**United States Statutory Invention Registration**

Reg. Number: H1513

Published: Jan. 2, 1996

**References Cited**

U.S. PATENT DOCUMENTS

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**ABSTRACT**

Detergent compositions comprise oleoyl sarcosinate and polyhydroxy fatty acid amide surfactants which, together, provide compositions with improved cleaning performance and good solubility. Thus, oleoyl sarcosinate is combined with C10-C18 N-methyl glucamide and builders, enzymes and other detergent ingredients to provide a laundry detergent. Use of this mixture of surfactants in dishwashing detergents is also described.

15 Claims, No Drawings

**OTHER PUBLICATIONS**

Chemical Abstracts No. 61:3244q “Different Electrostatic Behavior of Lubricated Fibers” 1964 (no month available).

Chemical Abstracts No. 70:58865x “Sizing Compositions for Polyolefin Filaments” 1969 (no month available).


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OLEOYL SARCOSINATE WITH POLYHYDROXY FATTY ACID AMIDES IN CLEANING PRODUCTS

FIELD OF THE INVENTION

The present invention relates to the use of oleoyl sarcosinate in combination with polyhydroxy nonionic surfactants to provide improved detergents compositions.

BACKGROUND OF THE INVENTION

The formulation of effective laundry detergent compositions which are sufficiently robust to remove a wide variety of soils and stains from fabrics under a variety of usage conditions remains a considerable challenge to the industry. This is especially true since the advent of legislation which limits the use of effective phosphate builders in many regions of the world.

Most conventional detergent compositions contain mixtures of various detergents surfactants in order to remove a wide variety of soils and stains from fabrics. For example, various anionic surfactants, especially the alkyl benzene sulfonates, are useful for removing particulate soils, and various nonionic surfactants, such as the alkyl ethoxylates and alkylphenol ethoxylates are useful for removing greasy soils. Accordingly, mixtures of anionic and nonionic surfactants are used in many modern detergent compositions.

While a review of the literature would seem to suggest that a wide selection of surfactants is available to the detergent manufacturer, the reality is that many such materials are specialty chemicals which are not suitable for routine use in low unit cost items such as home laundering compositions. The fact remains that most home-use detergents still comprise one or more of the conventional ethoxylated nonionic and alkyl sulfate or alkyl benzene sulfonate anionic surfactants, presumably due to the economic and performance considerations.

It has recently been discovered that the class of nonionic surfactants which comprise the polyhydroxy fatty acid amides can deliver desirable cleaning properties when properly formulated in laundry and dishwashing compositions. The polyhydroxy fatty acid amides, especially those based on N-methylglucamine, are available from renewable resources such as vegetable oils and sugars, and are biodegradable. In use, this class of nonionic surfactants provides quite low interfacial tensions, which results in excellent cleaning of greasy/oily stains and soils.

Unfortunately, one of the most commonly used anionic surfactants, the alkyl benzene sulfonates (LAS) may not always be optimal for use in combination with the important class of polyhydroxy fatty acid amide nonionic surfactants. Under well-built conditions, at high temperatures, such combinations perform well. However, in cases where there are significant amounts of free water hardness, performance is substantially reduced. It may be speculated that some form of complex or undesirable phase behavior in the mixed system diminishes the overall effectiveness of the compositions. Moreover, use of the alkyl benzene sulfonates in combination with polyhydroxy fatty acid amides is not preferred when detergent enzymes are present in the compositions. Accordingly, it has been necessary to seek suitable anionic surfactants to substitute for the alkyl benzene sulfonates.

By the practice of the present invention, oleoyl sarcosinate is employed as the anionic surfactant in conjunction with polyhydroxy fatty acid amide surfactants to provide improved cleaning benefits, particularly when laundering fabrics. The compositions are advantageously water-soluble over a broad range of temperatures, are easy to formulate, and would appear to have no untoward interaction with most detergent ingredients. Use of the combination of oleoyl sarcosinate with the polyhydroxy fatty acid amide and enzymes appears to provide superior stability and oily stain removal performance. Moreover, the compositions provide low interfacial tensions and excellent cleaning even in nonphosphate built compositions, especially with zeolite or silicate detergent builders. Improved cleaning of body soils from fabrics is thus secured. Improved removal of stains such as shoe polish, lipstick, clay, coffee and meat sauce is also noted. The compositions also provide excellent color care for dyed fabrics and excellent skin mildness for hand-wash operations. Accordingly, the present invention overcomes many of the problems associated with known technologies and provides excellent detergent compositions for use in a wide variety of cleaning operations, as will be seen from the following disclosures.

BACKGROUND ART


Polyhydroxy fatty acid amide surfactants are disclosed, for example, in U.S. Pat. Nos. 5,194,639; 2,965,576; 2,703,798; 1,985,424 and GB 809,060.

SUMMARY OF THE INVENTION

The present invention encompasses cleaning compositions which comprise:

(a) at least about 0.5%, by weight, of oleoyl sarcosinate; and
(b) at least about 1%, by weight, of a polyhydroxy fatty acid amide surfactant.

In a preferred embodiment, the polyhydroxy fatty acid amide is a member selected from the group consisting of the C12-18 fatty acid amides of N-methyl glucamine, the C10-C18 fatty acid amides of N-(3-methoxypropyl) glucamine, and mixtures thereof. In a highly preferred mode, such compositions comprise at least about 3%, by weight, of a mixture of said surfactants (a) and (b), and most preferably comprise from about 3% to about 55% of a mixture of surfactants (a) and (b), at a weight ratio of (a):(b) in the range from about 1:10 to about 10:1, especially from about 1:1 to about 3:1.

Fully formulated detergent compositions herein will additionally comprise: various adjunct materials such as detergency builders; enzymes; soil release agents; dye transfer inhibitors; bleach; various other non-oleoyl sarcosinate, nonpolyhydroxy fatty acid amide detergent surfactants; dispersing agents; suds suppressors; and the like, and mixtures thereof, according to the desires of the formulator and the intended end-use of the compositions.

The invention also encompasses a method for cleaning surfaces, especially fabrics and dishes, comprising contacting said surfaces with an aqueous medium which contains at least about 50 ppm, preferably from about 100 to about 10,000 ppm, of a composition according to the invention, preferably with agitation.
All percentages, ratios and proportions herein are by weight, unless otherwise specified. All documents cited are, in relevant part, incorporated herein by reference.

**DETAILED DESCRIPTION OF THE INVENTION**

**Oleoyl Sarcosinate:**

The present invention compositions comprise oleoyl sarcosinate, in its acid and/or salt form selected as desired for the compositions and uses herein, having the following formula:

![Chemical Structure](image)

wherein M is hydrogen or a cationic moiety. Preferred M are hydrogen and alkali metal salts, especially sodium and potassium. Oleoyl sarcosinate is commercially available, for example as Hampsoyl O supplied by W. R. Grace & Co. Compositions according to the present invention typically comprise from about 0.5% to about 55%, preferably from about 1% to about 20%, and most preferably from about 3% to about 15%, of oleoyl sarcosinate by weight of the composition.

In addition to the commercially-available oleoyl sarcosinate, oleoyl sarcosinate useful herein can also preferably be prepared from the ester (preferably the methyl ester) of oleic acid and a sarcosine salt (preferably the sodium salt) under anhydrous reaction conditions in the presence of a base catalyst with a basicity equal to or greater than alkoxide catalyst (preferably sodium methoxide). For example, the reaction may be illustrated by the scheme:

![Chemical Reaction](image)

This salt may optionally be neutralized to form the oleoyl sarcosinate in its acid form.

The preferred method for preparing oleoyl sarcosinate is conducted at a temperature from about 80°C to about 200°C, especially from about 120°C to about 200°C. It is preferred to conduct the reaction without solvent although alcohol solvents which have a boiling point of at least 100°C and are stable to the reaction conditions (i.e. glycerol is not acceptable) can be used. The reaction may proceed in about 85% yield with a molar ratio of methyl ester reactant to sarcosine salt reactant to basic catalyst of about 1:1:0.05-0.2.

Methyl ester mixtures derived from high oleic content natural oils (preferably having at least about 60%, more preferably at least about 75%, and most preferably at least about 90% oleic content) are especially preferred as starting materials. Examples include high-oleic sunflower and rapeseed/canola oil. In addition, a high-oleic methyl ester fraction derived from either palm kernel oil or tallow is acceptable. It is to be understood that such oils typically will contain some levels of impurities, including some fatty acid impurities that may be convened to sarcosinate compounds by this synthesis method. For example, commodity canola/rapeseed oil may comprise a majority of oleic acid, and a mixture of fatty acid impurities such as palmitic, stearic, linoleic, linolenic and/or eicosenoic acid, some or all of which are convened to the sarcosinate by this reaction method. If desired for formulation purposes, some or all of such impurity materials may be excluded from the starting oil before preparing the oleoyl sarcosinate to be used in the present compositions.

Finally, sarcosine remaining in the reaction mixture can be converted to an amide by addition of maleic or acetic anhydride to the mixture, thereby minimizing the sarcosine content and any potential for formation of undesired nitrogen-containing impurities.

The synthesis of oleoyl sarcosinate may be carried out as follows to prepare the sodium oleoyl sarcosinate.

**Synthesis of Oleoyl Amide of Sarcosine Sodium Salt—** A 2 L, 3-neck, round bottom flask is fitted with thermometer, Dean-Stark trap with condenser, mechanical stirring, and a gas inlet adapter through which nitrogen is passed over the reaction mixture. The reaction vessel is charged with sarcosine (43.3 g, 0.476 mol), sodium methoxide 25% in methanol (97.7 g, 0.452 mol), and methanol (400 mL). The reaction is refluxed 15 min to neutralize the sarcosine and then methyl ester derived from Cargill regular high-oleic sunflower oil (148.25 g, 0.5 mol) is added. After the methanol is removed with the Dean-Stark trap, reaction mixture is heated to 170°C for 1 hr to drive off any water. The reaction is initiated by the addition of sodium methoxide 25% in methanol (13.4 g, 0.0714 mol). Reaction is kept at 170°C for 2.5 hr during which methanol is collected in the Dean-Stark trap. The reaction is allowed to cool slightly and then methanol (200 g) is added. Maleic anhydride (9.43 g, 0.095 mol) is added to the methanol solution and the reaction is stirred at 60°C for 0.5 hr. Then most of the methanol is removed by rotary evaporation and acetone (2 L) is added to precipitate the product. The product is collected by suction filtration and allowed to air dry to give an off-white solid. Analysis of the reaction mixture by GC indicates the majority of the product is oleoyl sarcosinate, with minor amounts of the following impurities: sarcosine, oleic acid, and the sarcosinates derived from palmitic acid, stearic acid, and linoleic acid.

