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CLEANING COMPOSITIONS

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No Drawing. Filed May 22, 1957, Ser. No. 660,770

15 Claims. (Cl. 106—3)

This invention relates to cleaning compositions and, more particularly, to an improved liquid cleaning composition for removing dirt and grit from a surface. The liquid cleaning compositions of the invention are particularly suitable for cleaning and polishing glass, such as windows and mirrors, tile, porcelain, metal, painted and unpainted woodwork, and enameled surfaces.

Most liquid cleansers in common use may conveniently be classified into one of nine basic categories. In the approximate order of their complexity, these nine basic categories of liquid cleansers include (i) water, (ii) water and a base, (iii) water and an acid, (iv) water and a solvent, (v) water and a detergent, (vi) water, a base and a detergent, (vii) water, an acid and a detergent, (viii) water, a solvent and a detergent, and (ix) water, a base, a solvent and a detergent. Liquid cleansers in the first four categories are usually termed "non-residual" cleaners, since they contain no ingredients which leave a film or residue on a surface cleaned with the liquid. Those liquid cleansers which fall into the last five categories, however, are generally designated as "residual" cleaners, for they usually leave a film or residue on a surface cleaned with the liquid.

In each of these nine basic categories of liquid cleaners, water is a primary component. Indeed, most of the commercially-available liquid cleaners are merely water solutions to which other ingredients have been added to enhance the cleaning and polishing properties of the mixture. Although a plethora of different materials have been tested, at one time or another, for inclusion in cleaning formulations, only three basic additives have found universal acceptance. These additives are alkalies, organic solvents and detergents.

Each of these basic additives performs a definitive function when incorporated in a cleanser. For example, the alkalies have been found to contribute to quick and efficient grease and oil cutting. Many alkalies have been incorporated in liquid cleansers in low concentrations, including tetrasodium pyrophosphate, borax and other mild alkalies. But the base which has been and is employed most frequently in liquid cleansers is ammonium hydroxide, since the cleaning efficiency of ammonia is excellent and it is completely volatile. With the exception of ammonia, all of the alkalies leave some form of residue on a surface (i.e. glass) if allowed to evaporate to dryness, and consequently many manufacturers of liquid cleansers have tended to use ammonium hydroxide as the alkaline component in formulating liquid cleaning compositions.

The definitive functions of an organic solvent in a liquid cleanser are more manifold than those of the alkaline component. Not only do the organic solvents aid in solvating grease and oil, but the presence of an organic solvent in the liquid cleanser materially aids in reducing the surface tension of the liquid cleaner, thereby allowing the cleaner to more readily wet and penetrate soil on a surface. In addition, the inclusion of an organic solvent in the liquid cleanser functions to control the

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rate of evaporation of the liquid. Of the organic solvents which have been proposed for use in liquid cleansers, the water-miscible solvents have found the most extensive application. These include such low-boiling solvents as the alcohols, esters and ethers, as well as such high-boiling solvents as the glycols and glycol ethers.

The function of a detergent or surfactant in a liquid cleaning composition is to improve the wetting and penetrating properties of the cleanser. Virtually none of the surfactants are volatile, however, and as a result liquid cleansers containing a surfactant invariably deposit a small amount of residue on a surface. The superior wetting and cleaning properties which attend the use of a detergent in a liquid cleanser more than offset this disadvantage to their use.

Thus, those liquid cleansers which are termed "residual" cleaners, or are classified within one of the last five of the above-mentioned categories of liquid cleansers, all contain a surfactant which improves the wetting and cleaning properties of the composition but results in the formation of a residual film on a surface cleaned with the composition. In the dry state, this film is not visible with normal illumination. The film usually bears an electrostatic charge, however, and thus has a tendency to collect dust from the air. This dust, of course, becomes visible in any light when it collects on the surface. With any liquid cleaner, therefore, it is desirable that the cleaned surface not only appear to be soil-free immediately after use, but show no dust or dirt a day or so later.

