

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 May 2003 (15.05.2003)

PCT

(10) International Publication Number
WO 03/040277 A2

(51) International Patent Classification⁷: **C11D**
(21) International Application Number: PCT/US02/34844
(22) International Filing Date: 31 October 2002 (31.10.2002)
(25) Filing Language: English
(26) Publication Language: English
(30) Priority Data:
60/338,743 5 November 2001 (05.11.2001) US
10/265,004 4 October 2002 (04.10.2002) US
(71) Applicant: **COGNIS CORPORATION** [US/US]; 2500
Renaissance Boulevard, Suite 200, Gulph Mills, PA 19406
(US).

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

(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK,
TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

(72) Inventors: **GROSS, Stephen, F.**; 152 Chester Court,
Souderton, PA 18964 (US). **MILSTEIN, Norman**; 9715
Zig Zag Road, Cincinnati, OH 45242 (US).

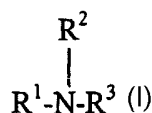
(74) Agents: **DRACH, John, E.** et al.; Cognis Corporation,
Suite 200, 2500 Renaissance Boulevard, Gulph Mills, PA
19406 (US).

Published:

— without international search report and to be republished
upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: BRANCHED REACTION PRODUCTS



(57) Abstract: Compounds of formula (I) below: wherein R¹ and R² can be independently a substituted or un-substituted, saturated or unsaturated C₁-C₃₆ hydrocarbon group, or a -RX(AO)_n-R⁴ group in which R is a C₆-C₁₀ arylene group, a straight or branched chain C₂-C₂₀ alkylene group, optionally containing an arylene group, or a C₄-C₂₀ straight chain alkylene group containing one or more -NH-groups in the alkylene chain, X is -O-, -S-, or -NR⁵- where R⁵ is hydrogen or C₁-C₆ alkyl, each AO group is independently an ethyleneoxy, a 1,2-propyleneoxy, or a 1,2-butyleneoxy group, n is number of from 1 to 100, and the R⁴ group is a C₁-C₃₆ organic group; and the R³ group is an -RX(AO)_n-R⁴ group as defined above; and aqueous and nonaqueous compositions containing them.

TITLE OF THE INVENTION

Branched Reaction Products

5

10

FIELD OF THE INVENTION

This invention relates to surfactants and defoaming agents useful in both aqueous and nonaqueous compositions.

15

BACKGROUND OF THE INVENTION

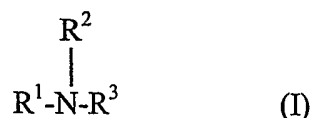
Surface active foam control agents and detergency enhancement agents are widely used in both aqueous and nonaqueous compositions. However, these agents vary in their effectiveness and ecotoxicity, and new and more effective agents with low ecotoxicity are in constant demand.

20

SUMMARY OF THE INVENTION

The present invention relates to compounds useful as surfactants, and/or foam control agents, and/or rheology modifiers.

These compounds are compounds of formula I given below:



- 5 wherein R^1 and R^2 can be independently a substituted or unsubstituted, saturated or unsaturated $\text{C}_1\text{-C}_{36}$ hydrocarbon group, or a $\text{-RX(AO)}_n\text{-R}^4$ group in which R is a $\text{C}_6\text{-C}_{10}$ arylene group, a straight or branched chain $\text{C}_2\text{-C}_{20}$ alkylene group, optionally containing an arylene group, or a $\text{C}_4\text{-C}_{20}$ straight chain alkylene group containing one or more -NH- groups in the alkylene chain, X is -O- , -S- , or $\text{-NR}^5\text{-}$ where R^5 is
- 10 hydrogen or $\text{C}_1\text{-C}_6$ alkyl, each AO group is independently an ethyleneoxy (EO), a 1,2-propyleneoxy (PO), or a 1,2-butylenedioxy (BO) group, n is a number of from 1 to 100, and the R^4 group is a $\text{C}_1\text{-C}_{36}$ organic group; and the R^3 group is an $\text{-RX(AO)}_n\text{-R}^4$ group as defined above.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a graph showing the foam behavior of surfactants, including combinations thereof, in aqueous solutions.

Figure 2 is a graph showing the % soil removal obtained by the aqueous surfactant solutions of Figure 1.

20 DETAILED DESCRIPTION

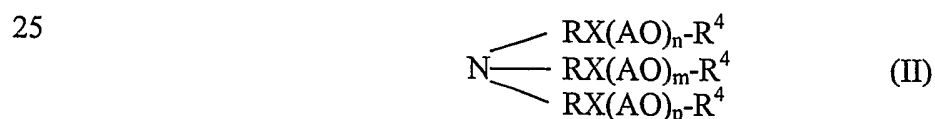
Other than in the operating examples, or where otherwise indicated, all numbers expressing quantities of ingredients or reaction conditions used herein are to be understood as modified in all instances by the term "about".

