SOLVENT TREATMENT OF FABRIC ARTICLES

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ABSTRACT
Solvent treatment methods for treating fabric articles, more particularly it relates to oxygenated solvent treatment methods are provided by the present invention.
SOLVENT TREATMENT OF FABRIC ARTICLES

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Serial No. 60/342,709 filed Dec. 20, 2001.

FIELD OF THE INVENTION

[0002] The present invention relates to solvent treatment methods for treating fabric articles, more particularly it relates to oxygenated solvent treatment methods.

BACKGROUND OF THE INVENTION

[0003] The use of solvents to treat fabric articles, especially in dry cleaning applications, is well known. For example, perchloroethylene (“PERC”), the most common solvent used, has been used by dry cleaners for decades. However, with the environmental problems associated with PERC, there is a need to identify alternative solvents.

SUMMARY OF THE INVENTION

[0004] The present invention fulfills the needs described above by providing a solvent that is environmentally preferred that can be used in solvent treatment methods for treating fabric articles.

[0005] In one aspect of the present invention, a method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has an ozone reactivity of less than 0.30 gramO₂/gram, is provided.

[0006] In another aspect of the present invention, a method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has a vapor pressure of less than 0.1 mm Hg at 25°C, is provided.

[0007] In yet another aspect of the present invention, a method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has a vapor pressure of greater than 0.1 mm Hg at 25°C and an ozone reactivity of less than 0.30 gramO₂/gram, is provided.

[0008] In still another aspect of the present invention, a fabric article treated by a method in accordance with the present invention is provided.

[0009] In still yet another aspect of the present invention, a fabric article treating apparatus comprising a fabric article treatment chamber and a source of a solvent selected from the group consisting of solvents that have an ozone reactivity of less than 0.30 gramO₂/gram, solvents that have a vapor pressure of less than or equal to 0.1 mm Hg at 25°C, solvents that have a vapor pressure greater than 0.1 mm Hg and an ozone reactivity of less than about 0.30 gramO₂/gram, and mixtures thereof.

[0010] Accordingly, the present invention provides solvent treatment methods for treating fabric articles that are environmentally preferred, fabric articles treated by such methods and fabric article treating apparatuses in which such methods can be performed.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Definitions

[0012] “Fabric article” as used herein is intended to mean any article that is customarily cleaned in a conventional laundry process or in a dry cleaning process. As such the term encompasses articles of clothing, linen, drapery, and clothing accessories. The term also encompasses other items made in whole or in part of fabric, such as tote bags, furniture covers, tarps and the like.

[0013] “Environmentally preferred” as used herein means that the solvents and/or methods of the present invention qualify for the U.S. Environmental Protection Agency’s criteria for exemption from Volatile Organic Compound (VOC) regulations.

[0014] “Ozone Reactivity” as used herein is a measure of a VOC’s ability to form ozone in the atmosphere. It is measured as grams of ozone formed per gram of volatile organics. A methodology to determine ozone reactivity has been developed by Dr. William P. L. Carter of University of California, Riverside. The US EPA has used this concept to exempt several compounds (e.g. cyclic methylated siloxanes and methyl acetate) from VOC regulations. The State of California has developed an ozone reactivity-based regulation for VOCs in aerosol coating products.


[0016] “Vapor Pressure” as used can be measured by techniques defined in Method 310 of the California Air Resources Board.

[0017] Solvents

[0018] Suitable solvents for use in the methods and/or apparatuses of the present invention include, but are not limited to, carbonate solvents, succinate solvents and/or mixtures thereof. The definition of solvents for use in the present invention as the primary solvent expressly excludes cyclic siloxane solvents, perfluorinated solvents and glycol ether solvents. However, such adjunct solvents may be used in combination with the solvents of the present invention.

[0019] Carbonate solvents suitable for use in the present invention include, but are not limited to, methyl carbonates, ethyl carbonate, propylene carbonates, glycereine carbonates and mixtures thereof.