**Polyhydroxy Fatty Acid Amide Surfactants:**

The N-alkoxy, N-aryloxy polyhydroxy fatty acid amide surfactants used herein comprise materials of the formula:

![Chemical Structure](image)
wherein in formulas (I) and (II): $R^3$ is C$_2$-C$_{21}$ hydrocarbyl, preferably C$_3$-C$_{17}$ hydrocarbyl, including straight-chain and branched-chain alkyl and alkoxyl, or mixtures thereof; $R^3$ is C$_2$-C$_6$ hydrocarbyl including straight-chain, branched-chain and cyclic (including aryl), and is preferably C$_2$-C$_5$ alkylene, i.e., -CH$_2$CH$_2$-, -CH$_2$CH$_2$CH$_2$-, and -CH$_2$(CH$_2$)$_2$-, -CH$_2$(CH$_2$)$_3$CH$_2$--; $R^2$ is C$_2$-C$_6$ straight-chain, branched-chain and cyclic hydrocarbyl including aryl and oxy-hydrocarbyl, and is preferably C$_1$-C$_5$ alkyl or phenyl; $R^1$ is C$_1$-C$_6$ alkyl or hydroxyalkyl, including methyl (preferred), ethyl, propyl, isopropyl, butyl, pentyl, hexyl, 2-hydroxyethyl, 3-hydroxypropyl, and the like; and Z is a polyhydroxyhydrocarbyl moiety having a linear hydrocarbyl chain with at least 2 (in the case of glyceraldehyde) or at least 3 hydroxyls (in the case of other reducing sugars) directly connected to the chain, or an alkoxylated derivative (preferably ethoxylated or propoxylated) thereof. Z preferably will be derived from a reducing sugar in a reductive amination reaction; more preferably Z is a glycoly moiety. Suitable reducing sugars include glucose, fructose, maltose, lactose, galactose, mannose, and xylose, as well as glyceraldehyde. As raw materials, high dextrose corn syrup, high fructose corn syrup, and high maltose corn syrup can be utilized as well as the individual sugars listed above. These corn syrups may yield a mix of sugar components for Z. It should be understood that it is by no means intended to exclude other suitable raw materials. Z preferably will be selected from the group consisting of -CH$_2$-(CHOH)$_n$-CH$_2$OH, -CH$_2$(CHOH)$_2$-(CHOH)$_n$-CH$_2$OH, -CHOH-(CHOH)$_n$-(CHOH)-CHOH, where n is an integer from 1 to 5, inclusive, and $R^i$ is H or a cyclic mono- or poly-saccharide, and alkoxylated derivatives thereof. Most preferred are glycolsyl where n is 4, particularly -CH$_2$-(CHOH)$_4$-CH$_2$OH.

In compounds of the above formula (I), nonlimiting examples of the amine substituent group —$R^1$—O—$R^2$ can be, for example, 2-methoxyethyl, 3-methoxypropyl, 4-methoxybutyl, 5-methoxypentyl, 6-methoxyhexyl, 2-ethoxyethyl, 3-ethoxypropyl, 2-methoxypropyl, methoxybenzyl, 2-isopropoxypropyl, 3-isopropoxypropyl, 2-(isobutyl)ethyl, 3-(isobutyl)propyl, 2-(isobutoxyl)ethyl, 3-(isobutoxy)propyl, 2-butoxyethyl, 2-butoxyl, 2-phenethoxyl, methoxycyclohexyl, methoxycyclohexylmethyl, tetrahydrofuranyl, tetrahydropyranoxyl, 3-[2-methoxy]propyl, 2-[2-methoxy]methylyl, 3-[3-methoxy]propoxyl, 2-[3-methoxy]propoxyl] ethyl, 3-[methyl polyethyleneoxy]propyl, 3-[methyl polybutoxy]propyl, 3-[methylpropoxyl]propyl, CH$_3$O-CH$_2$CH(CHOH)$_n$- and CH$_3$OCH$_2$CH(CHOH)$_n$-O-(CH$_2$)$_n$. R ——N-C$_2$H$_5$ can be, for example, cocamide, stearamide, oleamide, lauramide, myristamide, capricamide, palmitamide, tallowamide, etc.

While the synthesis of N-alkoxy, N-aryloxy or N-alkyl, alkenyl and hydroxyalkyl polyhydroxy fatty acid amides can prospectively be conducted using various processes, contamination with cyclized by-products and other colored materials may be problematic. As an overall proposition, the synthesis method for these surfactants can comprise reacting the appropriate N-substituted aminopolys with fatty acid methyl esters or fatty acid glycerides with or without a solvent, but preferably using methanol or an ethoxylated alcohol such as NEODOL as a solvent, using an alkoxide catalyst at temperatures of about 200°C. to provide high yields (90-98%) of the products having desirable low levels (preferably, less than about 10%) of ester amide or cyclized by-products and also with improved color and improved color stability, e.g., Gardner Colors below about 4, preferably between 0 and 2. See, for example, U.S. Pat. No. 5,194,639 to Connor, Schebitz and Severson, issued Mar. 16, 1993. If desired, any unreacted amino polyol remaining in the product can be acylated with an acid anhydride, e.g., acetic anhydride, maleic anhydride, or the like, in water at 50°C.—85°C. to minimize the overall level of such residual amines in the product. Residual sources of straight-chain primary fatty acids, which can suppress suds, can be depleted by reaction with, for example, monoethanolamine at 50°C.—85°C.

If desired, the water solubility of the solid N-alkoxy polyhydroxy fatty acid amide surfactants herein can be enhanced by quick cooling from a melt. While not intending to be limited by theory, it appears that such quick cooling re-solidifies the melt into a metastable solid which is more soluble in water than the pure crystalline form of the N-alkoxy polyhydroxy fatty acid amide. Such quick cooling can be accomplished by any convenient means, such as by use of chilled (0°F.—10°C.) rollers, by casting the melt onto a chilled surface such as a chilled steel plate, by means of refrigerant coils immersed in the melt, or the like.

By "cyclized by-products" herein is meant the undesirable reaction by-products of the primary reaction wherein it appears that the multiple hydroxyl groups in the polyhydroxy fatty acid amides can form ring structures. It will be appreciated by those skilled in the chemical arts that the preparation of the polyhydroxy fatty acid amides herein using the dl- and higher saccharides, in addition to the mono- and di-amines will result in the formation of polyhydroxy fatty acid amides wherein linear substituent Z (which contains multiple hydroxy substituents) is naturally "capped" by a polyhydroxy ring structure. Such materials are not cyclized by-products, as defined herein.

The synthesis of compounds of type (II) is fully described in U.S. Pat. No. 5,194,639 cited above. The following illustrates the synthesis of the type (I) compounds in more detail.

Preparation of C$_2$H$_5$-(3-Methoxypropyl)glucamide

N-(3-methoxypropyl)glucamine, 1265 g (5.0 mole) is melted at 140°C. under nitrogen. A vacuum is pulled to 25 inches (635 mm) Hg for 10 minutes to remove gases and moisture. Propylene glycol, 100 g (1.43 mole) and CE 1295 fatty acid methyl ester, 1097 (5.1 mole; Procter & Gamble) are added to the preheated amine. Immediately following, 25% sodium methoxide, 54 g (0.25 mole) is added in halves. Reactants weight: 2525 g

Theoretical MeOH generated:

(5.0x32)+(0.75x54)+(0.24x32)= 208.5 g

Theory product: FW 436 2180 g 5.0 mole

The reaction mixture is homogeneous within 1 minute of adding the catalyst. It is cooled with warm H$_2$O to 85°C. and allowed to reflux in a 5-liter, 4-neck round bottom flask equipped with a heating mantle, Trubore stirrer with Teflon paddle, gas inlet and outlet, Thermowatch, condenser, and air drive motor. When catalyst is added, time = 0. At 60 minutes, a GC sample is taken and a vacuum of 7 inches (178 mm) Hg is started to remove methanol. At 120 minutes, another GC sample is taken and the vacuum has been increased to 12 inches (305 mm) Hg. At 180 minutes, another GC sample is taken and the vacuum has been increased to 20 inches (508 mm) Hg. After 180 minutes at 85°C., the remaining weight of methanol in the reaction is 2.9% based on the following calculation: 2386 g current
reaction wt. —(2525 g reactants wt. — 208.5 g theoretical MeOH) / 2386 g = 2.9% MeOH remaining in the reaction. After 180 minutes, the reaction is bottled and allowed to solidify at least overnight to yield the desired product.

Highly preferred compositions herein will comprise at least about 3%, most preferably from about 3% to about 25%, by weight, of the aforesaid polyhydroxy fatty acid amide surfactants.

Various optional adjacent ingredients may be used in combination with the oleyl sarcosinate and polyhydroxy fatty acid amide surfactants herein to provide fully-formulated cleaning compositions of various types. The following ingredients are described for the convenience of the formulator, but are not intended to be limiting.

**Builders**—Detergent builders can optionally be included in the compositions herein to assist in controlling mineral hardness. Inorganic as well as organic builders can be used. Builders are typically used in fabric laundering compositions to assist in the removal of particulate soils.

The level of builder can vary widely depending upon the end use of the composition and its desired physical form. Where present, the compositions will typically comprise at least about 1% builder. Liquid formulations typically comprise from about 5% to about 50%, more typically about 5% to about 30%, by weight, of detergent builder. Granular formulations typically comprise from about 10% to about 80%, more typically from about 15% to about 50% by weight, of the detergent builder. Lower or higher levels of builder, however, are not meant to be excluded.

Inorganic or P-containing detergent builders include, but are not limited to, the alkaline metal, ammonium and alkanolammonium salts of polyphosphates (exemplified by the tripolyphosphates, pyrophosphates, and glassy polymeric meta-phosphates), phosphonates, phytic acid, silicates, carbonates (including bicarbonates and sesquicarbonates), sulphates, and aluminosilicates. However, non-phosphate builders are required in some locales. Importantly, the compositions herein function surprisingly well even in the presence of the so-called “weak” builders (as compared with phosphates) such as citrate, or in the so-called “underbuilt” situation that may occur with zeolite or layered silicate builders.

Examples of silicate builders are the alkaline metal silicates, particularly those having a SiO₂:Na₂O ratio in the range 1.0:1 to 3.2:1 and layered silicates, such as the layered sodium silicates described in U.S. Pat. No. 4,664,839, issued May 12, 1987 to H. P. Rice. NaSKS-6 is the trademark for a crystalline layered silicate marketed by Hoechst (commonly abbreviated herein as “SKS-6”). Unlike zeolite builders, the NaSKS-6 silicate builder does not contain aluminum. NaSKS-6 has the delta-Na₂SiO₅ morphology form of layered silicate. It can be prepared by methods such as those described in German DE-A-3,417,649 and DE-A-3,742,043.

SKS-6 is a highly preferred layered silicate for use herein, but other such layered silicates, such as those having the general formula Na₂MOSiO₂-SiO₂, where M is sodium or hydrogen, x is a number from 1.9 to 4, preferably 2, and y is a number from 0 to 20, preferably 0 can be used herein. Various other layered silicates from Hoechst include NaSKS-5, NaSKS-7 and NaSKS-11, as the alpha, beta and gamma forms. As noted above, the delta-Na₂SiO₅ (NaSKS-6 form) is most preferred for use herein. Other silicates may also be useful such as for example magnesious silicate, which can serve as a crimping agent in granular formulations, as a stabilizing agent for oxygen bleaches, and as a component of Suds control systems.

Examples of carbonate builders are the alkaline earth and alkanol metal carbonates as discussed in German Patent Application No. 2,921,001 published on Nov. 15, 1973.

Aluminosilicate builders are useful in the present invention. Aluminosilicate builders are of great importance in most currently marketed heavy duty granular detergent compositions, and can also be a significant builder ingredient in liquid detergent formulations. Aluminosilicate builders include those having the empirical formula:

\[ \text{M}_{x+y} (\text{AlO}_x \text{SiO}_y)_z \text{H}_2 \text{O} \]

where \( x \) and \( y \) are integers usually of at least 6, the molar ratio of \( z \) to \( y \) is in the range from 1.0 to 0, and \( x \) is an integer from 0 to about 264, and \( M \) is a Group IA or IIa element, e.g., Na, K, Mg, Ca with valence \( n \).

Useful aluminosilicate ion exchange materials are commercially available. These aluminosilicates can be crystalline or amorphous in structure and can be naturally-occurring aluminosilicates or synthetically derived. A method for producing aluminosilicate ion exchange materials is disclosed in U.S. Pat. No. 3,985,669, Krummel, et al., issued Oct. 12, 1976. Preferred synthetic crystalline aluminosilicate ion exchange materials useful herein are available under the designations Zeolite A, Zeolite P (B), Zeolite MAP and Zeolite X. In an especially preferred embodiment, the crystalline aluminosilicate ion exchange material has the formula:

\[ \text{Na}_{x+y} (\text{AlO}_x \text{SiO}_y)_z \text{H}_2 \text{O} \]

where \( x \) is from about 20 to about 30, especially about 27. This material is known as Zeolite A. Dehydrated zeolites (\( x=0 \) to 10) may also be used herein. Preferably, the aluminosilicate has a particle size of about 0.1-10 microns in diameter.

