

STABLE LIQUID DETERGENT COMPOSITIONS

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The present invention relates to heavy-duty liquid detergent compositions containing sulfonate surfactant, alcohol ethoxylate sulfate surfactant, ethoxylated nonionic surfactant, an optional quaternary ammonium, amine or amine oxide surfactant, saturated fatty acid, polycarboxylate builder, a neutralization system comprising sodium, potassium and preferably low levels of alkanolamines, and a solvent system comprising ethanol, polyol and water. The compositions are isotropic liquids which provide a high level of detergency performance and improved chlorine bleach compatibility.

There has been considerable demand for liquid detergents capable of providing superior cleaning under a wide variety of laundering conditions. Such compositions generally require a number of ingredients which tend to separate into discrete phases. Isotropic liquid detergents are desired for both consistency of performance and aesthetic reasons. The compositions should remain isotropic during shipping and storage, where temperatures of 55°F (12.8°C) or lower are often encountered. They preferably are also formulated to recover, after freezing and thawing, to an isotropic phase prior to consumer use.

Liquid detergents often contain high levels of alkanolamines to enhance performance and product stability. However, alkanolamines readily react with and destroy chlorine bleaches. Consumers who add chlorine bleaches to wash solutions containing alkanolamine-based detergents consequently do not obtain optimum bleaching performance. Thus, there is a continuing need for the

development of a liquid detergent capable of providing superior cleaning, bleach compatibility and product stability.

5 U.S. Patent 4,561,998

Wertz et al, filed May 24, 1982, discloses detergent compositions containing anionic surfactants, quaternary ammonium, amine or amine oxide surfactants, and fatty acids, and formulated to provide a near-neutral wash pH. 10 The compositions are preferably liquid detergents which additionally contain ethoxylated nonionic surfactants and polycarboxylate builders.

U.S. Patent 4,285,841, Barrat et al, issued August 25, 1981, discloses liquid detergents containing anionic 15 surfactants, nonionic surfactants and from about 8% to about 20% by weight of a fatty acid. The compositions have a pH of from about 6.0 to about 7.5.

U.S. Patent 4,287,082, Tolfo et al, issued September 1, 1981, discloses liquid detergents contain- 20 ing saturated fatty acids, enzymes, enzyme-accessible calcium and short-chain carboxylic acid salts, preferably formates.

EP-A2-0142886 discloses heavy duty detergent compositions containing a mixture of surfactants, fatty acids, polycarboxylate builder, and neutralization and solvent systems as defined herein but together with an odour-purified proteolytic enzyme.

The present invention encompasses heavy-duty liquid 25 detergent compositions comprising, by weight:

(a) from 5% to 15%, on an acid basis, of a sulfonate surfactant containing a C_{10} - C_{16} alkyl or alkenyl group;

(b) from 8% to 18%, on an acid basis, 30 of an alcohol ethoxylate sulfate surfactant of the formula $RO(C_2H_4O)_mSO_3M$, wherein R is a C_{10} - C_{16} alkyl or hydroxyalkyl group, m is from 0.5 to 4, and M is a compatible cation;

(c) from 2% to 15% of an ethoxylated nonionic surfactant of the formula $R^1(OC_2H_4)_nOH$, wherein R^1 is a C_{10} - C_{16} alkyl group or a C_8 - C_{12} alkyl phenyl group, n is from 3 to 9, and said nonionic surfactant has an HLB of from 10 to 13;

(d) from about 0% to about 5% of a cosurfactant selected from

(i) quaternary ammonium surfactants having the formula:

10 $[R^2(OR^3)_y][R^4(OR^3)_y]_2R^5N^+X^-$
wherein R^2 is an alkyl or alkyl benzyl group having from 6 to 16 carbon atoms in the alkyl chain; each R^3 is selected from $-CH_2CH_2-$, $-CH_2CH(CH_3)-$, $-CH_2CH(CH_2OH)-$, $-CH_2CH_2CH_2-$, and mixtures thereof; each R^4 is selected from

15 C_1 - C_4 alkyl, C_1 - C_4 hydroxyalkyl, benzyl, and hydrogen when y is not 0; R^5 is the same as R^4 or is an alkyl chain wherein the total number of carbon atoms of R^2 plus R^5 is from 8 to 16; each y is from 0 to 10 and the sum of the y values is from 0 to 15; and X is any compatible anion;

(ii) amine surfactants having the formula:

20 $[R^2(OR^3)_y][R^4(OR^3)_y]R^5N$
wherein R^2 , R^3 , R^4 , R^5 and y are as defined above;

