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DRY CLEANING METHOD AND MODIFIED SOLVENT

FIELD OF THE INVENTION

This invention is in the general field of dry cleaning of clothing, textiles, fabrics and the like, and is more particularly directed to a method and apparatus for dry cleaning fabrics using a modified solvent not heretofore used in dry cleaning.

BACKGROUND OF THE INVENTION

Dry cleaning is a major industry throughout the world. In the United States alone, there are more than forty thousand dry cleaners (many of these have multiple locations). The dry cleaning industry is an essential industry in the present economy. Many articles of clothing (and other items) must be dry cleaned in order to remain clean by removal of body fats and oils, and presentable by preventing shrinking and discoloring.

The most widely used dry cleaning solvent until now has been perchloroethylene (PERC). There are numerous disadvantages to PERC including inherent toxicity and odor.

Another problem in this field is that different fabrics require different handling in the presently used systems in order to prevent damage to the fabrics during the dry cleaning process.

Prior art dry cleaning processes include the use of various solvents with appropriate machinery to accomplish the cleaning. As mentioned earlier, the solvent most widely used has been PERC. PERC has the advantage of being an excellent cleaning solvent, but the disadvantage of being a major health and environmental hazard, i.e., it has been linked to numerous forms of cancer and it is very destructive to ground water and aquatic life. In some areas PERC is prohibited due to these disadvantages. Additionally, in the past, other solvents such as petroleum-based solvents and glycol ethers and esters have been tried and used. These various solvents have been used with mixed cleaning results and problematic fabric/textile compatibility as compared to the results obtained with PERC.



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The dry cleaning industry has long depended on petroleum-based solvents and the well-known chlorinated hydrocarbons, perchlorethylene and trichlorethylene, for use in the cleaning of fabrics and articles of clothing. Since the 1940's, PERC was praised as being a synthetic compound that is non-flammable and has great degreasing and cleaning qualities ideal for the dry cleaning industry. Beginning in the 1970's, PERC was found to cause liver cancer in animals. This was an alarming discovery, as dry cleaning waste was placed in landfills and dumpsters at that time, from which it leached into soil and ground water.

Environmental Protection Agency regulations gradually were tightened, culminating in a law that took effect in 1996 that required all dry cleaners to have "dry to dry" cycles, meaning that fabrics and articles of clothing go into the machine dry and come out dry. This required "closed loop" systems that can recapture almost all PERC, liquid or vapor. The process of "cycle" involves placing fabrics or articles of clothing into a specially designed washing machine that can hold 6.8 to 68 kilograms of fabrics or articles of clothing that are visible through a circular window. Prior to being placed into the machine, the fabrics or articles of clothing are checked and treated by being placed into the machine, the fabrics or articles of clothing are checked and treated by local hand spotting for stains. If the fabric is unusual or known to be troublesome, the label is checked to verify that the manufacturer has deemed the item safe for dry cleaning. If not, the stain may be permanent. As an example, a sugar stain may not be seen, but once it is run through the dry cleaning process, it oxidizes and turns brown. If the stain is grease related, water won't help, but PERC will as it solubilizes grease. In fact, the principle reason for dry cleaning certain clothes (which should not be washed in a regular washing machine) is to remove the build up of body oils (known as fatty acids) because they too oxidize and produce rancid nasty smells.

The grease which builds up in the solvent is removed by filter and by distilling the PERC. In other words, the dirty PERC is boiled and vapors are condensed back to a clean liquid. A small amount of detergent 1 to 1.5% by volume of the total mixture, is typically mixed with PERC to help solubilize stains and/or stain residues from pre-spotting.

Before clothes are removed from the machine, the washer becomes a dryer. Hot air is blown through the compartment, but instead of being vented outside, the air stream goes through a condenser that liquefies the PERC vapors and returns them for reuse. After the washing and drying, clothes are steamed and ironed.

The dry cleaning process removes most of the PERC from the clothes, however, a small amount does remain. Different fibers of clothes retain more solvent than others. For example, natural fibers such as cottons, wools and thicker articles such as sleeping bags, down coats and shoulder pads tend to retain more solvent than the lighter articles or synthetic fibers.