Organic detergent builders suitable for the purposes of the present invention include, but are not restricted to, a wide variety of polycarboxylate compounds. As used herein, ‘polycarboxylate’ refers to compounds having a plurality of carboxylate groups, preferably at least 3 carboxylate groups. Polycarboxylate builder can generally be added to the composition in acid form, but can also be added in the form of a neutralized salt. When utilized in salt form, alkali metals, such as sodium, potassium, and lithium, or alkanolammonium salts are preferred.

Included among the polycarboxylate builders are a variety of categories of useful materials. One important category of polycarboxylate builders encompasses the ether polycarboxylates, including oxysuccinate, as disclosed in Berg, U.S. Pat. No. 3,128,287, issued Apr. 7, 1964, and Lambert et al., U.S. Pat. No. 3,635,830, issued Jan. 18, 1972. See also “TMS/TDS” builders of U.S. Pat. No. 4,663,071, issued to Bush et al., May 5, 1987. Suitable ether polycarboxylates also include cyclic compounds, particularly cyclic compounds, such as those described in U.S. Pat. Nos. 3,923,679; 3,835,163; 4,158,635; 4,102,874 and 4,102,903.

Other useful detergent builders include the ether hydroxypolycarboxylates, copolymer of maleic anhydride with ethylene or vinyl methyl ether, 1, 3, 5-trihydroxy benzene-2, 4, 6-trisulfonic acid, and carboxymethylxysuccinic acid, the various alkaline metal, ammonium and substituted ammonium salts of polycarboxylic acids such as ethylenediamine tetraacetic acid and nitritotriacetic acid, as well as polycarboxylates such as mellitic acid, succinic acid, oxysuccinic acid, polymaleic acid, benzene 1,3,5-tricarboxylic acid, carboxymethylxysuccinic acid, and soluble salts thereof.
Citrates builders, e.g., citric acid and soluble salts thereof (particularly sodium salt), are polycarboxylate builders of particular importance for heavy duty liquid detergent formulations due to their availability from renewable resources and their biodegradability. Citrates can also be used in granular compositions, especially in combination with zeolite and/or layered silicate builders. Oxydisuccinates are also especially useful in such compositions and combinations.

Also suitable in the detergent compositions of the present invention are the 3,3-dicarboxy-4-oxa-1,6-hexanediolates and the related compounds disclosed in U.S. Pat. No. 4,566,984, Bush, issued Jan. 28, 1986. Useful succinic acid builders include the C6-C20 alkyl and alkenyl succinic acids and salts thereof. A particularly preferred compound of this type is dodecensuccinic acid. Specific examples of succinate builders include laurylsuccinate, myristylsuccinate, palmitylsuccinate, 2-dodecensuccinate (preferred), 2-pentadecysuccinate, and the like. Laurysuccinates are the preferred builders of this group, and are described in European Patent Application 86200695.0/200,263, published Nov. 5, 1986.


Fatty acids, e.g., C12-C18 monocarboxylic acids such as oleic acid and/or its salts, can also be incorporated into the compositions alone, or in combination with the aforesaid builders, especially citrate and/or the succinate builders, to provide additional builder activity. Such use of fatty acids will generally result in a diminution of sudsing, which should be taken into account by the formulator.

In situations where phosphorus-based builders can be used, and especially in the formulation of bars used for hand-laundrying operations, the various alkali metal phosphates such as the well-known sodium tripolyphosphate, sodium pyrophosphate and sodium orthophosphate can be used. Phosphonate builders such as ethane-1,2-diphosphates and other known phosphonates (see, for example, U.S. Pat. Nos. 3,159,581; 3,213,030; 3,422,021; 3,400,148 and 3,422,157) can also be used.

Enzymes—Enzymes can be included in the formulations herein for a wide variety of fabric laundering purposes, including removal of protein-based, carbohydrate-based, or triglyceride-based stains, for example, and for the prevention of refugee dye transfer, and for fabric restoration. The enzymes to be incorporated include proteases, amylases, lipases, cellulases, and peroxidases, as well as mixtures thereof. Other types of enzymes may also be included. They may be of any suitable origin, such as vegetable, animal, bacterial, fungal and yeast origin. However, their choice is governed by several factors such as pH activity and/or stability optima, thermostability, stability versus active detergents, builders and so on. In this respect bacterial or fungal enzymes are preferred, such as bacterial amylases and proteases, and fungal cellulases.

Enzymes are normally incorporated at levels sufficient to provide up to about 5 mg by weight, more typically about 0.001 mg to about 3 mg, of active enzyme per gram of the composition. Stated otherwise, the compositions herein will typically comprise from about 0.001% to about 5%, preferably 0.01%-2% by weight of a commercial enzyme preparation. Protease enzymes 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.

Suitable examples of proteases are the subtilisins which are obtained from particular strains of B. subtilis and B. licheniformes. Another suitable protease is obtained from a strain of Bacillus, having maximum activity throughout the pH range of 8-12, developed and sold by Novo Industries A/S under the registered trade name ESPERASE. The preparation of this enzyme and analogous enzymes is described in British Patent Specification No. 1,243,784 of Novo. Proteolytic enzymes suitable for removing protein-based stains that are commercially available include those sold under the tradenames ALCALASE and SAVINASE by Novo Industries A/S (Denmark) and MAXATASE by International Bio-Synthetics, Inc. (The Netherlands). See also European Patent Application 130,756, published Jan. 9, 1985 and European Patent Application Serial No. 87302761.8, filed Apr. 28, 1987. Most preferred is what is called "Protease C", which is a variant of an alkaline serine protease from Bacillus, particularly Bacillus licheniformis, in which arginine replaced lysine at position 27, tyrosine replaced valine at position 104, serine replaced asparagine at position 123, and alanine replaced threonine at position 274. Protease C is described in EP 90015958.4; U.S. Pat. No. 5,185,250; and U.S. Pat. No. 5,204,015. Also preferred are protease which are described in copending application U.S. Ser. No. 08/136,797, entitled Protease-containing Cleaning Compositions and copending Application U.S. Ser. No. 08/136,626, entitled Bleaching Compositions Comprising Protease Enzymes, which are incorporated herein by reference. Genetically modified variants, particularly of Protease C, are also included herein.

Amylases include, for example, α-amylases described in British Patent Specification No. 1,296,839 (Novo), RAPIDASE, International Bio-Synthetics, Inc. and TER-MAMYL, Novo Industries.

The cellulase usable in the present invention include both bacterial or fungal cellulase. Preferably, they will have a pH optimum of between 5 and 9. Suitable cellulases are disclosed in U.S. Pat. No. 4,435,307, Barbesgaard et al, issued Mar. 6, 1984, which discloses fungal cellulase produced from Humicola insolens and Humicola strain DSM1800 or a cellulase 212-producing fungus belonging to the genus Aeromonas, and cellulase extracted from the hepatopancreas of a marine mollusk (Dolabella Auricula Solander). Suitable cellulases are also disclosed in GB-A-2,075,028; GB-A-2,095,375 and DE-OS-2,247,832. CAREZYMEX (Novo) is especially useful.

Suitable lipase enzymes for detergent usage include those produced by microorganisms of the Pseudomonas group, such as Pseudomonas stutzeri ATCC 19,154, as disclosed in British Patent 1,372,034. See also lipases in Japanese Patent Application 53,204,487, laid open to public inspection on Feb. 24, 1978. This lipase is available from Amaro Pharmaceutical Co., Ltd., Nagoya, Japan, under the trade name Lipase P “Amano,” hereinafter referred to as “Amano-P.” Other commercial lipases include Amaro-CES, lipases ex Chromobacter viscous, e.g. Chromobacter viscous var. lipolyticum NRRL 3673, commercially available from Toyobo Co., Tagata, Japan; and further Chromobacter viscous lipases from U.S. Biochemical Corp., U.S.A. and Disoynt Co., The Netherlands, and lipases ex Pseudomonas gladioli. The LIPOLASE enzyme derived from Humicola lanuginosa and commercially available from Novo (see also EPO 341,947) is a preferred lipase for use herein.

Peroxidase enzymes are used in combination with oxygen sources, e.g., percarbonate, perborate, persulfate, hydrogen peroxide, etc. They are used for “solution bleaching,” i.e. to prevent transfer of dyes or pigments removed from substrates during wash operations to other substrates in the wash solution. Peroxidase enzymes are known in the art, and
include, for example, horseradish peroxidase, ligninase, and haloperoxidase such as chloro- and bromo-peroxidase. Peroxidase-containing detergent compositions are disclosed, for example, in PCT International Application WO 89/09091, published Oct. 19, 1989, by O. Kirk, assigned to Novo Industries A/S. It may be desired to use, in combination with these peroxidases, materials viewed as being peroxidase accelerators such as phenolsulfonate and/or phenothiazine.

A wide range of enzyme materials and means for their incorporation into synthetic detergent compositions are also disclosed in U.S. Pat. No. 3,553,139, issued Jan. 5, 1971 to McCarty et al. Enzymes are further disclosed in U.S. Pat. No. 4,101,457, Place et al, issued Jul. 18, 1978, and in U.S. Pat. No. 4,507,219, Hughes, issued Mar. 26, 1985, both.

Enzyme materials useful for liquid detergent formulations, and their incorporation into such formulations, are disclosed in U.S. Pat. No. 4,261,868, Hora et al, issued April 14, 1981.

Enzyme Stabilizers—Enzymes for use in detergents can be stabilized by various techniques. Enzyme stabilization techniques are disclosed and exemplified in U.S. Pat. No. 3,600,319, issued August 17, 1971 to Gedge, et al, and European Patent Application Publication No. 0 199 405, Application No. 86200586.5, published October 29, 1986, Venegas. Enzyme stabilization systems are also described, for example, in U.S. Pat. No. 3,519,570. The enzymes employed herein can be stabilized by the presence of water-soluble sources of calcium and/or magnesium ions in the finished compositions which provide such ions to the enzymes. (Calcium ions are generally somewhat more effective than magnesium ions and are preferred herein if only one type of cation is being used.)

Additional stability can be provided by the presence of various other art-disclosed stabilizers, especially borate species: see Severson, U.S. 4,537,706. Typical detergents, especially liquids, will comprise from about 1 to about 30, preferably from about 2 to about 20, more preferably from about 5 to about 15, and most preferably from about 8 to about 12, millimoles of calcium ion per liter of finished composition. This can vary somewhat, depending on the amount of enzyme present and its response to the calcium or magnesium ions. The level of calcium or magnesium ions should be selected so that there is always some minimum level available for the enzyme, after allowing for complexation with builders, fatty acids, etc., in the composition. Any water-soluble calcium or magnesium salt can be used as the source of the calcium or magnesium ions, including, but not limited to, calcium chloride, calcium sulfate, calcium malate, calcium maleate, calcium hydroxide, calcium formate, and calcium acetate, and the corresponding magnesium salts. A very small amount of calcium ion, generally from about 0.05 to about 0.4 millimoles per liter, is often also present in the composition due to calcium in the enzyme slurry and formula water. In solid detergent compositions the formulation may include a sufficient quantity of a water-soluble calcium ion source to provide such amounts in the laundry liquor. In the alternative, natural water hardness may suffice.

It is to be understood that the foregoing levels of calcium and/or magnesium ions are sufficient to provide enzyme stability. More calcium and/or magnesium ions can be added to the compositions to provide an additional measure of grease removal performance. Accordingly, as a general proposition the compositions herein will typically comprise from about 0.05% to about 2% by weight of a water-soluble source of calcium or magnesium ions, or both. The amount can vary, of course, with the amount and type of enzyme employed in the composition.

The compositions herein may also optionally, but preferably, contain various additional stabilizers, especially borate-type stabilizers. Typically, such stabilizers will be used at levels in the compositions from about 0.25% to about 10%, preferably from about 0.5% to about 5%, more preferably from about 0.75% to about 4%, by weight of boric acid or other borate compound capable of forming boric acid in the composition (calculated on the basis of boric acid).