Following an exhaustive investigation of the relative cleaning and polishing properties of the nine basic categories of liquid cleansers, I have found that each of these cleansers may be improved substantially by incorporating in the composition a dimethylpolysiloxane oil (or silicone fluid as the polymer is often termed). In the case of a liquid cleanser containing water, a solvent and a surfactant, the addition of a small amount of the dimethylpolysiloxane to the cleanser results in cleaning composition which is markedly superior in cleaning and polishing properties than any commercial cleanser presently available. When a volatile base, such as ammonium hydroxide, is also incorporated in the composition together with the silicone fluid, the cleaning properties of the resultant product are even further enhanced. The dimethylsiloxane polymer may be added directly to the composition, in which case the mixture must then be emulsified. Alternatively, the silicone polymer may be added to the cleanser in the form of an oil-in-water emulsion, in which form the entire mixture need only be vigorously stirred to form the liquid cleaning composition of the invention.

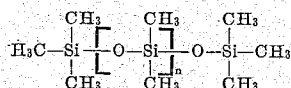
Although the cleaning and polishing properties of any two of the basic categories of liquid cleansers are, at best, only qualitatively discernible, the use of a dimethylpolysiloxane oil in the composition results in an immediately noticeable improvement in the composition. This improvement is manifested by an improved ease of wipe-off, soil removal and ease of cleaning. The dimethylsiloxane polymers which I have used in the liquid compositions of the invention have low surface tensions and thereby enhance the wetting, adherence and spread of the cleaning composition on glass, wood and metal surfaces. These polymers also impart a high glossy polish to the treated surfaces by depositing a monomolecular film on the surface. This film causes the treated surface to become smooth, slippery and electrostatically inert, thereby preventing the collection of dust, oil, grime and other soils on the surface.

Based on these discoveries, the invention provides an improved liquid cleaning composition which comprises an oil-in-water emulsion containing from 0.1 to 5 percent by weight of dimethylpolysiloxane oil having a vis-

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cosity of from 200 to 350 centistokes at 25° C., from 0.5 to 50 percent by weight of a water-miscible organic solvent for the dimethylpolysiloxane oil, from 0.01 to 1 percent by weight of a water-soluble synthetic surfactant selected from the group consisting of nonionic surfactants and anionic surfactants, and the balance water. From 0.1 to 5 percent by weight of a volatile base may also be used in the emulsion, in which case the amount of water is correspondingly decreased. I have found that in all instances the combined use of the dimethylpolysiloxane, the surfactant and the organic solvent exerts a synergistic effect on the cleaning and polishing properties of the composition as compared with the use of either ingredient alone or of any two ingredients together.

The dimethylpolysiloxane oils, which may be used in preparing the liquid cleaning composition of the invention, are usually represented by the following formula



in which n is an integer. Even though the terminal methyl groups may be replaced or substituted with other organic (i.e. ethyl or phenyl) or inorganic groups, the polymers are generically known as "dimethylpolysiloxanes." These silicone oils are high molecular weight polymers whose viscosity varies directly with molecular weight. Although silicone fluids having viscosities from 40 to 1000 centistokes (at 25° C.) have been used successfully in preparing the cleaning compositions, I have found that when dimethylpolysiloxane oils having a viscosity, at room temperature, of from 200 to 350 centistokes are used in the cleaning composition, the resultant product is far superior in cleaning and polishing properties than any commercially-available preparations tested for comparison. These dimethylpolysiloxane oils are heat stable and unaffected by heat and sunlight. The silicone oils are insoluble in water, but may be dispersed in an aqueous solution. In preparing the liquid cleaning compositions of the invention, the dimethylpolysiloxane oil may be dispersed in water, using vigorous agitation, and then the other ingredients added. Alternatively, an oil-in-water emulsion of the dimethylpolysiloxane oil (which is commercially available) may be diluted with water and the remaining ingredients added with stirring. In any event, the final concentration of dimethylpolysiloxane oil in the cleaning composition will be equivalent to from 0.1 to 5 percent by weight.