Another major problem associated with dry cleaning clothes is the color fastness of the dyes used. PERC is a very aggressive solvent and quite often the dyes used by manufacturers are fugitive within PERC or other dry cleaning solvents. At times the fabric may be labeled dry clean only but the prints or surface dyes are fugitive in solvents leaving the article non-serviceable. When an article is cleaned and has a fugitive dye the article suffers and the other articles will experience redeposition of dye on their surface.

Another problem associated with the dry cleaning of fabrics is the redeposition of water-soluble soils that have been loosened from one fabric or article of clothing, and redeposited onto the same or another fabric or article of clothing being cleaned. Volatile silicone solvents alone, are extremely effective in dissolving fats, oils and other organic soils from garments and keeping them in suspension, but cannot hold water-soluble soils in suspension without the aid of a proper detergent.

The same problems exist for PERC and the hydrocarbon based solvents. Special detergents have been developed to solve the problems of suspension of water-soluble soils in these organic solvents and of the redeposition of these soils from them. Detergents developed for use with PERC are not compatible with volatile silicone solvents.

The only use of a cyclic siloxane composition for cleaning purposes is disclosed in U.S. Patent No. 4,685,930 to Kasprzak. However, the disclosure therein is for spot cleaning applications only. There is no disclosure of immersing articles into the cyclic siloxane nor is there any suggestion of using the cyclic siloxane in a dry cleaning machine. Moreover, there is no suggestion of subjecting such articles to immersion in cyclic siloxane agitating, spinning, partial vacuum and heating in a continuous process to dry clean articles in a bulk process for removing fats, oils, grease and other soils from a large number of textile articles.

DE 37 39 711 A discloses a method of dry cleaning articles comprising the steps of immersing the articles in a fluid containing a cyclic siloxane composition, agitating the articles and removing liquid from the articles using heat.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a method of dry cleaning articles comprising the acts of:

immersing said articles to be dry cleaned in a dry cleaning fluid including a cyclic siloxane composition, wherein said cyclic siloxane composition further is modified with a chemical that is selected from the group of chemicals including 2-ethylhexyl acetate, esters, dibasic esters, glycol ether dipropylene methyl acetate, glycol ether ethylene butyl acetate, 2-ethylhexyl alcohol, cyclohexanol and hexanol;

agitating said articles in said cyclic siloxane composition;

removing said cyclic siloxane composition from said articles by centrifugal action and by circulating air about said articles; and

maintaining the temperature of said circulating air between 43 to 77 degrees Celsius during the removal of said cyclic siloxane composition from said articles.

The present invention comprises a novel dry cleaning system and method, in which specifically designed or modified machinery is used in conjunction with a specific solvent known as cyclic siloxanes. Cyclic siloxanes allow the dry cleaning processing to be very effective and result in environmentally friendly processing which is more effective in cleaning fabrics and the like than any known prior system. In order to enhance the cleaning capabilities of the cyclic siloxane based solvent, such solvent is modified with a chemical that is selected from the group of chemicals including 2-ethylhexyl acetate, esters, dibasic esters, glycol ether DPM acetate, glycol ether EB acetate, 2-ethylhexyl alcohol, cyclohexanol and hexanol. In a preferred embodiment, the method comprises the steps of loading articles into a cleaning basket; agitating the articles and the cyclic siloxane solvent in which the articles are immersed; removing most of the solvent; centrifuging the articles; and removing the articles from the basket after cooling the articles.

DESCRIPTION OF THE DRAWINGS

The aforementioned advantages of the present invention, as well as additional objects and advantages thereof, will be more fully understood hereinafter as a result of a detailed description of a preferred embodiment when taken in conjunction with the following drawing in which:

Figure 1 is a block diagram of the steps of the process showing one embodiment of the present invention

DISCLOSURE OF THE INVENTION

The present invention includes a method and apparatus for dry cleaning fabrics using a silicone based solvent which has a desirable flash point (over 60 degrees Celsius) and fabric-safe qualities (non-dye pulling and non-shrinkage) together with superior solvency for fatty acids, grease and oils in a dry cleaning process.

