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BUILT LIQUID DETERGENT COMPOSITIONS

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This invention relates to built liquid detergent compositions. More particularly it relates to novel nonaqueous liquid detergent compositions employing sodium tripolyphosphate.

A substantial portion of the heavy duty, home laundering detergent market is supplied by powdered detergents. These detergents have been able to hold this substantial portion of this market even though the powdered detergents have disadvantages as compared to a liquid detergent. For example, powdered detergents tend to vary in density which causes difficulties in measuring the correct amount in the normal home laundry. Under high humidity conditions, powdered detergents tend to cake. Caked detergents tend to clog automatic dispensing devices and in the home makes the measuring of proper quantities into the washing machines difficult. An additional disadvantage of powdered detergents is that they tend to be dusty causing housekeeping and health problems in manufacture. In home usage the dust is irritating to persons sensitive to dust. Also powdered detergents have relatively low densities thus causing excess requirements of storage and shelf space which is a disadvantage to the merchants who store the detergents prior to sale to the housewife.

The primary advantage of the powdered detergents, which has overshadowed the before-mentioned disadvantages, is that powdered detergents can employ major quantities of sodium polyphosphates, such as sodium tripolyphosphate and sodium pyrophosphate, as builders to improve the cleaning efficiency of the active in the detergent composition. Sodium polyphosphates are believed to be unrivaled as a builder on a performance basis and particularly on a price-performance basis.

Manufacturers of liquid detergents have not heretofore been able to effectively use the sodium tripolyphosphate or tetrasodium pyrophosphate as a builder due to their limited solubility in both aqueous and nonaqueous solvents. Most liquid detergents therefore are comprised of an aqueous solution of a detersive surfactant and of higher priced potassium polyphosphate (such as tetrapotassium pyrophosphate) as a builder. Even by employing the more soluble potassium polyphosphates which ordinarily do not rapidly degrade in alkaline aqueous solutions, the ratio of builder to active is below that used in dry detergents due to the water which has to be used to dissolve or disperse the other components. Because of the before-mentioned formulation problems, the cleaning efficiency of the present liquid detergents on a weight basis is less than that of most dry detergents.

It is believed, therefore, that a liquid detergent which, on a weight basis, has a cleaning efficiency equal to the commonly used dry detergents and which does not have many of the disadvantages of previous liquid and dry detergents would be a significant advancement in the art.

It is therefore an object of this invention to provide novel liquid detergents which have a cleaning efficiency better than the present liquid detergents when used in like concentrations.

It is another object of this invention to provide novel liquid detergent compositions which on a weight basis are equal in cleaning efficiency to commonly used dry detergents.

It is a further object of this invention to provide novel liquid detergent compositions which do not have many of the disadvantages of previous liquid and dry detergents.

Still further objects of the present invention will become

readily apparent to one skilled in the art from the following detailed description.

It has been discovered that by dissolving certain anionic detersive surfactants in a suitable amount of a solvent which contains a major amount of the dihydroxyl alcohol class of components, a solution is produced in which it is possible to incorporate up to about 80% by weight of sodium tripolyphosphate or tetrasodium pyrophosphate to thereby produce an effective liquid detergent.

The present invention, comprising (a) a water-soluble, dihydroxyl alcohol-soluble anionic detersive surface active agent (surfactant), (b) a solvent for the surfactant and (c) a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate, and mixtures thereof, in suspension in the liquid, gives better cleaning efficiency than the present commercial liquid detergents. When compared with commonly used dry detergents, the detergent of this invention has been found to be at least equal in performance. Since in the practice of this it is possible to employ up to 80% by weight of sodium polyphosphates in a nonaqueous detergent composition, many of the advantages of the dry detergent and of the liquid detergent are combined in one detergent composition. A composition which includes the lower cost sodium polyphosphates in place of the more expensive potassium phosphate salts also offers distinct cost advantages over present commercial liquid detergents. Also, the liquid detergent of this invention has a relatively high density as compared to the density of a powdered detergent. Therefore, less storage space is required for the liquid detergent composition of this invention than for an equal weight of a dry powdered detergent.

Anionic synthetic surface active agents (surfactants) are generally described as those compounds which contain both hydrophilic and lyophilic groups in their molecular structure and ionize in an aqueous medium to give anions containing both the lyophilic group and hydrophilic group. The class of surfactants useful in the practice of this invention are those classified as detersive surfactants, that is those which are used for cleaning and washing of clothes, dishes and the like.

It is also necessary that the anionic detersive surfactant used in the practice of this invention be water soluble, that is at least 5 parts of the surfactant will dissolve in 100 parts of distilled water at 25° C. and also be soluble in dihydroxyl alcohols. An anionic detersive surfactant is suitable for use in the practice of this invention if at least 20 parts of the anionic detersive surfactant will dissolve in 20 parts of hexylene glycol at 25° C. Ammonium and certain organic substituted amine salts of the alkyl aryl sulfonates, alkyl sulfates, sulfated oxyethylated phenol and alkyl sulfosuccinic acid classes of anionic detersive surfactants are useful in the practice of this invention. More particularly, the ammonium and alkanol ammonium subclasses of the foregoing classes of anionic detersive surfactants wherein the alkanol ammonium group contains at most 10 carbon atoms have been found to have suitable properties for the practice of this invention.

