

United States Patent

Piepmeyer

[15] 3,635,656

[45] Jan. 18, 1972

[54] DRYCLEANING METHOD

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[22] Filed: Jan. 11, 1971

[21] Appl. No.: 105,671

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 717,466, Mar. 29, 1968, abandoned.

[52] U.S. Cl.8/142, 252/118, 252/152, 252/162

[51] Int. Cl.D06F 1/00

[58] Field of Search8/142; 252/118, 152, 162

[56] References Cited

UNITED STATES PATENTS

2,165,356 7/1939 Dunbar282/153

3,345,123 10/1967 Chisholm8/142

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[57] ABSTRACT

A process for drycleaning fabrics such as garments and other drycleanable materials, particularly highly soiled garments, by using hydrocarbon and chlorinated hydrocarbon solvents. The process includes a plurality of phases in a cleaning cycle wherein soiled garments are agitated in drycleaning solvent in each of the phases by mixing the solvent of a first phase with a detergent having a substantivity for the garments, removing the solvent of the first phase from the garments while the detergent is substantively retained by the garments and combining the solvent of a second phase with the garments containing the detergent for continued cleaning.

13 Claims, No Drawings

DRYCLEANING METHOD

RELATED APPLICATION

This application is a continuation-in-part application of U.S. application Ser. No. 717,466, filed Mar. 29, 1968 by Joseph A. Piepmeyer is now abandoned.

BACKGROUND OF THE INVENTION

In the usual commercial practice of dry cleaning articles of clothing, the soiled garments are agitated in an organic solvent contained in a perforated cylinder to remove oil, grease stains and particles of soil. Small quantities of water and detergent are also added to the solvent to help remove water soluble soil and provide detergency. According to known practice, the dry cleaning solvent is repeatedly recirculated through a filter to remove the soil particles from the solvent. After this cleaning phase, the solvent is drained from the cylinder and the garments are extracted (spun) to remove the bulk of the solvent from the wet load. The residual solvent and moisture deposited in the clothes are then removed by drying.

This usual commercial practice is suitable for the average soiled domestic garment such as trousers or coats which generally never lose more than about 1 to 2 lbs. of soil per 100 lbs. of clothes cleaned. However, such practice is unsatisfactory when the soil load in dirty garments increases greatly, e.g., from about 10 to 50 times greater than that normally handled in dry cleaning the average soiled domestic garment. These high-soil loads are often found in the industrial garment of fabric. Typically, industrial garments such as wiper cloths can have more than 50 lbs. of soil in a 100 lb. load of dirty cloths. When these soiled industrial garments are agitated in the organic solvent which is then recirculated in the usual way through a filter to remove the soil particles suspended in the solvent, filtration problems are encountered. The soil load is so great that filter pressure raises at such a rate that usually only one to three loads can be processed before flow completely stops. This poor filtration or lack of filtration makes it virtually impossible to satisfactorily dry clean by this known practice.

The most common method perhaps for dry cleaning highly soiled garments requires an initial degreasing cycle. In the degreasing cycle, the dirty garments are flushed with solvent in a batch operation to remove the major portion of the solvent soluble soil. The solvent is then removed from the washing system by extraction (spun off) and sent to a still along with dissolved grease, suspended insoluble soil, etc. After degreasing, new solvent is brought into contact with the clothes in the washer and this solvent is repeatedly recirculated through a filter to remove supposedly insoluble soil that was not removed in the degreasing cycle. Then the washer is isolated from the filtration equipment and put back on a batch operation in which soap, water and usually size are added to remove the water soluble soil and starch the garments.

In this last mentioned method, the dry cleaning technique is so completely unsatisfactory that the garments must be washed after dry cleaning to make them presentable to customers. Because degreasing solvent has essentially no ability to suspend insoluble soil, it will redeposit back onto the garment almost immediately unless removed from the system. However, since the garments cannot be safely filtered in view of the soil load, redeposition of insoluble soil on the garment takes place before the solvent is removed, especially in this batch operation. Many dingy and dirty garments generally come out of this cleaning cycle because of these conditions. Moreover, when water soluble soil is attempted to be removed from the garment as to the last laundering phase of this known method, this attempt not only fails to remove the water soluble soil but also tends to degrade garments much faster than even the degreasing operation.