The dimethylpolysiloxane oils are employed in the liquid cleaning compositions with an organic solvent. My experiments indicate that any water-miscible organic solvent effectively cooperates to some degree with the silicone oils for improving the polishing and cleaning properties of the composition, though some solvents are more effective than others. The prime requisites for any solvent which may be employed in the liquid cleaning composition are (1) that they be water-miscible, and (2) that they are compatible with the other ingredients in the formulation. Of the many solvents tested, I have obtained particularly satisfactory results in using those lower alkanols which have a boiling point below 100° C., in particular isopropanol. In place of or in addition to these low-boiling solvents, an unusually large number of high-boiling organic solvents may be successfully used in the cleanser provided that these high-boiling solvents are water-miscible and compatible with the other ingredients in the formulation. The glycol and glycol ethers in particular have been used successfully in compounding the liquid cleaning compositions in accordance with the invention. These glycols and glycol ethers have a boiling point above 100° C., and include such compounds as hexylene glycol, 2-ethoxyethanol, 2-methoxyethanol, diethylene glycol monomethyl ether, dieth-

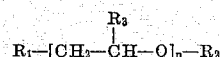
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ylene glycol monomethyl ether and diethylene glycol monobutyl ether.

In addition to dissolving greasy and oily soils, the water-miscible organic solvent contained in the liquid cleaning composition also acts to control the rate of evaporation of the mixture. By properly choosing a solvent or solvent-pair, the evaporation rate is controlled so that a large surface area may be cleaned without rapid evaporation of the cleanser. Depending upon the particular solvent employed, the concentration of water-miscible organic solvent in the emulsified cleaning composition will generally be between 0.5 to 50 percent by weight. When a volatile solvent such as a lower alkanol, is employed in the composition, I generally prefer to use from 1 to 35 percent by weight. In the case of a high-boiling solvent, the preferred concentration is from 0.5 to 15 percent by weight. When both a volatile solvent and a high-boiling solvent are used to prepare the cleaning compositions, my experience indicates that a very low rate of evaporation may be achieved by using both solvents in a ratio of 5 to 1 (volatile to high boiling). All of the solvents used have a low surface tension and as a result synergistically cooperate with the water, surfactant and dimethylpolysiloxane in the cleaning, wetting and soil removal.

Selection of a synthetic surfactant for inclusion in the cleaning composition is limited to water-soluble nonionic surfactants and anionic surfactants. These compounds not only contribute to the rapid spreading of the cleaning composition on a surface, but also impart lubricity and improved wipe-off to the product. Although these surfactants have been used over a wide range of concentrations, they are preferably employed in an amount in the range from 0.01 to 1 percent by weight. A higher concentration would tend to leave an excessive amount of residue on a treated surface, and in most cleaning compositions substantially the full benefit of its presence is achieved with 0.03 percent by weight or even less.

While any water-soluble nonionic surfactant may be employed in the cleaning composition in accordance with the invention I have obtained particularly satisfactory results using the water-soluble polyoxy surfactants. Compounds from among this group which have been found to be very satisfactory are those which have the formula



in which R_1 is a substituent selected from the group consisting of hydroxy, alkoxy, phenoxy, alkylphenoxy, alkylcarboxy, benzoxy, alkylbenzoxy, alkylcarboxamido, polyoxyethylethoxy, and polyoxypropylpropoxy radicals, R_2 is a substituent selected from the group consisting of hydrogen, alkyl, phenyl, alkylphenyl, alkoyl, benzoyl, alkylbenzoyl, hydroxyethylpolyoxyethyl, and hydroxypropylpolyoxypropyl radicals, R_3 is a substituent selected from the group consisting of hydrogen and methyl radicals, and n is an integer. Typical nonionic surfactants of this type include isoctylphenoxypolyoxyethylene glycol (e.g. Triton X-100), nonylphenoxypolyoxyethylene glycol (e.g. Neutronyx 600 and Antarox A-400), octadecanoxypolyoxyethylene glycol (e.g. Emulfor ON), octylphenoxypolyoxyethylene glycol (e.g. Tergitol NTX), and lauroxypolyoxyethylene glycol (e.g. Tergitol TNM). Other nonionic surfactants which may be successfully employed are N-hydroxyethyl lauramide (e.g. Ninol AB-21) and N,N-di(hydroxyethyl) lauramide (e.g. Onyxol 336 or Stepanol LDA).

