a number of 3 to 20, and t represents an average repeating number of PO and

is a number from 0 to 6.



wherein R^{13} is a hydrocarbon group having 6 to 22 carbon atoms, derived from a secondary alcohol, EO represents an oxyethylene group, PO represents an oxypropylene group, p represents an average number of repetitions of EO and is a number of 3 to 20, q represents an average number of repetitions of PO and is a number of 0 to 6, r represents an average number of repetitions of EO and is a number of 0 to 20.

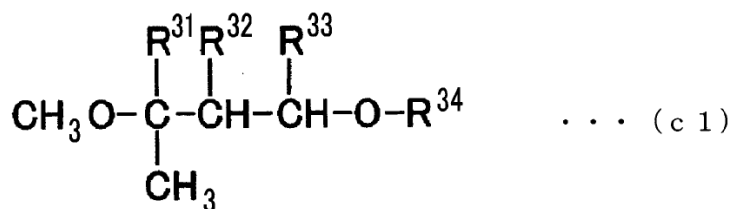
[0089]



[0090]

In the formula (a3), EO represents an oxyethylene group, m represents an average number of repetitions of EO and is a number of 3 to 10, and x and y are each a number of 1 to 7.

[0091]



[0092]

In the formula (c1), each of R^{31} to R^{33} is independently a hydrogen atom or an alkyl group having 1 to 3 carbon atoms, and R^{34} is a hydrogen atom or an acetyl group.

[0093]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a

5 linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

component (C): an organic solvent represented by the formula (c1) above;

water; and

an optional component acceptable as a liquid detergent,

10 wherein:

an amount of the component (B) is less than 50 % by mass, based on the total mass of the liquid detergent; and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0094]

15 The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): at least one organic solvent selected from the group consisting of

3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol,

20 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (B) is less than 50 % by mass, based on the total mass of the

25 liquid detergent; and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0095]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing the compound represented by the formula

5 (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

10 component (C): at least one organic solvent selected from the group consisting of 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

15 wherein:

an amount of the component (B) is less than 50 % by mass, based on the total mass of the liquid detergent; and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0096]

20 The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing a polyoxyethylene fatty acid methyl ester of the formula (a1) in which -X- is -COO-, R^{12} is a methyl group, and t is 0, and the compound represented by the formula (a2) or the compound represented by the formula (a3);

25 component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric

acid ester or a salt thereof;

component (C): an organic solvent containing 3-methoxy-3-methylbutanol;

water; and

an optional component acceptable as a liquid detergent,

5 wherein:

an amount of the component (B) is less than 50 % by mass, based on the total mass of the liquid detergent; and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0097]

10 The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

water; and

15 an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the above components does not exceed 100 % by mass, and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0098]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

25 component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

water; and

an optional component acceptable as a liquid detergent,

wherein:

5 an amount of the component (A) is 25 to 50 % by mass, an amount of the component (B) is 1 to 35 % by mass, and an amount of the component (C) is 3 to 10 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the above components does not exceed 100 % by mass, and

a mass ratio of the component (A) to the component (B), (A)/(B), is 1 to 2.5.

10 [0099]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

15 water; and

an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on
20 the total mass of the liquid detergent, with the proviso that the sum of the amounts of the component (A) and the component (B) is 15 to 80 % by mass and the sum of the respective amounts of the above components does not exceed 100 % by mass, and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0100]

25 The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

water; and

5 an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on

the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the

10 above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), $(A)/(B)$, is less than 3, and

a mass ratio of the component (B) to the component (C), $(B)/(C)$, is 0.1 to 15.

[0101]

The liquid detergent of the present invention in still another embodiment includes:

15 component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

water; and

an optional component acceptable as a liquid detergent,

20 wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on

the total mass of the liquid detergent, with the proviso that the sum of the amounts of the compo-

nent (A) and the component (B) is 15 to 80 % by mass and the sum of the respective amounts of the

25 above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3, and

a mass ratio of the component (B) to the component (C), (B)/(C), is 0.1 to 15.

