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HEAVY DUTY LIQUID DETERGENT COMPOSITIONS

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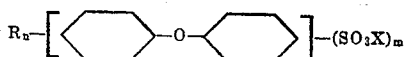
This invention concerns certain new liquid detergent compositions. It relates more particularly to aqueous detergent compositions suitable for use in the household and in the laundry where mild or heavy-duty performance is required in either soft or hard water, and comprises aqueous solutions containing alkyl diphenyl ether sulfonates and water-soluble alkali metal polyphosphate salts.

It is an object of the invention to prepare clear aqueous liquid detergent compositions containing alkyl diphenyl ether sulfonates and alkali metal polyphosphate salts, which compositions are suitable for cleansing and washing purposes in both soft and hard water. Another object is to provide concentrated aqueous liquid detergent compositions comprising alkyl diphenyl ether sulfonates and alkali metal polyphosphate salts dissolved in water to form clear solutions, which compositions can be marketed in liquid form and are suitable for use for cleaning or washing heavily soiled surfaces or fabrics. Other and related objects may appear from the following description of the invention.

According to the invention clear aqueous liquid detergent compositions can readily be prepared by dissolving certain alkyl diphenyl ether sulfonates and alkali metal polyphosphate salts in water in proportions as hereinafter defined.

The new compositions are transparent liquid solutions possessing excellent detergent and sudsing properties in both soft and hard water. The alkyl diphenyl ether sulfonates are unusual in that they have a remarkably high solubility in water, thus permitting the preparation of clear heavy-duty liquid detergent compositions in highly concentrated form, thereby greatly reducing the cost of packaging and marketing the liquid compositions.

The basic or essential ingredients of the liquid detergent compositions are (1) synthetic surface active agents which are alkyl diphenyl ether sulfonates, i.e. alkali metal salts of alkyl diphenyl ether sulfonic acids, having the general formula:



wherein R represents an alkyl radical containing from 9 to 15 carbon atoms, n is an average number between 1 and 1.3, X represents a monovalent alkali metal selected from the group consisting of sodium and potassium, and m is an average number between 1.8 and 2.4, and (2) at least one alkali metal polyphosphate salt selected from the group consisting of sodium tripolyphosphate, potassium pyrophosphate, potassium tripolyphosphate and mixtures of potassium pyrophosphate and sodium pyrophosphate.

The alkyl diphenyl ether sulfonate and the alkali metal polyphosphate salt are dissolved in water to form transparent aqueous solutions containing said ingredients in proportions within the lines ABCDA of the trilinear diagram of the accompanying drawing, and with or without additives such as corrosion inhibitors, foam boosting and stabilizing agents or anti-redeposition agents.

The materials are selected so that the total concentration of the alkali metal salt of the alkyl diphenyl ether sulfonic acid and the alkali metal polyphosphate salt is not less than 10 and not more than 55 percent by weight of

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the solution and within the ranges defined by the trilinear diagram of the drawing.

The proportions of the ingredients will vary depending upon the combination of sodium or potassium alkyl diphenyl ether sulfonate used and the alkali metal pyrophosphate or tripolyphosphate employed. More specifically, the ingredients can be employed in proportions of from 5 to 50 parts by weight of the potassium alkyl diphenyl ether sulfonate and from 5 to 45 parts of potassium pyrophosphate, per 100 parts by weight of the aqueous liquid composition, or with from 5 to 45 parts by weight of a mixture of potassium pyrophosphate and sodium pyrophosphate containing not more than 5 parts by weight of sodium pyrophosphate, per 100 parts by weight of the composition, and within the lines ABCDA of the trilinear diagram of the drawing. The ingredient sodium alkyl diphenyl ether sulfonate can be employed in amount corresponding to from 5 to 25 parts by weight with from 5 to 35 parts by weight of potassium pyrophosphate or with from 5 to 35 parts by weight of a mixture of potassium pyrophosphate and sodium pyrophosphate containing not more than 5 parts by weight of sodium pyrophosphate, per 100 parts by weight of the aqueous liquid composition and within the lines AEFHIA of the trilinear diagram of the drawing. The sodium or potassium alkyl diphenyl ether sulfonate can be used in amounts of from 5 to 40 parts by weight with from 5 to 40 parts by weight of potassium tripolyphosphate ($\text{K}_3\text{P}_3\text{O}_{10}$) per 100 parts by weight of the aqueous liquid composition and within the lines AJKLMNOA of the trilinear diagram of the drawing. The potassium alkyl diphenyl ether sulfonate can be employed in amounts of from 5 to 20 parts by weight with from 5 to 45 parts by weight of sodium tripolyphosphate ($\text{Na}_3\text{P}_3\text{O}_{10}$) per 100 parts by weight of the liquid composition and within the lines APQRA of the trilinear diagram of the drawing.