The anionic surfactants may be used in the cleaning compositions in place of or in addition to the nonionic surfactants. As a general rule, the anionic surfactants leave more residue on a surface treated with the liquid cleanser. Nonetheless, various water-soluble anionic surfactants have been used with notable success in the

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cleaning compositions of the invention, and include such compounds as the fatty alkanol sulfates, sulfonated amides and ester derivatives, sulfonated aliphatic polyesters, sulfonated aromatic and alkyl-aryl sulfonate derivatives, such as the ethyl sulfonate esters of oleic acid and petroleum sulfonates having ten to twenty carbon atoms.

When a base is employed in the cleaning composition, in addition to the silicone oil, solvents and surfactants, the resultant formulation has excellent cleaning properties. In such case, the amount of base which may be used is from 0.1 to 5 percent by weight, with correspondingly less water required. Although many alkaline compounds have been tested, I prefer to employ ammonium hydroxide since it is completely volatile and leaves no residue after evaporating to dryness. Other volatile bases may be used, including the mono-, di- and triethanolamines. These latter compounds are water-miscible and effectively dissolve grease and oil. In addition, they act as corrosion inhibitors when the liquid cleaning composition is stored in an unlined metal container or in a glass container having a metal cap.

To prepare the liquid cleaning compositions of the invention, an aqueous dispersion of the dimethylpolysiloxane is initially prepared. As indicated previously, this dispersion may be formed by diluting an oil-in-water emulsion of the dimethylpolysiloxane oil, or by mixing the silicone oil with water in emulsifying apparatus. After the dispersion has been formed, the remaining ingredients (surfactant, solvents and a base) are added with stirring. The resultant product is a stable oil-in-water emulsion, which is resistant to cleaning and oil separation in both concentrated and dilute solutions. If mild creaming occurs, a uniform dispersion may be readily restored by mild agitation or shaking without affecting the cleaning or polishing properties of the composition.

The following examples are illustrative of the cleaning compositions prepared in accordance with this invention:

Example I

Using a beaker equipped with a high speed agitator, a dilute aqueous silicone dispersion was prepared by slowly adding 89.5 g. of water, with vigorous stirring, to 1 g. of an oil-in-water emulsion of a dimethylsiloxane polymer. The emulsion used to prepare the dispersion is commercially available under the trade name "G-E Silicone Emulsion SM-55" and contains 36 to 38 percent by weight of a dimethylpolysiloxane polymer having a viscosity, at 25° C., of from 200 to 350 centistokes.

Preparation of the cleaning composition was accomplished by adding to the aqueous silicone dispersion, with stirring, 7.5 g. of isopropanol, 0.5 g. of 28% ammonium hydroxide, 1.5 g. of 2-methylpentanediol-2,4 (hexylene glycol), and 0.033 g. of a nonylphenoxypolyoxyethylene glycol (e.g. "Antarox A-400," which is manufactured by General Aniline & Film Corp.). To obtain a product having a uniform consistency, the mixture was agitated for about 5 to 15 minutes after the addition of all of the ingredients to the dispersion. The resultant mixture may be used without further processing as liquid cleaner for windows, tile, porcelain, chromium, metal surfaces, painted woodwork, and other surfaces. No matter how the liquid cleaner was applied to a surface, whether by spraying, brushing, or merely wiping, a brilliantly polished appearance was consistently obtained upon wiping the liquid cleaner from the surface.

Example II

A dilute aqueous silicone dispersion was prepared by adding 894.7 g. of water, with stirring, to 10 g. of an oil-in-water emulsion of a dimethylsiloxane polymer. This emulsion is commercially available as "G-E Silicone Emulsion SM-61" and contains from 36 to 38 percent by weight of a dimethylsiloxane polymer having an intrinsic vis-

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cosity, at 25° C., of from 200 to 350 centistokes. The molecular weight of the polymer, as determined from the viscosity, is about 11,000 to 16,000.

To the aqueous silicone dispersion were added, with vigorous stirring, 75 g. of ethanol, 5 g. of 28% ammonium hydroxide, 15 g. of 2-methylpentanediol-2,4, and 0.4 g. of an isooctylphenoxypolyoxyethylene glycol (M.W. ca. 600-1000), such as "Triton X-100." After stirring for an additional 5 minutes to obtain a uniform product, the resultant mixture could be used directly as a liquid cleanser.

