**Title:** NONAQUEOUS DETERGENT COMPOSITIONS COMPRISING CLAY SOIL REMOVAL POLYMERS

**Abstract**

The present invention provides a nonaqueous heavy-duty detergent composition which is in the form of a liquid, gel or paste, said composition comprising a bleaching agent and a specific clay soil removal polymer.
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NONAQUEOUS DETERGENT COMPOSITIONS
COMPRISING
CLAY SOIL REMOVAL POLYMERS

FIELD OF THE INVENTION

This invention relates to nonaqueous laundry detergent products which are in the form of a liquid, gel or paste comprising selected clay stain removal polymers.

BACKGROUND OF THE INVENTION

Detergent products in the form of liquid, gel or paste are often considered to be more convenient to use than are dry powdered or particulate detergent products. Said detergents have therefore found substantial favor with consumers. Such detergent products are readily measurable, speedily dissolved in the wash water, capable of being easily applied in concentrated solutions or dispersions to
soiled areas on garments to be laundered and are non-dusting. They also usually occupy less storage space than granular products. Additionally, such detergents may have incorporated in their formulations materials which could not withstand drying operations without deterioration, which operations are often employed in the manufacture of particulate or granular detergent products.

Although said detergents have a number of advantages over granular detergent products, they also inherently possess several disadvantages. In particular, detergent composition components which may be compatible with each other in granular products may tend to interact or react with each other. Thus such components as enzymes, surfactants, perfumes, brighteners, solvents and especially bleaches and bleach activators can be especially difficult to incorporate into liquid detergent products which have an acceptable degree of chemical stability.

One approach for enhancing the chemical compatibility of detergent composition components in detergent products has been to formulate nonaqueous (or anhydrous) detergent compositions. The formulation of such nonaqueous products, raises specific problems.

In particular, formulating nonaqueous products comprising polymers such as clay soil removal polymers raises a problem in that said polymers tend to increase the viscosity of the nonaqueous matrix thereby rendering the product difficult to be commercially usable. Therefore, the clay soil removal polymers must be selected such that they are suitable for imparting acceptable fabric cleaning performance to such compositions but utilization of such materials must not lead to an unacceptable degree of viscosity increase. Viscosity control agents can be added to such products, however, these add cost and bulk to the product without contributing to the laundering/cleaning performance of such detergent compositions.
In addition, formulating bleach-containing nonaqueous products comprising clay soil removal polymers raises a problem in that these polymers should be bleach-compatible.

Given the foregoing, there is clearly a continuing need to identify and provide detergent compositions in the form of nonaqueous products that have a commercially acceptable viscosity along with an excellent laundering performance. Accordingly, it is an object of the present invention to provide nonaqueous detergent products which have such especially desirable physical characteristics as well as outstanding fabric laundering performance characteristics.

It has now been found that the specific clay soil removal polymers according to the present invention are easily processed in the non-aqueous liquid detergent without the need for modifying the rheology of the detergent matrix.

In addition, it has been found that the specific clay soil removal polymers according to the present invention are fully compatible with bleaches formulated therewith.

**SUMMARY OF THE INVENTION**

The present invention provides a nonaqueous heavy-duty detergent composition which is in the form of a liquid, gel or paste, said composition comprising a specific clay soil removal polymer and a bleaching agent.

**DETAILED DESCRIPTION OF THE INVENTION**

The present invention relates to non-aqueous detergent compositions which comprise from 0.1 to 5% by weight of water-soluble cationic compounds having clay soil removal/anti-redeposition properties. These compounds are selected from the group consisting of:
(1) ethoxylated cationic diamines having the formula:

\[
\begin{align*}
\text{X-L-N}^+ & \text{R}^1 \text{N}^+ \text{L} \text{-} X \\
\text{L} & \text{L} \\
\text{X} & \text{X}
\end{align*}
\]

or

\[
\begin{align*}
\text{R}^1 & \text{N}^+ \text{L} \text{-} \text{R}^1 \text{N}^+ \text{L} \\
\text{L} & \text{L} \\
\text{X} & \text{X}
\end{align*}
\]

(2) ethoxylated cationic polyamines having the formula:

\[
\begin{align*}
\text{R} & \text{-(A}^1\text{)}_q \text{-(R}^5\text{)}_t \text{-N}^+ \text{L} \text{-X} \text{]}_p
\end{align*}
\]

(3) ethoxylated cationic polymers which comprise a polymer backbone, at least 2N⁺ groups and at least one L-X group, wherein ; and L connects the N⁺ positively charged center and X or connects group X to the polymer backbone; and

(4) mixtures thereof;

wherein \( A^1 \) is

\[
\begin{align*}
\text{NC} & \\
\text{NC} & \\
\text{NC} & \\
\text{CN} & \\
\text{OCN} & \\
\text{CO} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O} & \\
\text{O}
\end{align*}
\]

\( R \text{ is H or C}_1\text{-C}_4 \text{ alkyl or hydroxyalkyl, } R^1 \text{ is C}_2\text{-C}_{12} \text{ alkylene, hydroxyalkylene, alkyenylene, arylene or} \)
alkarylene, or a C₂-C₃ oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-N bonds are formed; each R² is C₁-C₄ alkyl or hydroxyalkyl, the moiety -L-X or two R² together form the moiety -(CH₂)ₓ-A²-(CH₂)ₛ-, wherein A² is -O- or -CH₂-, r is 1 or 2, s is 1 or 2 and r + s is 3 or 4; each R³ is C₁-C₈ alkyl or hydroxyalkyl, benzyl, the moiety L-X, or two R³ or one R² and one R³ together form the moiety -(CH₂)ₓ-r-A²-(CH₂)ₛ-; R⁴ is a substituted C₃-C₁₂ alkyl, hydroxyalkyl, alkenyl, aryl or alkaryl group having p substitution sites; R⁵ is C₁-C₁₂ alkylene, hydroxyalkylene, alkenylene, arylene or alkarylene, or a C₂-C₃ oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-O or O-N bonds are formed; X is a nonionic group selected from the group consisting of H, C₁-C₄ alkyl or hydroxyalkyl ester or ether groups, and mixtures thereof; L is a hydrophilic chain which contains the polyoxyalkylene moiety -[(R⁶O)ₘ(CH₂CH₂O)ₙ]-; wherein R⁶ is C₃-C₄ alkylene or hydroxyalkylene and m and n are numbers such that the moiety -(CH₂CH₂O)ₙ- comprises at least 50% by weight of said polyoxyalkylene moiety; n is at least 12 for said cationic monoamines, is at least 6 for said cationic diamines and is at least 3 for said cationic polyamines and cationic polymers; p is from 3 to 8; q is 1 or 0; t is 1 or 0, provided that t is 1 when q is 1.

In addition to the cationic compounds, the detergent compositions further comprise from 1 to 75% by weight of a nonionic, anionic, ampholytic, zwitterionic or cationic detergent surfactant or mixture thereof. In addition to these detergent surfactants, the detergent composition can optionally comprise from 0 to 80% by weight of a detergent builder.

The cationic compounds of the present invention provide clay soil removal benefits while being anionic detergent surfactant compatible. It is believed that the positively charged cationic groups cause adsorption of the compound onto the negatively charged layers of the clay particle. It is also believed that the hydrophilic ethoxy
units attached to the compound swell the clay particle so that it loses its cohesive character and is swept away in the wash water.

The anti-redemption benefits provided by these cationic compounds are also believed to be due to the positively charged cationic groups which cause it to be adsorbed onto soil, it becomes encased within a hydrophilic layer provided by the attached ethoxy units. As such, the hydrophilically encased soil is prevented from redepositing on fabrics, in particular hydrophobic fabrics such as polyester, during the laundering cycle.

The cationic clay soil removal polymers according to the present invention should be understood as clay soil removal polymers where the nitrogen atoms are quaternized by more than 50%, preferably more than 70%, most preferably more than 80% of the total nitrogen atoms.

The water-soluble cationic compounds of the present invention useful in detergent compositions include ethoxylated cationic diamines and ethoxylated cationic polyamines as previously defined.

In the preceding formulas for the cationic amines, \( R^1 \) can be branched (e.g.

\[
\text{CH}_3 - \text{CH}_2 - \text{CH}, \quad \text{CH}_2 - \text{CH}, \quad \text{cyclic (e.g. } \text{ } \text{CH}_3 \text{ )},
\]

or most preferably linear (e.g. \(-\text{CH}_2\text{CH}_{2}^-,\text{CH}_2\text{CH}_{2}\text{CH}_{2}^-,\text{CH}_2\text{CH}^-\))
alkylene, hydroalkylene, alkenylene, alkarylene or oxyalkylene. $R^1$ is preferably $C_2$-$C_6$ alkylene for the ethoxylated cationic diamines. Each $R^2$ is preferably methyl or the moiety $-L-X$; each $R^3$ is preferably $C_1$-$C_4$ alkyl or hydroxyalkyl, and most preferably methyl.

The positive charge of the $N^+$ groups is offset by the appropriate number of counter anions. Suitable counter anions include $Cl^-$, $Br^-$, $SO_3^{2-}$, $SO_4^{2-}$, $PO_4^{2-}$ or $MeOSO_3^-$. Particularly preferred counter anions are $Cl^-$ and $Br^-$. $X$ can be a nonionic group selected from hydrogen (H), $C_1$-$C_4$ alkyl or hydroxyalkyl ester or ether groups, or mixtures thereof. Preferred esters or ethers are the acetate ester and methyl ether, respectively. The particularly preferred nonionic groups are H and the methyl ether.

In the preceding formulas, hydrophilic chain $L$ usually consists entirely of the polyoxyalkylene moiety $-[(R^6O)_{m}(CH_2CH_2-O)_{n}]^-$. The moieties $-(R^6O)_{m}$ and $-(CH_2CH_2O)_{n}$ of the polyoxyalkylene moiety can be mixed together or preferably from blocks of $-(R^6O)_{m}$ & $-(CH_2CH_2O)_{n}$ moieties. $R^6$ is preferably $C_3H_6$ (propylene); $m$ is preferably from 0 to 5 and is most preferably 0, i.e. the polyoxyalkylene moiety consists entirely of the moiety $-(CH_2CH_2O)_{n}^-$. The moiety $-(CH_2CH_2O)_{n}$ - preferably comprises at least 85% by weight of the polyoxyalkylene moiety and most preferably 100% by weight ($m$ is 0).