[0102]

The liquid detergent of the present invention in still another embodiment includes:

5 component (A): a nonionic surfactant;

component (B): an anionic surfactant exclusive of higher fatty acid salts;

component (C): an organic solvent represented by the formula (c1) above;

water; and

an optional component acceptable as a liquid detergent,

10 wherein:

an amount of the component (A) is 25 to 50 % by mass, an amount of the component (B) is 1 to 35 % by mass, and an amount of the component (C) is 3 to 10 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the amounts of the component (A) and the component (B) is 30 to 70 % by mass and the sum of the respective amounts of the
15 above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), (A)/(B), is 1 to 2.5, and

a mass ratio of the component (B) to the component (C), (B)/(C), is 2 to 5.

[0103]

The liquid detergent of the present invention in still another embodiment includes:

20 component (A): a nonionic surfactant containing the compound represented by the formula (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric
25 acid ester or a salt thereof;

component (C): at least one organic solvent selected from the group consisting of 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

5 an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the
10 above components does not exceed 100 % by mass, and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0104]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing the compound represented by the formula
15 (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

20 component (C): at least one organic solvent selected from the group consisting of 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

25 wherein:

an amount of the component (A) is 25 to 50 % by mass, an amount of the component (B) is 1 to 35 % by mass, and an amount of the component (C) is 3 to 10 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the above components does not exceed 100 % by mass, and

5 a mass ratio of the component (A) to the component (B), (A)/(B), is 1 to 2.5.

[0105]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing the compound represented by the formula (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

component (C): at least one organic solvent selected from the group consisting of

15 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

wherein:

20 an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the amounts of the component (A) and the component (B) is 15 to 80 % by mass and the sum of the respective amounts of the above components does not exceed 100 % by mass, and

25 a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

[0106]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing the compound represented by the formula (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

component (C): at least one organic solvent selected from the group consisting of 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the respective amounts of the above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3,

a mass ratio of the component (B) to the component (C), (B)/(C), is 0.1 to 15, and

a mass ratio of the (b2) to the (b1), (b2)/(b1), is 0.1 to 9.

[0107]

The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing the compound represented by the formula (a1), and the compound represented by the formula (a2) or the compound represented by the formula (a3);

mula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric acid ester or a salt thereof;

5 component (C): at least one organic solvent selected from the group consisting of 3-methoxybutanol, 3-methoxy-3-methylbutanol, 3-methoxy-2-methylbutanol, 3-methoxy-1-methylbutanol, and 3-methoxy-3-methylbutyl acetate;

water; and

an optional component acceptable as a liquid detergent,

10 wherein:

an amount of the component (A) is 10 to 80 % by mass, an amount of the component (B) is less than 50 % by mass, and an amount of the component (C) is 1 to 30 % by mass, each based on the total mass of the liquid detergent, with the proviso that the sum of the amounts of the component (A) and the component (B) is 15 to 80 % by mass and the sum of the respective amounts of the
15 above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3,

a mass ratio of the component (B) to the component (C), (B)/(C), is 0.1 to 15, and

a mass ratio of the (b2) to the (b1), (b2)/(b1), is 0.1 to 9.

[0108]

20 The liquid detergent of the present invention in still another embodiment includes:

component (A): a nonionic surfactant containing a polyoxyethylene fatty acid methyl ester of the formula (a1) in which -X- is -COO-, R^{12} is a methyl group, and t is 0, and the compound represented by the formula (a2) or the compound represented by the formula (a3);

component (B): an anionic surfactant (exclusive of higher fatty acid salts) including (b1) a
25 linear alkylbenzene sulfonic acid or a salt thereof, and (b2) a polyoxyalkylene alkyl ether sulfuric

acid ester or a salt thereof;

component (C): an organic solvent containing 3-methoxy-3-methylbutanol;

water; and

an optional component acceptable as a liquid detergent,

5 wherein:

an amount of the component (A) is 25 to 50 % by mass, an amount of the component (B) is 1 to 35 % by mass, and an amount of the component (C) is 3 to 10 % by mass, each based on the

total mass of the liquid detergent, with the proviso that the sum of the amounts of the component (A) and the component (B) is 30 to 70 % by mass and the sum of the respective amounts of the

10 above components does not exceed 100 % by mass,

a mass ratio of the component (A) to the component (B), (A)/(B), is 1 to 2.5,

a mass ratio of the component (B) to the component (C), (B)/(C), is 2 to 5, and

a mass ratio of the (b2) to the (b1), (b2)/(b1), is 0.5 to 9.

15 Examples

[0109]

Hereinbelow, the present invention will be described with reference to the Examples which, however, should not be construed as limiting the present invention. The amounts of the components used in the Examples are shown in terms of amounts of pure forms thereof unless otherwise
20 specified.

