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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
C11D 3/48, 3/37, 3/20, A01N 31/14, 25/30, A61K 7/48

A1

(11) International Publication Number: **WO 98/17773**

(43) International Publication Date: 30 April 1998 (30.04.98)

(21) International Application Number: PCT/US97/17701

(22) International Filing Date: 30 September 1997 (30.09.97)

(30) Priority Data:
08/735,425 22 October 1996 (22.10.96) US

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(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD OF INCREASING THE ANTIMICROBIAL ACTIVITY OF AN AQUEOUS, ANTIMICROBIAL LIQUID CLEANING FORMULATION

(57) Abstract

A method of increasing the antimicrobial activity of an aqueous, antimicrobial liquid cleaning formulation. The method includes the step of blending a polymeric deposition aid composed of a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol together with a phenol derivative antimicrobial agent and a surfactant such that the liquid cleaning formulation has at least 10 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid.

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METHOD OF INCREASING THE ANTIMICROBIAL ACTIVITY OF AN AQUEOUS, ANTIMICROBIAL LIQUID CLEANING FORMULATION

FIELD OF THE INVENTION

The present invention relates to a method of enhancing the antimicrobial effectiveness of liquid formulations for personal cleaning.

BACKGROUND

It is well known that certain types of surfactants tend to inhibit desirable antimicrobial activity of some antimicrobial agents derived from phenol. Exemplary phenol derivative antimicrobial agents include, for example, triclosan, phenoxyethanol, chloroxylenol, *o*-phenylphenol and *o*-phenylphenate and the like. Nonionic and cationic surfactants have been identified as having a particularly negative influence on antimicrobial activity. Their activity is stated to be highly dependent on the pH of the system. The effect of some of these surfactants may be so great as to completely eliminate most measurable antimicrobial activity.

In view of this, many aqueous, antimicrobial liquid formulations for personal cleaning contain other surfactants and compounding additives that strive to minimize interfering with antimicrobial activity of phenol derivative antimicrobial agents. However, even these surfactants and compounding additives may cause some reduction in the activity of phenol derivative antimicrobial agents.

Accordingly, there is a need for a simple, inexpensive method of increasing the activity of aqueous, antimicrobial liquid cleaning formulations that contain phenol derivative antimicrobial agents. This need extends to a method of increasing the activity of such aqueous, antimicrobial liquid cleaning formulations containing anionic surfactants and cationic surfactants. This need also extends to such formulations containing predominantly nonionic surfactants and amphoteric surfactants and/or surfactant systems.

SUMMARY OF THE INVENTION

The problems described above are addressed by the present invention which provides a method of increasing the antimicrobial activity of an aqueous, antimicrobial liquid cleaning formulation containing an phenol derivative antimicrobial agent and a surfactant or surfactant system. The method includes the step of blending a polymeric deposition aid composed of a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol together with a phenol derivative antimicrobial agent, and a surfactant or surfactant system such that the liquid cleaning formulation has at least 10 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid. For example, the method of the present invention may increase the antimicrobial activity of an aqueous, antimicrobial liquid cleaning

formulation by at least 20 percent more than the antimicrobial activity than the same formulation without the polymeric deposition aid. The formulation may further include one or more conventional formulating components including, but not limited to, carriers, preservatives, humectents, emollients and combinations thereof. Generally speaking, greater antimicrobial activity may be characterized as a percent decrease in Microbial Colony Number values as determined by techniques such as, for example, R.O.D.A.C. (Replicate Organism Detection And Counting) plate testing.

According to the invention, the polymeric deposition aid is a hydroxy terminated urethane compound having the formula:

formula:

$$H-\left[(O-R')_m-O-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}\right]_n-$$

$$-(O-R')_m-O-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-O-(R'-O)_m-$$

$$-\left[\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-O-(R'-O)_m\right]_{n'}-H$$

wherein ***R*** is selected from an alkylene or alkenylene radical containing from one to about 20 carbon atoms, a cycloalkylene or cycloalkenylene radical containing from about 5 to about 10 carbon atoms, a mononuclear or fused ring arylene radical containing from about 6 to about 10 carbon atoms, unsubstituted or substituted with one or more lower alkyl, lower alkoxy, nitro or amino groups or halogen atoms, wherein ***R'*** is the same or different alkylene or alkenylene radical, wherein ***m*** is an integer selected to provide an (O-R') moiety having molecular weight of from about 40 to about 6000, and

wherein ***n*** and ***n'*** are the same or different integers of from 0 to about 30 inclusive, correlated with ***m*** so as to provide a hydroxy-terminated urethane compound having a molecular weight of up to about 200,000.