Illustrative of the preferred anionic detersive surfactants used to practice this invention are the alkyl aryl sulfonates, the alkyl sulfates and mixtures thereof.

The alkyl aryl sulfonates useful in the practice of this invention are those which are dihydroxyl alcohol soluble and are represented by the general formula

$$(I) \qquad (R)_{n_1}AR(SO_3M)_{n_2}$$

where R is a straight or branched chain saturated hydrocarbon radical having from about 6 to about 24 carbon atoms; n_1 is from 1 to 3; n_2 is from 1 to 2; AR is benzene or napthalene and M is either ammonium or an alkanol

substituted ammonium radical represented by the following formula

(II) NH_nR_m

In Formula II, n is an integer from 1 to 4, m is an integer from 0 to 3 and $m+n$ equals 4 and R is an alkanol radical. The total number of carbon atoms in the cation of Formula II is at most 10.

Compounds illustrative of the alkyl aryl sulfonates useful in the practice of this invention include monohexanolammonium dodecylbenzene sulfonate; triisopropanolammonium tricosyl benzene sulfonate; diisobutanolammonium dodocylbenzene sulfonate; 1-n-decanolammonium octyl benzene sulfonate. triethanolammonium nonylbenzene sulfonate; triisopropanolammonium dodecylnaphthalene sulfonate; monoethanolammonium heptadecylbenzene sulfonate; ammonium eicosyl naphthalene sulfonate; methanolammonium undecylnaphthalene sulfonate; ammonium 5-ethyl-1,4,6-tridocosylnaphthalene sulfonate and the like.

Although the alkyl aryl sulfonates of the general formula previously given can be used in the practice of this invention, it is preferred when using alkyl aryl sulfonates to use compounds where R is a straight or branched chain saturated hydrocarbon radical containing from about 8 to 18 carbon atoms; n_1 and n_2 are 1; AR is benzene and M is ammonium or an alkanol substituted ammonium radical with from 1 to 3 alkanol groups which contain from 1 to 3 carbon atoms. R can be, for example, octyl; nonyl; decyl; undecyl; dodecyl; octadecyl; tridecyl; tetradecyl; 2 methyldodecyl; 2,3,5-triethyldecyl; 2,7,8-trimethyldecyl and the like and M can be, for example, ammonium; mono-, di- and trimethanolammonium; mono-, di- and triethanolammonium and mono-, di- and tripropanolammonium. Compounds illustrative of the foregoing alkyl aryl sulfonates include triethanolammonium dodecyl benzene sulfonate; methanol-ammonium tetradecyl benzene sulfonate; ammonium octadecyl benzene sulfonate; triisopropanolammonium decylbenzene sulfonate; ammonium pentadecyl benzene sulfonate and the like.

The alkyl sulfates useful in the practice of this invention are those represented by the general formula

(III) RSO_3M

where M is either ammonium or an alkanol substituted ammonium radical represented by the following formula

(IV) NH_nR_m

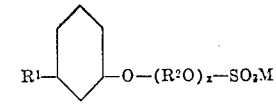
In Formula IV, n is an integer from 1 to 4, m is an integer from 0 to 3 and $m+n$ equals 4 and R is an alkanol radical. The total number of carbon atoms in the cation of Formula IV is at most 10. R in Formula III is a straight or branched chain alkyl radical, such as octyl; decyl; dodecyl; tetradecyl and hexadecyl; 5 methyl-4 propylnonyl; 2,7,8-trimethyldecyl; 2,3,5-trimethylhexyl; and 3 methyldecyl and the like, as well as the mixed alkyl radicals derived from fatty oils, such as coconut oil, tallow, cottonseed oil and the like, with R containing from 6 to 24 carbon atoms and are dihydroxyl alcohol soluble as previously described. The sulfate radical is generally attached at the 1-position on the straight or branched chained alkyl radical.

Compounds illustrative of alkyl sulfate class of anionic detersive surfactants useful in the practice of this invention include triisopropanolammonium tetracosyl sulfate; 2-hexanolammonium hexadecyl sulfate; 1-decanolammonium 2,7,8-trimethyldecyl sulfate; monoethanol ammonium nonyl sulfate; ammonium decyl sulfate; ammonium 2,3,5-trimethylhexyl sulfate; trimethanolammonium octyl sulfate; n-dipentanolammonium octadecyl sulfate; 3-heptanolammonium nonyl sulfate and the like.