[0110]

[Raw Materials Used]

As the component (A), the following compounds were used.

A-1: A product (polyoxyethylene fatty acid methyl ester (MEE)) obtained by adding 15 moles of
25 ethylene oxide to a coconut fatty acid methyl ester (mixture with a methyl laurate/methyl myristate

mass ratio of 8/2) using an alkoxylation catalyst. This product has a structure represented by the formula (a1) in which R^{11} = a linear alkyl group having 11 carbon atoms and a linear alkyl group having 13 carbon atoms, R^{12} = a methyl group, -X- is -COO-, $s = 15$, and $t = 0$. Further, this product has a narrow rate of 33 %. This product was synthesized according to the synthesis method described below.

A-2: A product (tradename "Softanol 70" manufactured by Nippon Shokubai Co., Ltd.) obtained by adding 7 moles of ethylene oxide to a secondary alcohol having 12 to 14 carbon atoms. This product has a structure represented by the formula (a2) in which R^{13} = a branched alkyl group having 12 to 14 carbon atoms, $p = 7$, $q = 0$, and $r = 0$.

A-3: A product (C13 oxo alcohol ethoxylate with a trade name "Lutensol TO 10", manufactured by BASF) obtained by adding 10 moles of ethylene oxide to C13 alcohol obtained by subjecting a C12 alkene obtained by trimerizing butene to oxo process. This product has a structure represented by the formula (a3) in which $x + y = 11$, and $m = 10$.

A-4: A product (polyoxyethylene alkyl ether (LMAO)) obtained by adding 15 moles of ethylene oxide to natural alcohols (primary alcohols) having 12 and 14 carbon atoms. This product was synthesized according to the synthesis method described below.

[0111]

(Method for Synthesizing A-1)

According to the synthesis method described in Japanese Unexamined Patent Application Publication No. 2000-144179, A-1 was synthesized as follows.

Aluminum magnesium hydroxide having a composition of $2.5\text{MgO} \cdot \text{Al}_2\text{O}_3 \cdot w\text{H}_2\text{O}$ (trade-name "KYOWAAD 300", manufactured by Kyowa Chemical Industry Co., Ltd.) was calcined at 600 °C for 1 hour in a nitrogen atmosphere to obtain a calcined aluminum magnesium hydroxide (unmodified) catalyst. 2.2 g of the calcined aluminum magnesium hydroxide (unmodified) catalyst, 2.9 mL of 0.5 N potassium hydroxide ethanol solution, 280 g of methyl laurate and 70 g of

methyl myristate were placed in a 4 L autoclave, and the catalyst was modified in the autoclave. Subsequently, after replacing the interior of the autoclave with nitrogen, 1052 g of ethylene oxide was introduced while maintaining the temperature at 180 °C and the pressure at 0.3 MPa, to perform a reaction while stirring.

5 The resulting reaction solution was cooled to 80 °C, followed by addition of and mixing with 159 g of water and 5 g each of activated clay and diatomaceous earth as filter aids. From the resulting, the catalyst was filtered off to obtain A-1.

[0112]

The narrow rate of A-1 was measured by the following procedure.

10 Under the measurement conditions described below, the distribution of ethylene oxide adducts with different moles of added ethylene oxide was measured, and the narrow rate (% by mass) was calculated by the above equation (S).

[Conditions for HPLC Measurement of Distribution of Ethylene Oxide Adduct]

Apparatus: LC-6A (manufactured by Shimadzu Corporation)

15 Detector: SPD-10A

Measurement wavelength: 220 nm

Column: Zorbax C8 (manufactured by Du Pont Co., Ltd.)

Mobile phase: acetonitrile/water = 60/40 (volume ratio)

Flow rate: 1 mL/min.

20 Temperature: 20 °C

[0113]

(Method for Synthesizing A-4)

861.2 g of CO-1214 (trade name) manufactured by Procter & Gamble Co., Ltd. and 2.0 g of a 30 % by mass NaOH aqueous solution were charged into a pressure resistant reactor, and the
25 interior of the reactor was purged with nitrogen. Next, after dehydrating at a temperature of

100 °C and a pressure of 2.0 kPa or less for 30 minutes, the temperature was raised to 160 °C. Subsequently, while stirring the reaction solution, 760.6 g of ethylene oxide (gaseous form) was gradually added to the reaction solution. During this process, ethylene oxide was added via a blowing tube, while adjusting the addition rate such that the reaction temperature does not exceed
5 180 °C.

