ABSTRACT OF THE DISCLOSURE

A non-phosphate and non-NTA containing detergent composition comprising from about 30 to 95% by weight of a detergent, especially an anionic or nonionic detergent and from about 5 to 75% by weight of tetrahydroxy succinic acid and salts thereof.

This invention relates to builders for synthetic detergents and, more particularly, to calcium ion precipitating agents as substitutes for phosphate builders in detergent compositions.

It is widely known that detergent compositions for use in home laundering and general purpose washing operations have been rapidly developed and improved in accordance with existing technology, the demand of the consumer and the need to develop products which overcome specific problems which arise in the cleaning art. For example, in the past, it was readily accepted that the cleaning power of a detergent composition was proportional to the amount of suds or foam which could be produced in the washing medium. Therefore, various additives were developed which, when added to detergent compositions produced voluminous amounts of suds or foam. However, with the advent of the automatic washing machine, the extensive foaming produced by the more efficient agitation encountered in these machines created increasing problems with rinsing the studds from the materials being washed and disposed of the suds into sewage systems. To overcome this problem, powerful detergents were developed which possess low foaming properties. Such powerful detergents commonly contain phosphate builders which are used to improve the detergency level of the detergent compositions. Although several factors are involved in obtaining cleaning agents with high levels of detergency one such factor is believed to be the interference of metal ions normally present in water with the active ingredient of the cleaning composition and also the redeposition of these metal ions on the washed article. Several phosphate type builders are known to be effective in the sequestration of these ions in washing solutions. However, due to the high molecular weight of the phosphate builders and their susceptibility to hydrolysis and limited degradation in water and, further, because of the widespread use of such phosphates and detergents today, serious problems such as pollution of rivers, lakes and streams have been attributed to the great volume of such phosphates dumped into these bodies of water. Therefore, much attention has recently been given to the replacement of the phosphate materials in detergent compositions with materials which are biodegradable and which lessen the danger of pollution of waters.

As can be appreciated from the foregoing, several factors must be considered in the replacement of phosphates as builders for detergent compositions so that predictability of the effect of one compound on another is virtually non-existent. One example of the complexity of the problem of substitution of phosphate builders is demonstrated by the history of substitution of nitrilotriacetic acid for polyphosphates in detergents. Within the past decade when the possibility of water pollution as the result of the use of billions of pounds of phosphates in detergents became apparent, manufacturers turned to nitrilotriacetic acid (NTA) as the replacement for the phosphate builders because of its known sequestration properties. However, much controversy has arisen over the possibility that NTA may be an even more dilatious agent to the environment than the polyphosphates. Consequently, the replacement of phosphate builders with NTA has recently been discontinued as a suitable solution to the problem.

Several polycarboxylic acid containing compounds have been used as effective calcium, magnesium, iron and aluminum metal ion capturing or chelating materials. As is shown in U.S. Pat. 2,264,103, acetyl citric acid, tricarballylic acid, acetic acid, mellitic acid and the like are utilized for chelation of such ions present in water to soften it. Other efforts are noted in the search to find polycarboxylic acid containing materials having the sequestration properties of the phosphate and NTA builders but without the disadvantageous environmental consequences thereof. U.S. Pat. 3,459,670, for example, discloses the use of cycloalkane tri- and teta-carboxylic acids as detergent builders in liquid cleaning compositions. Somewhat similar detergent builders are disclosed in U.S. Pat. 3,580,852 wherein water soluble salts of tetrahydrofurans 2,3,4,5-tetracarboxylic acids are substituted for the well known phosphate builders. Likewise the use of oxydisuccinic acid salts is recognized in U.S. Pat. 3,635,830 to be an effective phosphate builder replacement.

In addition to the above considerations, several other properties of the phosphate builder substitutes must be considered which thereby intensifies the effort required to find suitable substitutes. Major considerations, include for example, the detergent cleaning power enhancement of the builder, the compatibility of the phosphate builder substitute with solvents and other ingredients utilized in liquid and dry detergent compositions, the metal ion control properties of the builder and the stability of such builders when used with bleaching agents and many other additives.

