

LIQUID DETERGENT COMPOSITION

BACKGROUND OF THE INVENTION

Field of the Invention:

This invention relates to a liquid detergent composition comprising a specific anionic surface active agent, a specific succinic acid derivative, and a specific sulfo-betaine. The liquid detergent composition possesses excellent low temperature stability and film forming resistance, and provides a pleasant feeling when used.

Description of the Background

Anionic surface active agents possess both excellent detergency and foaming capability. They are hence used as the main components in detergent compositions including light duty liquid detergents such as a dishwashing detergent, shampoo, and heavy duty liquid detergents for clothing. Ethanol, p-toluene sulfonate, and urea, for all of which a hydrotrope is a general term, are also formulated into detergent compositions in order to promote their low temperature stability.

For the promotion of the low temperature stability of a liquid detergent composition, a relatively large amount of hydrotrope has to be formulated. The use of such a large amount of this component, however, entails various drawbacks, such as the danger of fire, undesirable odor,

unacceptable lather and increase in pH over time.

In addition, if a surface active agent is used at a high concentration, the water evaporates from the liquid and a film that forms on the surface of the liquid blocks the hole of the bottle. This takes place in a long term use or storage, especially at a low temperature and in the dry conditions of winter. Conventional hydrotropes such as ethanol, p-toluene sulfonate, urea, and the like have no effect on preventing the liquid from forming a film. There has been, therefore, a desire for an additive having good effects on both the low temperature stability and the film forming resistance.

Recently, consumers have become greatly concerned with the feeling imparted by detergents when used. For detergents, especially for washing directly with the hands, those having a good fresh feeling without stickiness are desired. Detergents using an anionic surface active agent as a main component are apt to be sticky, since quite a bit of the anionic surface active agent stays attached to the skin. The use of such a detergent may sometimes cause dishes to slip from the hands and to break. Also, such a detergent causes the consumer to worry about rough skin. Therefore, there is also a need to reduce the stickiness of the detergent.

In view of this situation, the present inventors have undertaken extensive studies to obtain a liquid detergent composition having excellent stability at a low temperature and superior film forming resistance and providing a

pleasant feeling when used, and found that the desired detergent composition could be obtained by formulating a specific succinic acid derivative and a specific sulfo-betaine into a detergent composition containing a specific anionic surface active agent. This finding has led to the completion of this invention.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to provide a liquid detergent composition comprising:

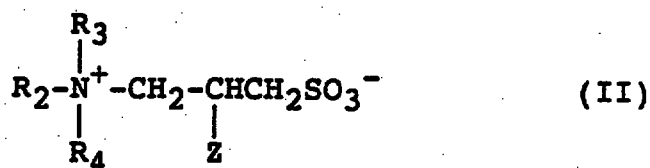
(A) 10 to 40% by weight of at least one anionic surface active agent selected from polyoxyethylene alkylether sulfate, alkylbenzene sulfonate, α -olefin sulfonate, alkane sulfonate, and polyoxyethylene alkylether carboxylate;

(B) a succinic acid derivative represented by the following formula (I):



in which R_1 represents an alkyl or alkenyl group having 8 to 18 carbon atoms and X and Y independently represent a hydrogen atom, alkali metal, ammonium, or alkanolamine, and

(C) sulfo-betaine represented by the following formula (II):



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in which R_2 represents an alkyl or alkenyl group having 8 to 18 carbon atoms, R_3 and R_4 independently represent an alkyl group having 1 or 2 carbon atoms, and Z represents a hydrogen atom or hydroxyl group, and wherein the content of (B) + (C) is 1 to 10% by weight and the ratio by weight of (B)/(C) is 0.1 to 1.

Other objects, features and advantages of the invention will hereinafter become more readily apparent from the following description.

DETAILED DESCRIPTION OF THE INVENTION
AND PREFERRED EMBODIMENTS

Any one or more types of anionic surface active agent selected from polyoxyethylene alkylether sulfate, alkylbenzene sulfonate, α -olefin sulfonate, alkane sulfonate, and polyoxyethylene alkylether carboxylate can be used as the anionic surface active agent of the (A) component of this invention.