Although the alkyl sulfate of the general formula previously given can be used in the practice of this invention, it is preferred when using alkyl sulfates to use compounds where M is either ammonium or an alkanol substituted ammonium radical with from 1 to 3 alkanol groups which contain 1 to 3 carbon atoms such as mono-, di- and trimethanolammonium; mono-, di- and triethanolammonium and mono-, di- and tripropanolammonium, and R is a straight or branched chain alkyl radical as well as the mixed alkyl radicals derived from fatty oils with R containing an average of from 8 to 18 carbon atoms. Compounds illustrative of the preferred alkyl sulfates include trimethanolammonium tetradecyl sulfate, triethanolammonium dodecyl sulfate, triisopropanolammonium octyldecyl sulfate, ammonium octyl sulfate, ammonium undecyl sulfate, diethanolammonium pentadecyl sulfate, trimethanolammonium hexyldecyl sulfate and the like.

Although the preferred anionic detersive surfactants in the practice of this invention are the alkyl aryl sulfonates and the alkyl sulfates, other anionic detersive surfactants which are water soluble and dihydroxyl alcohol soluble and can also be used. For example, those sulfated oxyethylated phenols of the following general formula which are dihydroxyl alcohol soluble can be used.

(V)



where R′ is a straight or branched chain alkyl group having from about 5 to about 24 carbon atoms, R^2 is an alkyl radical containing from 2 to 4 carbon atoms, x is an integer from 3 to 30 and M is either ammonium or an alkanol substituted ammonium radical containing from 1 to 10 carbon atoms represented by the following general formula

(VI) NH_nR_m

In Formula VI, n is an integer of from 1 to 4 and m is an integer of from 0 to 3 and $n+m$ equals 4 and R is an alkanol radical. The cation represented by Formula VI can contain at most 10 carbon atoms.

Compounds illustrative of the sulfated oxyethylated alkyl phenol class of anionic surface active agents useful in the practice of this invention include ammonium nonylphenoxy tricosapropyleneoxy sulfate; triisopropanolammonium dodecylphenoxy hexadecaethyleneoxy sulfate; ammonium decylphenoxy tripropyleneoxy sulfate; monoethanolammonium octylphenoxy decabutyleneoxy sulfate, 1-mono-decanolammonium hexylphenoxy tridecylethyleneoxy sulfate; trimethanolammonium dodecylphenoxy eicosylpropyleneoxy sulfate; dibutanolammonium decylphenoxy cosylbutyleneoxy sulfate; monomethanolammonium octylphenoxy hexylethyleneoxy sulfate; diethanolammonium tridecylphenoxy tetradecylpropyleneoxy sulfate; monobutanolammonium tetradecylphenoxy heptapropyleneoxy sulfate; triethanolammonium cosylphenoxy octadecylethyleneoxy sulfate; and methanolammonium dodecylphenoxy tridecylbutyleneoxy sulfate.

Although the sulfated oxyethylated alkylphenols of the general formula previously given are useful in the practice of this invention, it is preferred when using sulfated oxyethylated alkylphenols to use compounds where R_1 has from 8 to 18 carbon atoms, R_2 has 2 or 3 carbon atoms, x is an integer between 5 and 25 and M is ammonium or an alkanol substituted ammonium radical with from 1 to 3 alkanol groups which contain from 1 to 3 carbon atoms such as mono-, di- and trimethanolammonium; mono-, di-, and triethanolammonium and mono-, di-, and tripropanolammonium. Compounds illustrative of the preferred sulfated oxyethylated alkylphenols include triethanolammonium dodecylphenoxy decaethyleneoxy sulfate; monomethanolammonium tetradecylphenoxy decapropyleneoxy sulfate; monoethanolammonium octaphenoxy pentaethyleneoxy sulfate; diisopropanolammonium octadecylphenoxy sulfate; ammonium penteicosaethyleneoxy sulfate; monoethanolammonium tridecylphenoxy tridecylethyleneoxy sulfate; triethanolammonium tetradecylphenoxy decylethyleneoxy sulfate; triisopropanolam-

monium dodecylphenoxy octyldecylethyleneoxy sulfate and the like.

Other anionic detersive surfactants which can be used include the ammonium and alkanol substituted ammonium salts containing at most 10 carbon atoms of alkyl containing sulfosuccinic acid such as diamyl, dihexyl, dioctyl esters of sulfosuccinic acid. In addition a number are described in Schwartz, Perry and Berch, Surface Active Agents and Detergents, Interscience Publishers, New York (1958). In any event, the anionic detersive surfactant must be dihydroxyl alcohol-soluble as previously described.

In the practice of this invention, it is possible to use certain mixtures of anionic detersive surfactants of the classes described and nonionic detersive surfactants.

Nonionic surfactants can be broadly described as compounds which do not ionize but acquire hydrophilic characteristics from an oxygenated side chain such as polyoxyethylene. The lyophilic part of the nonionic surfactant molecule may come from fatty acids, phenol, alcohols, amides or amines. The nonionic detersive surfactants are usually made by reacting an alkylene oxide such as ethylene oxide, butylene oxide, propylene oxide and the like with fatty acids, a straight or branched chain alcohol, phenols, thiophenols, amides and amines to form polyoxyalkylene glycol ethers and esters, polyoxyalkylene alkyl phenol and polyoxyalkylene thiophenols, and polyoxyalkylene amides and the like. It is generally preferred to react from about 3 to about 30 moles of alkylene oxide per mole of the fatty acids, alcohols, phenols, thiophenols, amides or amines.