Preferred ethoxylated diamines have the formula:

$$X-\left(OCH_2CH_2\right)_n{\bigl[}\ \begin{array}{c}
\text{CH}_3 \\
\text{N}^\text{+} \end{array}\text{-CH}_2-\text{CH}_2-\text{(CH}_2)_{\text{a}}\text{-}\end{array}\text{-(CH}_2\text{CH}_2\text{O})_{\text{n}}^\text{+X}}$$

$$(CH_2CH_2O)_{n}^-X \quad (CH_2CH_2O)_{n}^-X$$
wherein X and n are defined as before, a is from 0 to 4 (e.g. ethylene, propylene, hexamethylene)b is 1.
For preferred cationic diamines (b=1), n is at least 12 with a typical range of from 12 to 42.

In the preceding formula for the ethoxylated cationic polyamines, $R^4$ (linear, branched or cyclic) is preferably a substituted $C_3$-$C_6$ alkyl, hydroxyalkyl or aryl group; $A^1$ is preferably

$$
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N} \\
\text{H}
\end{array}
$$

n is preferably at least 12, with a typical range of from 12 to 42; p is preferably from 3 to 6. When $R^4$ is a substituted aryl or alkaryl group, q is preferably 1 and $R^5$ is preferably $C_2$-$C_3$ alkylene. When $R^4$ is a substituted alkyl, hydroxalkyl or alkenyl group, and when q is 0, $R^5$ is preferably a $C_2$-$C_3$ oxyalkylene moiety; when q is 1, $R^5$ is preferably $C_2$-$C_3$ alkyylene.

These ethoxylated cationic polyamines can be derived from polyamino amides such as:

$$
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{HO} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2
\end{array}
$$

or

$$
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{O} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2
\end{array}
$$

or

$$
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{O} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2 \\
\text{H} \\
\text{C} \\
\text{N}-(C_3H_6)-\text{NH}_2
\end{array}
$$

These ethoxylated cationic polyamines can also be derived from polyaminopropyleneoxide derivatives such as:
wherein each c is a number from 2 to 20.

The preferred water-soluble cationic polymers of the present invention comprise a polymer backbone, at least 2 $N^+$ groups at at least one L-X group, X is a nonionic group selected from the group consisting of H, C$_1$-C$_4$ alkyl or hydroxyalkyl ester or ether groups, and mixtures thereof; and L is a hydrophilic chain connecting groups $N^+$ and X or connecting X to the polymer backbone.

As used herein, the term "polymer backbone" refers to the polymeric moiety to which groups $N^+$ and L-X are attached to or integral with. Included within this term are oligomer backbones (2 to 4 units), and true polymer backbones (5 or more units).

As used herein, the term "attached to" means that the group is pendent from the polymer backbone, examples of which are represented by the following general structures A and B:

```
   N^+          N^+ L
   |             |    
   |             X  
   L           X
   \       /  
    X     L

A     B
```

As used herein, the term "integral with" means that the group forms part of the polymer backbone, examples of which are represented by the following general structures C and D:

```
   N^+          N^+ L
   |             |    
   |             X  
   L           X
   \       /  
    X     L

A     B
```
Any polymer backbone can be used as long as the cationic polymer formed is water-soluble and has clay soil removal/anti-redemption properties. Suitable polymer backbones can be derived from the polyurethanes, the polyesters, the polyethers, the polyethylenes, the polypropylenes, the polystyrenes, the polyalkyleneamines, the polyalkyleneimines, the polyvinylamines, the polyallylamines, the polydiallylamines, the polyvinylpyridines, the polyaminotriazoles, polyvinyl alcohol, the aminopolyureylenes and mixtures thereof.

The quaternary positively charged center can be represented by the following general structures E and F:

![Diagram](Image)

E       F

The cationic group is preferably positioned close to or integral with the polymer backbone.

The positive charge of the N⁺ centers is offset by the appropriate number of counter anions. Suitable counter anions include Cl⁻, Br⁻, SO₃⁻², SO₄⁻², PO₄⁻³ or MeOSO₃⁻. Particularly preferred counter anions are Cl⁻ and Br⁻.

X can be a nonionic group selected from hydrogen (H), C₁-C₄ alkyl or hydroxyalkyl ester or ether groups, and mixtures thereof. The preferred ester or ether groups are the acetate ester and methyl ether, respectively. The
particularly preferred nonionic groups are H and the methyl ether.

The cationic polymers of the present invention normally have a ratio of cationic groups $N^+$ to nonionic groups $X$ of from 1:1 to 1:2. However, for example, by appropriate copolymerization of cationic, nonionic (i.e. containing the group $L-X$) and mixed cationic/nonionic monomers, the ratio of cationic groups $N^+$ to nonionic groups $X$ can be varied. The ratio of groups $N^+$ to groups $X$ can usually range 2:1 to 1:10. In preferred cationic polymers, the ratio is from 1:1 to 1:5. The polymers formed from such copolymerization are typically random, i.e. the cationic, nonionic and mixed cationic/nonionic monomers copolymerize in a nonrepeating sequence.

The units which contain groups $N^+$ and groups $L-X$ can comprise 100% of the cationic polymers of the present invention. However, inclusion of other units (preferably nonionic) in the polymers is also permissible. Examples of other units include acrylamides, vinyl ethers and those containing unquaternized tertiary amine groups containing an N center. These other units can comprise from 0 to 90% of the polymer (from 10 to 100% of the polymer being units containing $N^+$ and $L-X$ groups. Normally, these other units comprise from 0 to about 50% of the polymer (from 50 to 100% of the polymer being units containing $N^+$ and $L-X$ groups). The cationic clay soil removal polymers according to the present invention should be understood as clay soil removal polymers where the nitrogen atoms are quaternized by more than 50%, preferably more than 70%, most preferably more than 80% of the total nitrogen atoms.

The number of groups $N^+$ and $L-X$ each usually ranges from 2 to 200. Typically, the number of groups $N^+$ and $L-X$ are each from 3 to 100. Preferably, the number of groups $N^+$ and $L-X$ are each from 3 to 40.
Other than moieties for connecting groups N⁺ and X, or for attachment to the polymer backbone, hydrophilic chain L usually consists entirely of the polyoxyalkylene moiety - [R'O]_m(CH₂CH₂O)_n -. The moieties -(R'O)_m- and -(CH₂CH₂O)_n- of the polyoxyalkylene moiety can be mixed together, or preferably from blocks of -(R'O)_m- and (CH₂CH₂O)_n- moieties. R' is preferably C₃H₆ (propylene); m is preferably from 0 to 5, and most preferably 0; i.e. the polyoxyalkylene moiety consists entirely of the moiety - (CH₂CH₂O)_n -. The moiety -(CH₂CH₂O)_n- preferably comprises at least 85% by weight of the polyoxyalkylene moiety, and most preferably 100% by weight (m is 0). For the moiety - (CH₂CH₂O)_n-, n is usually from 3 to 100. Preferably, n is from 12 to 42.

A plurality (2 or more) of moieties -L-X can also be hooked together and attached to group M or to the polymer backbone, examples of which are represented by the following general structures G and H:

```
  L   L
  |   |
 X   X
  
  G

  L   L
  |   |
 X   X
  
  H
```

Structures such as G and H can be formed, for example, by reacting glycidol with group M or with the polymer backbone, and ethoxylating the subsequently formed hydroxy groups.

Representative classes of cationic polymers of the present invention are as follows:
A. Polyurethane, polyester, polyether, polyamide

One class of suitable cationic polymers are derived from polyurethanes, polyesters, polyethers, polyamides. These polymers comprise units selected from those having formulas I, II and III:

![Chemical Structures I, II, III]

wherein $A^1$ is

\[
\begin{align*}
\text{\begin{array}{c}
\text{O} \\
\text{R}
\end{array}} & , \quad \begin{array}{c}
\text{O} \\
\text{R}
\end{array}, \\
\text{\begin{array}{c}
\text{O} \\
\text{C}
\end{array}} & , \quad \begin{array}{c}
\text{O} \\
\text{C}
\end{array}, \quad \begin{array}{c}
\text{O} \\
\text{C}
\end{array}, \quad \begin{array}{c}
\text{C}
\end{array}
\end{align*}
\]
x is 0 or 1; R is H or C_1-C_4 alkyl or hydroxyalkyl; R^1 is C_2-C_{12} alkylene, hydroxyalkylene, alkenylene, cycloalkylene, arylene or alkarylene, or a C_2-C_3 oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-O or O-N bonds are formed with A^1; when x is 1, R^2 is -R^5- except when

\[ \text{A}^1 \text{is } \begin{array}{c} \text{O} \\ \text{-} \end{array} \]

or is -(OR^8)_y- or -OR^5- provided that no O-O or N-O bonds are formed with A^1, and R^3 is -R^5- except when

\[ \text{A}^1 \text{is } \begin{array}{c} \text{O} \\ \text{-} \end{array} \]

or is -(R^8O)_y- or -R^{50}- provided that no O-O or O-N bonds are formed with A^1; when x is 0, R^2 is

\[ \begin{array}{c} \text{(OR^8)_y-} \\ \text{-OR^5-} \\ \text{OCOR^5-} \\ \text{OCR^5-} \\ \text{OCOR^5-} \\ \text{NCR^5-} \end{array} \]

\[ \begin{array}{c} \text{-NCOR^5-} \\ \text{CNR^5-} \text{ or } -\text{OCNR}^5- \end{array} \]

and R^3 is -R^5-; R^4 is C_1-C_4 alkyl or hydroxyalkyl, or the moiety -(R^5)_k-[(C_3H_6O)_m(CH_2CH_2O)_n]-X; R^5 is C_1-C_{12} alkylene, hydroxyalkylene, alkenylene, arylene, or alkarylene; each R^6 is C_1-C_4 alkyl or hydroxyalkyl, or the moiety -(CH_2)_r-A^2-(CH_2)_s-, wherein A^2 is -O- or -CH_2-; R^7 is H or R^4; R^8 is C_2-C_3 alkylene or hydroxyalkylene; X is H,

\[ \begin{array}{c} \text{O} \\ \text{CR^9} \end{array} \]

or a mixture thereof,
wherein $R^3$ is $C_1$-$C_4$ alkyl or hydroxyalkyl; $k$ is 0 or 1; $m$ and $n$ are numbers such that the moiety $-\text{(CH}_2\text{CH}_2\text{O})_n^-$ comprises at least 85% by weight of the moiety $-\text{[(C}_3\text{H}_6\text{O})_m\text{(CH}_2\text{CH}_2\text{O})_n^-]$; $m$ is from 0 to 5; $n$ is at least 3; $r$ is 1 or 2, $s$ is 1 or 2, and $r+s$ is 3 or 4; $y$ is from 2 to 20; the number of $u$, $v$ and $w$ are such that there are at least $2N^+$ centers and at least $2X$ groups.

