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(54) **UNIT FOR DRY CLEANING TEXTILE ARTICLES USING A COMPOSITE SOLVENT AND FOR RECYCLING THE USED COMPOSITE SOLVENT FOR RE-USE**

(71) Applicant: **ARCANE INDUSTRIES**, Aubagne (FR)

(72) Inventors: **Alfred TESTA**, Fuveau (FR); **Jean-Philippe TESTA**, Aubagne (FR)

(73) Assignee: **ARCANE INDUSTRIES**, Aubagne (FR)

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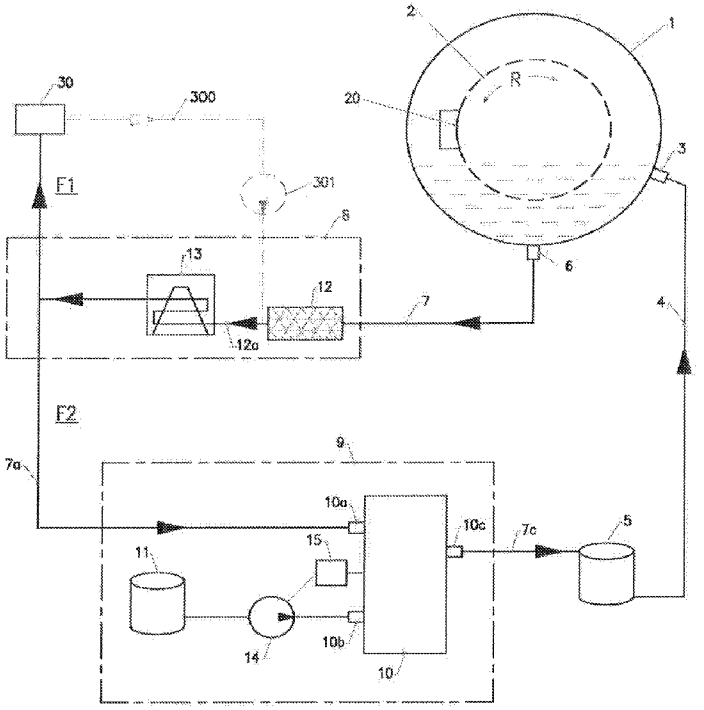
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(57) **ABSTRACT**

The invention relates to a unit for dry cleaning textile articles using a composite solvent comprising multiple components, said unit including: a dry cleaning chamber (**1**) configured to mix the textile articles to be cleaned with the composite solvent during a cleaning cycle; a device (**7**) for recovering the used composite solvent after a cleaning cycle; a treatment device (**8**) for removing water and dirt and recycling at least part of the used composite solvent in order to use same in another dry cleaning cycle. The unit is characterised in that it also comprises a re-adjustment device (**9**) for re-adjusting the composition of the recycled composite solvent, incorporating therein at least the part of the component(s) that was lost in the treatment device (**8**), said re-adjustment device comprising at least: a buffer tank (**10**) provided with at least one supply inlet (**10***a*) for the recycled composite solvent, at least one supply inlet (**10***b*) for at least the part of the component(s) of the composite solvent to be introduced into the buffer tank (**10**) in order to re-adjust the composition of the recycled composite solvent, and at least one outlet (**10***c*) for the re-adjusted and recycled composite solvent, said outlet (**10***c*) being connected to the storage tank (**5**) for the dry cleaning composite solvent; a storage tank (**11**) for one or more components of the dry cleaning composite solvent; and a metering pump (**14**) for metering the quantity of the component(s) of the composite solvent to be introduced into the buffer tank (**10**) through the inlet (**10***b*) in order to re-adjust the composition of the recycled composite solvent, said pump being linked upstream to at least one storage tank (**11**) containing one or more components of the dry cleaning composite solvent.