- 25 In the compounds of formula I, when R^1 and/or R^2 are hydrocarbon groups, such groups include linear or branched alkyl groups having from 1 to 36 carbon atoms, preferably from 4 to 22 carbon atoms, more preferably from 4 to 12 carbon

atoms, and most preferably from 8 to 10 carbon atoms; linear or branched alkenyl or alkynyl groups having from 2 to 36 carbon atoms, preferably from 4 to 22 carbon atoms, aryl groups having from 6 to 22 carbon atoms, e.g. phenyl, tolyl, xylyl, naphthyl, etc. and arenyl groups having from 7 to 36 carbon atoms. Arenyl groups are
 5 alkyl-substituted aromatic radicals having a free valence at an alkyl carbon atom, such as a benzylic group. These R^1 and/or R^2 groups can also be saturated carbocyclic groups, unsaturated carbocyclic groups having one or more multiple bonds, saturated heterocyclic groups, e.g. piperidino, morpholino, thiomorpholino, pyrrolidino, and the like, or unsaturated heterocyclic groups, such as the above groups having one or more
 10 multiple bonds. Any of the above groups can be substituted groups, i.e. the substituent groups can be single or multiple substituents such as a sulfur functionality, e.g. a mercaptan or thio group; a nitrogen functionality such as an amine or amide functionality; an alcohol functionality; a silicon functionality, e.g., a siloxane; an ether functionality, e.g. a C_1 - C_6 alkoxy group; or any combination thereof.

15 With respect to the $-RX(AO)_n-R^4$ groups, the AO groups are preferably all ethyleneoxy groups, n is preferably a number of from 4 to 50, and the R^4 group can be
 20 a C_1 - C_{36} hydrocarbon group as defined above, or an $-\overset{\text{O}}{\parallel}CR^6$ group, where R^6 is a C_1 - C_{18} saturated or unsaturated, substituted or unsubstituted, hydrocarbon group, e.g. alkyl, alkenyl, cycloalkyl, arenyl, or aryl, optionally containing one or more of the substituents described above.

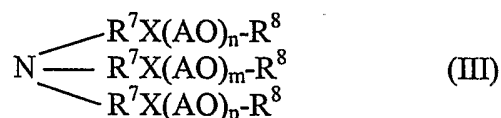
The compounds of the invention preferably have the following structure II:



wherein R, X, AO, n, and R^4 have the meanings given in Formula I, and m and p are independently a number of from 1 to 100, provided that the sum of n, m, and p is from

3 to 100, preferably from 4 to 50. In the above Formula II, the AO groups are preferably at least mostly ethyleneoxy groups, and the R⁴ groups are preferably all independently C₁-C₃₆ hydrocarbon groups.

More preferred compounds of the invention have the formula III below:

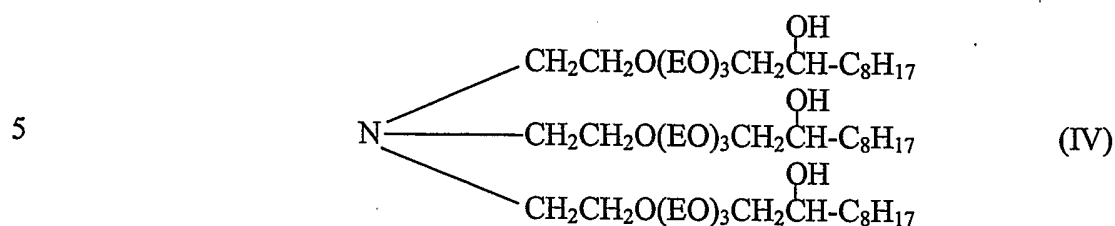


wherein R⁷ is a straight or branched chain C₂-C₁₀ alkylene group, X has the meaning given in formula I, AO has the meaning given in formula I, but preferably all AO groups are ethyleneoxy groups, the sum of n, m, and p is from 6 to 27, preferably from 6 to 18, and more preferably from 6 to 12, and each R⁸ group is independently a

–CH₂– $\overset{\text{OH}}{\underset{|}{\text{CH}}}$ –R⁹ group in which R⁹ is a C₁-C₁₈ straight or branched chain, saturated or unsaturated hydrocarbon group.

Even more preferred compounds of formula III are those in which the R⁷ groups are all ethylene groups; the X groups are all –O–; the AO groups are all ethyleneoxy groups; n, m, and p total from 6 to 18, preferably from 6 to 12; and R⁹ is a C₄-C₁₂ alkyl group.

The most preferred compound of the invention is the reaction product of (a) triethanolamine ethoxylated with an average of 9 moles of ethylene oxide and (b) about 3 moles of epoxylated 1-decene. The reaction mixture resulting therefrom will contain the following compound of formula IV:



in which the 3 EO groups per chain represent an average of a total of 9 EO groups, and the C₈H₁₇ groups are straight or branched chain.

10 The compounds of formulae I, II, III, and IV can be prepared by (a) reacting a tertiary amine having at least one hydrogen atom which will react with an alkylene
oxide, with a C₂-C₄ alkylene oxide, and (b) reacting the reaction product from step (a)
15 with either (i) a C₁-C₃₆ organic halide, preferably a chloride or bromide, (ii) a C₅-C₂₀ epoxy compound or (iii) a C₂-C₁₉ carboxylic acid-based esterifying agent e.g. R⁶ $\overset{\text{O}}{\parallel}\text{COH}$,
20 R⁶ $\overset{\text{O}}{\parallel}\text{CX}$, where X is a halogen atom, or R⁶ $\overset{\text{O}}{\parallel}\text{COR}'$ where R' is a C₁-C₆ alkyl group and R⁶ has the meaning given above.

Where the reactant in step (b) is a C₅-C₂₀ epoxy compound, the epoxy
25 compound preferably has the formula $\text{CH}_2\text{---}\overset{\text{O}}{\text{---}}\text{CH---R}^9$ where R⁹ has the meaning given above in formula III. However, epoxy compounds in which the epoxy group is not in the alpha position can also be used herein.