After completion of the addition of ethylene oxide, aging was carried out at a temperature of 180 °C and a pressure of 0.3 MPa or less for 30 minutes, and unreacted ethylene oxide was distilled off at a temperature of 180 °C and a pressure of 6.0 kPa or less for 10 minutes.

Next, the temperature was cooled to 100 °C or lower and, then, 70 % by mass
10 p-toluenesulfonic acid was added for neutralization so as to adjust the pH of 1 % by mass aqueous solution of the reaction product to about 7, thus obtaining A-4.

[0114]

As the component (B), the following compounds were used.

B-1: A linear alkylbenzene sulfonic acid (LAS), (trade name "LIPON LH-200", manufactured by
15 Lion Corporation).

B-2: A polyoxyalkylene alkyl ether sulfuric acid ester salt (AES) (mixture of a polyoxyethylene lauryl ether sulfate sodium salt and a polyoxyethylene myristyl ether sulfate sodium salt, average number of moles of added EO = 1).

[0115]

20 As the component (C), the following compounds were used.

C-1: 3-methoxy-3-methylbutanol (trade name "Solfit", manufactured by Kuraray Co., Ltd.). This product has a structure represented by the formula (c1) in which R^{31} = a methyl group, R^{32} = a hydrogen atom, R^{33} = a hydrogen atom, R^{34} = a hydrogen atom.

[0116]

25 As the optional components, the following compounds were used.

Coconut fatty acid: tradename "Yahi Shibousan (coconut fatty acid)", manufactured by NOF CORPORATION.

Ethanol (water-miscible organic solvent): tradename "Tokutei Arukoru 95do Gousei (specified alcohol synthesized at 95 degrees)", manufactured by Japan Alcohol Trading Co., Ltd.

5 PPG 4000: a polyoxypropylene glyceryl ether (tradename "Actcol T-4000", manufactured by Mitsui Chemicals, Inc., weight average molecular weight 4000).

PTSH: paratoluenesulfonic acid (tradename "PTS acid", manufactured by Kyowa Hakko Kogyo Co., Ltd.).

10 Sodium lactate (enzyme stabilizer): tradename "Nyusan Natoriumu (sodium lactate)", manufactured by Kanto chemical co.,inc.

MGDA: trisodium methylglycine diacetate (trade name "Trilon M Liquid", manufactured by BASF)

Calcium chloride (enzyme stabilizer): tradename "Enka Karushiumu (calcium chloride)", manufactured by Kanto chemical co., inc.

15 Sodium benzoate (preservative): tradename "Ansokukousan Natoriumu (sodium benzoate)", manufactured by Toagosei Co., Ltd.

Perfume (flavoring agent): perfume composition A described in Tables 11 to 18 of Japanese Unexamined Patent Application Publication No. 2002-146399

20 SR agent: a soil release polymer (tradename "TexCare SRN-170C", manufactured by Clariant(Japan)K.K., weight average molecular weight: 2000 to 3000, pH (5 % by mass aqueous solution at 20 °C): 4, viscosity: 300 mPa · s) TexCare SRN-170C is a 70 % by mass aqueous solution of a product with a tradename TexCare SRN-100 (manufactured by Clariant(Japan)K.K., weight average molecular weight: 2000 to 3000).

HP-20: ethylene oxide adduct of polyethyleneimine (tradename "Sokalan HP 20", manufactured by BASF)

25 Sodium hydroxide: tradename "Suisanka Natoriumu (sodium hydroxide)", manufactured by Tsuru-

mi Soda Co., Ltd.

Diclosan (antibacterial agent): 4,4'-dichloro-2-hydroxydiphenyl ether (tradename "Tinosan HP 100", manufactured by BASF)

Alcalase (enzyme): tradename "Alcalase 2.5 L", manufactured by Novozymes Inc.

5 Pigment (colorant): tradename "Green No. 3", manufactured by Kishi Kasei Co., LTD.

MEA (alkaline agent): monoethanolamine (tradename "Mono Metanoru Amin (monoethanolamine)", manufactured by Nippon Shokubai Co., Ltd.)

Purified water: manufactured by Kanto Chemical Co., Inc.

