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PHOSPHATE FREE HEAVY DUTY DETERGENT FORMULATIONS

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3 Claims

ABSTRACT OF THE DISCLOSURE

Heavy duty built synthetic detergent compositions wherein the surfactant is either a lower alkanol amine or N-methyl taurine salt of a linear alkylbenzene sulfonic acid and the builders are free of phosphates.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to heavy duty built synthetic detergent compositions which are entirely free of phosphate builders and contain either an amino salt of an alkylbenzene sulfonic acid or a non-ionic as the surfactant material.

Prior art

For many years polyphosphates such as sodium triphosphate have been used as builders in commercial synthetic detergent compositions since it was believed that their use was required because of their synergistic action in such formulations. These polyphosphate builders were utilized both in alkylbenzene sulfonate type detergents and in nonionic surfactant type detergents. The synergistic action of polyphosphates is so well known and has been published so widely that it need not be discussed further.

There has been gathered in recent years, however, a considerable amount of evidence which indicates that phosphates provide an environment which promotes excessive algae formation in surface waters such as ponds, streams, rivers, lakes and the like. Although the phosphates may come from a number of sources, for example, from the run-off from phosphate fertilized fields, the polyphosphates which have been utilized in synthetic detergent formulations also undoubtedly contribute to the overall total of phosphate contamination. Accordingly, there has been a considerable amount of work expended in an effort to find detergent formulations having the high detergency of phosphate built detergents but which are entirely free of phosphates.

It now has been found that certain amino salts of alkylbenzene sulfonic acids or non-ionic surfactants can be utilized in conjunction with certain inorganic compounds to provide built synthetic detergent formulations containing no phosphates but which have detergencies equal to commercial built synthetic detergent formulations

SUMMARY OF THE INVENTION

In accordance with this invention alkanol amine salts of linear alkylbenzene sulfonic acids or the N-methyltaurine salts of linear alkylbenzene sulfonic acids or non-ionic surfactants can be combined with sodium carbonate, sodium metasilicate, sodium sulfate and small amounts of other compounds to provide the heavy duty detergent compositions whose detergency characteristics are equal to those of commercial heavy duty detergent formulations.

It is an object of this invention therefore to provide heavy duty built synthetic detergent compositions free of phosphate builders.

It is another object of this invention to provide a

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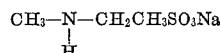
heavy duty built synthetic detergent composition wherein amino salts of linear alkylbenzene sulfonic acids are utilized as the surfactant in combination with non-phosphate inorganic builders.

It is another object of this invention to provide a heavy duty built synthetic detergent composition wherein a nonionic surfactant is utilized in combination with non-phosphate inorganic builders.

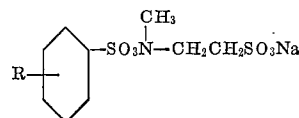
Other objects of this invention will be apparent from the description of the preferred embodiments which follow and from the claims.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The surfactant portion of the formulations of this invention can be an anionic material consisting of either an alkanol amine salt such as a monoethanolamine, diethanolamine, triethanolamine, isopropanolamine or the like salt of a linear alkylbenzene sulfonic acid wherein the straight chain alkyl group contains from 9 to 15 carbon atoms or the N-methyltaurine salt of the linear alkylbenzene sulfonic acid. The N-methyltaurine is preferably in the form of the sodium salt of the N-methyltaurine compound, i.e. it has the formula



The N-methyltaurine salt of the alkylbenzene sulfonic acid thus has the formula



wherein R is a straight chain alkyl group having from 9 to 15 carbon atoms and preferably about 9 to 13 with an average of about 11.0-12.0. That this carbon range for the linear alkyl group can be utilized in the formulations of this invention is a surprising discovery since an alkylbenzene sulfonate sodium salt wherein the alkyl group is in this range cannot be utilized to provide a satisfactory detergent even with phosphate builders. In general, commercially useful built synthetic detergent compositions utilizing phosphate builders require that the alkyl groups on the alkylbenzene sulfonic acid have an average of about 13 carbon atoms, i.e. about 13.3 average. The same carbon number range for the R group on the benzene ring (i.e. 9 to 15, preferably about 9 to 13 with an average of 11 to 12) is also utilized with the above-mentioned alkanolamine salts in the compositions of this invention.

