ORGANIC SULFONATES

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18 Claims

ABSTRACT OF THE DISCLOSURE

Novel, low foaming, highly biodegradable alkyl aryl sulfonates are provided by sulfonating that portion of an aryl alkylation product containing up to 50% by weight monoalkylbenzenes, from 10% to 50% by weight dialkylbenzenes and dialkyletherhydrophthalenes and about 35% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes.

Synthetic detergents have found wide use in industrial and household cleaning, particularly in the laundering of fabrics. A property desired in materials for such uses is high detergency. However, there are additional properties which are highly desirable in a detergent, such as low cost and high biodegradability. For a number of years, high foaming was also considered a desirable property in detergents. However, in the recent years it has been recognized that high foaming detergents have certain disadvantages. Consequently, a market for low foaming synthetic detergents has developed and there has been continuing effort to provide synthetic detergents which not only have commercially acceptable detergent properties and are low in cost and highly biodegradable, but are also low foaming.

One of the disadvantages of high foaming in a detergent is that the concentration in which high foaming detergents can be used is necessarily limited in order to avoid excessive foaming. In laundering fabrics excessive foaming is undesirable since additional rinse cycles are required to remove the detergent completely and restore the hand of the cloth. Excessive foaming is particularly undesirable in top-loading washing machines, since foam overflow occurs resulting in deposition of detergent particles into the shell of the washing machine causing corrosion and clogging thereof. In addition, soil particles remaining in suspension throughout the foam may be redeposited, during the rinse cycle, on the garments being washed. A high foam density furnishes a cushioning effect which reduces actual contact of the washing machine agitator with the garments being washed and of the garments with each other, thereby reducing the extent of physical loosening of dirt particles from the fibers.

Similarly, in front-loading machines, a high foam concentration inhibits efficient contact of the garments being washed with each other and with the sides of the washer, thereby reducing physical loosening of dirt particles from fiber interstices.

In other cleaning applications excessive foaming is similarly undesirable; disadvantageously requiring additional rinsing thus increasing operational times and water requirements.

The anionic alkylbenzene sulfonates having satisfactory detergent and biodegradability properties and relatively low cost are, however, high foaming. In order to overcome the high foaming of such detergents, it is necessary to add relatively expensive foam-depressing agents, thereby increasing the cost of the product without improving its cleansing action.

Nonionic detergents, such as the ethylene oxide condensates, having satisfactory detergent and biodegradability properties and low foaming, are, however, relatively high in cost.

High biodegradability, i.e., rapid decomposition by microorganisms, is desirable in detergents as detergents of low biodegradability stand accused of being a factor in the rising rate of pollution of fresh water sources, which is increasingly becoming the subject of public and commercial concern.

Accordingly it is an object of this invention to provide compositions of low cost having high detergent properties. It is a further object of this invention to provide low cost compositions which have high detergent properties and low foaming and high biodegradability. Other objects and advantages will be apparent from the following detailed description.

I have discovered that these and other objects are achieved by the anionic surface active compositions of this invention, hereinafter referred to as the organic sulfonates of this invention, which are the sulfonates of a hydrocarbon mixture having (A) up to about 50% by weight of monoaicylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, and (B) from about 10% to 50% by weight of a mixture of dialkylindanes and dialkyltetrahydrophthalenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and (C) from about 35% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

Particularly useful organic sulfonates of this invention are the sulfonates of a hydrocarbon mixture having (A) from about 15% to 50% by weight of monoaicylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoaicylbenzenes consisting predominantly of 2-phenylalkanes, (B) from about 10% to 40% by weight of a mixture of dialkylindanes and dialkyltetrahydrophthalenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and (C) from about 35% to 70% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

Other particularly useful organic sulfonates of this invention are the sulfonates of a hydrocarbon mixture having (A) up to about 10% by weight of monoaicylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoaicylbenzenes consisting predominantly of 2-phenylalkanes, (B) from about 10% to 50% by weight of a mixture of dialkylindanes and dialkyltetrahydrophthalenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule and (C) from about 45% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