Desirably, ***m*** will have a value of 8 and ***n*** and ***n'*** will have a value of 1 to 4 predominately. It is also desirable that the values of ***m***, ***n*** and ***n'*** be correlated so as to provide a hydroxy-terminated urethane compound having a molecular weight of about 1,800.

In an embodiment of the invention, the polymeric deposition aid may be poly(oxy-1,2-ethanediyl),α-hydro-ω-hydroxy-, polymer with 1,1'-methylene-bis-(4,isocyanatocyclohexane).

The phenol derivative antimicrobial agent may be selected from 2,4,4'-trichloro-2'-hydroxy diphenyl ether (also referred to as triclosan), phenoxyethanol, chloroxylenol, *o*-phenylphenol and *o*-phenylphenate). Desirably, the phenol derivative antimicrobial agent is 2,4,4'-trichloro-2'-hydroxy diphenyl ether.

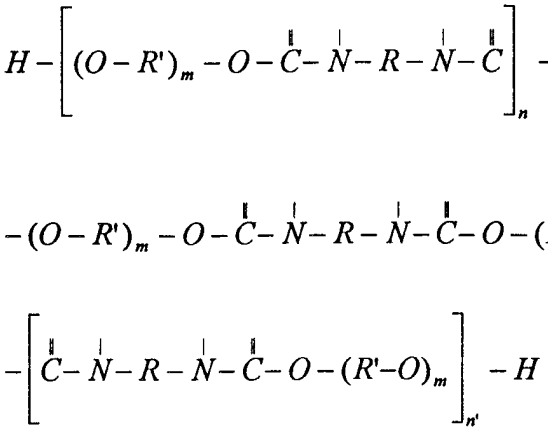
According to the invention, at least one surfactant or surfactant system is combined with the other components. The surfactant or surfactant system may be composed of one or more anionic surfactants, cationic surfactants, nonionic surfactants and/or amphoteric surfactants. At least one other conventional formulating component may be combined with the polymeric deposition aid, phenol derivative antimicrobial agent and surfactant. One or more conventional formulating components may be selected from carriers, preservatives, humectants, emollients and combinations thereof.

DETAILED DESCRIPTION

The present invention which provides a method of increasing the antimicrobial activity of an aqueous, antimicrobial liquid cleaning formulation containing an phenol derivative antimicrobial agent and a surfactant or surfactant system.

The method of the present invention includes the step of blending a polymeric deposition aid composed of a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol together with a phenol derivative antimicrobial agent, a surfactant or surfactant system, and at least one other formulating component such that the liquid cleaning formulation has at least 10 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid.

The polymeric deposition aid is a hydroxy terminated urethane compound having the general formula:



wherein ***R*** is selected from an alkylene or alkenylene radical containing from one to about 20 carbon atoms, a cycloalkylene or cycloalkenylene radical containing from about 5 to about 10 carbon atoms, a mononuclear or fused ring arylene radical containing from about 6 to about 10 carbon atoms, unsubstituted or substituted with one or more lower alkyl, lower alkoxy, nitro or amino groups or halogen atoms, wherein ***R'*** is the same or different alkylene or alkenylene radical, wherein ***m*** is an integer selected to provide an (O-R') moiety having molecular weight of from about 40 to about 6000, and

wherein ***n*** and ***n'*** are the same or different integers of from 0 to about 30 inclusive, correlated with ***m*** so as to provide a hydroxy-terminated urethane compound having a molecular weight of up to about 200,000. Exemplary polymeric deposition aids of this type are generally described in U.S. Patent No. 5,051,260, issued September 24, 1991, to Chess et al.; U.S. Patent No. 5,045,317, issued September 3, 1991,to Chess et al.; and U.S. Patent No. 4,97,080, issued November 20, 1990, to Chess et al.; all of which are incorporated herein by reference.

