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SOLUBILIZER FOR SYNTHETIC DETERGENT

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The present invention relates to improved organic sulfonate detergent compositions, and more specifically to a method for increasing the solubility of organic sulfonate detergent compositions in water solution.

Synthetic detergents of the alkyl aryl sulfonate variety have found wide application in the detergent industry. Their ionic stability in the presence of alkaline earth metal ions makes them particularly adaptable for use in the so-called "hard" waters commonly encountered in many areas.

While alkyl aryl sulfonates are considered to be efficient surface-active agents by themselves, it is often found that the detergent action of a given amount of these compounds can be economically extended through the addition of inorganic "builder" salts such as alkali metal chlorides, borates, sulfates, phosphates, and so forth. Since alkyl aryl sulfonates are inherently hygroscopic in nature, the addition of inorganic salts lends further improvement to particulate formulations of these compounds in that the inorganic salts reduce the tendency of the sulfonate compositions to lump and harden into solid masses under conditions of high humidity.

While alkyl aryl sulfonates in combination with relatively large amounts of builder salts are generally highly regarded in the cleaning industry for their economy and efficiency, many of them possess the undesirable characteristic of salting the active detergent out of solution when present in the usual deterging concentrations. In addition, it is often found that compounded sulfonate detergents are rather slow to go into solution at normal washing temperatures.

It is therefore an object of this invention to provide a detergent composition having improved solubility in aqueous solution.

It is another object of this invention to provide a means by which detergents of the alkyl aryl sulfonate variety may be rendered more soluble in aqueous solutions.

It is a further object of this invention to provide a built surface-active composition containing alkyl aryl sulfonates that goes rapidly into solution.

It is still another object of this invention to provide a method by which particulate alkyl aryl sulfonate detergent compositions containing substantial portions of inorganic builder salts may be rendered more soluble in aqueous solvents.

It is still a further object of this invention to provide a compounded synthetic detergent composition that remains soluble in aqueous solvents over a wide range of temperatures and concentrations.

These and still further objects of the present invention will become readily apparent to one skilled in the art from the following detailed description of the invention:

In general, the present invention involves the addition of minor quantities of the sodium salts of ethylene diamine tetracetic acid and one or more of the sequestrants selected from a group comprising N,N-di(2 hydroxyethyl) glycine, imino diacetic acid, nitrilo triacetic acid, hydroxyethyl amino diacetic acid, and hydroxyethyl ethylene diamine triacetic acid, to synthetic organic detergent compositions which contain alkyl aryl sulfonates as the active organic detergent ingredient in combination with substantial amounts of inorganic "builder" salts.

More specifically, this invention contemplates the addition of solubilizing amounts of a mixture of amino compounds which comprises from about 50% to about 95% by weight of the tetrasodium salt of ethylene diamine tetracetic acid and from about 5% to about 50% of one or more members selected from a group comprising the above mentioned sequestrants to mixtures of compounded, i.e., built, synthetic detergents which contain alkyl aryl sulfonates as the major organic surface-active component. In order to produce the desirable solubilizing effect, the herein contemplated mixture of amino solubilizing agents is added in quantities in excess of at least about 0.25% by weight based on the combined total weight of the organic and inorganic active ingredients of the compounded detergent composition. While amounts as low as 0.25% will in some cases produce the desired result, the generally preferred range is from about 1% to about 4% by weight of the amino mixture based on the combined weight of the organic sulfonate and inorganic builder components, the upper limit of about 4% being the proportion at which further addition of the solubilizing agents produces a progressively diminishing amount of solubilizing effect, and further addition of the solubilizing agents becomes economically unsound. However, amounts of the amino solubilizing compounds in excess of 4% generally have no detrimental effect on the over-all detergent composition other than acting as a diluent.

The amino solubilizing agents, i.e., ethylene diamine tetracetic acid tetrasodium and the members of the group of sequestrants consisting of the sodium salts of N,N-di(2 hydroxyethyl) glycine, imino diacetic acid, nitrilo triacetic acid, hydroxyethyl ethylene diamine triacetic acid are individually all well known sequestering or chelating agents as are the others which are sold under the trade name of "Versenes" along with various other sequestering agents having carboxy-methylated amino groups. Various members of the group known as Versenes have previously been added to detergents in very small amounts for purposes of sequestering polyvalent metal ions such as magnesium, calcium, and iron and thereby prevent their precipitation as turbidity from solution in the presence of various inorganic ions. However, in the present invention it has been found that the particular combination of the Versenes with the amino compounds mentioned above, possess the unexpected characteristic of preventing the precipitation and increasing the solubility of the anionic surface-active agent whether or not there is an excessive quantity of soluble inorganic ions. Further, it is significant that these specific combinations of sequestrants are necessary.