Other particularly useful organic sulfonates of this invention are the sulfonates of a hydrocarbon mixture...
having (A) from about 30% to 40% by weight of mono-
alkylbenzenes in which the alkyl groups are essentially
linear and contain from 8 to 18 carbon atoms, said
monoalkylbenzenes consisting predominantly of 2-phenyl-
alkanes (B) from about 10% to 15% by weight of a
mixture of dialkyldiindanes and dialkyldiethyldiphenyl-
thalenes wherein the alkyl groups are essentially linear
and contain from 1 to 14 carbon atoms, the sum of said
alkyl carbon atoms being a maximum of 15 for each
molecule, and (C) from about 45% to 60% by weight of a
mixture of diphenylalkanes and dialkylbenzenes in
which the alkyl groups are essentially linear and contain
from 8 to 18 carbon atoms. Such sulfonates combine
excellent detereve and cleansing properties with a sur-
prisingly high biodegradability of at least 90 percent,
in spite of the complex nature of the components of the
hydrocarbon mixture from which these sulfonates are
derived.

The term organic sulfonates as used herein is intended
to describe organic compounds having sulfonate groups
which may be sulfonic acids or salts thereof, including
alkali and alkaline earth metal, ammonium and organic
amine salts.

The sulfonates of this invention are low in cost, i.e., comparable in cost to the conventional anionic
detergents, as they can be produced from readily avail-
able low cost raw materials by a process, hereinafter
described.

The organic sulfonates of this invention can be pro-
duced by a process of this invention comprising (A)
passing chlorine in intimate contact with an essentially
linear alkane hydrocarbon having 8 to 18 carbon atoms,
or mixture thereof, in an amount insufficient to chlorinate
all the alkane and to produce primarily monochloro-
alkanes, (B) reacting the chlorination mixture produced
by step (A) with a large excess of benzene in the presence
of a Friedel-Crafts catalyst under alkylation conditions
to produce an alkylation mixture, (C) recovering by fra-
tional distillation of said alkylation mixture an alkylate
fraction composed of (a) up to about 50% by weight of
monoalkylbenzenes in which the alkyl groups are essen-
tially linear and contain from 8 to 18 carbon atoms, said
monoalkylbenzenes consisting predominantly of 2-phenyl-
alkanes; (b) from about 10% to 50% by weight of a
mixture of dialkyldiindanes and dialkyldiethyldiphenyl-
thalenes wherein the alkyl groups are essentially linear
and contain from 1 to 14 carbon atoms, the sum of said
alkyl carbon atoms being a maximum of 15 for each
molecule; and (c) from about 35% to 90% by weight of a
mixture of diphenylalkanes and dialkylbenzenes in
which the alkyl groups are essentially linear and contain
from 8 to 18 carbon atoms; (D) sulfonating said alkylate
fraction, and (E) recovering a mixture of organic sul-
fonates from the sulfonation mixture produced in (D).

The chlorination step (A) of the process of this in-
vention is known in the art as “underchlorination.” In
“underchlorination” the amount of chlorine and condi-
tions of reaction are carefully controlled in order to
partially chlorinate the alkane to obtain a mixture com-
prising a minor portion of chloroalkanes, consisting essen-
tially of monochloroalkanes, and a major portion of
unreacted alkanes. In the process of this invention chlorination of up to about 25 mol percent of the alkane
is preferred.

In carrying out the alkylation step (b) of the process
of this invention conventional Friedel-Crafts catalysts,
such as aluminum chloride, aluminum metal in admix-
ture with aluminum chloride, aluminum bromide, zinc chlo-
ride, etc., is present in amounts of from about 0.1 to 4%,
preferably from about 0.4 to 2% based on the weight
of the chlorinated alkanes, and benzene is charged in a
molar ratio of from about 2 to 12:1, preferably from about
4 to 6:1 of chlorinated alkanes present. The alkylation
can be carried out under conventional benzene
alkylation conditions, e.g., at temperatures of from about
20° to 100° C., preferably from about 30 to 80° C. Re-
action times in batch operations are about ½ to 1 hour
after digestion of the reaction mixture, while in con-
tinuous operations a residence time of from about 2 to
15 minutes is generally required.