It is within the above environment and background that the composition of the present invention was developed. Briefly the instant composition which provides a non-phosphate and non-NTA built detergent composition having similar detergency properties from 95 to 30% by weight of a detergent and from 5 to 70% by weight of a tetrahydroxy succinic acid compound.

Accordingly, it is an object of the present invention to provide an improved builder substitute for synthetic detergent compositions.

It is another object of the present invention to provide a builder substitute for synthetic organic detergents which may replace all or part of the conventional phosphate builders previously used.

It is still another object of the present invention to provide a phosphate builder substitute which is compatible with the organic solvents used in liquid detergents.

It is still a further object of the present invention to provide a builder for synthetic detergent compositions which has metal ion control properties at least equal to that of conventional phosphate builders.

It is still a further object of the present invention to provide a non-phosphate containing detergent composition containing a tetrahydroxy succinic acid or salts thereof as a builder.

Other objects and advantages will become more apparent from the following more detailed description.

The foregoing objects and advantages are achieved by the detergent composition of the present invention which comprises from 95 to 30% by weight of a detergent selected from a nonionic, anionic, cationic, ampholytic or
zwitterionic detergents and 5 to 70% by weight of tetrahydroxysuccinic acid compound selected from tetrahydroxysuccinic acid, and the alkali and ammonium salts thereof.

In accordance with the present invention, it has been found that tetrahydroxysuccinic acid and the water soluble salts thereof are effective as builder substitutes for synthetic detergents and may, therefore, be used in place of the conventional phosphorous containing builders. These compounds have, in addition, a relatively high density and a low molecular weight and yield particularly good metal ion control and anti-redeposition properties when used in detergent compositions.

The tetrahydroxysuccinic acid compounds which are suitable replacements for prior art building include tetrahydroxysuccinic acid, disodium salt, tetrahydroxysuccinic acid, dipotassium salt, tetrahydroxysuccinic acid, di-ammonium salt, etc. Suitable other salts include alkylamino salts, alkanolamino salt and water-soluble salts formed from any salt forming material which does not interfere with the precipitating activity of the tetrahydroxysuccinic acid.

The tetrahydroxysuccinic acid and water-soluble salts thereof may be used as a builder substitute in a wide variety of synthetic detergents, such as anionic, nonionic, cationic, amphoteric, zwitterionic and mixtures thereof. Tetrahydroxysuccinic acid and the salts thereof are especially useful as builders for nonionic and anionic detergents, especially straight chain biodegradable anionics and nonionics. The effectiveness of the builder substitutes in such detergent compositions is equal to that of the phosphate builders conventionally used, such as sodium tripolyphosphate, at the conventional pH levels of the washing medium. In addition to the aforementioned properties, the compound of this invention provides the detergent with cleaning powers equal to that of the phosphate built detergents and, yet, without the undesirable environmental consequences of phosphate build-up in rivers, lakes, streams and other bodies of water. An additional factor important to the suitability of the tetrahydroxysuccinic acid builders of this invention is the improved clarity of final liquid detergent products due to the fact that the builders of this invention are more compatible with organic solvents normally used in liquid detergents than are the conventional phosphate builders.

The effectiveness of the tetrahydroxysuccinic acid and water-soluble salts thereof has been found to be equivalent to sodium tripolyphosphate on a weight basis and therefore may be used in amounts which are generally known to be effective for phosphate built detergent compositions e.g. from 5 to 70% by weight and preferably from 15 to 50% by weight and preferably from 85 to 50% by weight detergent composition. The weight percent of detergent and builder present in a washing solution is generally from 0.05 to 2.5 weight percent with normal detergent concentration being about 0.1%. At these standard concentrations, the detergent builder of this invention provides a dilute solution which appears colorless.

The synthetic detergent and washing solution of this invention should generally be used at a pH above 8.5 and preferably at a pH above 9.5. Because of the desirability of an alkaline pH and because most synthetic detergent compositions yield only mildly alkaline solutions in use, it may be necessary to adjust the pH of the final detergent compositions of this invention since the tetrahydroxysuccinic acids are not basic themselves using conventional pH adjustments.

As previously mentioned, the builder may be used with any conventional detergent class such as anionic, cationic, nonionic, amphoteric, zwitterionic and any suitable mixtures thereof.