Reaction conditions for carrying out the above reactions will depend on the
30 particular reactants employed and can be readily determined by those skilled in the art, especially since alkoxylation reactions, organic halide reactions, reactions with epoxy compounds, and esterification reactions are known reaction types.

When the X group in the above compounds of Formulas I, II, and III is -S- or -NR⁵-, the amines in step (a) prior to alkoxylation containing an -SH or -NR⁵H
35 group can be readily prepared from the corresponding alcohols. For example, where

X is $-\text{NR}^5\text{H}$, the corresponding alcohol can be subjected to a catalyzed ammoniation (with ammonia, or a lower alkylamine) for replacement of the hydroxyl, or to a capping of the hydroxyl with epichlorohydrin followed by ammoniation (with ammonia, or a lower alkylamine) of the resulting glycidal group. Where X is $-\text{SH}$,
5 the corresponding alcohol can be converted to the mercaptan by methods well known to the art, e.g. by converting the alcohol to a halide and reacting the halide with sodium hydrosulfide.

The compounds of the invention can be used as surfactants and/or foam control agents and/or rheology modifying agents in both aqueous and nonaqueous
10 compositions, and are particularly useful in minimizing or eliminating foaming in aqueous compositions containing high foaming surfactants, such as alkyl polyglycosides and anionic surfactants such as alcohol sulfates.

These reaction products can be used in aqueous cleaning compositions, in emulsion polymer latex compositions such as latex paints, in inks, in adhesives, in
15 metal working compositions, and in other aqueous and nonaqueous compositions in which surfactants and/or defoaming agents and/or rheology modifying agents are advantageously present.

The reaction products of the invention are biodegradable, can act as surfactants, defoaming agents, and rheology modifying agents at the same time,
20 contain no organic solvents, and do not adversely affect the detergency of other surfactants that may be present in compositions in which they are used since they are themselves surfactants. In addition, they do not contain any organically bound chlorine or other halides, i.e. they have a very low eco-toxicity.

The degree of hydrophilic and hydrophobic properties of the compounds of
25 the invention can be readily controlled by controlling the type and number of

alkyleneoxy groups and the carbon content of the hydrophobic groups. For example, the greater the number of ethyleneoxy groups present, the greater the water solubility, while the presence of 1,2-propyleneoxy groups and/or 1,2-butylenoxy groups will decrease water solubility.

5 The compounds of the invention can be added to the above aqueous and nonaqueous compositions in a surfactant-effective and/or defoaming-effective quantity, and/or rheology modifying-effective quantity, usually from 0.01 to 20% by weight, preferably from 0.1 to 10% by weight, based on the weight of solids in the composition.

10 The compounds of the invention are particularly useful as a defoaming agent component of aqueous solutions containing one or more alkyl polyglycosides.

Alkyl polyglycosides are a class of nonionic surfactants that exhibit significantly higher foaming profiles than other nonionic surfactants, such as alcohol ethoxylates. In fact, it can be said that the foaming tendencies of alkyl polyglycosides
15 more closely resemble those of anionic surfactants, such as alcohol sulfates, than the foaming tendencies of other nonionic surfactants. This higher foaming tendency makes the use of alkyl polyglycosides undesirable for many applications, e.g. cleaning-in-place for food processing plants, high pressure spray cleaning, bottle washing, floor cleaners and automatic dishwashing, wherein high levels of foam
20 interfere with the cleaning and rinsing operation and reduce the efficiency of the operation.

A defoaming-effective amount is an amount effective to eliminate or decrease the foam generated by the alkyl polyglycoside as a result of some type of mechanical action such as mixing, pouring, and/or shaking. The amount required to eliminate
25 and/or decrease foam will vary from one instance to another depending upon the

nature of the alkyl polyglycoside surfactant or mixture of surfactants and the defoaming effect desired. A defoaming effective amount will be readily determinable by one of ordinary skill in the art. The defoaming effective amount will typically vary from a weight ratio of alkyl polyglycoside/defoamer of 4.0/1.0 to about 1.0/1.0.

5 Alkyl polyglycosides include those having formula IV below:



wherein R_1 is a monovalent organic radical having from 6 to 30 carbon atoms, preferably from 6 to 16 carbon atoms; R_2 is a divalent alkylene radical having from 2 to 4 carbon atoms; Z is a saccharide residue having 5 or 6 carbon atoms; b is a number
10 having a value from 0 to 12; a is a number having a value from 1 to 6, preferably from 1.2 to 2.2, and more preferably from 1.4 to 1.7. Preferred alkyl polyglycosides which can be used in the compositions according to the invention have the formula I wherein Z is a glucose residue and b is zero. Such alkyl polyglycosides are commercially available, for example, as APG®, GLUCOPON®, or PLANTAREN® surfactants
15 from Cognis Corporation, Ambler, PA, 19002. Examples of such surfactants include but are not limited to:

1. GLUCOPON® 225 DK Surfactant – an alkyl polyglycoside in which the alkyl group contains 8 to 10 carbon atoms and having an average degree of polymerization of 1.7
- 20 2. GLUCOPON® 425N Surfactant – an alkyl polyglycoside in which the alkyl group contains 8 to 16 carbon atoms, having an average of 10.3 carbon atoms, and having an average degree of polymerization of 1.5.
3. GLUCOPON® 625 UP Surfactant – an alkyl polyglycoside in which the alkyl group contains 12 to 16 carbon atoms and having an average degree
25 of polymerization of 1.6.