[0117]

10 [Examples 1 to 9, Comparative Examples 1 and 2]

<Preparation of Liquid Detergent>

The components (A), (B), (C) and optional components (excluding sodium hydroxide and MEA) were added and mixed together according to the blending ratio shown in Tables 1 and 2, and the pH of the resulting mixed solution at 25 °C was adjusted to 7 with sodium hydroxide and MEA, 15 thus preparing a liquid detergent. For the measurement of pH, a pH meter (product name "HM-30G", manufactured by DKK-TOA Corporation) was used.

Regarding the obtained liquid detergent of each of the Examples and the Comparative Examples, the recontamination prevention ability, direct application detergency and ordinary detergency were evaluated in the following manner. The results are shown in Tables 1 and 2.

20 [0118]

<Evaluations>

(Evaluation of Recontamination Prevention Ability)

Using the liquid detergent of each of the Examples and the Comparative Examples, a washing treatment was conducted by repeating three time a set of a washing step, a rinsing step and 25 a drying step, each described below, which were performed in this order. As items to be washed,

the following cotton cloth, polyester (PE) cloth, artificially wet-soiled cloth and undershirt were used.

Cotton cloth: Five pieces (5 cm × 5 cm) of cotton knitted fabric (manufactured by Tanigashira Shoten) as cloths for recontamination evaluation

5 PE cloth: Five pieces (5 × 5 cm) of polyester tropical (manufactured by Tanigashira Shoten) as cloths for recontamination evaluation

Artificially wet-soiled cloth: Twenty pieces of soiled cloth manufactured by Cleaning Science Association of Japan (cloth with dirt having a composition of oleic acid 28.3 %, triolein 15.6 %, cholesterol oleate 12.2 %, liquid paraffin 2.5 %, squalene 2.5 %, cholesterol 1.6 %, gelatin 10 7.0 %, mud 29.8 %, carbon black 0.5 % (mass ratio))

Undershirt: Shreds (about 3 cm × 3 cm) obtained by finely cutting a BVD undershirt (LL size, manufactured by Fuji Boshoku Holdings Co., Ltd.)

[0119]

Washing Step:

15 900 mL of 3°dH hard water having a temperature of 25 °C was placed in Terg-o-tometer (manufactured by UNITED STATES TESTING CO., LTD.), into which 0.6 g of the liquid detergent of each of the Examples and the Comparative Examples was added, and then the items to be washed were added. Thereafter, the liquor ratio was adjusted to 20 times with 3 °dH hard water and washing was performed at 120 rpm at 25 °C for 10 minutes.

20 [0120]

Rinsing Step:

The items after washing were dehydrated for 1 minute, followed by addition of 900 mL of 3 °dH hard water having a temperature of 25 °C and subsequent rinsing at 120 rpm and 25 °C for 3 minutes. This series of operations (dehydration and rinsing) was repeated twice. In the second 25 round, a predetermined amount of softener was added to 900 mL of the 3 °dH hard water having a

temperature of 25 °C, and the rinsing was performed. As the softener, Soflan Heyaboshi (Hang-to-Dry Indoors) (manufactured by Lion Corporation) was used.

[0121]

Drying Step:

5 After dehydrating the rinsed items for 1 minute, only the cloths for recontamination evaluation (cotton cloths) were taken out, sandwiched between filter paper, and dried with an iron.

Separately, only the cloths for recontamination evaluation (PE cloths) were taken out, sandwiched between filter paper, and dried with an iron.

[0122]

10 Using a spectroscopic color difference meter (product name "SE 200", manufactured by Nippon Denshoku Industries Co., Ltd.), the reflectance values (Z values) of the cloths for recontamination evaluation (cotton cloth) before and after the washing treatment were measured, and ΔZ was determined by the following equation. Similarly, the reflectance values (Z values) of the cloths for recontamination evaluation (PE cloth) before and after the washing treatment were measured, and ΔZ was determined by the following equation.

$$\Delta Z = (Z \text{ value before washing treatment}) - (Z \text{ value after washing treatment})$$

[0123]

20 With respect to the ΔZ of the cotton cloth for recontamination evaluation, the average value of 5 pieces was determined, and the recontamination prevention ability of the liquid detergent relative to the cotton cloth was evaluated based on the following criteria. With ◎ or ○, the recontamination prevention property relative to cotton cloth was judged as good.