Other detergent materials, such as soaps of coconut oil, palm kernel oil and the like, may be also utilized with the novel builders of this invention to produce improved cleaning compositions. These soaps are well known, highly saponified, mixtures of long chain fatty acids of from 12 to 18 carbon atoms.

The anionic surface active compounds are generally described as compounds which contain hydrophilic and lipophilic groups in a molecular structure and which ionize in an aqueous medium to give anions containing the lipophilic group. Typical of these compounds are the sulfo- nated and sulfated alkyl hydrocarbons and alkali metals salts thereof, such as sodium dodecylbenzene sulfonate, sodium tridecylsulfonate, magnesium dodecylbenzene sulfonate, potassium tetradecylbenzene sulfonate, ammonium dodecylsulfonate, lithium pentadecylbenzene sulfonate, sodium dioctylbenzene sulfonate, disodium dioctylsulfonate, dioctylsodium isopropylnaphthalene disulfonate and the like as well as the alkali metal salts of fatty alcohol esters of sulfuric and sulfonic acids, the alkali metal salts of alkyaryl (sulfonflic acid) esters and the alkylthiol sulfonic acid esters and the like, sodium salts of sulfonated mineral acids, sodium salts of sulfosuccinic acid esters and the ethoxylated alkyl sulfates of the formula RO(C₂H₄O)nSO₃M

wherein R is an alkyl group, preferably having a straight chain, of from 10 to 20 carbon atoms, n is a number from 2 to 6, preferably n is from ½ to ½ the average number of carbon atoms in R and M is a cation selected from alkali metals such as sodium, potassium, etc., ammonium lower alkylamino and lower alkanolamino such as mixed C12-14 normal primary alkyl thiocyno salt, sodium salt; myristyl thiocyno salt, potassium salt; n-decyl dithiocyaneate salt, diethanolamine salt; lauryl dithiocyaneate salt, ammonium salt; palmityl tetraethylenesulfate, sodium salt; mixed C16-18 normal primary alkyl mixed tri- and tetraethoxy sulfate, sodium salt; stearyl pentethylenesulfate, trimethylamine salt; mixed C10-18 normal primary alkyl thiocyno salt, potassium salt, etc.

By the term "cationic detergents," it is meant surfactants which ionize in an aqueous medium to give cations containing the lipophilic group. Some typical examples of these compounds are the quaternary ammonium compounds which contain an alkyl group of about 12 to 18 carbon atoms, such as laurylbenzyldimethylammonium chloride.

The nonionic surface active agents are generally described as compounds which do not ionize in water solutions. Usually, these compounds possess hydrophilic characterities by virtue of the presence of a hydrophilic group, such as polyoxyethylene with the lipophilic part of the molecule coming from fatty acids, phenols, alcohols, amines or amides. Suitable examples of nonionic surfactants are the products formed generally by condensing one or more alkali oxides of 2 to 4 carbon atoms, such as ethylene oxide, propylene oxide and the like, with relatively hydrophobic compounds, such as fatty alcohol, fatty acids, sterol, fatty glycerides, fatty amines, aryl amines, fatty mercaptans, tall oil and so on. Other suitable nonionic surfactants include those products produced by condensing one or more relatively lower alkyl alcohol amines, such as methanol amine, ethanolamine, propanolamine and the like, with fatty acid, abietic acid, and so on, to produce the corresponding amide.

The synthetic nonionic detergents utilized will normally be nonionic synthetic organic detergents known for their utility in separating dirt, grease, stains and other soil from fabrics such as cotton, polyester, nylons acrylic rayons, woolens and other fibrous materials. While several possible nonionic surface active compounds are mentioned above, particularly advantageous nonionic detergents are the condensation products of a hydrophobic compound having at least one active hydrogen atom and a lower alkylene oxide i.e., from about 3 to about 30 moles of alkylene oxide per mole active hydrogen atom
or the condensation product of an alkyl phenol containing from about 8 to about 18 carbon atoms in the alkyl group and from about 3 to 30 moles of ethylene oxide per mole of anionic water solubilizing group. Anionic surfactants are known to be effective in the liquid detergent compositions of this invention. Soaps and other esters of fatty acids or the condensation product of an alkyl phenol containing from about 8 to about 18 carbon atoms in the alkyl group and from about 3 to 30 moles of ethylene oxide per mole of anionic water solubilizing group are lower alkyl (C1-C4) and the third alkyl group is a higher alkyl group (C8-C18) may also be combined with the de-