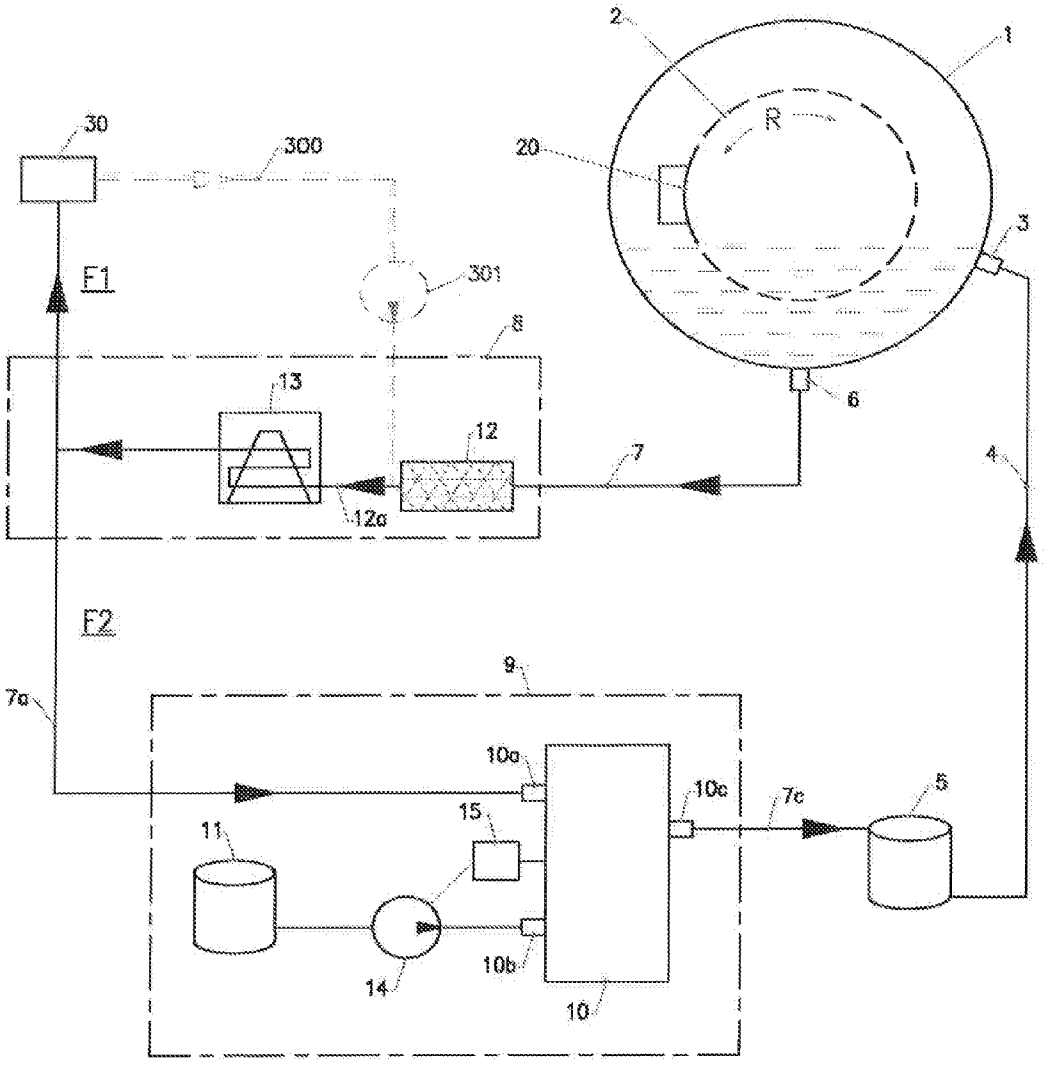

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Fig. 1

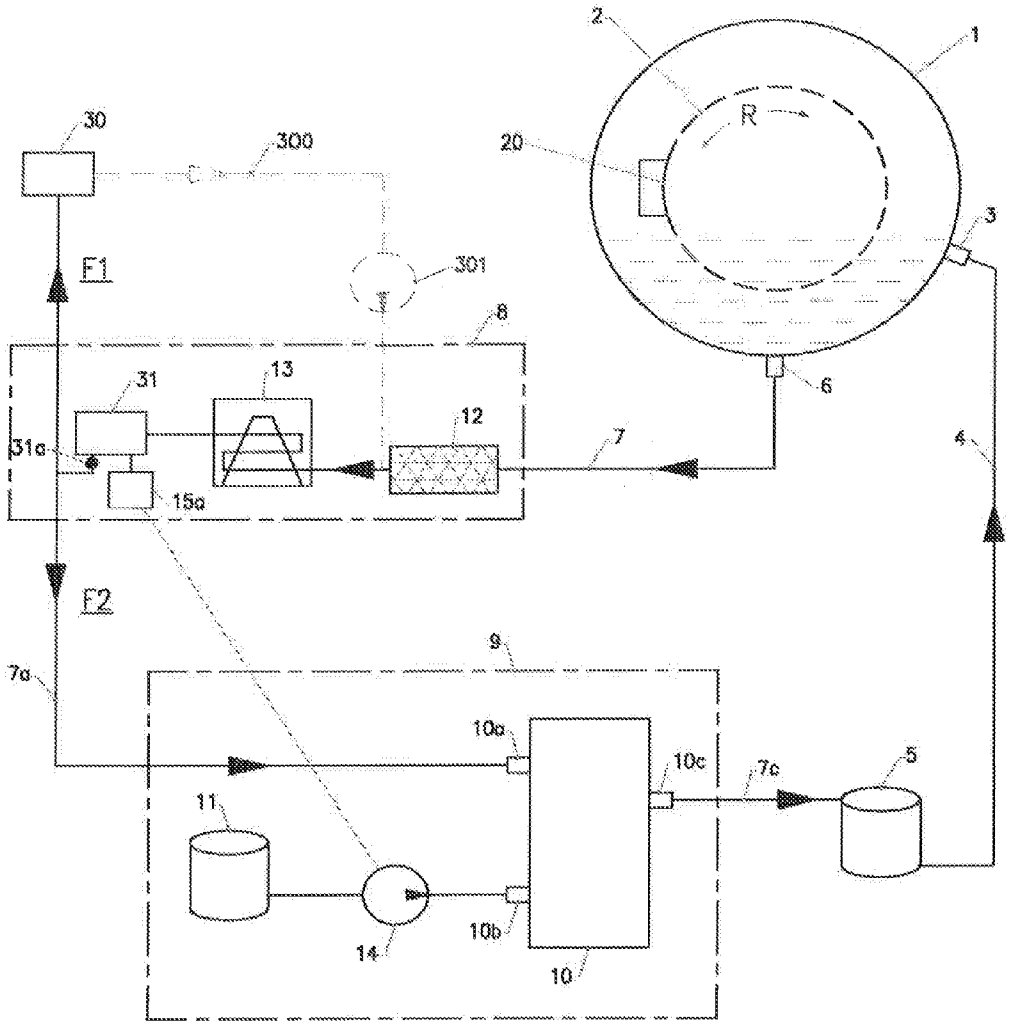

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Fig. 2

UNIT FOR DRY CLEANING TEXTILE ARTICLES USING A COMPOSITE SOLVENT AND FOR RECYCLING THE USED COMPOSITE SOLVENT FOR RE-USE

TECHNICAL FIELD OF THE INVENTION

[0001] The invention has for object a unit for dry cleaning textile articles using a composite solvent comprising multiple components and for recycling used composite solvent for the purposes of re-using it.

[0002] The technical field of the invention can, in general, be defined as that of techniques for dry cleaning clothing, textiles, fabrics and similar items, and more particularly techniques for recycling dirty solvents in order to re-use them.

STATE OF THE ART

[0003] The methods for dry cleaning textile articles use, in the washing phase, an organic solvent. The latter can be a single-component solvent such as perchloroethylene which is classified as a possible carcinogen (category 3) by the European Union and which is now banned in France, or a composite solvent comprising multiple components such as aqueous solutions of propylene glycol ethers (see for example the documents of U.S. Pat. No. 6,273,919 (Hayday, W. A.), U.S. Pat. No. 7,144,850 (Galick et al.)); mixtures of C_{10}-C_{13} aliphatic hydrocarbons such as the solvent Ecosolv® marketed by Chevron Phillips®; compositions comprising a volatile siloxane and an organic surfactant, and optionally water (see U.S. Pat. No. 6,521,580 (Perry et al.)); or compositions comprising a siloxane solvent and/or a hydrocarbon solvents and an amplifying compound with a KB value of the composition (US2012/0085634 (Douglas et al.).

