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OIL-SOLUBLE LIQUID DETERGENT COMPOSITIONS

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This invention relates to oil-soluble liquid detergent compositions and more particularly to oil-soluble liquid detergent compositions containing a mixture of an anionic surface-active agent and a nonionic surface-active agent.

In recent years, a demand has arisen for so-called heavy-duty liquid cleaners for use either in concentrated form or diluted with a relatively light hydrocarbon oil such as kerosene. Such cleaners are particularly useful for cleaning metal surfaces or, in the concentrated form, as a hand cleanser for removing grease and oil from the hands. Such heavy-duty liquid detergent compositions may be sold in their concentrated form directly to the consumer or the concentrate may be sold to a distributor for dilution with kerosene to be re-sold as a cleaner for metals and the like. Since both the concentrated detergent and the diluted detergent must have a satisfactory "shelf life," it is necessary that the concentrated liquid detergent remain in the form of a homogeneous solution without separation into two phases on standing, and that when admixed with kerosene, for example, with 3 volumes, it forms a homogeneous solution which on standing for weeks or months does not separate into two phases.

Thus, the criteria for an oil-soluble, heavy-duty liquid detergent are that in concentrated form it is homogeneous and remains so on standing and, likewise, when diluted with about three volumes of kerosene, it forms a homogeneous, stable solution which does not separate on standing. In addition, of course, such detergents also must be highly efficient for removing oil and grease from hands or, when diluted, for cleaning metal surfaces. A composition now has been found which consists of a mixture of an anionic surface-active agent and a nonionic surface-active agent dissolved in a solvent which composition is a clear, homogeneous, non-separating solution and which, when admixed with kerosene, also gives a homogeneous, non-separating solution.

It is an object of this invention to provide an oil-soluble liquid detergent composition which is homogeneous and does not separate on standing.

It is another object of this invention to provide a liquid detergent composition which, when admixed with kerosene, forms a homogeneous, non-separating solution.

It is a further object of this invention to provide a liquid detergent composition consisting of a mixture of an anionic surface-active agent and a nonionic surface-active agent in a solvent for use as a hand cleanser.

It is a further object of this invention to provide a liquid detergent composition consisting of a mixture of an anionic surface-active agent and a nonionic surface-active agent in a solvent which, when admixed with kerosene, is suitable for use in cleaning metal surfaces.

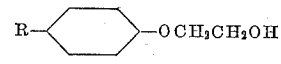
Other objects of this invention will be apparent from the detailed description of the invention and the claims that follow.

In accordance with this invention, a concentrated liquid detergent composition is compounded from about 50 weight percent to 60 weight percent of a mixture consisting of from about 50 weight percent to 75 weight percent of an anionic surface-active agent and from about

25 weight percent to 50 weight percent of a nonionic surface-active agent with the remainder of the composition consisting of a solvent. The anionic surface-active agent which is utilized to produce the composition of this invention consists of the triethanolamine salt of a C_{10}–C_{16} alkyl benzene sulfonic acid wherein the alkyl group averages about 12 carbon atoms in the form of an aqueous solution containing about 60 weight percent of the triethanolamine sulfonate. One such commercial product is sold under the trade name "Ultrawet 60L." It is made by polymerizing propylene to the tetramer using phosphoric acid-on-kieselguhr catalyst, alkylating benzene with the propylene tetramer using an aluminum chloride catalyst to obtain a C_{10}–C_{16} alkylated benzene with the average being 12 carbon atoms in the alkyl group, sulfonating the alkylated benzene using 20 percent oleum, and finally neutralizing the sulfonic acid with triethanolamine.

The nonionic surface-active agent which is admixed with the anionic surface-active agent consists of the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide.

The condensation product has the structural formula



wherein R is a C_8 alkyl (octyl) group. This condensation product is available commercially under the trade name "Triton X–15."