The non-ionic surfactants which are used in this invention are the linear alkyl ethoxylates and the linear alkyl phenol ethoxylates. The linear alkyl ethoxylates are commercial compounds having the formula $\text{RO}(\text{C}_2\text{H}_4\text{O})_n\text{H}$ wherein R is a straight chain alkyl group having from 12 to 18 carbon atoms with 12 to 16 being somewhat more preferred.

The alcohols are condensed with ethylene oxide groups such that the ethylene oxide portion of the ethoxylate amounts to between 60 and 65 weight percent of the molecule. The linear alkyl phenol ethoxylates are less preferred since they are not as biodegradable as the straight chain alkyl ethoxylates, however, these compounds may contain from 9 to 12 carbon atoms in the alkyl group attached to the phenyl nucleus and the alkyl phenol is likewise condensed with sufficient ethylene oxide groups to give a molecule wherein 60 to 65 weight percent of the molecule is ethylene oxide. In general, at least about 9 ethylene oxide groups are condensed with the alcohol or phenol portions of the molecule.

The inorganic builders which are employed in the formulations of this invention are sodium carbonate, sodium silicate, sodium sulfate and sodium carboxymethylcellulose.

The amount of sodium carbonate can range from 30 to 45 weight percent preferably from 33 to 37 weight percent of the formulation.

The sodium silicate can have a ratio of SiO₂ to Na₂O in the range of from 1:1 to 3:1. The formulations herein are shown with sodium metasilicate (ratio 1:1) including the commercial linear alkylbenzene sulfonate formulation since the formulations are shown for comparison purposes. Commercial formulations, however, would employ the commercial sodium silicate wherein the SiO₂ to Na₂O ratio is from 1.6:1.0 to 2.4:1.0. The commercial sodium silicate is used as a corrosion inhibitor for washing machine pumps. All the sodium silicates in the range are equally effective for detergency. The amount of sodium silicate can range from 4 to 10 weight percent and preferably from 6 to 8 weight percent of the formulation.

The sodium sulfate can range from 35 to 50 weight percent and preferably from about 43 to 47 weight percent of the formulation.

The amount of sodium carboxymethylcellulose can be from 0.1 to 2 weight percent with about 1 weight percent being, in general, sufficient.

In addition to the foregoing compounds in the built formulation up to 1 weight percent of sodium hydroxide can be employed in the formulation, i.e. it can range from 0-1 weight percent.

The remainder of the formulation is the surfactant. The amount of surfactant is preferably about 10 weight percent, however, this can range between about 8 and about 20 weight percent although the higher quantities do not materially improve the detergency but do increase the cost of the formulation rather markedly since the surfactant is the most costly ingredient.

The following examples are provided to illustrate the invention in somewhat greater detail and to show the specific embodiments of the invention but these should not be construed as limiting.

EXAMPLE I

A number of formulations were made and tested by the Tergotometer Cotton Detergency Test (Tergotometer Detergency, Journal of American Oil Chemists' Society, vol. 42, pp. 723-7 (1965), 0.15 solid concentration, 120° F., 3 cycles, using 150 p.p.m. hardness water) and various anionic surfactants and builders as shown in Table I.

TABLE I

Composition	A ¹	B	C	D
LAS	20	20		
TEA LAS			10	
NMT LAS				10
STPP	35			
Na ₂ CO ₃		35	35	35
Na ₂ SiO ₃	7	7	7	7
Na ₂ SO ₄	37	36	46	45
CMC	1	1	1	1
NaOH		1	1	1
Tergotometer cotton detergency	77	62	76	76

¹ Commercial type H.D. detergent.

In the table the abbreviation LAS stands for linear alkylbenzene sulfonate sodium salt wherein the alkyl group ranges between 10 and 15 carbon atoms and averages about 13.3 carbon atoms. This is the commercial material utilized in a commercial heavy duty detergent formulation.