The desired hydrocarbon fraction can be recovered by
allowing the alkylation mixture to stand until the heavy
tarry layer has settled, decanting off the upper layer which
can then be washed with aqueous base and then sub-
jected to fractional distillation to remove unreacted
benzene and an alkylate mixture of monochloroalkanes
having up to about 35% by weight of 2-phenylalkanes,
leaving the hydrocarbon fraction suitable for produc-
tion of the organic sulfonates of this invention, which is
then preferably subjected to further fractional distillation
to obtain a mixture of hydrocarbons from which partic-
ularly useful organic sulfonates of this invention can be
produced.

As already indicated, the hydrocarbon mixtures of my
invention contain a certain amount of monoalkylate,
which remains in the residue, after distillation of the
bulk of the alkylate. The remainder of the hydrocarbon
mixture consists essentially of disubstituted tetrahydro-
thalenes and indanes as well as diphenyl alkanes and
dialkylbenzenes. The disubstituted tetrahydrothalenes
and indanes may be formed during the alkylation process
by condensation of one benzene molecule with a dichloro-
alkyl molecule formed during preparation of the mono-
chloroalkyl reactant. The occurrence of disubstituted
tetrahydrothalenes and indanes in the hydrocarbon
mixtures of my invention may be identified by aromatiza-
tion, to produce dissubstituted naphthalenes and indenes.
The diphenyl alkane fraction of the residues of our in-
vention is identified by the fact that on fractional dis-
tillation, a distillate fraction is obtained having a rela-
tively high refractive index and aniline point due to the
high aromatic to aliphatic content of such fractions. The
presence of dialkylbenzenes in alkylation residues has
been suggested in the prior art and may be further indi-
cated by a transalkylation reaction in which benzene
and a dialkylbenzene are reacted in the presence of alumi-
num chloride to produce additional monoalkylbenzene.

However, while alkylation residues employed in
the prior art for the production of oil soluble detergents
consisted mainly of dialkyl and polyalkylbenzenes, the com-
positions of my invention contain such di- and polyaryl
benzenes in relatively small amounts. Such relatively
small amounts of di- and polyarylbenzenes in the hydro-
carbon mixtures of my invention due to the utiliza-
tion, in the alkylation process, of a large benzene to alkyl
halide ratio in order to avoid polyalkylation, as well as
utilization of the well known “underchlorination” tech-
nique in the chlorination of the n-alkanes to produce
essentially a mixture of n-alkylmonochlorides and un-
changed n-alkanes. In the latter procedure, some poly-
chlorination inevitably occurs but such anomalous re-
action is held to a convenient minimum.

The sulfonation of the hydrocarbon mixtures of this
invention can be conducted by any conventional sulfa-
tonation technique using well-known sulfonating agents, e.g.
100% sulfuric acid. Salts of the resulting sulfonation
products can be produced by treatment with bases such as
ammonium hydroxide, alkali and alkaline earth metal
hydroxides, alkaliphilic amines, alkanolamines and the like
and mixtures thereof.

The organic sulfonates of this invention are surpris-
ingly effective as detergents even in cold water, and low
foaming, being particularly useful in the laundering of
fabrics; compositions thereof comparing favorably with
commercial low foaming detergents, as illustrated in the
examples hereinafter presented. The term low-foaming
as used herein is intended to imply that the surfactant
composition, in use, does not generate copious foam, or
if a copious foam is initially produced, it is quickly dis-
sipated. "Low-foaming" and "controlled sudsing" are generally equivalent terms in this art.

The organic sulfonates of this invention are surprisingly high in biodegradability, i.e., readily decomposed by micro-organisms, as determined by standard tests, as illustrated in the examples hereinafter presented. The organic sulfonates of this invention were found to be at least 80% biodegradable whereas anionic alkybenzene detergents of low biodegradability, known as "the hard detergents," are shown by such tests to be only about 30 to 40% biodegradable.

Detergent compositions particularly useful in the laundering of fabrics, can be prepared comprising from about 5 to 50 weight percent, preferably from about 8 to about 30 weight percent of the organic sulfonates of my invention as the surface active ingredients and one or more other detergents, fillers, builders or additives. Typically, the most useful, and tetrasodium pyrophosphate, sodium sulfate, sodium silicate, sodium orthosilicate and the like may be added as fillers and/or builders. Built compositions comprising the organic sulfonates of my invention may also contain other additives, such as carboxymethyl cellulose to prevent soil redeposition. Other additives may include optical brighteners, bleaches, colorants, desiccants to avoid balking of the composition particles and such other agents as the particular application for which the formulation is intended may require.