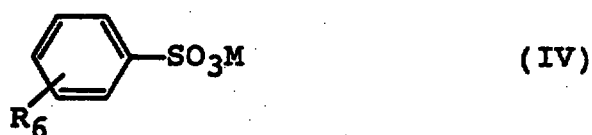
Among these compounds, polyoxyethylene alkyl ether sulfates are desirable because of their mildness to the skin. In particular, sulfates having the formula (III) below are preferable.



wherein R_5 represents an alkyl or alkenyl group having 10 to 18 carbon atoms, M is an alkali metal, ammonium, or an alkanolamine, and n has an average value of 1 to 7. If the R_5 carbon number is less than 10, the detergency of the

compositions is insufficient, while if the carbon number is greater than 18, the low temperature stability of the compositions deteriorates considerably. An especially desirable range for the number of carbons is 12 to 14. If the added molar number n for ethylene oxide in formula (III) is less than 1, skin irritability increases, while if the number is greater than 7, the detergent capability of the composition deteriorates considerably. An especially preferable range for the added molar number for ethylene oxide is between 2 and 5.

On the other hand, in view of the detergency and the cost performance, alkylbenzene sulfonates shown of the following formula (IV) are desirable.



wherein R_6 represents an alkyl or alkenyl group having 10 to 16 carbon atoms and M has the same meaning as previously defined. If the R_6 carbon number is less than 10, the detergency is insufficient, while if it is greater than 16, the stability of the compositions at a low temperature decreases considerably. An especially desirable range for the number of carbons is 11 to 13.

The content of component (A) in the present invention is in the range of 10 to 40% by weight. If the content is below 10% by weight, the detergent strength and foaming capability are insufficient, while if the content is above

40% by weight, the low temperature stability of the compositions deteriorates. A particularly desirable content range is 15 to 25% by weight.

A succinic acid derivative, component (B) of the present invention, has remarkable effects on improving the low temperature stability and film forming resistance of the detergent composition, when it is used in combination with sulfo-betaine mentioned above. If the carbon atom content of R_1 is less than 8, these effects are reduced. If the carbon atom content of R_1 is greater than 18, the solubility of the succinic acid derivative is considerably decreased, resulting in deterioration of the low temperature stability. A preferable carbon atom content of R_1 , therefore, is in the range of 10 to 14.

Component (C) of this invention is sulfo-betaine represented by formula (II). Sulfo-betaine of this invention in combination with a succinic acid derivative, component (B) of this invention, has remarkable effects on improving the low temperature stability and the film forming resistance of the detergent composition. If the carbon atom content of R_1 is less than 8, these effects are reduced. If the carbon atom content of R_1 is greater than 18, the solubility of sulfo-betaine is considerably decreased, resulting in deterioration of the low temperature stability. A preferable carbon atom content of R_1 , therefore, is in the range of 10 to 14.

Certain types of succinic acid derivatives have conventionally been used as a component of detergents. For

example, succinic acid derivatives possessing an alkyl group or alkenyl group with a carbon atom content of 4 to 14 are disclosed in Japanese Laid-open No. 142,603/1975. This patent application describes a method of using the succinic acid derivative together with a lower alcohol as a solubilizing agent of a detergent composition containing an alkali builder. Also, succinic acid derivatives having an alkyl or alkenyl group with a carbon atom content of 4 to 8 are disclosed [Japanese Laid-open No. 196299/1983 and Japanese Laid-open No. 196296/1983], wherein the succinic acid derivatives are used in order to improve low temperature stability and film forming resistance.

These examples, however, only describe the use of a succinic acid derivative in conjunction with a volatile component or the independent use of a relatively short chained succinic acid derivative. There has been no technological concept of using a relatively long chained succinic acid derivative together with sulfo-betaine, a kind of an amphoteric surface active agent, in order to exhibit their combined effect in a detergent composition.

In the film forming process of a liquid detergent, liquid on or close to its surface is first concentrated by evaporation of volatile components such as water.

The concentrated liquid containing a surface active agent often forms a liquid crystal structure or a gel structure and loses its fluidity. A film is thus formed at

the gas/liquid interface. Volatile hydrotropes, such as ethanol, therefore, have a little or no film forming inhibitory effect.

Since succinic acid derivatives are non-volatile and possess a hydrophobic group, they are thought to penetrate into the associated structure of surface active agents, (main component of the detergent) and to form mixed micelles. The formation of a liquid crystal structure or a gel structure is considered to be difficult in such mixed micelles even though the composition is concentrated. Film formation is hence disturbed.

For the purpose of preventing a liquid from forming a film through formation of mixed micelles, the use of succinic acid derivatives having a longer alkyl or an alkenyl group than those of the succinic acid derivatives disclosed in Japanese Patent Application Laid-open Nos. 196299/1983 or 196296/1983 is preferable. These succinic acid derivatives having a longer alkyl or alkenyl group have stronger surface activities themselves and are expected to exhibit a greater film forming inhibiting effect at a small amount.