tergent builders of this invention. Specific examples of such amine and phosphine oxide, dimethyltetradecyl amine... sulphonate, sodium N-methyl taurate and related compounds, such as the higher alkyl esters of amino acids, betaines, the-
tines, sulfated long chain olefinic amines and sulfated imidazoline derivatives.

The synthetic surfactants known as zwitterionic surfactants are generally derivatives of aliphatic quaternary ammonium compound in which the aliphatic radical may be a straight chain or branched and wherein one of the al-
phatic substituents contains from about 8 to about 18 carbon atoms and one contains an anionic water solubilizing group such as the sulfo, sulfato and carboxy groups mentioned above. Some examples of zwitterionic surfactants are 3 - (N,N - dimethyl-N-hexadecylamine)-propene-1-
sulphonate and the related hydroxy propane derivative.

It is important to note that while the above-mentioned synthetic surfactants are merely typical compounds accept-
able for use with the builders of this invention, they do not constitute an exhaustive listing of suitable detergents. Other typical examples of these detergents are described in Schwartz, Perry and Berch Synthetic Detergents, In-
tioned detergents are also encompassed by this invention.

Although a wide range of detergents have been found to be suitable for use with the tetrahydroxyacidsine ac-
cids of this invention, the pH of the detergent in the washing solution should be maintained at or above
8.5, preferably above 9.5 for best results. At these pH levels, the cleaning composition possesses remarkable

clearness, even when diluted with water of relatively high hardness (calcium ions 150 p.p.m.) to form the con-
vventional washing medium. At pH levels below about 8.5 the effectiveness of the calcium ion precipitation prop-
erties of tetrahydroxyacidsine is seriously limited.

When the final composition is in the form of a liquid detergent, it may include a lower monohydric alcohol and polyhydric alcohol having from 2 to 4 carbon atoms such as ethanol, isopropanol, n-propanol, n-butanol, sec-
butanol, t-butanol, propylene glycol, ethylene glycol, etc. Although any of the above lower monohydric alcohols can be used, isopropanol is preferred. Suitable amounts of alcohols are widely variable depending upon the make up of the detergent. Among the alcohols, however, none is said to range from 7-25% and preferably from 7-15% by weight. The lower monohydric alcohol is important to the composition of the present invention since the lower monohydric alcohol prevents the formation of a gel when the anionic materials is added to warm water. Although the initial gel dissolve with a little stirring, it is preferred for both practical and aesthetic reasons that the liquid detergent composition of the present in-
vention be readily dispersed in water upon immediate pouring of the same into the wash water. Since gelling and improper dispersion in the wash water creates high concentration of soap and other adjuvants and materials included in the novel detergent composition of the present invention, this leads to a marked degree of staining if the lower monohydric alcohol is omitted from a liquid detergent composition.

The final detergent compositions may also contain in addition to the above mentioned surfactants and the tetra-
hydroxyacidsine acid compounds mentioned, other commonly used materials which enhance the effectiveness or attractiveness of the finished product included in what may be considered minor additives of this type are con-
ventional soil redeposition inhibitors, sequestering agents, pH adjustors, hydrotropic agents, conventional detergent builders, polyelectrolytes, solvents, dyes and pigments, fluorescents, perfumes, brightening agents and the like.

The water used in liquid detergent compositions is pref-
erably deionized so that it will be lower in content of ions which can form insoluble compounds. However, ordinary tap water can be used providing that the hardness thereof is sufficiently low so that there is no detrimental precipitation out of salts on standing. When additional sequestrants are used, hardness will be less important and in such cases even waters with hardnesses over 300 parts per million equivalent calcium carbonate can be acceptable. Generally, however, the water hardness should be less than 150 p.p.m. and most preferably, less than 50 p.p.m.