In addition to being valuable in laundering applications, the sulfonates of this invention may be used in dry cleaning formulations, for example in the form of solutions in dry cleaning solvents such as perchloroethylene, Stoddard solvent and the like. Furthermore, the organic sulfonates of my invention can be used in emulsification applications or in the manufacture of specialty detergents, for example such as used in electroplating baths and the like. Also the organic sulfonates of this invention can be used as foam depressants.

The following examples illustrate in detail the preparation of the compositions of this invention and properties thereof. The examples are merely illustrative, and this invention is not intended to be confined to any limitation contained therein.

All percents given are percent by weight unless specified otherwise.

EXAMPLE I

A mixture of 750 parts of benzene and 10 parts AlCl₃ was heated to about 45 to 50°. To this mixture was added with agitation during one-half hour, 500 parts of chlorinated normal tridecane mixture containing about 25 mol percent of normal tridecyl chlorides. The resulting reaction mass was distilled at 45–50° for one-half hour and then permitted to stand until the suspended tar settled out. After separation of the tarry material, 28 parts, the remaining mass was washed with 5% aqueous caustic soda and then fractionally distilled to remove as distillate unreacted benzene and tridecane leaving the alklylation products. The alklylation products were further fractionally distilled at up to about 165° C. at 5 mm. Hg to remove as distillate essentially all monoalkylbenzenes, leaving a hydrocarbon mixture composed of about 15% 2-phenyltridecane, leaving a hydrocarbon mixture composed of about 30% of monoalkylbenzenes of which about 95% were 2-phenylalkanes, about 5% of a mixture of dialkylbenzenes and dialkylethylenaphthalenes, and about 58% of a mixture of dialkylbenzenes and diphenylalkanes.

The drum dried product obtained was designated I–13.

EXAMPLE II

A procedure as described in Example I was followed except that in place of the chlorinated normal tridecane mixture, chlorinated normal dodecane mixture containing about 25 mol percent normal dodecyl monochlorides was used, and a distillate fraction containing about 22% 2-phenylundecane was collected, leaving a homologous hydrocarbon mixture of essentially the same composition as in Example I. A drum dried product was obtained and designated I–12.

EXAMPLE III

A procedure as described in Example I was followed except that in place of the chlorinated normal tridecane mixture, a chlorinated normal tetradecane mixture containing about 25 mol percent normal tetradecyl monochlorides was used, and a distillate fraction containing about 8% 2-phenyltetradecane was collected, leaving a homologous hydrocarbon mixture of essentially the same composition as in Example I. A drum dried product was obtained and designated I–14.

EXAMPLE IV

A hydrocarbon mixture was prepared by mixing 7.1 parts, 45.2 parts and 47.7 parts respectively of hydrocarbon mixtures obtained in the preparation of I–12, I–13 and I–14, as described in Examples I to III. A drum dried product was obtained from the hydrocarbon mixture by following a procedure as described in Example I and the product designated I-blend.

EXAMPLE V

A procedure similar to that described in Example I was followed except that the alklylation products were fractionally distilled up to about 177° C. at 0.5 mm. Hg, to remove as distillate essentially all monoalkylbenzenes, leaving a hydrocarbon mixture composed of about 3% of monoalkylbenzenes of which about 95% were 2-phenylalkanes, about 59% of a mixture of dialkylbenzenes and dialkylethylenaphthalenes, and about 58% of a mixture of dialkylbenzenes and diphenylalkanes.

The drum dried product obtained was designated II–13.

EXAMPLE VI

Following a procedure as described in Example V, except that in place of the chlorinated normal tridecane, a mixture containing about 25 mol percent normal tetradecyl chlorides was used. A homologous hydrocarbon mixture of essentially the same composition was obtained. A drum dried product was obtained and designated II–14.

EXAMPLE VII

A hydrocarbon mixture was obtained by mixing 57 parts and 43 parts respectively of hydrocarbon mixtures obtained in the preparation of II–13 and II–14, as described in Examples V and VI.