25 (iii) amine oxide surfactants having the formula:

$[R^2(OR^3)_y][R^4(OR^3)_y]R^5N \rightarrow O$
wherein R^2 , R^3 , R^4 , R^5 and y are as defined above;

30 (e) from 5% to 20% of a C_{10} - C_{14} saturated fatty acid, the weight ratio of C_{10} - C_{12} fatty acid to C_{14} fatty acid being at least 1;

(f) from 3% to 8%, on an acid basis, of a water-soluble polycarboxylate builder material;

35 (g) from 0 to 0.04 moles per 100 grams of composition of an alkanolamine selected from the group consisting of monoethanolamine, diethanolamine and triethanolamine;

(h) potassium and sodium ions in a potassium to sodium molar ratio of from 0.1 to 1.3;

(i) from 2% to 10% ethanol;

(j) from 2% to 15% of a polyol containing from 2 to 6 carbon atoms and from 2 to 6 hydroxy groups; and

(k) from 25% to 40% water;

said composition containing from 20% to 35% of (a), (b), (c) and (d); from 8% to 28% of (e) and (f); from 33% to 50% of (a), (b), (c), (d), (e) and (f); from 8% to 20% of (i) and (j); and from 35% to 55% of (i), (j) and (k); the weight ratio of (a) to (b) being from 0.3 to 1.7; the weight ratio of (a) plus (b) to (c) being from 1 to 10; and all of said components being selected to provide an isotropic liquid at 55°F (12.8°C) having an initial pH of from 7.5 to 9.0 at a concentration of 10% by weight in water at 68°F (20°C), and wherein are excluded liquid detergent compositions comprising odour-purified proteolytic enzymes which have no detectable odour at a concentration of less than 0.002 Anson units per gram of distilled water as determined by averaging the concentrations at which a panel of at least 3 expert graders first detects protease odour.

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Detailed Description of the Invention

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The liquid detergents of the present invention contain sulfonate and alcohol ethoxylate sulfate anionic surfactants, ethoxylated nonionic surfactant, optional quaternary ammonium, amine or amine oxide surfactants, saturated fatty acid, polycarboxylate builder, a neutralization system comprising sodium, potassium and preferably low levels of alkanolamines, and a solvent system comprising ethanol, polyol and water.

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The compositions herein are formulated to provide a high level of detergency performance under a wide variety of laundering conditions. They also provide improved chlorine bleach compatibility due to the limited amount of alkanolamines. Since the compositions contain a relatively high level of active components and little or no alkanolamine to enhance product stability, the types, levels and ratios of the components must be

carefully balanced to provide isotropic liquids at 55°F (12.8°C). Preferred compositions herein are isotropic liquids at 50°F (10°C). They preferably also recover, after freezing and thawing, to an isotropic form by 55°F (12.8°C), more preferably by 50°F (10°C).

In order to meet these stability constraints, the present compositions require a neutralization system comprising mixed potassium and sodium ions. Complete sodium neutralization causes crystallization of the polycarboxylate builder, whereas all potassium neutralization results in an unacceptably high gel point. The total level of organic and inorganic bases must also be selected to provide a sufficiently high product pH to minimize the level of poorly-soluble free fatty acids, without being so high that pH sensitive stain removal, enzyme stability, and greasy/oily soil removal are compromised.

The compositions also require a solvent system comprising water and a mixture of ethanol and polyol. Crystallization occurs without the polyol and unacceptably high gel points are obtained without the ethanol. The amount of ethanol and polyol must also be sufficient to prevent organic phase separation (i.e., keep free fatty acids and poorly-soluble surfactants in solution), and yet not be so high as to cause lye phase separation and/or crystallization by limiting the amount of water available.

Sulfonate Surfactant

The detergent compositions herein contain from 5% to 15%, preferably from 6% to 10%, by weight (on an acid basis) of an anionic sulfonate surfactant containing a C₁₀-C₁₆ alkyl or alkenyl group. Anionic sulfonate surfactants useful herein are disclosed in U.S. Patent 4,285,841, Barrat et al, issued August 25, 1981, and in U.S. Patent 3,919,678, Laughlin et al, issued December 30, 1975.

Preferred sulfonate surfactants are the water-soluble salts, particularly the alkali metal, and alkanolammonium (e.g., monoethanolammonium or triethanolammonium) salts of alkylbenzene sulfonates in which the
5 alkyl group contains from 10 to 15 carbon atoms, in straight chain or branched chain configuration, e.g., those of the type described in U. S. Patents 2,220,099 and 2,477,383,

Especially valuable are linear straight chain
10 alkylbenzene sulfonates in which the average number of carbon atoms in the alkyl group is from about 11 to about 13.

