(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 May 2006 (26.05.2006)

PCT

(10) International Publication Number
WO 2006/055599 A1

(51) International Patent Classification:
*C11D 1/72* (2006.01) *C07C 41/03* (2006.01)
*C11D 3/20* (2006.01) *C08G 65/48* (2006.01)
*C11D 10/04* (2006.01) *C08G 65/30* (2006.01)

(21) International Application Number: PCT/US2005/041464

(22) International Filing Date: 16 November 2005 (16.11.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/988,844 16 November 2004 (16.11.2004) US

(71) Applicant (*for all designated States except US*): **BASF AKTIENGESELLSCHAFT** [DE/DE]; Legal/Patent Department, Carl-Bosch-Strasse 38, 6700 Ludwigshafen, Rheinland-Pfalz (DE).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **THANKACHAN, Chacko** [US/US]; 3170 Hartslock Woods Drive, West Bloomfield, MI 48322 (US). **BETKE, Brian, J.** [US/US]; 20349 Maplewood Drive, Riverview, MI 48192 (US).

(74) Agents: **LAPRAIRIE, David, M.** et al.; Howard & Howard Attorneys, PC, Suite 101, 39400 Woodward Avenue, Bloomfield, MI 48304-5151 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*
— *with amended claims and statement*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

WO 2006/055599 A1

(54) **Title:** ALKOXY SURFACTANTS HAVING INCREASED CLOUD POINTS AND METHODS OF MAKING THE SAME

(57) **Abstract:** Neutralizing a surfactant which is comprised of an alkaline-catalyzed reaction product between a monomeric of polymeric alcohol having at least one active hydrogen group and an alkylene oxide with a fatty acid allows the cloud point of the surfactant to be adjusted.

# ALKOXY SURFACTANTS HAVING INCREASED CLOUD POINTS AND METHODS OF MAKING THE SAME

## FIELD OF THE INVENTION

The present invention relates generally to the field of surfactants and methods of making the same. In particularly preferred form. the present invention relates to nonionic surfactants having increased cloud points and to methods of making the same.

## BACKGROUND AND SUMMARY OF THE INVENTION

The clouding behavior of surfactants in water with increasing temperature has several practical applications For example the defoaming action of surfactants becomes effective just above their cloud point See Otten et al Anionic Hydrotropes for Industrial and Institutional Rinse Aids JAOCS; 63(8); 1078; 1986 (the entire content of which is incorporated expressly hereinto by reference). An end user will therefore select a particular surfactant for specific problem solving abilities such as wetting detergency foaming defoaming and the like. In cleaning applications such as machine dish washing. the properties noted above are important. Since the water temperature in dish washing applications is relatively high the surfactant selected often cannot meet all of the desired performance criteria As a result, additives are typically included with the surfactant to achieve the desired solubilization However often times. when all other properties of the surfactant are in agreement for a specific application. often the surfactant s cloud point is too low While the cloud point can be engineered by altering the surfactant's chemical structure such structural alteration usually is accompanied by a change in one of its other properties thereby making it no longer useful for the intended application

Recently it has been suggested that certain electrolytes may be added so as to adjust the cloud point of a block copolymer surfactant comprised of an ethylene oxide (EO) and propylene oxide (PO) units. Pandya et al, Effect of Additives on the Clouding Behavior of an Ethylene Oxide-Propylene Oxide Block copolymer in Aqueous Solution'; J.M.S-Pure Appl. Chem; A30(1); 1; 1993 (the entire content of which is expressly incorporated hereinto by reference). However, the technique described in this paper involves the addition of foreign materials often adding extra cost and unwanted interferences in the surfactant's performance.