[0020] Succinate solvents suitable for use in the present invention include, but are not limited to, dimethyl succinate.

[0021] Adjunct Solvents

[0022] Adjunct solvents may be used in combination with the solvents of the present invention. The adjunct solvents include, but are not limited to, lipophilic fluids.

[0023] The lipophilic fluid herein is one having a liquid phase present under operating conditions of a fabric article treating appliance, in other words, during treatment of a fabric article in accordance with the present invention. In general such a lipophilic fluid can be fully liquid at ambient temperature and pressure, can be an easily melted solid, e.g., one which becomes liquid at temperatures in the range from...
about 0 deg. C. to about 60 deg. C., or can comprise a mixture of liquid and vapor phases at ambient temperatures and pressures, e.g., at 25 deg. C. and 1 atm. pressure. Thus, the lipophilic fluid is not a compressible gas such as carbon dioxide. It is preferred that the lipophilic fluid herein be inflammable or, have relatively high flash points and/or low VOC characteristics, these terms having their conventional meanings as used in the dry cleaning industry, to equal or, preferably, exceed the characteristics of known conventional dry cleaning fluids. Moreover, suitable lipophilic fluids herein are readily flowable and nonviscous. In general, lipophilic fluids herein are required to be fluids capable of at least partially dissolving sebum or body soil as defined in the test hereinafter. Mixtures of lipophilic fluid are also suitable, and provided that the requirements of the Lipophilic Fluid Test, as described below, are met, the lipophilic fluid can include any fraction of dry-cleaning solvents, especially newer types including fluorinated solvents, or perfluorinated amines. Some perfluorinated amines such as perfluorotributylamines while unsuitable for use as lipophilic fluid may be present as one of many possible adjuncts present in the lipophilic fluid-containing composition. Other suitable lipophilic fluids include, but are not limited to, diol solvent systems e.g., higher alcohols such as C6- or C8- or higher diols, organosilicone solvents including both cyclic and acyclic types, and the like, and mixtures thereof. A preferred group of nonaqueous lipophilic fluids suitable for incorporation as a major component of the compositions of the present invention include low-volatility nonfluorinated organics, silicones, especially those other than amino functional silicones, and mixtures thereof. Low volatility nonfluorinated organics include for example OLEfIN and other polyol esters, or certain relatively nonvolatile biodegradable midchain branched petroleum fractions. Another preferred group of nonaqueous lipophilic fluids suitable for incorporation as a major component of the compositions of the present invention include, but are not limited to, glycol ethers, for example propylene glycol methyl ether, propylene glycol n-propyl ether, propylene glycol n-butyl ether, propylene glycol n-butyric acid methyl ester, propylene glycol n-butyric acid ethyl ester, propylene glycol n-propyl ether, propylene glycol n-butyl ether, propylene glycol n-butyric acid methyl ester, propylene glycol n-butyric acid ethyl ester, propylene glycol n-propyl ether, propylene glycol n-butyl ether, propylene glycol n-butyric acid methyl ester, propylene glycol n-butyric acid ethyl ester. Suitable silicones for use as a major component, e.g., more than 50%, of the composition include cyclopentanols, sometimes termed “DS”, and/or linear analogs having approximately similar volatility, optionally complemented by other compatible silicones. Suitable silicones are well known in the literature, see, for example, Kirk Othmer's Encyclopedia of Chemical Technology, and are available from a number of commercial sources, including General Electric, Toshiba Silicone, Bayer, and Dow Corning. Other suitable lipophilic fluids are commercially available from Procter & Gamble or from Dow Chemical and other suppliers. For example, one suitable silicone is SF-1528, available from GE silicone fluids. It is worth noting that SF-1528 fluid is 90% cyclopentasiloxane (DS).