[0004] Typically, a method for dry cleaning textile articles comprises the steps consisting in: (a) placing the textile articles to be cleaned in contact with the liquid solvent in a washing and drying machine provided with a cleaning and stirring basket in rotation about a horizontal axis; (b) subjecting the textile articles in the presence of the solvent to rotation movements (alternating-reversed) in order to ensure removal of the dirt contaminating the textile articles; (c) extracting the used solvent from the basket by pumping, (d) subjecting the cleaned textile articles to centrifugation in order to extract the greatest possible amount of used solvent, and (e) removing the residual solvent by vaporization by injecting a flow of hot air through the textile articles.

[0005] After a dry cleaning cycle, the recovered solvent, is most often contaminated by different sorts of dirt, namely (i) insoluble dirt such as dust, balls or isolated strands of textile fibers and dyeing pigments detached from cleaned articles and (ii) soluble dirt such as fat, fatty acids coming from transpiration, coloring agents, etc. The recovered solvent is also very often contaminated by the water that comes from the relative humidity of the air, moisture (ex. sweat) contained in the textile articles to be cleaned, and/or the water introduced into the cleaning device following operations of pre-treating textile articles for example with aqueous stain-removing or aqueous pre-brushing solutions.

[0006] However, for reasons concerning public health and protecting the environment, but also the cost of the solvent, it is not desirable to discard the used solvent. It is as such common to recycle, in particular by distillation, the used solvent in the same dry cleaning machine for the purpose of re-using it in one or several new dry cleaning cycles.

[0007] Document US2012/0085634 (Douglas et al.) discloses a method for dry cleaning textile articles using a composition constituted of a dry cleaning agent comprising a siloxane solvent, a hydrocarbon solvent or mixtures thereof and an amplifying compound, which makes it possible to increase a KB value of said composition. This method also comprises the recycling via distillation of the used cleaning composition for the purpose of re-using it. However, this method requires the implementing of a first energy-consuming atmospheric distillation (at more than 100° C.) but above all time-consuming, during which the water, azeotropes, and other volatile compounds are removed, followed by a second distillation under reduced pressure (at around 150° C.) during which the dry cleaning agent and the amplifying compound are recovered and redirected to the storage tank in order to be re-used. This method is delicate to implement for the recycling for the re-use of composite solvents of which the components can be broken down or be hydrolyzed at such temperatures or form separate azeotropes between them and/or with the water, making the distillation complicated and difficult to manage in the dry cleaning machine.

[0008] As such, in light of the above, this invention has for purpose to propose a method and a unit for dry cleaning textile articles using a composite solvent comprising multiple components, which also makes it possible to satisfactorily regenerate the used solvent for the purpose of a second use.

[0009] This invention also has for purpose to propose such a method and such a unit that are simple and safe and which can adapt to different composite solvents.

DISCLOSURE OF THE INVENTION

[0010] The solution proposed by the invention is a unit for the dry cleaning of textile articles using a composite solvent comprising several components, said unit comprising:

[0011] a dry cleaning chamber configured to mix, during a cleaning cycle, the textile articles to be cleaned with the composite solvent,

[0012] a device for recovering the used composite solvent after a cleaning cycle,

[0013] a treatment device for removing water and dirt and recycling at least a portion of the used composite solvent for the purpose of using it for another dry cleaning cycle.

[0014] This unit is remarkable by the fact that it further comprises a re-adjustment device for re-adjusting the composition of the recycled composite solvent by incorporating therein at least the portion of the component or components that was lost in the treatment device, said re-adjustment device comprises at least:

[0015] a buffer tank provided with at least one supply inlet for the recycled composite solvent, with at least one supply inlet of at least the portion of the component or components of the composite solvent to be introduced into said buffer tank in order to re-adjust the composition of the recycled composite solvent, and with at least one outlet of the recycled and re-adjusted composite solvent, with this outlet being connected to the storage tank for the dry cleaning composite solvent,

[0016] a storage tank of one or several components of the dry cleaning composite solvent, and

[0017] a metering pump of the quantity of the component or components of the composite solvent to be introduced into the buffer tank through said inlet for the re-adjustment of the composition of the recycled composite sol-

vent, this pump is connected upstream to at least one storage tank containing one or several components of the dry cleaning composite solvent.