4. APG® 325N Surfactant – an alkyl polyglycoside in which the alkyl group contain 9 to 11 carbon atoms and having an average degree of polymerization of 1.5.
5. GLUCOPON® 600UP Surfactant – an alkyl polyglycoside in which the alkyl group contains 12 to 16 carbon atoms and having an average degree of polymerization of 1.4.
6. PLANTAEREN® 2000 Surfactant – a C₈-C₁₆ alkyl polyglycoside in which the alkyl group contains 8 to 16 carbon atoms and having an average degree of polymerization of 1.5.
- 10 7. PLANTAEREN® 1300 Surfactant – a C₁₂-C₁₆ alkyl polyglycoside in which the alkyl group contains 12 to 16 carbon atoms and having an average degree of polymerization of 1.6.
8. GLUCOPON® 220N Surfactant – an alkyl polyglycoside in which the alkyl group contains 8 to 10 carbon atoms and having an average degree of polymerization of 1.5.
- 15

Other examples include alkyl polyglycoside surfactant compositions which are comprised of mixtures of compounds of formula I wherein Z represents a moiety derived from a reducing saccharide containing 5 or 6 carbon atoms; a is a number having a value from 1 to about 6; b is zero; and R₁ is an alkyl radical having from 8 to 20 carbon atoms. The compositions are characterized in that they have increased surfactant properties and an HLB in the range of about 10 to about 16 and a non-Flory distribution of glycosides, which is comprised of a mixture of an alkyl monoglycoside and a mixture of alkyl polyglycosides having varying degrees of polymerization of 2 and higher in progressively decreasing amounts, in which the amount by weight of polyglycoside having a degree of polymerization of 2 or mixtures thereof with the

polyglycoside having a degree of polymerization of 3 predominate in relation to the amount of monoglycoside, said composition having an average degree of polymerization of about 1.8 to about 3. Such compositions, also known as peaked alkyl polyglycosides, can be prepared by separation of the monoglycoside from the original reaction mixture of alkyl monoglycoside and alkyl polyglycosides after removal of the alcohol. This separation may be carried out by molecular distillation and normally results in the removal of about 70-95% by weight of the alkyl monoglycosides. After removal of the alkyl monoglycosides, the relative distribution of the various components, mono- and poly- glycosides, in the resulting product changes and the concentration in the product of the polyglycosides relative to the monoglycoside increases as well as the concentration of individual polyglycosides to the total, i.e. DP2 and DP3 fractions in relation to the sum of all DP fractions. Such compositions are disclosed in U.S. Pat. No. 5,266,690, the entire contents of which are incorporated herein by reference.

This invention will be illustrated but not limited by the following examples.

EXAMPLES

Example 1

Synthesis of POE(9) triethanolamine tris (2-hydroxydecyl) ether.

Into a 500 ml 4-neck flask fitted with a cold trap was placed 100 g. of POE(9) triethanolamine (triethanolamine ethoxylated with 9 moles of ethylene oxide) under nitrogen. The flask was heated to 150°C with agitation and nitrogen sparge to drive off any moisture. Then 100 g. of 1,2-epoxydecane was added dropwise at 150°C, and the resulting reaction mixture was heated at 150°C for 3.5 hours. The flask was then subjected to vacuum to remove any unreacted epoxide. No epoxide was seen in

the cold trap. The reaction mixture was then cooled to 90°C and 0.8g. of 30% hydrogen peroxide was added with agitation for 45 minutes to bleach the product.

Example 2

The following 4% active aqueous surfactant compositions were prepared by dissolving the non-aqueous components in water:

<u>Components</u>		<u>% by weight</u>	<u>Active Ratio</u> <u>GLUCOPON® 425N: additive</u>
10	a) DI WATER	92.0	1:0
	GLUCOPON® 425N	8.0	
15	b) DI WATER	92.59	5.75:1
	GLUCOPON® 425N	6.82	
	9TTE ¹	0.59	
20	c) DI WATER	92.73	4.5:1
	GLUCOPON® 425N	6.55	
	9TTE	0.72	
25	d) DI WATER	92.73	4.5:1
	GLUCOPON® 425N	6.55	
	DEHYPOUND® ST-15 ²	0.72	

1- 9TTW is POE(9) triethanolamine tris-(2-hydroxydecyl) ether prepared in Example 1.

2 – DEHYPOUND® ST-15 is a commercial highly effective foam control agent produced by the base-catalyzed reaction between epichlorohydrin and n-octyl/n-decyl (45:55) alcohol · 4EO (mole ratio 1:0.65).

The above surfactant compositions were further diluted by adding 10 grams of the composition to 400 grams of soft water, resulting in 0.1% total active solutions.

The 0.1% active solutions were transferred to a dynamic foam cell and circulated for a total of 8 minutes. The foam cell consisted of a 2-liter jacketed graduate, peristaltic pump with variable voltage controller, and silicone and glass tubing. The test mixture was circulated at a constant temperature and flow rate; and fell from a constant height of 30 cm back into itself, creating foam. The tests were run under the following set of conditions: a 0.1% active solution of the test surfactant in soft (10-15 ppm) water was circulated at 25°C and the foam volume was read every 30 seconds.