It has, therefore, become essential that a dry cleaning technique be provided which offers a satisfactory solution to the problems encountered in the presently proposed methods of cleaning highly soiled garments of the industrial type. There

is a need for a dry cleaning process which not only removes all major types of soil adequately but also prevents degradation of the fabric or garment. This is especially true since newly developed synthetics and synthetic blends, particularly those treated with permanent press finishes, cannot satisfactorily be washed. Moreover, it is important that other properties be obtained in such a process which make the garments presentable in addition to being clean.

SUMMARY OF THE INVENTION

This invention provides a process for effectively dry cleaning soiled fabrics such as industrial and domestic garments without degrading the fabric. Remarkably, according to this invention, highly soiled garments containing as much as 100 percent by weight or more of grease, dirt, grime and perspiration can be economically cleaned to provide soft, antistatic, nonwrinkled and comfortable garments. At the same time, the disadvantages heretofore encountered in the mentioned known dry cleaning methods have virtually been eliminated.

According to the principles of this invention, in a dry cleaning process having a plurality of phases in a cleaning cycle wherein soiled garments are agitated in a dry cleaning solvent, a substantive detergent is mixed with the solvent in a first phase. This detergent has a "substantivity," i.e., a specific or preferential affinity for the fabric or garment even in the presence of the dry cleaning solvent such that when the solvent is removed from the first phase, the detergent remains substantively associated with the garment and is carried over into a second phase of the operation for continued cleaning of the garment.

This invention is predicated in part upon the discovery that specific detergents can be introduced into the first phase of a two-phase dry cleaning cycle and these detergents can effectively be carried over into a second cleaning phase for continued cleaning. This process has been found to provide a number of remarkable results. First, it affords more cleaning time than prior art multiphase methods because the substantive detergent remains in contact with the garment in the first cleaning phase, during transfer to the second cleaning phase and also in the second phase, thereby providing detergency during the entirety of the multiphase cycle.

Moreover, it has been found that the use of a substantive detergent according to this invention provides a way to remove the bulk of the insoluble soil, solvent soluble soil, etc., in the initial cleaning phase without requiring filtration and without adverse redeposition of the soil particles. Thus, these heretofore serious problems are eliminated by extracting solvent (spinning off) from the first phase instead of filtering while the substantive detergent prevents redeposition of the soil. This process affords the advantage of doubling the work load of a detergent since by reason of its substantivity for the fabric, it is carried over into the second phase rather than being lost with the solvent of the first phase when the latter is removed to the still.

In a presently preferred mode, the process according to this invention is practiced by injecting an amphoteric or cationic substantive detergent as a water dispersion or solution into the solvent of the first phase, i.e., the degreasing or initial flush phase. This is done in the conventional perforated cylinder on a batch operation. The presence of water is preferred because it provides a less viscous liquid for injection, aids in the removal of water insoluble soils and is also substantive for the fabric which further enhances cleaning. By using this injection technique, the amount of water and detergent can also be better controlled.

Detergents of the cationic type which have been found to possess a desirable substantivity include cation-active agents of the type disclosed in U.S. application Ser. No. 539,675 directed to "Dry Cleaning Method and Detergents Therefore," filed Apr. 4, 1966, now abandoned, and two derivative U.S. applications based thereon, namely, a continuation-in-part application, Ser. No. 870,388 and a divisional application

Ser. No. 871,734, both filed Oct. 27, 1969. These cationic agents have been fully described in these applications along with their methods of preparation and that disclosure is incorporated herein by reference. Briefly, cationic agents of this invention include betaines and quaternary ammonium compounds. Specific examples of betaines include the following:

Imidazoline betaines, such as 1-hydroxyethyl, 1-carboxyethyl, 2-pelargonyl (nonyl) imidazoline; 1-hydroxypropyl, 1-carboxyethyl, 2-lauryl imidazoline, pyridine betaines, such as N-dodecyl pyridinyl acetic acid; piperidine betaines, such as N-hexadecylpiperidinopropionic acid; aliphatic and carbocyclic betaines, such as N-dodecyl-, N-bis(β-hydroxyethylamino)-acetic acid; N-octadecyl-N-β-hydroxyethyl-N-carboxymethylaminopropionic acid; N-hexadecyl-N, N-bis-carboxymethylaminopropionic acid; N-dodecyl-N-β,α-bis-hydroxypropyl-N-carboxypropylaminopropionic acid; N-heptadecyl-N, N-hydro-ethoxyethyl-N-carboxymethylaminopropionic acid; N-dodecyl-N-β-hydroxyethyl-N-methyl-β-aminosuccinic acid; N-heptadecyl-N, N-bis-hydroxyethylaminopropionic acid; N-dodecylphenyl-N, N-bis-hydroxyethylaminopropionic acid; N, N-bis dodecyl-N-β-hydroxyethylaminopropionic acid; and betaines with hetero atoms in the hydrophobic chains such as dodecyloxypropyldimethyl aminoacetic acid, and mixed C₁₂ to C₁₈ alkoxyethyldimethyl aminopropionic acid.

Typical of the quaternary ammonium compounds may be mentioned cetyl pyridinium acetate; methyl cetyl piperidinium propionate, hydroxyethyl octadecyl morpholinium methosulfate, octyltrimethyl ammonium phosphate, N-oleylamidopropyl N, N, trimethyl ammonium dimethophosphate p-stearamidophenyl trimethyl ammonium ethosulfate, N, N dilauryl, N, N dimethyl ammonium diethophosphate.

It is to be understood that other detergents or surfactants can demonstrate a substantivity for the fabric such as the anionic and nonionic detergents commonly used in dry cleaning. The anionic detergents contain a negatively charged ionic-containing portion and an oil dispersible (dry cleaning solvent soluble) cationic portion in the detergent molecule. The detergent may be (1) of the group of saponified fatty acids or soaps, or (2) of saponified petroleum oil such as sodium salts or organic sulfonates or sulfates, or (3) of saponified esters, alcohols or glycols, with the latter being well known as anionic synthetic detergents. Examples of these anionic detergents include the alkylaryl sulfonates or amine salts thereof such as sulfonates of dodecyl benzene or diethanolamine salt of dodecyl benzene sulfonic acid; the sulfates of straight chain primary alcohols, or fatty alcohols (C₆-C₂₄) which are products of the Oxo process (i.e., sodium lauryl sulfate). A saponified light petroleum oil such as sulfonated petroleum distillation residue (e.g., mahogany oil) is suitable. In general, the majority of dry cleaning detergents of the "anionic" type are alkali or amine salts of organic acids. Frequently, sulfonic acids are employed where the structure of the organic portion is not well known, as in the case of familiar "petroleum sulfonates." Most of these sulfonates contain many chemical species. The class name given to most of them is "alkylaryl sulfonate." Simply, this means that a paraffinic hydrocarbon is bonded to an aromatic or benzene hydrocarbon nucleus (usually benzene or naphthalene) and the aromatic portion has been sulfonated. Examples of saponified fatty acids (C₆-C₂₄) are the sodium or potassium salts of myristic, palmitic, stearic, oleic or linoleic acids or mixtures thereof. Also, in this class of anionic detergents are alkali and alkaline earth metal salts of neutral phosphoric acid esters of oxyalkylated (e.g., oxyethylated) higher alkyl phenols or aliphatic monohydric alcohols. Examples are potassium and sodium salts of phosphate esters of isodecyl alcohol, ethylene oxide adducts. Thus, herein anionic detergents include soaps, which are preferably synthetic detergents of the class of alkali, alkaline and amine salts of the organic sulfonates, phosphates or sulfates. These soaps are prepared by well-known techniques which obviously form no part of this invention.