[0018] The advantages of this invention consist in that the unit can be applied to the dry cleaning composite solvents currently available in the market, in particular to composite solvents of which the components can form between them and/or with water separate azeotropes and as such make the regenerating by distillation of the used composite solvent complicated and difficult to manage in the dry cleaning machine. The unit of the invention also has the advantage of allowing for the re-use of the recycled composite solvent and in optimum conditions. Indeed, thanks to the step of re-adjusting, the recycled composite solvent recovers at least the portion of the component or components or at least the component or components that were lost during the step of treatment, and/or of recycling, with the step of treatment able to be carried out for example by filtration followed by a conventional distillation, preferably in a vacuum, then by settling; or by fractionated distillation, preferably in a vacuum.

[0019] Other preferred characteristics of the invention are listed hereinbelow, with each one of these characteristics able to be considered individually or in combination with the remarkable characteristics defined hereinabove:

[0020] Preferentially, the re-adjustment device is provided with an analyzer making it possible to analyze the composition of the recycled composite solvent, in such a way as to determine the quantity of the component or components of the composite solvent to be taken from the storage tank or tanks of one or several components of the dry cleaning composite solvent, and to be introduced into the "buffer" tank.

[0021] In particular, the cleaning chamber is provided with a perforated drum intended to receive the textile articles to be cleaned, said perforated drum being mounted rotatingly in said chamber, with the latter having:

[0022] an opening for the placing of textile articles to be dry cleaned in the perforated drum, with this opening able to be closed by a door or a porthole,

[0023] an orifice connected to a duct for introducing the composite solvent which is placed in a storage tank.

[0024] an orifice connected to the recovery device.

[0025] According to an embodiment, the treatment device for the used composite solvent comprises at least one filtration device for filtering insoluble dirt contained in said used composite solvent and a fractionated distillation unit, said treatment device comprising:

[0026] an outlet for the removal of an overhead fraction F1 representing less than 15% $w/w_{used\ composite\ solvent}$ and containing at least water, one or several azeotropes formed between the water and one or several components of the composite solvent, and

[0027] an outlet for the recycling of an intermediate fraction F2 representing more than $w/w_{used\ composite\ solvent}$ and containing the dry cleaning composite solvent less at least one portion, by weight, of one or of several of its components, said intermediate fraction F2 being placed after recycling in a buffer tank.

[0028] According to another advantageous detail, the fractionated distillation unit is provided with a collection container configured to receive in a first step the overhead fraction F1 before it is discharged to the removal tank, then in a second step, the intermediate fraction F2 before it is sent to the buffer tank, said collection container:

[0029] having a drawing-off point in its lower portion, through which the overhead fraction F1 and the intermediate fraction F2 are removed to their respective tanks; and

[0030] being provided with an analyzer making it possible to analyze the physical and/or chemical characteristics of the overhead fraction F1 or of the intermediate fraction F2 in such a way as to determine the quantity of the component or components of the composite solvent to be introduced into said buffer tank.

[0031] Advantageously, the removal tank intended to contain the overhead fraction F1, comprises a duct connected to an injection device making it possible to inject, after N dry cleaning cycles, said fraction F1 into the fractionated distillation unit for the purpose of separating it into at least two fractions: one overhead fraction F'1 intended to be removed, and a fraction F'2 intended to be added, before the re-adjusting of the recycled composite solvent, to the intermediate fraction F2 collected after the cycle N of dry cleaning.

[0032] Particularly advantageously, the dry cleaning composite solvent implemented in the unit according to the invention, comprises at least:

[0033] 40% to 80% $w/w_{composite\ solvent}$ of dipropylene glycol monomethyl ether,

[0034] 5% to 40% $w/w_{composite\ solvent}$ of an amphiphilic solvent A having the following formula: $R—(O—C_3H_6)_n—OH$ (I) wherein n is an integer equal to 1 or 2, and R an alkyl group in C_3 or in C_4,

[0035] 10% to 40% $w/w_{composite\ solvent}$ Of a dibasic ester B selected from the group comprising dimethyl succinate, dimethyl glutarate, dimethyl adipate and mixtures thereof, and −0% to 10% $w/w_{composite\ solvent}$ of additional components.