Polyether polyol surfactants are typically prepared by the reaction of monomeric or polymeric initiators containing one or more active hydrogen-containing group(s) such as OH, $NH_2$ NH, $CO_2H$ and the like, with alkylene oxides. The alkylene oxide reactions with the active hydrogen-containing compounds are catalyzed with alkaline catalysts such as potassium hydroxide and sodium hydroxide. At the end of the reaction the catalyst is deactivated by either removing the catalyst physically from the resulting reactant mixture or by adding an acid such as acetic acid, phosphoric acid, sulfuric acid and the like in order to neutralize the catalyst. The most cost-effective way of deactivating the alkaline catalyst is by neutralizing the catalyst with an acid and leaving the resulting salt physically in the polyether polyol reaction product

It has now been surprisingly discovered that by neutralizing a surfactant which is the alkaline-catalyzed reaction product between a monomeric or polymeric compound (initiator) having at least one active hydrogen group and an alkylene oxide with a fatty acid, the cloud point of the surfactant may be raised as compared to otherwise identical surfactants which have not been neutralized (i.e non-neutralized surfactants) and/or otherwise identical surfactants that have been neutralized with conventional non-fatty acids. such as acetic acid. phosphoric acid, sulfuric acid and the like.

These and other aspects and advantages will become more apparent after careful consideration is given to the following detailed description of the preferred exemplary embodiments thereof.

## DETAILED DESCRIPTION OF THE INVENTION

The preferred surfactants employed in the practice of the present invention include the alkaline-catalyzed reaction products between a monomeric or polymeric initiator having at least one active hydrogen-containing group with an alkylene oxide (e.g., polyether polyols). Especially preferred surfactants include at least one of an alcohol alkoxylates and block copolymers of ethylene oxide (EO) and propylene oxide (PO) The preferred alcohol alkoxylates have the general formula:

$$R1\text{-}(EO)_m\text{-}(PO)_n\text{-}OH$$

where R1 is a C6-C30 alkyl, alkenyl alicyclic or aromatic hydrocarbon. and m and n are each. independent of one another numbers from 0 to 100 provided that the total of m+n is 2 to 100. The alcohol alkoxylates most preferably include an alcohol chain having from 1 to 25 carbon atoms and most preferably include a linear alkyl alcohol alkoxylates and alkylphenol alkoxylates (e.g dodecyl alcohol ethoxylates tridecyl alcohol ethoxylates, nonylphenol ethoxylates, octylphenol ethoxylates and the like). Suitable alcohol alkoxylate surfactants are commercially available from BASF Corporation under the trademarks PLURAFAC® and ICONOL™.

The preferred block copolymers of EO and PO units will typically have a number average molecular weight of from 500 to 15 000 preferably between 1 000 to 10.000. Suitable block copolymers of EO and PO are commercially available from BASF Corporation under the registered trademark TETRONIC®.

Virtually any saturated or unsaturated fatty acid may be employed in the practice of this invention. Preferably the fatty acid will have at least 8 carbon atoms in its chain. Most preferably, C8 up to C24 fatty acids are employed Specific examples of preferred fatty acids include caprylic acid capric acid lauric acid, myristic acid palmitic acid palmitoleic acid stearic acid. oleic acid vaccenic acid. linoleic acid. arachidic acid behenic acid erucic acid and lignoceric acid. In addition the fatty acids may be supplied by natural sources such as tall oil coconut oil palm kernel oil animal fats. olive oil. butter fat. corn oil linseed oil. peanut oil fish oil, rapeseed oil and the like.

The fatty acid is employed in amounts sufficient to neutralize the alkaline catalysts (typically potassium hydroxide. sodium hydroxide or the like) employed in the reaction of monomeric or polymeric alcohols containing one or more active hydrogen-containing group(s) with alkylene oxides. By the term neutralize" is meant that the resulting surfactant following the addition of the fatty acid has a pH of between about 5.5 to about 8.5, more preferably about 7 0 +/- 0.9. The fatty acid is preferably employed in an amount which increases the cloud point temperature of the surfactant by between about 2$^0$C to about 50$^0$C more preferably, between about 5$^0$C to about 35$^0$C as compared to the unneutralized surfactant and/or the surfactant which has been neutralized conventionally (i.e., neutralized with non-fatty acids such as acetic acid phosphoric acid, sulfuric acid and the like) It should of course be understood that the cloud point temperature increase achieved by the present invention is dependent upon the particular surfactant that is neutralized with the fatty acid. That is some surfactants will experience a greater cloud point temperature increase as compared to other surfactants. Most preferably the fatty acid will be employed in amounts sufficient to neutralize the alkaline catalyst used in the production of the surfactant to a pH range of between about 6 5 to about 8.5