Boric acid is preferred, although other compounds such as borate oxide, borax and other alkali metal borates (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. It is to be recognized that such materials may also be used in formulations as the sole stabilizer as well as being used in combination with added calcium and/or magnesium ions. Finally, it may be desired to add chlorine scavengers, especially to protease-containing compositions, to protect the enzymes from chlorine typically present in municipal water supplies. Such materials are described, for example, in U.S. Pat. No. 4,810,413 to Pancheri et al.

Bleaches—The detergent compositions herein may optionally contain bleaching agents or bleaching compositions containing a bleaching agent and one or more bleach activators. When present, bleaching agents will typically be at levels of from about 1% to about 30%, more typically from about 5% to about 20%, of the detergent composition, especially for fabric laundering. If present, the amount of bleach activators will typically be from about 0.1% to about 60%, more typically from about 0.5% to about 40% of the bleaching composition comprising the bleaching agent-plus-bleach activator.

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

Another category of bleaching agent that can be used without restriction encompasses percarboxylic acid bleaching agents and salts thereof. Suitable examples of this class of agents include magnesium monoperoxyphtalate hexahydrate, the magnesium salt of meta-chloro perbenzoic acid, 4-nonylaminobenzoic acid and diperoxodicacetic acid. Such bleaching agents are disclosed in U.S. Pat. No. 4,483,781, Hartman, issued Nov. 20, 1984, U.S. patent application No. 740,446, Burn et al, filed Jun. 3, 1985, European Patent Application 0,133,354, Banks et al, published Feb. 20, 1985, and U.S. Pat. No. 4,412,934, Chung et al, issued Nov. 1, 1984. Highly preferred bleaching agents also include 6-nonylaminom-6-oxoperoxyacetic acid as described in U.S. Pat. No. 4,634,551, issued Jan. 6, 1987 to Burns et al.

Peroxide bleaching agents can also be used. Suitable peroxo bleaching compounds include sodium carbonate peroxide and equivalent "percarbonate" bleaches (preferred), sodium pyrophosphate peroxide, urca peroxo- hydrate, and sodium peroxide. Persulfate bleach (e.g., OXONE, manufactured commercially by DuPont) can also be used.

A preferred percarbonate bleach comprises dry particles having an average particle size in the range of from about 500 micrometers to about 1,000 micrometers, not more than about 10% by weight of said particles being smaller than about 200 micrometers and not more than about 10% by weight of said particles being larger than about 1,250
micrometers. Optionally, the percarbonate can be coated with silicate, borate or water-soluble surfactants. Percarbonate is available from various commercial sources such as FMC, Solvay and Tokai Denka.

Mixtures of bleaching agents can also be used.

 Peroxyxenon bleaching agents, the perborates, the percarbonates, etc., are preferably combined with bleach activators, which lead to the in situ production in aqueous solution (i.e., during the washing process) of the peroxy acid corresponding to the bleach activator. Various nonlimiting examples of activators are disclosed in U.S. Pat. No. 4,915,854, issued Apr. 10, 1990 to Mao et al., and U.S. Pat. No. 4,412,934. The nonanoxybenzene sulfonate (NOBS) and tetraacetyl ethylene diamine (TAED) activators are typical, and mixtures thereof can also be used. See also U.S. Pat. No. 4,634,551 for other typical bleaches and activators useful herein.

Highly preferred amido-derived bleach activators are those of the formulae:

\[ \text{R}^1\text{NH}_{2}\text{COR}\text{COOL} \]

or

\[ \text{R}^1\text{COO}N\text{R}^2\text{H} \]

wherein \( \text{R}^1 \) is an alkyl group containing from about 6 to about 12 carbon atoms, \( \text{R}^2 \) is an alkylene containing from 1 to about 6 carbon atoms, \( \text{R}^2 \) is H or alkyl, aryl, or alkyaryl containing from about 1 to about 10 carbon atoms, and \( \text{L} \) is any suitable leaving group. A leaving group is any group that is displaced from the bleach activator as a consequence of the nucleophilic attack on the bleach activator by the perhydrolysis anion. A preferred leaving group is phenyl sulfonyl.

Preferred examples of bleach activators of the above formulae include (6-octanamido-caproyl)oxybenzenesulfonate, (6-nonanamido-caproyl)oxybenzenesulfonate, (6-decanamido-caproyl)oxybenzenesulfonate, and mixtures thereof as described in U.S. Pat. No. 4,634,551, incorporated herein by reference.

Another class of bleach activators comprises the benzoxazin-type activators disclosed by Hodge et al. in U.S. Pat. No. 4,966,723, issued Oct. 30, 1990, incorporated herein by reference. A highly preferred activator of the benzoxazin-type is:

\[ \text{O} \]

Still another class of preferred bleach activators includes the acyl lactam activators, especially acyl caprolactams and acyl valerolactams of the formulae:

\[ \text{R}^1\text{C}N\text{H}_2\text{CH} \]

wherein \( \text{R}^1 \) is H or an alkyl, aroyl, alkoxyaryl, or alkaryl group containing from 1 to about 12 carbon atoms. Highly preferred lactam activators include benzyol caprolactam, octanoyl caprolactam, 3,5,5-trimethylhexanoyl caprolactam, nonanoyl caprolactam, decanoyl caprolactam, undecenoyl caprolactam, benzoyl valerolactam, octanoyl valerolactam, decanoyl valerolactam, undecenoyl valerolactam, nonanoyl valerolactam, 3,5,5-trimethylhexanoyl valerolactam and mixtures thereof. See also U.S. Pat. No. 4,545,784, issued to Sanderson, Oct. 8, 1985, incorporated herein by reference, which discloses acyl caprolactams, including benzyol caprolactam, desorbed into sodium perborate.

Bleaching agents other than oxygen bleaching agents are also known in the art and can be utilized herein. One type of non-oxygen bleaching agent of particular interest includes photocatalytically activated bleaching agents such as the sulfonated zinc and/or aluminum phthalocyanines. See U.S. Pat. No. 4,033,718, issued Jul. 5, 1977 to Holcombe et al. If used, detergent compositions will typically contain from about 0.025% to about 1.25%, by weight, of such bleaches, especially sulfonate zinc phthalocyanine.

If desired, the bleaching compounds can be catalyzed by means of a manganese compound. Such complexes are well known in the art and include, for example, the manganese-based catalysts disclosed in U.S. Pat. No. 5,246,621, U.S. Pat. No. 5,244,594; U.S. Pat. No. 5,194,416; U.S. Pat. No. 5,114,606; and European Pat. App. Pub. Nos. 549,271A1, 549,272A1, 544,402A2, and 544,401A1; Preferred examples of these catalysts include \( \text{Mn}_{14}^{IV} \text{(u-O)}_2 \text{(1,4,7,tri-thienyl-1,4,7-triazacyclononane)}_2 \text{(PF}_6)_2 \), and \( \text{Mn}_{14}^{IV} \text{(u-O)}_2 \text{(1,4,7-trimethyl-1,4,7-triazacyclononan} \text{a)}_2 \text{(ClO}_4)_2 \), \( \text{Mn}_{14}^{IV} \text{(1,4,7-trimethyl-1,4,7-triazacyclononan} \text{e)}_2 \text{(OCH}_3)_2 \), and mixtures thereof. Other metal-based bleach catalysts include those disclosed in U.S. Pat. No. 4,430,243 and U.S. Pat. No. 5,114,611. The use of manganese with various complex ligands to enhance bleaching is also reported in the following U.S. Pat. Nos.: 4,728,455; 5,284,944; 5,246,612; 5,256,779; 5,280,117; 5,274,147; 5,153,161; and 5,227,084.

As a practical matter, and not by way of limitation, the compositions and processes herein can be adjusted to provide on the order of at least one part per ten million of the active bleach catalyst species in the aqueous washing liquor, and will preferably provide from about 0.1 ppm to about 700 ppm, more preferably from about 1 ppm to about 500 ppm, of the catalyst species in the laundry liquor.

Polymeric Soil Release Agent—Any polymeric soil release agent known to those skilled in the art can optionally be employed in the compositions and processes of this invention. Polymeric soil release agents are characterized by having both hydrophilic segments, to hydrophilize the surface of hydrophobic fibers, such as polyester and nylon, and hydrophobic segments, to deposit upon hydrophobic fibers and remain adhered thereto through completion of washing and rinsing cycles and, thus, serve as an anchor for the hydrophilic segments. This can enable stains occurring subsequent to treatment with the soil release agent to be more easily cleaned in later washing procedures.
The polymeric soil release agents useful herein especially include those soil release agents having: (a) one or more nonionic hydrophobe components consisting essentially of (i) polyoxyethylene segments with a degree of polymerization of at least 2, or (ii) oxypropylene or polyoxypropylene segments with a degree of polymerization of from 2 to 10, wherein said hydrophobe segment does not encompass any oxypropylene unit unless it is bonded to adjacent moieties at each end by ether linkages, or (iii) a mixture of oxalkylene units comprising oxyethylene and from 1 to about 30 oxypropylene units wherein said mixture contains a sufficient amount of oxyethylene units such that the hydrophobe component has hydrophilicity great enough to increase the hydrophilicity of conventional polyester synthetic fiber surfaces upon deposit of the soil release agent on such surface; said hydrophobe segments preferably comprising at least about 25% oxyethylene units and more preferably, especially for such components having about 20 to 30 oxypropylene units, at least about 50% oxyethylene units; or (b) one or more hydrophobe components comprising (i) C₃₋₅ oxyalkylene terephthalate segments, wherein, if said hydrophobe components also comprise oxyethylene terephthalate, the ratio of oxyethylene terephthalate: C₃₋₅ oxyalkylene terephthalate units is about 2:1 or lower, (ii) C₆₋₁₀ alkylene or ox C₂₋₅ alkylene segments, or mixtures therein, (iii) poly (vinyl ester) segments, preferably polyvinyl acetate, having a degree of polymerization of at least 2, or (iv) C₆₋₁₀ alkyl ether or C₆₋₁₀ hydroxalkyl ether substituents, or mixtures therein, wherein said substituents are present in the form of C₁₋₅ alkyl ether or C₆₋₁₀ hydroxalkyl ether cellulose derivatives, or mixtures therein, and such cellulose derivatives are amphiphilic, whereby they have a sufficient level of C₁₋₅ alkyl ether and/or C₆₋₁₀ hydroxalkyl ether units to deposit upon conventional polyester synthetic fiber surfaces and retain a sufficient level of hydroxyls, once adhered to such conventional synthetic fiber surface, to increase fiber surface hydrophilicity, or a combination of (a) and (b).

Typically, the polyoxyethylene segments of (a)(i) will have a degree of polymerization of from about 200, although higher levels can be used, preferably from 3 to about 150, more preferably from 6 to about 100. Suitable oxy C₂₋₅ alkylene hydrophobe segments include, but are not limited to, end-caps of polymeric soil release agents such as MO₃S(CH₂)nOCH₂CH₂O⁻, where M is sodium and n is an integer from 4–6, as disclosed in U.S. Pat. No. 4,721,580, issued Jan. 26, 1988 to Gosselin.

Polymeric soil release agents useful in the present invention also include cellulose derivatives such as hydroxyethy cellulose polymers, copolymeric blocks of ethylene terephthalate or propylene terephthalate with polyethylene oxide or polyoxypropylene oxide terephthalate, and the like. Such agents are commercially available and include hydroxyethers of cellulose such as METHOCEL (Dow). Cellulosic soil release agents for use herein also include those selected from the group consisting of C₁₋₅ alkyl and C₆₋₁₀ hydroxyalkyl cellulose; see U.S. Pat. No. 4,000,093, issued Dec. 28, 1976 to Nicol, et al.

Soil release agents characterized by poly(vinyl ester) hydrophobe segments include graft copolymers of poly(vinyl ester), e.g., C₁₋₅ vinyl esters, preferably poly(vinyl acetate) grafted onto polyalkylene oxide backbones, such as polyethylene oxide backbones. See European Patent Application 0 219 048, published Apr. 22, 1987 by Kud, et al. Commercially available soil release agents of this kind include the SOKALAN type of material, e.g., SOKALAN HP-22, available from BASF (West Germany).