Also useful herein are the water-soluble salts of paraffin sulfonates, olefin sulfonates, alkyl glyceryl
15 ether sulfonates, esters of α -sulfonated fatty acids containing from about 1 to 10 carbon atoms in the ester group, 2-acyloxy-alkane-1-sulfonates containing from about 2 to 9 carbon atoms in the acyl group, and β -alkyloxy alkane sulfonates containing from about 1 to
20 3 carbon atoms in the alkyl group.

Mixtures of the above-described sulfonates, particularly with the C_{11-13} linear alkylbenzene sulfonates, can also be used.

Alcohol Ethoxylate Sulfate Surfactant

25 The present compositions also contain an alcohol ethoxylate sulfate surfactant of the formula $RO(C_2H_4O)_mSO_3M$, wherein R is a $C_{10}-C_{16}$ alkyl (preferred) or hydroxyalkyl group, m is from 0.5 to 4, and M is a compatible cation. This surfactant represents from 8% to 18%, preferably from
30 9% to 14%, by weight (on an acid basis) of the composition.

Preferred alcohol ethoxylate sulfate surfactants of the above formula are those wherein the R substituent is
35 a C_{12-15} alkyl group and m is from about 1.5 to about 3.

Examples of such materials are C_{12-15} alkyl polyethoxylate (2.25) sulfate ($C_{12-15} E_{2.25} S$); $C_{14-15} E_{2.25} S$; $C_{12-13} E_{1.5} S$; $C_{14-15} E_3 S$; and mixtures thereof. The sodium, potassium, monoethanolammonium, and triethanolammonium salts of the above are preferred.

Ethoxylated Nonionic Surfactant

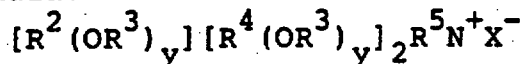
The compositions also contain from 2% to 15%, preferably from 4% to 10%, by weight of an ethoxylated nonionic surfactant of the formula $R^1(OC_2H_4)_n OH$, wherein R^1 is a $C_{10}-C_{16}$ alkyl group or a C_8-C_{12} alkyl phenyl group, n is from 3 to 9, and said nonionic surfactant has an HLB (hydrophile-lipophile balance) of from 10 to 13. These surfactants are more fully described in U.S. Patents 4,285,841, Barrat et al, issued August 25, 1981, and 4,284,532, Leikhim et al, issued August 18, 1981,

Particularly preferred are condensation products of $C_{12}-C_{14}$ alcohols with from 3 to 7 moles of ethylene oxide per mole of alcohol, e.g., $C_{12}-C_{13}$ alcohol condensed with about 6.5 moles of ethylene oxide per mole of alcohol.

Cosurfactant

The compositions herein can contain from 0% to 5%, preferably from 0.5% to 3%, by weight of a cosurfactant selected from certain quaternary ammonium, amine, and amine oxide surfactants. The quaternary ammonium surfactants are particularly preferred.

The quaternary ammonium surfactants useful herein are of the formula:



wherein R^2 is an alkyl or alkyl benzyl group having from 6 to 16 carbon atoms in the alkyl chain; each R^3 is selected from

$-CH_2CH_2-$, $-CH_2CH(CH_3)-$, $-CH_2CH(CH_2OH)-$, $-CH_2CH_2CH_2-$, and

mixtures thereof; each R^4 is selected from

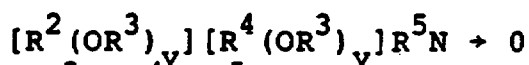
C_1-C_4 alkyl, C_1-C_4 hydroxyalkyl, benzyl, and hydrogen when y is not 0; R^5 is the same as R^4 or is an alkyl chain wherein the total number of carbon atoms of R^2 plus R^5 is from 8 to 16; each y is from 0 to 10 and the sum of the y values is from 0 to 15; and X is any compatible anion.

Preferred of the above are the alkyl quaternary ammonium surfactants, especially the mono-long chain alkyl surfactants described in the above formula when R^5 is selected from the same groups as R^4 . The most preferred quaternary ammonium surfactants are the chloride, bromide and methylsulfate C_{8-16} alkyl trimethylammonium salts, C_{8-16} alkyl di(hydroxyethyl)methylammonium salts, the C_{8-16} alkyl hydroxyethyldimethylammonium salts, C_{8-16} alkyloxypropyl trimethylammonium salts, and the C_{8-16} alkyloxypropyl dihydroxyethylmethylammonium salts. Of the above, the $C_{10}-C_{14}$ alkyl trimethylammonium salts are preferred, e.g., decyl trimethylammonium methylsulfate, lauryl trimethylammonium chloride, myristyl trimethylammonium bromide and coconut trimethylammonium chloride and methylsulfate.