In the above formulas, $A_1$ is preferably

$$\begin{array}{c}
\text{N} \\
R
\end{array} \quad \text{or} \quad \begin{array}{c}
\text{O} \\
R
\end{array}$$

$A^2$ is preferably $-\text{O}^-$; $x$ is preferably 1; and $R$ is preferably H. $R^1$ can be linear

\[\begin{array}{c}
\text{CH}_2 \cdots \text{CH}_2 \\
\text{CH}_2 \cdots \text{CH}_2
\end{array}\] or branched

\[\begin{array}{c}
\text{CH}_2 \\
\text{CH}_2
\end{array}\]

alkylene, hydroxyalkylene, alkenylene, cycloalkylene, alkarylene or oxyalkylene; when $R^1$ is a $C_2$-$C_3$ oxyalkylene moiety, the number of oxyalkylene units is preferably from 2 to 12; $R^1$ is preferably $C_2$-$C_6$ alkyne or phenylene, and most preferably $C_2$-$C_6$ alkylene (e.g. ethylene, propylene, hexamethylene). $R^2$ is preferably $-\text{OR}^5$- or $-(\text{OR}^8)^-$; $R^3$ is preferably $-\text{R}^5\text{O}^-$ or $(\text{R}^8\text{O})_y^-; R^4$ and $R^6$ are preferably methyl. Like $R^1$, $R^5$ can be linear or branched, and is preferably $C_2$-$C_3$ alkylene; $R^7$ is preferably H or $C_1$-$C_3$ alkyl; $R^8$ is preferably ethylene; $R^9$ is preferably methyl; $X$ is preferably H or methyl; $k$ is preferably 0; $m$ is preferably 0; $r$ and $s$ are each preferably 2; $y$ is preferably from 2 to 12.
In the above formulas, n is preferably at least 6 when the number of N⁺ centers and X groups is 2 or 3; n is most preferably at least 12, with a typical range of from 12 to 42 for all ranges of u + v + w. For homopolymers (v and w are 0), u is preferably from 3 to 40, and is most preferably from 3 to 20. For random copolymers (u is at least 1 or preferably 0), v and w are each preferably from 3 to 40.

B. Polyacrylate, polyacrylamide, polyvinylether

Another class of suitable cationic polymers are derived from polyacrylates, polyacrylamides or polyvinylethers. These polymers comprise units selected from those having formulas IV, V and VI:

```
[\begin{array}{c}
R^1 \\
\vdots \\
R^1 \\
\end{array}]
```

\begin{align*}
\text{u} & \quad \text{N}^+ \quad \underbrace{\underbrace{\underbrace{(R^2_k)}_{m} (CH_2CH_2O)}_{n}}_{X} \\
\end{align*}

```
[\begin{array}{c}
R^1 \\
\vdots \\
R^1 \\
\end{array}]
```

\begin{align*}
\text{v} & \quad \text{N}^+ \quad \underbrace{\underbrace{\underbrace{(R^2_k)}_{m} (CH_2CH_2O)}_{n}}_{X} \\
\end{align*}

```
[\begin{array}{c}
R^1 \\
\vdots \\
R^1 \\
\end{array}]
```

\begin{align*}
\text{w} & \quad \text{N}^+ \quad \underbrace{\underbrace{\underbrace{(R^2_k)}_{m} (CH_2CH_2O)}_{n}}_{X} \\
\end{align*}

wherein A1 is
hydroxyalkyl; \( R^1 \) is substituted \( C_2-C_{12} \) alkylene, hydroxyalkylene, alkenylene, arylene or alkarylene, or \( C_2-C_3 \) oxyalkylene; each \( R^2 \) is \( C_1-C_{12} \) alkylene, hydroxyalkylene, alkenylene, arylene or alkarylene; each \( R^3 \) is \( C_1-C_4 \) alkyl or hydroxyalkyl, the moiety \(-(R^2)_{k-1}(C_2H_6O)_{m}(CH_2CH_2O)_n-X, \) or together form the moiety \(-(CH_2)_r-A^{2-}(CH_2)_s^-\), wherein \( A^2 \) is \(-O-\) or \(-CH_2-\); each \( R^4 \) is \( C_1-C_4 \) alkyl or hydroxyalkyl, or two \( R^4 \) together form the moiety \(-(CH_2)_r-A^{2-}(CH_2)_s^-\); \( X \) is \( H, \)
\[ -R^5, \]
\[ -CR^5, \]
-\( R^5 \) or mixture thereof, wherein \( R^5 \) is \( C_1-C_4 \) alkyl or hydroxyalkyl; \( j \) is 1 or 0; \( k \) is 1 or 0; \( m \) and \( n \) are numbers such that the moiety \(-(CH_2CH_2O)_n^-\) comprises at least 85% by weight of the moiety \-(\{C_3H_6O\}_m(CH_2CH_2O)_{n-})^-\); \( m \) is from 0 to 5; \( n \) is at least 3; \( r \) is 1 or 2, \( s \) is 1 or 2 and \( r+s \) is 3 or 4; the number of \( u, v \) and \( w \) are such that there are at least \( 2N+ \) centers and at least \( 2X \) groups.

In the above formulas, \( A1 \) is preferably
\[ -O-, \]
\[ -C=O, \]
\[ -NC=O- \]
$A^2$ is preferably $-O-$; $R$ is preferably $H$. $R_1$ can be linear, e.g.

\[
\text{CH}_2\text{CHCH}_2, \quad \text{CH}_2\text{CHCH}_2
\]
or branched (e.g.

\[
\text{CH}_3\text{CHCH}_2, \quad \text{CH}_2\text{CHCH}_2, \quad \text{CH}_2\text{CHCH}_2, \quad \text{CH}_2\text{CHCH}_2
\]

substituted alkylenes, hydroxyalkylene, alkenylene, alkarylene or oxyalkylene; $R_1$ is preferably substituted C$_2$-C$_6$ alkylenes or substituted C$_2$-C$_3$ oxyalkylene, and most preferably

\[
\text{CH}_2\text{CHCH}_2, \quad \text{CH}_2\text{CHCH}_2
\]

Each $R_2$ is preferably C$_2$-C$_3$ alkylenes; each $R_3$ and $R_4$ are preferably methyl; $R_5$ is preferably methyl; $X$ is preferably $H$ or methyl; $j$ is preferably 1; $k$ is preferably 0; $m$ is preferably 0; $r$ and $s$ are each preferably 2.

In the above formulas, $n$, $u$, $v$ and $w$ can be varied according to the $n$, $u$, $v$ and $w$ for the polyurethane.

C. **Polyalkyleneamine, polyalkyleneimine**

Another class of suitable cationic polymers are derived from polyalkyleneamines or polyalkyleneimines. These polymers comprise units selected from those having formulas VII and VIII and IX:
wherein R\(^1\) is C\(_2\)-C\(_{12}\) alkylene, hydroxyalkylene, alkenylene, cycloalkylene, arylene or alkarylene, or a C\(_2\)-C\(_3\) oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-N bonds are formed; each R\(^2\) is C\(_1\)-C\(_4\) alkyl or hydroxyalkyl, or the moiety -(R\(^3\))\(_k\)-(C\(_3\)H\(_6\)O\(_m\))(CH\(_2\)CH\(_2\)O\(_n\))\(_X\); R\(^3\) is C\(_1\)-C\(_{12}\) alkylene, hydroxyalkylene, alkenylene, arylene or alkarylene; X is H

-\(CR^4\),

\(\|

0

\)

-R\(^4\) or mixture thereof, wherein R\(^4\) is C\(_1\)-C\(_4\) alkyl or hydroxyalkyl; k is 1 or 0; m and n are numbers such that the moiety -(CH\(_2\)CH\(_2\)O\(_n\))\(^-\) comprises at least 85% by weight of the moiety -[(C\(_3\)H\(_6\)O\(_m\))(CH\(_2\)CH\(_2\)O\(_n\))]\(^-\); m is from 0 to 5; n is at least 3; the number of x, y and z are such that there are at least 2N+ groups and at least 2X groups.

In the above formulas, R\(^1\) can be varied like R\(^1\) of the polyurethane; each R\(^2\) is preferably methyl or the moiety -(R\(^3\))\(_k\)-(C\(_3\)H\(_6\)O\(_m\))(CH\(_2\)CH\(_2\)O\(_n\))\(_X\); R\(^3\) is preferably C\(_2\)-C\(_3\) alkylene; R\(^4\) is preferably methyl; X is preferably H; k is preferably 0; m is preferably 0.
In the above formulas, \( n \) is preferably at least 6 when the number of \( N^+ \) and \( X \) groups is 2 or 3; \( n \) is most preferably at least 12 with a typical range of from 12 to 42 for all ranges of \( x+y+z \). Typically, \( x+y+z \) can range from 2 to 9 with from 2 to 9 \( N^+ \) centers and from 2 to 11 \( X \) groups. For long chain length polymers, \( x+y+z \) is at least 10, with a preferred range of from 10 to 42.