The alkyl diphenyl ether sulfonates to be employed in preparing the liquid detergent compositions consist essentially of diphenyl ether modified by having an average of from 1 to 1.3 alkyl radicals and from 1.8 to 2.4 sulfonate radicals as nuclear substituents, each alkyl radical containing from 9 to 15 carbon atoms.

The alkyl diphenyl ether sulfonate starting material can be prepared by a series of steps. In brief, an alkyl diphenyl ether is prepared by reacting an olefin or an olefin halide such as tripropylenes, tetrapropylenes, pentapropylenes, or dodecyl bromide, with diphenyl ether at reaction temperatures between 50° and 100° C. in the presence of a Friedel-Crafts type catalyst, e.g. aluminum chloride. The reacted mixture is washed with water to remove the catalyst and is subjected to distillation to obtain a fraction consisting principally of monoalkylated diphenyl ether or a mixture of mono and dialkylated diphenyl ethers, such that the distillate contains an average number of from 1 to 1.3 alkyl substituents per diphenyl ether nucleus. In an alternate procedure, the distillation can be carried out so as to separate the mono and dialkylated diphenyl ethers from one another and from lower or higher boiling ingredients, after which the mono- and dialkylated diphenyl ether fractions can be combined in proportions such as to provide a mixture having an average number of nuclear alkyl substituents not exceeding 1.3 per diphenyl ether nucleus.

The alkyl diphenyl ether or mixture of mono- and dialkyl diphenyl ethers is reacted with a sulfonating agent such as chlorosulfonic acid or sulfur trioxide while having the reactants dissolved in an inert liquid polychlorinated aliphatic hydrocarbon solvent such as methylene chloride, carbon tetrachloride, perchloroethylene, sym-tetrachloroethane or ethylene dichloride, and at reaction temperatures between 20° and 60° C. The sulfonating reaction can be carried out employing the sulfur trioxide

or chlorosulfonic acid in amounts corresponding to from 2 to 3 gram molecular proportions of the sulfonating agent per gram molecular equivalent diphenyl ether nucleus in the starting material. The sulfonating reaction proceeds readily with the introducing of sulfonic acid radicals onto carbon atoms of the aromatic nuclei of the alkyl diphenyl ethers in amounts corresponding to from 1.8 to 2.4 sulfonic acid radicals per diphenyl ether nucleus, as determined by test, but it is difficult to introduce three or more of such radicals. For this reason, the sulfonating agent is usually employed in amounts of from 2 to 2.5 moles per diphenyl ether nucleus in the starting material to be sulfonated.

Upon completing the sulfonating reaction, the mixture is neutralized or made slightly alkaline, e.g. is brought to a pH value between 7 and 8, with an alkali such as sodium hydroxide or potassium hydroxide or an aqueous solution of the same, to convert the alkyl diphenyl ether to the corresponding salt, i.e. the sodium or potassium salt of the alkyl diphenyl ether sulfonic acid. The aqueous and organic layers are separated. The salt or alkyl diphenyl ether sulfonate is recovered by heating the aqueous layer to evaporate the water. In an alternate procedure the neutralized or slightly alkaline mixture can be heated to vaporize and distill volatile ingredients such as water and the organic solvent employed as the reaction medium for the sulfonating reaction from the non-volatile material. The alkyl diphenyl ether sulfonate is obtained as a dry or substantially anhydrous free-flowing powder containing 75 percent by weight or more of the alkyl diphenyl ether sulfonate in admixture with lesser amounts of inert materials, principally alkali sulfates, e.g. sodium sulfate or potassium sulfate, with lesser amounts of alkali chlorides and water. The presence of such inert materials in small quantities is not disadvantageous in the invention.