Under cold water washing conditions, i.e., less than about 65°F (18.3°C), the C_{8-10} alkyl trimethylammonium surfactants are particularly preferred since they have lower Kraft boundaries and crystallization temperatures than the longer chain quaternary ammonium surfactants.

Amine surfactants useful herein are of the formula:
 $[R^2(OR^3)_y][R^4(OR^3)_y]R^5N$
wherein the R^2 , R^3 , R^4 , R^5 and y substituents are as defined above for the quaternary ammonium surfactants. Particularly preferred are the C_{12-16} alkyl dimethyl amines.

Amine oxide surfactants useful herein are of the formula:



wherein the R^2 , R^3 , R^4 , R^5 and y substituents are also as defined above for the quaternary ammonium surfactants. Particularly preferred are the C_{12-16} alkyl dimethyl amine oxides.

Amine and amine oxide surfactants are preferably used at higher levels than the quaternary ammonium surfactants since they are only partially protonated in the present systems. For example, preferred compositions herein can contain from 0.5% to 1.5% of the quaternary ammonium surfactant, or from 1% to 3% of the amine or amine oxide surfactants.

Fatty Acid

The compositions of the present invention contain from 5% to 20%, preferably from 8% to 18%, most preferably from 10% to 16%, by weight of a saturated fatty acid containing from 10 to 14 carbon atoms. In addition, the weight ratio of C_{10} - C_{12} fatty acid to C_{14} fatty acid should be at least 1, preferably at least 1.5.

Suitable saturated fatty acids can be obtained from natural sources such as plant or animal esters (e.g., palm kernel oil, palm oil and coconut oil) or synthetically prepared (e.g., via the oxidation of petroleum or by hydrogenation of carbon monoxide via the Fischer-Tropsch process). Examples of suitable saturated fatty acids for use in the compositions of this invention include capric, lauric, myristic, coconut and palm kernel fatty acid. Preferred are saturated coconut fatty acids, from about 5:1 to 1:1 (preferably about 3:1) weight ratio mixtures of lauric and myristic acid, mixtures of the above with minor amounts (e.g., 10%-50% of total fatty acid) of oleic acid; and palm kernel fatty acid.

Polycarboxylate Builder

The compositions herein also contain from 3% to 8%, preferably from 3% to 6%, more preferably from 3.5% to 5% by weight on an acid basis, of a water-soluble polycarboxylate detergent builder material. Polycarboxylate builders are described in U.S. Patent 4,284,532, Leikhim et al, issued August 18, 1981,

The various aminopolycarboxylates, cycloalkane polycarboxylates, ether polycarboxylates, alkyl polycarboxylates, epoxy polycarboxylates, tetrahydrofuran polycarboxylates, benzene polycarboxylates, and polyacetal polycarboxylates are suitable for use herein.

Examples of such polycarboxylate builders are sodium and potassium ethylenediaminetetraacetate; sodium and potassium nitrilotriacetate; the water-soluble salts of phytic acid, e.g., sodium and potassium phytates, disclosed in U.S. Patent 1,739,942, Eckey, issued March 27, 1956; the polycarboxylate materials described in U.S. Patent 3,364,103; and the water-soluble salts of polycarboxylate polymers and copolymers described in U.S. Patent 3,308,067, Diehl, issued March 7, 1967,

Useful detergent builders also include the water-soluble salts of polymeric aliphatic polycarboxylic acids having the following structural and physical characteristics:

(a) a minimum molecular weight of about 350 calculated as to the acid form; (b) an equivalent weight of about 50 to about 80 calculated as to acid form; (3) at least 45 mole percent of the monomeric species having at least two carboxyl radicals separated from each other by not more than two carbon atoms; (d) the site of attachment of the polymer chain of any carboxyl-containing radical being separated by not more than three carbon atoms

along the polymer chain from the site of attachment of the next carboxyl-containing radical. Specific examples of such builders are the polymers and copolymers of itaconic acid, aconitic acid, maleic acid, mesaconic acid, fumaric acid, methylene malonic acid, and citraconic acid.

Other suitable polycarboxylate builders include the water-soluble salts, especially the sodium and potassium salts, of mellitic acid, citric acid, pyromellitic acid, benzene pentacarboxylic acid, oxydiacetic acid, carboxymethyloxysuccinic acid, carboxymethyloxymalonic acid, cis-cyclohexanehexacarboxylic acid, cis-cyclopentanetetracarboxylic acid and oxydisuccinic acid.