While the method by which the aforementioned solubilizing agents produce their unexpected result is not fully understood, it is believed that the solubilizing effect is due possibly to a crystal-inhibiting mechanism. It cannot be attributed to the sequestering of any polyvalent metal ions which might be present. This view is substantiated when it is observed the solubilizing effect produced by the additive is the same whether the composition is being used in hard or distilled water. It is also observed that any of the agents alone will not produce the same solubilizing result nor will other well known sequestering agents such as the alkali tripolyphosphates, and hexametaphosphates, saccharic acid, urea, thiourea, and so forth.

The organic synthetic detergents to which the presently disclosed combination of amino solubilizers are to be added includes primarily the alkyl aryl sulfonates of both the mono- and polynuclear aromatic hydrocarbons and their homologs having from 9 to 18 carbon atoms in an alkyl chain, as for example, the alkali metal, ammonium, and amino salts of straight and branch chained nonyl-,

decyl-, dodecyl-, pentadecyl-, hexadecyl-, and octadecyl benzene sulfonic acids, the corresponding alkyl substituted alkali metal, ammonium, and amino toluene sulfonate salts, and alkali metal, ammonium, and amino naphthalene sulfonate salts, and so forth. Of particular importance in the practice of the present invention are the C_9–C_{18} monalkyl benzene sulfonates prepared by reacting benzene with a long-chain C_9–C_{18} aliphatic alcohol, or with a C_9–C_{18} olefin, produced by cracking petroleum hydrocarbon gases and polymerizing the olefins thus formed, or with an alkyl halide obtained by chlorinating petroleum hydrocarbons of the boiling range of kerosene; sulfonating the alkyl benzene compounds with sulfuric acid, chlorosulfonic acid or sulfur trioxide, etc.; and neutralizing the resultant sulfonated product with a base such as NaOH, KOH, Na_2CO_3, etc.

The sulfonates mentioned above may be combined with inorganic builder salts such as sodium sulfate, sodium silicate, potassium sulfate, borax, sodium chloride, the sodium phosphates, such as sodium tripolyphosphate and tetrasodium pyrophosphate, and so forth, in most all practical proportions. For purposes of the present invention the detergent compositions include from about 10% to about 90% and usually about 40% to 60% inorganic salts with the remainder constituting the active organic detergent component. The detergent compositions to which the presently disclosed combination of amino solubilizing agents may be added may also include minor amounts of other well known organic foam builders and emulsifying additives such as fatty alcohols, alkylolamides of fatty acids, and so forth in addition to the alkyl aryl sulfonate present. Additional optional ingredients such as brighteners, protective colloids, abrasives, perfumes etc., do not inhibit the solubilizing action of these amino additives.

The solubilizing compounds are preferably added to an aqueous solurry of the detergent composition. Incorporation in this manner assures their even distribution throughout the mixture. The compounded slurry may then be dried by conventional methods which include drum and spray drying procedures. While the present invention is primarily directed to detergent composition which are ultimately processed to a particulate state, it should be understood the novel combination of solubilizing additives herein contemplated could also be advantageously incorporated in detergent compositions which are delivered to the consumer in slurry or solution form.

The following examples listed in tabular form, wherein all percentages are by weight, illustrate specific formulations of the detergent compositions which are within the intended scope of the present invention. In the table below, the first shows the example number; the second column gives the total amount of the amino additives added; ethylene diamine tetracetic acid tetrasodium is designated as ET, and the sodium salts of the following sequestrants have the corresponding designations—N,N-di-(2-hydroxyethyl) glycine is designated as DM, imino diacetic acid is designated as IDA, nitrilo triacetic acid is designated at NTA, hydroxyethyl imino diacetic acid is designated as HDA, hydroxyethyl ethylene diamine triacetic acid is designated as HETA; the third column discloses the composition of the amino additive used wherein N,N-di(2 hydroxyethyl) glycine, imino diacetic acid, nitrilo triacetic acid, hydroxyethyl ethylene diamine triacetic acid is used; the fourth column specifies the sulfonate used; and the succeeding columns define the percentage by weight of the sulfonate and the various inorganic builder salts used.

The compositions shown below are preferably compounded by first forming an aqueous slurry of the detergent components using from about 25% to about 50% their total weight of water, then adding the amino components with continuous agitation until the ingredients are homogeneously mixed. The resultant aqueous mixture may then be dried in the usual manner, or the mixture may be utilized in the slurry form if desired.