The results obtained are set forth in Table 1 below:

TABLE 1
FOAM VOLUMES

Time min.	COMPOSITION a)	COMPOSITION b)	COMPOSITION c)	COMPOSITION d)
0	0	0	0	0
0.5	1200	200	200	280
1		240	200	280
1.5		260	200	300
2		260	200	300
2.5		240	220	280
3		240	220	280
3.5		240	220	300
4		240	220	300
4.5		240	200	320
5		240	200	320
5.5		240	200	340
6		240	200	340
6.5		240	200	340
7		240	200	340
7.5		240	200	320
8		240	200	320

5 The above results have been plotted in graph form in FIGURE 1.

It should be noted that the compound of Example 1 is a more effective foam control agent than the commercial product DEHYPOUND® ST-15 since 1 part of DEHYPOUND® ST-15 for every 4.5 parts of actives in GLUCOPON® 425N is required to obtain satisfactory foam control, while only 1 part of the compound of

10 Example 1 is needed for every 5.75 parts of actives in GLUCOPON® 425N to achieve even better foam control results.

Example 3

The aqueous surfactant compositions prepared in Example 2, diluted 1% total actives, were tested for hard surface detergency according to the following procedure:

15 The test soil used had the following composition:

	<u>Composition</u>	<u>Parts by weight</u>
	Kerosene	55
	Mineral Oil	6
	Vegetable Oil	8
5	Carbon Black	1.5
	Bandy Black Clay	25

0.4 ml of the above test soil was applied to the rough side of 3" X 3"

Armstrong 56830 Chalk II vinyl composite tiles. The soil was spread with the grain in the panel, using a nylon brush. An additional 0.1 ml of soil was then added to the tile and spread as above. The panels were dried for 20 minutes at room temperature, then for 20 minutes at 100°C, and finally for 20 minutes at room temperature.

The cleaning operation was carried out as follows, after first measuring the reflectance of the soiled tiles:

1. Two soiled test panels were placed in a Gardner Apparatus wash tray, with the "grain" parallel to the direction of sponge travel.
2. 200 ml of test solution were added to the wash tray, and left for one minute.
3. The test panels were scrubbed with a synthetic sponge for 16 cycles, rotating panels 90° after 8 cycles. The total number of cycles can be varied from 8 to 40, provided the same number is used for each test solution.
4. The panels were rinsed with DI water and dried at room temperature for at least one hour.
5. Steps 1-4 were repeated for a total of four panels for each test solution.

The reflectance of the washed panels were measured after the drying period, and averaged for each test solution.

Calculation:

$$\begin{aligned} \text{\% Soil Removal} = & \frac{\{R_w - R_s\}}{\{R_u - R_s\}} \times 100 \\ \text{panel} & \end{aligned}$$

5

R_w = Reflectance of washed
 R_s = Reflectance of soiled panels
 R_u = Reflectance of unsoiled panels

The results obtained are set forth in Table 2 below, and shown in graph form
 10 in Figure 2.

TABLE 2

\% of soil removal

Composition a)	Composition b)	Compositions c)	Composition d)
71.2	77.2	77.7	76.6

It can be seen from the above table that the compositions containing the
 15 compounds of the invention (compositions b) and c)) are more effective hard surface
 detergents than both GLUCOPON® 425N alone (composition a)), and composition d)
 containing DEHYPOUND® ST-15 even though DEHYPOUND® ST-15 is present in
 composition d) in greater quantity than the compound of Example 1 in compositions
 b) and c).

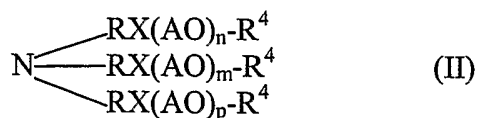
What is claimed is:

1. A compound of formula I below:



- wherein R^1 and R^2 can be independently a substituted or unsubstituted, saturated or unsaturated $\text{C}_1\text{-C}_{36}$ hydrocarbon group, or a $\text{-RX(AO)}_n\text{-R}^4$ group in which R is a $\text{C}_6\text{-C}_{10}$ arylene group, a straight or branched chain $\text{C}_2\text{-C}_{20}$ alkylene group optionally containing an arylene group, or a $\text{C}_4\text{-C}_{20}$ straight chain alkylene group containing one or more -NH- groups in the alkylene chain, X is -O- , -S- , or $\text{-NR}^5\text{-}$ where R^5 is hydrogen or $\text{C}_1\text{-C}_6$ alkyl, each AO group is independently an ethyleneoxy (EO), a 1,2-propyleneoxy (PO), or a 1,2-butylenedioxy (BO) group, n is a number of from 1 to 100, and the R^4 group is a $\text{C}_1\text{-C}_{36}$ organic group; and the R^3 group is an $\text{-RX(AO)}_n\text{-R}^4$ group as defined above.
2. The compound of formula I wherein the R^1 and/or R^2 groups are branched chain alkyl groups containing from 4 to 36 carbon atoms.
 3. The compound of formula I wherein said alkyl groups contain from 4 to 12 carbon atoms.
 4. The compound of formula I wherein in the $\text{-RX(AO)}_n\text{-R}^4$ groups the AO groups are all ethyleneoxy groups, n is a number of from 4 to about 50, and the R^4 groups are independently a $\text{C}_1\text{-C}_{36}$ hydrocarbon group, or an -O-C(=O)-R^6 group where R^6 is a $\text{C}_1\text{-C}_{18}$ saturated or unsaturated, substituted or unsubstituted hydrocarbon group.