Desirably, ***m*** will have a value of 8 and ***n*** and ***n'*** will have a value of 1 to 4 predominately. It is also desirable that the values of ***m***, ***n*** and ***n'*** be correlated so as to provide a hydroxy-terminated urethane compound having a molecular weight of about 1,800.

An exemplary polymeric deposition aid is Topicare® Delivery Compound PP-15 (Polyolprepolymer-15) made by Penederm, Inc., Foster City, California. Polyolprepolymer-15 is a mixture of liquid, hydroxyl-terminated polymers in polyethylene glycol. The CAS name is poly(oxy-1,2-ethanediyl),α-hydro-ω-hydroxy-, polymer with 1,1'-methylene-bis-(4,isocyanatocyclohexane). The CTFA name is PEG-8/SMDI Copolymer.

The polymeric deposition aid should be miscible or soluble in water. Although the inventors should not be held to any particular theory of operation, miscibility of the polymeric

deposition aid in water is important for the aqueous, antimicrobial liquid cleaning formulations of the present invention to function properly.

Solubility information for Polyolprepolymer-15 (PP-15) provided by Penederm Inc., is listed in Table 1.

TABLE 1

SOLVENT	PERCENT SOLUBILITY (% w/w)
Water	soluble[1]
Alcohol (95%SDA 40-2)	50
Isopropyl Alcohol	50
Propylene Glycol	50
PEG 300	50
Polysorbate 20	50
Miglyol 812	insoluble
Silicone (Dimethicone)	insoluble
Mineral Oil	insoluble
Ethoxydiglycol	50
Glycerine	dispersible[2]

1 - PP-15 shows increasing aqueous solubility as temperature decreases.
2 - When a level of 1.0% or less of PP-15 was added to Glycerine, tiny droplets were observed under the microscope.

The phenol derivative antimicrobial agent may be selected from 2,4,4'-trichloro-2'-hydroxy diphenyl ether (also referred to as triclosan), 3,4,4'-trichlorocarbanilide (also referred to as triclocarban), phenoxyethanol, chloroxylenol, *o*-phenylphenol and *o*-phenylphenate). The method of the present invention has been found to work well when the phenol derivative antimicrobial agent is 2,4,4'-trichloro-2'-hydroxy diphenyl ether. The phenol derivative antimicrobial agent is generally present in an amount ranging from about 0.1% to about 10%, by weight. Desirably, the phenol derivative antimicrobial agent is present in an amount ranging from about 0.1% to about 3%, by weight. More desirably, the phenol derivative antimicrobial agent is present in an amount ranging from about 0.1% to about 1%, by weight.

According to the invention, at least one surfactant or surfactant system is combined with the other components. The surfactant may be an anionic surfactant, cationic surfactant, nonionic surfactant and/or amphoteric surfactant.

Exemplary anionic surfactants include, but are not limited to ethoxylated alkyl sulfates, alkyl glyceryl ether sulfonates, methyl acyl taurates, fatty acyl glycinates, alkyl sulfosuccinates, alpha-sulfonated fatty acids, their salts and/or their esters, alkyl ethoxy carboxylates and mixtures thereof.

Exemplary amphoteric surfactants include, but are not limited to, cocamphocarboxypropionate, cocamphocarboxy propionic acid, cocamphoacetate and cocamphodiacetate. Generally speaking, commercially available amphoteric surfactants of this type are made and sold in the form of electroneutral complexes with, for example, hydroxide counterions or with anionic sulfate or sulfonate surfactants. Suitable commercial products include, but are not limited to, products sold under the trade names of Empigen (Albright & Wilson); Miranol (Rhone-Poulenc); Alkateric (Alkaril Chemicals); Amphoterge (Lonza, Inc.); Monateric (Mona Industries); Rewoteric (Rewo Chemical Group); and Schercotic (Scher Chemicals).

The surfactant systems may be composed of a combination of surfactants. For example, the surfactant systems may be composed of a mixture of one or more anionic surfactants with nonionic, amphoteric and/or betaine surfactants. Various conventional surfactant systems are commercially available and are known to those of skill in the art.

