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HARD-SURFACE TREATING COMPOSITIONS

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ABSTRACT OF THE DISCLOSURE

Surface-treating compositions containing surface-active agents able to exist in substantive cationic or non-substantive and non-cationic form are disclosed. The compositions contain a buffering agent to control pH and the cationic or non-cationic character of the surface-active agents and are effective in the treatment of hard surfaces. Methods of treating hard surfaces to provide soil-release properties are also disclosed.

BACKGROUND OF THE INVENTION

This invention relates to compositions for treating hard surfaces so as to facilitate cleaning them. By "hard surfaces" are meant principally those exposed to air-borne soiling, such as windows, whether of buildings or of vehicles, motor bodies and metal trim, paintwork, stone or brick work, domestic furniture especially sanitary ware and cookers and the like. The invention is also applicable to crockery, plate, cutlery and like surfaces.

These surfaces often become soiled by air-borne dust, by spray and splashing, for instance on roads or by deposits from smoke and fumes or the like. These soil deposits usually contain grease, as for example, soot, deposits from motor exhaust or cooking fumes. They also often contain clay or like particles, for example, from wind-borne dust and road spray. Generally, they adhere quite strongly to most surfaces so that the surfaces must be rubbed, preferably in the presence of detergents or wetting agents, in order to clean them. Treatment with the compositions of the invention renders such surfaces easier to clean, so that if they are sprayed or flushed with water the adherent soil deposits are mostly carried away without rubbing. Alternatively, surfaces which cannot conveniently be sprayed or flushed with water may be cleaned with a cloth wet with water, with a minimum of rubbing. Detergent solutions can of course also be used.

SUMMARY OF THE INVENTION

The present invention is based in part on the discovery that members of a certain class of surface-active agents can be applied in a predominantly cationic and substantive form to hard surfaces and, thereafter, be converted to a non-substantive and non-cationic form which is removed from the surface carrying with it soiling substances. Accordingly, the invention provides a composition for treating hard surfaces comprising a surface-active agent able to exist in cationic form, substantive to the surface, or in zwitterionic, nonionic, or anionic form, non-substantive to the surface, and having a pKa value as hereinafter defined in the range from 4 to 8, together with one or more pH buffering compounds such that the pH of an aqueous solution of the composition which contains 0.1% by weight of the surface-active agent is below, equal to, or not more than two units above its pKa value.

In its process or method aspect, the present invention provides a method of treating hard surfaces whereby a predominantly cationic and substantive form of a surface-active agent is applied to a hard surface, the surface is subjected to soiling effects, and the cationic form is at least partly removed from the surface along with soiling substances by altering the pH of the treated surface to effect conversion of the substantive form to a non-cationic and non-substantive form.

DETAILED DESCRIPTION OF THE INVENTION

The compositions of the invention are based upon members of a very special class of surface-active agents, which are cationic at suitable relatively low pH and non-cationic at suitably higher pH. Thus, the surface-active agent must be cationic and substantive to the surfaces to be treated when applied from a weakly acid aqueous solution, so that part of the surface-active agent remains adsorbed on the surface. It must be such that, when the treated surface is soiled and then washed with less acidic water or solution, for example rain or tapwater, or with a nonacidic detergent solution, the surface-active agent is at least partly, but preferably not wholly, converted to a non-substantive non-cationic form, and is at least partly removed form the surface, carrying the soiling substances with it. Preferably some of the cationic form of the surface-active agent remains unaltered on the surface, and is effective during a succeeding cycle of soiling and washing.

The compositions also render the treated surfaces to some degree antistatic, reducing the tendency for dust to adhere to them. They also render windows less liable to condensation of moisture and misting.

The term "pKa value" of a surface-active agent, as used herein, denotes that pH value at which the surface-active agent is exactly 50% in cationic form and 50% in zwitterionic, nonionic or anionic form, according to its nature. In solutions at pH's near to the pKa value, both forms are present to a considerable degree.