The present invention will be further described by reference to the following non-limiting examples

The following nonionic surfactants identified as surfactants S1 – S5 commercially available from BASF Corporation were employed in the following Examples:

S1 = TETRONIC® 90R4: A tetrafunctional block ethylene-oxide-propylene oxide copolymer with terminal secondary hydroxyl groups.

S2 = PLURAFAC® D-25: A monofunctional fatty alcohol onto which is added propylene oxide and ethylene oxide.

S3 = PLURAFAC® RA30: A polyoxyethylene-polyoxypropylene block monool a mixture of fatty monohydroxyl alcohols, terminated with oxypropylene units, having an OH number of about 90.

S4 = PLURAFAC® RA40: A polyoxyethylene-polyoxypropylene block monool a mixture of fatty monohydroxyl alcohols, terminated with oxypropylene units. having an OH number of about 69.

S5 = ICONOL™ OP-10: A water-soluble nonionic surfactant composed of a 10-mole adduct of octylphenol

S6 = ICONOL™ NP-9: A water-soluble nonionic surfactant composed of a 9-mole adduct of nonylphenol

A cloud point is the temperature at which a surfactant solution becomes cloudy. The cloud points were determined on the samples listed in examples S1-S6 as outlined below. The method was applicable to both neutralized product and in-process samples (unneutralized). The process was terminated often by checking the cloud point of the in-process sample (unneutralized) to the set commercial specification of the product neutralized with conventional acids or after removal of the catalyst. The determined cloud points of the unneutralized process samples were the same for the neutralized commercial samples.

Cloud points were determined by forcing a surfactant solution of known concentration in water or water solvent mixture to cloud by adjusting its temperature. The solution temperature at which the clouding solution becomes clear was recorded was determined to be the cloud point for the surfactant.

**Example 1:** Unneutralized samples of nonionic surfactants identified in Table 1 were neutralized with oleic acid and tall oil fatty acid. The cloud points of the samples were measured before and after neutralization. The results appear in Table 1.

TABLE 1

| Surfactant | Specifications* | | Measured** | Fatty Acid | Resultant Change | |
|---|---|---|---|---|---|---|
| | pH | Cloud Pt. °C | Cloud Pt. °C | | pH | Cloud Pt. °C |
| S1 | 7.5-9.5 | 39-44 | 42.5 | Oleic | 7.1 | 45.5 |
| S2 | 5-6.5 | 52-62 | 55.5 | " | 7.5 | 69.7 |
| S3 | " | 35-39 | 38.2 | " | 7.8 | 52.0 |
| S4 | " | 22-27 | 26.3 | " | 7.9 | 31.8 |
| S5 | 6-7.5 | 63-67 | 64.9 | " | 7.5 | 80.2 |
| | | | | | | |
| S1 | 7.5-9.5 | 39-44 | 42.5 | Tall Oil FA | 7.3 | 45.4 |
| S2 | 5-6 5 | 52-62 | 55.5 | " | 7.6 | 67.9 |
| S3 | " | 35-39 | 38.2 | " | 7.9 | 50.5 |
| S4 | " | 22-27 | 26.3 | " | 7.9 | 33.5 |
| S5 | 6-7 5 | 63-67 | 64.9 | " | 7.9 | 77.0 |

* All cloud points were measured on a 1% aqueous solution of the surfactant. The values given are the specification range for products neutralized with acetic acid or phosphoric acid

** These cloud points were measured using the unneutralized surfactants.

The data show that the addition of oleic acid to each of the nonionic surfactants increased their respective cloud points.