Table I

Example	Percent Amino Additive	Composition of Amino Additive	Sulfonate	Percent Sulfonate	Percent Na_2SO_4	Percent NaCl	Percent $Na_2B_4O_7$	Percent Na_2SiO_3	Percent Na_3PO_4
1	0.25	92% ET, 8% DM	Sodium, dodecyl benzene sulfonate	10	35	2	3		50
2	0.50	85% ET, 15% DM	Sodium, dodecyl benzene sulfonate	30	50	10			10
3	1.0	75% ET, 25% DM	Sodium, dodecyl benzene sulfonate	40	50	10			
4	2.0	50% ET, 50% DM	Sodium, dodecyl benzene sulfonate	90	5	2	3		
5	2.0	92% ET, 8% DM	Sodium tridecyl benzene sulfonate	40	50	10			
6	3.0	92% ET, 8% DM	Sodium toluene sulfonate	40	50	10			
7	3.0	92% ET, 8% DM	Sodium naphthalene sulfonate	40	50	10			
8	2.0	92% ET, 8% DM	Sodium dodecyl benzene sulfonate	20	20		3	5	52
9	2.0	92% ET, 8% DM	Potassium dodecyl benzene sulfonate	40	50	10			
10	2.0	92% ET, 8% DM	Potassium dodecyl benzene sulfonate	30	50	10			10
11	2.0	90% ET, 10% IDA	Sodium dodecyl benzene sulfonate	40	50	10			
12	2.0	90% ET, 10% NTA	Sodium dodecyl benzene sulfonate	40	60				
13	2.0	90% ET, 10% HDA	Sodium dodecyl benzene sulfonate	40	50	10			
14	2.0	90% ET, 10% HEDA	Sodium dodecyl benzene sulfonate	40	60				

The above composition may be tested for solubility in the following manner: An amount of the compositions equivalent to 5 grams of solids is dissolved in 95 grams of water heated to a temperature of 150°. This solution is then cooled without shaking to a temperature of 80° F. at which time no precipitation of the detergent ingredients will be observed.

In order to ascertain the effectiveness of the added solubilizing agents detergent compositions similar to those given in Examples 1–7, but which did not include the solubilizing agents, were prepared. 5 g. (solids basis) of these products, when dissolved in 95 g. of water and held at 150° F. followed by cooling to 80° F., produced considerable precipitation of the active synthetic detergent ingredient in every instance.

The above specific examples clearly demonstrate the solubilizing effectiveness of the proposed combination of sequesterants when added to detergent compositions containing substantial amounts or organic sulfonate detergents in combination with inorganic builder salts.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. A surface active detergent composition, characterized by exhibiting a high degree of water solubility at effective concentration levels, which comprises: a detergent consisting essentially of an alkyl aryl sulfonate and an inorganic detergency builder salt, and at least 0.25% by weight of a mixture consisting of about 50% to about 95% by weight of ethylene diamine tetraacetic acid tetrasodium and from about 5% to about 50% by weight of the sodium salt of N,N-di(2-hydroxyethyl) glycine.

2. A surface active detergent composition, characterized by exhibiting a high degree of water solubility at deterging concentration levels, which comprises: a detergent consisting essentially of from about 10% to about 90% by weight of an alkyl aryl sulfonate and from about

10% to about 90% of an inorganic detergency builder salt; and at least 0.25% by weight of a mixture consisting of from about 50% to about 95% by weight of ethylene diamine tetraacetic acid tetrasodium and from about 5% to about 50% by weight of the sodium salt of N,N-di(2-hydroxyethyl) glycine.

3. A surface active detergent composition, characterized by exhibiting a high degree of water solubility at deterging concentration levels, which comprises: from about 96% to about 99.75% by weight of a detergent consisting essentially of an alkyl aryl sulfonate and an inorganic detergency builder salt; and from about 0.25% to about 4% by weight of a mixture consisting of from about 50% to about 95% by weight of ethylene diamine tetraacetic acid tetrasodium and from about 5% to about 50% by weight of the sodium salt of N,N-di(2-hydroxyethyl) glycine.

4. The composition of claim 2 wherein the alkyl aryl sulfonate is selected from the group consisting of alkali metal, ammonium, and amine salts of alkyl substituted benzene, toluene, and naphthalene sulfonic acids, said

alkyl substituent having from about 9 to about 18 carbon atoms therein, and mixtures thereof.

5. The composition of claim 4 wherein the inorganic detergency builder salts are selected from the group consisting of sodium sulfate, sodium chloride, sodium borate, sodium silicate, sodium phosphate, sodium hexametaphosphate, sodium tripolyphosphate, tetrasodium pyrophosphate, and mixtures thereof.

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