However, since a long chained succinic acid derivatives have a limited solubility in a solution, their addition exceeding the maximum dissolvable amount causes the succinic acid derivative to precipitate and the solution to become turbid. Thus, the use of the succinic acid derivative alone does not give a desired effect. If sulfo-betaine, which is a kind of amphoteric surface active agent, is used together

with a long chained succinic acid derivative at a certain proportion, the solubility of the succinic acid derivative in the solution is promoted and the solid precipitation is prevented even when the liquid is concentrated at the gas/liquid interface. The combined use of these two components, even in a small amount, thus provides remarkable film forming resistance and low temperature stability.

The formulation of the succinic acid derivative and sulfo-betaine into a detergent composition containing as a main component an anionic surface active agent brings about unexpected results that the sticky feeling inherent to an anionic surface active agent is reduced and a pleasant feeling upon use is remarkably improved.

From the reasons mentioned above, the use of (B) succinic acid derivative and (C) sulfo-betaine in combination is essential for the detergent composition of this invention. The amount of (B) + (C) formulated into the detergent composition of this invention is in the range of 1 to 10% by weight, with the ratio by weight of (B)/(C) being 0.1 to 1. If the amount of (B) + (C) is less than 1% by weight, the film forming resistance is insufficient and the feeling upon use becomes worse. The amount of (B) + (C) greater than 10% by weight exceeds the critical solubilizing amount for a succinic acid derivative in a detergent composition, resulting in precipitation of this compound separating out of solids or an increase in the viscosity of the solution, and thus is undesirable. The preferable

amount is in the range of 2 to 5% by weight.

If the ratio by weight of (B)/(C) is less than 0.1, the film forming resistance is insufficient. If the ratio of (B)/(C) exceeds 1, the mutual solubilities of the succinic acid derivative and anionic surface active agent become worse and the precipitation tends to take place. A preferable ratio is in the range of 0.2 to 0.5.

Besides the above essential components, surface active agents commonly used in detergent compositions can be formulated, as required, to the detergent composition of this invention in so far as the performance of the composition is not damaged. Such surface active agents include, for example, nonionic surface active agents such as polyoxyethylene alkyl or alkenyl ether (wherein the average addition mols of polyoxyethylene is 3 to 20, and the alkyl or alkenyl group is linear or branched with 8 to 18 carbon atoms), higher fatty acid alkanolamide (wherein the higher fatty acid has 8 to 18 carbon atoms), and the like; anionic surface active agents such as α -sulfo-fatty acid ester, N-acyl glutamate, monoalkyl phosphate, and amphoteric surface active agents such as tertiary alkylamine oxide (wherein the alkyl group has 8 to 18 carbon atoms) and alkyl betaine (wherein the alkyl group has 8 to 18 carbon atoms)

Further, other known components used for conventional liquid detergent compositions can be formulated as required. Such components include, for example, lower alcohols such as ethanol; lower alkylbenzene sulfonates such as

p-toluene sulfonate and the like; glycols such as ethylene glycol and propylene glycol; hydrotropes such as urea and the like; pH buffers such as citric acid and malic acid; organic or inorganic builders; natural fruit juices such as lemon and lime. In addition, skin protecting agents, enzymes, protein derivatives, pigments, perfumes, turbidity agents, chelating agents, antiseptics and UV ray absorbents can be formulated as required.

Other features of the invention will become apparent in the course of the following description of the exemplary embodiments which are given for illustration of the invention and are not intended to be limiting thereof.

EXAMPLES

Example 1

The liquid detergent compositions having formulations shown in Table 1 were prepared. The film forming resistance and the low temperature stability of each composition were measured according to the following methods:

Film forming resistance

50 g of the composition was put into a beaker and left for 3 days at 20°C and 40% humidity in a thermo-hygrostat. The film forming resistance was evaluated according to the following standard.

AAA	No change
BBB	Film formed slightly
CCC	Film formed completely

Low temperature stability

The liquid detergent composition was left at -5°C in a thermostat for 10 days. The low temperature stability was evaluated by the following standard.