[0024] Qualification of Lipophilic Fluid—Lipophilic Fluid Test (LF Test)

[0025] Any non-aqueous fluid that is both capable of meeting known requirements for a dry-cleaning fluid (e.g., flash point etc.) and is capable of at least partially dissolving sebum, as indicated by the test method described below, is suitable as a lipophilic fluid herein. The ability of a particular material to remove sebum can be measured by any known technique. As a general guideline, perfluorotributylamine (Fluorinert FC-43®) on its own (with or without adjuncts) is a reference material that, by definition, is unsuitable as the lipophilic fluid herein (it is essentially a non-solvent) while DS dissolves sebum.

[0026] The following is the method for investigating and qualifying other materials, e.g., other low-viscosity, flowable silicones, for use as the lipophilic fluid. The method uses commercially available Crisco® canola oil, oleic acid (95% pure, available from Sigma Aldrich Co.) and squalene (99% pure, available from J.T. Baker) as model soils for sebum. The test materials should be substantially anhydrous and free from any added adjuncts, or other materials during evaluation.

[0027] Prepare three vials. Place 1.0 g of canola oil in the first; in a second vial place 1.0 g of the oleic acid (95%), and in a third and final vial place 1.0 g of the squalene (99%). To each vial add 1 g of the fluid to be tested for lipophilicity. Separately mix at room temperature and pressure each vial containing the lipophilic fluid and the fluid to be tested for 20 seconds on a standard vortex mixer at maximum setting. Place vials on the bench and allow settling for 15 minutes at room temperature and pressure. If, upon standing, a single phase is formed in any of the vials containing lipophilic solvents, then the fluid qualifies as suitable for use as a "lipophilic fluid" in accordance with the invention. However, if two or more separate layers are formed in all three vials, then the amount of fluid dissolved in the oil phase will need to be further determined before rejecting or accepting the fluid as qualified.

[0028] In such a case, with a syringe, carefully extract a 200 microliter sample from each layer in each vial. The syringe-extracted layer samples are placed in GC autosampler vials and subjected to conventional GC analysis after determining the retention time of calibration samples of each of the three models soils and the fluid being tested. If more than 1% of the test fluid by GC, preferably greater, is found to be present in any one of the layers which consists of the oleic acid, canola oil or squalene layer, then the test fluid is also qualified for use as a lipophilic fluid. If needed, the method can be further calibrated using heptacosaneolotributylamine, i.e., Fluorinert FC-43 (fail) and cyclopentasiloxane (pass).

[0029] A suitable GC is a Hewlett Packard Gas Chromatograph HP5890 Series II equipped with a split/splitless injector and FID. A suitable column used in determining the amount of lipophilic fluid present is a J&W Scientific capillary column DB-1HT, 30 meter, 0.25 mm id, 0.1 μm film thickness cat#122113. The GC is suitably operated under the following conditions:

| Carrier Gas: | Hydrogen |
| Column Head Pressure: | 9 psi |
| Flows: | Column Flow @ ~1.5 ml/min. |
| | Split Vent @ ~250–500 ml/min. |
| Septum Purge | @ 1 ml/min. |
| Injection: | HP 7673 Autosampler, 10 μl syringe, 1 μl injection |

Jul. 3, 2003
Typical lipophilic fluids suitable for use herein can further be qualified for use on the basis of having an excellent garment care profile. Garment care profile testing is well known in the art and involves testing a fluid to be qualified using a wide range of garment or fabric article components, including fabrics, threads and elastics used in seams, etc., and a range of buttons. Typical lipophilic fluids for use herein have an excellent garment care profile, for example they have a good shrinkage or fabric puckering profile and do not appreciably damage plastic buttons.

For purposes of garment care testing or other qualification, e.g., flammability, a lipophilic fluid for use in the lipophilic fluid can be present in a mixture, e.g., with water, at approximately the ratio to be used in the final lipophilic fluid which will come into contact with fabric articles. Certain materials, which remove sebum, qualify for use as lipophilic fluids; for example, ethyl lactates can be quite objectionable in their tendency to dissolve buttons, and if such a material is to be used in the lipophilic fluid, it will be formulated with water and/or other solvents such that the overall mix is not substantially damaging to buttons. Other lipophilic fluids, D5 for example, meet the garment care requirements commendably. Some suitable lipophilic fluids may be found in granted U.S. Pat. Nos. 5,865,852; 5,942,007; 6,042,617; 6,042,618; 6,056,789; 6,059,845; and 6,063,135, which are herein incorporated by reference.