Preferably, the compositions are buffered so that the pH of their aqueous solution of the stated concentration is within 2, more preferably within 1 pH unit above or below the pKa value.

When applied thus, it is found that these surface-active agents are not only substantive to most hard surfaces insofar as they are in cationic form, but also render other nonionic or zwitterionic surfactants present substantive to most surfaces. In this context, the other nonionic or zwitterionic surfactants may include that part of the surface-active agent of the invention which is not in cationic form. When the surfaces are given an alkaline wash, the surface active agent of the invention becomes non-substantive, and no longer promotes the substantivity of the other surfactants which are also released. By this means non-cationic detergents can be made to act as substantive soil-release agents, removable in a subsequent washing.

Any surface-active agent having a pKa value in the above-mentioned range and substantive to the surfaces to be treated can be employed. It is preferable to use compounds that are converted from cationic to a nonionic or zwitterionic form. These surface-active agents include:

Condensation products of a long-chain amine and a polyethylenimine or polyethylenoxy group or both. Suitable compounds are those having the formula

$$R_1R_2R_3N$$

wherein R_1 is an alkyl group of from 8 to 30 carbon atoms, or an alkyl benzyl group having from 6 to 20 carbon atoms in the alkyl group; R_2 is a group defined as R_1 or as R_3 or is an alkyl of from 1 to 7 carbon atoms; and R_3 is a group

$$-(C_2H_4O)_n(C_2H_4NH)_mH$$

wherein n is 0 to 30, m is 0 to 30. The preferred compounds are those wherein each of R_2 and R_3 is a group given for R_3, and the total number of (C_2H_4O) groups is in the range from 3 to 6 and the total number of

(C_2H_4NH) groups is also in the range from 3 to 6. It is immaterial how these groups are distributed in R_2 and R_3. Other compounds which are effective are those where, in R_3, n or m is zero and the other is from 1 to 30 preferably from 3 to 18. In all these compounds, R_1 is preferably an alkyl of from 12 to 18 carbon atoms or an alkyl benzyl group having 9 to 16 carbon atoms in the alkyl group, and R_2, when not as defined for R_3, is a methyl or ethyl group.

Another class of compounds suitable for use in the compositions of the invention have the formula

$$R_1OR_3$$

and can be considered to be derived from alcohols R_1OH. In this class, the symbols R_1 and R_3 have the meanings given above, with the same preferences, except that m must not be zero, that is to say there must be at least one (C_2H_4NH) group present.

Yet another class of suitable compounds are tertiary amine oxides having one or two long chain alkyl groups with from 10 to 20 carbon atoms, preferably 12 to 18, attached to the nitrogen atom and correspondingly two or one short chain alkyl or hydroxyalkyl groups having 1 to 4 carbon atoms, preferably, 1 or 2 carbon atoms.

Buffering agents that are able to control the pH in a range below the pKa value of the surface-active agents are well known in the art, and the invention does not depend upon the nature of the particular agent chosen. As suitable agents there may be mentioned: phosphates, polyphosphates, borates, salts of weak organic acids, e.g., citric, glycolic, malic, tartaric, acetic, capric, benzoic, adipic and lactic. The corresponding acids or mixtures of buffers can be employed. Preferred salts are the metal, e.g., sodium and potassium, salts. The buffering agents are employed at a concentration providing the required degree of pH control.