Other polycarboxylates for use herein are the polyacetal carboxylates described in U.S. Patent 4,144,226, issued March 13, 1979 to Crutchfield et al, and U.S. Patent 4,146,495, issued March 27, 1979 to Crutchfield et al,

Citric acid is a highly preferred polycarboxylate builder.

Neutralization System

The present compositions can contain from 0 to 0.04 moles, preferably from 0.01 to 0.035 moles, more preferably from 0.015 to 0.03 moles, per 100 grams of composition of an alkanolamine selected from the group consisting of monoethanolamine, diethanolamine, triethanolamine, and mixtures thereof. Low levels of the alkanolamines, particularly monoethanolamine, are preferred to enhance product stability, detergency performance, and odor. However, the amount of alkanolamine should be minimized for best chlorine bleach compatibility. While the present compositions can contain mixtures of the alkanolamines, best color stability is obtained using single alkanolamines.

In addition, the compositions contain potassium and sodium ions in a potassium to sodium molar ratio of from 0.1 to 1.3, preferably from 0.6 to 1.

5 Solvent System

The solvent system for the compositions is comprised of ethanol, a polyol and water. Ethanol is present at a level of from 2% to 10%, preferably from 5% to 9%, by weight of the composition.

Any polyol containing from 2 to 6 carbon atoms and from 2 to 6 hydroxy groups can be used in the present compositions. Examples of such polyols are ethylene glycol, propylene glycol and glycerine. Propylene glycol is particularly preferred. The polyol represents from 2% to 15%, preferably from 3% to 10%, by weight of the composition.

The compositions also contain from 25% to 40%, preferably from 28% to 37%, by weight of water.

In addition to the above, the ethanol and polyol together represent from 8% to 20%, preferably 11% to 16%, by weight of the composition. The ethanol, polyol and water should total from 35% to 55%, preferably 40% to 50%, by weight of the composition.

The compositions of the present invention are further constrained by the following limits, in which all percentages and ratios are calculated on an acid basis where anionic materials are involved. The sulfonate, alcohol ethoxylate sulfate, ethoxylated nonionic and quaternary ammonium, amine or amine oxide surfactants, together, represent from 20% to 35%, preferably from 23% to 30%, by weight of the composition. The weight ratio of the sulfonate surfactant to the alcohol ethoxylate sulfate surfactant should

also be from 0.3 to 1.7, preferably from 0.6 to 1. The weight ratio of these anionic surfactants to the ethoxylated nonionic surfactant should also be from 1 to 10, preferably from 2 to 5.

The fatty acid and polycarboxylate builder together represent from 8% to 28%, preferably from 13% to 22%, by weight of the composition. In addition, the fatty acid, polycarboxylate builder and above surfactants represent a total of from 33% to 50%, preferably from 36% to 48%, by weight of the composition.

Finally, all of the above components are selected to provide an isotropic liquid detergent at 55°F (12.8°C), preferably at 50°F (10°C). The components are also selected to provide an initial pH of from 7.5 to 9.0, preferably from 7.8 to 8.8, at a concentration of 10% by weight in water at 68°F (20°C).

20 Optional Components

Optional components for use in the liquid detergents herein include enzymes, enzyme stabilizing agents, polyacids, soil removal agents, antiredeposition agents suds regulants, hydrotropes, opacifiers, antioxidants, bactericides, dyes, perfumes, and brighteners described in the U.S. Patent 4,285,841, Barrat et al, issued August 25, 1981, Such optional components generally represent less than 15%, preferably from 2% to 10%, by weight of the composition.

Enzymes are highly preferred optional ingredients and are incorporated in an amount of from 0.025% to 2%, preferably from 0.05% to 1.5%. Preferred proteolytic enzymes should provide a proteolytic activity of at least about 5 Anson units (about 1,000,000 Delft units) per liter, preferably from about

15 to about 70 Anson units per liter, most preferably from about 20 to about 40 Anson units per liter. A proteolytic activity of from about 0.01 to about 0.05 Anson units per gram of product is desirable. Other enzymes, including amylolytic enzymes, are also desirably included in the present compositions.

Suitable proteolytic enzymes include the many species known to be adapted for use in detergent compositions. Commercial enzyme preparations such as "Alcalase (RTM)" sold by Novo Industries, and "Maxatase (RTM)" sold by Gist-Brocades, Delft, The Netherlands, are suitable. Other preferred enzyme compositions include those commercially available under the tradenames SP-72 ("Esperase (RTM)" manufactured and sold by Novo Industries, A/S, Copenhagen, Denmark and "AZ-Protease" manufactured and sold by Gist-Brocades, Delft, The Netherlands.