**Example 2:** Unneutralized samples of surfactant S6 (ICONOL™ NP-9) was neutralized with several fatty acids identified below in Table 2. The pH and 1% aqueous cloud points after neutralization were measured with the results being noted in Table 2 below

TABLE 2

| Surfactant | Specifications* | | Measured** | Fatty Acid | Resultant Change | |
|---|---|---|---|---|---|---|
| | pH | Cloud Pt. °C | Cloud Pt. °C | | pH | Cloud Pt. °C |
| S6 | 5-8 | 52-56 | 52.2 | Oleic | 6.9 | 87.2 |
| " | " | " | " | Capric | 6.2 | 61.4 |
| " | " | " | " | Palmitic | 6.6 | 90.5 |
| " | " | " | " | Coconut FA | 6.3 | 67.1 |

* All cloud points were measured on a 1% aqueous solution of the surfactant. The values given are the specification range for products neutralized with acetic acid or phosphoric acid

** These cloud points were measured using the unneutralized surfactants.

It was observed that neutralization with fatty acids increased the cloud point of the nonionic surfactant.

**Example 3:** Example 2 was repeated except that blends of acetic acid and oleic acid were employed to neutralize an unneutralized sample of surfactant S6. The results appear in Table 3 below

TABLE 3

| Surfactant | Resultant Changes | |
|---|---|---|
| | pH | Cloud Pt. °C |
| S6 neutralized with 5:1 oleic acid:acetic acid by weight | 5.8 | 55.1 |
| S6 neutralized with 17.5:1 oleic acid:acetic acid by weight | 6.5 | 73.5 |

The data above reveal that higher ratios of the fatty acid are needed in order to achieve a cloud point increase.

**Example 4 (Comparative):** Various amounts of oleic acid were added to a commercial sample (already neutralized with acetic acid) of surfactant S6. No increase in cloud point was observed.

*************************

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment but on the contrary is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. A surfactant composition comprising an alkaline-catalyzed alkoxy surfactant, and an amount of a fatty acid sufficient to neutralize the alkaline catalyst and effect an increase in cloud point temperature of the surfactant.

2. The surfactant composition of claim 1 wherein the surfactant is a an alkaline-catalyzed reaction product between a monomeric or polymeric alcohol having at least one active hydrogen-containing group and an alkylene oxide

3 The surfactant composition of claim 2 wherein the active hydrogen-containing group is at least one selected from the group consisting of OH. $NH_2$ NH and $CO_2H$.

4. The surfactant composition of claim 1. wherein the surfactant comprises at least one of an alcohol alkoxylate and a block copolymer comprised of ethylene oxide and propylene oxide units.

5. The surfactant composition of claim 1. wherein the surfactant has the formula:

$$R1\text{-}(EO)_m\text{-}(PO)_n\text{-}OH,$$

where R1 is a C6-C30 alkyl, alkenyl alicyclic or aromatic hydrocarbon. and m and n are each independent of one another. numbers from 0 to 100 provided that the total of m+n is 2 to 100.

6 The surfactant composition of claim 1, wherein the surfactant comprises a block copolymer comprised of ethylene oxide and propylene oxide units having a number average molecular weight of from 500 to 15,000.

7 The surfactant composition as in any one of claims 1-6. wherein the fatty acid has from 8 to 24 carbon atoms.

8. The surfactant composition as in claim 7. wherein the fatty acid is at least one selected from the group consisting of caprylic acid capric acid lauric acid. myristic acid palmitic acid palmitoleic acid stearic acid, oleic acid. vaccenic acid linoleic acid arachidic acid behenic acid erucic acid and lignoceric acid.