Example III

Using the stirring apparatus described in Example I, a dilute aqueous silicone dispersion was prepared by adding 89.47 g. of water, with stirring, to 1 g. of an oil-in-water emulsion of a dimethylsiloxane polymer having a viscosity, at 25° C., of from 200 to 350 centistokes. This emulsion is commercially available under the trade name "G-E Silicone Emulsion SM-33" and contains 36 to 38 percent by weight of the polydimethylsiloxane. The emulsion differs from those products designated as SM-61 and SM-55 chiefly in the particular emulsifying agents used to maintain the dimethylsiloxane polymer emulsified in the water phase.

The liquid cleaning product was prepared by adding to the aqueous silicone dispersion, with vigorous agitation, 7.5 g. of isopropanol, 0.5 g. of 28% ammonium hydroxide, 1.5 g. of 2-methylpentanediol-2,4, and 0.033 g. of a nonylphenoxypolyoxyethylene glycol (e.g. "Neutronyx 600," manufactured by the Onyx Oil & Chemical Co.). Following the addition of all the ingredients, the mixture was agitated for an additional 5 minutes to obtain a product of uniform consistency. The resultant product could be used directly as a liquid cleanser.

Example IV

A dilute aqueous silicone dispersion was prepared by mixing 1.5 g. of a 200 centistoke dimethylpolysiloxane fluid in 899.67 g. of water, using high speed agitation. The polymer is available under the trade name "Dow Corning 200 Fluids" and has a molecular weight of approximately 11,300 [cf. M. J. Hunter et al., J. Am. Chem. Soc., 68, 2284 (1946)].

To this aqueous silicone dispersion was added, with mixing, 75 g. of ethanol, 5 g. of 28% ammonium hydroxide, 15 g. of diethylene glycol monomethyl ether (methyl "carbitol"), and 0.33 g. of a lauroxypolyoxyethylene glycol (M.W. ca. 600-1000). Following the addition of all of the ingredients, the mixture was stirred for about 10 minutes to obtain a product of uniform consistency. The resultant product was a clear liquid and could be used directly as a liquid cleanser.

Example V

Using a vessel equipped with high speed agitator, a dilute aqueous silicone dispersion was prepared by slowly adding 899.67 g. of water, with vigorous stirring, to 5 g. of an oil-in-water emulsion of a dimethylsiloxane polymer. The emulsion used to prepare the dispersion is commercially available under the trade name "Dow Corning 200 Fluids" and contains about 40 percent by weight of a 350 centistoke dimethylsiloxane polymer (M.W. ca. 15,800).

The cleaning composition was prepared by adding to the aqueous silicone dispersion, with vigorous stirring, 75 g. of isopropanol, 5 g. of triethanolamine, 15 g. diethylene glycol monobutyl ether (butyl "carbitol"), and 0.33 g. of an octadecanoxypolyoxyethylene glycol (e.g. Emulfor ON). The resultant product showed excellent cleaning properties when applied to soiled windows.

Example VI

By adding 8996.7 g. of water, with vigorous stirring, to 50 g. of an oil-in-water emulsion of a dimethylsiloxane polymer ("G-E Silicone Emulsion SM-61"), a dilute aqueous silicone dispersion was readily prepared. To this

dispersion was added, while continuing rapid agitation, 750 g. of isopropanol, 50 g. of 28% ammonium hydroxide, 150 g. of 2-methylpentanediol-2,4, and 3.3 g. of a nonylphenoxypolyoxyethylene glycol (M.W. ca. 600-1000). Following the addition of all the ingredients, the mixture was agitated for an additional 15 minutes to obtain a homogeneous product. The resultant product was a clear liquid having remarkable cleaning properties when sprayed over a soiled surface.

Cleaning compositions prepared in an identical manner, except that G-E Silicone Emulsion SM-55 or SM-33 were substituted for SM-61, were also found to possess excellent cleaning properties. Both of these silicone emulsions, SM-55 and SM-61, employ a dimethylsiloxane polymer having a viscosity of from 200 to 350 centistokes at 25° C. These siloxane emulsions differ chiefly in the emulsifying agents used to maintain the dimethylsiloxane polymer emulsified throughout the water phase.