Suitable amylases include "Rapidase (RTM)" sold by Gist-Brocades and "Termamyl (RTM)" sold by Novo Industries.

A more complete disclosure of suitable enzymes can be found in U.S. Patent 4,101,457, Place et al, issued July 18, 1978,

When enzymes are incorporated in the detergent compositions of this invention, they are desirably stabilized by using a mixture of a short chain carboxylic acid salt and calcium ion, such as disclosed in U.S. Patent 4,318,818, Letton et al, issued March 9, 1982,

The short chain carboxylic acid salt is preferably water-soluble, and most preferably is a formate, e.g., sodium formate. The short chain carboxylic acid salt is used at a level from 0.25% to 10%, preferably from 0.3% to 3%, more preferably from 0.5% to 1.5%. Any water-soluble calcium salt can be used as a source of calcium ion, including calcium acetate, calcium formate and calcium propionate. The composition should contain from 0.1 to

30 millimoles of calcium ion per liter, preferably from
0.5 to 15 millimoles of calcium ion per
liter. When materials are present which complex calcium
ion, it is necessary to use high levels of calcium ion so
5 that there is always some minimum level available for the
enzyme.

Enzymes are preferably stabilized in the present
compositions by the addition of from 0.25% to
10%, preferably from 0.5% to 5%, more
10 preferably from 0.75% to 3%, by weight of
boric acid or a compound capable of forming boric acid in
the composition (calculated on the basis of the boric
acid). Boric acid is preferred, although other compounds
such as boric oxide, borax and other alkali metal borates
15 (e.g., sodium ortho-, meta- and pyroborate, and sodium
pentaborate) are suitable. Substituted boric acids
(e.g., phenylboronic acid, butane boronic acid, and
p-bromo phenylboronic acid) can also be used in place of
boric acid.

20 The combination of boric acid and formate provides
improved protease stability, although amylase stability
appears to be slightly less than that obtained using
boric acid alone.

Preferred compositions also contain from
25 0.01% to 1% of a polyacid or salt thereof, to
enhance pretreatment performance. Preferred polyacids
for use herein are ethylenediamine tetramethylenephos-
phonic acid, diethylene triamine pentamethylenephos-
phonic acid, and diethylenetriamine pentaacetic acid, or
30 the salts thereof. These polyacids/salts are preferably
used in an amount from 0.1% to 0.8%.

Preferred compositions herein further contain from
0.5% to 3%, preferably from 1% to
2%, by weight of a highly ethoxylated polyethy-
leneamine or polyethyleneimine soil removal and antire-
35 deposition agent,

A particularly preferred material is tetraethylene pentamine ethoxylated with about 15-18 moles of ethylene oxide at each hydrogen site.

5 The following examples illustrate the compositions of the present invention.

All parts, percentages and ratios used herein are by weight unless otherwise specified.

EXAMPLE I

10 Liquid detergent compositions of the present invention are as follows:

<u>Component</u>		<u>Wt. %</u>	
		<u>A</u>	<u>B</u>
	C ₁₃ linear alkylbenzene sulfonic acid	7.2	7.2
15	C ₁₄₋₁₅ alkyl polyethoxylate (2.25)		
	sulfuric acid	10.8	10.8
	C ₁₂₋₁₃ alcohol polyethoxylate (6.5)*	6.5	6.5
	C ₁₂ alkyl trimethylammonium chloride	1.2	0.6
	C ₁₂₋₁₄ fatty acid	13.0	---
20	Oleic acid	2.0	---
	Palm kernel fatty acid (stripped)	---	15.0
	Citric acid (anhydrous)	4.0	4.0
	Diethylenetriamine pentaacetic acid	0.23	0.23
	Protease enzyme (2.0 AU/g)	0.75	0.75
25	Amylase enzyme (375 Am. U/g)	0.16	0.16
	TEPA-E ₁₅₋₁₈ **	1.5	1.5
	Monoethanolamine	2.0	---
	(moles of alkanolamine)	(0.033)	(0)
	Sodium ion	1.66	2.75
30	Potassium ion	2.65	2.55
	(molar K ⁺ :Na ⁺)	(0.94)	(0.55)
	Propylene glycol	6.8	5.0
	Ethanol	7.8	8.5
	Formic acid	0.66	0.66
35	Calcium ion	0.03	0.03
	Minors and water	Balance to 100	

pH at concentration of 10%

in water at 68°F (20°C)

8.65 8.5

*Alcohol and monoethoxylated alcohol removed.