Lipophilic solvents can include linear and cyclic polyglycols, hydrocarbons and chlorinated hydrocarbons. More preferred are the linear and cyclic polyglycols and hydrocarbons of the glycol alcohol, acetate ester, lactate ester families. Preferred lipophilic solvents include cyclic siloxanes having a boiling point at 760 mm Hg. of about below 250°C. Specifically preferred cyclic siloxanes for use in this invention are octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, and dodecamethylcyclohexasiloxane. It should be understood that useful cyclic siloxane mixtures might contain, in addition to the preferred cyclic siloxanes, minor amounts of other cyclic siloxanes including hexamethylcyclotrisiloxane or higher cyclics such as tetramethylcyclodecasiloxane. Generally the amount of these other cyclic siloxanes in useful cyclic siloxane mixtures will be less than about 10 percent based on the total weight of the mixture.

Adjunct Ingredients

Adjunct materials can vary widely and can be used at widely ranging levels. For example, detriene enzymes such as proteases, amylases, cellulases, lipases and the like as well as bleach catalysts including the macrocyclic types having manganese or similar transition metals all useful in laundry and cleaning products can be used herein at very low, or less commonly, higher levels. Adjunct materials that are catalytic, for example enzymes, can be used in “forward” or “reverse” modes, a discovery independently useful from the specific appliances of the present invention. For example, a lipolase or other hydrolase may be used, optionally in the presence of alcohols as adjuncts, to convert fatty acids to esters, thereby increasing their solubility in the solvent. This is a “reverse” operation, in contrast with the normal use of this hydrolase in water to convert a less water-soluble fatty ester to a more water-soluble material. In any event, any adjunct ingredient must be suitable for use in combination with the solvent.

The compositions may comprise emulsifiers. Emulsifiers are well known in the chemical art. Essentially, an emulsifier acts to bring two or more insoluble or semi-soluble phases together to create a stable or semi-stable emulsion. It is preferred in the claimed invention that the emulsifier serves a dual purpose wherein it is capable of acting not only as an emulsifier but also as a treatment performance booster. For example, the emulsifier may also act as a surfactant thereby boosting cleaning performance. Both ordinary emulsifiers and emulsifier/surfactants are commercially available.

Some suitable cleaning additives include, but are not limited to, builders, surfactants, enzymes, bleach activators, bleach catalysts, bleach boosters, bleaches, alkalinity sources, antibacterial agents, colorants, perfumes, pro-prefumes, finishing aids, lime soap dispersants, composition malodor control agents, odor neutralizers, polymeric dye transfer inhibiting agents, crystal growth inhibitors, photosensitizers, heavy metal ion sequestants, anti-tarnishing agents, anti-microbial agents, anti-oxidants, anti-redispersion agents, soil release polymers, electrolytes, pH modifiers, thickeners, abrasives, divalent or trivalent ions, metal ions salts, enzyme stabilizers, corrosion inhibitors, dyes or polyelectrolytes and/or their alkoxylates, suds stabilizing polymers, solvents, process aids, fabric softening agents, optical brighteners, hydrotropes, suds or foam suppressors, suds or foam boosters, fabric softeners, antistatic agents, dye fixatives, dye abrasion inhibitors, anti-crocking agents, wrinkle reduction agents, wrinkle resistance agents, soil release polymers, soil repellency agents, sunscreen agents, anti-fade agents, and mixtures thereof.