In practice, the liquid detergent compositions of the invention are prepared by dissolving an amount based on the active ingredient, of the alkyl diphenyl ether sulfonate and the inorganic polyphosphate salt, e.g. potassium pyrophosphate or potassium tripolyphosphate, in sufficient water to make 100 parts by weight of solution and containing said ingredients in a total concentration between 10 and 55 percent by weight of the solution. The compositions may contain additives such as corrosion inhibitors, foam boosting and stabilizing agents or anti-redeposition agents. In preparing the compositions or liquid detergent compositions, obviously care should be taken to avoid the addition of materials that will promote the formation of highly insoluble compounds or precipitation by common-ion effects, etc. The materials are selected so that the total concentration of the alkyl diphenyl ether sulfonate and the alkali metal polyphosphate salt is not less than 10 and not more than 55 percent by weight of the solution and within the ranges defined by the trilinear diagram of the drawing. At higher concentrations the solutions tend to become opaque or cloudy or are viscous liquids which are difficult to pour. The alkyl diphenyl ether sulfonate and the alkali metal polyphosphate salt are preferably employed in proportions relative to one another of from 1 to 1.5 parts by weight of the alkali metal polyphosphate salt per part of the alkyl diphenyl ether sulfonate. The compositions of the invention are transparent, aqueous solutions containing the alkyl diphenyl ether sulfonate and the alkali metal polyphosphate in high concentration and are effective heavy duty liquid detergent compositions for cleansing or washing heavily soiled cotton clothes such as are encountered in home laundry washing.

The following examples illustrate ways in which the principle of the invention has been applied, but are not to be construed as limiting its scope.

EXAMPLE 1

(A) A charge of 180 pounds of diphenyl ether and

9.4 pounds of anhydrous aluminum chloride was placed in a reaction vessel equipped with a stirrer and means for heating or cooling the contents. The mixture was stirred and heated to a temperature of 80° C. Thereafter, a charge of 119 pounds of a polypropylene fraction boiling at temperatures between 185° and 210° C. at 760 millimeters absolute pressure and consisting of tetrapropylenes as the principal components, was added over a period of 4 hours, together with a total of 0.5 pound of gaseous hydrogen chloride, while maintaining the reacting mixture at temperatures between 78° and 85° C. Stirring and heating of the mixture was continued for a period of 0.5 hour after addition of the tetrapropylenes. The reacted mixture was washed with water to remove the catalyst, then was distilled. A fraction of the alkylated diphenyl ether product boiling at 185°-245° C. at 8 millimeters was separated. The product was a mixture of mono- and dialkylated diphenyl ether and contained an average of 1.14 tetrapropyl radicals per diphenyl ether nucleus.

(B) A charge of the alkyl diphenyl ether product boiling at 185°-245° C. at 8 millimeters prepared in part A above was dissolved in methylene chloride to form a solution containing 6.6 percent by weight of the alkyl diphenyl ether. The solution was fed to a reaction zone under pressure and into admixture with sulfur trioxide in amount corresponding to 2.3 moles of the sulfur trioxide per diphenyl ether nucleus in the alkyl diphenyl ether starting material. The resulting mixture was maintained in the reaction zone under a pressure of 30 pounds per square inch, gauge pressure, at reaction temperatures between 40° and 60° C. for a period of 10 seconds, then was withdrawn. The material withdrawn from the reaction zone was mixed with an equal volume of water, then with an aqueous 50 weight percent solution of sodium hydroxide in amount sufficient to bring the resulting mixture to a pH value of 8. The aqueous and organic layers were separated. The aqueous layer was spray dried and the solids collected as a free-flowing light yellow powder. The product consisted of 90.53 percent by weight of alkyl diphenyl ether sulfonate, being diphenyl ether modified by having an average of 1.14 tetrapropyl radicals and 2.27 sulfonate radicals of the formula $\text{—SO}_3\text{Na}$ as nuclear substituents per diphenyl ether nucleus, 3.36 percent of sodium sulfate, 2.54 percent of sodium chloride and 3.57 percent of water.