A drum dried product was obtained by following a procedure as described in Example I and the product designated II-blend.

EXAMPLE VIII

In order to illustrate the relative detergents and foaming properties of the organic sulfonates of this invention, about 170 parts water was added and the mixture allowed to settle until phase separation was complete, after which the spent acid layer was withdrawn. One hundred parts of the resulting sulfonated hydrocarbon mixture were mixed with about 300 parts of water, the mixture was then neutralized to pH 7 by the gradual addition of a 30% aqueous solution of caustic soda to produce a slurry suitable for drum drying. The drum dried product contained about 90% organic sulfonates in the form of sodium salts and about 10% sodium sulfate and was designated I–13.
TABLE II—FRONT-LOADING WASHING MACHINE

<table>
<thead>
<tr>
<th>Detergent</th>
<th>Percent</th>
<th>3 Min.</th>
<th>6 Min.</th>
<th>9 Min.</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD..........</td>
<td>79.7</td>
<td>20</td>
<td>20</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>ALX.........</td>
<td>81.8</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>DAX.........</td>
<td>80.4</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>DASH .......</td>
<td>78.4</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>I-12 .......</td>
<td>81.6</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>I-14 .......</td>
<td>83.7</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>I-16 .......</td>
<td>83.5</td>
<td>30</td>
<td>30</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
<tr>
<td>I-18 .......</td>
<td>83.3</td>
<td>20</td>
<td>20</td>
<td>&lt;10</td>
<td>Low</td>
</tr>
</tbody>
</table>

CODE—Foam rating: 0 to 25 = Low; 26 to 50 = Moderate; 51 to 75 = High foam.

EXAMPLE IX

In order to illustrate the low foaming properties of the organic sulfonates of this invention, dish washing tests were carried out according to the procedure described below.

An inverted conical container having a ¾ inch diameter spout attached to its narrow end is held at a height of 34 inches from the base of a 15 inch diameter and 5 inch deep wash basin. The container is filled with a solution of detergent preterned to 115°F. The spout of the container is opened and the solution is allowed to run into the wash basin to produce a foamy detergent solution. Each of forty 9 inch diameter glazed porcelain plates in smeared on the top side with 0.5 gram of Crisco and the plates are stacked on top of each other. Five of the plates are immersed all at once in the detergent solution after which one plate is picked up and while still immersed in the solution is wiped five times with a dish cloth in a circular motion at the rate of one complete circular wiping per second. The operation is repeated on the bottom side of the plate for four times after which the plate is withdrawn from the solution. Additional plates are then washed until the last traces of foam disappear from the surface of the detergent solution. The number of plates washed prior to the disappearance of the foam is observed.

Built composition solutions were prepared from 2.5 grams of drum dried products of the above examples, 3.5 grams of sodium tripolyphosphate, 0.8 gram of sodium orthosilicate and 2.2 grams of sodium sulfate in 6 liters of distilled water. Solutions of equivalent concentrations of commercial high foaming detergents were also prepared. Tests on the above-described solutions indicated that the compositions of this invention were low foaming, i.e. the last traces of foam disappeared after only one dish was washed, whereas ten to twenty dishes could be washed prior to the disappearance of the foam when solutions of commercial high foaming detergents were used.

EXAMPLE X

A hydrocarbon mixture was obtained by mixing 12 parts, 48 parts and 40 parts, respectively, of hydrocarbon mixtures as obtained in the preparation of I-12, I-13 and I-14, as described in Examples I to III.

A portion of the hydrocarbon mixture was treated as described in Example I to obtain a drum dried product, designated A-I.

Another portion of the hydrocarbon mixture was fractionally distilled as described in Example V and the hydrocarbon mixture remaining after the distillation was treated as described in Example I to obtain a drum dried product, designated A-II.