Preferred cationic polymers within this class are derived from the \( C_2-C_3 \) polyalkyleneamines (\( x+y+z \) is from 2 to 9) and polyalkyleneimines (\( x+y+z \) is at least 10, preferably from 10 to 42). Particularly preferred cationic polyalkyleneamines and polyalkyleneimines are the cationic polyethyleneamines (PEAs) and polyethyleneimines (PEIs). These preferred cationic polymers comprise units having the general formula:

\[
\begin{align*}
\left( R_2 \right)^2 & \quad \left[ N^+ \right]_a \quad \left[ \left( CH_2 - CH_2 N \right) \right]_x \quad \left[ \left( CH_2 CH_2 N \right) \right]_y \quad \left[ \left( CH_2 CH_2 N \right)^+ \right]_z \\
& \quad \left[ \left( CH_2 CH_2 O \right) - X \right]_{n_2} \quad \left( CH_2 CH_2 O \right) - X \quad \left[ \left( CH_2 CH_2 O \right) - X \right]_{n_2}
\end{align*}
\]

wherein \( R_2 \) (preferably methyl), \( X \), \( x \), \( y \), \( z \) and \( n \) are defined as before; \( a \) is 1 or 0.

Prior to ethoxylation, the PEAs used in preparing cationic polymers of the present invention have the following general formula:

\[
\begin{align*}
\left[ H_2 N \right] &\quad - \left[ CH_2 CH_2 N \right] \quad - \left[ CH_2 CH_2 N \right] \quad - \left[ CH_2 CH_2 NH_2 \right] \\
&\quad \left[ H \right]
\end{align*}
\]
wherein \( x+y+z \) is from 2 to 9, and \( a \) is 0 or 1 (molecular weight of from 100 to 400). Each hydrogen atom attached to each nitrogen atom represents an active site for subsequent ethoxylation. For preferred PEAs, \( x+y+z \) is from 3 to 7 (molecular weight of from 140 to 310). These PEAs can be obtained by reactions involving ammonia and ethylene dichloride, followed by fractional distillation. The common PEAs obtained are triethylenetetramine (TETA) and tetraethylenepentamine (TEPA). Above the pentamines, i.e. the hexamines, heptamines, octamines and possibly nonamines, the cogenerically derived mixture does not appear to separate by distillation and can include other materials such as cyclic amines and particularly piperazines. There can also be present cyclic amines with side chains in which nitrogen atoms appear. See US Patent 2,792,372 to Dickson, issued May 14, 1957, which describes the preparation of PEAs.

The minimum degree of ethoxylation required for preferred clay soil removal/anti-redeposition performance can vary depending upon the number of units in the PEA. Where \( y+z \) is 2 or 3, \( n \) is preferably at least 6. Where \( y+z \) is from 4 to 9, suitable benefits are achieved when \( n \) is at least 3. For preferred cationic PEAs, \( n \) is at least 12, with a typical range of from 12 to 42.

The PEIs used in preparing the polymers of the present invention have a molecular weight of at least 440 prior to ethoxylation, which represents at least 10 units. Preferred PEIs used in preparing these polymers have a molecular weight of from 600 to 1800. The polymer backbone of these PEIs can be represented by the general formula:

\[
\begin{align*}
    \text{H} & \\
    \text{H}_2\text{N} & -[-\text{CH}_2\text{CH}_2\text{N}^-]_x -[-\text{CH}_2\text{CH}_2\text{N}^-]_y -[-\text{CH}_2\text{CH}_2\text{NH}_2]_z \\
\end{align*}
\]

wherein the sum of \( x, y \) and \( z \) represents a number of sufficient magnitude to yield a polymer having the molecular weight previously specified. Although linear
polymer backbones are possible, branch chains can also occur. The relative proportions of primary, secondary and tertiary amine groups present in the polymer can vary, depending on the manner of preparation. The distribution of amine groups is typically as follows:

-CH₂CH₂-NH₂  30%
-CH₂CH₂-NH-  40%
-CH₂CH₂-N-   30%

Each hydrogen atom attached to each nitrogen atom of the PEI represents an active site for subsequent ethoxylation. These PEIs can be prepared, for example, by polymerizing ethylenimine in the presence of a catalyst such as carbon dioxide, sodium bisulfite, sulfuric acid, hydrogen peroxide, hydrochloric acid, acetic acid, etc. Specific methods for preparing PEIs are disclosed in U.S. Patent 2,182,306 to Ulrich et al., issued December 5, 1939; U.S. Patent 3,033,746 to Mayle et al., issued May 8, 1962; U.S. Patent 2,208,095 to Esselmann et al., issued July 16, 1949; U.S. Patent 2,806,839 to Crowther, issued September 17, 1957; and U.S. Patent 2,553,696 to Wilson, issued May 21, 1951.

As defined in the preceding formulas, n is at least 3 for the cationic PEIs. However, it should be noted that the minimum degree of ethoxylation required for suitable clay soil removal/anti-redeposition performance can increase as the molecular weight of the PEI increases, especially much beyond 1800. Also, the degree of ethoxylation for preferred polymers increases as the molecular weight of the PEI increases. For PEIs having a molecular weight of at least 1800, n is preferably at least 24, with a typical range of from 24 to 42.
D. Diallylamine polymers

Another class of suitable cationic polymers are those derived from the diallylamines. These polymers comprise units selected from those having formulas X and XI:

\[
\begin{align*}
\text{XI} & \\
\text{X} & \\
\end{align*}
\]

wherein R1 is C1-C4 alkyl or hydroxyalkyl, or the moiety - (R2)k-[(CH3H60)m(CH2CH20)n]-X; R2 is C1-C12 alkylene, hydroxylalkylene, alkylene, arylene or alkarylene; each R3 is C1-C4 alkyl or hydroxyalkyl, or together form the moiety -(CH2)r-A-(CH2)s-, wherein A is -O- or -CH2-; X is H, -CR4, -R4 or mixture thereof, wherein R4 is C1-C4 alkyl or hydroxyalkyl; k is 1 or 0; m and n are numbers such that the moiety -(CH2CH20)n- comprises at least 85% by weight of the moiety [(CH3H60)m(CH2CH20)n]-; m is from 0 to 5; n is at least 3; r is 1 or 2, s is 1 or 2, and r+s is 3 or 4; x is 1 or 0; y is 1 when x is 0 and 0 when x is 1; the number of
u and v are such that there are at least 2N+ centers and at least 2X groups.

In the above formulas, A is preferably -O--; R1 is preferably methyl; each R2 is preferably C2-C3 alkylene; each R3 is preferably methyl; R4 is preferably methyl; X is preferably H; k is preferably 0; m is preferably 0; r and s are each preferably 2.

In the above formulas, n is preferably at least 6 when the number of N+ centers and X groups are each 2 or 3, n is preferably at least 12, with a typical range of from 12 to 42 for all ranges of u + v. Typically, v is 0, and u is from 2 to 40, and preferably from 2 to 20.

The nonaqueous detergent compositions of this invention may further comprise a surfactant- and low-polarity solvent-containing liquid gel phase having dispersed therein bleaching agent and a bleach activator salt. The components of the liquid and solid phases of the detergent compositions herein, as well as composition form, preparation and use, are described in greater detail as follows: All concentrations and ratios are on a weight basis unless otherwise specified.

**Bleaching agents and bleach activators**

The bleaching agents used herein can be any of the bleaching agents useful for detergent or bleaching compositions in textile cleaning, hard surface cleaning, or other cleaning purposes that are now known or become known, and are useful for bleaching compositions as used in the present invention to treat fabrics. These include oxygen bleaches as well as other bleaching agents. Perborate bleaches, e.g., sodium perborate (e.g., mono- or tetra-hydrate) can be used herein.

Peroxylene bleaching agents are preferably used in the compositions. Suitable peroxylene bleaching compounds include perborate, sodium carbonate peroxyhydrate and
equivalent "percarbonate" bleaches, sodium pyrophosphate peroxypolyhydrate, urea peroxypolyhydrate, and sodium peroxide. Persulfate bleach (e.g., OXONE, manufactured commercially by DuPont) can also be used.

The bleach activators according to the present invention are present as a divalent and/or trivalent metal salt. The bleach activator salt can be added as a powder dispersed in the non-aqueous base. The bleach activator salt can also be premixed with a liquid non-aqueous ingredient such as a nonionic surfactant, organic solvent and/or mixtures thereof. The bleach activator salts can be obtained by any method known to prepare divalent metal salts of anionic surface active solutions.

The bleach activator salts of the present invention can comprise mixed salts whereby at least one of the salts is a divalent or trivalent salt. The mixed salts are obtained by cocrystallization of the bleach activator salts. Examples of these salts are Na₃Mg 4-sulfophenyl 6-(1-oxononylamino) hexanoate.

Preferred salts according to the present invention are Ca, Mg and Al salts. Highly preferred are Ca and Mg salts or mixtures thereof.

The bleach activators suitable for the present invention are the anionic bleaching activators described in the literature, such as in the GB Patents 836,988; 864,798; 907,356; 1,003,310 and 1,519,351; German Patent 3,337,921; EP-A-0185522; EP-A-0174132; EP-A-0120591; and U.S. Pat. Nos. 1,246,339; 3,332,882; 4,128,494; 4,412,934 and 4,675,393.