Illustrative of these nonionic detersive surfactants are the products obtained from the reaction of alkylene oxide such as ethylene oxide and/or propylene oxide, with an aliphatic alcohol having from 8 to 18 carbon atoms, such as octyl, nonyl, decyl, octadecyl, dodecyl, tetradecyl and the like; with an alkyl phenol in which the alkyl group contains between 4 and 20 carbon atoms, such as butyl, dibutyl, amyl octyl, dodecyl, tetradecyl and the like; with an alkyl amine in which the alkyl group contains between 1 to 8 carbon atoms; and with a fatty alkanol amide in which the alkyl group contains between 6 and 24 carbon atoms.

Compounds illustrative of synthetic nonionic surface active agents include the products obtained from condensing from 3 to 30 moles of ethylene oxide or propylene oxide per mole of the following: propylene glycol, ethylene diamine, diethylene glycol, dodecyl phenol, nonyl phenol, tetradecyl alcohol, N-octadecyl diethanolamide and N-dodecyl monoethanolamide. A number of nonionic detersive surfactants are described in Schwartz, Perry and Berch, Surface Active Agents and Detergents, Interscience Publishers, New York (1958).

It is preferred in the practice of this invention (when using a mixture of an anionic and a nonionic surface active agent) to use at least 60% by weight of the anionic surface active agent in the surfactant mixture. The use of at least 70% by weight of the surfactant mixture consisting of the anionic detersive surfactant is especially preferred. Although larger quantities of nonionic can be used with beneficial cleaning results, the anionic:nonionic weight ratio in the surface active agent mixture should be held below 1:1.

Although dihydroxy substituted saturated hydrocarbons of the general formula

(VII) $C_nH_{2n}(OH)_2$

wherein in Formula VI n is from 5 to 10 are suitable solvents in the practice of this invention, it is preferred to use those saturated dihydroxyl alcohols of Formula VII in which n is between about 6 and about 8. Of the preferred materials hexylene glycol is especially preferred. The dihydroxyl alcohols of the general formula with less than five carbon atoms such as ethylene glycol, propylene glycol and other polyhydroxyl alcohols such as glycerol do not impart the necessary low viscosity to the detergent composition. In the practice of this invention, it is possible to use a minor portion, that is less than about 40% by weight, of another solvent which will dissolve the anionic detersive surfactant. For example, a suitable solvent would be a saturated dihydroxyl alcohol-primary alcohol mixture in which the weight ratio of dihydroxyl alcohol to primary alcohol is 3:1. It is preferred to exceed a weight ratio of dihydroxyl alcohol to other solvents of 3:1. Use of solvents in which the dihydroxyl alcohol is less than about 40% by weight results in an unstable dispersion of sodium tripolyphosphate when preferred amounts of sodium tripolyphosphate are used.

The builder in the detergent composition of this invention is a finely divided sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof. Although it is preferred in the practice of this invention to use a finely divided sodium polyphosphate with a maximum particle size of about 2 microns as measured by Cintel Flying Spot Analyzer; and particle sizes below about 0.5 micron are especially preferred, larger particle sizes may be used. For example, stable sodium polyphosphate dispersions in the previously described actives and solvents which products have suitable end use properties can be made by using particles having a maximum particle size of about 5 microns and with 88% by weight less than about 3 microns as measured by micro screens. Sodium polyphosphate particles larger than about 5 microns tend to precipitate from suspension and segregate upon prolonged standing unless extremely viscous dispersion mediums (greater than 100 poises measured by Brookfield Viscometer) are used. Extremely viscous dispersing mediums impart unsuitable viscosities to the resulting detergent compositions.

Although a detergent composition of this invention can comprise, on a 100 parts by weight basis (a) from about 8 parts to about 40 parts by weight of a surfactant composition as described (b) from about 5 parts by weight to about 20 parts by weight of a solvent as described and (c) from about 20 parts by weight to about 80 parts by weight of finely divided sodium polyphosphate as described; the weight ratio of said surfactant composition to sodium polyphosphate being from about 2:1 to 1:10, it is preferred to use a surfactant to sodium polyphosphate ratio of 3:2 to 1:4. In addition it is further preferred to use (a) from about 10 parts by weight to about 30 parts by weight of the surfactant compositions as described (b) from about 5 parts by weight to about 20 parts by weight of a solvent as described and (c) from about 20 parts by weight to about 80 parts by weight of finely divided sodium polyphosphate as described and a surfactant to sodium polyphosphate and ratio in said detergent of from about 2:3 to about 1:4.