5 **Tetraethylene pentaimine ethoxylated with 15-18 moles (avg.) of ethylene oxide at each hydrogen site.

Composition A was prepared by adding the components, with continuous mixing, in the following order: paste premix of alkylbenzene sulfonic acid, sodium hydroxide, propylene glycol and ethanol; paste premix of
10 alkyl polyethoxylate sulfuric acid, sodium hydroxide and ethanol; pentaacetic acid; alcohol polyethoxylate; premix of water, brighteners, alkanolamine, and alcohol polyethoxylate; ethanol; sodium and potassium hydroxide; fatty acid; citric acid; formic acid and calcium; alkyl
15 trimethylammonium chloride; TEPA-E₁₅₋₁₈; adjust pH to about 8.1; and balance of components.

Composition B was prepared by adding the components, with continuous mixing, in the following order: paste premix of alkyl polyethoxylate sulfuric acid and
20 ethanol; 2.5 parts water; propylene glycol; premix of ethanol and brightener; ethanol; premix of water, propylene glycol and brightener; alcohol polyethoxylate; sodium hydroxide; potassium hydroxide; fatty acid; alkylbenzene sulfonic acid; premix of citric acid and
25 calcium; pentaacetic acid; formic acid; alkyl trimethylammonium chloride; TEPA-E₁₅₋₁₈; potassium hydroxide and water; and balance of components.

Compositions A and B were isotropic liquids as made and remained isotropic down to about 50°F (10°C). They
30 also recovered to an isotropic form, after freezing and thawing, by about 55°F (12.8°C).

EXAMPLE II

The following liquid detergents of the invention were made using the same order of addition as for Composition A of Example I. The compositions were stable isotropic liquids at 50°F (10°C). They also recovered, after freezing and thawing, to an isotropic form by 50°F (10°C).

<u>Components</u>		<u>Wt %</u>	
		<u>A</u>	<u>B</u>
10	C ₁₃ linear alkylbenzene sulfonic acid	8.0	8.0
	C ₁₄₋₁₅ alkyl polyethoxylate (2.25)		
	sulfuric acid	12.0	12.0
	C ₁₂₋₁₃ alcohol polyethoxylate (6.5)*	5.0	5.0
	C ₁₂ alkyl trimethylammonium chloride	0.6	0.6
15	C ₁₂₋₁₄ fatty acid	10.0	7.7
	Oleic acid	0.5	---
	Palm kernel fatty acid	---	3.3
	Citric acid	4.0	4.0
	Diethylenetriamine pentaacetic acid	0.23	0.23
20	Protease enzyme (2.0 AU/g)	0.75	0.75
	Amylase enzyme (375 Am. U/g)	0.16	0.16
	TEPA-E ₁₅₋₁₈ **	2.0	2.0
	Monoethanolamine	2.0	2.0
	(moles of alkanolamine)	(0.033)	(0.033)
25	Sodium ion	2.53	2.53
	Potassium ion	1.11	1.11
	(molar K ⁺ :Na ⁺)	(0.26)	(0.26)
	Propylene glycol	3.5	3.5
	Ethanol	8.5	8.5
30	Formic acid	0.08	0.08
	Boric acid	1.25	1.25
	Calcium ion	0.03	0.03
	Minors and water	Balance to 100	
	pH at concentration of 10% in water at		
35	68°F (20°C)	8.45	8.45



CLAIMS

1. A heavy-duty liquid detergent composition comprising, by weight:

5 (a) from 5% to 15%, on an acid basis, of a sulfonate surfactant containing a C_{10} - C_{16} alkyl or alkenyl group;

(b) from 8% to 18%, on an acid basis, of an alcohol ethoxylate sulfate surfactant of the formula $RO(C_2H_4O)_mSO_3M$, wherein R is a C_{10} - C_{16} alkyl or hydroxyalkyl group, m is from 0.5 to 4, and
10 M is a compatible cation;

(c) from 2% to 15% of an ethoxylated nonionic surfactant of the formula $R^1(OC_2H_4)_nOH$, wherein R^1 is a C_{10} - C_{16} alkyl group or a C_8 - C_{12} alkyl phenyl group, n is from 3 to 9, and said nonionic
15 surfactant has an HLB of from 10 to 13;

(d) from 0% to 5% of a cosurfactant selected from

(i) quaternary ammonium surfactants having the formula:

20 $[R^2(OR^3)_y][R^4(OR^3)_y]_2R^5N^+X^-$

wherein R^2 is an alkyl or alkyl benzyl group having from 6 to 16 carbon atoms in the alkyl chain; each R^3 is selected from