The present method of dry cleaning employs a fluid class of cyclic siloxanes commonly used for cosmetics and topical pharmaceuticals. These cyclic siloxanes are more particularly known as octamethyl-cyclotetrasiloxane (tetramer), decamethyl-cyclopentasiloxane (pentamer) and dodecamethyl-cyclo-hexasiloxane (hexamer).

The solvent of the present invention is thus environmentally friendly, does not deposit and or build up in clothing, is hypoallergenic, and has unique flammability characteristics. In use, the flashpoint and forepoint of the solution are separated by at least 5.56 degrees Celsius, whereby the solvent is self extinguishing between the flashpoint and the firepoint. Further, the solvent can be heated (over 38 degrees Celsius) without causing harm to fabrics which further improves and speeds up the cleaning process. Finally, the solvent may have a surface tension less than 18 dynes/square centimetre to better penetrate fabric fibres to remove debris to make it easier to remove the solvent from the fabric.

The invention discloses the application of volatile organo silicones as alternative solvents to the common petroleum based aliphatic compounds and the halogenated hydrocarbons. Organosilicones are not found in nature and must be prepared synthetically. The ultimate starting material is sand (silicone dioxide) or other inorganic silicates, which make up 75% of the earth's crust. The organosilicones were first synthesised in 1863 by Friedel and Crafts, who first prepared tetraethyl silane. In the following years, although many other derivatives were synthesised, it was not until the 1940's that widespread interest in organosilicone chemistry emerged.

Silica is a relatively electropositive element that forms polar covalent bonds with carbon and other elements, including the halogens, nitrogen and oxygen. The strength and reactivity of silicone depend on the relative electronegativity of the element to which silicones will be covalently bound. The polysilanes upon controlled hydrolysis readily form the polysiloxanes. These cyclic and linear polymers are commercially known as silicone fluids.

Silicone fluids are non-polar and insoluble in water or the lower alcohols. They are completely miscible in typical aliphatic and aromatic solvents, including the halogenated solvents, but are only partially miscible with the intermediate petroleum fractions such as naphthenes. Silicone fluids are insoluble in the higher hydrocarbons, lube oils, waxes, fatty acids, vegetable oils and animal oils... however, the volatile cyclic silicone fluids (tetramer and pentamer) are somewhat soluble in the higher hydrocarbons.

In fact, the lack of dye-pulling and cross staining by the cyclic siloxanes was unexpectedly discovered through the actual reduction to practice of the said cyclic siloxanes as a dry cleaning solvent in a conventional dry cleaning apparatus. The applicants further experienced that the dye pulling problems associated with the conventional solvents were virtually eliminate which resulted in a significant economic gain to the dry cleaning operator. This gain was measured by the ability of the operator to mix garments and articles of clothing, regardless of color, and thus increase cleaning productivity.

As an option, volatile organo silicones (cyclics) may be used in conjunction with an ester additive, more particularly, 2-ethylhexyl acetate (EHA) , provide the basis for superior solvency and cleaning ability.

In testing the degreasing ability of the volatile cyclic silicone/EHA mixtures it was found that they performed better than the petroleum-based aliphatic solvents and comparable to the level of PERC. PERC is a very good and aggressive solvent as a degreaser, however, it can be an over-kill for the purpose of normal dry cleaning. The principle purpose of dry cleaning is to pull out the soil and smelly fatty acids which accumulate in a garment or piece of clothing during wear. An ideal dry cleaning solvent should not have the strength to pull dyes, melt plastics and alter the color or texture of the material to be cleaned

The volatile cyclic silicones in conjunction with certain organic esters, ether and alcohols possess many unique physical and chemical qualities which conventional solvents cannot match. The preferred mixture of decamethylpentacyclosiloxane and 2-Ethyl Hexyl Acetate are unique for many reasons and are truly selective degreasing agents which are chemically inert to the dyed fibre of a fabric no matter if it is synthetic or natural. This means that the dye is not attacked or pulled from the fibre chemically, as it would be with the present solvents.