9. The surfactant composition as in claim 6. wherein the fatty acid is derived from at least one of tall oil coconut oil, palm kernel oil animal fats olive oil butter fat corn oil linseed oil peanut oil fish oil and rapeseed oil.

10. The surfactant composition as in claim 1. wherein the fatty acid is present in an amount sufficient to achieve a pH of the surfactant composition of between about 5 5 to about 8.5..

11. The surfactant composition as in claim 10, wherein the fatty acid is present in an amount sufficient to achieve a pH of the surfactant composition of about 7 0 +/- 0.9 .

12 The surfactant composition as in claim 1. wherein the fatty acid is present in an amount sufficient to increase the cloud point temperature

of the surfactant by between about 2$^0$C to about 50$^0$C as compared to the unneutralized surfactant and/or the surfactant which has been neutralized with non-fatty acids.

13. The surfactant composition as in claim 12 wherein the fatty acid is present in an amount sufficient to increase the cloud point temperature of the surfactant by between about 5$^0$C to about 35$^0$C.

14. The surfactant of claim 1 wherein the surfactant comprises at least one of an alcohol alkoxylate of ethylene oxide/propylene oxide or a block copolymer comprised of ethylene oxide and/or propylene oxide units

15. A method of adjusting the cloud point temperature of a alkaline-catalyzed alkoxy surfactant comprising adding to an alkaline-catalyzed alkoxy surfactant an amount of a fatty acid sufficient to neutralize the alkaline catalyst and thereby raise the cloud point temperature of the surfactant.

16. The method of claim 15 wherein the surfactant is a an alkaline-catalyzed reaction product between a monomeric or polymeric alcohol having at least one OH group and an alkylene oxide.

17. The method of claim 15 wherein the surfactant comprises at least one of an alcohol alkoxylate of ethylene oxide/propylene oxide or a block copolymer comprised of ethylene oxide and/or propylene oxide units.

18. The method of claim 15 wherein the surfactant has the formula:

$$R1\text{-}(EO)_m\text{-}(PO)_n\text{-}OH,$$

where R1 is a C6-C30 alkyl, alkenyl alicyclic or aromatic hydrocarbon, and m and n are each independent of one another numbers from 0 to 100, provided that the total of m+n is 2 to 100.

19. The method of claim 15, wherein the surfactant comprises a block copolymer comprised of ethylene oxide and propylene oxide units having a number average molecular weight of from 500 to 15,000.

20. The method as in any one of claims 15-19, wherein the fatty acid has from 8 to 24 carbon atoms.

21. The method as in claim 20 wherein the fatty acid is at least one selected from the group consisting of caprylic acid capric acid, lauric acid myristic acid, palmitic acid, palmitoleic acid, stearic acid oleic acid vaccenic acid, linoleic acid, arachidic acid behenic acid, erucic acid and lignoceric acid.

22. The method as in claim 20 wherein the fatty acid is derived from at least one of tall oil, coconut oil, palm kernel oil, animal fats olive oil, butter fat corn oil linseed oil peanut oil fish oil and rapeseed oil.

23. The method as in claim 15 wherein the fatty acid is present in an amount sufficient to achieve a pH of the surfactant composition of between about 5.5 to about 8 5..

24. The method as in claim 23. wherein the fatty acid is present in an amount sufficient to achieve a pH of the surfactant composition of about 7.0 +/- 0.9.

25. The method as in claim 15, wherein the fatty acid is present in an amount sufficient to increase the cloud point temperature of the surfactant by between about $2^0$C to about $50^0$C as compared to the pH of the surfactant having the unneutralized acid catalyst present therein.

26. The method as in claim 25 wherein the fatty acid is present in an amount sufficient to increase the cloud point temperature of the surfactant by between about $5^0$C to about $35^0$C.

27. The method as in claim 25. wherein the fatty acid is present in an amount sufficient to deactivate the catalyst and establish a pH of the surfactant of between 5.5 to 8.5.