(C) In each of a series of experiments a charge of the alkyl diphenyl ether sulfonate powder obtained in part B above was dissolved in water having 150 parts per million of hardness, together with potassium pyrophosphate in amounts as stated in the following table to form liquid detergent compositions. A number of the compositions were tested for detergency. The procedure for determining a detergency value for the composition was to add 4 grams of the liquid detergent composition to one liter of water having 150 parts per million of hardness, place the solution, together with three swatches of soiled cloth, American Conditioning House No. 115, in a Terg-O-Tometer beaker and wash the swatches at a temperature of 120° F. for 10 minutes at 100 cycles per minute. After washing, the swatches are removed from the wash water, wrung by hand and rinsed in water having a hardness of 150 parts per million. The swatches are then returned to the Terg-O-Tometer and rinsed for 5 minutes at 100° F. in water having 150 parts per million of hardness. Thereafter, the swatches are removed from the rinse water, wrung through a hand wringer, placed between paper towels and pressed dry with a hand iron. A reflectance value for the dried swatches was measured using a photovolt reflectometer Model 610. The reflectance value for the swatches of soiled cloth washed with the alkyl diphenyl ether sulfonate detergent composition was compared to the reflectance value for swatches of cloth prepared as a standard by subjecting other test pieces of the soiled cloth to a similar Terg-O-

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Tometer washing test employing a similar proportion of alkyl benzene sulfonate (Ultrawet K) and a similar amount of potassium pyrophosphate on a weight basis, in one liter of water having 150 parts per million of hardness. The detergency value for the aqueous composition is calculated as the product of the average reflectance value for the swatches washed with the alkyl diphenyl ether sulfonate wash solution divided by the average reflectance value for the swatches washed with the alkyl benzene sulfonate, standard, wash solution multiplied by 100. Thus, the detergency for the composition is expressed as the percent of the detergency value of the standard wash solution. A value greater than 100 percent indicates that the alkyl diphenyl ether sulfonate detergent composition has greater detergency or washing properties than has the standard wash composition. Table I identifies the detergent compositions and gives the proportions in percent by weight of the essential ingredients based on the weight of the liquid solution. The table also indicates the solubility of the ingredients in the aqueous solution and gives a detergency value for certain of the compositions. For purpose of comparison compositions which are not clear solutions and are outside the scope of the invention are included in the table.

Table I

Run No.	Starting Materials			Product	
	Alkyl Diphenyl Ether Sulfonate, Wt. Percent	K ₂ P ₂ O ₇ , Wt. Percent	Water, Wt. Percent	Solution, Kind	Detergency compared to Standard, Percent
1	5	45	50	insoluble	
2	5	35	60	clear	101
3	10	35	55	do	
4	15	35	50	do	103
5	20	30	50	do	
6	25	25	50	do	101.5
8	25	15	60	do	
9	30	10	60	insoluble	

EXAMPLE 2

A charge of 20 parts by weight of tetrapropyl diphenyl ether sulfonate and 30 parts of potassium pyrophosphate was dissolved in 50 parts of water. A clear detergent solution was obtained. The tetrapropyl diphenyl ether sulfonate employed in the experiment was prepared by procedures similar to those described in parts A and B of Example 1 and consisted of diphenyl ether modified by having an average of 1.07 tetrapropyl radicals derived from tetrapropylenes and 2.23 sulfonate groups of the formula $-\text{SO}_3\text{Na}$ as nuclear substituents. The material was obtained as a light yellow powder having the composition 77.20 percent by weight tetrapropyl diphenyl ether sulfonate, 19.16 percent sodium sulfate and 3.64 percent water. A detergency value for the liquid composition was determined employing procedure similar to that employed in part C of Example 1. The composition had a detergency value of 97.5 percent.

EXAMPLE 3

A tripropyl diphenyl ether sulfonate consisting of diphenyl ether modified by having an average of one tripropyl radical derived from tripropylenes and 1.8 sulfonate groups of the formula $-\text{SO}_3\text{Na}$ as nuclear substituents was prepared by procedures similar to those described in parts A and B of Example 1. The tripropyl diphenyl ether sulfonate was obtained as a light yellow powder having the composition 89.97 percent by weight tripropyl diphenyl ether sulfonate, 5.76 percent sodium sulfate, 0.17 percent sodium chloride and 4.10 percent water.

A charge of 20 parts by weight of the tripropyl diphenyl ether sulfonate and 30 parts of potassium pyrophosphate were dissolved in 50 parts of water. A clear liquid deter-

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gent composition was obtained. The composition had a detergency value of 100 percent.