Preferably about equal weights of the anionic and nonionic surface-active agents are employed in the compositions of this invention. However, the quantity of anionic surface-active agent may range from 50 weight percent up to 75 weight percent with the nonionic ranging from about 50 weight percent to 25 weight percent of the mixture of surface-active agents.

It has been found necessary, in order to obtain the clear liquid detergent compositions which also can be diluted with kerosene to produce non-separating solutions in accordance with this invention, to utilize the triethanolamine salt rather than the sodium salt or other metal salts of the alkyl benzene sulfonic acid.

Likewise it has been found that the described octyl phenol-ethylene oxide condensation product is required to produce the desired clear and homogeneous compositions and solutions.

Thus, the balance between the solubility properties of the anionic surface-active agent and the solubility properties of the nonionic surface-active agent is exceedingly critical in order to obtain an oil-soluble, clear homogeneous, non-separating solution.

The solvent employed for the remainder of the composition consists preferably of from about 10 weight percent to 20 weight percent of tetrahydrofurfuryl alcohol and from about 80 weight percent to 90 weight percent of a hydrocarbon. The hydrocarbon may be a petroleum distillate fraction boiling between about 175° F. and 600° F. or it may be a C_{10}–C_{15} alkyl benzene having an average of about 12 carbon atoms in the alkyl group or in cases when the anionic surface-active agent predominates in the surface-active agent mixture; for example, when it constitutes about 70 percent of the mixture of surface-active agents, the entire solvent may consist of the C_{10}–C_{15} alkyl benzene hydrocarbon.

In a preferred composition, the solvent consists of 80 percent by weight of a petroleum distillate fraction boiling between 300° F. and 600° F. (approximately 48 percent paraffins, 34 percent cycloparaffins and 18 percent

aromatics, all by weight) together with 20 weight percent of tetrahydrofurfuryl alcohol.

In a similar preferred composition, the hydrocarbon portion of the solvent consists of the C_{10}–C_{15} alkyl benzene having an average of 12 carbon atoms in the alkyl group. It is also preferred that with these preferred solvents, the mixture of surface-active agents ranges between 50 and 55 weight percent of the composition with the quantity of anionic surface-active agent and nonionic surface-active agent being approximately equal in parts by weight.

The following examples are provided to illustrate the types of components and quantities thereof suitable for use in this invention.

Example I

Comparable compositions were prepared utilizing the triethanolamine salt and the sodium salt of the C_{10}–C_{16} alkyl benzene sulfonic acid having an average of about 12 carbon atoms in the alkyl group in the form of 60 percent aqueous solutions with various condensation products of octyl phenol with various amounts of ethylene oxide and with various solvents. The properties of the compositions obtained are shown in Table I.

TABLE I

Composition Number	A-1	A-2	N-1	N-3	N-5	S-1	S-2	S-3	Composition Properties
1	26.7	------	26.7	------	------	37.2	------	9.4	Clear—M.K.
2	------	26.7	26.7	------	------	37.2	------	9.4	Cryst. ppt.
3	------	26.7	------	26.7	------	37.2	------	9.4	Do.
4	------	26.7	------	------	26.7	37.2	------	9.4	Do.
5	------	26.7	------	------	26.7	------	37.2	9.4	Do.
6	26.7	------	26.7	------	------	------	37.2	9.4	Clear—M.K.

A-1=Triethanolamine C_{10}–C_{16} alkyl benzene sulfonate, 60 weight percent aqueous solution (Ultrawet 60L).
A-2=Sodium C_{10}–C_{16} alkyl benzene sulfonate, 60 weight percent aqueous solution.
N-1=1 mole octyl phenol condensed with 1 mole of ethylene oxide (Triton X-15).
N-3=1 mole octyl phenol condensed with 3 moles of ethylene oxide (Triton X-35).
N-5=1 mole octyl phenol condensed with 5 moles of ethylene oxide (Triton X-45).
S-1=Petroleum distillate fraction boiling between 300° F. and 600° F. containing 48 percent paraffins, 34 percent cycloparaffins and 18 percent aromatics, by weight.
S-2=C_{10}–C_{15} alkyl benzene. (Boiling range 515° F.-590° F.)
S-3=Tetrahydrofurfuryl alcohol.
Clear=Forms clear solution.
M.K.=Miscible with 3 volumes of kerosene.
Cyst. ppt.=Crystals precipitated from the mixture.