The term “surfactant” conventionally refers to materials that are surface-active either in the water, the lipophilic fluid, or the mixture of the two. Some illustrative surfactants include nonionic, cationic and silicone surfactants as used in conventional aqueous detergent systems. Suitable nonionic surfactants include, but are not limited to:

Polyethylene oxide condensates of nonyl phenol and myristyl alcohol, such as in U.S. Pat. No. 4,685,930 Kasprzak; and

b) fatty alcohol ethoxylates, R—(OCH₂CH₃)ₙOH = 1 to 100, typically 12-40, R=hydrocarbon residue 8 to 20 C atoms, typically linear alkyl. Examples polyoxyethylene lauryl ether, with 4 or 23 oxyethylene groups; polyoxyethylene cetyl ether with 2, 10 or 20 oxyethylene groups; polyoxyethylene stearyl ether, with 2, 10, 20, 21 or 100 oxyethylene groups; polyoxyethylene (2), (10) oleyl ether, with 2 or 10 oxyethylene groups. Commercially available examples include, but are not limited to: ALFONIC, BRIL, GENAPOL, NEOBOL, SURFONIC, TRYCOL. See also U.S. Pat. No. 6,013,683 Hill et al.,
Suitable cationic surfactants include, but are not limited to dialkyl dimethylammonium salts having the formula:
\[
RR'N^+\text{[(CH₃)₂SO]}_{a+b}\text{[(CH₃)₃SO]}_{c}\text{[R'R'SO]}_{d}
\]

Where each \(RR'\) is independently selected from the group consisting of 12-30 C atoms or derived from tallow, coconut oil or soy, X=Cl or Br. Examples include: didodecyl dimethylammonium bromide (DDAB), dihexadecyl dimethyl ammonium chloride, dihexadecyl dimethyl ammonium bromide, dioctadecyl dimethyl ammonium chloride, dioctyldimethyl ammonium chloride, dioctadecyl dimethyl ammonium chloride, dioctadecyl dimethyl ammonium bromide (DTAB). Commercially available examples include, but are not limited to: ADOGEN, ARQUAD, TOMAH, VARIQUAT. See also U.S. Pat. No. 6,013,683 Hill et al.

Suitable silicone surfactants include, but are not limited to the polyalkylene oxide polysiloxanes having a dimethyl polysiloxane hydrophilic moiety and one or more hydrophilic polyalkylene side chains and have the general formula:
\[
R^1\text{-(CH₃)₃SO-[[(CH₃)₂SO]}_{a+b}\text{[(CH₃)₃SO]}_{c}\text{[R'R'SO]}_{d}\text{[S(CH₂)₉]}_{R^2}
\]

Wherein \(a+b\) are from about 1 to about 50, preferably from about 3 to about 30, more preferably from about 10 to about 25, and each \(R^1\) is the same or different and is selected from the group consisting of methyl and a poly-(ethylene oxide/propane oxide) copolymer group having the general formula:
\[
-(\text{CH₂O})_{n}(\text{CH₃H₂O})_{m}(\text{CH₃H₂O})_{n}\text{[R'}_{n}
\]

With at least one \(R^1\) being a poly(ethylene oxide/propane oxide) copolymer group, and wherein \(n\) is 3 or 4, preferably 3; total \(c\) for (all polyalkylene oxide side groups) has a value of from 1 to about 100, preferably from about 6 to about 100; total \(d\) is from 0 to about 14, preferably from 0 to about 3, and more preferably \(d\) is 0; total \(c+d\) has a value of from about 5 to about 150, preferably from about 9 to about 100 and each \(R^2\) is the same or different and is selected from the group consisting of hydrogen, an alkyl having 1 to 4 carbon atoms, and an acetyl group, preferably hydrogen and methyl group. Examples of these surfactants may be found in U.S. Pat. No. 5,705,562 Hill and U.S. Pat. No. 5,707,613 Hill, both of which are incorporated herein by reference.