DESCRIPTION OF THE FIGURES

[0036] Other advantages and characteristics of the invention shall appear better when reading the following description of a preferred embodiment, in reference to the annexed drawings, provided by way of example for the purposes of information and not restricted and wherein:

[0037] FIG. **1** diagrammatically shows a unit in accordance with the invention.

[0038] FIG. **2** diagrammatically shows an alternative according to the invention.

EMBODIMENTS OF THE INVENTION

[0039] This invention is based on the experimental findings that the used composite solvents recovered after a first dry cleaning cycle of textile articles, recycled, in particular via distillation, and used again in another cleaning cycle, are less effective in removing hydrophilic dirt and/or hydrophobic dirt than starting composite solvents. This drop in performance can be explained by the fact that during the recycling operations, in particular via distillation, composite solvents lose one or several of their components or a portion of one or more of their components. Such a loss of component(s) or portion of component(s) induces a modification in the composition of the recycled composite solvents, and therefore a significant modification in the dry cleaning properties. The applicant resolved this problem of a decrease in performance experienced by the recycled composite solvents, by incorpo-

rating into the composition of the latter at least the portion of the component or components that was lost during the recycling operations.

[0040] In this text:

[0041] "composite solvent" means solvent containing at least two components playing an essential role in conferring properties of dry cleaning of textile articles.

[0042] "dry cleaning" means the cleaning wherein the composite solvents double as a solvent or cleaning liquid as a replacement for water.

[0043] "textile articles" means the object used in a personal or professional framework (e.g. various industries, hospitals, etc.), and manufactured using natural fibers such as cotton, wool, flax, silk or others, and/or from synthetic fibers such as nylon, polyamide, acrylic, polyester, acetate, viscose, or others. As examples of textile articles can be mentioned shirts, pants, sweaters, vests, coats, tablecloths, covers, sheets, napkins, quilts, leather clothing, suede, etc.

[0044] "dirt" means the dirt, whether hydrophilic or hydrophobic, soluble in the composite solvent, and the dirt that is insoluble therein such as dust, balls or isolated strands of textile fibers and dyeing pigments detached from cleaned articles or others.

[0045] "hydrophobic dirt" means the dirt contaminating the textile articles and which is generally comprised of organic matter or materials that do not have an affinity for water and which are insoluble therein. By way of non-restricted examples of "hydrophobic dirt" fat, oil, mayonnaise, mustard, body oils, tar or motor oil stains etc. can be mentioned.

[0046] "hydrophilic dirt" means the dirt contaminating the textile articles and which is mainly comprised of organic or inorganic matter that have certain affinities with water and which are entirely or partially soluble therein. By way of non-restricted examples of "hydrophilic dirt", body fluids such as sweat, blood, urine, food products that are soluble in water such as sugar, salt, chocolate, fruit juices, tea, coffee, etc. can be mentioned.

[0047] "major portion" according to the invention means the initial composition of the composite solvent used for the dry cleaning of textile articles, less at least a portion, by weight, of one or several components of the composite solvent lost during the steps of treating and of recycling the used composite solvent.

[0048] The percentages, content and ratios used hereinbelow are all given in relation to the total weight of the composition "$w/w_{composite\ solvent}$", unless mentioned otherwise.

Method for Dry Cleaning Textile Articles and for Recycling the Used Composite Solvent

[0049] This invention first aims for a method for dry cleaning textile articles using a composite solvent comprising multiple components and recycling used composite solvent for the purpose of re-use. Advantageously, this method comprises:

[0050] a) a dry cleaning cycle comprising the putting of the textile articles to be cleaned in contact with the composite solvent,

[0051] b) the recovery of the used composite solvent contaminated by the water and the dirt after the dry cleaning cycle,

[0052] c) the treatment of the used composite solvent in such a way as to remove at least the water and the dirt,

[0053] d) the recycling of at least a portion of the composite solvent treated in the step c) for the purpose of using it for another dry cleaning cycle,

[0054] e) the re-adjusting of the composition of the recycled composite solvent in the step d) by incorporating into this composition at least the portion of the component or components of the composite solvent that was lost during the steps c) and/or d).