For example, in an embodiment of the invention, at least one nonionic surfactant and/or amphoteric surfactant may be combined with the other components. Of course, a nonionic and/or amphoteric surfactant system may be used. The surfactant/surfactant system is desirably a nonionic surfactant and/or amphoteric surfactant that is mild to the skin and induces significantly less redness and dryness and is less disruptive to the statum corneum. Of course, anionic and/or cationic surfactants may be blended withthe nonionic and/or amphoteric surfactants.

Suitable surfactant systems include Miracare MS-1 (available from Rhone-Poulenc) and Standamox CAW (available from Henkel Corp.). Miracare MS-1 includes PEG 80 sorbitan laurate, sodium trideceth sulfate, PEG 150 distearate and lauroamphodiacetate in a water base. Standamox CAW includes cocamidopropylamine oxide in a water base. It is contemplated that other individual surfactants and/or surfactant systems noted for their mildness may be used.

Other suitable surfactant systems may include components such as, for example, sodium cocoyl isothionate, sodium laureth sulfate, ammonium sulfate, cocamidopropyl betaine, ammonium lauryl sulfate, PEG 80 sorbitan laurate, and/or sodium trideceth sulfate.

One or more other conventional formulating component or components may be combined with the polymeric deposition aid, phenol derivative antimicrobial agent and

surfactant or surfactant system. For example, carriers, preservatives, humectants, solvents and the like may be combined with the conventional formulating components.

Generally speaking, the carrier used for the formulations of the present invention is water. The carrier may include, viscosity modifiers, thickeners, colorants, fragrances and/or buffers and/or pH control agents. For example, an exemplary additive to the carrier is Ucare JR 400 which provides a smooth after-use feel to the skin.

Useful humectants include, for example, glycerine. Humectants are added so the formulation retains moisture in the skin to prevent erythema. Useful preservatives and preservative enhancers include, for example, DMDM Hydantoin and Tetrasodium ETDA.

With respect to the method of the present invention, it is important to be aware of the distinction between aqueous, antimicrobial liquid cleaning formulations used for washing and emulsion compositions used to cleanse, treat or condition skin.

Generally speaking, aqueous, antimicrobial liquid cleaning formulations refer to detergent-based, antibacterial "liquid soaps" used for washing skin (e.g., hand-washing, bathing, showering, or the like). The formulations are typically applied to the skin (with or without water), worked into a lather, and then rinsed off the skin with water. Exemplary detergent-based liquid soaps of this type include Lever 2000® antibacterial liquid soap (Lever Brothers) and Dial® antibacterial liquid soap (Dial Corporation). Frequent, repeated use of these aqueous, antimicrobial liquid cleaning formulations have a tendency to cause erythema and skin irritation.

In contrast, emulsion compositions are generally used to cleanse, treat and/or condition the skin. Such emulsion compositions are oil-in-water emulsions used to deposit certain ingredients on the skin from the oil phase of the oil-in-water emulsion. These oil-in-water emulsions are usually in the form of a cream, lotion or the like. It is generally thought that such oil-in-water emulsions have little or no tendency to cause erythema and skin irritation and, in some cases, are actually used to treat skin irritation.

An exemplary formulation useful in practicing the method of the present invention may originate as a water phase, a surfactant phase, a preservative phase and an active phase that are blended together utilizing conventional mixing techniques to produce the aqueous, antimicrobial liquid cleaning formulation.

The water phase may be composed of sterile, deionized water and may include additives such as for example Ucare JR 400.

The surfactant phase contains one or more nonionic or amphoteric surfactants or surfactant systems. It is contemplated that the surfactant phase may include minor amounts

of cationic or anionic surfactants. The surfactant phase may also contain the polymeric deposition aid. Desirably, the surfactant phase may contain surfactant systems such as, for example, Miracare MS-1, Standamox CAW, and the like.

The preservative phase may contain glycerine and preservatives and preservative enhancers such as, for example, DMDM Hydantoin, Tetrasodium EDTA, and the like.

The active phase contains the phenol derivative antimicrobial agent and may also include additional nonionic surfactant and a fragrance. Desirably, the active phase contains triclosan as the antimicrobial agent. The nonionic surfactant may be Polysorbate 40, NF, available under the trade designation Tween 40 from ICI Specialty Chemicals, Wilmington, Delaware. An exemplary fragrance is Elias Fragrance #16783 available from the Elias Fragrance Company.