For successful practice of this invention, the novel liquid detergent composition of this invention need only contain the surface active agent of the classes described, the solvent of the class described and the sodium polyphosphate builder selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof as described and within the ranges and proportions as described. It is possible in a liquid detergent of this invention to incorporate up to about 20% by weight of an inorganic nonphosphate salt such as sodium sulfate. Additives, such as sodium carboxymethyl cellulose as an antiredeposition agent, or anhydrous sodium silicate as corrosion inhibitor and perfumes, dyes, and brightening agents may also be added. The antiredeposition agents, corrosion inhibitors, perfumes, dyes, brightening agents if used are generally added in amounts of below about 10% by weight.

This invention is not to be limited to any particular method of preparing a detergent containing the active, the solvent and sodium tripolyphosphate. Any conventional means of uniformly mixing the components can be

used. For example, a uniform liquid detergent composition can be formed by charging the solvent into an agitated tank and then adding the active and the finely divided sodium polyphosphate while agitating. In addition the dry components, that is the detersive surfactant and sodium polyphosphate, can be blended together and then added to the solvent.

A suitable method of achieving the desired cleaning results is to add the liquid detergent of the invention to water to form a aqueous solution of the desired concentration. When used in this manner the detergent compositions of this invention give excellent cleaning results when used in aqueous solutions conventional concentrations used for washing clothes and the like.

To illustrate the invention, the following examples are presented. All parts, percentages, and proportions are by weight unless otherwise indicated.

Example I

A detergent composition of the following composition was prepared by mixing the components of the detergent in a Eppenback Homo mixer. The sodium tripolyphosphate, which had been previously ground in a Mikro Atomizer, had an average particle size of 1.9 microns and had 90% by weight less than 3 microns. Particle size measurement was made by the Centil Flying Spot Analyzer. The various ingredients are listed below:

Triethanolamine salt of dodecylbenzene sulfonate	19.5
Product produced from condensing 10 moles of ethylene oxide per mole of dodecylphenol	7.8
Sodium tripolyphosphate	63.1
Hexylene glycol	5.9
Ethyl alcohol	2.9
Sodium carboxymethyl cellulose	0.8

Example II

The detergent composition of Example I was compared to three liquid detergents each of which can be purchased at local stores. For example purposes, these three products are identified as "Commercial Liquid Detergent A," "Commercial Liquid Detergent B," and "Commercial Liquid Detergent C."

The tests were made in a Launder-Ometer machine on standard soiled fabric specimens under the following controlled conditions:

Hardness, p.p.m.	300
Detergency concentration, percent by weight	0.25
Temperature, ° C.	65
pH	9.5

In the tests cleaning efficiency of each detergent was compared to an industry standard, sodium lauryl sulfate. The following tabulated results indicate the cleaning efficiency of the indicated detergent composition as compared to that of the industry standard.

TABLE I

Detergent:	Percent cleaning efficiency
Industry Standard	100
Liquid Detergent of Example I	122
Commercial Liquid Detergent A [1]	100
Commercial Liquid Detergent B [2]	89
Commercial Liquid Detergent C [3]	75

[1] Consists essentially of an aqueous solution of tetrapotassium pyrophosphate, sodium silicate, and an emulsified nonionic.
[2] Consists essentially of an aqueous solution of tetrapotassium pyrophosphate, sodium silicate and sodium alkylbenzene sulfonate.
[3] Consists essentially of an aqueous solution of tetrapotassium pyrophosphate, sodium silicate and sodium alkylbenzene sulfonate.

The results of the above tests dramatically illustrate the excellent cleaning efficiency of the detergent composition of this invention. More particularly the results show significantly greater cleaning efficiency with the detergent of this invention than with any of the commercial liquid detergents.

Example III

The detergent composition as prepared in Example I was compared with three common powdered detergents which were available for purchase at local grocery stores. The tests were conducted using a Launder-Ometer machine on standard soiled fabric specimens under the following control conditions:

Hardness, p.p.m.	300
Detergent Concentration, percent by weight	0.25
pH	9.5
Temperature, ° C.	65

In each test the cleaning efficiency of an industry standard, sodium lauryl sulfate, was taken as 100 and the cleaning efficiency of the test detergents was compared with this standard. The three dry powdered detergents are identified in the tabulated results as "Commercial Powder A," "Commercial Powder B," and "Commercial Powder C." Essential components of these detergents are listed below the tabulated results. Results of the test are given in the following table under Test 1. The dry powdered detergent exhibiting the highest cleaning efficiency identified as "Commercial Powder A" was compared with the detergent composition of this invention as prepared in Example I under the same test conditions except the detergent concentration of both detergents were varied from 0.15% to 0.25%. The tabulated results of these tests are shown in Table II under Tests 2 and 3.

TABLE II

Detergent	Test 1	Test 2	Test 3
Detergent Concentration, percent	0.25	0.20	0.15
Liquid Detergent of Example I	122	120	121
Commercial Powder A[1]	120	121	111
Commercial Powder B[2]	112	----------	----------
Commercial Powder C[3]	107	----------	----------

[1] Consists essentially of sodium alkylbenzene sulfonate, fatty alcohol sulfate, and sodium tripolyphosphate.
[2] Consists essentially of sodium alkylphenol oxyethylate, sodium sulfate and sodium tripolyphosphate.
[3] Consists essentially of sodium alkylbenzene sulfonate, sodium sulfate and sodium tripolyphosphate.