The uniform molecular weight of the volatile cyclic silicones and ester combinations give them the desired surface tension that is important for cleaning. Another major point of importance is that the volatile cyclic silicone fluid imparts a "Silky, Soft Hand" to virtually all fabric or textiles. This feature is important because PERC removes the oils of natural fibres and results in a harsh feel or texture.

The cyclic molecular structure makes them much more oxidation resistant than petroleum based materials. This makes distillation of a cyclic silicone much more reliable. This cyclic nature also makes the fluid penetrate the clothing fibres more readily, and releases entrapped soils.

The two main volatile cyclic silicones, namely the tetramer and the pentamer have a wide range in freezing points i.e. the freezing point for the tetramer is 12 degrees Celsius and the freezing point for the pentamer is -40 degrees Celsius. Each of these materials has unique physical properties which by themselves do not make them a viable degreasing solvent for use in a dry cleaning process. For example, the flashpoint of the pentamer is 77 degrees to 88 degrees Celsius but its firepoint is 102 degrees Celsius. Both the tetramer and pentamer can be mixed together to create the desired composition or formula with the right flammability characteristics as well as its freezing point. The preferred ester additive, 2-Ethyl Hexyl Acetate also has a high flashpoint and an extremely low freezing point.

Therefore, the preferred mixture shall be less than 40% EHA and more than 50% pentamer. This range will allow for the development of solvent compositions which are suitable for most dry cleaning operations. Although the EHA ester is the preferred material, there are numerous materials from the ester, ether and alcohol families, which may exhibit similar capabilities as mentioned earlier. The following is a list of chemicals which can be used as a replacement for EHA in the preferred mixture:

Esters

Dibasic Esters

Glycol Ether DiPropylene Methyl (DPM) Acetate. The DPM in Glycol Ether DiPropylene Methyl (DPM) Acetate means DiPropylene Methyl for the chemical dipropylene glycol methyl ether acetate (CAS# 88917-22-0)

Glycol Ether EthylButyl (EB) Acetate. The EB in Glycol Ether EthylButyl (EB) Acetate means Ethylene Butyl for the chemical ethylene glycol mono butyl ether acetate (CAS # 112-07-2).

Alcohols

2-Ethylhexyl Alcohol

Cyclohexanol

Hexanol

Ethers

Glycol Ether PTB

Glycol Ether DPTB

Glycol Ether DPNP

Although the above represent only a few of the likely additives to the volatile organo cyclic siloxanes, it is the scope of this invention to include those not listed.

It should also be noted that certain additives such as petroleum based derivatives i.e. mineral spirits, halogenated hydrocarbons may be added to the above formulae to attain certain cleaning and/or degreasing results which may not be achievable solely by the above composition.

The following lists various materials compositions relative to the above:

Composition-1:

Tetramer-75% by weight

EHA- 25% by weight

Composition - 2:

EHA - 50% by weight

Pentamer - 50% by weight

Composition - 3:

EHA - 30% by weight

Pentamer - 70% by weight

Composition - 4:

Tetramer - 15% by weight

Pentamer - 55% by weight

EHA - 30% by weight

Composition - 5:

EHA - 85% by weight

Pentamer - 15% by weight

Although the above compositions are mainly based on the volatile organo cyclic siloxanes and EHA, it is within the scope of this invention that the following ranges of composition mixtures are contemplated:

EHA - 1% to 99% by weight

Pentamer - 1% to 99% by weight

Tetramer - 1% to 99% by weight

Combinations of the aforementioned solvents or by themselves may be modified and enhanced in one embodiment of the dry cleaning method of the present invention. The modification is in the form of adding soil suspending additives to prevent re-deposition of dirt during the wash and rinse cycle, detergents for water-base stains, and disinfectants for the disinfection of bacteria and other forms of microorganisms which are present in all clothing. It should be noted that the additive may be included as a component of the solvent solution or as a separate agent

A suitable detergent, compatible with the siloxane solvent hereof, is disclosed herein and forms a part of the invention. The detergent comprises an amphipathic molecular configuration having a highly hydrophobic linear or cyclic organo-silicone backbone with hydrophilic polar side-chain substitutions and comprising a pure organic molecule or mixed organo-silicone molecule having 1 to 300 moles of polar fingers. Such polar fingers may be ionic. Further, ionic surfactants may be employed in conjunction with the solvent.