Bleach activators also useful in the present invention are amide substituted compounds of the general formulas:

\[
R^1-\text{C-N-R}^2-\text{C-L},
R^1-\text{N-C-R}^2-\text{C-L}
\]

or mixtures thereof, wherein \( R^1 \) is an alkyl, aryl, or alkaryl group containing from about 1 to about 14 carbon atoms, \( R^2 \) is an alkylene, arylene or alkarylene group containing from about 1 to about 14 carbon atoms, \( R^5 \) is \( H \) or an alkyl, aryl, or alkaryl group containing from about 1 to about 10 carbon atoms, and \( L \) can be essentially any suitable leaving group. A leaving group is any group that is displaced from the bleaching activator as a consequence of the nucleophilic attack on the bleach activator by the perhydroxide anion. This, the perhydrolysis reaction, results in the formation of the peroxycarboxylic acid. Generally, for a group to be a suitable leaving group it must exert an electron attracting effect. It should also form a stable entity so that the rate of the back reaction is negligible. This facilitates the nucleophilic attack by the perhydroxide anion.

The \( L \) group must be sufficiently reactive for the reaction to occur within the optimum time frame (e.g., a wash cycle). However, if \( L \) is too reactive, this activator will be difficult to stabilize for use in a bleaching composition. These characteristics are generally paralleled by the pKa of the conjugate acid of the leaving group, although exceptions to this convention are known. Ordinarily, leaving groups that exhibit such behavior are those in which their conjugate acid has a pKa in the range of from about 4 to about 13, preferably from about 6 to about 11 and most preferably from about 8 to about 11.

Preferred bleach activators are those of the above general formula wherein \( R^1 \), \( R^2 \) and \( R^5 \) are as defined for
the peroxycacid and L is selected from the group consisting of:

\[
\begin{align*}
&\text{and} \\
&\text{and}
\end{align*}
\]

and mixtures thereof, wherein \( R^1 \) is an alkyl, aryl, or alkaryl group containing from about 1 to about 14 carbon atoms, \( R^3 \) is an alkyl chain containing from 1 to about 8 carbon atoms, \( R^4 \) is H or \( R^3 \), and \( Y \) is a solubilizing anionic group.

The solubilizing groups are \(-\text{SO}_3^-\text{M}^+\), \(-\text{CO}_2^-\text{M}^+\), \(-\text{SO}_4^-\text{M}^+\), and most preferably \(-\text{SO}_3^-\text{M}^+\) and \(-\text{CO}_2^-\text{M}^+\) wherein \( R^3 \) is an alkyl chain containing from about 1 to about 4 carbon atoms, \( M \) is a divalent/trivalent metal ion.
Preferred anionic bleach activators are those of the above general formula wherein \( L \) is selected from the group consisting of:

\[
\begin{align*}
\text{Y} & \quad \text{R}^3
\end{align*}
\]

wherein \( R^3 \) is as defined above and \( Y \) is \(-\text{SO}_3^-\text{M}^+\) or \(-\text{CO}_2^-\text{M}^+\) wherein \( M \) is as defined above.

Preferred examples of bleach activators of the above formulae include 4-\([N\text{-octanoyl}-6\text{-aminohexanoyloxy}]\) benzene sulfonate, 4-\([N\text{-nonanoyl}-6\text{-aminohexanoyloxy}]\) benzene sulfonate, 4-\([N\text{-decanoyl}-6\text{-aminohexanoyloxy}]\) benzene sulfonate and mixtures thereof. Said activators are described in US 4,634,551 and US 4,852,989.

Another important class of anionic bleach activators provide organic peracids as described herein by ring-opening as a consequence of the nucleophilic attack on the carbonyl carbon of the cyclic ring by the perhydroxide anion. For instance, this ring-opening reaction in certain activators involves attack at the lactam ring carbonyl by hydrogen peroxide or its anion. Since attack of an acyl lactam by hydrogen peroxide or its anion occurs preferably at the exocyclic carbonyl, obtaining a significant fraction of ring-opening may require a catalyst. Another example of ring-opening bleach activators can be found in other activators, such as those disclosed in U.S. Patent 4,966,723, Hodge et al, issued Oct. 30, 1990.

In addition, it has been found that bleach activators, when agglomerated with certain acid such as citric acid, are more chemically stable.
Surfactant

The amount of the surfactant mixture component of the detergent compositions herein can vary depending upon the nature and amount of other composition components and depending upon the desired rheological properties of the ultimately formed composition. Generally, this surfactant mixture will be used in an amount comprising from about 10% to 90% by weight of the composition. More preferably, the surfactant mixture will comprise from about 15% to 50% by weight of the composition.

A typical listing of anionic, nonionic, ampholytic and zwitterionic classes, and species of these surfactants, is given in US Patent 3,664,961 issued to Norris on May 23, 1972.

Preferred anionic surfactants include the alkyl sulfate surfactants hereof are water soluble salts or acids of the formula ROSO₃M wherein R preferably is a C₁₀₋C₂₄ hydrocarbyl, preferably an alkyl or hydroxyalkyl having a C₁₀₋C₁₈ alkyl component, more preferably a C₁₂₋C₁₅ alkyl or hydroxyalkyl, and M is H or a cation, e.g., an alkali metal cation (e.g. sodium, potassium, lithium), or ammonium or substituted ammonium (quaternary ammonium cations such as tetramethyl-ammonium and dimethyl piperidinium cations).

Highly preferred anionic surfactants include alkyl alkoxylated sulfate surfactants hereof are water soluble salts or acids of the formula RO(A)ₘSO₃M wherein R is an unsubstituted C₁₀₋C₂₄ alkyl or hydroxyalkyl group having a C₁₀₋C₂₄ alkyl component, preferably a C₁₂₋C₁₈ alkyl or hydroxyalkyl, more preferably C₁₂₋C₁₅ alkyl or hydroxyalkyl, A is an ethoxy or propoxy unit, m is greater than zero, typically between about 0.5 and about 6, more preferably between about 0.5 and about 3, and M is H or a cation which can be, for example, a metal cation (e.g., sodium, potassium, lithium, calcium, magnesium, etc.), ammonium or substituted-ammonium cation. Alkyl ethoxylated
sulfates as well as alkyl propoxylated sulfates are contemplated herein. Specific examples of substituted ammonium cations include quaternary ammonium cations such as tetramethyl-ammonium and dimethyl piperidinium cations. Exemplary surfactants are C₁₂-C₁₅ alkyl polyethoxylate (1.0) sulfate (C₁₂-C₁₅E(1.0)M), C₁₂-C₁₅ alkyl polyethoxylate (2.25) sulfate (C₁₂-C₁₅E(2.25)M), C₁₂-C₁₅ alkyl polyethoxylate (3.0) sulfate (C₁₂-C₁₅E(3.0)M), and C₁₂-C₁₅ alkyl polyethoxylate (4.0) sulfate (C₁₂-C₁₅E(4.0)M), wherein M is conveniently selected from sodium and potassium.

Other suitable anionic surfactants to be used are alkyl ester sulfonate surfactants including linear esters of C₈-C₂₀ carboxylic acids (i.e., fatty acids) which are sulfonated with gaseous SO₃ according to "The Journal of the American Oil Chemists Society", 52 (1975), pp. 323-329. Suitable starting materials would include natural fatty substances as derived from tallow, palm oil, etc.

The preferred alkyl ester sulfonate surfactant, especially for laundry applications, comprise alkyl ester sulfonate surfactants of the structural formula:

\[
\begin{align*}
&\text{O} \\
&\text{||} \\
&\text{R}^3 - \text{CH - C - OR}^4 \\
&\text{||} \\
&\text{SO}_3\text{M}
\end{align*}
\]

wherein R³ is a C₈-C₂₀ hydrocarbyl, preferably an alkyl, or combination thereof, R⁴ is a C₁-C₆ hydrocarbyl, preferably an alkyl, or combination thereof, and M is a cation which forms a water soluble salt with the alkyl ester sulfonate. Suitable salt-forming cations include metals such as sodium, potassium, and lithium, and substituted or unsubstituted ammonium cations. Preferably, R³ is C₁₀-C₁₆ alkyl, and R⁴ is methyl, ethyl or isopropyl. Especially preferred are the methyl ester sulfonates wherein R³ is C₁₀-C₁₆ alkyl.
Other anionic surfactants useful for detergent purposes can also be included in the laundry detergent compositions of the present invention. These can include salts (including, for example, sodium, potassium, ammonium, and substituted ammonium salts such as mono-, di- and triethanolamine salts) of soap, C₉-C₂₀ linear alkylbenzenesulfonates, C₈-C₂₂ primary of secondary alkanesulfonates, C₈-C₂₄ olefin sulfonates, sulfonated polycarboxylic acids prepared by sulfonation of the pyrolyzed product of alkaline earth metal citrates, e.g., as described in British patent specification No. 1,082,179, C₈-C₂₄ alkylpolyglycolylethersulfates (containing up to 10 moles of ethylene oxide); alkyl glycerol sulfonates, fatty acyl glycerol sulfonates, fatty oleyl glycerol sulfates, alkyl phenol ethylene oxide ether sulfates, paraffin sulfonates, alkyl phosphates, isethionates such as the acyl isethionates, N-acyl taurates, alkyl succinamates and sulfosuccinates, monoesters of sulfosuccinates (especially saturated and unsaturated C₁₂-C₁₈ monoesters) and diesters of sulfosuccinates (especially saturated and unsaturated C₆-C₁₂ diesters), sulfates of alkylpolysaccharides such as the sulfates of alkylpolyglucoside (the nonionic nonsulfated compounds being described below), and alkyl polyethoxy carboxylates such as those of the formula RO(CH₂CH₂O)ₓ-CH₂COO-M⁺ wherein R is a C₈-C₂₂ alkyl, ᵐ is an integer from 1 to 10, and M is a soluble salt-forming cation. Resin acids and hydrogenated resin acids are also suitable, such as rosin, hydrogenated rosin, and resin acids and hydrogenated resin acids present in or derived from tall oil. Further examples are described in "Surface Active Agents and Detergents" (Vol. I and II by Schwartz, Perry and Berch). A variety of such surfactants are also generally disclosed in U.S. Patent 3,929,678, issued December 30, 1975 to Laughlin, et al. at Column 23, line 58 through Column 29, line 23 (herein incorporated by reference).
When included therein, the detergent compositions of the present invention typically comprise from about 1% to about 40%, preferably from about 5% to about 25% by weight of such anionic surfactants.