EXAMPLE 4

A pentapropyl diphenyl ether sulfonate consisting of diphenyl ether modified by having an average of one pentapropyl radical derived from pentapropylenes and 2.17 sulfonate groups of the formula $-\text{SO}_3\text{Na}$ as nuclear substituents was prepared by procedures similar to those described in parts A and B of Example 1. The pentapropyl diphenyl ether sulfonate was obtained as a light yellow powder having the composition 87.16 percent by weight pentapropyl diphenyl ether sulfonate, 7.90 percent sodium sulfate, 0.09 percent sodium chloride and 4.75 percent water. Twenty parts by weight of the pentapropyl diphenyl ether sulfonate and 30 parts of potassium pyrophosphate were dissolved in 50 parts of water. A clear aqueous liquid detergent solution was obtained. The solution had a detergency value of 103 percent.

EXAMPLE 5

A tetrapropyl diphenyl ether sulfonate consisting of diphenyl ether modified by having an average of 1.14 tetrapropyl radicals derived from tetrapropylenes and 1.95 sulfonate groups of the formula $-\text{SO}_3\text{K}$ as nuclear substituents was prepared by procedures similar to those described in parts A and B of Example 1, except that the tetrapropyl diphenyl ether sulfonic acid was neutralized with potassium hydroxide to obtain the corresponding salt. The tetrapropyl diphenyl ether sulfonic acid, potassium salt, was obtained as a free-flowing powder. Twenty parts by weight of the tetrapropyl diphenyl ether sulfonate and 30 parts of potassium pyrophosphate were dissolved in 50 parts of water. A clear aqueous solution was obtained. The solution had good detergency properties.

EXAMPLE 6

A charge of 20 parts by weight of tetrapropyl diphenyl ether sulfonate similar to that described in part B of Example 1 was dissolved in 70 parts of water containing 10 parts of potassium tripolyphosphate. A clear aqueous solution was obtained. The liquid composition had good detergency properties.

EXAMPLE 7

A dodecyl diphenyl ether sulfonate consisting of diphenyl ether modified by having 1.27 dodecyl radical derived from dodecyl bromide and 2.14 sulfonate groups of the formula $-\text{SO}_3\text{Na}$ as nuclear substituents was dissolved in water together with potassium pyrophosphate in amounts of 20 parts by weight of the dodecyl diphenyl ether sulfonate, 30 parts of the potassium pyrophosphate and 50 parts of water. A clear aqueous solution was obtained. The liquid composition had good detergency properties.

EXAMPLE 8

A liquid detergent composition was prepared by dissolving 5 parts by weight of tetrapropyl diphenyl ether sulfonate similar to that described in part B of Example 1, 15 parts of potassium pyrophosphate, 5 parts of sodium silicate having an $\text{Na}_2\text{O}/\text{SiO}_2$ ratio of 1:1.8 and 0.2 part of sodium carboxymethyl cellulose (detergent grade) in 75 parts of water. A clear aqueous solution was obtained. The liquid composition had good detergency properties and was suitable for washing heavily soiled fabrics.

EXAMPLE 9

In each of a series of experiments, a potassium tetrapropyl diphenyl ether sulfonate having an average of 1.14 tetrapropyl radicals derived from tetrapropylenes and 1.95 sulfonate groups of the formula $-\text{SO}_3\text{K}$ as nuclear substituents per diphenyl ether nucleus, and similar to that employed in Example 5, was mixed with water and potassium pyrophosphate in proportions as stated in the

following table. The mixture was stirred and heated to a temperature of 90° C. then allowed to cool to room temperature. After standing for three days the mixtures were examined. Table II identifies the mixtures and gives the proportions of the ingredients based on the weight of the mixture. The table also indicates the solubility of the ingredients in the aqueous liquid.

Table II

Run No.	Starting Materials			Product
	K-Tetra-propyl Diphenyl Ether Sulfonate, Wt. Percent	K ₄ P ₂ O ₇ , Wt. Percent	Water, Wt. Percent	
1.....	5	5	90	clear.
2.....	5	45	50	Do.
3.....	5	50	45	insoluble.
4.....	10	45	45	clear.
5.....	10	50	40	insoluble.
6.....	20	35	45	clear.
7.....	20	40	40	insoluble.
8.....	25	30	45	clear.
9.....	30	25	45	Do.
10.....	35	20	45	Do.
11.....	45	10	45	Do.
12.....	50	5	45	Do.
13.....	55	5	40	opaque.
14.....	45	5	50	clear.
15.....	40	5	55	Do.
16.....	25	5	70	Do.

The compositions in Table II which form clear solutions are within the lines ABCDA of the trilinear diagram of the drawing.