◎: ΔZ (average value) is less than 5.

○: ΔZ (average value) is 5 or more and less than 7.

△: ΔZ (average value) is 7 or more and less than 9.

×: ΔZ (average value) is 9 or more.

[0124]

With respect to the ΔZ of the PE cloth for recontamination evaluation, the average value of 5 pieces was determined, and the recontamination prevention ability of the liquid detergent relative to the PE cloth was evaluated based on the following criteria. With ◎ or ○, the recontamination prevention property relative to PE cloth was judged as good.

◎: ΔZ (average value) is less than 3.

○: ΔZ (average value) is 3 or more and less than 4.

△: ΔZ (average value) is 4 or more and less than 5.

10 ×: ΔZ (average value) is 5 or more.

[0125]

(Evaluation of Detergency: Direct application detergency against Ink Stain)

10 cut pieces (5 cm × 5 cm) of cotton cloth (cotton knitted fabric, manufactured by Tanigashira Shoten) were used as an evaluation cloth, and an oil-based ink of an oil ballpoint pen (tradename "Clip-on-Slim oil ballpoint pen", manufactured by ZEBRA) was applied to the evaluation cloth to prepare an ink-stained cloth with an oil-based ink stain. In this process, an oil-based ink was applied to the center of the cotton cloth so as to form a circle having a diameter of 2 cm.

This ink-stained cloth was washed using the liquid detergents of each of the Examples and the Comparative Examples by the following procedure.

20 [0126]

0.05 mL of the liquid detergent of each of the Examples and the Comparative Examples was applied to the oil-based ink stain adhered to the ink-stained cloth, and the resultant was left to stand for 3 minutes and, then washed by the following washing method with a washing liquid obtained by dissolving 6 mL of the liquid detergent of each of the Examples and the Comparative

Examples in 15 L of water.

Terg-O-Tometer (manufactured by UNITED STATES TESTING) was used as a washing tester. 10 pieces of the above ink-stained cloth after application of the liquid detergent of each of the Examples and the Comparative Examples and being allowed to stand for 3 minutes were placed in the washing tester together with the above washing liquid, and the liquor ratio of the resulting was adjusted to 30 times, followed by washing at 120 rpm at 15 °C for 10 minutes. Next, the pieces of cloth were transferred to a twin tub washing machine (product number "CW-C30A1-H1", manufactured by Mitsubishi Electric Corporation), dehydrated for 1 minute, rinsed in 30 L of tap water (15 °C, 4 °dH) for 3 minutes, and air-dried.

With respect to each of the cloth for evaluation without the oil-based ink stain, the ink-stained cloth before washing and the ink-stained cloth after washing, the reflectance was measured with a color difference meter (product name "SE 200", manufactured by Nippon Denshoku Industries Co., Ltd.), and the cleaning rate (%) was calculated by the following equation (1).

$$\text{Cleaning rate (\%)} = \{(\text{K/S of ink-stained cloth before washing} - \text{K/S of ink-stained cloth after washing}) / (\text{K/S of ink-stained cloth before cleaning} - \text{K/S of cloth for evaluation})\} \times 100 \quad (1)$$

K/S is a value obtained by the formula: $(1 - R / 100)^2 / (2R/100)$, and R is the reflectance (%) of the cloth for evaluation, the ink-stained cloth before washing or the ink-stained cloth after washing.

[0127]

Cleaning rate (%) was calculated for 10 ink-stained cloths, the average value thereof was obtained, and the direct application detergency against the ink stain was evaluated based on the following criteria. With ◎ or ○, the direct application detergency was judged as good.

◎: Cleaning rate (average value) is 40 % or more.

○: Cleaning rate (average value) is 35 % or more and less than 40 %.

△: Cleaning rate (average value) is 30 % or more and less than 35 %.

×: Cleaning rate (average value) is less than 30 %.

[0128]

(Evaluation of Detergency: Ordinary Detergency against Lipstick Stain)

5 A lipstick, which is a typical example of oil-based complex stain that is difficult to remove, was used as a contaminant for evaluating detergency. By taking a lipstick (tradename "MAQUILLAGE Moisture Rouge Color-on type Red", manufactured by Shiseido Company, Limited) with a finger and applying it to the surfaces of 10 pieces of PE cloth (polyester tropical, manufactured by Tanigashira Shoten), lipstick-stained cloths with lipstick stain adhering thereto were
10 prepared. In this process, a lipstick was applied to the center of the PE cloth so as to draw a circle having a diameter of 3 cm.