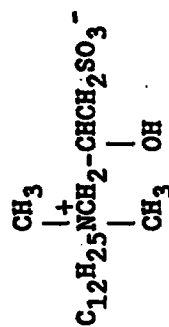
AAA	No change in the composition
BBB	The composition became slightly turbid
CCC	Separation or precipitation of components took place

Table 1

Component	Inventive composition				5	Comparative composition				
	1	2	3	4		6	7	8	9	10
Sodium polyoxyethylene(3) dodecylether sulfate	WtZ 20.0	WtZ 10.0	WtZ 10.0	WtZ 10.0	WtZ -	WtZ 20.0	WtZ 10.0	WtZ 10.0	WtZ 10.0	WtZ -
Sodium dodecylbenzene sulfonate	-	10.0	-	-	-	-	10.0	-	-	-
Sodium α -olefin sulfonate (MW = 326)	-	-	10.0	-	-	-	-	10.0	-	-
Sodium octadecane sulfonate (MW = 356)	-	-	-	10.0	-	-	-	-	10.0	-
Sodium polyoxyethylene(3) dodecylether carboxyrate	-	-	-	-	20.0	-	-	-	-	20.0
Pottasium dodecenyl succinate	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-
Dodecylhydroxyl sulfo-betaine *1	2.0	2.0	2.0	2.0	2.0	-	-	-	-	-
Coconut oil fatty acid diethanolamide	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Ethanol	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Tap water	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Film forming resistance	AAA	AAA	AAA	AAA	AAA	CCC	CCC	BBB	BBB	CCC
Low temperature stability	AAA	AAA	AAA	AAA	AAA	AAA	CCC	CCC	BBB	BBB

Note: Unit of the value in Table is % by weight

*1 Formula:

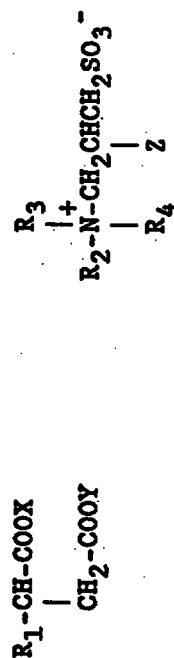


Example 2

The liquid detergent compositions comprising basic detergent components shown below plus various succinic acid derivatives and sulfo-betaine listed in Table 2 were prepared. The film forming resistance and the low temperature stability of each composition were measured. The results obtained are shown in Table 2.

Components	Wt%
Sodium polyoxyethylene(4) dodecylether sulfate	15.0
Dodecyldimethylamine oxide	3.0
Polyoxyethylene(7) dodecyl ether	5.0
Succinic acid derivative (refer to Table 2)	0 or 1.0
Sulfo-betaine (refer to Table 2)	0 or 2.5
Ethanol	4.0
Tap water	Balance
pH/25°C of the solution	7.0

Table 2



Inventive composition					Comparative composition				
11	12	13	14	15	16	17	18	19	
R ₁	C ₁₂ H ₂₃	C ₁₂ H ₂₃	C ₁₂ H ₂₃	C ₁₂ H ₂₃	C ₁₂ H ₂₃	C ₆ H ₁₃	C ₂₀ H ₃₉	-	
X or Y	K	K	K	K	K	Na	K	-	
R ₂	C ₁₀ H ₂₁	C ₁₂ H ₂₅	C ₁₄ H ₂₉	C ₁₈ H ₃₄	C ₆ H ₁₃	C ₁₂ H ₂₅	C ₁₂ H ₂₅	-	
R ₃	C ₂ H ₅	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	-	
R ₄	C ₂ H ₅	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	-	
Z	H	OH	H	OH	OH	OH	OH	-	
Film forming resistance	AAA	AAA	AAA	AAA	BBB	CCC	CCC	CCC	
Low temperature stability	AAA	AAA	AAA	AAA	BBB	BBB	CCC	CCC	

Example 3

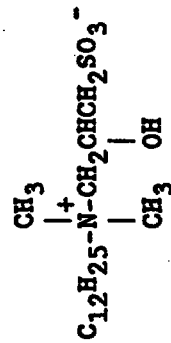
The liquid detergent compositions having formulations shown in Table 3 were prepared. The detergency, foaming capability, viscosity, and low temperature stability of each composition were measured.