The appearance and properties of the various compositions set forth show that it is not possible to utilize the sodium salt in the compositions of this invention and that only the triethanolamine salt may be utilized.

Example II

In order to demonstrate the criticality of using the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide, a number of compositions were prepared utilizing various nonionics in which 1 mole of the octyl phenol was condensed with various quantities of ethylene oxide. The results obtained are set forth in Table II.

TABLE II

Composition Number	A-1	N-1	N-5	N-7	N-9	S-1	S-2	S-3	Composition Properties
1	26.7	26.7	------	------	------	37.2	------	9.4	Clear—M.K.
6	26.7	26.7	------	------	------	------	37.2	9.4	Do.
7	26.7	------	26.7	------	------	------	37.2	9.4	Do.
8	26.7	------	------	26.7	------	------	37.2	9.4	Separated.
9	13.3	------	------	40.1	------	37.2	------	9.4	Do.
10	26.7	------	------	------	26.7	------	37.2	9.4	Do.
11	26.7	------	------	------	26.7	18.6	18.6	9.4	Do.

A-1, N-1, N-5, S-1, S-2, S-3, and M.K. are the same as in Example I.
N-7=1 mole octyl phenol condensed with 7-8 moles of ethylene oxide (Triton X-114).
N-9=1 mole octyl phenol condensed with 9-10 moles of ethylene oxide (Triton X-100).
H.K.=Hazy in 3 volumes of kerosene.

These results show that only the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide may be utilized in preparing the compositions of this invention.

Example III

Various combinations of solvents were utilized in combination with the preferred quantities of anionic surface-active agent and nonionic surface-active agent. The results are set forth in Table III.

TABLE III

Composition Number	A-1	N-1	S-1	S-2	S-3	Composition Properties
1	26.7	26.7	37.2	------	9.4	Clear—M.K.
12	26.7	26.7	46.6	------	------	Hazy.
6	26.7	26.7	------	37.2	9.4	Clear—M.K.
13	26.7	26.7	------	46.6	------	Hazy.
14	26.7	26.7	------	41.9	4.7	Clear—M.K.
15	39.8	13.6	------	46.6	------	Hazy.
16	38.4	15.0	------	46.6	------	Clear—M.K.

A-1, N-1, N-5, S-1, S-2, S-3 and M.K. are the same as in Example I.

The results set forth in Table III show that the entire solvent may consist of a hydrocarbon such as a C_{10}–C_{15} alkyl benzene (Composition No. 16), but it is preferred that the hydrocarbon range from about 80 weight percent to 90 weight percent and that the remainder of the solvent consist of from about 10 weight percent to 20 weight percent tetrahydrofurfuryl alcohol. In the preferred composition, the hydrocarbon may be a petroleum distillate fraction boiling between about 175° F. and 600° F., preferably between 300° F. and 600° F., or it may be a C_{10}–C_{15} alkyl benzene having an average of about 12 carbon atoms in the alkyl group.

Example IV

Compositions were prepared in which the proportions of anionic and nonionic surface-active agents were varied. Results obtained are set forth in Table IV.

TABLE IV

Composition Number	A-1	N-1	S-1	S-2	S-3	Composition Properties
6	26.7	26.7	------	37.2	9.4	Clear—M.K.
17	40.1	13.3	------	37.2	9.4	Do.
18	48.0	5.4	------	37.2	9.4	Separated.
19	13.3	40.1	------	37.2	9.4	Do.
20	21.4	32.0	37.2	------	9.4	Do.

A-1, N-1, S-1, S-2, S-3 and M.K. are the same as in Example I.