5. The compound of claim 1 wherein the compound has the formula II below:

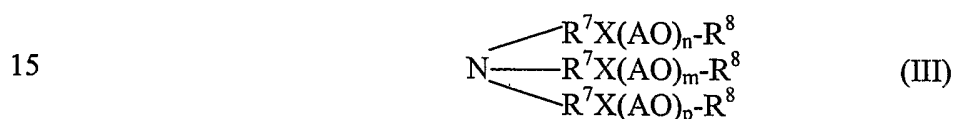


5 wherein R, X, AO, n, and R⁴ have the meanings given in Formula I, and m and p are independently a number of from 1 to 100, provided that the sum of n, m, and p is from 3 to 100.

6. The compound of claim 5 wherein the sum of n, m, and p is from 4 to about 50.

10 7. The compound of claim 5 wherein the AO groups are all ethyleneoxy groups.

8. The compound of claim 1 wherein the compound has the formula III below:

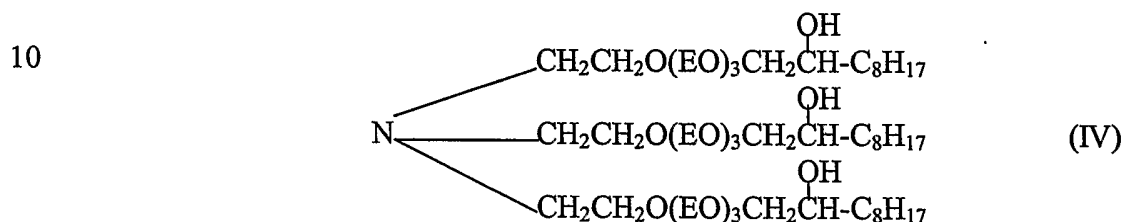


15 wherein R⁷ is a straight or branched chain C₂-C₁₀ alkylene group, X has the meaning given in formula I, AO has the
20 meaning given in formula I, the sum of n, m, and p is from 6 to 27, and each R⁸ group is independently a

25 $\begin{array}{c} \text{OH} \\ | \\ -\text{CH}_2-\text{CH}-\text{R}^9 \end{array}$ group in which R⁹ is a C₁-C₁₈ straight or branched chain, saturated or unsaturated hydrocarbon group.

- 30 9. The compound of claim 8 wherein all AO groups are ethyleneoxy groups.
10. The compound of claim 8 wherein the X groups are all -O- groups.
11. The compound of claim 8 wherein the R⁷ groups are all ethylene groups, the X groups are all -O- groups, and the sum of n, m, and p is from 6 to 18.

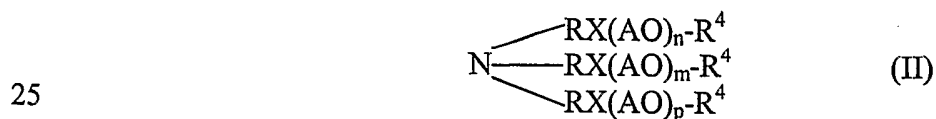
12. The compound of claim 11 wherein all R⁹ groups are C₄-C₁₂ alkyl groups.
13. The compound of claim 11 wherein the sum of n, m, and p is from 6 to 12.
14. The compound of claim 11 wherein all AO groups are ethyleneoxy groups.
15. The compound of claim 11 wherein all R⁹ groups are C₄-C₁₂ alkyl groups,
 5 the sum of n, m, and p is from 6 to 12, and all AO groups are ethyleneoxy groups.
16. The compound of claim 8 wherein the compound has the following formula IV:



- 15 in which the 3 EO groups per chain represent an average of a total of 9 EO groups, and the C₈H₁₇ groups are straight or branched chain.
17. An aqueous or nonaqueous composition containing a surfactant-effective quantity of at least one compound of claim 1.
 18. An aqueous or nonaqueous composition containing a surfactant-effective
 20 quantity of at least one compound of claim 5.
 19. An aqueous or nonaqueous composition containing a surfactant-effective quantity of at least one compound of claim 8.
 20. An aqueous or nonaqueous composition containing a surfactant-effective quantity of the compound of claim 16.
 - 25 21. An aqueous or nonaqueous composition containing a defoaming-effective quantity of at least one compound of claim 1.
 22. An aqueous or nonaqueous composition containing a defoaming-effective quantity of at least one compound of claim 5.

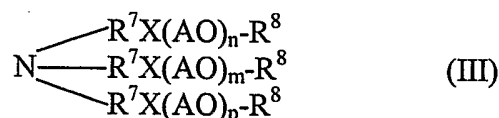
23. An aqueous or nonaqueous composition containing a defoaming-effective quantity of at least one compound of claim 8.
24. An aqueous or nonaqueous composition containing a defoaming-effective quantity of the compound of claim 16.
- 5 25. The composition of claim 17 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
26. The composition of claim 18 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
27. The composition of claim 19 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
- 10 28. The composition of claim 20 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
29. The composition of claim 21 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
- 15 30. The composition of claim 22 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
31. The composition of claim 23 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
32. The composition of claim 24 wherein the composition is a latex paint, an ink, an adhesive, or a metal working composition.
- 20 33. A reaction product of (a) the alkoxylation product of an amine having at least one hydrogen atom that will react with an alkylene oxide; and (b) a C₅-C₂₀ epoxy compound; wherein the alkoxylation product in step (a) contains one or more of ethyleneoxy, propyleneoxy, and butyleneoxy groups.
- 25