The abbreviation TEALAS refers to the triethanolamine salt of a linear alkylbenzene sulfonate wherein the alkyl group contains from about 10 to 13 carbon atoms with the average being about 11.2 carbon atoms. This is one

of the preferred surfactants of the instant invention. The abbreviation NMTLAS stands for the sodium N-methyl taurine salt of the linear alkylbenzene sulfonate having an average of 11.2 carbon atoms in the alkyl group. This is also a preferred surfactant of the instant invention. The abbreviation STPP and CMC stand for sodium tripolyphosphate and sodium carboxymethylcellulose, respectively.

It will be seen from the data that the formulations of this invention which are free of phosphate are substantially equal in cotton detergency to the commercial type heavy duty detergent but that if the commercial linear alkylbenzene sulfonate (average 13.3 carbon atoms in the alkyl group) is utilized in a phosphate-free formulation it will be seen that it is completely inferior and unsatisfactory (formulation B).

EXAMPLE II

Another series of formulations were made utilizing a commercial nonionic surfactant consisting of an alcohol ethoxylate wherein the straight chain alkyl portion of the molecule contained from 12 to 16 carbon atoms and the alcohol was condensed with sufficient ethylene oxide groups such that the ethylene oxide portion of the molecule amounted to between 60 and 65 weight percent of the entire compounds. The cotton detergencies of these formulations are shown in Table II wherein the abbreviations described for Table I also apply.

For comparison purposes formulation A and formulation B of Table I have also been included. It will be noted that the detergency decreases as the phosphate decreases until the composition is phosphate-free, then the detergency of the phosphate-free composition is equal to that of the commercial heavy duty detergent.

TABLE II

	A ¹	B	E ¹	F	G	H	I	J
Nonionic			10	10	10	10	10	10
LAS	20	20						
Na ₂ CO ₃		35		15	25	35	35	35
Na ₂ SiO ₃	7	7	7	7	7	7	7	7
STPP	35		35	20	10	20	10	
Na ₂ SO ₄	37	37	46	46	46	26	36	46
CMC	1	1	1	1	1	1	1	1
NaOH		1	1	1	1	1	1	1
Tergotometer cotton detergency	77	6	76	69	66	69	65	77

¹ Commercial type H.D. detergent.

As many possible embodiments can be made of this invention without departing from the broad scope thereof, it is to be understood that all matter herein set forth is to be interpreted as illustrative and not as unduly limiting the invention.

We claim:

1. A heavy duty phosphate free detergent composition consisting essentially of in weight percent

- Sodium carbonate 30-45
- Sodium silicate 4-10
- Sodium sulfate 35-50
- Sodium carboxymethyl cellulose 0.1-2
- Sodium hydroxide 0-1

A salt of a linear alkylbenzene sulfonic acid selected from the group consisting of the lower alkanol amine and the N-methyltaurine salts, the alkyl group of said linear alkyl benzene sulfonic acid having from 9 to 15 carbon atoms 8-20

2. The composition according to claim 1 wherein the salt of the linear alkylbenzene sulfonic acid is a triethanolamine salt and the alkyl group of the alkylbenzene sulfonic acid contains 9 to 13 carbon atoms with an average of 11 to 12.

3. The composition according to claim 1 wherein the salt of the linear alkyl benzene sulfonic acid is an N-methyltaurine salt and the alkyl group of the alkylbenzene

sulfonic acid contains from 9 to 13 carbon atoms with an average of 11 to 12.

References Cited

UNITED STATES PATENTS

3,066,104	11/1962	Dasch et al.	252—137
3,079,344	2/1963	Fries et al.	252—113
3,213,028	10/1965	Wood	252—89
3,303,135	2/1967	Goldwasser	252—137

FOREIGN PATENTS

208,545	5/1957	Australia	252—138
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OTHER REFERENCES

Pitts, P. M. Jr.; "Amino-sulfonates: Organic Surfactant Builders," Detergent Age, February 1968, pp. 20, 21, 22 and 70.

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