The additional sequestering agent when used may be any suitable such compound, including the aminopoly-

The lower monohydric alcohol will be present in a suitable proportion to maintain the detergents in a non-
gelled state and sufficient alcohol will be present to aid in stabilizing and dispersing any other constituent in the product. As noted above, the utilization of a lower monohydric alcohol, preferably isopropanol, enables the formation of a thin or less viscous concentrated product and the alcohol is generally employed in an amount from 7 to 15% by weight, preferably around 10% by weight. Furthermore, it is advantageous when used as one constituent of the composition of the present invention may be from 5 to 20% by weight with the preferred range being from 25 to 40% by weight.

The sequestrants and adjuvants which are utilized should generally not exceed a total concentration of 1% and generally will be maintained at less than 5% and preferably less than 3%. Furthermore, any individual component should not exceed 5% and preferably 3% and most preferably less than 1% of the product.

In the preferred liquid form, the use of the present composition is marvelously simple and efficient. Compared to present heavy duty laundry detergent powders, much smaller volumes of the present liquids may be employed to obtain cleaning of soiled laundry. For example, in a typical and preferred formulation of this invention, only about 2 ounces or 1/4 cup of liquid need to be used for a full automatic machine. Usually, the dilution of the water volume might be from 15 to 18 gallons. Thus, the concentration of liquid detergent in the wash water is on the order of 0.1% i.e. 1 gram per liter or 1,000 parts per million. Generally, the proportion employed will be from 0.7 to 1.5 grams per liter. The proportions of other constants of the liquid compositions may vary. Of course, equivalent results can be obtained by using larger proportions to a more dilute liquid detergent but the greater quantity needed will require additional packaging and shipping space and will be less convenient for the consumer to use. However, it is considered that the use of such more dilute product is within the present invention if the relative proportions of components is maintained. In other words, the present invention is not avoided by merely preliminarily diluting the liquid detergent with water since the same and result is obtained because the wash water also serves to dilute the detergent down to a use concentration.

Although it is preferred to employ wash water of reasonable hardness and at an elevated temperature, the present invention is also useful in laundering clothes and other items in hard waters and in extremely soft waters, as well as in waters at room temperature or below. The water hardnesses may range from 0 to over 300 parts per million as calcium carbonate and washing temperatures may be from 10°C to 80°C. Preferably, the temperatures will be from room temperature, 20 to 25°C, to 70°C.

Also, although washing will ordinarily be effected in an automatic washing machine, with the washing followed by rinse and spin or draining or wringing operations, it is contemplated that the detergent may also be used for hand washing of laundry. In such cases, the concentration in water of the liquid detergent will often be increased and sometimes it may be full strength to assist in washing out otherwise difficult to remove soil or stains. After completion of the washing and spinning operations, it will be general practice to dry the laundry in an automatic dryer soon thereafter but such particular drying operation is not necessary.

When the liquid detergent is added to water, whether that water is hot or cold, the detergent immediately dissolved uniformly throughout the wash water, even in the absence of significant agitation. Washing and brightening agents are carried into contact with all the laundry and there are no localized overconcentrations of either of these materials. The clothing washed, following normal methods, is exceptionally clean and in comparative tests the product has been rated as good as some of the best of the
commercial heavy duty detergents on the market. Although it is a low- and non-foaming detergent composition and thus very suitable for side-loading washing machines, excellent washing is also obtained in top loading machines in which foaming detergents are normally employed. Repeated testing of soiled and re-soiled laundry items, using the present compositions and larger quantities of commercial heavy duty detergents built with phosphate or NTA, show that the soils are repeatedly removed and no objectionable build-up thereof occurs. For the most part, users do not note any really significant differences between the washing properties of the present composition and commercial compositions tested. In fact, there has been a significant preference for the present product.

The novel composition of the present invention will now be illustrated by the following specific examples which are for the purposes of illustration only and are to be taken as in no way limiting the scope of the instant invention. In the following examples, all the parts and percentages are by weight and all temperatures in degrees centigrade, unless otherwise noted.