One type of preferred soil release agent is a copolymer having random blocks of ethylene terephthalate and polyethylene oxide (PEO) terephthalate. The molecular weight of this polymeric soil release agent is in the range of from about 25,000 to about 55,000. See U.S. Pat. No. 3,959,230 to Hays, issued May 25, 1976 and U.S. Pat. No. 3,893,929 to Basadur issued Jul. 8, 1975.

Another preferred polymeric soil release agent is a poly-ester with repeat units of ethylene terephthalate units containing 10–15% by weight of ethylene terephthalate units together with 90–80% by weight of polyoxyethylene terephthalate units, derived from a polyoxyethylene glycol of average molecular weight 300–500. Examples of this polymer include the commercially available material ZEL- CON 5126 (from Dupont) and MILEASE T (from ICI). See also U.S. Pat. No. 4,702,857, issued Oct. 27, 1987 to Gosselin.

Another preferred polymeric soil release agent is a sulphonated product of a substantially linear ester oligomer comprised of an oligomeric ester backbone of terephthaloyl and oxoalkyleneoxide repeat units and terminal moieties covalently attached to the backbone. These soil release agents are described fully in U.S. Pat. No. 4,968,451, issued Nov. 6, 1990 to J. J. Scheibel and E. P. Gosselin. Other suitable polymeric soil release agents include the terephthaloyl polyesters of U.S. Pat. No. 4,711,730, issued Dec. 8, 1987 to Gosselin et al, the anionic end-capped oligomeric esters of U.S. Pat. No. 4,721,580, issued Jan. 26, 1988 to Gosselin, and the block polyester oligomeric compounds of U.S. Pat. No. 4,702,857, issued Oct. 27, 1987 to Gosselin.

Preferred polymeric soil release agents also include the soil release agents of U.S. Pat. No. 4,877,896, issued Oct. 31, 1989 to Maldonado et al, which discloses anionic, especially sulfoaryl, end-capped terephthalate esters.

Still another preferred soil release agent is an oligomer with repeat units of terephthaloyl units, sulfoisoterephthaloyl units, oxoalkyleneoxy and oxo-1,2-propylene units. The repeat units form the backbone of the oligomer and are preferably terminated with modified isothionate end-caps. A particularly preferred soil release agent of this type comprises about one sulfoisothialoyl unit, 5 terephthaloyl units, oxoalkyleneoxy and oxo-1,2-propyleneoxy units in a ratio of from about 1.7 to about 1.8, and two end-cap units of sodium 2-(2-hydroxyethoxy)-ethanesulfonate. Said soil release agent also comprises from about 0.5% to about 20%, by weight of the oligomer, of a crystalline-reducing stabilizer, preferably selected from the group consisting of xylene sulfonate, cumene sulfonate, toluene sulfonate, and mixtures thereof.

If utilized, soil release agents will generally comprise from about 0.01% to about 10.0%, by weight, of the detergent compositions herein, typically from about 0.1% to about 5%, preferably from about 0.2% to about 3.0%.

Clay Soil Removal/Anti-redeposition Agents—The compositions of the present invention can also optionally contain water-soluble ethoxylated amines having clay soil removal and antiredeposition properties. Granular detergent compositions which contain these compounds typically contain from about 0.01% to about 10.0% by weight of the water-soluble ethoxylates amines; liquid detergent compositions typically contain about 0.01% to about 5%.

The most preferred soil release and anti-redeposition agent is ethoxylated, tetraethylenepentamine. Exemplary ethoxylated amines are further described in U.S. Pat. No. 4,597,898, VanderMeer, issued Jul. 1, 1986. Another group of preferred clay soil removal-antiredeposition agents are the cationic compounds disclosed in European Patent Appli-
Other clay soil removal/antiredeposition agents which can be used include the ethoxylated amine polymers disclosed in European Patent Application 111,984, Gosselink, published Jun. 27, 1984; the zwitterionic copolymers disclosed in European Patent Application 112,592, Gosselink, published Jul. 4, 1984; and the amine oxides disclosed in U.S. Pat. No. 4,548,744, Connor, issued Oct. 22, 1985. Other clay soil removal and/or anti redeposition agents known in the art can also be utilized in the compositions herein. Another type of preferred antiredeposition agent includes the carboxy methyl cellulose (CMC) materials. These materials are well known in the art.

Polymeric Dispersing Agents—Polymeric dispersing agents can advantageously be utilized at levels from about 0.1% to about 7%, by weight, in the compositions herein. Suitable polymeric dispersing agents include polymeric polycarboxylates and polyethylene glycols, although others known in the art can also be used.

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, acrylonitrile, mesaconic acid, citraconic acid and methyl/maleinmalonic acid. The presence in the polymeric polycarboxylates herein or mono meric 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.

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, ammonium and substituted ammonium salts. Soluble polymers of this type are known materials. Use of polycarboxylates of this type in detergent compositions has been disclosed, for example, in Dietil, U.S. Pat. No. 3,308,067, issued Mar. 7, 1967.

Acrylic/maleic-based copolymers may also be used as a preferred component of the dispersing/anti-redeposition agent. Such materials include the water-soluble salts of copolymers of acrylic acid and maleic acid. The average molecular weight of such copolymers in the acid form preferably ranges from about 2,000 to 100,000. A preferred copolymer has an average molecular weight of about 2,000 to 15,000, more preferably about 6,000 to about 13,000, and most preferably about 7,000 to about 12,000. Other preferred copolymers have an average molecular weight from about 5,000 to 75,000, most preferably from about 7,000 to 65,000. The ratio of acrylic to maleate segments in such copolymers will generally range from about 30:1 to about 1:2, more preferably from about 10:1 to 1:1, and most preferably about 2.5:1 to 1:1. Water-soluble salts of such acrylic/maleic acid copolymers can include, for example, the alkali metal, ammonium and substituted ammonium salts. Soluble acrylate/maleate copolymers of this type are known materials which are described in European Patent Application No. 66915, published Dec. 15, 1982, as well as in EP 193,360, published Sep. 3, 1986, which also describes such polymers comprising hydroxypropylacrylate. Still other useful dispersing agents include the maleic/acrylic/vinyl alcohol terpolymers. Such materials are also disclosed in EP 193,360, including, for example, the 45/45/10 terpolymer of acrylic/maleic/vinyl alcohol.

Particularly preferred dispersant polymers are low molecular weight modified polycrylate copolymers. Such copolymers contain as monomer units: a) from about 90% to about 10%, preferably from about 80% to about 20% by weight acrylic acid or its salts and b) from about 10% to about 90%, preferably from about 20% to about 80% by weight of a substituted acrylic monomer or its salt and have the general formula: —[(RCOR)2(NR)](COOR)—wherein the incomplete valences inside the square brackets are hydrox ygen and at least one of the substituents R¹, R² or R³, preferably R¹ or R², is a 1 to 4 carbon alkyl or hydroxylalkyl group, R¹ or R² can be a hydrogen and R³ is hydrogen or an alkali metal salt. Most preferred is a substituted acrylic monomer wherein R¹ is methyl, R² is hydrogen and R³ is sodium.

The low molecular weight polycrylic ester dispersant polymer preferably has a molecular weight of less than about 15,000, preferably from about 500 to about 10,000, most preferably from about 1,000 to about 5,000. The most preferred polycrylic copolymer for use herein has a molecular weight of about 3500 and is the fully neutralized form of the polymer comprising about 70% by weight acrylic acid and about 30% by weight methacrylic acid.

Other suitable modified polycrylic copolymers include the low molecular weight copolymers of unsaturated aliphatic carboxylic acids disclosed in U.S. Pat. Nos. 4,530,766, and 5,084,535, both incorporated herein by reference. Agglomerated forms of the present invention may employ aqueous solutions of polymer dispersants as liquid binders for making the agglomerate (particularly when the composition consists of a mixture of sodium citrate and sodium carbonate). Especially preferred are polycrylates with an average molecular weight of from about 1,000 to about 10,000, and acrylate/maleate or acrylate/fumarate copolymers with an average molecular weight of from about 2,000 to about 80,000 and a ratio of acrylate to maleate or fumarate segments of from about 30:1 to about 1:2. Examples of such copolymers based on a mixture of unsaturated mono- and dicarboxylic monomers are disclosed in European Patent Application No. 66,915, published Dec. 15, 1982, incorporated herein by reference.

Other dispersant polymers useful herein include the polyethylene glycols and polypropylene glycols having a molecular weight of from about 950 to about 30,000 which can be obtained from the Dow Chemical Company of Midland, Mich. Such compounds for example, having a melting point within the range of from about 30° to about 100° C. can be obtained at molecular weights of 1450, 3400, 4500, 6000, 7400, 9500, and 20,000. Such compounds are formed by the polymerization of ethylene glycol or propy- lene glycol with the requisite number of moles of ethylene or propylene oxide to provide the desired molecular weight and melting point of the respective polyethylene glycol and polypropylene glycol. The polyethylene, polypropylene and mixed glycols are referred to using the formula HO(CH₂CH₂O)ₙ(CH₂=CH₂O)ₘ(CH₂=CH₂CH₂O)ₙH wherein m, n, and o are integers satisfying the molecular weight and temperature requirements given above.

Yet other dispersant polymers useful herein include the cellulose sulfate esters such as cellulose acetate sulfate, cellulose sulfate, hydroxethyl cellulose sulfate, methylocel- lulose sulfate, and hydroxypropylcellulose sulfate. Sodium cellulose sulfate is the most preferred polymer of this group.
Other suitable dispersant polymers are the carboxylated polysaccharides, particularly starches, celluloses and alginites, described in U.S. Pat. No. 3,723,522, Diehl, issued Mar. 27, 1973; the dextrin esters of fatty carboxylic acids disclosed in U.S. Pat. No. 3,929,107, Thompson, issued Nov. 11, 1975; the hydroxyalkyl starch ethers, starch esters, oxidized starches, dextrins and starch hydrolysates described in U.S. Pat. No. 3,803,285, Jensen, issued Apr. 9, 1974; the carboxylated starches described in U.S. Pat. No. 3,629,121, Eldib, issued Dec. 21, 1971; and the dextrin starches described in U.S. Pat. No. 4,141,841, McDaniel, issued Feb. 27, 1979; all incorporated herein by reference. Preferred cellulose-derived dispersant polymers are the carboxymethyl celluloses.

Another polymer material which can be included is polyethylene glycol (PEG). PEG can exhibit dispersing agent performance as well as act as a clay soil removal antiredeposition agent. Typical molecular weight ranges for these purposes range from about 500 to about 100,000, preferably from about 1,000 to about 50,000, more preferably from about 1,500 to about 10,000.

Polyaspartate and polyglutamate dispersing agents may also be used, especially in conjunction with zeolite builders. In compositions containing detergent builders, it is believed, though it is not intended to be limited by theory, that such polymeric dispersing agents enhance overall detergent builder performance, especially zeolite and/or silicate builders, when used in combination with other builders (including lower molecular weight polymeric esters) by crystal growth inhibition, particulate soil release peptization, and antiredeposition. Dispersing agents such as polyaspartate preferably have a molecular weight (avg.) of about 10,000.