34. The reaction product of triethanolamine ethoxylated with 9 moles of ethylene oxide and an epoxylated C₁₀ olefin.
35. The reaction product of claim 34 wherein the C₁₀ olefin is an alpha olefin.
36. An aqueous surfactant composition comprising
- 5 I) at least one compound of claim 1; and
- II) at least one alkyl polyglycoside; wherein component I is present in the aqueous composition in a defoaming-effective quantity.
37. The aqueous surfactant composition of claim 36 wherein the at least one
- 10 alkyl polyglycoside has the following formula IV:
- $$R_1O(R_2O)_b(Z)_a \quad (IV)$$
- wherein R₁ is a monovalent organic radical having from 6 to about 30 carbon atoms, R₂ is a divalent alkylene radical having from 2 to 4 carbon atoms, Z is a saccharide residue having 5 or 6 carbon atoms, b is a number
- 15 of from 0 to about 12, and a is a number of from 1 to about 6.
38. The aqueous surfactant composition of claim 36 wherein Z is a glucose residue and b is zero.
39. The aqueous surfactant composition of claim 38 wherein a is a number of from about 1.4 to about 1.7, and R₁ is an alkyl group having on average
- 20 from 6 to 16 carbon atoms.
40. The aqueous surfactant composition of claim 36 wherein the at least one compound of claim 1 has the formula II below:



wherein R, X, AO, n, and R⁴ have the meanings given in Formula I, and m and p are independently a number of from 1 to 100, provided that the sum of n, m, and p is from 3 to 100.

41. The aqueous surfactant composition of claim 36 wherein the at least one compound of claim 1 has the formula III below:



wherein R⁷ is a straight or branched chain C₂-C₁₀ alkylene group, X has the meaning given in formula I, AO has the meaning given in formula I, the sum of n, m, and p is from 6 to 27, and each R⁸ group is independently a

$\text{-CH}_2\text{-}\overset{\text{OH}}{\text{CH}}\text{-R}^9$ group in which R⁹ is a C₁-C₁₈ straight or branched chain, saturated or unsaturated hydrocarbon group.

42. The aqueous surfactant composition of claim 41 wherein the R⁷ groups are all ethylene groups, the X groups are all -O- groups, the sum of n, m, and p is from 6 to 18, and all three R⁸ groups are identical $\text{-CH}_2\text{-}\overset{\text{OH}}{\text{CH}}\text{-R}^9$ groups.

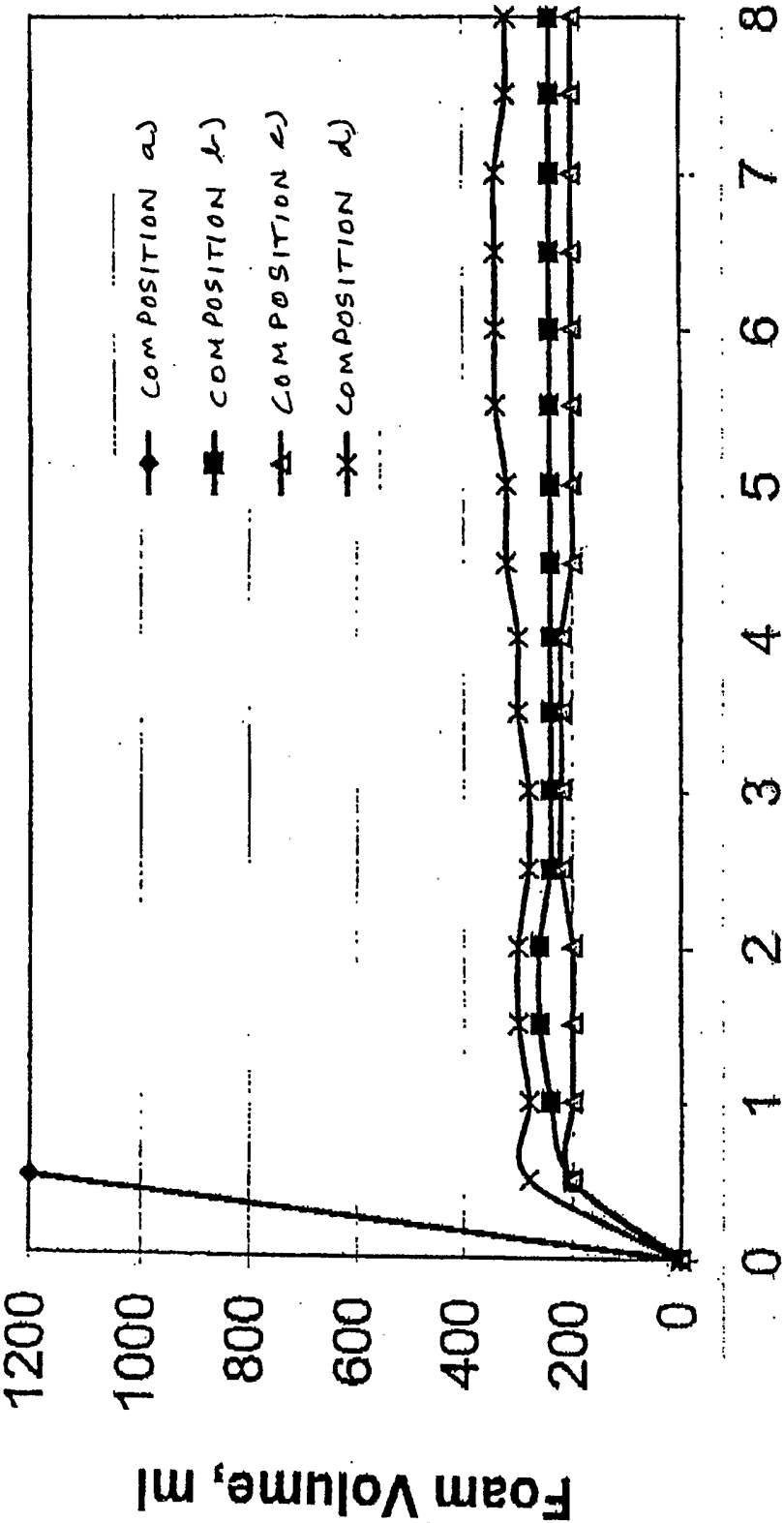
43. The aqueous surfactant composition of claim 42 wherein all R⁹ groups are C₄-C₁₂ alkyl groups.