The nonionic detergents suitable for use commonly have hydrophilic portions or side chains usually of the polyoxyalkylene type. The oil soluble or dispersible part of the molecule is derived from either fatty acids, alcohols, amides or amines. By suitable choice of the starting materials and regulation of the length of the polyoxyalkylene chain, the deterative parts of nonionic detergents may be varied as is well known. Suitable examples of nonionic detergents include alkylphenoxy polyoxyethylene glycols, for example, ethylene oxide adduct of either octyl-, nonyl- or tridecyl- phenol and the like. These mentioned nonionic detergents are usually prepared by the reaction of alkyl phenol with ethylene oxide and commercial products are sold under the trademarks Triton x-100 by Rohm and Haas Co. or "Tergitol" by Union Carbide and Carbon Corporation. Other specific examples of nonionic detergents include glyceryl monooleate, oleyl monoisopropanolamide sorbitol dioleate, alkylol amides prepared by reacting alkanolamides such as monoisopropanolamine, diethanolamine, or monobutanolamine with fatty acids such as oleic, pelargonic, lauric and elaidic.

Surfactants normally classified as anionic, cationic or nonionic are of wide spread use in the dry cleaning industry and it will be understood that other typical examples of detergents which have a substantivity for the fabric are suitable in accordance with the principles of this invention. Reference is made to National Institute of Drycleaning Bulletin, NID Bulletin T-403, Dec. 1963; McGraw-Hill Encyclopedia of Science and Technology, Volume 13, pages 321-322 (1960) and the Condensed Chemical Dictionary, 5th Ed. by Rhinehold Publishing Company, page 348, (1956) for a discussion of these different types of detergents in general.

The most essential characteristic of the detergent or a mixture of detergents suitable in accordance with this invention is its substantivity for the fabric in the first phase of the cleaning cycle in the presence of dry cleaning solvent and this characteristic controls its applicability here. Also, the substantive detergents can be soluble or dispersible either in the dry cleaning solvent or water and even both. While the presence of water is preferred for the above mentioned reasons, solvent can be used alone. The amount of substantive detergent to solvent employed is in the range of from about 0.1 to 1 percent by volume of solvent. The amount also depends upon the number of pounds of garment and it may be stated in general that the quantity of detergent is in the range of from about 0.01 to 5.0 ounces per pound of garment load.

The dry cleaning solvents suitable for use in this invention include hydrocarbon and chlorinated hydrocarbon solvents, e.g., Stoddard solvent and perchloroethylene or trichlorethylene or mixtures of these solvents; and other conventional dry cleaning solvents.

As mentioned, in the preferred form, the water is added in the initial phase of the batch operation in a limited amount. The exact amount depends upon the type of garment and the soil load, but it has generally been found that water in an amount of about 0.1 ounce up to an amount of about 1 ounce of water per pounds of garment load is preferred. Below the lower limit of about 0.1 ounce of water, the water gradually diminishes in its effectiveness for reducing viscosity and removing water soluble soil. Above 1 ounce, the water tends to shrink and distort fibers of the fabric.

After the first phase of the cleaning operation, substantially all of the solvent is extracted (e.g., spun off) and sent to the still. The remaining garments contain the substantive detergent in a substantive amount (with perhaps moisture when water has been added). Substantivity tests have demonstrated, for example, with betaine detergents of the type mentioned above, that as much as 100 percent of substantive detergent is retained by various fabrics, after extraction of first phase solvent, for continued detergency during extraction and in the second phase of the cleaning cycle. This substantivity varies, for example, with the type of fabric and detergent, the electronic attraction between them and the specific affinity that a particular detergent has for a certain type fabric in the

presence of solvent or water. For instance, while one substantive betaine detergent (oleylimidazolium propiobetaine) has been found to be about 100 percent retained by 100 percent polyester fabric, about 70 percent of the same betaine is retained by 100 percent cotton or a blend of 65-35 percent cotton-polyester. Having found that advantageous results of this invention can be obtained by the use of substantive detergent, the invention should not be limited to specific percents of substantive detergent retained. Ordinarily, however, it has been found that the detergent will be retained by the fabric or associated with the fabric in an amount of about 10 to 15 percent or about 40 to 50 percent and even up to about 70 to 100 percent of the original amount of detergent charged.