[0055] By way of example of composite solvents comprising multiple components and suitable for the dry cleaning of textile articles according to this invention the composite solvent S can be mentioned that comprise at least:

[0056] dipropylene glycol monomethyl ether (DPM),

[0057] an amphiphilic solvent A having the following formula: $R—(O—C_3H_6)_n—OH$ (1) wherein n is an integer equal to 1 or 2, and R an alkyl group in C_3 or in C_4, and

[0058] a dibasic ester B selected from the group comprising dimethyl succinate, dimethyl glutarate, dimethyl adipate and mixtures thereof.

[0059] This composite solvent S was recently developed by the Applicant who was able to demonstrate that it manifests a strong cleaning power with regards to hydrophobic dirt (fat in particular), but also with regards to hydrophilic dirt (organic matter or water soluble minerals) which can appear on textile articles. The Applicant also demonstrated that such a composite solvent can be can be adapted to the type of dirt (hydrophobic or hydrophilic) as well as to the type of textile articles to be dry cleaned by varying the proportions of the three essential ingredients namely dipropylene glycol monomethyl ether, the amphiphilic solvent A and the dibasic ester B. The Applicant also noted that this composite solvent also has the advantage of maintaining, in a solution or in a suspension, the liquid or solid dirt extracted during the operation of dry cleaning preventing it as such from being re-deposited on the cleaned textile articles.

[0060] This composite solvent S can advantageously replace perchloroethylene (PERC) which is classified as a possible carcinogen (category 3) by the European Union and which is now banned in France for its use in dry cleaning machines.

[0061] The Applicant was further able to demonstrate that the best dry cleaning results were obtained with composite solvents S comprising: (i) dipropylene glycol monomethyl ether (DPM), mono-n-butyl ether of dipropylene glycol (PnB) and of dibasic ester DBE; (ii) dipropylene glycol monomethyl ether (DPM), mono-n-butyl ether of dipropylene glycol (DPnB) and of dibasic ester DBE; or (iii) dipropylene glycol monomethyl ether (DPM), mono-tert-butyl ether of dipropylene glycol (DPtB) and of dibasic ester DBE; or (iv) dipropylene glycol monomethyl ether (DPM), mono-n-butyl ether of dipropylene glycol (DPnB), mono-n-propyl ether of dipropylene glycol (DPnP), and of dibasic ester DBE; or (v) dipropylene glycol monomethyl ether (DPM), mono-n-butyl ether of dipropylene glycol (DPnB), mono-n-butyl ether of propylene glycol (PnB), and of dibasic ester DBE.

[0062] Note: The preferred dibasic ester (DBE) according to the invention is the dibasic ester Rhodiasolv® RPDE marketed by Rhodia.

[0063] This composite solvent S (or these composite solvents) can advantageously further comprise all sorts of additional components normally used in the field of dry cleaning. By way of example, additional components can be chosen from antioxidants, disinfecting agents, perfumes and mix-

tures thereof. These additional components can be present in the composition according to this invention in a quantity between 0.001% and 10% in $w/w_{composition}$ without substantially affecting its advantageous properties.

[0064] By way of example of antioxidant agents (or stabilizers) 2,6-di-$_{tert}$-butyl-p-methylphenol (BHT), 2-$_{tertio}$-butyl-4-hydroxyanisole (2-BHA) and 3-tertio-butyl-4-hydroxyanisole (3-BHA) or mixtures thereof can be mentioned. Such antioxidant agents have for function to prevent or decrease or delay a possible formation of peroxides.

[0065] By way of examples of disinfecting agents, quaternary ammonium salts, aldehydes, phenolic derivatives, halogenated compounds (e.g. iodinated), alcohols or others can be mentioned. Such disinfecting agents will have the role of making possible an action of disinfection of the textile articles to be cleaned, in particular household, medical or veterinary laundry. They furthermore have a cleaning action of the chamber devoted to dry cleaning.