44. The aqueous surfactant composition of claim 42 wherein the sum of n, m, and p is from 6 to 12.

45. The aqueous surfactant composition of claim 42 wherein all AO groups are ethyleneoxy groups.

46. The aqueous surfactant composition of claim 42 wherein all R⁹ groups are C₄-C₁₂ alkyl groups, the sum of n, m, and p is from 6 to 12, and all AO groups are ethyleneoxy groups.

Foam Behavior



Time, min.

FIGURE 1

Hard Surface Detergency

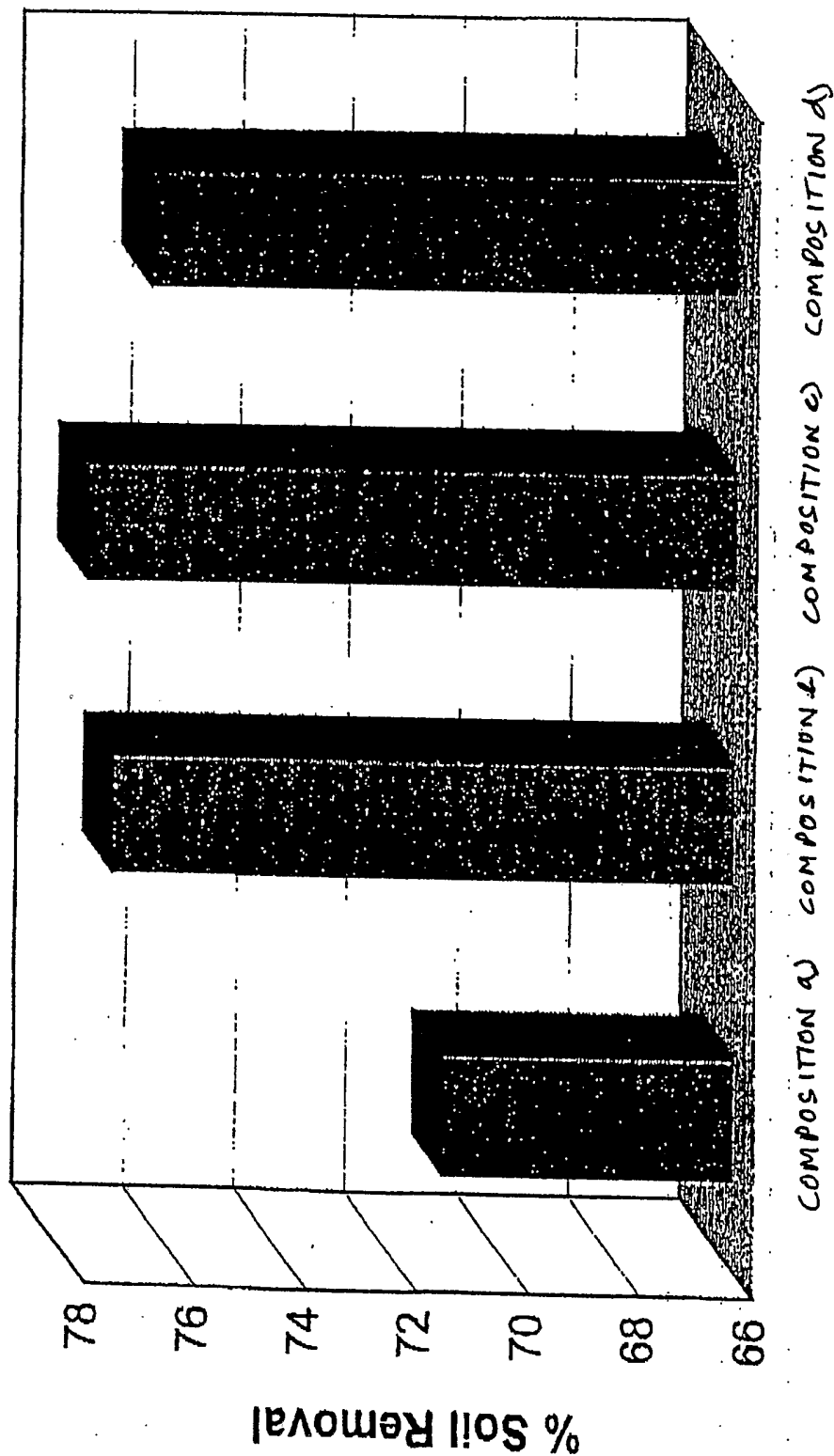


FIGURE 2