The design of a preferred detergent formulation for the volatile silicone solvent should have the following molecular characteristics, in whole or in combination with others:

1. An amphipathic molecular configuration that consists of a highly hydrophobic linear or cyclic backbone with hydrophilic polar side-chain substitutions or "fingers" arrayed from the backbone. The backbone may be a pure organic molecule or a mixed organo-silicone molecule
2. 1-300 moles of polar fingers per molecule.
3. 20% to 90% by weight of polar fingers.
4. Hydrophile: Lipophile Balance (HLB) of 4 to 18.
5. Where the hydrophilic fingers result from substitutions of the hydrophobic backbone through reactions with ethylene oxide and/or propylene oxide to create polyethers.

Examples of such material compositions that use organo-silicate backbones are:

1. Cyclic Organo-silicone products developed by, and currently available from, General Electric Silicones Division, Waterbury, NY and known by their designated product names as:

SF-1288 (Cyclic Organo-silicone backbone; 66% by weight of ethylene oxide polar fingers)

SF-1528 (Cyclic Organo-silicone backbone; 24% by weight of ethylene oxide and propylene oxide polar fingers; dissolved (10% in 90%) in pentamer).

SF-1328 (Organo-silicone backbone, 24% by-weight of ethylene oxide and propylene oxide polar fingers; dissolved (10% in 90%) in a tetramer and pentamer mixture).

SF-1488 (Organo-silicone backbone; 49% by weight of ethylene oxide polar fingers)

2. Organo-silicone products developed by and currently available from Dow Corning Corp., Midland MI, and known by their designated product names as:

3225C (Organo-Silicone backbone; ethylene oxide and propylene oxide polar fingers, dissolved in chyclomethicone).

3. A series of linear organic polyethers with ethylene oxide polar fingers developed by Air Products and Chemicals, Inc , Allentown PA and known by their designated product names as:

Surfynol 420 (20% by weight, of ethylene oxide polar fingers).

Surfynol 440 (40% by weight, of ethylene oxide polar fingers)

Surfynol 465 (65% by weight, of ethylene oxide polar fingers)

The preferred detergent is an 80:20 combination of GE SF-1528 and Surfynol 440.

The above categorizes the basis of the preferred detergent for use with volatile silicone solvents.

The principal intent of this disclosure is to address the fact that volatile silicone solvents should have added compatible detergents in order to fulfill the required dry cleaning parameters required by the industry.

Preferred detergent compositions are as follows:

1. SF-1328 (50%-90%, by weight), and Surfynol 420 (50%-10%, by weight)

2. SF-1328 (70%-95%, by weight), and Surfynol 440 (30%-5%, by weight)

3. SF-1328 (60%-95%, by weight), and SF-1488 (40%-5%, by weight)
4. SF-1528 (60%-95%, by weight), and Surfynol 420 (40%-5%, by weight)
5. SF-1528 (70%-95%, by weight), and Surfynol 440 (30%-5%, by weight)
6. SF-1528 (60%-95%, by weight) and SF-1488 (40%-5%, by weight)
7. SF-1528 (50%-85%, by weight), Surfynol 440 (49%-5%, by weight) and SF-1288 (1%-10% by weight)
8. SF-1528 (50%-70%, by weight), Surfynol 440 (49%-5%, by weight), and SF-1488 (1%-25%, by weight).