Example VII

Using a dilute aqueous silicone dispersion, prepared by vigorously mixing 2 g. of an oil-in-water emulsion of a dimethylsiloxane polymer (G-E SM-55) with 88.47 g. of water, a liquid cleanser was obtained by adding to the aqueous silicone dispersion 7.5 g. of ethanol, 0.5 g. of monoethanolamine, 1.5 g. of 2-methylpentanediol-2,4, and 0.033 g. of a nonylphenoxypolyoxyethylene glycol (M.W. ca. 1200). After all of the ingredients had been incorporated in the aqueous silicone dispersion, the mixture was stirred for about 15 minutes to obtain an oil-in-water emulsion of uniform consistency. The resultant emulsion was a clear liquid which could be used directly as a liquid cleanser.

Example VIII

To illustrate the preparation of a cleaning composition containing larger amounts of the dimethylpolysiloxane, a concentrate was prepared by emulsifying in a colloid mill a mixture containing 5 g. of a 200 centistoke dimethylsiloxane fluid, 35 g. of isopropanol, 5 g. of triethanolamine, and 15 g. of ethylene glycol monoethyl ether ("carbitol"). By merely diluting the emulsified concentrate with water in the ratio of 1:10, a liquid cleaning product was obtained. The emulsified concentrate could be stored for long periods without separation, was easily dispersed in water to form the liquid cleaning product.

Example IX

An unusually large number of nonionic surfactants may be employed in the cleaning compositions. The nonionic alkanolamides of fatty acids, in particular, have been found to be especially suitable. Using a dilute aqueous silicone dispersion, obtained by vigorously mixing 1 g. of an oil-in-water emulsion of a dimethylpolysiloxane (e.g. G-E Silicone Emulsion SM-33) with 89.47 g. of water, a liquid cleanser was prepared by adding to the silicone dispersion 7.5 g. of isopropanol, 5 g. of diethanolamine, 1.5 g. of ethylene glycol monomethyl ether, and 0.033 g. of a monoethanolamide of a fatty acid (e.g. Ninol AB21, available from the Ninol Laboratories). Following the addition of all of the components to the silicone dispersions, the mixture was agitated with a high speed stirrer for about 15 minutes to obtain a uniform oil-in-water emulsion. The resultant liquid remained clear and stable after prolonged storage, and possessed excellent cleansing properties.

Liquid cleaning compositions prepared in an identical manner, except that 0.033 g. of the N,N-diethanolamide of lauric acid (e.g. Stepanol LDA, manufactured by the Stepan Chemical Company) was substituted for the monoethanolamide, were also found to exhibit excellent cleaning properties.

Example X

Small amounts of anionic surfactants may also be employed in the cleaning compositions of the invention in

addition to or in place of the nonionic surfactants. By way of illustration, a dilute aqueous silicone dispersion was prepared by separately adding 894.67 g. of water, with vigorous stirring, to 10 g. of an oil-in-water emulsion of a dimethylpolysiloxane (G-E Silicone Emulsion SM-33). To this silicone dispersion was added, with stirring, a mixture containing 75 g. of isopropanol, 5 g. of 28% ammonium hydroxide, 15 g. of ethylene glycol monobutyl ether, and 1 g. of dioctyl sodium sulfosuccinate ("Aerosol OT"). The mixture was agitated for approximately 5 minutes to obtain a uniform product. The resultant product although an oil-in-water emulsion, was a clear liquid which could be used directly as a liquid cleanser. Various other anionic surfactants, such as sodium alkyl naphthalenesulfonates (Nekal NS), may be interchangeably used in place of the dioctyl sodium sulfosuccinate in preparing the liquid cleaning compositions of the invention.

Example XI

In some instances, the low boiling solvent may be completely dispensed with in preparing the cleaning compositions of the invention. In such cases, the amount of water is proportionally increased. To illustrate the preparation of liquid cleanser containing no low boiling solvent, a dilute aqueous silicone dispersion was prepared by adding 969.7 g. of water, with stirring, to 10 g. of an oil-in-water emulsion of a dimethylpolysiloxane (G-E Silicone Emulsion SM-61). The liquid cleaning composition was then prepared by adding to the silicone dispersion, with mixing, 5 g. of monoethanolamine, 15 g. of ethylene glycol monomethyl ether, and 1 g. of dioctyl sodium sulfosuccinate. The mixture was agitated with a high speed stirrer for 15 minutes following the addition of all of the components to the silicone dispersion. The resultant emulsion, which was uniform in consistency, possessed excellent cleaning properties.