Detersive Surfactants—Nonlimiting examples of surfactants which may optionally be co-present with the oleoyl sarcosinate and polyhydroxy fatty acid amide surfactants herein typically at levels from about 1% to about 55%, by weight of the compositions, include the preferred primary, branched-chain and random C16-C30 alkyl sulfates ("AS"), the C10-C18 secondary (2,3) alkyl sulfates of the formula CH2(CH2)x(CHOSO2-M)x CH2 and CH2(CH2)y(CHOSO2-M) MOCH2CH2 where x and (y+1) are integers of at least about 7, preferably at least about 9, and M is a water-solubilizing cation, especially sodium, unsaturated sulfates such as oleyl sulfate, the C10-C18 alkyl alkoy sulfates ("AES"; especially x up to about 7 EO ethoxy sulfates), the C10-C18 alkyl alkoy carboxylates (especially the EO 1–5 ethoxy carboxylates), the C10-C18 glycerol ethers, the C10-C18 alkyl polyglycosides and their corresponding sulfated polyglycosides, and the C12–C18 alpha-sulfonated fatty acid esters. If desired, the ethylenimine nonionic and amphoteric surfactants such as the C20–C120 alkyl ethoxyethoxides ("AE" including the so-called narrow peaked alkyl ethoxyethoxides and C6–C12 alkyl phenol alkoxylates (especially ethoxylates and mixed ethoxy/propoxy), C5–C18 betaines and sulfobetaines ("sultaines"), C10–C18 amine oxides, and the like, can also be included in the overall composition. C10–C20 conventional soaps may also be used. If high sudsing is desired, the branched-chain C10–C14 soaps may be used. C12–C14 alkyl benzene sulfonates ("LAS") may also be used, but are not preferred herein. Other conventional useful surfactants are listed in standard texts.

Dye Transfer Inhibiting Agents—The compositions of the present invention may also include one or more materials effective for inhibiting the transfer of dyes from one fabric to another during the cleaning process. Generally, such dye transfer inhibiting agents include polyvinyl pyrrolidone polymers, polyamine N-oxide polymers, copolymers of N-vinylpyrrolidone and N-vinylimidazolone, manganese phthalocyanine, peroxidases, and mixtures thereof. If used, these agents typically comprise from about 0.01% to about 10% by weight of the composition, preferably from about 0.01% to about 5%, and more preferably from about 0.05% to about 2%.

More specifically, the polyanime N-oxide polymers preferred for use herein contain units having the following structural formula: R-A-P, wherein P is a polymerizable unit to which an N—O group can be attached or the N—O group can form part of the polymerizable unit or the N—O group can be attached to both units; A is one of the following structures: —NC(O)—, —CO(O)—, —S—, or —O—; R is naphthyl, alkyl, ary, or aryl groups or any combination thereof to which the nitrogen of the N—O group can be attached or the N—O group is part of these groups. Preferred polyanime N-oxides are those wherein R is a heterocyclic group such as pyridine, pyrrole, imidazole, pyrroline, piperidine and derivatives thereof.

The N—O group can be represented by the following general structures:

wherein R1, R2, R3 are aliphatic, aromatic, heterocyclic or alicyclic groups or combinations thereof, x, y and z are 0 or 1; and the nitrogen of the N—O group can be attached or form part of any of the aforementioned groups. The amine oxide unit of the polyanime N-oxides has a pkac<10, preferably pkac<7, more preferred pkac<6.

Any polymer backbone can be used as long as the amine oxide polymer formed is water-soluble and has dye transfer inhibiting properties. Examples of suitable polymeric backbones are polyvinyls, polypolyklyenes, polysteres, polyethers, polyamides, polypolyimides, polyacrylates and mixtures thereof.

These polymers include random or block copolymers where one monomer type is an amine N-oxide and the other monomer type is an N-oxide. The amine oxide polymers typically have a ratio of amine to the amine N-oxide of 10:1 to 1:1,000,000. However, the number of amine oxide groups present in the polyanime oxide polymer can be varied by appropriate copolymerization or by an appropriate degree of N-oxidation. The polyanime oxides can be obtained in almost any degree of polymerization. Typically, the average molecular weight is within the range of 500 to 1,000,000; more preferred 1,000 to 500,000; most preferred 5,000 to 100,000. This preferred class of materials can be referred to as "PNVO".

The most preferred polyanime N-oxide useful in the detergent compositions herein is poly(4-vinylpyrridine-N-oxide) which as an average molecular weight of about 50,000 and an amine to amine N-oxide ratio of about 1:4.

Copolymers of N-vinylpyrrolidone and N-vinylimidazolone polymers (referred to as a class as "PVPI") are also preferred for use herein. Preferably the PVPI has an average molecular weight range from 5,000 to 1,000,000, more preferably from 5,000 to 200,000, and most preferably from 10,000 to 20,000. (The average molecular weight range is determined by light scattering as described in Bath, et al., Chemical Analysis, Vol. 113, "Modern Methods of Polymer Characterization", the disclosures of which are incorporated herein by reference.) The PVPI copolymers typically have a molar ratio of N-vinylimidazolone to N-
nylpymyrlidone from 1:1 to 0.2:1, more preferably from 0.8:1 to 0.3:1, most preferably from 0.6:1 to 0.4:1. These copolymers may be either linear or branched.

The present invention compositions also may employ a polyvinylpyrrolidone ("PVP") having an average molecular weight of from about 5,000 to about 400,000, preferably from about 5,000 to about 200,000, and more preferably from about 5,000 to about 50,000. PVP's are known to persons skilled in the detergent field; see, for example, EP-A-262,897 and EP-A-256,696, incorporated herein by reference. Compositions containing PVP can also contain polyethylene glycol ("PEG") having an average molecular weight from about 500 to about 100,000, preferably from about 1,000 to about 10,000. Preferably, the ratio of PEG to PVP on a ppm basis delivered in wash solutions is from about 2:1 to about 5:1, and more preferably from about 3:1 to about 10:1.

The detergent compositions herein may also optionally contain from about 0.005% to 5% by weight of certain types of hydrophilic optical brighteners which also provide a dye transfer inhibition action. If used, the compositions herein will preferably comprise from about 0.01% to 1% by weight of such optical brighteners.

The hydrophilic optical brighteners useful in the present invention are those having the structural formula:

$$R_1$$

$$R_2$$

$$R_3$$

wherein $$R_1$$ is selected from anilino, N-2-bis-hydroxyethyl and NH-2-hydroxyethyl; $$R_2$$ is selected from N-2-bis-hydroxyethyl, N-2-hydroxyethyl-N-methylamino, morpholinio, chloro and amino; and $$R_3$$ is a salt-forming cation such as sodium or potassium.

When in the above formula, $$R_1$$ is anilino, $$R_2$$ is N-2-bis-hydroxyethyl and M is a cation such as sodium, the brightener is 4,4'-bis(4-anilino-6-N-2-bis-hydroxyethyl-s-triazine-2-yl)aminio)2,2'-stilbenedisulfonic acid and disodium salt. This particular brightener species is commercially marketed under the tradename Tinopal-UNPA-GX by Ciba-Geigy Corporation. Tinopal-UNPA-GX is the preferred hydrophilic optical brightener useful in the detergent compositions herein.

When in the above formula, $$R_1$$ is anilino, $$R_2$$ is N-2-hydroxyethyl-N-2-methylamino and M is a cation such as sodium, the brightener is 4,4'-bis(4-anilino-6-N-hydroxyethyl-N-methylamino)s-triazine-2-yl)aminio)2,2'-stilbenedisulfonic acid and disodium salt. This particular brightener species is commercially marketed under the tradename Tinopal 5BM-GX by Ciba-Geigy Corporation.

When in the above formula, $$R_1$$ is anilino, $$R_2$$ is morpholinio and M is a cation such as sodium, the brightener is 4,4'-bis(4-anilino-6-morpholino-s-triazine-2-yl)aminio)2,2'-stilbenedisulfonic acid and sodium salt. This particular brightener species is commercially marketed under the tradename Tinopal AMS-GX by Ciba Geigy Corporation.

The specific optical brightener species selected for use in the present invention provide especially effective dye transfer inhibition performance benefits when used in combination with the selected polymeric dye transfer inhibiting agents hereinbefore described. The combination of such selected polymeric materials (e.g., PVNO and/or PVPVI) with such selected optical brighteners (e.g., Tinopal UNPA-GX, Tinopal 5BM-GX, Tinopal-PLC, and/or Tinopal AMS-GX) provides significantly better dye transfer inhibition in aqueous wash solutions than does either of these two detergent composition components when used alone. Without being bound by theory, it is believed that such brighteners work this way because they have high affinity for fabrics in the wash solution and therefore deposit relatively quick on these fabrics. The extent to which brighteners deposit on fabrics in the wash solution can be defined by a parameter called the "exhaustion coefficient". The exhaustion coefficient is in general as the ratio of a) the brightener material deposited on fabric to b) the initial brightener concentration in the wash liquor. Brighteners with relatively high exhaustion coefficients are the most suitable for inhibiting dye transfer in the context of the present invention.

Of course, it will be appreciated that other, conventional optical brightener types of compounds can optionally be used in the present compositions to provide conventional fabric "brightness" benefits, rather than a true dye transfer inhibiting effect. Such usage is conventional and well-known to detergent formulations.

Brightener—Any optical brighteners or other brightening or whitenning agents known in the art can be incorporated at levels typically from about 0.05% to about 1.2%, by weight, into the detergent compositions herein. Commercial optical brighteners which may be useful in the present invention can be classified into subgroups, which include, but are not necessarily limited to, derivatives of stilbene, pyrazoline, coumarin, carboxylyic acid, methinecyanines, dibenzothiophene-5,5-dioxide, azoles, 5- and 6-membered-ring heterocycles, and other miscellaneous agents. Examples of such brighteners are disclosed in "The Production and Application of Fluorescent Brightening Agents", M. Zahradnik, Published by John Wiley & Sons, New York (1982).

Specific examples of optical brighteners which are useful in the present compositions are those identified in U.S. Pat. No. 4,790,856, issued to Wixon on Dec. 13, 1988. These brighteners include the PHORWHITE series of brighteners from Verona. Other brighteners disclosed in this reference include: Tinopal UNPA, Tinopal CBS and Tinopal 5BM; available from Ciba-Geigy; Artic White CC and Artic White CWD, available from Hilton-Davis, located in Italy; the 2-(4-styrylphenyl)-2H-naphthol [1,2-d]triazoles; 4,4'-bis (1,2,3-triazol-2-yl)- stil-benenes; 4,4'-bis(styryl)bisphenyls; and the aminocoumarins. Specific examples of these brighteners include 4-methyl-7-diethyl-amino coumarin; 1,2-bis(ven-zimidazol-2-yl)ethylene; 1,3-diphenyl-phrazolenes; 2,5-bis(benzooxazol-2-yl)thiophene; 2-styryl-naph[1,2-d]oxazole; and 2-stilbene-4-yl)2H-naphthol [1,2-d]triazole. See also U.S. Pat. No. 3,646,015, issued Feb. 29, 1972 to Hamilton. Anionic brighteners are preferably herein.

Chelating Agents—The detergent compositions herein may also optionally contain one or more iron and/or manganese chelating agents. Such chelating agents can be selected from the group consisting of amino carboxylates, amino phosphonates, polyfunctionally-substituted aromatic chelating agents and mixtures therein, all as hereinafter defined. Without intending to be bound by theory, it is believed that the benefit of these materials is due in part to their exceptional ability to remove iron and manganese ions from washing solutions by formation of soluble chelates.

Amino carboxylates useful as optional chelating agents include ethylenediaminetetraacetates, N-hydroxyethyl- ylenediaminetetraacetates, nitroltriacetates, ethylenediamine tetraproprionates, triethylenetetraminehexacetates, diethyl enetrimetamioneacetates, and ethanoldiglycines, alkali metal, ammonium, and substituted ammonium salts therein and mixtures therein.
Amino phosphonates are also suitable for use as chelating agents in the compositions of the invention when at least low levels of total phosphorus are permitted in detergent compositions, and include ethylenediaminetetraakis (methyleneephosphonates) as DEQUEST. Preferred, these amino phosphonates to not contain alkyl or alkenyl groups with more than about 6 carbon atoms.

Polyfunctionally-substituted aromatic chelating agents are also useful in the compositions herein. See U.S. Pat. No. 3,812,044, issued May 21, 1974, to Connor et al. Preferred compounds of this type in acid form are dihydroxydisulfobenzenes such as 1,2-dihydroxy-3,5-disulfobenzene.

A preferred biodegradable chelator for use herein is ethylenediamine disuccinate ("EDDS"), especially the [S,S] isomer as described in U.S. Pat. No. 4,704,233, Nov. 3, 1987, to Hartman and Perkins.