One class of nonionic surfactants useful in the present invention are condensates of ethylene oxide with a hydrophobic moiety to provide a surfactant having an average hydrophilic-lipophilic balance (HLB) in the range from 8 to 17, preferably from 9.5 to 14, more preferably from 12 to 14. The hydrophobic (lipophilic) moiety may be aliphatic or aromatic in nature and the length of the polyoxyethylene group which is condensed with any particular hydrophobic group can be readily adjusted to yield a water-soluble compound having the desired degree of balance between hydrophilic and hydrophobic elements.

Especially preferred nonionic surfactants of this type are the C₉-C₁₅ primary alcohol ethoxylates containing 3-12 moles of ethylene oxide per mole of alcohol, particularly the C₁₂-C₁₅ primary alcohols containing 5-8 moles of ethylene oxide per mole of alcohol.

Another class of nonionic surfactants comprises alkyl polyglucoside compounds of general formula

$$RO\left(C_{n}H_{2n}O\right)_{t}Z_{x}$$

wherein Z is a moiety derived from glucose; R is a saturated hydrophobic alkyl group that contains from 12 to 18 carbon atoms; t is from 0 to 10 and n is 2 or 3; x is from 1.3 to 4, the compounds including less than 10% unreacted fatty alcohol and less than 50% short chain alkyl polyglucosides. Compounds of this type and their use in detergent are disclosed in EP-B 0 070 077, 0 075 996 and 0 094 118.
Also suitable as nonionic surfactants are poly hydroxy fatty acid amide surfactants of the formula
\[
R^2 - C - N - Z,
\]
\[
\| \quad \| \quad \quad 0 \quad R^1
\]

wherein \( R^1 \) is H, or \( R^1 \) is \( C_{1-4} \) hydrocarbyl, 2-hydroxy ethyl, 2-hydroxy propyl or a mixture thereof, \( R^2 \) is \( C_{5-31} \) hydrocarbyl, and Z is a polyhydroxyhydrocarbyl having a linear hydrocarbyl chain with at least 3 hydroxyls directly connected to the chain, or an alkoxylated derivative thereof. Preferably, \( R^1 \) is methyl, \( R^2 \) is a straight \( C_{11-15} \) alkyl or alkenyl chain such as coconut alkyl or mixtures thereof, and Z is derived from a reducing sugar such as glucose, fructose, maltose, lactose, in a reductive amination reaction.

**Nonaqueous Liquid Diluent**

To form the liquid gel of paste phase of the detergent compositions, the hereinbefore described surfactant (mixture) may be combined with a nonaqueous liquid diluent such as a liquid alcohol alkoxylate material or a nonaqueous, low-polarity organic solvent.

**Alcohol Alkoxylates**

One component of the liquid diluent suitable to form the compositions herein comprises an alkoxylated fatty alcohol material. Such materials are themselves also nonionic surfactants. Such materials correspond to the general formula:

\[
R^1(C_{mH_{2mO}})_nOH
\]

wherein \( R^1 \) is a \( C_8 - C_{16} \) alkyl group, \( m \) is from 2 to 4, and \( n \) ranges from about 2 to 12. Preferably \( R^1 \) is an alkyl
group, which may be primary or secondary, that contains from about 9 to 15 carbon atoms, more preferably from about 10 to 14 carbon atoms. Preferably also the alkoxylated fatty alcohols will be ethoxylated materials that contain from about 2 to 12 ethylene oxide moieties per molecule, more preferably from about 3 to 10 ethylene oxide moieties per molecule.

The alkoxylated fatty alcohol component of the liquid diluent will frequently have a hydrophilic-lipophilic balance (HLB) which ranges from about 3 to 17. More preferably, the HLB of this material will range from about 6 to 15, most preferably from about 8 to 15.

Examples of fatty alcohol alkoxylates useful as one of the essential components of the nonaqueous liquid diluent in the compositions herein will include those which are made from alcohols of 12 to 15 carbon atoms and which contain about 7 moles of ethylene oxide. Such materials have been commercially marketed under the trade names Neodol 25-7 and Neodol 23-6.5 by Shell Chemical Company. Other useful Neodols include Neodol 1-5, an ethoxylated fatty alcohol averaging 11 carbon atoms in its alkyl chain with about 5 moles of ethylene oxide; Neodol 23-9, an ethoxylated primary C_{12} - C_{13} alcohol having about 9 moles of ethylene oxide and Neodol 91-10, an ethoxylated C_9 - C_{11} primary alcohol having about 10 moles of ethylene oxide. Alcohol ethoxylates of this type have also been marketed by Shell Chemical Company under the Dobanol tradename. Dobanol 91-5 is an ethoxylated C_9-C_{11} fatty alcohol with an average of 5 moles ethylene oxide and Dobanol 25-7 is an ethoxylated C_{12}-C_{15} fatty alcohol with an average of 7 moles of ethylene oxide per mole of fatty alcohol.

Other examples of suitable ethoxylated alcohols include Tergitol 15-S-7 and Tergitol 15-S-9 both of which are linear secondary alcohol ethoxylates that have been commercially marketed by Union Carbide Corporation. The former is a mixed ethoxylation product of C_{11} to C_{15} linear secondary alkanol with 7 moles of ethylene oxide and the
latter is a similar product but with 9 moles of ethylene oxide being reacted.

Other types of alcohol ethoxylates useful in the present compositions are higher molecular weight nonionics, such as Neodol 45-11, which are similar ethylene oxide condensation products of higher fatty alcohols, with the higher fatty alcohol being of 14-15 carbon atoms and the number of ethylene oxide groups per mole being about 14. Such products have also been commercially marketed by Shell Chemical Company.

The alcohol alkoxylate component when utilized as part of the liquid diluent in the nonaqueous compositions herein will generally be present to the extent of from about 1% to 60% by weight of the composition. More preferably, the alcohol alkoxylate component will comprise about 5% to 40% by weight of the compositions herein. Most preferably, the alcohol alkoxylate component will comprise from about 10% to 25% by weight of the detergent compositions herein.

Nonaqueous Low-Polarity Organic Solvent

Another component of the liquid diluent which may form part of the detergent compositions herein comprises nonaqueous, low-polarity organic solvent(s). The term "solvent" is used herein to connote the non-surface active carrier or diluent portion of the liquid phase of the composition. While some of the essential and/or optional components of the compositions herein may actually dissolve in the "solvent"-containing phase, other components will be present as particulate material dispersed within the "solvent"-containing phase. Thus the term "solvent" is not meant to require that the solvent material be capable of actually dissolving all of the detergent composition components added thereto.

The nonaqueous organic materials which are employed as solvents herein are those which are liquids of low polarity. For purposes of this invention, "low-polarity"
liquids are those which have little, if any, tendency to
dissolve one of the preferred types of particulate material
used in the compositions herein, i.e., the peroxxygen
bleaching agents, sodium perborate or sodium percarbonate.
Thus relatively polar solvents such as ethanol should not
be utilized. Suitable types of low-polarity solvents
useful in the nonaqueous liquid detergent compositions
herein do include alkylene glycol mono lower alkyl ethers,
lower molecular weight polyethylene glycols, lower
molecular weight methyl esters and amides, and the like.

A preferred type of nonaqueous, low-polarity solvent
for use herein comprises the mono-, di-, tri-, or tetra-
C₂-C₃ alkylene glycol mono C₂-C₆ alkyl ethers. The specific
eamples of such compounds include diethylene glycol
monobutyl ether, tetraethylene glycol monobutyl ether,
dipropylene glycol monoethyl ether, and dipropylene glycol
monobutyl ether. Diethylene glycol monobutyl ether and
dipropylene glycol monobutyl ether are especially
preferred. Compounds of the type have been commercially
marketed under the tradenames Dowanol, Carbitol, and
Cellosolve.

Another preferred type of nonaqueous, low-polarity
organic solvent useful herein comprises the lower molecular
weight polyethylene glycols (PEGs). Such materials are
those having molecular weights of at least about 150. PEGs
of molecular weight ranging from about 200 to 600 are most
preferred.

Yet another preferred type of non-polar, nonaqueous
solvent comprises lower molecular weight methyl esters.
Such materials are those of the general formula: R¹-C(O)-
OCH₃ wherein R¹ ranges from 1 to about 18. Examples of
suitable lower molecular weight methyl esters include
methyl acetate, methyl propionate, methyl octanoate, and
methyl dodecanoate.

The nonaqueous, low-polarity organic solvent(s)
employed should, of course, be compatible and non-reactive
with other composition components, e.g., bleach and/or
activators, used in the liquid detergent compositions herein. Such a solvent component will generally be utilized in an amount of from about 1% to 60% by weight of the composition. More preferably, the nonaqueous, low-polarity organic solvent will comprise from about 5% to 40% by weight of the composition, most preferably from about 10% to 25% by weight of the composition.

**Liquid Diluent Concentration**

As with the concentration of the surfactant mixture, the amount of total liquid diluent in the compositions herein will be determined by the type and amounts of other composition components and by the desired composition properties. Generally, the liquid diluent will comprise from about 20% to 80% by weight of the compositions herein. More preferably, the liquid diluent will comprise from about 40% to 60% by weight of the composition.

**SOLID PHASE**

The nonaqueous detergent compositions herein may further comprise a solid phase of particulate material which is dispersed and suspended within the liquid phase. Generally such particulate material will range in size from about 0.1 to 1500 microns. More preferably such material will range in size from about 5 to 200 microns.

The particulate material utilized herein can comprise one or more types of detergent composition components which in particulate form are substantially insoluble in the nonaqueous liquid phase of the composition. The types of particulate materials which can be utilized are described in detail as follows:
Surfactants

Another possible type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein includes ancillary anionic surfactants which are fully or partially insoluble in the nonaqueous liquid phase. The most common type of anionic surfactant with such solubility properties comprises primary or secondary alkyl sulfate anionic surfactants. Such surfactants are those produced by the sulfation of higher C₈–C₂₀ fatty alcohols.