## AMENDED CLAIMS
## Received by the International Bureau on 25 April 2006 (25.04.2006)
## + STATEMENT

1. A surfactant composition comprising:

an alkaline-catalyzed alkoxy surfactant formed in the presence of an alkaline catalyst, and

a salt of:

said alkaline catalyst, and

a straight-chain fatty acid having from 8 to 24 carbon atoms,

wherein the pH of said surfactant composition is between about 5.5 and about 8.5.

2. The surfactant composition of claim 1 wherein said alkaline-catalyzed alkoxy surfactant comprises the reaction product of a monomeric or polymeric alcohol having at least one active hydrogen-containing group and an alkylene oxide in the presence of said alkaline catalyst.

3. The surfactant composition of claim 2 wherein said active hydrogen-containing group is at least one selected from the group consisting of OH, $NH_2$, NH, and $CO_2H$.

4. The surfactant composition of claim 1 wherein said alkaline-catalyzed alkoxy surfactant comprises at least one of an alcohol alkoxylate and a block copolymer comprised of ethylene oxide and propylene oxide units.

5. The surfactant composition of claim 1 wherein said alkaline-catalyzed alkoxy surfactant has the formula:

$R1\text{-}(EO)_m\text{-}(PO)_n\text{-}OH$

where R1 is a C6-C30 alkyl, alkenyl, alicyclic, or aromatic hydrocarbon, and m and n are each independent of one another numbers from 0 to 100 provided that the total of m+n is 2 to 100.

6. The surfactant composition of claim 1, wherein said alkaline-catalyzed alkoxy surfactant comprises a block copolymer comprised of ethylene oxide and propylene oxide units having a number average molecular weight of from 500 to 15,000.

8. The surfactant composition as in claim 1, wherein said straight-chain fatty acid is at least one selected from the group consisting of caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, vaccenic acid, linoleic acid, arachidic acid, behenic acid, erucic acid, and lignoceric acid.

9. The surfactant composition as in claim 6, wherein said straight-chain fatty acid is derived from at least one of tall oil, coconut oil, palm kernel oil, animal fats, olive oil, butter fat, corn oil, linseed oil, peanut oil, fish oil, and rapeseed oil.

11. The surfactant composition as in claim 1, having a pH of about 7.0 +/- 0.9.

12. The surfactant composition as in claim 1, wherein the cloud point temperature of said surfactant is increased by between about 2°C to about 50°C as compared to the unneutralized surfactant and/or a surfactant which has been neutralized with non-straight-chain fatty acids.

13. The surfactant composition as in claim 12 wherein the cloud point temperature of said surfactant composition is increased by between about 5°C to about 35°C.

14. The surfactant of claim 1 wherein said alkaline-catalyzed alkoxy surfactant comprises at least one of an alcohol alkoxylate of ethylene oxide/propylene oxide or a block copolymer comprised of ethylene oxide and/or propylene oxide units.

15. A method of adjusting the cloud point temperature of a surfactant composition including an alkaline-catalyzed alkoxy surfactant formed in the presence of an alkaline catalyst comprising adding to the surfactant composition an amount of a straight-chain fatty acid having from 8 to 24 carbon atoms sufficient to achieve a pH of the surfactant composition of between about 5.5 and about 8.5 and thereby raise the cloud point temperature of the surfactant composition.

16. The method of claim 15 wherein the alkaline-catalyzed alkoxy surfactant comprises the reaction product of a monomeric or polymeric alcohol having at least one OH group and an alkylene oxide in the presence of the alkaline catalyst.

17. The method of claim 15 wherein the alkaline-catalyzed alkoxy surfactant comprises at least one of an alcohol alkoxylate of ethylene oxide/propylene oxide or a block copolymer comprised of ethylene oxide and/or propylene oxide units.