Examples of this type of surfactants are the Silwet® surfactants which are available CK Witco, OSI Division, Danbury, Conn. Representative Silwet surfactants are as follows:

<table>
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<th>Name</th>
<th>Average MW</th>
<th>Average a + b</th>
<th>Average total c</th>
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</thead>
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<tr>
<td>L-7608</td>
<td>600</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>L-7607</td>
<td>1,000</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>L-77</td>
<td>600</td>
<td>1</td>
<td>9</td>
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<tr>
<td>L-7605</td>
<td>6,000</td>
<td>20</td>
<td>99</td>
</tr>
<tr>
<td>L-7604</td>
<td>4,000</td>
<td>21</td>
<td>53</td>
</tr>
<tr>
<td>L-7600</td>
<td>4,000</td>
<td>11</td>
<td>68</td>
</tr>
<tr>
<td>L-7657</td>
<td>5,000</td>
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<td>76</td>
</tr>
<tr>
<td>L-7602</td>
<td>3,000</td>
<td>20</td>
<td>29</td>
</tr>
</tbody>
</table>

The molecular weight of the polyalkyleneoxy group (\(R^1\)) is less than or equal to about 10,000. Preferably, the molecular weight of the polyalkyleneoxy group is less than or equal to about 8,000, and most preferably ranges from about 300 to about 5,000. Thus, the values of \(c\) and \(d\) can be those numbers which provide molecular weights within these ranges. However, the number of ethyleneoxy units (\(\text{CH₂O}\)) in the polyether chain (\(R^2\)) must be sufficient to render the polyalkyleneoxy polysiloxane water dispersible or water soluble. If polypropylene groups are present in the polyalkyleneoxy chain, they can be distributed randomly in the chain or exist as blocks. Preferred Silwet surfactants are L-7600, L-7602, L-7604, L-7605, L-7657, and mixtures thereof. Besides surface activity, polyalkyleneoxy polysiloxane surfactants can also provide other benefits, such as antistatic benefits, and softness to fabrics.

The preparation of polyalkyleneoxy polysiloxanes is well known in the art. Polyalkyleneoxy polysiloxanes of the present invention can be prepared according to the procedure set forth in U.S. Pat. No. 3,299,112, incorporated herein by reference.

Another suitable silicone surfactant is SF-1488, which is available from GE silicone fluids.

These and other surfactants suitable for use in combination with the lipophilic fluid as adjuncts are well known in the art, being described in more detail in Kirk Othmer’s Encyclopedia of Chemical Technology, 3rd Ed., Vol. 22, pp. 360-379, “Surfactants and Detensive Systems”, incorporated by reference herein. Further suitable nonionic detergent surfactants are generally disclosed in U.S. Pat. No. 3,929,678, Laughlin et al., issued Dec. 30, 1975, at column 13, line 14 through column 16, line 6, incorporated herein by reference.

The adjunct may also be an antistatic agent. Any suitable well-known antistatic agents used in laundering and dry cleaning art are suitable for use in the methods and compositions of the present invention. Especially suitable as antistatic agents are the subset of fabric softeners which are known to provide antistatic benefits. For example those fabric softeners which have a fatty acyl group which has an iodine value of about 20, such as N,N-di(tallowoyl-oxy-ethyl)-N,N-dimethyl ammonium methylsulfate. However, it is to be understood that the term antistatic agent is not to be limited to just this subset of fabric softeners and includes all antistatic agents.

Although the methods and/or compositions utilized in present invention will be described in detail, it should be understood, and one skilled in the art will recognize, that any compositions, processes, and/or apparatuses capable of carrying out the invention could be used.

Method

The method of the present invention is directed to attaining improved fabric cleaning in a solvent treatment regimen, and includes the steps of exposing the fabric to a solvent, in accordance with the present invention, and optionally, simultaneously and/or sequentially, exposing the fabric to an adjacent solvent and/or an adjacent ingredient, in accordance with the present invention. Optionally but preferably, it may include the step of exposing the fabric to a polar phase.
[0054] The polar phase may include water, alcohol, or mixtures thereof. If the polar phase does include water, it preferably comprises at least about 0.5% water by weight of fabric and at most about 10% water by weight of fabric.