EXAMPLE 10

In each of a series of experiments, a potassium tetrapropyl diphenyl ether sulfonate similar to that employed in Example 9, was mixed with water and sodium tripolyphosphate in proportions as stated in the following table. The mixture was stirred and heated to a temperature of 90° C. then allowed to cool to room temperature and stand for three days. Table III identifies the mixtures and indicates the solubility of the ingredients in the aqueous liquid.

Table III

Run No.	Starting Materials			Product
	K-Tetra-propyl Diphenyl Ether Sulfonate, Wt. Percent	Na ₃ P ₃ O ₁₀ , Wt. Percent	Water, Wt. Percent	
1.....	5	5	90	clear.
2.....	5	20	75	Do.
3.....	5	25	70	insoluble.
4.....	10	20	70	clear.
5.....	10	25	65	insoluble.
6.....	15	20	65	clear.
7.....	20	20	60	insoluble.
8.....	25	15	60	clear.
9.....	30	15	55	insoluble.
10.....	35	10	55	clear.
11.....	30	15	55	insoluble.
12.....	45	5	50	clear.

The compositions which form clear solutions in Table III are within the lines APQRA of the trilinear diagram of the drawing.

EXAMPLE 11

In each of a series of experiments, a sodium tetrapropyl diphenyl ester sulfonate having an average of 1.14 tetrapropyl radicals derived from tetrapropylenes and 2.27 sulfonate groups of the formula —SO₃Na as nuclear substituents per diphenyl ether nucleus and similar to that described in part B of Example 1, was mixed with water and potassium tripolyphosphate in proportions as stated in the following table. The mixture was stirred and

heated to a temperature of 90° C., then allowed to cool to room temperature. After standing for three days the mixture was examined. Table IV identifies the mixtures and indicates the solubility of the product.

Table IV

Run No.	Starting Materials			Product
	Na-Tetra-propyl Diphenyl Ether Sulfonate, Wt. Percent	K ₄ P ₂ O ₇ , Wt. Percent	Water, Wt. Percent	
1.....	5	5	90	clear.
2.....	5	40	55	Do.
3.....	5	50	45	insoluble.
4.....	10	40	50	clear.
5.....	10	45	45	insoluble.
6.....	15	40	45	Do.
7.....	20	35	45	Do.
8.....	25	30	45	clear.
9.....	30	25	45	Do.
10.....	30	30	40	insoluble.
11.....	40	15	45	Do.
12.....	40	10	50	clear.
13.....	40	5	55	Do.

The compositions in Table IV which form clear solutions are within the lines AJKLMNOA of the trilinear diagram of the drawing.

EXAMPLE 12

In each of a series of experiments, a sodium tetrapropyl diphenyl ether sulfonate similar to that employed in Example 11 was mixed with water and potassium pyrophosphate in proportions as stated in the following table. The mixture was stirred and heated to a temperature of 90° C. then allowed to cool and stand at room temperature for a period of three days. Table V identifies the mixtures and indicates the solubility of the ingredients in the aqueous liquid.

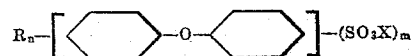
Table V

Run No.	Starting Materials			Product
	Na-Tetra-propyl Diphenyl Ether Sulfonate, Wt. Percent	K ₄ P ₂ O ₇ , Wt. Percent	Water, Wt. Percent	
1.....	5	5	90	clear.
2.....	5	35	60	Do.
3.....	5	40	55	insoluble.
4.....	10	35	55	clear.
5.....	10	40	50	insoluble.
6.....	15	35	50	clear.
7.....	15	40	45	insoluble.
8.....	20	30	50	clear.
9.....	20	35	45	insoluble.
10.....	25	25	50	clear.
11.....	25	30	45	insoluble.
12.....	28.5	21.5	50	Do.
13.....	25	20	55	clear.
14.....	25	15	60	Do.
15.....	30	10	60	insoluble.
16.....	25	10	65	Do.
17.....	23.5	11.5	65	clear.
18.....	25	5	70	insoluble.
19.....	21.5	8.5	70	clear.
20.....	20	5	75	Do.

The compositions in Table V which form clear solutions are within the lines AEFHGIA of the trilinear diagram of the drawing.