If utilized, these chelating agents will generally comprise from about 0.1% to about 10% by weight of the detergent compositions herein. More preferably, if utilized, the chelating agents will comprise from about 0.1% to about 3.0% by weight of such compositions.

Suds Suppressors—Compounds for reducing or suppressing the formation of suds can be incorporated into the compositions of the present invention. Suds suppression can be of particular importance in the so-called "high concentration cleaning process" as disclosed in U.S. Pat. Nos. 4,489,455 and 4,489,574, and in front-loading European-style washing machines.

A wide variety of materials may be used as suds suppressors, and suds suppressors are well known to those skilled in the art. See, for example, Kark Othmer Encyclopedia of Chemical Technology, Third Edition, Volume 7, pages 430-447 (John Wiley & Sons, Inc., 1979). One category of suds suppressor of particular interest encompasses mono-carboxylic fatty acid and soluble salts therein. See U.S. Pat. No. 2,954,347, issued Sep. 27, 1960 to Wayne St. John. The monocarboxylic fatty acids and salts thereof used as suds suppressor typically have hydrocarbyl chains of 10 to about 24 carbon atoms, preferably 12 to 18 carbon atoms. Suitable salts include the alkali metal salts such as sodium, potassium, and lithium salts, and ammonium and alkylammonium salts.

The detergent compositions herein may also contain non-surfactant suds suppressors. These include, for example, high molecular weight hydrocarbons such as paraffin, fatty acid esters (e.g., fatty acid triglycerides), fatty acid esters of monovalent alcohols, aliphatic C<sub>18</sub>-C<sub>40</sub> ketones (e.g., stearone), etc. Other suds inhibitors include N-alkylated amino triazoles such as tri- to hexa-alkylmellamines or di- to tetra-alkylidamine chlorotriazines formed as products of cyanuric chloride with two or three moles of a primary or secondary amine containing 1 to 24 carbon atoms, propylene oxide, and monostearoyl phosphates such as monostearoyl alcohol phosphate ester and monostearoyl di-alkyl metal (e.g., K, Na, and Li) phosphates and phosphate esters. The hydrocarbons such as paraffin and haloparaffin can be utilized in liquid form. The liquid hydrocarbons will be liquid at room temperature and atmospheric pressure, and will have a pour point in the range of about -40° C. and about 50° C., and a minimum boiling point not less than about 110° C. (atmospheric pressure). It is also known to utilize waxy hydrocarbons, preferably having a melting point below about 100° C. The hydrocarbons constitute a preferred category of suds suppressor for detergent compositions.

Hydrocarbon suds suppressors are described, for example, in U.S. Pat. No. 4,265,779, issued May 5, 1981 to Gandolfo et al. The hydrocarbons, thus, include aliphatic, alicyclic, aromatic, and heterocyclic saturated or unsaturated hydrocarbons having from about 12 to about 70 carbon atoms. The term "paraffin," as used in this suds suppressor discussion, is intended to include mixtures of true paraffins and cyclic hydrocarbons.

Another preferred category of non-surfactant suds suppressors comprises silicone suds suppressors. This category includes the use of polyorganosiloxane oils, such as polydimethylsiloxane, dispersions or emulsions of polyorganosiloxane oils or resins, and combinations of polyorganosiloxane with silica particles wherein the polyorganosiloxane is chemisorbed or fused onto the silica. Silicone suds suppressors are well known in the art and are, for example, disclosed in U.S. Pat. No. 4,265,779, issued May 5, 1981 to Gandolfo et al and European Patent Application No. 89307851.9, published Feb. 7, 1990, by Starch, M. S.

Other silicone suds suppressors are disclosed in U.S. Pat. No. 3,455,839 which relates to compositions and processes for defoaming aqueous solutions by incorporating therein small amounts of polydimethylsiloxane fluids.


An exemplary silicone based suds suppressor for use herein is a suds suppressing amount of a suds controlling agent consisting essentially of:

(i) polydimethylsiloxane fluid having a viscosity of from about 20 cs. to about 1,500 cs. at 25° C.;
(ii) from about 5 to about 50 parts per 100 parts by weight of (i) of siloxane resin composed of (CH₃)₂SiO units of SiO₂ units in a ratio of from (CH₃)₂SiO₂ units to SiO₂ units of from about 0.6:1 to about 1.21; and
(iii) from about 1 to about 20 parts per 100 parts by weight of (i) of a solid silica gel.

In the preferred silicone suds suppressor used herein, the solvent for a continuous phase is made up of certain polyethylene glycols or polyethylene/polypropylene glycol copolymers or mixtures thereof (preferred), or polypropylene glycol. The primary silicone suds suppressor is branched/crosslinked and preferably not linear.

To illustrate this point further, typical liquid laundry detergent compositions with controlled suds will optionally comprise from about 0.001 to about 1, preferably from about 0.01 to about 0.7, most preferably from about 0.05 to about 0.5, weight % of said silicone suds suppressor, which comprises (1) a nonaqueous emulsion of a primary antifoam agent which is a mixture of (a) a polyorganosiloxane, (b) a resinous siloxane or a silicone resin-producing silicone compound, (c) a finely divided filler material, and (d) a catalyst to promote the reaction of mixture components (a), (b) and (c), to form silanolates; (2) at least one nonionic silicone surfactant; and (3) polyethylene glycol or a copolymer of polyethylene-polypropylene glycol having a solubility in water at room temperature of more than about 2 weight %; and without polypropylene glycol. Similar amounts can be used in granular compositions, gels, etc. See also U.S. Pat. No. 4,978,471, Starch, issued Dec. 18, 1990, and U.S. Pat. No. 4,983,316, Starch, issued Jan. 8, 1991, U.S. Pat. No. 5,288,431, Huber et al., issued Feb. 22, 1994, and U.S. Pat. Nos. 4,639,489 and 4,749,745, Aizawa et al at column 1, line 46 through column 4, line 35.

The silicone suds suppressor herein preferably comprises polyethylene glycol and a copolymer of polyethylene glycol/polypropylene glycol, all having an average molecular
weight of less than about 1,000, preferably between about 100 and 800. The polyethylene glycol and polyethylene/ polypropylene copolymers herein have a solubility in water at room temperature of more than about 2 weight %, preferably more than about 5 weight %.

The preferred solvent herein is polyethylene glycol having an average molecular weight of less than about 1,000, more preferably between about 100 and 800, most preferably between 200 and 400, and a copolymer of polyethylene glycol/polypropylene glycol, preferably PEG 200/PEG 300. Preferred is a weight ratio of between about 1:1 and 1:10, most preferably between 1:3 and 1:6, of polyethylene glycol/copolymer of polyethylene-polypropylene glycol.

The preferred silicone suds suppressors used herein do not contain polypropylene glycol, particularly of 4,000 molecular weight. They also preferably do not contain block copolymers of ethylene oxide and propylene oxide, like PLURONIC L101.

Other suds suppressors useful herein comprise the secondary alcohols (e.g., 2-alkyl alkanols) and mixtures of such alcohols with silicone oils, such as the silicones disclosed in U.S. Pat. Nos. 4,798,679, 4,075,118 and EP 150,872. The secondary alcohols include the C₆-C₁₄ alkyl alcohols having a C₆-C₁₄ chain. A preferred alcohol is 2-butyl octanol, which is available from Condea under the trademark ISOL. MIXTURES OF SECONDARY ALCOHOLS ARE AVAILABLE UNDER THE TRADEMARK ISALCHEM 123 FROM ENICHEM. MIXED SUDS SUPPRESSORS TYPICALLY COMPRISI MIXTURES OF ALCOHOL+ SILICONE AT A WEIGHT RATIO OF 1.5 TO 5.1.

For any detergent compositions to be used in automatic laundry washing machines, suds should not form to the extent that they overflow the washing machine. Suds suppressors, when utilized, are preferably present in a "suds suppressing amount. By "suds suppressing amount" is meant that the formulator of the composition can select an amount of this suds controlling agent that will sufficiently control the suds to result in a low-sudsing laundry detergent for use in automatic laundry washing machines.

The compositions herein will generally comprise from 0% to about 10% of a suds suppressor. When utilized as suds suppressors, monocarboxylic fatty acids, and salts therein, will be present typically in amounts up to about 10%, by weight, of the detergent composition. Preferably, from about 0.5% to about 3% of fatty monocarboxylate suds suppressor is utilized. Silicone suds suppressors are typically utilized in amounts up to about 2.0%, by weight, of the detergent composition, although higher amounts may be used. This upper limit is practical in nature, due primarily to concerns with keeping costs minimized and effectiveness of lower amounts for effectively controlling sudding. Preferably from about 0.01% to about 1% of silicone suds suppressor is used, more preferably from about 0.1% to about 0.5%. As used herein, these weight percentage values include any silica which may be utilized in combination with polyorganosiloxane, as well as any adjacent materials that may be utilized. Monostearyl phosphate suds suppressors are generally utilized in amounts ranging from about 0.1% to about 2%, by weight, of the composition. Hydrocarbon suds suppressors are typically utilized in amounts ranging from about 0.01% to about 5.0%, although higher levels can be used. The alcohol suds suppressors are typically used at 0.2%–3% by weight of the finished compositions.

Fabric Softeners—Various through-the-wash fabric softeners, especially the impalpable smectite clays of U.S. Pat. No. 4,062,647, Storm and Nirschi, issued Dec. 13, 1977, as well as other softener clays known in the art, can optionally be used typically at levels of from about 0.5% to about 10% by weight in the present compositions to provide fabric softener benefits concurrently with fabric cleaning. Clay softeners can be used in combination with amine and cationic softeners as disclosed, for example, in U.S. Pat. No. 4,373,416, Crisp et al., Mar. 1, 1983 and U.S. Pat. No. 4,291,071, Harris et al., issued Sept. 22, 1981.

Other Ingredients—A wide variety of other ingredients useful in detergent compositions can be included in the compositions herein, including other active ingredients, carriers, hydrotopes, processing aids, dyes or pigments, solvents for liquid formulations, solid fillers for bar compositions, etc. If high sudsing is desired, suds boosters such as the C₁₀–C₁₆ alkanolamides can be incorporated into the compositions, typically at 1%–10% levels. The C₁₀–C₁₄ monoethanol and diethanol amides illustrate a typical class of such suds boosters. Use of such suds boosters with high sudsing adjunct surfactants such as the amine oxides, betaines and sulfonates noted above is also advantageous. If desired, soluble magnesium salts such as MgCl₂, MgSO₄, and the like, can be added at levels of, typically, 0.1%–2%, to provide additional suds and to enhance grease removal performance.

Various detergent ingredients employed in the present compositions optionally can be further stabilized by absorbing said ingredients onto a porous hydrophobic substrate, then coating said substrate with a hydrophobic coating. Preferably, the detergent ingredient is admixed with a surfactant before being absorbed into the porous substrate. In use, the detergent ingredient is released from the substrate into the aqueous washing liquor, where it performs its intended detergent function.

To illustrate this technique in more detail, a porous hydrophobic silica (trademark SIPERNAT D10, DeGussa) is admixed with a proprietary enzyme solution containing 3%–5% of C₉–₁₅ ethoxylated alcohol (EO 7) nonionic surfactant. Typically, the enzyme/surfactant solution is 25% by weight of silica. The resulting powder is dispersed with stirring in silicone oil (various silicone oil viscosities in the range of 300–12,500 can be used). The resulting silicone oil dispersion is emulsified or otherwise added to the final detergent matrix. By this means, ingredients such as the aforementioned enzymes, bleaches, bleach activators, bleach catalysts, photoactvators, dyes, fluorescers, fabric conditioners and hydrolyzable surfactants can be "protected" for use in detergents, including liquid laundry detergent compositions.

Liquid detergent compositions can contain water and other solvents as carriers. Low molecular weight primary or secondary alcohols exemplified by methanol, ethanol, propanol, and isopropanol are suitable. Monohydric alcohols are preferred for solubilizing surfactant, but polyols such as those containing from 2 to about 6 carbon atoms and from 2 to about 6 hydroxy groups (e.g., 1,3-propanediol, ethylene glycol, glycerine, and 1,2-propanediol) can also be used. The compositions may contain from 5% to 90%, typically 10% to 50% of such carriers.