25 $-CH_2CH_2-$, $-CH_2CH(CH_3)-$, $-CH_2CH(CH_2OH)-$, $-CH_2CH_2CH_2-$, and mixtures thereof; each R^4 is selected from

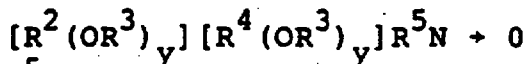
C_1 - C_4 alkyl, C_1 - C_4 hydroxyalkyl, benzyl, and hydrogen when y is not 0; R^5 is the same as R^4 or is an alkyl chain wherein the total number of carbon atoms of R^2 plus R^5 is from 8 to 16; each y is
30 from 0 to 10 and the sum of the y values is from 0 to 15; and X is any compatible anion;

(ii) amine surfactants having the formula:

$[R^2(OR^3)_y][R^4(OR^3)_y]R^5N$
wherein R^2 , R^3 , R^4 , R^5 and y are as defined above;



35 (iii) amine oxide surfactants having the formula:



wherein R^2 , R^3 , R^4 , R^5 and y are as defined above;

(e) from 5% to 20% of a C_{10} - C_{14} saturated fatty acid, the weight ratio of C_{10} - C_{12} fatty acid to C_{14} fatty acid being at least 1;

(f) from 3% to 8%, on an acid basis, of a water-soluble polycarboxylate builder material;

(g) from 0 to 0.04 moles per 100 grams of composition of an alkanolamine selected from monoethanolamine, diethanolamine and triethanolamine;

(h) potassium and sodium ions in a potassium to sodium molar ratio of from 0.1 to 1.3;

(i) from 2% to 10% ethanol;

(j) from 2% to 15% of a polyol containing from 2 to 6 carbon atoms and from 2 to 6 hydroxy groups; and

(k) from 25% to 40% water;

said composition containing from 20% to 35% of (a), (b), (c) and (d); from 8% to 28% of (e) and (f); from 33% to 50% of (a), (b), (c), (d), (e) and (f); from 8% to 20% of (i) and (j); and from 35% to 55% of (i), (j) and (k); the weight ratio of (a) to (b) being from 0.3 to 1.7; the weight ratio of (a) plus (b) to (c) being from 1 to 10; and all of said components being selected to provide an isotropic liquid at 55°F (12.8°C) having an initial pH of from 7.5 to 9.0 at a concentration of 10% by weight in water at 68°F (20°C), and wherein are excluded liquid detergent compositions comprising odour-purified proteolytic enzymes which have no detectable odour at a concentration of less than 0.002 Anson units per gram of distilled water as determined by averaging the concentrations at which a panel of at least 3 expert graders first detects protease odour.



2. The composition of Claim 1 wherein the sulfonate surfactant is a C_{11} - C_{13} linear alkylbenzene sulfonate; in the alcohol ethoxylate sulfate surfactant, R is a C_{12} - C_{15} alkyl group and m is from 1.5 to 3; and in the ethoxylated nonionic surfactant, R is a C_{12} - C_{14} alkyl group and n is from 3 to 7.
3. The composition of Claim 1 comprising from 0.5% to 1.5% of the cosurfactant, which is a C_{10} - C_{14} alkyl trimethylammonium chloride, bromide or methylsulfate.
4. The composition of Claim 1 wherein the polycarboxylate builder is citric acid.
5. The composition of Claim 1 comprising from 0.01 to 0.035 moles per 100 grams of composition of the alkanolamine, which is monoethanolamine.
6. The composition of Claim 2 comprising from 6% to 10% of the sulfonate surfactant, from 9% to 14% of the alcohol ethoxylate sulfate surfactant, from 4% to 10% of the ethoxylated nonionic surfactant, and from 0.5% to 1.5% of the cosurfactant, which is a C_{10} - C_{14} alkyl trimethylammonium chloride, bromide or methylsulfate.
7. The composition of Claim 6 comprising from 10% to 16% of the saturated fatty acid and from 3% to 6% of the polycarboxylate builder, which is citric acid.
8. The composition of Claim 7 comprising from 0.01 to 0.035 moles per 100 grams of composition of the alkanolamine, which is monoethanolamine.

9. The composition of Claim 8 comprising from 5% to 9% of ethanol, from 3% to 10% of the polyol, which is propylene glycol, and from 28% to 37% of water.

10. The composition of Claim 9 having an initial pH of from 7.8 to 8.8 at a concentration of 10% by weight in water at 68°F (20°C).