[0055] The adjunct solvent may comprise a linear siloxane, a cyclic siloxane, or mixtures thereof. The adjunct solvent can be a lipophilic fluid selected from the group consisting essentially of octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, and mixtures thereof. If the polar phase does include water, it may be substantially free (i.e., less than 5%, less than 3%, less than 1%, less than 0.5%) of octamethylcyclotetrasiloxane. Due to the flash points of the aforementioned siloxanes, the method typically occurs at less than about 80°C.

[0056] While carrying out the method of the present invention, the fabrics may also be exposed to an emulsifier and/or a surfactant either separately or as a result of being contained within the polar phase, the solvent, the adjunct solvent and/or the adjunct ingredient. The fabrics may also be exposed to adjunct ingredients selected from the group consisting essentially of enzymes, bleaching systems, surfactants, fabric softeners, perfumes, antibacterial agents, antistatic agents, brighteners, dyes, stabilizers, dyes, abrasion inhibitors, anti-crocking agents, wrinkle reduction agents, wrinkle resistance agents, soil release polymers, sunscreen agents, anti-fade agents, builders, chelants, sudsing agents, composition malodor control agents, composition coloring agents, pH buffers, waterproofing agents, soil repellency agents, and mixtures thereof. These adjuncts can also be applied either separately or as a result of being contained within the polar phase, the solvent, and/or the adjunct solvent.

[0057] Composition

[0058] The composition of the present invention is directed to attaining improved fabric cleaning in a solvent treatment regimen, wherein the composition comprises a solvent in accordance with the present invention and optionally, an adjunct solvent, and optionally an adjunct ingredient. Optionally, the composition can further comprise a polar phase.

[0059] If included, the polar phase may include water, alcohol, and mixtures thereof. Also, the polar phase preferably comprises at least about 0.1% water by weight of composition and at most about 5% water by weight of composition.

[0060] The adjunct solvent may comprise a linear siloxane, a cyclic siloxane, or mixtures thereof. The adjunct solvent may be a lipophilic fluid that comprises a lipophilic fluid selected from the group consisting essentially of octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, and mixtures thereof. The lipophilic fluid may comprise decamethylcyclopentasiloxane. Further, the lipophilic fluid may comprise decamethylcyclopentasiloxane and may be substantially free (i.e., less than 5%, less than 3%, less than 1%, less than 0.5%) of octamethylcyclotetrasiloxane.

[0061] It will be understood that the methods and/or compositions of the present invention may be combined with other fabric treatments. For example, prior to the application of the lipophilic fluid the fabric articles may be subjected to the particulate removal method described in co-pending application Serial No. 60/191,365, to Noyes et al., filed Mar. 24, 2000, the relevant parts of which are incorporated herein by reference.

[0062] The present invention may be used in a service, such as a dry cleaning service, diaper service, uniform cleaning service, or commercial business, such as a Laundromat, dry cleaner, linen service which is part of a hotel, restaurant, convention center, airport, cruise ship, port facility, casino, or may be used in the home.

[0063] The methods and/or compositions of the present invention may be performed in an apparatus that is a modified existing apparatus and is retrofitted in such a manner as to conduct the process of the present invention in addition to related processes.

[0064] The methods and/or compositions of the present invention may also be performed in an apparatus, which is not a modified existing apparatus but is one specifically built in such a manner so as to conduct the process of the present invention or may be added to another apparatus as part of a solvent and/or adjunct solvent processing system. This would include all the associated plumbing, such as connection to a chemical and water supply, and sewerage for waste wash fluids.

[0065] Finally, the methods of the present invention may be performed in an apparatus, which is not a modified existing apparatus but is one specifically built in such a manner so as to conduct the process of the present invention and related processes.