Example XII

The cleaning compositions of the invention may even be prepared without use of a base. By eliminating the use of a base in the formulation, the pH of the composition is correspondingly lowered from about 8 to 11 to about 7 to 7.5. Using a dilute aqueous silicone dispersion, obtained by vigorously mixing 900 g. of water with 10 g. of an oil-in-water dimethylpolysiloxane emulsion (G-E Silicon Emulsion SM-55), a liquid cleanser was prepared by adding to the silicone dispersion 75 g. of isopropanol, 15 g. of 2-methylpentanediol-2,4, and 1 g. of dioctyl sodium sulfosuccinate. After stirring the mixture for about 5 minutes, to obtain uniform consistency, the resultant product could be used directly as a liquid cleanser.

The cleaning and polishing properties of the liquid cleaning compositions of the invention are markedly superior to all commercially available window cleaning preparations which were tested for comparison. Normally, the differences in cleaning properties between the various commercial window cleaning compositions are, at best, only qualitatively discernible. But even when qualitatively compared, the liquid cleaning compositions of the invention were found to possess a higher degree of cleansing ability and leave less residue on a surface than all commercial preparations tested for comparison. In addition, the liquid cleaning compositions of the invention were found to impart a more highly polished gloss to a surface than that obtained by using one of the commercial preparations tested for polishing properties. After a window has been cleaned with a standard commercial window cleaner, there is a noticeable drag on wiping the window with a dry cloth; no comparable drag was experienced, however, upon using the liquid cleaning composition of the invention.

In cleaning such surfaces as tile, porcelain, metal surfaces, painted woodwork, windows and other surfaces with the liquid cleaning composition of the invention, a

monomolecular film of the dimethylpolysiloxane is deposited on the surface, which on normal rubbing results in a glossy and highly polished appearance. This silicone film in no way impairs the cleaning properties and ease of wipe-off of the product, but rather appears to synergistically co-operate with the other ingredients contained in the liquid composition. Windows cleaned with these liquid cleaning compositions show less tendency to pick up grease, dirt, and dust and, as a result, remain clean for a long period of time.

This application is a continuation-in-part of my co-pending application, Serial No. 375,572, filed August 20, 1953, now abandoned.

I claim:

1. A liquid cleaning composition for removing dirt and grit from a surface consisting essentially of an oil-in-water emulsion consisting essentially of from 0.1 to 5 percent by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25° C., from 0.5 to 50 percent by weight of a water-miscible organic solvent for the dimethylpolysiloxane oil, said organic solvent being compatible with the other ingredients of the emulsion, from 0.01 to 1 percent by weight of a water-soluble synthetic surfactant selected from the group consisting of nonionic surfactants and anionic surfactants, and the balance water.

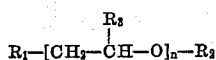
2. A liquid cleaning composition for removing dirt and grit from a surface consisting essentially of an oil-in-water emulsion consisting essentially of from 0.1 to 5 percent by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25° C., from 0.5 to 50 percent by weight of a water-miscible organic solvent for the dimethylpolysiloxane oil, said organic solvent being compatible with the other ingredients of the emulsion, from 0.01 to 1 percent by weight of a water-soluble synthetic surfactant selected from the group consisting of nonionic surfactants and anionic surfactants, from 0.1 to 5 percent by weight of a volatile base selected from the group consisting of ammonium hydroxide, monoethanolamine, diethanolamine, and triethanolamine, and the balance water, said emulsion having a pH of from 7 to 11.

3. A liquid cleaning composition for removing dirt and grit from a surface consisting essentially of an oil-in-water emulsion consisting essentially of from 0.1 to 5 percent by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25° C., from 1 to 35 percent by weight of a water-miscible volatile organic solvent for the dimethylpolysiloxane oil, from 0.5 to 15 percent by weight of a water-miscible high-boiling organic solvent, both of said organic solvents being compatible with the other ingredients of the emulsion, from 0.01 to 1 percent by weight of a water-soluble synthetic surfactant selected from the group consisting of nonionic surfactants and anionic surfactants, from 0.1 to 5 percent by weight of a volatile base selected from the group consisting of ammonium hydroxide, monoethanolamine, diethanolamine, and triethanolamine, and the balance water, said emulsion having a pH of from 7 to 11.