The second phase of the process can be conducted by merely adding the solvent of a second phase to the garments which contain the substantive detergent and cleaning can be continued. However, further in accord with this invention, this second phase is used to impart other desirable properties to the garment. Thus, preferably a solvent solution of the second phase is charged to the garments in the washer and this solvent solution is constantly being filtered. This filtration can be accomplished here because the bulk of the soil load, like solvent soluble soil, insoluble soil, excess water, etc., has been removed effectively without soil redeposition occurring.

As just mentioned, the second phase of the process can be used to impart other desirable properties to the garment by adding other additives. In one embodiment, a nonionic surfactant is present in the solvent of this second phase to synergistically act with the preferred amphoteric or cationic detergent, or optionally anionic detergent, and contribute other properties to the garment, such as softness, antistatic ability and non-wrinkledness. For example, a number of nonionic, anionic and cationic agents employed in this second phase of the cycle are those of the type described above or identified in the above-mentioned applications and that disclosure is incorporated herein by reference. The ratio of cationic or anionic detergent to nonionic surfactant may vary over a wide range but preferably should be from about 1:20 to 6:2. Specific examples of such nonionics are glyceryl monooleate, oleyl monoisopropanolamide, sorbitol dioleate, and alkylol amides prepared by reacting alkanolamides such as monoisopropanolamine, diethanolamine, or monobutanolamine with fatty acids such as oleic, pelargonic, lauric, elaidic and other preferably liquid acids. Also, these nonionic surfactants or optionally other additives can be present in the solvent of the second phase in combination with additionally charged ionic detergents such as 1-hydroxyethyl 1-carboxyethyl, 2-oleylimidazoline and cationic detergents of the type exemplified above. The added ionic detergent can be present in the solvent of the second phase with nonionic detergent in the ratio of about 1:20 to 6:2.

The following examples further illustrate the practice of this invention.

EXAMPLE I

Distilled perchloroethylene solvent containing water and a substantive detergent are injected into the cleaning wheel of a Permac Bôwe SE 120 ME (about 110 gallon capacity) industrial dry cleaning containing 100 lbs. of soiled industrial shirts until the wheel is filled to one-third of its capacity with solvent. The solvent is pumped from a distilled solvent tank; and water and a substantive detergent are injected upstream via spray nozzles under 50 p.s.i. air and water pressures. Seventy-five ounces of water are injected along with 30 ounces of the substantive detergent composition containing 19 percent of 1-hydroxyethyl, 1-carboxyethyl, 2-oleylimidazoline and the balance composed of 9.5 percent triethylene glycol (coupling agent), 5 percent anhydrous isopropanol (viscosity modifier), 1.3 percent phosphoric acid (stabilizer) and 65.2 percent water. The loaded wheel is agitated or "batched" for 5 minutes and then the solvent is drained and extracted by centrifugation to a still leaving about 3 ounces or 50 percent by

weight of the charged substantive detergent (1-hydroxyethyl, 1-carboxyethyl, 2-oleylimidazoline) deposited on the shirts. The amount of substantive detergent deposited or retained by the shirts is determined by analyzing the substantive detergent contained in the drained solvent and subtracting that amount from the total added. The wheel is then recharged with perchloroethylene solvent containing 0.39 percent by volume of a detergent composition comprising 59 percent by weight oleylmonoisopropanolamide, 29 percent by weight of 1-hydroxyethyl, 1-carboxyethyl, 2-oleylimidazoline, and 12 percent by weight perchloroethylene. The shirts are agitated for an additional eleven minutes during which time the solvent is constantly recirculated from the wheel through a filter to remove insoluble oil. At the end of the cleaning cycle the free solvent is drained and the solvent absorbed in the clothes is extracted by centrifuge and stored in a filtrate tank for reuse. The shirts are dried and removed from the wheel.