The detergent compositions herein will preferably be formulated such that, during use in aqueous cleaning operations, the wash water will have a pH of between about 6.5 and about 11, preferably between about 7.5 and 10.5. Liquid dishwashing product formulations preferably have a pH between about 6.8 and about 9.0. Laundry products are typically at pH 9–11. Techniques for controlling pH at recommended usage levels include the use of buffers, alka- lins, acids, etc., and are well known to those skilled in the art.

The following examples illustrate compositions according to this invention, but are not intended to be limiting thereof.
EXAMPLE I

These granular detergents can be prepared by spray-drying (final product density 520 g/l) or agglomerating (final product density above 600 g/l) the Base Granule. The remaining dry ingredients are admixed in granular or powder form with the Base Granule in a rotary mixing drum, and the liquid ingredients (nonionic surfactant and perfume) are sprayed on.

<table>
<thead>
<tr>
<th>Base Granule</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_{14-15} alkyl sulfate</td>
<td>5.8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Oleoyl sarcosinate, Na</td>
<td>5.0</td>
<td>11.0</td>
<td>6.0</td>
</tr>
<tr>
<td>C_{16-18} fatty acid</td>
<td>2.2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Zeolite A (1–10 microns)</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
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<tr>
<td>Polyacrylate (5000 MW)</td>
<td>3.3</td>
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<tr>
<td>Polyethylene glycol (8000 MW)</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
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<tr>
<td>Sodium carbonate</td>
<td>10.7</td>
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</tr>
<tr>
<td>Sodium sulfate</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Sodium silicate (SiO_{2}/NaO=2)</td>
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<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>7.1</td>
<td>7.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Admix

| Zeolite A (1–10 microns) | 5.0 | 5.0 | 5.0 |
| C_{12-16} — N-(3-methoxypropyl)glucamide | — | 6.4 | — |
| C_{12-16}N-methyl glucamide | 4.0 | — | 4.4 |
| C_{12-16} alkyl sulfate | 1.8 | — | — |
| C_{12-16} alkyl ethoxy (2) sulfate | — | — | 5.0 |
| C_{14-16} alkyl ethoxy (2.5) sulfate | 4.0 | — | — |
| Suds suppressor flake* | — | 1.0 | 0.5 |
| Miscellaneous (flour salts, brightener, enzyme, buffer, zeolite or other builder, etc) | 17.2 | 17.2 | 16.5 |

Spray-on

| C_{12-15} alkyl ethoxylate (6.5 EO) | 2.0 | 2.0 | 2.0 |
| Perfume | 0.5 | 0.5 | 0.5 |
| Water and miscellaneous | Balance | Balance | Balance |

*Suds Suppressor Flakes contains approximately 5% of a silica/silicone oil dispersion encapsulated in a flake containing primarily PEG (8000 MW), at greater than 80%, and minor optional water soluble ingredients.

The composition of Example I may be modified to form a bleach-containing composition by adding sodium percarbonate (in an amount to provide 12 weight percent) and TAED bleach activator (in an amount to provide 4 weight percent). Also, the TAED may be replaced by NOBS bleach activator.

EXAMPLE II

The composition of Example I(A) is modified by the addition of 0.2% (based on final product) CAREZYMEx (cellulase) in the admix. Alternatively, a 1:1:1 mixture of LIPOASE (lipase), cellulase and protease at a total weight % of product of 0.9% can be added via the admix.

EXAMPLE III

The composition of Example I(B) is modified by the addition of 10% sodium percarbonate (100–500 micron) or sodium perborate monohydrate and 1% tetracetylene-ethylene-diamine or 1% nonanoyloxybenzene sulfonate (based on final product) via the admix to provide a bleaching function.
EXAMPLE VI

Highly concentrated liquid laundry detergents are as follows.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>C_{12-14} N-methyl glucamide</th>
<th>C_{14/18} N-(3-methoxypropyl) glucamide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oleoyl sarcosinate, Na*</td>
<td>15.0</td>
<td>5.0</td>
</tr>
<tr>
<td>C_{14-15} EO(2.25) sulfate, Na</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Glucamide surfactant</td>
<td>10.90</td>
<td>10.40</td>
</tr>
<tr>
<td>Citric acid</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>C_{12-14} fatty acid</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Ethoxyolated terechylene pentanolate</td>
<td>1.00</td>
<td>0.99</td>
</tr>
<tr>
<td>Boric acid</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>NaOH</td>
<td>3.85</td>
<td>3.79</td>
</tr>
<tr>
<td>1,2-propanediol</td>
<td>10.00</td>
<td>9.15</td>
</tr>
<tr>
<td>Ethanol</td>
<td>7.00</td>
<td>6.55</td>
</tr>
<tr>
<td>Monoethanolamine</td>
<td>1.06</td>
<td>1.05</td>
</tr>
<tr>
<td>Sodium curene sulfonate</td>
<td>4.00</td>
<td>3.96</td>
</tr>
<tr>
<td>H_{4}O Oxirors</td>
<td>Balance</td>
<td>Balance</td>
</tr>
<tr>
<td>pH 10%aq. solution</td>
<td>8.00</td>
<td>8.29</td>
</tr>
</tbody>
</table>

*Potassium, ammonium or triethanolammonium salts may also be used.

EXAMPLE VII

A liquid laundry detergent with improved grease/oil stain removal especially at 70° F. (21° C.) is as follows.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>% (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_{14-15} EO(2.25) sulfate</td>
<td>15.33</td>
</tr>
<tr>
<td>Oleoyl sarcosinate</td>
<td>5.67</td>
</tr>
<tr>
<td>C_{12-14} N-methyl glucamide*</td>
<td>6.00</td>
</tr>
<tr>
<td>Citric acid</td>
<td>4.80</td>
</tr>
<tr>
<td>Fatty acids</td>
<td>3.00</td>
</tr>
<tr>
<td>Monoethanolamine</td>
<td>2.00</td>
</tr>
<tr>
<td>Ethoxyolated terechylene pentanolate</td>
<td>0.91</td>
</tr>
<tr>
<td>Protease</td>
<td>0.89</td>
</tr>
<tr>
<td>Boric acid</td>
<td>1.20</td>
</tr>
<tr>
<td>1,2-propane diol</td>
<td>10.00</td>
</tr>
<tr>
<td>Ethanol</td>
<td>7.00</td>
</tr>
<tr>
<td>Silicone suds suppressor</td>
<td>0.06</td>
</tr>
<tr>
<td>Water/miscellaneous</td>
<td>Balance</td>
</tr>
</tbody>
</table>

The following composition is designed for use at 0.39 cup (92.4 ml) in a conventional U.S. top-loading automatic washing machine, or its equivalent.

EXAMPLE VIII

A laundry bar suitable for hand-washing soiled fabrics is prepared by standard extrusion processes and comprises the following:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>% (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oleoyl sarcosinate, Na</td>
<td>20</td>
</tr>
<tr>
<td>Palm N-(3-methoxypropyl)glucamide*</td>
<td>5</td>
</tr>
<tr>
<td>C_{11-13} alkyl sulfate, Na**</td>
<td>10</td>
</tr>
<tr>
<td>Sodium tripolyphosphate</td>
<td>7</td>
</tr>
<tr>
<td>Sodium pyrophosphate</td>
<td>7</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>25</td>
</tr>
<tr>
<td>Zeolite A (0.1-10 m)</td>
<td>5</td>
</tr>
<tr>
<td>Coconut monoethanolamide</td>
<td>2</td>
</tr>
<tr>
<td>Carboxymethylcellulose</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*The N-(3-methoxypropyl) material may be substituted for the N-methyl material. For lower sudsing, the N-berxyl material may be used.

EXAMPLE IX

A high sudsing liquid composition suitable for dishwashing is as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>% (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oleoyl sarcosinate</td>
<td>3.0</td>
</tr>
<tr>
<td>C_{14} dimethylamine oxide</td>
<td>3.0</td>
</tr>
<tr>
<td>C_{12-14} sultaine</td>
<td>2.2</td>
</tr>
<tr>
<td>C_{12-14} N-methyl glucamide</td>
<td>6.0</td>
</tr>
<tr>
<td>Ethanol</td>
<td>3.0</td>
</tr>
<tr>
<td>Water, dye and minor</td>
<td>Balance</td>
</tr>
</tbody>
</table>

The following illustrates another typical composition herein.

EXAMPLE X

A high sudsing liquid composition suitable for dishwashing is as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>% (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oleoyl sarcosinate</td>
<td>9.0</td>
</tr>
<tr>
<td>C_{14} N-methyl glucamide</td>
<td>6.0</td>
</tr>
<tr>
<td>C_{11-13} EO(8)</td>
<td>6.0</td>
</tr>
<tr>
<td>Fatty Acid</td>
<td>7.0</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>4.0</td>
</tr>
<tr>
<td>Protease (34 g/l)</td>
<td>0.48</td>
</tr>
<tr>
<td>Lipolose (100 KLUg)</td>
<td>0.18</td>
</tr>
<tr>
<td>Anlyase (500 KNUg)</td>
<td>0.132</td>
</tr>
<tr>
<td>Carezyme (5000 CEU/g)</td>
<td>0.084</td>
</tr>
<tr>
<td>Endo A (5000 CEU/g)</td>
<td>0.035</td>
</tr>
<tr>
<td>Boric Acid</td>
<td>4.5</td>
</tr>
<tr>
<td>DETPA*</td>
<td>0.94</td>
</tr>
<tr>
<td>Brightener**</td>
<td>0.15</td>
</tr>
<tr>
<td>DYTMAP***</td>
<td>0.7</td>
</tr>
<tr>
<td>Inert Carrier and Minor</td>
<td>Balance</td>
</tr>
</tbody>
</table>

*Diethylene triminepentenacetic acid
**4,4'-bis-(4-amino-6-(bis-(2-hydroxyethyl)amin0)-s-triazin-2-yl) amino-2,2'-sulphone disulfonate sodium salt
***Ethyloxyulated terehylene pentanolate

If desired, from about 0% to about 9%, by weight, of AS, AES or mixtures thereof, can be added to the composition of Example X to provide additional cleaning benefits.
What is claimed is:

1. A cleaning composition comprising:
   (a) at least about 0.5%, by weight, of oleoyl sarcosinate; and
   (b) at least about 1%, by weight, of a polyhydroxy fatty acid amide surfactant.

2. A composition according to claim 1, wherein the polyhydroxy fatty acid amide is a member selected from the group consisting of the C_{10-18} fatty acid amides of N-methyl glucamine, the C_{10-18} fatty acid amides of N-(3-methoxypropyl) glucamine, and mixtures thereof.

3. A composition according to claim 1 which comprises at least about 3%, by weight, of a mixture of said surfactants (a) and (b).

4. A composition according to claim 3 which comprises from about 3% to about 55%, by weight, of a mixture of surfactants (a) and (b), at a weight ratio of (a):(b) in the range from about 1:10 to about 10:1.

5. A composition according to claim 4 wherein the (a):(b) ratio is from about 1:1 to about 3:1.

6. A detergent composition according to claim 1 which additionally comprises a detergent builder.

7. A detergent composition according to claim 1 which additionally comprises enzymes.

8. A detergent composition according to claim 1 which additionally comprises a soil release agent.

9. A composition according to claim 1 which additionally comprises a dye transfer inhibitor.

10. A composition according to claim 1 which additionally comprises bleach.

11. A composition according to claim 1 which additionally comprises a non-oleoyl sarcosinate, non-polyhydroxy fatty acid amide detersive surfactant.

12. A composition according to claim 1 which additionally comprises a dispersing agent.

13. A composition according to claim 1 which additionally comprises a suds suppressor.

14. A composition according to claim 1 which additionally comprises a mixture of builder, bleach and enzyme.

15. A method for cleaning surfaces, comprising contacting said surfaces with an aqueous medium which contains at least about 50 ppm of a composition according to claim 1.

* * * *