4. A liquid cleaning composition according to claim 3, wherein the water-miscible volatile organic solvent is a lower alkanol having a boiling point below 100° C.

5. A liquid cleaning composition according to claim 3, wherein the water-miscible high-boiling organic solvent is an oxygen-containing compound selected from the group consisting of glycols and glycol ethers having a boiling point above 100° C.

6. A liquid cleaning composition according to claim 3, wherein the water-soluble synthetic surfactant is a non-ionic polyoxy surfactant having a structure represented by the formula



in which R₁ is a substituent selected from the group con-

sisting of hydroxy, alkoxy, phenoxy, alkylphenoxy, alkylcarboxy, benzoxy, alkylbenzoxy, alkylcarboxamido, polyoxyethlethoxy, and polyoxypropylpropoxy radicals, R₂ is a substituent selected from the group consisting of hydrogen, alkyl, phenyl, alkylphenyl, alkoyl, benzoyl, alkylbenzoyl, hydroxyethylpolyoxyethyl, and hydroxypropylpolyoxypropyl radicals, R₃ is a substituent selected from the group consisting of hydrogen and methyl radicals, and n is an integer.

7. A liquid cleaning composition according to claim 3, wherein the water-soluble synthetic surfactant is an anionic surfactant.

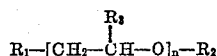
8. A liquid cleaning composition according to claim 3, wherein the volatile base is ammonium hydroxide.

9. A liquid cleaning composition consisting essentially of an oil-in-water emulsion consisting essentially of from 0.1 to 5 percent by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25° C., from 1 to 35 percent by weight of a water-miscible lower alkanol having a boiling point below 100° C., from 0.5 to 15 percent by weight of a water-miscible oxygen-containing organic solvent selected from the group consisting of glycols and glycol ethers having a boiling point above 100° C., both the lower alkanol and the oxygen-containing organic solvent being compatible with the other ingredients of the emulsion, from 0.01 to 1 percent by weight of a water-soluble synthetic surfactant selected from the group consisting of nonionic surfactants and anionic surfactants, from 0.1 to 5 percent by weight of a volatile base, and the balance water, said emulsion having a pH from 7 to 11.

10. A liquid cleaning composition according to claim 9, wherein the lower alkanol is isopropanol.

11. A liquid cleaning composition according to claim 9, wherein the water-miscible oxygen-containing organic solvent is 2-methylpentanediol-2,4.

12. A liquid cleaning composition according to claim 9, wherein the water-soluble synthetic surfactant is a nonionic polyoxy surfactant having a structure represented by the formula



in which R₁ is a substituent selected from the group consisting of hydroxy, alkoxy, phenoxy, alkylphenoxy, alkylcarboxy, benzoxy, alkylbenzoxy, alkylcarboxamido, polyoxyethlethoxy, and polyoxypropylpropoxy radicals, R₂ is a substituent selected from the group consisting of hydrogen, alkyl, phenyl, alkylphenyl, alkoyl, benzoyl, alkylbenzoyl, hydroxyethylpolyoxyethyl, and hydroxypropylpolyoxypropyl radicals, R₃ is a substituent selected from the group consisting of hydrogen and methyl radicals, and n is an integer.

13. A liquid cleaning composition according to claim 9, wherein the water-soluble synthetic surfactant is an alkylphenoxypolyoxyethylene glycol.

14. A liquid cleaning composition according to claim 9, wherein the volatile base is ammonium hydroxide.

15. A liquid cleaning composition consisting essentially of an oil-in-water emulsion consisting essentially of from 0.1 to 5 percent by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25° C., from 1 to 35 percent by weight of isopropanol, from 0.5 to 15 percent by weight of 2-methylpentanediol-2,4, from 0.01 to 1 percent by weight of an alkylphenoxypolyoxyethylene glycol, from 0.1 to 5 percent by weight of ammonium hydroxide, and the balance water.

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