We claim:

1. A clear transparent aqueous liquid detergent composition consisting of a transparent aqueous solution containing (1) an alkyl diphenyl ether sulfonate having the general formula:



wherein R represents an alkyl radical containing from 9

to 15 carbon atoms and n is an average number from 1 to 1.3, X represents a member of the group consisting of sodium and potassium and m is an average number from 1.8 to 2.4, and (2) an inorganic phosphate selected from the group consisting of sodium tripolyphosphate, potassium tripolyphosphate, potassium pyrophosphate and mixtures of potassium pyrophosphate and sodium pyrophosphate, said solution containing a combination of ingredients in proportions by weight, based on 100 parts by weight of the solution, which combination is selected from the group consisting of: (a) from 5 to 50 parts by weight of the potassium alkyl diphenyl ether sulfonate (1) and from 5 to 45 parts of inorganic phosphate (2) selected from the group consisting of potassium pyrophosphate and mixtures of potassium pyrophosphate and sodium pyrophosphate, which mixtures contain not more than 5 parts by weight of sodium pyrophosphate, and in a total concentration between 10 and 55 percent by weight of the solution and within the lines ABCDA of the trilinear diagram of the drawing; (b) from 5 to 25 parts by weight of the sodium alkyl diphenyl ether sulfonate (1) and from 5 to 35 parts by weight of the inorganic phosphate (2) selected from the group consisting of potassium pyrophosphate and mixtures of potassium pyrophosphate and sodium pyrophosphate, which mixtures contain not more than 5 parts by weight of sodium pyrophosphate, and in a total concentration between 10 and 50 percent by weight of the solution and within the lines AEF GHIA of the trilinear diagram of the drawing; (c) from 5 to 40 parts by weight of the alkyl diphenyl ether sulfonate (1) and from 5 to 40 parts of the inorganic phosphate (2) consisting of potassium tripolyphosphate, and in a total concentration between 10 and 55 percent by weight of the solution and within the lines AJKLMNOA of the trilinear diagram of the drawing; and (d) from 5 to 45 parts by weight of the potassium alkyl diphenyl ether sulfonate (1) and from 5 to 20 parts by weight of the inorganic phosphate (2) consisting of sodium tripolyphosphate, and in a total concentration between 10 and 50 percent by weight of the solution and within the lines APQRA of the trilinear diagram of the drawing, said inorganic phosphate (2) being in proportions of from 1 to 1.5 parts by weight per part by weight of the alkyl diphenyl ether sulfonate (1).

2. A liquid detergent composition as claimed in claim 1, wherein the aqueous solution contains from 5 to 50 parts by weight of the potassium alkyl diphenyl ether sulfonate (1) and from 5 to 45 parts of potassium pyro-

phosphate per 100 parts by weight of the solution, and in a total concentration between 10 and 55 percent by weight of the solution and within the lines ABCDA of the trilinear diagram of the drawing.

3. A liquid detergent composition as claimed in claim 1, wherein the aqueous solution contains from 5 to 40 parts by weight of the sodium alkyl diphenyl ether sulfonate (1) and from 5 to 40 parts of potassium tripolyphosphate per 100 parts by weight of the solution and in a total concentration between 10 and 55 percent by weight of the solution and within the lines AJKLMNOA of the trilinear diagram of the drawing.

4. A liquid detergent composition as claimed in claim 1, wherein the aqueous solution contains from 5 to 25 parts by weight of the sodium alkyl diphenyl ether sulfonate (1) and from 5 to 35 parts of potassium pyrophosphate per 100 parts by weight of the solution and in a total concentration between 10 and 50 percent by weight of the solution and within the lines AEF GHIA of the trilinear diagram of the drawing.

5. A liquid detergent composition as claimed in claim 4, wherein the potassium pyrophosphate and the sodium alkyl diphenyl ether sulfonate are employed in proportions corresponding to from 1 to 1.5 parts by weight of the potassium pyrophosphate per part of sodium alkyl diphenyl ether sulfonate.

6. A liquid detergent composition as claimed in claim 1, wherein the aqueous solution contains from 5 to 25 parts by weight of the sodium alkyl diphenyl ether sulfonate (1) and from 5 to 35 parts of a mixture of potassium pyrophosphate and sodium pyrophosphate, which mixture contains not more than 5 parts by weight of sodium pyrophosphate, per 100 parts by weight of the solution and in a total concentration between 10 and 50 percent by weight of the solution and within the lines AEF GHIA of the trilinear diagram of the drawing.

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