The above results show that over a wide range of detergent concentrations that the liquid detergent composition of this invention is equal to one of the leading powdered detergents. In addition it shows that under comparable conditions the liquid detergent of this invention is superior in cleaning efficiency to two of the common powdered detergents.

Example IV

A liquid detergent is prepared by dissolving 36 parts of triethanolamine salt of dodecylbenzene sulfonic acid in 10 parts of hexylene glycol. To this solution 54 parts of finely divided tetrasodium pyrophosphate with an average particle size of about 0.5 micron and with a maximum particle size of about 2 microns is added. Particle size is measured by a Cintel Flying Spot Analyzer. After storage for 6 months without agitation, the sodium pyrophosphate remains uniformly dispersed throughout the solution. The viscosity of the liquid detergent is measured using a Brookfield Viscometer and a special spider spindle to be about 20 poises.

The above detergent composition gives good cleaning results in conventional automatic washing machines when used in concentrations of about 0.20% by weight in aqueous solutions for laundering soiled clothes.

Other comparable detergent compositions can be prepared in the same manner as described by substituting similar amounts of other alkanol substituted ammonium alkyl aryl sulfonates useful in practicing this invention. For example similar amounts of monoethanolamine salt of dodecylbenzene sulfonic acid, triethanolamine salt of tetradecyl benzene sulfonic acid, diethanolamine salt of

nonylbenzene sulfonic acid, dimethanolamine salt of heptadecyl benzene sulfonic acid and triethanol amine salt of dodecylnaphthalene sulfonic acid can be substituted for triethanol salt of dodecylbenzene sulfonic acid in the foregoing detergent composition and the resulting detergent compositions give good results when used for laundering clothes under the same conditions as the detergent compositions of this example.

Example V

A liquid detergent is prepared by dissolving 30 parts of triethanolamine salt of dodecyl sulfuric acid and 15 parts octylene glycol. To this solution 55 parts of finely divided sodium tripolyphosphate is added with the sodium tripolyphosphate having an average particle size of about 1 micron and a maximum particle size of about 3 microns. After storage for 6 months without agitation the sodium tripolyphosphate remains uniformly dispersed throughout the solution. The above liquid detergent composition gives good cleaning results in conventional automatic washing machines when used in concentrations of about 0.25% by weight in an aqueous solution for laundering soiled clothes. Other comparable detergent compositions can be prepared in the same manner as described by substituting similar amounts of other alkanol substituted ammonium alkyl sulfates useful in the practice of this invention. For example, similar amounts of diethanolamine salt of dodecylbenzene sulfuric acid; triethanolamine salt of tetradecyl sulfuric acid; diethanol salt of heptadecyl sulfuric acid; triethanolamine salt of nonyl sulfuric acid; diethanolamine salt of decyl sulfuric acid; triethanolamine salt of tetradecyl sulfuric acid; and triethanolamine salt of octadecyl sulfuric acid can be substituted for triethanolamine salt of dodecyl sulfuric in the foregoing detergent composition and the resultant detergent composition gives good results when used for laundering clothes under the same conditions the detergent composition of this example.

Example VI

The liquid detergent composition is prepared by dissolving 20 parts of triethanol ammonium dodecylbenzene sulfonate, 10 parts of triethanol ammonium tetradecyl sulfate, and 10 parts of triethanol ammonium dodecylphenoxy trietholeneoxy sulfate and 20 parts of pentamethylene glycol. To this solution 40 parts sodium tripolyphosphate with an average particle size of 3 microns and with a maximum particle size of 5 microns are added. The above liquid detergent composition gives good cleaning results in conventional automatic washing machines when used in concentrations of about 0.20% by weight in aqueous solutions for laundering heavily soiled clothes.

Other comparable detergent compositions can be prepared in the same manner as described by substituting similar amounts of other alkanol ammonium substituted sulfated oxyethylene alkyl phenols useful in practicing this invention. For example similar amounts of diethanolammonium nonylphenoxy tetraethyleneoxy sulfate, triethanolammonium dodecylphenoxy triethyleneoxy sulfate, triethanolammonium decylphenoxy tetraethyleneoxy sulfate, and triethanolammonium octylphenoxy triethyleneoxy sulfate can be substituted for triethanol ammonium dodecylphenoxy triethyleneoxy sulfate in the foregoing detergent composition and the resulting detergent composition gives good results when used for laundering clothes under the same conditions as the detergent composition of this example.

Examples VII through XI

The following detergent compositions are prepared by dissolving the surface active agent in the dihydroxyl alcohol and adding finely divided sodium polyphosphate and mixing the sodium polyphosphate and the solution in a conventional agitated vessel to obtain a uniform dispersion of sodium polyphosphate throughout the solution. The sodium polyphosphate has an average (by number) particle size of about 0.4 micron and a maximum particle size of about 1.5 mcirons. The liquid detergents exhibit suitable viscosity properties of about 20 poises as measured by a Brookfield Viscometer at 25° C. using a special spider spindle. The detergent compositions show good stability characteristics and demonstrate no tendency for the sodium polyphosphate to settle to the bottom of the containers.