Table 3

Component	inventive composition 20		inventive composition 21		22	Comparative composition					26	27
	WtZ	WtZ	WtZ	WtZ		23	24	25	WtZ	WtZ		
Linear sodium dodecylbenzene sulfonate	-	10.0	-	-	-	-	-	10.0	10.0	10.0	10.0	10.0
Sodium polyoxyethylene(3) tetradecylether sulfate	18.0	5.0	18.0	18.0	18.0	18.0	18.0	5.0	5.0	5.0	5.0	5.0
Sodium dodecenyl succinate	0.5	1.0	0.2	5.0	-	0.2	5.0	-	0.5	3.0	3.0	3.0
Dodecylhydroxy sulfo-betaïne *1	2.0	2.0	0.2	6.0	-	0.2	6.0	-	6.0	1.0	1.0	1.0
Dodecyltrimethylamine oxide	2.0	-	2.0	2.0	2.0	2.0	2.0	-	-	-	-	-
Coconut oil fatty acid monoethanolamide	3.0	-	3.0	3.0	3.0	3.0	3.0	-	-	-	-	-
Polyoxyethylene(12) tetradecyl ether	-	10.0	-	-	-	-	-	10.0	10.0	10.0	10.0	10.0
Monoethanolamine	-	2.0	-	-	-	-	-	2.0	2.0	2.0	2.0	2.0
Ethanol	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Tap water	Balance		Balance		Balance					Balance		
Film forming resistance	AAA	AAA	CCC	BBB	CCC	CCC	CCC	CCC	BBB	CCC	AAA	CCC
Low temperature stability	AAA	AAA	CCC	CCC	CCC	CCC	CCC	CCC	AAA	CCC	AAA	CCC

Note: Unit of the value in Table is % by weight

*1 Formula:



Example 4

The kitchen detergents A and B having the formulations shown below were prepared. They were subjected to the blind in home use test using a pair comparison method, by 50 ordinary housewives younger than 49 years of age for one week. The results obtained are shown in Table 4.

Components	Detergent A (Inventive composition)	Detergent B (Comparative composition)
	Wt%	Wt%
Linear sodium dodecylbenzene sulfonate	17.0	17.0
Sodium polyoxyethylene(3) dodecyl ether sulfate	5.0	5.0
Coconut oil fatty acid monoethanolamide	6.0	6.0
Sodium decenyl succinate	1.0	—
Dodecylhydroxy sulfo-betaine	3.0	—
Ethanol	5.0	5.0
Tap water	Balance	Balance

Table 4

Question	Detergent A is better	Same	Detergent B is better
Removal of stains	40%	30%	30%
Foaming capability	36%	34%	30%
Feeling to the skin when washing	50%	30%	20%
Feeling to the skin after washing	40%	40%	20%

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.



CLAIMS:

1. A liquid detergent composition comprising:

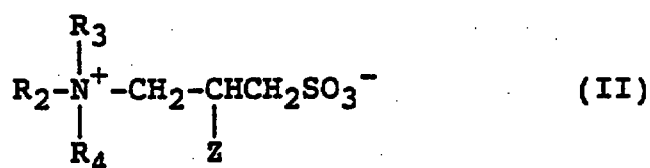
(A) 10 to 40% by weight of at least one anionic surface active agent selected from polyoxyethylene alkylether sulfate, alkylbenzene sulfonate, α -olefin sulfonate, alkane sulfonate, and polyoxyethylene alkylether carboxylate;

(B) a succinic acid derivative represented by the following formula (I):



in which R_1 represents an alkyl or alkenyl group having 8 to 18 carbon atoms and X and Y independently represent a hydrogen atom, alkali metal, ammonium, or alkanolamine, and

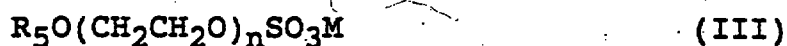
(C) sulfo-betaine represented by the following formula (II):



in which R_2 represents an alkyl or alkenyl group having 8 to 18 carbon atoms, R_3 and R_4 independently represent an alkyl group having 1 or 2 carbon atoms, and Z represents a hydrogen atom or hydroxyl group, and wherein the content of (B) + (C) is 1 to 10% by weight and the ratio by weight of (B)/(C) is 0.1 to 1.



2. The liquid detergent composition according to Claim 1, wherein component (A) is polyoxyethylene alkylether sulfate represented by the following formula (III):



in which R_5 represents an alkyl or alkenyl group having 10 to 18 carbon atoms, n is an average value of 1 to 7, and M represents an alkali metal, ammonium, or alkanolamine.

3. The liquid detergent composition according to Claim 1, wherein component (A) is alkylbenzene sulfonate represented by the following formula (IV):



in which R_6 represents an alkyl or alkenyl group having 10 to 16 carbon atoms and M has the same meaning as defined in formula (III).

4. The composition as claimed in Claim 1 and substantially as described in the examples.