Another portion of the hydrocarbon mixture was fractionally distilled to yield about 85% distillate which was a hydrocarbon mixture composed of about 35% of mono-alkylbenzenes, of which about 50% were 2-phenylalkanes, about 14% of a mixture of dialkylbenzenes and dialkyl-alkylphosphates, and about 51% of a mixture of di-

TABLE I—TOP-LOADING WASHING MACHINE

<table>
<thead>
<tr>
<th>Detergent</th>
<th>Percent</th>
<th>3 Min.</th>
<th>6 Min.</th>
<th>9 Min.</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD..........</td>
<td>80.8</td>
<td>80.6</td>
<td>0.1</td>
<td>0.1</td>
<td>Low</td>
</tr>
<tr>
<td>ALX.........</td>
<td>81.1</td>
<td>81.0</td>
<td>0.2</td>
<td>0.4</td>
<td>Do</td>
</tr>
<tr>
<td>DAX.........</td>
<td>80.7</td>
<td>80.5</td>
<td>0.5</td>
<td>0.6</td>
<td>Do</td>
</tr>
<tr>
<td>I-12 .......</td>
<td>80.9</td>
<td>80.4</td>
<td>0.5</td>
<td>0.6</td>
<td>Do</td>
</tr>
<tr>
<td>I-14 .......</td>
<td>81.8</td>
<td>81.0</td>
<td>0.6</td>
<td>0.8</td>
<td>Do</td>
</tr>
<tr>
<td>I-16 .......</td>
<td>81.3</td>
<td>80.3</td>
<td>0.6</td>
<td>0.8</td>
<td>Do</td>
</tr>
<tr>
<td>I-18 .......</td>
<td>82.3</td>
<td>81.0</td>
<td>0.6</td>
<td>0.8</td>
<td>Do</td>
</tr>
<tr>
<td>I-20 .......</td>
<td>82.8</td>
<td>81.0</td>
<td>0.6</td>
<td>0.8</td>
<td>Do</td>
</tr>
</tbody>
</table>

CODE—Foam rating: 0 to 1.5 = Low; 1.5 to 3 = Moderate; 3 to 4 = High; 4 to 6 = All-purpose nonionic household detergent; 6 to 9 = All-purpose anionic household detergent; 9 = All-purpose anionic household detergent; Alkalal = Alkalalyl sulfonate monoionic detergent; AD = A low solubility all-purpose nonionic household detergent; DAX = A low solubility monoionic detergent (from McCutcheon's "Detergent and Emulsiifier 1960 Annual").
alkylenzenes and diphenylalkanes, which was then treated as described in Example I to obtain a drum dried product, designated A—III. A—III had a reflectance of over 65% (magnesium oxide standard), i.e. was a more intense white than the other drum dried products described above. A—I, A—II and A—III were tested for biodegradability by the Soap and Detergent Association’s Semi-Continuous Activated Sludge Test. The tests indicated the average biodegradabilities of A—I, A—II and A—III to be 93.8%, 81.5% and over 90%, respectively.

EXAMPLE XI

A built composition was prepared from the above-described product A—III, having 15% of organic sulfonate, 40% sodium tripolyphosphate, 28.5% sodium sulfate, 7% sodium ortho-silicate, 9% sodium chloride and 0.5% carboxymethylcellulose.

The built composition was tested in laundering fabrics in hot water, e.g. above 120°F, and cold water, e.g. 85—90°F, of varying hardnesses, e.g. up to 300 p.p.m. and was found to have detergent and low foaming properties comparable to commercial low foaming detergents.

1. An anionic surface active composition consisting essentially of sulfonates of a hydrocarbon mixture having
(A) up to about 50% by weight of monoalkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoalkylbenzenes consisting predominantly of 2-phenylalkanes,
(B) from about 10% to 50% by weight of a mixture of dialkylindanes and dialkylenetharydrophenaphthenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and
(C) from about 35% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

2. An anionic surface active composition as specified in claim 1, wherein the sulfonates are alkali metal, ammonium, or amine salts, said sulfonates being low foaming and highly biodegradable.

3. An anionic surface active composition as specified in claim 1 wherein the hydrocarbon mixture has
(A) from about 12% to 50% by weight of monoalkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoalkylbenzenes consisting predominantly of 2-phenylalkanes,
(B) from about 10% to 40% by weight of a mixture of dialkylindanes and dialkylenetharydrophenaphthenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and
(C) from about 35% to 70% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

4. An anionic surface active composition as specified in claim 3, wherein the sulfonates are alkali metal, ammonium, or amine salts, said sulfonates being low foaming and highly biodegradable.