18. The method of claim 15 wherein the alkaline-catalyzed alkoxy surfactant has the formula:

$R1-(EO)_m-(PO)_n-OH$

where R1 is a C6-C30 alkyl, alkenyl, alicyclic, or aromatic hydrocarbon, and m and n are each independent of one another numbers from 0 to 100, provided that the total of m+n is 2 to 100.

19. The method of claim 15, wherein the alkaline-catalyzed alkoxy surfactant comprises a block copolymer comprised of ethylene oxide and propylene oxide units having a number average molecular weight of from 500 to 15,000.

21. The method as in claim 15 wherein the straight-chain fatty acid is at least one selected from the group consisting of caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, vaccenic acid, linoleic acid, arachidic acid, behenic acid, erucic acid, and lignoceric acid.

22. The method as in claim 15 wherein the straight-chain fatty acid is derived from at least one of tall oil, coconut oil, palm kernel oil, animal fats, olive oil, butter fat, corn oil, linseed oil, peanut oil, fish oil, and rapeseed oil.

24. The method as in claim 15, wherein the straight-chain fatty acid is added in an amount sufficient to achieve a pH of the surfactant composition of about 7.0 +/- 0.9.

25. The method as in claim 15, wherein the straight-chain fatty acid is added in an amount sufficient to increase the cloud point temperature of the surfactant composition by between about 2°C to about 50°C as compared to the pH of a surfactant having the

unneutralized alkaline catalyst present therein.

26. The method as in claim 25 wherein the straight-chain fatty acid is added in an amount sufficient to increase the cloud point temperature of the surfactant composition by between about 5°C to about 35°C.

27. The method as in claim 25, wherein the straight-chain fatty acid is added in an amount sufficient to deactivate the alkaline catalyst and establish a pH of the surfactant of between 5.5 to 8.5.

## STATEMENT UNDER ARTICLE 19(1)

Claims 1 and 15 have been amended to add that the alkaline-catalyzed alkoxy surfactant is formed in the presence of an alkaline catalyst. Claims 2 and 16 have been similarly amended.

Claims 1 and 15 have also been amended to specify that the fatty acid is a straight-chain fatty acid having from 8 to 24 carbon atoms. Support for this is found in the specification and in claims 8, 9, 21, and 22, in which each of the claimed fatty acids is a straight-chain fatty acid, or source thereof, as opposed to a branched fatty acid, and in which each of the claimed fatty acids has from 8 to 24 carbon atoms, or is a source thereof.

A pH of the surfactant composition is now claimed in claims 1 and 15 to clearly define the subject matter for which protection is sought.

Claim 1 has also been amended to specify that a salt of a fatty acid and an alkaline catalyst is present in the surfactant composition.

The rest of the claims have been amended based on the amendments to claims 1, 2, 15, and/or 16 or are non-substantive amendments.

With regard to the novelty and the inventive step of the claimed invention in view of:

(D1) EP1028138

(D2) EP0677578

(D3) US4430490

(D4) US4110268

(D5) US4118326

which were all cited in the International Search Report, the claimed invention is distinguishable over these documents as none of these documents disclose, teach, or suggest the features of the amended claims 1 and/or 15. More specifically, with respect to claim 1, these documents do not disclose, teach, or suggest salts of alkaline catalysts and straight-chain fatty acids having from 8 to 24 carbon atoms present in a surfactant composition, or do not disclose adding to a surfactant composition a straight-chain fatty acid having from 8 to 24 carbon atoms. Although D5 discloses the broad category of carboxylic acids having up to 18 carbon atoms as suitable for neutralizing potassium hydroxide in a nonionic surfactant, there is no mention of the specific straight-chain fatty acids having from 8 to 24 carbon atoms as claimed in amended claims 1 and 15 of the present application. Further, the potassium hydroxide present in D5 is for promoting stability and there is no recognition that neutralizing the potassium hydroxide with the specific straight-chain fatty acids claimed in amended claims 1 and 15 of the present application would having any different effect than neutralizing with acetic acid (which only has 2 carbon atoms). Further, there is no recognition within D5 of neutralizing the potassium hydroxide to achieve a pH of from 5.5 to 8.5 in the surfactant composition, as now claimed in amended claims 1 and 15.