Generally speaking, the water phase is heated to about 65°C and the surfactant phase is blended into the water phase with stirring. Next, the preservative phase is blended into the mixture with stirring and then the active phase is added last. The pH is usually adjusted to between 6.5 and 7 using citric acid and the mixture is stirred thoroughly. Exemplary formulations of an embodiment of the invention are given in Table 2.

TABLE 2

Exemplary Formulations

INGREDIENT	Percent Composition (Broad Range)	Percent Composition (Narrower Range)
WATER PHASE		
Deionized water	**20.0 to 75.0**	**25.0 to 35.0**
Ucare JR 400	**0.05 to 0.5**	**0.1 to 0.25**
SURFACTANT PHASE		
Miracare MS-1	**20.0 to 50.0**	**40.0 to 50.0**
Standamox CAW	**2.0 to 10.0**	**4.0 to 6.0**
Topicare PP-15	**0.5 to 5.0**	**1.0 to 3.0**
Amercil 357	**0.0 to 1.0**	**0.0 to 1.0**
PRESERVATIVE PHASE		
Glycerine	**1.0 to 10.0**	**5.0 to 10.0**
DMDM Hydantoin	**0.4 or as needed**	**0.4 or as needed**
Tetrasodium EDTA	**0.1 or as needed**	**0.1 or as needed**
ACTIVE PHASE		
Triclosan	**0.1 to 1.0**	**0.5 to 1.0**
Tween 40	**1.0 to 5.0**	**1.0 to 3.0**
Fragrance	**0.0 to 0.3**	**0.0 to 0.1**

According to the invention, these aqueous, antimicrobial liquid cleaning formulations provides at least about 10 percent greater (e.g., 20 percent greater or more) antimicrobial activity than the same formulation without the polymeric deposition aid.

EXAMPLES

Formulation

The following examples describe aqueous, antimicrobial liquid cleaning formulations. Generally speaking, the ingredients are identified by their chemical name, CFTA name, or in some cases, by their trade names. The ingredients were combined by conventional mixing and/or soap formulating techniques. The specific amounts of ingredients for Examples 1-5 are identified in Table 3.

TABLE 3

Percent Composition

	Example 1	Example 2	Example 3	Example 4	Example 5
WATER PHASE					
Deionized water	**30.2**	**29.2**	**29.2**	**27.2**	**25.2**
Ucare JR 400	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
SURFACTANT PHASE					
Miracare MS-1	**50.0**	**50.0**	**50.0**	**50.0**	**50.0**
Standamox CAW	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
Topicare PP-15	**0.0**	**0.0**	**1.0**	**3.0**	**5.0**
Amercil 357	**0.0**	**1.0**	**0.0**	**0.0**	**0.0**
PRESERVATIVE PHASE					
Glycerine	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
DMDM Hydantoin	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**
Tetrasodium EDTA	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
ACTIVE PHASE					
Triclosan	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Tween 40	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**
Fragrance	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**

The general procedure for combining the ingredients utilized conventional techniques. A water phase was prepared by adding polymer Ucare JR 400 to deionized water at room temperature. Generally speaking, sufficient time was allowed for dispersion of polymer Ucare JR 400 (e.g., about 10 minutes). The water phase was then heated to 65°C.

In three separate vessels the surfactant phase, the preservative phase and the active phase were each pre-mixed. The surfactant phase was prepared by mixing Miracare MS-1 with Standamox CAW and Topicare PP-15. Other optional ingredients such as, for example, Amercil 357 were added to the surfactant phase at this point. Thus, the surfactant phase contained the polymeric delivery aid and the surfactant.

The preservative phase was prepared by combining glycerine with DMDM Hydantoin and Tetrasodium EDTA.

The active phase was prepared by combining triclosan with Tween 40 and a fragrance.

After the water phase reached a temperature of 65°C, the surfactant phase was added to the water phase with slow stirring.

The combined water phase and surfactant phase was maintained at a temperature of 50°C while the preservative phase was added with stirring.

Next, the combined water phase, surfactant phase and preservative phase was maintained at a temperature of 40°C while the active phase with stirring.