This lipstick-stained cloth was washed by the following washing method using washing liquids respectively obtained by dissolving 6 mL of the liquid detergents of each of the Examples and the Comparative Examples in 15 L of water.

15 [0129]

Terg-O-Tometer (manufactured by UNITED STATES TESTING) was used as a washing tester. 10 pieces of the above lipstick-stained cloth, a knitted fabric for washing and the liquid detergent were placed in the washing tester, and the liquor ratio of the resulting was adjusted to 30 times, followed by washing at 120 rpm at 15 °C for 20 minutes. Next, the pieces of cloth were
20 transferred to a twin tub washing machine (product number "CW-C30A1-H1", manufactured by Mitsubishi Electric Corporation), dehydrated for 1 minute, rinsed in 30 L of tap water (15 °C, 4 °dH) for 3 minutes, and air-dried.

With respect to each of the lipstick-stained cloth before washing and the lipstick-stained cloth after washing, the a value was measured with a color difference meter (product name "SE

200", manufactured by Nippon Denshoku Industries Co., Ltd.), and the cleaning rate (%) was calculated by the following equation (2).

$$\text{Cleaning rate (\%)} = \{(\text{a value of lipstick-stained cloth before washing} - \text{a value of lipstick-stained cloth after washing}) / \text{a value of lipstick-stained cloth before washing}\} \times 100 \quad (2)$$

5 [0130]

The cleaning rate (%) was calculated for 10 lipstick-stained cloths, the average value thereof was obtained, and the ordinary detergency against the lipstick stain was evaluated based on the following criteria. With ◎ or ○, the ordinary detergency was judged as good.

◎: Cleaning rate (average value) is 60 % or more.

10 ○: Cleaning rate (average value) is 50 % or more and less than 60%.

△: Cleaning rate (average value) is 40 % or more and less than 50 %.

×: Cleaning rate (average value) is less than 40 %.

[0131]

[Table 1]

Blending ratio [% by mass]		Examples									
		1	2	3	4	5	6	7	8	9	
Component (A)	A-1	30	30	30	30	30	45	30	26	10	
	A-2	0	5	0	5	0	0	0	0	0	
	A-3	5	0	5	0	5	0	5	0	0	
	A-4	0	0	0	0	0	5	0	8	11	
Component (B)	B-1	5	5	5	5	15	5	5	8.5	12	
	B-2	10	10	10	10	15	12	10	7	2	
Component (C)	C-1	5	5	6	6	6	6	5	4	6	
Optional component	Coconut fatty acid	2	2	2	2	5	2	2	2	4	
	Ethanol	1	1	0	0	0	0	1	2	2	
	PPG4000	1	1	1	1	1	1	1	1	0	
	PTSH	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0	0	
	Sodium lactate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	
	MGDA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0	
	Calcium chloride	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0	0	
	Sodium benzoate	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	
	Perfume	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	
	SR agent	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	HP-20	1	1	1	1	1	1	1	1	0	
	Sodium hydroxide	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.2	0
	Diclosan	0	0	0	0	0	0	0.2	0	0	
	Alcalase	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	
	Pigment	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	MEA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	3.5
Purified water		Balance									
Total		100	100	100	100	100	100	100	100	100	
Ratio [% by mass]	Component (B)		15.00	15.00	15.00	15.00	30.00	17.00	15.00	15.00	14.00
	A+B		50.00	50.00	50.00	50.00	65.00	67.00	50.00	49.50	35.00
Mass ratio	A/B ratio		2.33	2.33	2.33	2.33	1.17	2.94	2.33	2.19	1.50
	B/C ratio		3.00	3.00	2.50	2.50	5.00	2.83	3.00	3.88	2.33
	B-2/B-1 ratio		2.00	2.00	2.00	2.00	1.00	2.40	2.00	0.82	0.17
Recontami- nation pre- vention ability	vs. cotton cloth	ΔZ	3.5	3.5	3.5	3.5	2.0	5.5	3.5	3.5	5.0
		Evaluation	◎	◎	◎	◎	◎	○	◎	◎	○
	vs. PE cloth	ΔZ	2.5	2.5	2.5	2.5	1.5	2.5	2.5	2.5	3.0
		Evaluation	◎	◎	◎	◎	◎	◎	◎	◎	◎
Direct application detergency			○	◎	◎	◎	○	○	○	○	○
Ordinary detergency			◎	◎	○	◎	○	○	◎	◎	○