These detergents easily remove soil from clothes when used in conventional concentrations of about 0.20% in aqueous solutions in automatic washing machines.

Example VII

Ingredients:	Parts
Triethanolammonium dodecyl naphthalene sulfonate	10
Diethanolammonium tetradecyl sulfate	10
The product produced from condensing 10 moles of ethylene oxide per mole of nonylphenol	10
Hexylene glycol	10
Tetrasodium pyrophosphate	60

Example VIII

Monoethanolammonium dodecylbenzene sulfonate	20
The product from condensing 15 moles of propylene glycol per mole of tetradecyl alcohol	5
3 methyl hexylene glycol	12
Ethyl alcohol	3
Sodium tripolyphosphate	50
Sodium sulfate	7
Sodium carboxymethyl cellulose	2
Brightener	.75
Dye	.25

Example IX

Diethanolammonium hexadecyl sulfate	20
Hexylene glycol	10
Sodium tripolyphosphate	70

Example X

Monoethanolammonium decylphenoxy tetraethyleneoxy sulfate	20
Decylene glycol	15
Sodium tripolyphosphate	60
Sodium silicate	5

Example XI

Ammonium dodecylbenzene sulfonate	30
Hexylene glycol	10
Ethyl alcohol	5
Sodium tripolyphosphate	25
Tetrasodium pyrophosphate	20
Sodium sulfate	10

What is claimed is:

1. A liquid detergent composition consisting essentially of, on a 100 parts by weight basis (a) from about 8 parts by weight to about 40 parts by weight of a water-soluble, dihydroxyl alcohol-soluble, anionic detersive surfactant, said surfactant containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said surfactant is selected from the group consisting of detersive alkyl aryl sulfonates, detersive alkyl sulfate, detersive alkyl phenol polyoxyethylene ether sulfates, detersive dialkyl sulfosuccinates and mixtures thereof; (b) from about 5 parts by weight to about 20 parts by weight of a dihydroxy substituted saturated hydrocarbon containing from 5 to 10 carbon atoms and (c) from about 20 parts by weight to about 80 parts by

weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of about 5 microns and an average particle size of at most about 3 microns; the weight ratio of said anionic detersive surfactant to said sodium polyphosphate in said liquid detergent composition being from about 2:1 to about 1:10.

2. The detergent composition of claim 1 wherein the water soluble dihydroxyl alcohol soluble anionic detersive surfactant is an alkyl sulfate.

3. The detergent composition of claim 1 wherein the anionic detersive surfactant is an alkyl aryl sulfonate.

4. The detergent composition of claim 1 wherein the dihydroxy substituted saturated hydrocarbon is hexylene glycol.

5. A liquid detergent composition consisting essentially of, on a 100 parts by weight basis, (a) from about 10 parts by weight to about 30 parts by weight of a detersive surfactant composition, said detersive surfactant composition containing at least 50% by weight of a water-soluble, dihydroxyl alcohol-soluble, anionic detersive surfactant, said surfactant containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said surfactant is selected from the group consisting of detersive alkyl aryl sulfonates, detersive alkyl sulfates, detersive alkyl phenol polyoxyethylene ether sulfates dialkyl sulfosuccinates and mixtures thereof, and said detersive surfactant composition containing from 0% by weight to about 50% by weight of a nonionic detersive surfactant; (b) from about 5 parts by weight to about 20 parts by weight of a solvent, said solvent containing at least 60% by weight of a dihydroxy substituted saturated hydrocarbon containing from 5 to 10 carbon atoms and said solvent containing from 0% to about 40% by weight of a water soluble monohydroxy primary alcohol which will dissolve said anionic surface active agent and (c) from about 20 parts by weight to about 80 parts by weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of about 5 microns and an average particle size of at most about 3 microns and the weight ratio of said detersive surfactant to said sodium polyphosphate is from about 2:3 to about 1:4.

6. The detergent composition of claim 5 wherein said dihydroxy substituted saturated hydrocarbon is hexyleneglycol.

7. The detergent composition of claim 6 wherein said water soluble, dihydroxy alcohol soluble anionic detersive surfactant is an alkyl sulfate.

8. The detergent composition of claim 6 wherein said water soluble, dihydroxy alcohol soluble anionic detersive surfactant is an alkyl aryl sulfonate.