The pH of the mixture was checked and adjusted to a pH between 6.5 and 7 with addition of small amounts of a 5% solution of citric acid. The mixture was stirred at a high stirring speed overnight during which time it cooled to room temperature.

Antimicrobial Activity

Aqueous, antimicrobial liquid cleaning formulations were tested to measure their antimicrobial effects. These antimicrobial effects were compared to control formulations and conventional liquid soaps both with and without antimicrobial ingredients.

Antimicrobial effects were measured utilizing R.O.D.A.C. (Replicate Organism Detection and Counting) plates. These plates are 65 x 15 mm dishes specially designed to allow a raised convex surface of culture medium. Lecithin and Polysorbate 80 are incorporated in the culture medium to inactivate residual chemicals on the hands that would interfere with growth of microorganisms in the culture dish.

The three types of culture media are: Trypticase Soy Agar (TSA), MacConkey Agar (MAC), and Sabouraud Dextrose Agar (SDA). Each media contained approximagely 0.7 g.L of lecithin and 5.0 g/L of Polysorbate 80.

The TSA media was used to grow gram positive bacteria that may be present on the thumb The MAC media was used to grow gram negative bacteria that may be present on the middle finger. The SDA media was used to grow yeast and molds that may be present on the palm of the hand.

The procedure was: 1) contact the target area with the specific R.O.D.A.C. media to develop an initial count of the microorganism; 2) wet and wash hands for 1 minute followed by drying with a paper towel; and 3) contact the target area with the specific R.O.D.A.C. media to develop an after-washing count of the microorganism. The percentage decrease was calculated by subtracting the count of step 3 from the count of step 1 and dividing that value by the count of step 1. This procedure was repeated for several test participants and an average value was calculated.

The liquid cleaning formulations of Example 1 and Example 3 were tested along with the following commercially available liquid soaps: Dial® Antibacterial Soap, Lever 2000®, Operating Room Scrub, Sanifresh Soap with 1.25% parachlorometaxylenol (PCMX). Three non-antibacterial soaps were also tested. They were as follows: Softsoap®, Sanifresh Premium, and Eurobath®. The results are reported in Table 4.

TABLE 4

Material Tested	Percent Decrease in Microbial Colony Number (all)	Percent Decrease in Microbial Colony Number (gram negative bacteria only)
Example 3	60	55
Example 1	0	0
Dial® Soap	40	38
Lever 2000®	28	20
O-R Scrub	45	50
Sani-Fresh 1.25%PCMX	50	62
Softsoap®	0	0
Sani-Fresh Premium	0	0
Eurobath®	0	0

The R.O.D.A.C. (Replicate Organism Detection and Counting) plates test described above (with the same data reporting procedure) was used to study the effect of adding a polymeric delivery aid to a conventional liquid antibacterial soap formulation. Dial® Liquid Antibacterial soap was used as the control. The test formulation was Dial® Liquid Antibacterial soap with 3%, by weight, Topicare® Delivery Compound PP-15. The results are reported in Table 5.

TABLE 5

Material Tested	% Kill (Bacteria)	% Kill (Yeast/Mold)
Dial® Soap	55	33
Dial® Soap + 3% PP-15	65	53

The R.O.D.A.C. (Replicate Organism Detection and Counting) plates test described above (but with a different data reporting procedure) was used to study the effect of adding a polymeric delivery aid to a aqueous, antimicrobial liquid cleaning formulation that includes mild surfactants which may decrease antimicrobial activity. The formulation of Example 1 was used as the control. The formulation of Example 3 containing 1.0%, by weight, Topicare® Delivery Compound PP-15 was used as the test. The results are reported in Table 6. The Percent Decrease in Microbial Colony Number values reported in Table 6 were calculated as described above except that negative numbers were zeroed for averaging. This generates a greater percentage decrease for poorer performing formulations that are likely to have microbial growth instead of a decrease. Average values calculated in this manner provide a more conservative comparison of products that perform well (i.e., provide large decreases in microbial growth).