It should be noted that the above formulations and materials are merely examples of material composition that will achieve the desired objective, in this case a detergent. Any organic, and/or organo-silicone-based detergent such as the numerous aforementioned organic and/or inorganic organo-silicone compounds may be used to achieve the desired result along with any other related detergent which is compatible with the volatile silicone dry cleaning solvents as long as it removes water-soluble soils from fabrics and prevents their redeposition during the following dry cleaning process.

The following steps more specifically describe the dry cleaning method of the preferred embodiment.

At step 1 garments or other items to be dry cleaned are placed in a vertical combination washer dryer with a horizontally rotating agitating cleaning basket (known to those skilled in the art). The barrel of the basket will have numerous holes or perforations, preferably each hole will be 0.3175 to 1.27 centimetres in diameter. One of the main reasons for these hole sizes, is to take advantage of the low surface tension of this cyclic siloxane to allow the immediate removal of the same during centrifugation.

At step 2 the wash cycle is initiated with the solvent consisting of a combination of the tetramer and pentamer cyclic siloxane. The preferred combination is 80% tetramer and 20% pentamer by weight. In the alternative, the cyclic siloxane solvent may include any of the aforementioned combinations. The additives which modify the above mixture may be added separately just before the washing cycle and need not be part of the solvent composition. The use of these additives, namely detergents and suspending agents, allows the solvent to perform a total garment cleaning process. The solvent and detergent (if used) is pumped from a holding tank into the cleaning basket. The items being cleaned are agitated, such that the mechanical rubbing of the clothes and the penetrating solvent dissolves and loosens dirt, debris and body fats from the fabric fibres, said agitation lasting from 1 to 15 minutes. During the cleaning cycle, the solvent and the detergent mixture (if used) is pumped out of the basket through a "button trap" and then across a filter. The filter system helps to remove the particulate and impurities from the mixture. At times a choice of a "batch" solvent flow may be used wherein the mixture may not be exposed to the filter system, but be pumped from the button trap directly back to the

basket. In the alternative, any type of cartridge, discs, flex-tubular, rigid-tubular either individually or in combination. As yet another option, the filtration system further comprises either an additive such as carbon or diatomaceous earth.

At step 3 the items having been cleaned, the mixture is pumped from the basket to the working tank or still and then the articles are centrifuged to remove as much mixture as possible and pump or gravity feed the remaining mixture to its destination. The centrifuging process lasts from 1 to 7 minutes depending on the articles and greater than 350 Revolutions Per Minute (RPM); preferably between 450 to 750 rpm. This operation leaves no more than 2-5%, or typically 3%, solvent residue in the items being cleaned. The higher the rpm, the faster the solvent is removed by the centrifugal force of the spinning basket. The very low surface tension of the solvent maximises the efficiency of solvent removal via this centrifugal process.

At steps 4 and 5 the garments are tumbled in the basket and heated to a temperature between 43 to 77 degrees Celsius. The temperature is measured as the vapour-laden air exits the cleaning basket at the pre-condensation point. The heating is accomplished by passing pressurised steam through a coil that heats up the air inside the basket through the use of a circulating fan. While this is happening, a partial vacuum can optionally be created inside the machine at negative pressure between 6.67 kPa and 80 kPa (where atmospheric pressure is 101.3 kPa), thereby reducing the vapour points of said composition such that recovery time can be shortened. During this heating cycle, the solvent mixture is vaporised and carried by circulating air to a refrigerated condensing coil that condenses the vapours to a liquid that is collected out of the main air stream. The air stream may then be heated again in a closed loop-type system. In time, typically 10 to 55 minutes, the solvent mixture is removed from the articles and recovered for reuse.

At step 6 the heating cycle is stopped and the cooling cycle begins. The cooling cycle may take between 1 to 10 minutes. The temperature is reduced from a range of 43 to 77 degrees Celsius to below 38 degrees Celsius, preferably in a range between 21 to 38 degrees Celsius. This is accomplished by eliminating the heat and circulated about the heated coil without steam flowing through the coils. The cleaning process is completed when the garments are removed from the machine at the cooled down temperature to reduce secondary wrinkling. Removing the garments at a high temperature would cause wrinkling.