**EXAMPLE 1**

A mixture of sodium salts of C₁₂-C₁₅ carbon atom long chain fatty acids is maintained in heavy fluid form so that the disodium salt of tetrahydroxy succinic acid can be homogeneously blended therewith. Various adjuvants are then added to the thick mixture. The soap composition is then transferred to a conventional solid soap-bar making apparatus and the minor amount of solvent present is removed. The resultant product has the following composition and provides a solid soap-bar which may be used in the conventional manner:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium salt of C₁₂-C₁₅ long chain fatty acids</td>
<td>70</td>
</tr>
<tr>
<td>Disodium salt of tetrahydroxy succinic acid</td>
<td>29</td>
</tr>
<tr>
<td>Perfume</td>
<td>1</td>
</tr>
<tr>
<td>Coloring agent</td>
<td>0.5</td>
</tr>
<tr>
<td>Germicidal agent</td>
<td>0.4</td>
</tr>
</tbody>
</table>

This soap-bar provides excellent cleaning action when used for washing glass test plates in water of varying hardnesses (e.g., calcium ion content 50 p.p.m., 100 p.p.m., 150 p.p.m. and 300 p.p.m.). All of the glass plates appear cleaner than the control plates washed with the same soap composition but without the sodium salt of tetrahydroxy succinic acid.

This example demonstrates the chelating activity of the cleaning composition in the form of a hard soap or bar-soap.

**EXAMPLE 2**

A clear liquid detergent having the following formula is prepared by stirring a mixture of optical brighteners in isopropanol followed by the addition of water with stirring. Subsequently, the anionic detergent is added and following a few minutes agitation at moderate speed, the solution becomes clear:

- Neodol 45-11 polyoxyethylene nonionic surfactant with 14 to 15 alcohol polyethylene (11EO) — 62.5
- pH adjuster — 2.5
- Disodium salt of tetrahydroxy succinic acid — 25
- Isopropanol — 10

The above formulation forms a clear, one-phase, low viscosity liquid detergent which dissolves rapidly and completely in wash water at 100°F. Without any stirring whatsoever. Furthermore, when compared with other conventional detergent compositions whether biodegradable or non-biodegradable and whether built or non-built, the above noted composition possesses similar detergency and cleaning characteristics.

**EXAMPLE 4**

A liquid detergent containing 15.0 Neodol 25-3S, 1.8% of 80/20 tallow coco soap, 20%, 20% tetrahydroxy succinic acid, 8.9% isopropyl alcohol and 35.7% water, impurities and brighteners is prepared. When this formulation is placed in a top-loading washer without laundry in 17 gallons of 120°F. tap water, 51 grams of this formulation fill only 50% of the air space within the washing machine with foam and there is no foam in the rinse water. However, a similar amount of a formulation without the tallow/coco soap completely fills the air space within the washer with foam within three minutes and there is some foam in the rinse water.

**EXAMPLE 5**

This example demonstrates the improved compatibility of the builders of this invention in detergent compositions when compared to a conventional phosphate built deter-
gent comprising 15% linear triadecyl benzene sulfonate, 35% pentasodium tripolyphosphate and 50 sodium sulf-

In the phosphate built detergent and each of the deter-
gent formulations given in Examples 2, 3, and 4 above, the isopropanol alcohol content is varied as follows with a proportionate increase in water content:

<table>
<thead>
<tr>
<th>Percent A1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>33.6</td>
</tr>
<tr>
<td>11.3</td>
</tr>
<tr>
<td>Tetrahydroxy succinic acid</td>
</tr>
<tr>
<td>LDOS</td>
</tr>
<tr>
<td>Soap, 40/60 tallow/coconut</td>
</tr>
<tr>
<td>Isopropyl alcohol</td>
</tr>
<tr>
<td>Water and impurities</td>
</tr>
</tbody>
</table>

When each of the above formulations is tested at a 0.1% concentration according to Spangler Soil Tests, the results are observed by measuring Rd as a measure of greyness on a scale of 1–100 (100 being white) with a Gardener Automatic Color Difference Meters. About a one Rd unit difference is visually discernible. In each of the Span Nylon soiled cloth samples (Testfabrics, Inc.) washed in Rd, reading did not differ greater than 1 unit from the Rd reading of the fabric washed in the phos-