TABLE 6

Organism	Example 1 % Decrease	Example 3 % Decrease
gram (+) bacteria	38	50
gram (-) bacteria	18	39
yeast/mold	16	39

The R.O.D.A.C. (Replicate Organism Detection and Counting) plates test described was compare the antimicrobial activity of commercially Lever 2000® Liquid Antibacterial soap with the formulation of Example 3. The results are reported in Table 7. The Percent Decrease in Microbial Colony Number values reported in Table 7 were calculated as described above with the negative numbers included for averaging.

TABLE 7

Organism	Lever 2000® % Decrease	Example 3 % Decrease
gram (+) bacteria	35	50
gram (-) bacteria	30	39
yeast/mold	34	39

As can be seen from data reported in Tables 5 and 7, the present invention provides a method of increasing the antimicrobial activity of conventional antibacterial soap formulations such as, for example, Dial® Antibacterial liquid soap and Lever 2000® liquid soap. The improvement in the Percent Decrease in Microbial Colony Number by the practice of the method of the present invention may be 10% or more. For example, the improvement may be 20%. In some cases, the improvement may be 40% or even 60% or more.

The data in Tables 4 and 6 indicate the present invention provides a mild, liquid cleaning formulation that also has acceptable levels of antimicrobial activity. Without the addition of the polymeric delivery aid, the mild, liquid cleaning formulation had lower levels of antimicrobial activity. In fact, the data in Table 4 show essentially no measurable antimicrobial activity for the formulation without the polymeric delivery compound.

While the present invention has been described in connection with certain embodiments, it is to be understood that the subject matter encompassed by way of the present invention is not to be limited to those specific embodiments. On the contrary, it is intended for the subject matter of the invention to include all alternatives, modifications and equivalents as can be included within the spirit and scope of the following claims.

WHAT IS CLAIMED IS:

1. A method of increasing the antimicrobial activity of an aqueous, antimicrobial liquid cleaning formulation, the method comprising the step of blending a polymeric deposition aid comprising a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol together with a phenol derivative antimicrobial agent and at least one surfactant such that the liquid cleaning formulation has at least 10 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid.

2. The method of claim 1, wherein the polymeric deposition aid is a hydroxy terminated urethane compound having the formula:

$$H-\left[(O-R')_m-O-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}\right]_n-$$

$$-(O-R')_m-O-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-O-(R'-O)_m-$$

$$-\left[\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-R-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-O-(R'-O)_m\right]_{n'}-H$$

wherein ***R*** is selected from an alkylene or alkenylene radical containing from one to about 20 carbon atoms, a cycloalkylene or cycloalkenylene radical containing from about 5 to about 10 carbon atoms, a mononuclear or fused ring arylene radical containing from about 6 to about 10 carbon atoms, unsubstituted or substituted with one or more lower alkyl, lower alkoxy, nitro or amino groups or halogen atoms,

wherein ***R'*** is the same or different alkylene or alkenylene radical,

wherein ***m*** is an integer selected to provide an (O-R') moiety having molecular weight of from about 40 to about 6000, and

wherein ***n*** and ***n'*** are the same or different integers of from 0 to about 30 inclusive, correlated with ***m*** so as to provide a hydroxy-terminated urethane compound having a molecular weight of up to about 200,000.

is an integer having a value ranging from about 1 to about 8.

3. The method of claim 1, wherein the polymeric deposition aid is poly(oxy-1,2-ethanediyl),α-hydro-ω-hydroxy-, polymer with 1,1'-methylene-bis-(4,isocyanato-cyclohexane).

4. The method of claim 1,wherein the polymeric deposition aid is a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol, said mixture of polymers having an average molecular weight of approximately 1800 and includes 1,1'methylene-bis-(4,isocyanatocyclohexane) moieties.

5. The method of claim 1, wherein the phenol derivative antimicrobial agent is 2,4,4'-trichloro-2'-hydroxy diphenyl ether.

6. The method of claim 1, wherein at least one surfactant is selected from anionic surfactants, cationic surfactants, nonionic surfactants, amphoteric surfactants and combinations thereof.