[0132]

[Table 2]

Blending ratio [% by mass]		Comparative Examples		
		1	2	
Component (A)	A-1	50	30	
	A-2	0	0	
	A-3	0	0	
	A-4	0	5	
Component (B)	B-1	5	5	
	B-2	5	10	
Component (C)	C-1	6	0	
Optional com- ponent	Coconut fatty acid		2	2
	Ethanol		0	6
	PPG4000		1	1
	PTSH		0.2	0.2
	Sodium lactate		0.5	0.5
	MGDA		0.5	0.5
	Calcium chloride		0.01	0.01
	Sodium benzoate		0.3	0.3
	Perfume		0.445	0.5
	SR agent		0.5	0.5
	HP-20		1.15	1.15
	Sodium hydroxide		0.75	0.75
	Diclosan		0	0
	Alcalase		0.3	0.3
	Pigment		0.0003	0.0003
	MEA		0.5	0.5
Purified water		Balance		
Total		100	100	
Ratio [% by mass]	Component (B)		10.00	15.00
	A+B		60.00	50.00
Mass ratio	A/B ratio		5.00	2.33
	B/C ratio		1.67	—
	B-2/B -1 ratio		1.00	2.00
Recontamination prevention abil- ity	vs. cotton cloth	ΔZ	7.5	5.0
		Evaluation	Δ	○
	vs. PE cloth	ΔZ	4.0	3.5
		Evaluation	Δ	○
Direct application detergency		○	Δ	
Ordinary detergency		Δ	Δ	

[0133]

In Tables 1 and 2, the term "balance" means a blending amount (% by mass) of water (purified water) such that the entire amount of the liquid detergent becomes 100 % by mass.

5 "A + B" means a sum of the amounts of the components (A) and (B) in the liquid detergent. "A/B ratio" means a mass ratio of the component (A) to the component (B). "B/C ratio" means a mass ratio of the component (B) to the component (C). "B-2/B-1 ratio" means a mass ratio of the component B-2 to the component B-1.

[0134]

10 As is apparent from Table 1, the liquid detergent of each of the Examples was excellent in recontamination prevention ability and had good direct application detergency. Further, the liquid detergent of each of the Examples was also superior in ordinary detergency as compared to the liquid detergents of Comparative Examples 1 and 2.

On the other hand, as is clear from Table 2, the liquid detergent of Comparative
15 Example 1 having an A/B ratio of 5.00 was inferior in recontamination prevention ability.

The liquid detergent of Comparative Example 2 containing no component (C) was inferior in direct application detergency.

INDUSTRIAL APPLICABILITY

20 [0135]

The liquid detergent of the present invention is excellent in recontamination prevention ability and has good direct application detergency.

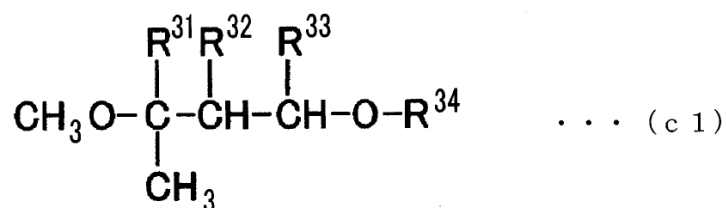
CLAIMS

1. A liquid detergent comprising:

component (A): a nonionic surfactant;

5 component (B): an anionic surfactant exclusive of higher fatty acid salts; and

component (C): an organic solvent represented by formula (c1) below,



wherein each of R^{31} to R^{33} is independently a hydrogen atom or an alkyl group having 1 to 3 carbon atoms, and R^{34} is a hydrogen atom or an acetyl group,

10 wherein:

an amount of the component (B) is less than 50 % by mass, and

a mass ratio of the component (A) to the component (B), (A)/(B), is less than 3.

2. The liquid detergent according to claim 1, wherein the component (C) is

15 3-methoxy-3-methylbutanol.

3. The liquid detergent according to claim 1 or 2, wherein the component (A)

comprises two or more nonionic surfactants, at least one of which is an alkylene oxide

adduct of a secondary alcohol or an alkylene oxide adduct of a branched primary alcohol.