Conventional primary alkyl sulfate surfactants have the general formula

\[ \text{ROS}_3^- \text{M}^+ \]

wherein R is typically a linear C₈–C₂₀ hydrocarbyl group, which may be straight chain or branched chain, and M is a water-solubilizing cation. Preferably R is a C₁₀–C₁₄ alkyl, and M is alkali metal. Most preferably R is about C₁₂ and M is sodium.

Conventional secondary alkyl sulfates may also be utilized as the essential anionic surfactant component of the solid phase of the compositions herein. Conventional secondary alkyl sulfate surfactants are those materials which have the sulfate moiety distributed randomly along the hydrocarbyl "backbone" of the molecule. Such materials may be depicted by the structure

\[ \text{CH}_3(\text{CH}_2)_n(\text{CHOS}_3^-\text{M}^+) (\text{CH}_2)_m\text{CH}_3 \]

wherein m and n are integers of 2 or greater and the sum of m + n is typically about 9 to 15, and M is a water-solubilizing cation.

If utilized as all or part of the requisite particulate material, ancillary anionic surfactants such as alkyl sulfates will generally comprise from about 1% to 10% by weight of the composition, more preferably from about 1% to 5% by weight of the composition. Alkyl sulfate used as all
or part of the particulate material is prepared and added to the compositions herein separately from the unalkoxyalted alkyl sulfate material which may form part of the alkyl ether sulfate surfactant component essentially utilized as part of the liquid phase herein.

**Organic Builder Material**

Another possible type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein comprises an organic detergent builder material which serves to counteract the effects of calcium, or other ion, water hardness encountered during laundering/bleaching use of the compositions herein. Examples of such materials include the alkali metal, citrates, succinates, malonates, fatty acids, carboxymethyl succinates, carboxylates, polycarboxylates and polyacetal carboxylates. Specific examples include sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids and citric acid. Other examples of organic phosphonate type sequestering agents such as those which have been sold by Monsanto under the Dequest tradename and alkanehydroxy phosphonates. Citrate salts are highly preferred.

Other suitable organic builders include the higher molecular weight polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic acid copolymers and their salts, such as those sold by BASF under the Sokalan trademark.

Another suitable type of organic builder comprises the water-soluble salts of higher fatty acids, i.e., "soaps". These include alkali metal soaps such as the sodium, potassium, ammonium, and alkylolammonium salts of higher fatty acids containing from about 8 to about 24 carbon atoms, and preferably from about 12 to about 18 carbon atoms. Soaps can be made by direct saponification of fats
and oils or by the neutralization of free fatty acids. Particularly useful are the sodium and potassium salts of the mixtures of fatty acids derived from coconut oil and tallow, i.e., sodium or potassium tallow and coconut soap.

If utilized as all or part of the requisite particulate material, insoluble organic detergent builders can generally comprise from about 2% to 20% by weight of the compositions herein. More preferably, such builder material can comprise from about 4% to 10% by weight of the composition.

Inorganic Alkalinity Sources

Another possible type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein can comprise a material which serves to render aqueous washing solutions formed from such compositions generally alkaline in nature. Such materials may or may not also act as detergent builders, i.e., as materials which counteract the adverse effect of water hardness on detergency performance.

Examples of suitable alkalinity sources include water-soluble alkali metal carbonates, bicarbonates, borates, silicates and metasilicates. Although not preferred for ecological reasons, water-soluble phosphate salts may also be utilized as alkalinity sources. These include alkali metal pyrophosphates, orthophosphates, polyphosphates and phosphonates. Of all of these alkalinity sources, alkali metal carbonates such as sodium carbonate are the most preferred.

The alkalinity source, if in the form of a hydratable salt, may also serve as a desiccant in the nonaqueous liquid detergent compositions herein. The presence of an alkalinity source which is also a desiccant may provide benefits in terms of chemically stabilizing those composition components such as the peroxygen bleaching agent which may be susceptible to deactivation by water.
If utilized as all or part of the particulate material component, the alkalinity source will generally comprise from about 1% to 15% by weight of the compositions herein. More preferably, the alkalinity source can comprise from about 2% to 10% by weight of the composition. Such materials, while water-soluble, will generally be insoluble in the nonaqueous detergent compositions herein. Thus such materials will generally be dispersed in the nonaqueous liquid phase in the form of discrete particles.

**OPTIONAL COMPOSITION COMPONENTS**

In addition to the composition liquid and solid phase components as hereinbefore described, the detergent compositions herein can, and preferably will, contain various optional components. Such optional components may be in either liquid or solid form. The optional components may either dissolve in the liquid phase or may be dispersed within the liquid phase in the form of fine particles or droplets. Some of the materials which may optionally be utilized in the compositions herein are described in greater detail as follows:

**Optional Inorganic Detergent Builders**

The detergent compositions herein may also optionally contain one or more types of inorganic detergent builders beyond those listed hereinbefore that also function as alkalinity sources. Such optional inorganic builders can include, for example, aluminosilicates such as zeolites. Aluminosilicate zeolites, and their use as detergent builders are more fully discussed in Corkill et al., U.S. Patent No. 4,605,509; Issued August 12, 1986, the disclosure of which is incorporated herein by reference. Also crystalline layered silicates, such as those discussed in this '509 U.S. patent, are also suitable for use in the detergent compositions herein. If utilized, optional
inorganic detergent builders can comprise from about 2% to 15% by weight of the compositions herein.

Optional Enzymes

The detergent compositions herein may also optionally contain one or more types of detergent enzymes. Such enzymes can include proteases, amylases, cellulases and lipases. Such materials are known in the art and are commercially available. They may be incorporated into the nonaqueous liquid detergent compositions herein in the form of suspensions, "marumes" or "prills". Another suitable type of enzyme comprises those in the form of slurries of enzymes in nonionic surfactants. Enzymes in this form have been commercially marketed, for example, by Novo Nordisk under the tradename "LDP."

Enzymes added to the compositions herein in the form of conventional enzyme prills are especially preferred for use herein. Such prills will generally range in size from about 100 to 1,000 microns, more preferably from about 200 to 800 microns and will be suspended throughout the nonaqueous liquid phase of the composition. Prills in the compositions of the present invention have been found, in comparison with other enzyme forms, to exhibit especially desirable enzyme stability in terms of retention of enzymatic activity over time. Thus, compositions which utilize enzyme prills need not contain conventional enzyme stabilizing such as must frequently be used when enzymes are incorporated into aqueous liquid detergents.

If employed, enzymes will normally be incorporated into the nonaqueous liquid compositions herein at levels sufficient to provide up to about 10 mg by weight, more typically from about 0.01 mg to about 5 mg, of active enzyme per gram of the composition. Stated otherwise, the nonaqueous liquid detergent compositions herein will typically comprise from about 0.001% to 5%, preferably from about 0.01% to 1% by weight, of a commercial enzyme.
preparation. Protease enzymes, for example, are usually present in such commercial preparations at levels sufficient to provide from 0.005 to 0.1 Anson units (AU) of activity per gram of composition.

Optional Chelating Agents

The detergent compositions herein may also optionally contain a chelating agent which serves to chelate metal ions, e.g., iron and/or manganese, within the nonaqueous detergent compositions herein. Such chelating agents thus serve to form complexes with metal impurities in the composition which would otherwise tend to deactivate composition components such as the peroxycyanogen bleaching agent. Useful chelating agents can include amino carboxylates, phosphonates, amino phosphonates, polyfunctionally-substituted aromatic chelating agents and mixtures thereof.

Amino carboxylates useful as optional chelating agents include ethylenediaminetetraacetates, N-hydroxyethyl-ethylene-diaminetriacetates, nitrilotriacetates, ethylenediamine tetracarboxylates, triethylenetetraminehexaacetates, diethylenetriaminepentacarboxylates, ethylenediaminedi-succinates and ethanoldiglycines. The alkali metal salts of these materials are preferred.

Amino phosphonates are also suitable for use as chelating agents in the compositions of this invention when at least low levels of total phosphorus are permitted in detergent compositions, and include ethylenediaminetetras (methylenephosphonates) as DEQUEST. Preferably, these amino phosphonates do not contain alkyl or alkenyl groups with more than about 6 carbon atoms.

Preferred chelating agents include hydroxyethyl-diphosphonic acid (HEDP), diethylene triamine penta acetic acid (DTPA), ethylenediamine disuccinic acid (EDDS) and dipicolinic acid (DPA) and salts thereof. The chelating agent may, of course, also act as a detergent builder
during use of the compositions herein for fabric laundering/bleaching. The chelating agent, if employed, can comprise from about 0.1% to 4% by weight of the compositions herein. More preferably, the chelating agent will comprise from about 0.2% to 2% by weight of the detergent compositions herein.

Optional Thickening, Viscosity Control and/or Dispersing Agents

The detergent compositions herein may also optionally contain a polymeric material which serves to enhance the ability of the composition to maintain its solid particulate components in suspension. Such materials may thus act as thickeners, viscosity control agents and/or dispersing agents. Such materials are frequently polymeric polycarboxylates but can include other polymeric materials such as polyvinylpyrrolidone (PVP).

Polymeric polycarboxylate materials can be prepared by polymerizing or copolymerizing suitable unsaturated monomers, preferably in their acid form. Unsaturated monomeric acids that can be polymerized to form suitable polymeric polycarboxylates include acrylic acid, maleic acid (or maleic anhydride), fumaric acid, itaconic acid, aconitic acid, mesaconic acid, citraconic acid and methylenemalonic acid. The presence in the polymeric polycarboxylates herein of monomeric segments, containing no carboxylate radicals such as vinylmethyl ether, styrene, ethylene, etc. is suitable provided that such segments do not constitute more than about 40% by weight of the polymer.