EXAMPLE II

Distilled perchloroethylene solvent containing water and a substantive detergent are injected into the cleaning wheel of a Detrex Crown 100 dry cleaning machine (about 90 gallon capacity) containing 100 lbs. of soiled industrial pants until the wheel is filled to one-third of its capacity with solvent. The solvent is pumped from a distilled solvent tank; and water and a substantive detergent are injected upstream via spray nozzles under 41 p.s.i. air and water pressures. Twenty-five ounces of water are injected along with 15 ounces of the substantive detergent composition specified in example I. The cleaning cycles of example I are then repeated here with results being obtained similar to those of example I.

EXAMPLE III

Distilled Stoddard solvent containing water and a substantive detergent are injected into the cleaning wheel of a Washex P-65 dry cleaning machine (about 60 gallons capacity) containing 65 lbs. of industrial shirts until the wheel is filled to one-third of its capacity with solvent. The solvent is pumped from a distilled solvent tank; and water and a substantive detergent are injected upstream via spray nozzles under 56 p.s.i. air and water pressure. 48.7 ounces of water are injected along with 9.75 ounces of the substantive detergent specified in example I.

The loaded wheel is agitated or "batched" for about 6 to 10 minutes, then the solvent is drained and extracted by centrifuge to a still, leaving about 1 ounce of the substantive detergent (1-hydroxyethyl, 1-carboxyethyl, 2-oleylimidazoline) deposited or retained by the shirts. The wheel is recharged with perchloroethylene solvent containing 0.39 percent by volume of oleylmonoisopropanolamide. The continuous second phase of the cleaning cycle in example I is repeated here, after which the shirts are freed of solvent and dried.

EXAMPLE IV

Distilled Stoddard solvent containing water and a substantive detergent are injected into the cleaning wheel of a Washex P-65 dry cleaning machine (about 60 gallons capacity) containing about 65 pounds of industrial garments, e.g., cotton fabrics or cotton-polyester fabrics, until the wheel is filled to one-third of its capacity with solvent. The solvent is pumped from a distilled solvent tank; and water and a substantive detergent are injected upstream by spray nozzles under about 60 p.s.i. air and water pressure. About 65 ounces of water are injected along with about 26 ounces of a substantive detergent consisting of a diethanolamine salt of dodecylbenzene sulfonic acid. The wheel is agitated or "batched" for about 6 to 10 minutes, then the solvent is drained and extracted by centrifuge to a still, leaving about 10.4 ounces (or 40 percent by weight) of the anionic detergent deposited or retained by the garments. The amount of substantive detergent deposited or retained by the garments is determined by analyzing the substantive detergent contained in the drained

solvent by anionic-cationic titration with alkyl dimethylbenzyl ammonium chloride by common titration procedure ASTM Standard Method D1681-62 and subtracting that amount from the total of about 26 ounces which are previously added. The wheel is recharged with perchloroethylene solvent and the continuous second phase of the cleaning cycle as in example I is repeated here, after which the garments are freed of solvent and dried.

EXAMPLE V

The procedures of example IV are repeated except that the anionic detergent employed is a potassium salt of the phosphate ester of isodecyl alcohol-ethylene oxide adduct having 9 moles of ethylene oxide, e.g., "TriFac 9-10K" by Trylon Chemical Co. The amount of detergent deposited or retained by the garments is about 5.2 ounces (20 percent by weight) after the cleaning cycle of the first phase for use in the second phase.

EXAMPLE VI

Distilled perchloroethylene solvent containing water and a nonionic substantive detergent are injected into the cleaning wheel of a Prosperity 7-B dry cleaning machine (about 25 gallons capacity) containing about 25 pounds of industrial garments, e.g., cotton or cotton-polyester fabrics, until the wheel is filled to one-third of its capacity with solvent. The solvent is pumped from a distilled solvent tank; and water and a nonionic substantive detergent are injected upstream by spray nozzles under about 30 p.s.i. air and water pressure. About 25 ounces of water are injected along with about 2.5 ounces of a nonionic substantive detergent consisting of octylphenol-ethylene oxide adduct having an average of 10 moles of ethylene oxide per mole of octyl phenol, e.g., "Triton X-100" sold by Rohm & Haas. The wheel is agitated or batched for about 3 to 5 minutes, then the solvent is drained and extracted by centrifuge to a still, leaving about 1.1 ounces (45 percent by weight) of the substantive detergent (octylphenolethylene oxide adduct) deposited or retained by the garments. This is determined by ultraviolet spectrophotometric examination of the drained solvent for the amount of detergent therein and subtracting that amount from the amount originally added. The wheel is recharged with only perchloroethylene solvent to about one-third of its capacity and the continuous second phase of the cleaning cycle is accomplished by agitating the garments for an additional 10 minutes. At the end of the second phase cleaning cycle, free solvent is drained from the garments and they are dried.