The compositions of the invention can contain other compatible ingredients according to their intended function. Thus, if they are intended primarily for cleaning and washing surfaces, they can contain other organic nonionic or zwitterionic detergents. Anionic detergents are unsuitable as they would react with the cationic form of the surface active agents present according to the invention. Normal cationic detergents would remain substantive to the surface during washing with water and tend to retain soil, and are therefore preferably avoided. Suitable nonionic and zwitterionic detergents include those known in the art. As examples of the nonionics there may be mentioned: polyethylene oxide condensates of long chain fatty acids, fatty alcohols, amines, alkyl phenols and the like; polyethylenimine condensates of fatty acids, amines or amides; polyethoxy-polypropoxy condensates such as the "Pluronics" (trade name); and polyethoxy sorbitan esters such as the "Tweens" (trade name). The zwitterionics include long chain alkyl or alkyl benzyl betaines; sulpho-betaines, certain amino acids and the like. Other examples of suitable nonionic and zwitterionic detergents are provided in U.S. Pat. 3,213,030, issued Oct. 19, 1965, at column 4, line 13 to column 5, line 30, which disclosure is incorporated herein by reference.

Other inorganic or organic salts, or chelating agents can be present provided, of course, that the pH of the total composition in solution is within the stated limits. If the compositions are intended primarily as polishes, suitable fine abrasives and/or waxes can be present. In either case minor ingredients can be included, for example, perfumes, colors, tarnish removers or inhibitors, and ingredients necessary so that the products are in suitable physical form such as liquids, pastes, hard or soft solids, or powders, granules.

Hard surfaces can be made less attractive to dirt, and more easily cleaned by water, by wetting said surfaces with an aqueous solution of a composition as defined above containing a surface-active agent as defined above, and thereafter removing surplus solution. Preferably the solution contains from 0.01% to 10% by weight of the surface-active agent, more preferably from 0.1% to 5%, based on the solution. The composition can contain the surface-active agent in the hereinbefore prescribed amounts, the buffering agent, and the balance water, although other detergents, builders and the like can also be present. In practice, the lower limit of the amount of surface-active agent is that which just gives sufficient effect for a desired application, and the upper limit is fixed by economic considerations and/or by the solubility of the particular surface-active agent employed.

The following examples illustrate the invention:

Example I

An aqueous solution in distilled water was prepared containing, by weight of the solution, 1% of the condensation product of octadecyl methyl amine with 12 molar proportions of ethylenimine, and citric acid to bring the pH to 3.5. The amine condensate had a pKa value of 7.

This solution was sprayed on to the inside surface of a window pane in an amount sufficient to wet it all over, and the pane was wiped dry. For comparison, other panes in the same window were cleaned with water, and with a number of commercial window cleaning compositions. During and after four weeks without attention, the pane treated with the composition of the invention was found to be cleaner and less prone to misting, when the conditions were such as to give rise to condensation, than the comparative panes.

Pieces of window glass treated similarly were artificially soiled by first impressing a greasy stain upon them viz. the print of a hand which had recently been rubbed with a cosmetic hand cream, and then dusting the whole of the surface (both where stained and where unstained) with soot. The glass sheets were then dipped in or sprayed with tap water (pH6). The soot on the non-greased part of the glass treated with the composition of the invention was more rapidly removed than that from the comparative glasses, and the greasy stain was substantially completely removed from the former, but not removed from the comparative glasses.

Example II

Glass plates were sprayed with a test solution and dried and polished with a cloth. Garden soil was then rubbed on to them to leave them substantially uniformly soiled. They were then dipped into a beaker of water (pH 6½) to a depth corresponding to about half their length. A visual comparison of the top (unwetted) and bottom (dipped) halves gave a measure of the degree of soil release action, and the glasses treated in various ways were compared.

The test solution comprised water (as bland), a commercial detergent based window cleaner, and 1% solutions, buffered to pH 4.5 by means of sodium citrate/citric acid mixtures, of the following compounds:

(1) $[C_{12}H_{25}N(C_2H_4O)_n(C_2H_4NH)_mH]_2$ where the total n and the total m each amounted to 3.
(2) As 1, but the total n and the total m each amounted to 6.
(3) $C_{18}H_{37}N[(C_2H_4O)_n(C_2H_4NH)_mH]_2$ wherein the total n and the total m each amounted to 3.
(4) As 3, but the total n and the total m each amounted to 6.
(5) $C_{12}H_{25}N(CH_3)_2O$
(6) $C_{18}H_{37}N(CH_3)_2O$

The pKa of the compounds was in the range 5–6.