Particularly suitable polymeric polycarboxylates can be derived from acrylic acid. Such acrylic acid-based polymers which are useful herein are the water-soluble salts of polymerized acrylic acid. The average molecular weight of such polymers in the acid form preferably ranges from about 2,000 to 10,000, more preferably from about
4,000 to 7,000, and most preferably from about 4,000 to
5,000. Water-soluble salts of such acrylic acid polymers
can include, for example, the alkali metal, salts. Soluble
polymers of this type are known materials. Use of
polyacrylates of this type in detergent compositions has
been disclosed, for example, Diehl, U.S. Patent 3,308,067,
issued March 7, 1967. Such materials may also perform a
builder function.

If utilized, the optional thickening, viscosity control
and/or dispersing agents should be present in the
compositions herein to the extent of from about 0.1% to 4%
by weight. More preferably, such materials can comprise
from about 0.5% to 2% by weight of the detergents
compositions herein.

Optional Brighteners, Suds Suppressors and/or Perfumes

The detergent compositions herein may also optionally
contain conventional brighteners, suds suppressors,
silicone oils, bleach catalysts, and/or perfume materials.
Such brighteners, suds suppressors, silicone oils, bleach
catalysts, and perfumes must, of course, be compatible and
non-reactive with the other composition components in a
nonaqueous environment. If present, brighteners suds
suppressors and/or perfumes will typically comprise from
about 0.1% to 2% by weight of the compositions herein.

Suitable bleach catalysts include the manganese based
complexes disclosed in US 5,246,621, US 5,244,594, US
5,114,606 and US 5,114,611.

COMPOSITION FORM

The particulate-containing liquid detergent
compositions of this invention are substantially nonaqueous
(or anhydrous) in character. While very small amounts of
water may be incorporated into such compositions as an
impurity in the essential or optional components, the
amount of water should in no event exceed about 5% by weight of the compositions herein. More preferably, water content of the nonaqueous detergent compositions herein will comprise less than about 1% by weight.

The particulate-containing nonaqueous detergent compositions herein will be in the form of a liquid, gel or paste.

COMPOSITION PREPARATION AND USE

The nonaqueous detergent compositions herein can be prepared by combining the bleach activator salts and optional components thereof in any convenient order and by mixing, e.g., agitating, the resulting component combination to form the phase stable compositions herein.

The compositions of this invention, prepared as hereinbefore described, can be used to form aqueous washing solutions for use in the laundering and bleaching of fabrics. Generally, an effective amount of such compositions is added to water, preferably in a conventional fabric laundering automatic washing machine, to form such aqueous laundering/bleaching solutions. The aqueous washing/bleaching solution so formed is then contacted, preferably under agitation, with the fabrics to be laundered and bleached therewith.

An effective amount of the liquid detergent compositions herein added to water to form aqueous laundering/bleaching solutions can comprise amounts sufficient to form from about 500 to 7,000 ppm of composition in aqueous solution. More preferably, from about 1,000 to 3,000 ppm of the detergent compositions herein will be provided in aqueous washing/bleaching solution.
EXAMPLE

The following example illustrates the compositions of the present invention, but is not necessarily meant to limit or otherwise define the scope of the invention herein.

A nonaqueous laundry detergent is prepared having the composition as set forth in Table I.

<table>
<thead>
<tr>
<th>Component</th>
<th>Wt.%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquid Base</strong></td>
<td></td>
</tr>
<tr>
<td>C₁₂-₁₅ alkyl ether (EO=3) sulfate Na salt</td>
<td>19%</td>
</tr>
<tr>
<td>C₁₂-₁₄ N-methyl glucamide</td>
<td>7.9%</td>
</tr>
<tr>
<td>C₁₂-₁₄, EO=5 alcohol ethoxylate</td>
<td>16.5%</td>
</tr>
<tr>
<td>N-Butoxy propoxy propanol</td>
<td>8.6%</td>
</tr>
<tr>
<td>Chloride salt of methyl quaternized poly-ethoxylated hexamethylene diamine</td>
<td>2%</td>
</tr>
<tr>
<td>Perfume</td>
<td>0.75%</td>
</tr>
<tr>
<td>Polyethylene glycol 200</td>
<td>5.4%</td>
</tr>
<tr>
<td>Acetyl triethyl citrate</td>
<td>10.2%</td>
</tr>
<tr>
<td><strong>Solids</strong></td>
<td></td>
</tr>
<tr>
<td>Topped palm kernel fatty acid Na salt</td>
<td>5.9%</td>
</tr>
<tr>
<td>Trisodium Citrate</td>
<td>2%</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>8%</td>
</tr>
<tr>
<td>Sodium percarbonate</td>
<td>10%</td>
</tr>
<tr>
<td>Sodium hydroxyethyl diphosphonate (HEDP)</td>
<td>1.8%</td>
</tr>
<tr>
<td>Brightener</td>
<td>0.13%</td>
</tr>
<tr>
<td>Silicone Oil DB-100</td>
<td>0.47%</td>
</tr>
<tr>
<td>Enzymes and minor</td>
<td>Up to 100%</td>
</tr>
<tr>
<td>Viscosity : 3000 cps.</td>
<td></td>
</tr>
<tr>
<td>Stability : remains liquid after 1 month at 25°C.</td>
<td></td>
</tr>
</tbody>
</table>
This composition is an non-aqueous heavy duty liquid laundry detergent which provides excellent clay stain removal performance when used in normal fabric laundering operations.
What is claimed is:

1. A nonaqueous detergent composition which is in a liquid, gel or paste form comprising a bleaching agent and a clay-soil removal polymer selected from

(1) ethoxylated cationic diamines having the formula:

\[ R^3_N^+R^1L-N^+R^1L-X \]

or

\[ (X-L)_2-N^+R^1L-N^+R^2 \]

(2) ethoxylated cationic polyamines having the formula:

\[ R^4\{[A^1q-(R^5)^t-N-L-X]_p \} \]

(3) ethoxylated cationic polymers which comprise a polymer backbone, at least 2N\(^+\) groups and at least one L-X group, wherein ; and L connects the N\(^+\) positively charged center and X or connects group X to the polymer backbone; and

(4) mixtures thereof;

wherein A\(^1\) is

\[ \text{---NC---, ---NCO---, ---NCN---, ---CN---, ---OCN---, ---CO---,} \]

or

\[ \text{---OC---, ---C---, ---CNC--- or ---O---,} \]
R is H or C₁-C₄ alkyl or hydroxyalkyl, R¹ is C₂-C₁₂ alkyene, hydroxyalkylene, alkyenylene, arylenylene, or alkarylene, or a C₂-C₃ oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-N bonds are formed; each R² is C₁-C₄ alkyl or hydroxyalkyl, the moiety -L-X or two R² together form the moiety -(CH₂)r-A²-(CH₂)s-, wherein A² is -O- or -CH₂-, r is 1 or 2, s is 1 or 2 and r + s is 3 or 4; each R³ is C₁-C₈ alkyl or hydroxyalkyl, benzyl, the moiety L-X, or two R³ or one R² and one R³ together form the moiety -(CH₂)r-A²-(CH₂)s--; R⁴ is a substituted C₃-C₁₂ alkyl, hydroxyalkyl, alkenyl, aryl or alkaryl group having p substitution sites; R⁵ is C₁-C₁₂ alkyene, hydroxyalkylene, alkyenylene, arylenylene, or alkarylene, or a C₂-C₃ oxyalkylene moiety having from 2 to 20 oxyalkylene units provided that no O-O or O-N bonds are formed; X is a nonionic group selected from the group consisting of H, C₁-C₄ alkyl or hydroxyalkyl ester or ether groups, and mixtures thereof; L is a hydrophilic chain which contains the polyoxyalkylene moiety -[(R⁶O)m(CH₂CH₂O)n]-; wherein R⁶ is C₃-C₄ alkyene or hydroxyalkylene and m and n are numbers such that the moiety -(CH₂CH₂O)n- comprises at least 50% by weight of said polyoxyalkylene moiety; n is at least 12 for said cationic monoamines, is at least 6 for said cationic diamines and is at least 3 for said cationic polyamines and cationic polymers; p is from 3 to 8; q is 1 or 0; t is 1 or 0, provided that t is 1 when q is 1.

2. A nonaqueous detergent composition according to claim 1 wherein said clay-soil removal polymer is an ethoxylated cationic diamine, wherein R¹ is C₂-C₆ alkyene, preferably hexamethylenylene.

3. A nonaqueous detergent composition according to claim 1 wherein said clay soil removal polymer is an ethoxylated cationic polyamine wherein R⁴ is a substituted C₃-C₆ alkyl, hydroxyalkyl or aryl group;
A is

\[ \begin{array}{c}
\text{O} \\
\text{C-N} \\
\text{H}
\end{array} \]

and p is from 3 to 6.

4. A nonaqueous detergent composition according to claims 1-3 wherein each moiety R² or R³ is methyl.

5. A nonaqueous detergent composition according to claim 1 wherein said clay-soil removal polymer is an ethoxylated cationic polymer selected from the group consisting of the polyurethanes, the polyesters, the polyethers, the polyamides, the polyimides, the polycrlylates, the polyacrylamides, the polyvinylethers, the polyalkylenes, the polyalkarylenes, the polyalkyleneimines, the polyvinylamines, the polyallylamines, the polydiallylamines, the polyvinylpyridines, the polyaminetriazoles, polyvinyl alcohol, the aminopolyureylene and mixtures thereof.

6. A nonaqueous detergent composition according to claim 1 wherein said bleaching agent is selected from perborates and percarbonates.

7. A nonaqueous detergent composition according to claims 1-6 further comprising a polyol surfactant.

8. A nonaqueous detergent composition according to claim 7 wherein the polyol surfactant is selected from polyhydroxy fatty acid amides.

9. A nonaqueous detergent composition according to claims 1-8 further comprising 5 to 25% by weight of anionic surfactant.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**


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)

IPC 6 C11D

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)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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**Date of the actual completion of the international search**

17 April 1996

**Date of mailing of the international search report**

26-04-1996

**Name and mailing address of the ISA**

European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Td. (+31-70) 340-2040, Tx. 31 651 epo nl Fax (+31-70) 340-3016

**Authorized officer**

Serbetsoglou, A

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