[0066] An apparatus used to carry out the present invention will typically contain some type of control system. These include electrical systems, such as, the so-called smart control systems, as well as more traditional electromechanical systems. The control systems would enable the user to select the size of the fabric load to be cleaned, the type of soiling, the extent of the soiling, the time for the cleaning cycle. Alternatively, the user could use pre-set cleaning and/or refreshing cycles, or the apparatus could control the length of the cycle, based on any number of selectable parameters. This would especially be true for electrical control systems. For example, when the collection rate of solvent and/or adjunct solvent reaches a steady rate the apparatus could turn its self off after a fixed period of time, or initiate another process for the solvent and/or adjunct solvent.

[0067] In the case of electrical control systems, one option is to make the control device a so-called “smart device”. This could mean including, but not limited to, self diagnostic system, load type and cycle selection, linking the machine to the Internet and allowing for the consumer to start the apparatus remotely, be informed when the apparatus has cleaned a fabric article, or for the supplier to remotely diagnose problems if the apparatus should break down. Furthermore, if the apparatus of the present invention is only a part of a cleaning system, the so called “smart system” could be communicating with the other cleaning devices which would be used to complete the remainder of the cleaning process, such as a washing machine, and a dryer.
What is claimed is:

1. A method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has an ozone reactivity of less than 0.30 gramO₂/gram.

2. The method according to claim 1 wherein the solvent has an ozone reactivity of less than 0.30 gramO₂/gram.

3. The method according to claim 1 wherein the solvent is selected from the group consisting of carbonate solvents, succinate solvents and mixtures thereof.

4. The method according to claim 3 wherein the solvent comprises a carbonate solvent selected from the group consisting of methyl carbonates, ethyl carbonates, propylene carbonates, glycerine carbonates and mixtures thereof.

5. The method according to claim 3 wherein the solvent comprises a succinate solvent selected from the group consisting of dimethyl succinates and mixtures thereof.

6. The method according to claim 1 wherein the method further comprises contacting the fabric article with an adjunct solvent.

7. The method according to claim 6 wherein the adjunct solvent comprises a lipophilic fluid.

8. The method according to claim 7 wherein the lipophilic fluid comprises a linear siloxane, a cyclic siloxane and mixtures thereof.

9. The method according to claim 7 wherein said lipophilic fluid comprises a lipophilic fluid selected from the group consisting of octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, dodecamethylcyclohexasiloxane, and mixtures thereof.

10. The method according to claim 7 wherein said lipophilic fluid comprises decamethylcyclopentasiloxane.

11. The method according to claim 7 wherein said lipophilic fluid comprises decamethylcyclopentasiloxane and is substantially free of octamethylcyclotetrasiloxane.

12. The method according to claim 1 wherein the method further comprises contacting the fabric article with a polar phase.

13. The method according to claim 12 wherein said polar phase comprises water.

14. The method according to claim 13 wherein said polar phase comprises at least about 0.1% water by weight of the fabric article.

15. The method according to claim 14 wherein said polar phase comprises at most about 5% water by weight of the fabric article.

16. The method according to claim 12 wherein said polar phase comprises alcohol.

17. The method according to claim 1 wherein the method further comprises contacting said fabric article with an emulsifier.

18. The method according to claim 1 wherein the method further comprises contacting said fabric article with a surfactant.

19. The method according to claim 1 wherein the method further comprises contacting said fabric article with an adjunct ingredient.

20. The method according to claim 1 wherein the method occurs at less than about 80°C.

21. A method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has a vapor pressure of less than or equal to 0.1 mm Hg.

22. A method for treating a fabric article in need of treatment comprising contacting the fabric article with a solvent that has a vapor pressure of greater than 0.1 mm Hg, and an ozone reactivity of less than 0.30 gramO₂/gram.


26. A fabric article treating apparatus comprising a fabric article treatment chamber and a source of a solvent selected from the group consisting of solvents that have an ozone reactivity of less than 0.30 gramO₂/gram, solvents that have a vapor pressure of less than or equal to 0.1 mm Hg, solvents that have a vapor pressure greater than 0.1 mm Hg and an ozone reactivity of less than about 0.30 gramO₂/gram, and mixtures thereof.