9. A liquid detergent composition consisting essentailly of, on a 100 parts by weight basis, (a) from about 10 parts by weight to about 30 parts by weight of a detersive surfactant composition, said detersive surfactant composition containing at least 70% by weight of a water-soluble dihydroxy alcohol-soluble anionic detersive surfactant, said surfactant containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said surfactant is selected from the group consisting of detersive alkyl aryl sulfonates, detersive alkyl sulfate, detersive alkyl phenol polyoxyethylene ether sulfates, detersive dialkyl sulfosuccinates and mixtures thereof; said detersive surfactant composition containing from 0% by weight to about 30% by weight of an nonionic detersive surfactant; (b) from about 5 parts by weight to about 20 parts by weight of a solvent, said solvent containing at least 67 parts by weight of a dihydroxy substituted saturated hydrocarbon alcohol containing from about 6 to about 8 carbon atoms and said solvent containing from about 0 to about 33 parts by weight of a water-soluble monohydroxy primary alcohol which will dissolve; said detersive anionic surfactant; and (c) from about 20 parts by weight to about 80 parts by weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of 2 microns and an average particle size of 0.5 micron; the weight ratio of said detersive surfactant to sodium polyphosphate is from about 2:3 to about 1:4.

10. A liquid detergent composition consisting essentially of, on a 100 parts by weight basis (a) from about 10 parts by weight to about 30 parts by weight of a detersive surfactant composition, said detersive surfactant composition containing at least 50% by weight of a water-soluble, dihydroxyl alcohol-soluble, detersive alkyl sulfate containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said detersive surfactant composition containing from 0% by weight to about 50% by weight of a nonionic detersive surfactant, (b) from about 5 parts by weight to about 20 parts by weight of a solvent, said solvent containing at least 60% by weight of a dihydroxy substituted saturated hydrocarbon containing from 6 to 8 carbon atoms and said solvent containing from 0% to about 40% by weight of a water-soluble monohydroxy primary alcohol which will dissolve said anionic surface active agent and (c) from about 20 parts by weight to about 80 parts by weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of about 5 microns and an average particle size of at most about 3 microns and the weight ratio of said detersive surfactant to said sodium polyphosphate is from about 2:3 to about 1:4.

11. The detergent composition of claim 10 wherein the dihydroxy substituted saturated hydrocarbon is hexylene glycol.

12. The detergent composition of claim 10 wherein the cationic radical is triethanol ammonium.

13. The detergent composition of claim 10 wherein the anionic detersive surfactant is triethanol ammonium dodecyl sulfate.

14. The detergent composition of claim 10 wherein the anionic detersive surfactant is triethanol ammonium tridecyl sulfate.

15. A liquid detergent composition consisting essentially of, on a 100 parts by weight basis (a) from about 10 parts by weight to about 30 parts by weight of a detersive surfactant composition, said detersive surfactant composition containing at least 50% by weight of a water-soluble, dihydroxyl alcohol-soluble, detersive alkyl aryl sulfonate containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said detersive surfactant composition containing from 0% by weight to about 50% by weight of a

nonionic detersive surfactant, (b) from about 5 parts by weight to about 20 parts by weight of a solvent, said solvent containing at least 60% by weight of a dihydroxy substituted saturated hydrocarbon containing from 6 to 8 carbon atoms and said solvent containing from 0% to about 40% by weight of a water-soluble monohydroxy primary alcohol which will dissolve said anionic surface active agent and (c) from about 20 parts by weight to about 80 parts by weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of about 5 microns and an average particle size of at most about 3 microns and the weight ratio of said detersive surfactant to said sodium polyphosphate is from about 2:3 to about 1:4.

16. The detergent composition of claim **15** wherein the dihydroxy substituted saturated hydrocarbon is hexylene glycol.

17. The detergent composition of claim **15** wherein the cationic radical is triethanol ammonium.

18. The detergent composition of claim **15** wherein the anionic detersive surfactant is the triethanol amine salt of tridecylbenzene sulfonic acid.

19. The detergent composition of claim **15** wherein the anionic detersive surfactant is the triethanol amine salt of tetradecylbenzene sulfonic acid.

20. A liquid detergent composition consisting essentially of, on a 100 parts by weight basis, (a) from about 10 parts by weight to about 30 parts by weight of a water-soluble, dihydroxyl alcohol-soluble, anionic detersive surfactant, said surfactant containing a cationic radical of the general formula

$$N(H)_n(R)_m$$

wherein n is an integer of from 1 to 4, m is an integer of from 0 to 3, $n+m$ equals 4, R is an alkanol radical and said cationic radical contains at most about 10 carbon atoms and said surfactant is selected from the group consisting of detersive alkyl aryl sulfonates, containing from about 6 to about 24 carbon atoms, detersive alkyl sulfates, containing an alkyl group having from 6 to 24 carbon atoms, detersive alkyl phenol polyoxyethylene ether sulfates, containing an alkyl group having about 5 to 24 carbon atoms, and mixtures thereof; (b) from about 10 parts by weight to about 20 parts by weight of hexylene glycol and (c) from about 20 parts by weight to about 80 parts by weight of a sodium polyphosphate selected from the group consisting of sodium tripolyphosphate, tetrasodium pyrophosphate and mixtures thereof, said sodium polyphosphate having a maximum particle size of about 5 microns and an average particle size of at most about 3 microns; the weight ratio of said anionic detersive surfactant to said sodium polyphosphate in said liquid detergent composition being from about 2:3 to about 1:4.

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