EXAMPLE 7

A white, free-flowing, spray-dried detergent having the following formula is evaluated in comparison with a commercially acceptable detergent utilizing New Bruns-

<table>
<thead>
<tr>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neodol 24–38 (A1)</td>
</tr>
<tr>
<td>Diammonium tetrahydroxy succinic acid</td>
</tr>
<tr>
<td>Soda ash</td>
</tr>
<tr>
<td>Carboxy methyl cellulose (CMS)</td>
</tr>
<tr>
<td>Brighteners</td>
</tr>
<tr>
<td>Na2SO4</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

In one set of tests, cotton cloths are repeatedly soiled by rubbing these cloths against human skin at various periods during the day followed by evenly dividing these cloths and washing utilizing the above noted dried detergent and the phosphate built control product in a laboratory Terg-

EXAMPLE 8

The formulation of Example 2 is repeated except that the Neodol 25–35 is replaced by the following amounts of Neodol 25–38 and combinations of 25–35 and other syn-

EXAMPLE 9

In each of the detergent formulations of Examples 2, 3, and 4, the isopropanol is replaced with the following monohydric and polyhydric alcohols:

<table>
<thead>
<tr>
<th>Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>G</td>
</tr>
<tr>
<td>H</td>
</tr>
</tbody>
</table>

All of the cleaning compositions were clear and pos-
sessed excellent detrusive properties.

EXAMPLE 10

This example demonstrates the suitability of additional sequestration agents in detergent compositions with the builders of this invention. The following conventional
detergent builders, such as sodium tripolyphosphates and NTA, are substituted for part of the disodium salt of tetrahydroxy succinic acid as follows in detergents of the formulation of Example 4:

A --- Detergent of Example 4.
B --- Detergent of Example 4 with 1/2 of the builder replaced with sodium tripolyphosphate.
C --- Detergent of Example 4 with 1/2 of the builder replaced with NTA.

Fabrics are washed in the manner of Example 7 and examined for comparative results. No discernible visual difference can be noticed among the fabrics washed with samples A, B and C. Reflectometer readings verified these results as no Rd value differed greater than 1 unit.

While the builders of the present invention have been illustrated by way of the foregoing specific examples, such examples and specification are for the purpose of illustration only and are to be in no way taken as limiting the scope of the present invention which is properly defined by the appended claims.

What is claimed is:

1. A cleaning composition comprising from 95 to 30% by weight of a detergent and from 5 to 70% by weight of a detergent builder selected from the group consisting of tetrahydroxy succinic acid and the water soluble salts thereof.

2. The cleaning composition of claim 1, wherein said detergent is an organic synthetic detergent selected from the group consisting of anionic, cationic, nonionic, amphoteric and zwitterionic surface active compounds and mixtures thereof.

3. The cleaning composition of claim 1, wherein said detergent builder is the disodium salt of tetrahydroxy succinic acid.

4. The cleaning composition of claim 1 which, mixed with an aqueous medium, yields a pH of at least about 9.

5. The cleaning composition of claim 2, wherein said detergent is a nonionic or anionic detergent.

6. A liquid cleaning composition comprising from 95 to 30% by weight of a detergent, from 5 to 70% by weight of detergent builder selected from the group consisting of tetrahydroxy succinic acid, and the water soluble salts thereof and from 7 to 25% by weight of an organic solvent.

7. The liquid cleaning composition of claim 6, wherein said detergent is an organic synthetic detergent selected from the group consisting of anionic, cationic, nonionic, amphoteric and zwitterionic surface active compounds and mixtures thereof.

8. The liquid cleaning composition of claim 6, wherein said detergent builder is the disodium salt of tetrahydroxy succinic acid.

9. The liquid cleaning composition of claim 6, wherein said organic solvent is selected from the group consisting of lower monohydroxy and polyhydroxy alkanols.

10. The liquid cleaning composition of claim 7, wherein said detergent is a nonionic or anionic detergent.

11. The liquid cleaning composition of claim 6, which when mixed with an aqueous medium, has a pH of at least about 9.

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WILLIAM E. SCHULZ, Primary Examiner
U.S. Cl. X.R.

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