5. An anionic surface active composition as specified in claim 4, wherein the sulfonates are sodium salts.

6. An anionic surface active composition as specified in claim 1, wherein the hydrocarbon mixture has
(A) up to about 10% by weight of monoalkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoalkylbenzenes consisting predominantly of 2-phenylalkanes,
(B) from about 10% to 50% of a mixture of dialkylindanes and dialkylenetharydrophenaphthenes wherein the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said dialkylindanes and dialkylenetharydrophenaphthenes containing alkyl groups having from 5 to 10 carbons,
(C) from about 50% to 90% of a mixture of dialkylbenzenes in which the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and
(D) about 45% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

7. An anionic surface active composition as specified in claim 6, wherein the sulfonates are alkali metal, ammonium, or amine salts, said sulfonates being low foaming and highly biodegradable.

8. An anionic surface active composition as specified in claim 6, wherein the sulfonates are sodium salts.

9. An anionic surface active composition as specified in claim 1 wherein the hydrocarbon mixture has
(A) from about 30% to 40% by weight of monoalkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoalkylbenzenes consisting predominantly of 2-phenylalkanes,
(B) from about 10% to 15% by weight of a mixture of dialkylindanes and dialkylenetharydrophenaphthenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and
(C) from about 45% to 60% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms.

10. An anionic surface active composition as specified in claim 9, wherein the sulfonates are alkali metal, ammonium, or amine salts, said sulfonates being low foaming and highly biodegradable.

11. An anionic surface active composition as specified in claim 9, wherein the sulfonates are sodium salts.

12. As a new composition of matter a detergent composition consisting essentially of about 5 to 50% by weight of the product of claim 2 as a detergent component and the balance consisting of inorganic builders.

13. As a new composition of matter a detergent composition consisting essentially of about 5 to 50% by weight of an anionic surface active composition as specified in claim 2 wherein the sulfonates are sodium salts, and which additionally contains sodium tripolyphosphate, sodium sulfate and sodium orthosilicate as fillers and sodium carboxymethylcellulose to prevent soil redeposition.

14. A process for the preparation of an anionic surface active composition which comprises
(A) passing chlorine in intimate contact with an essentially linear alkane hydrocarbon having 8 to 18 carbon atoms, or mixture thereof, in an amount insufficient to chlorinate all the alkane and to produce primarily monochloroalkanes,
(B) reacting the chlorination mixture produced by step (A) with a large excess of benzene in the presence of a Friedel-Crafts catalyst under alkylation conditions to produce an alkylation mixture,
(C) recovering, as distillate, by fractional distillation of said alkylation mixture an alkylate fraction consisting essentially of:
(a) up to about 50% by weight of monoalkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said monoalkylbenzenes consisting predominantly of 2-phenylalkanes,
(b) from about 10% to 50% by weight of a mixture of dialkylindanes and dialkylenetharydrophenaphthenes wherein the alkyl groups are essentially linear and contain from 1 to 14 carbon atoms, the sum of said alkyl carbon atoms being a maximum of 15 for each molecule, and
(c) from about 35% to 90% by weight of a mixture of diphenylalkanes and dialkylbenzenes in which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms, said diphenylalkanes and dialkylbenzenes consisting predominantly of 2-phenylalkanes,
which the alkyl groups are essentially linear and contain from 8 to 18 carbon atoms,
(D) sulfonating said alkylate fraction, neutralizing the sulfonate product and
(E) recovering a mixture of alkylaryl sulfonates from the sulfonation mixture produced in (D).

15. A process for the preparation of an anionic surface active composition as specified in claim 14 wherein the sulfonation reaction mixture produced in (D) is neutralized with a compound of an alkali metal compound, an alkaline earth metal compound, an ammonium compound or an organic amine.

16. A process for the preparation of an anionic surface active composition as specified in claim 14 wherein the alkylaryl sulfonates from the sulfonation mixture produced in (D) are recovered as sodium salts.

17. The process of claim 14 wherein up to about 25 mol percent of the alkanes are chlorinated.

18. The process of claim 14 wherein the mol ratio of benzene to chlorination mixture is in the range 4:1 to 6:1.

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