These results show that from about 50 weight percent to 60 weight percent of the mixture of anionic and nonionic may be utilized with the quantity of anionic surface-active agent ranging between 50 weight percent and 75 weight percent and the quantity of the nonionic surface-active agent ranging between 25 weight percent and 50 weight percent of the mixture of surface-active agents.

Example V

Certain of the preferred compositions were tested for their ability to clean metal surfaces. Sand-blasted steel strips were coated with an asphalt cut-back by dipping and allowing the excess cut-back to drain off. The cut-back was composed of 75 volume percent of an 85–100 penetration, 115° F. softening point asphalt dissolved in 25 volume percent of petroleum gas oil boiling between 340° F. and 640° F. These strips were dipped into a solution of the concentrated liquid detergent composition which had been diluted with three volumes of kerosene. At the end of 15 minutes, the strip was removed from the kerosene-detergent solution and rinsed with a stream of water. When the preferred compositions of this invention, such as Compositions Nos. 1 and 6, were utilized, the metal strip was washed completely clean and free of asphalt and oil, thus demonstrating that the compositions of this invention are excellent for cleaning metal surfaces. Strips which were soiled in the same manner and which were placed in the flowing water stream were not cleaned in any way because of the strong adherence of the asphalt cut-back to the metal.

We claim:

1. An oil-soluble liquid detergent composition consisting essentially of from about 50 weight percent to 60 weight percent of a mixture of an anionic surface-active agent and a nonionic surface-active agent, the remainder of the composition consisting of a solvent for said mixture of surface-active agents, said mixture of surface-active agents consisting of from about 50 weight percent to 75 weight percent of an aqueous solution of triethanolamine C_{10}–C_{16} alkyl benzene sulfonate of about 60 weight percent concentration and from about 25 weight percent to 50 weight percent of the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide, said solvent consisting of from about 80 weight percent to 100 weight percent of hydrocarbons boiling in the range of 175° F. to 600° F., and from about 20 weight percent to 0 weight percent of tetrahydrofurfuryl alcohol.

2. The composition according to claim 1 wherein the quantities of anionic surface-active agent and nonionic surface-active agent are about equal in parts by weight.

3. An oil-soluble liquid detergent composition consisting essentially of from about 50 weight percent to 60 weight percent of a mixture of an anionic surface-active agent and a nonionic surface-active agent, the remainder of the composition consisting of a solvent for said mixture of surface-active agents, said mixture of surface-active agents consisting of from about 50 weight percent to 75 weight percent of an aqueous solution of triethanolamine C_{10}–C_{16} alkyl benzene sulfonate of about 60 weight percent concentration and from about 25 weight percent to 50 weight percent of the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide, said solvent consisting of from about 80 weight percent to 100 weight percent of C_{10}–C_{15} alkyl benzene and from about 20 weight percent to 0 weight percent tetrahydrofurfuryl alcohol.

4. The composition according to claim 3 wherein the quantities of anionic surface-active agent and nonionic surface-active agent are about equal in parts by weight.

5. An oil-soluble liquid detergent composition consisting essentially of from about 50 weight percent to 60 weight percent of a mixture of an anionic surface-active agent and a nonionic surface-active agent, the remainder of the composition consisting of a solvent for said mixture of surface-active agents, said mixture of surface-active agents consisting of from about 50 weight percent to 75 weight percent of an aqueous solution of triethanolamine C_{10}–C_{16} alkyl benzene sulfonate of about 60 weight percent concentration and from about 25 weight percent to 50 weight percent of the condensation product of 1 mole of octyl phenol with 1 mole of ethylene oxide, said solvent consisting of about 80 weight percent of a petroleum distillate fraction boiling between 300° F. and 600° F. and about 20 weight percent tetrahydrofurfuryl alcohol.

6. The composition according to claim 5 wherein the quantities of anionic surface-active agent and nonionic surface-active agent are about equal in parts by weight.

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