When the water sprayed plate was dipped, little soil was removed. The plate sprayed with commercial product had lost part of the soiling, but considerable deposits remained. Plates sprayed with solutions of Compounds 1 and 2 were almost entirely cleaned. Traces of soil remained on plates sprayed with the Compounds 3 to 6, but less than left by the said commercial product.

Generally similar results were obtained when the following compounds were employed in the initial treatment of the glass plates.

(a) Compounds as (1) where $n=m=9, 12, 18, 24$.
(b) Compounds as (3) where $n=m=9, 12, 18, 24$.
(c) Compounds as (1) where $m=3$, $n=0, 6, 12$.
(d) Compounds as (1) where $m=6$, $n=0, 3, 9, 12$.

Example III

Two adjacent windows of an office were treated, one with a commercial spray-on window cleaner and the other with a 1% solution of Compound 1 of Example II. Both were dried and polished with a cloth. On a cold day, it was observed that the former window was misted while the other remained clear.

Example IV

The two treated windows of Example III were both caused to mist up by operating a water boiler in the office. When the source of steam was removed, the window treated with the composition of the invention cleared before the other.

Example V

Aluminum tiles were dipped for two minutes in a 0.2% by weight solution of

(a) bis(2-hydroxyethyl)stearylamine oxide or
(b) a commercial dishwashing liquid based on anionic surfactants.

The solutions were made up in soft water, adjusted to pH 7, and were at 45° C. The tiles were dried, and coated with a mixture of 4 parts raw egg and 1 part milk. They were then placed on an electric hot plate until the soil had burnt on. The soiled tiles were dipped into fresh solutions, as above, for one minute and then agitated in the solution for ½ minute, and loosened soil was removed by gentle rubbing with a toilet tissue. At least 80% of the soil was removed from tiles treated in solution (a) compared with about 10% from those treated in solution (b).

What I claim is:

1. A composition for treating hard surfaces consisting essentially of from 0.1% to 10% by weight of a surface-active tertiary amine derivative of the formula:

$$R_1R_2R_3N$$

wherein R_1 is an alkyl group of from 8 to 30 carbon atoms, or an alkyl benzyl group having from 6 to 20 carbon atoms in the alkyl group; R_2 is a group defined as R_1 or as R_3 or is an alkyl of from 1 to 7 carbon atoms; and R_3 is a group

$$-(C_2H_4O)_n(C_2H_4NH)_mH$$

wherein n is 0 to 30, m is 0 to 30 and n or m must be at least 1, which in cationic form is substantive to hard surfaces and in zwitterionic or nonionic form is non-substantive to hard surfaces, said surface-active tertiary amine derivative having a pKa value in the range from 4 to 8; together with one or more pH buffering compounds selected from the group consisting of water soluble phosphates, borates, citrates, tartrates, the corresponding acids and mixtures thereof such that the pH of the composition or an aqueous solution of the composition which contains 0.1% of the surface-active agent by weight is below its pKa value.

2. A method of facilitating the cleaning of hard surfaces which comprises applying a cationic and substantive surface-active agent to a hard surface by treating the surface with an aqueous solution of the composition of claim 1, and, thereafter, removing the cationic and substantive surface-active agent along with soil deposited on the surface, if any, by converting the surface-active agent at least in part to a non-substantive and non-cationic form.

3. The composition of claim 1, wherein each of R_2 and R_3 is a group $-(C_2H_4O)_n(C_2H_4NH)_mH$ such that the total number of (C_2H_4O) groups is from 3 to 6 and the total number of (C_2H_4NH) groups is from 3 to 6.

4. The composition of claim 1 wherein R_3 either n or m is zero, and the other is within the range from 1 to 30.

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