At step 7 the contaminated siloxane solvent is reprocessed and purified through vacuum distillation by way of the liquid ring pump method or the venturi method with additional fan assist. This is accomplished by pumping the solvent with impurities into a vacuum still whose chamber is evacuated to assist the drying process. Heat is generated

through steam energised coils in contact with the chamber in the range of 110 to 149 degrees Celsius.

The cyclic siloxanes have boiling points over 66 degrees Celsius. For example, the tetramer has a boiling point over 79 degrees Celsius and the pentamer has a boiling point over 98 degrees Celsius. To distil these siloxanes at their normal boiling point without vacuum temperatures can assist the cause of chemical destruction, i.e., the ring structure is broken down to a linear structure over 66 degrees Celsius and results in the formation of formaldehyde. In one embodiment of the present invention, it is economically advantageous that provisions be made to purify and recover the contaminated cyclic siloxane which will keep their cyclic ring structure intact, bringing the reprocessed solvent. Vacuum distilling the contaminated cyclic siloxane solvent (s) eliminates the low boiling point contaminants, including residual water, as well as high boiling point contaminants.

It has been discovered that the cyclic siloxanes, namely, the tetramer and pentamer will azetrope at a low temperature such as 98 degrees Celsius, resulting in pure water and pure solvent with the solvent's contaminated solubles remaining behind as a residue.

CLAIMS:

1. A method of dry cleaning articles comprising the acts of:
immersing said articles to be dry cleaned in a dry cleaning fluid including a cyclic siloxane composition, wherein said cyclic siloxane composition further is modified with a chemical that is selected from the group of chemicals including 2-ethylhexyl acetate, esters, dibasic esters, glycol ether dipropylene methyl acetate, glycol ether ethylene butyl acetate, 2-ethylhexyl alcohol, cyclohexanol and hexanol;
agitating said articles in said cyclic siloxane composition;
removing said cyclic siloxane composition from said articles by centrifugal action and by circulating air about said articles; and
maintaining the temperature of said circulating air between 43 to 77 degrees Celsius during the removal of said cyclic siloxane composition from said articles.
2. The method of claim 1, wherein said cyclic siloxane composition comprises a cyclic siloxane composition selected from the group including pentamer, tetramer, and hexamer cyclic siloxanes.
3. The method of claim 2, wherein said cyclic siloxane composition comprises a detergent.
4. The method of claim 1, wherein said articles are contained in a cleaning basket that includes a plurality of holes having diameters between 0.3175 and 1.27 cm.
5. The method of claim 1, wherein said articles in said cyclic siloxane compositions are agitated for a time between 1 minute and 15 minutes.
6. The method of claim 1, further comprising the step of filtering said cyclic siloxane composition for removing impurities that have entered said cyclic siloxane composition when said articles are agitated.
7. The method of claim 6, wherein said filtering is carried out by a filtration system taking the form of at least one of a cartridge, a disc, a flexible tube, and a rigid tube.
8. The method of claim 7, wherein said filtration system further comprises an additive selected from the group of media including absorbing carbon and diatomaceous earth.
9. The method of claim 1, further comprising the act of vacuum distilling said cyclic siloxane composition for purification from non-volatile residue.
10. The method of claim 9, wherein said vacuum distillation is carried out by at least one of the liquid ring pump method and the venturi method or with fan assist.
11. The method of claim 1, wherein said centrifugal action includes spinning said articles at a rate greater than 350 RPM.

12. The method of claim 11, wherein said centrifugal action has a duration between one and seven minutes.

13. The method of claim 1, wherein said articles after being centrifuged are heated by circulating air (measured at the vapour laden point) between 43 to 77 degrees Celsius for the removal of said cyclic siloxane composition from said articles.

14. The method claim 13, wherein the drying chamber is subjected to a partial vacuum between 6.67 kPa and 80 kPa which reduces vapour pressure and reduces recover time.

15. The method of claim 1, wherein said articles may be comprised of synthetic or natural articles or combinations thereof.