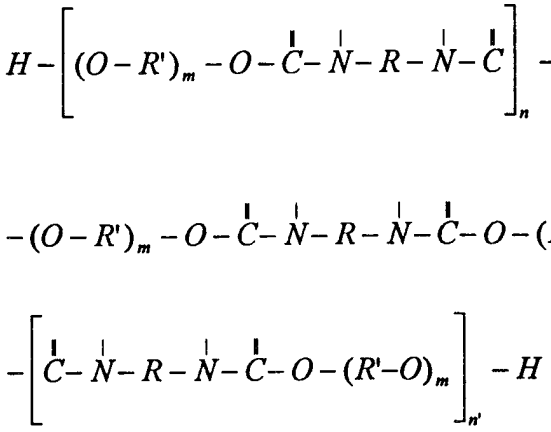
7. The method of claim 1, wherein the method further includes the step of adding at least one conventional formulating component.

8. The method of claim 7, wherein the at least one conventional formulating component is selected from carriers, preservatives, humectants, emollients and combinations thereof.

9. The method of claim 1, wherein the liquid cleaning formulation has at least 20 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid.

10. A method of increasing the antimicrobial activity of an aqueous, antimicrobial liquid cleaning formulation, the method comprising the step of blending a polymeric deposition aid comprising a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol together with a phenol derivative antimicrobial agent and at least one surfactant such that the liquid cleaning formulation has at least 20 percent greater antimicrobial activity than the same formulation without the polymeric deposition aid.

11. The method of claim 10, wherein the polymeric deposition aid is a hydroxy terminated urethane compound having the formula:



wherein ***R*** is selected from an alkylene or alkenylene radical containing from one to about 20 carbon atoms, a cycloalkylene or cycloalkenylene radical containing from about 5 to about 10 carbon atoms, a mononuclear or fused ring arylene radical containing from about 6 to about 10 carbon atoms, unsubstituted or substituted with one or more lower alkyl, lower alkoxy, nitro or amino groups or halogen atoms,

wherein ***R'*** is the same or different alkylene or alkenylene radical,

wherein ***m*** is an integer selected to provide an (O-R') moiety having molecular weight of from about 40 to about 6000, and

wherein ***n*** and ***n'*** are the same or different integers of from 0 to about 30 inclusive, correlated with ***m*** so as to provide a hydroxy-terminated urethane compound having a molecular weight of up to about 200,000.

is an integer having a value ranging from about 1 to about 8.

12. The method of claim 10, wherein the polymeric deposition aid is poly(oxy-1,2-ethanediyl),α-hydro-ω-hydroxy-, polymer with 1,1'-methylene-bis-(4,isocyanato-cyclohexane).

13. The method of claim 10,wherein the polymeric deposition aid is a mixture of liquid, hydroxyl-terminated urethane polymers in polyethylene glycol, said mixture of polymers having an average molecular weight of approximately 1800 and includes 1,1'methylene-bis-(4,isocyanatocyclohexane) moieties.

14. The method of claim 10, wherein the phenol derivative antimicrobial agent is 2,4,4'-trichloro-2'-hydroxy diphenyl ether.

15. The method of claim 10, wherein at least one surfactant is selected from anionic surfactants, cationic surfactants, nonionic surfactants, amphoteric surfactants and combinations thereof.

16. The method of claim 10, wherein the method further includes the step of adding at least one conventional formulating component.

17. The method of claim 16, wherein the at least one conventional formulating component is selected from carriers, preservatives, humectants, emollients and combinations thereof.

INTERNATIONAL SEARCH REPORT

Int. ational Application No
PCT/US 97/17701

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C11D3/48 C11D3/37 C11D3/20 A01N31/14 A01N25/30 A61K7/48

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C11D A01N A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 37 23 994 A (CIBA GEIGY AG) 4 February 1988 see the entire document ---	1-17
A	US 4 157 977 A (DEWAR NORMAN E ET AL) 12 June 1979 see the entire document ---	1-17
A	GB 2 211 093 A (UNILEVER PLC) 28 June 1989 see the entire document ---	1-17
A	US 4 312 855 A (GRAND PAUL S) 26 January 1982 see column 2, line 11 - column 13, line 2; claims 1-4,7,10,14,15; example 4 -----	1-17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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1

Date of the actual completion of the international search	Date of mailing of the international search report
6 February 1998	19/02/1998

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INTERNATIONAL SEARCH REPORT

Information on patent family members

In. ational Application No
PCT/US 97/17701

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