In sum, none of these documents, either independently or in combination, disclose, teach, or suggest the novelty and the inventive step of the claimed invention as set forth in amended claims 1 and 15. Claims 2-6, 8-9, 11-14, 16-19, 21-22, and 24-27 depend from the novel and inventive features of claims 1 or 15, respectively. Hence, these dependent claims are also novel and involve an inventive step.

It is respectfully submitted that the claimed invention, as amended, is novel and involves an inventive step over the documents cited in the International Search Report. Further and favorable reconsideration of the subject application is hereby requested.

Respectfully submitted,

# INTERNATIONAL SEARCH REPORT

application No
PCT/US2005/041464

**A. CLASSIFICATION OF SUBJECT MATTER**
C11D1/72 C11D3/20 C11D10/04 C07C41/03 C08G65/48
C08G65/30

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
C11D C07C C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | EP 1 028 138 A (BASF CORPORATION) 16 August 2000 (2000-08-16) paragraphs ‘0006!, ‘0011! paragraphs ‘0043! - ‘0049!; examples 2a,2b,3a,3b claims 1-5,15 | 1-27 |
| X | EP 0 677 578 A (COLGATE-PALMOLIVE COMPANY) 18 October 1995 (1995-10-18) page 3, lines 18-36 examples 1,B,C | 1-27 |
| X | US 4 430 490 A (DOERGE ET AL) 7 February 1984 (1984-02-07) examples A,7 | 1-27 |

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 23 February 2006 | 03/03/2006 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Bertran Nadal, J |

1

# INTERNATIONAL SEARCH REPORT

application No
PCT/US2005/041464

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 4 110 268 A (LONGLEY ET AL) 29 August 1978 (1978-08-29) column 3, line 34 - column 4, line 32 examples 1-3 ----- | 1-27 |
| X | US 4 118 326 A (LOGIN ET AL) 3 October 1978 (1978-10-03) column 3, lines 13-58 ----- | 1-27 |

1

# INTERNATIONAL SEARCH REPORT

**Information on patent family members**

application No
PCT/US2005/041464

| Patent document cited in search report | | Publication date | Patent family member(s) | | | Publication date |
|---|---|---|---|---|---|---|
| EP 1028138 | A | 16-08-2000 | AT | 233289 | T | 15-03-2003 |
| | | | CA | 2298264 | A1 | 11-08-2000 |
| | | | DE | 69905549 | D1 | 03-04-2003 |
| | | | DE | 69905549 | T2 | 21-08-2003 |
| | | | ES | 2193656 | T3 | 01-11-2003 |
| | | | US | 6191315 | B1 | 20-02-2001 |
| EP 0677578 | A | 18-10-1995 | AT | 213015 | T | 15-02-2002 |
| | | | AU | 681487 | B2 | 28-08-1997 |
| | | | AU | 1502095 | A | 26-10-1995 |
| | | | BR | 9501578 | A | 14-11-1995 |
| | | | CA | 2146068 | A1 | 16-10-1995 |
| | | | DE | 69525275 | D1 | 21-03-2002 |
| | | | DK | 677578 | T3 | 27-05-2002 |
| | | | JP | 8081693 | A | 26-03-1996 |
| US 4430490 | A | 07-02-1984 | NONE | | | |
| US 4110268 | A | 29-08-1978 | DE | 2737473 | A1 | 30-03-1978 |
| | | | FR | 2365596 | A1 | 21-04-1978 |
| | | | GB | 1557403 | A | 12-12-1979 |
| | | | NL | 7709638 | A | 29-03-1978 |
| US 4118326 | A | 03-10-1978 | CA | 1069519 | A1 | 08-01-1980 |