EXAMPLE VII

The procedures of examples VI are repeated except that the nonionic detergent employed is a diethanolamine condensate of coconut fatty acid wherein 2 moles of the amine are condensed with 1 mole of fatty acid, i.e., "Monamine 100" by Mona Chemical Co. The amount of nonionic detergent deposited or retained by the garments is about 25 ounces (100 percent by weight) as determined by said ASTM Standard Method D1681-62 as in example IV, after the cleaning cycle of the first phase for use in the second phase.

It is to be understood that these foregoing examples illustrate various embodiments of this invention and there are modifications which can be made thereto according to the foregoing description or the skill of the art without departing from the spirit and scope of this invention.

What is claimed is:

1. A dry cleaning process having a plurality of phases in a cleaning cycle wherein soiled garments are agitated in a hydrocarbon dry cleaning solvent in each of the phases, the steps of,

mixing the solvent of a first phase with a detergent having a substantivity for said garments,

extracting substantially all of the solvent of said first phase with the bulk of the soil from said garments at the end of said first phase cleaning cycle while at least a portion of said detergent is substantively retained by said garments, and

combining the solvent of a second phase with said garments containing the substantively retained detergent for continued cleaning in said second phase cleaning cycle.

2. The process according to claim 1 wherein said detergent is a cationic detergent.

3. The process according to claim 2 wherein said cationic detergent is selected from the group consisting of betaines and quaternary ammonium compounds.

4. The process according to claim 1 wherein said detergent is present in an amount of from about 0.01 to 5.0 ounces per pound of garment load.

5. The process according to claim 4 wherein said detergent is present in an amount of from about 0.1 to 1.0 percent by volume of said solvent.

6. The process according to claim 1 wherein water is also mixed with the dry cleaning solvent of said first phase in an amount of from about 0.1 to about 1 ounce of water per pound of garment load.

7. The process according to claim 6 wherein said water is added to said detergent before mixing with said solvent.

8. The process according to claim 7 wherein said detergent is a cationic detergent selected from the group consisting of betaines and quaternary ammonium compounds.

9. The process according to claim 1 wherein said mixing takes place in a batch operation and said solvent of the second phase is combined with said garments in a continuous operation.

10. A dry cleaning process having a plurality of phases in a cleaning cycle wherein heavily soiled garments are agitated in a hydrocarbon dry cleaning solvent in each of the phases consisting essentially of,

mixing the solvent of a first phase with water and a cationic detergent having a substantivity for said garments, said detergent selected from the group consisting of betaines and quaternary ammonium compounds,

extracting substantially all of the solvent of said first phase with the bulk of the soil from said garments at the end of said first phase cleaning cycle while at least a portion of said detergent is substantively retained by said garments to prevent adverse redeposition of the soil onto said garments, and

combining the solvent of a second phase with said garments containing the substantively retained detergent for continued cleaning in said second phase cleaning cycle.

11. The process according to claim 10 wherein said solvent of said second phase contains a nonionic surfactant.

12. A process according to claim 11 wherein the ratio of detergent of said nonionic surfactant is from about 1:20 to 6:2.

13. The process according to claim 10 wherein said detergent is present in an amount of from about 0.01 to 5.0 ounces per pound of garment load, said water is present in an amount of from about 0.1 to 1 ounce per pound of garment load and said solvent contains said detergent in an amount of from about 0.1 to 1 percent by volume of said solvent.

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