[0066] A preferred composite solvent S for the implementing of the method of dry cleaning articles according to this invention, comprises:

- **[0067]** 40% to 80% $w/w_{composite\ solvent}$ of dipropylene glycol monomethyl ether,
- **[0068]** 5% to 40% $w/w_{composite\ solvent}$ of an amphiphilic solvent A having the following formula: $R—(O—C_3H_6)_n—OH$ (I) wherein n is an integer equal to 1 or 2, and R an alkyl group in C_3 or in C_4,
- **[0069]** 10% to 40% $w/w_{composite\ solvent}$ of a dibasic ester B selected from the group comprising dimethyl succinate, dimethyl glutarate, dimethyl adipate and mixtures thereof, and –0% to 10% $w/w_{composite\ solvent}$ of additional components.

[0070] Such a composite solvent S further has the advantage of being able to be prepared by any method of mixing known to those skilled in the art, using non-toxic components, classified as easily biodegradable, inexpensive and available in the market. It advantageously has the form of a limpid and colorless liquid and can be conditioned, in anhydrous state, in any contained able to receive a liquid, such as for example, a storage tank made of steel or from plastic materials such as polyethylene and polypropylene.

[0071] However, the Applicant was able to note that using such a composite solvent S in the form of an aqueous solution containing more than 8% $w/w_{composite\ solvent}$ s of water, does not result in optimum dry cleaning.

[0072] The step a) of the method according to this invention, can be carried out by any method of dry cleaning known to those skimmed in the art. Generally, the textile articles are: i) placed in a washing and drying machine (known to those skilled in the art) comprising for example a leaktight chamber which is provided with a rotating perforated drum and which is connected to a solvent circuit comprising a solvent circulation device, ii) placed in contact with the composite solvent, for example par immersion, iii) stirred in the composite solvent according to the movement of rotation (alternating-reversed) in order to allow for the dissolution of the dirt contaminating the textile articles, iv) spun through centrifugation in order to extract the largest possible quantity of the used composite solvent, and dried v) in order to remove the residual solvent, for example by injecting a flow of hot air through the textile articles.

[0073] In practice, the phase of stirring iii) can be carried out at a temperature ranging from 15° C. to 60° C. according to the composite solvent used and the textile articles to be cleaned. This phase of stirring iii) can be repeated several times, for example two times. The hot air injected during the drying phase v) has a temperature greater than 40° C., preferably between 60° C. to 80° C., according to the composite solvent used and the textile articles to be cleaned.

[0074] After this dry cleaning cycle, textile articles with the dirt removed and used composite solvent are obtained. In practice, the used composite solvent is recovered in the step b), on the one hand, by pumping at the step of spinning iv) and, on the other hand, by cooling the vapors generated during the step of drying v).

[0075] The solvent recovered as such is generally contaminated by various sorts of dirt, namely (i) insoluble dirt such as dust, balls or isolated strands of textile fibers and the dyeing pigments detached from cleaned articles and (ii) soluble dirt, whether hydrophilic or hydrophobic, such as fat, fatty acids coming from transpiration, etc. At this stage, the used composite solvent recovered is also contaminated by the water which comes from the relative humidity of the air and/or the moisture (ex. sweat) contained in the textile articles to be cleaned, and/or the water introduced into the cleaning device following the operations of pre-treating textile articles for example with aqueous stain-removing or aqueous pre-brushing solutions.

[0076] By way of example, the preferred composite solvent S developed by the Applicant (described hereinabove) is contaminated at this stage by at least 0.5% $w/w_{composite}$ solvent S of water, in particular by at most $w/w_{composite\ solvent}$ S of water, as well as by insoluble dirt and soluble dirt.

[0077] The step c) of the method of this invention has for purpose to purify the used composite solvent recovered in the step b) by removing at least the water, the dirt.

[0078] In an advantageous embodiment, the removal of the insoluble dirt is carried out via filtration on means of filtration selected in the group constituted by button (or pin) filters, carbon filters and combinations thereof. This filtration is constant from the beginning to the end of the dry cleaning cycle. The used composite solvent filtered as such is subjected to fractionated distillation. This fractionated distillation is, preferably, conducted under reduced pressure, in such a way as to remove an overhead fraction F1, on the one hand, and to collect an intermediate fraction F2, on the other hand.

[0079] The overhead fraction F1 represents less than 15% $w/w_{used\ composite\ solvent}$ and contains at least water and one or several azeotropes formed between the water and one or several components of the composite solvent. The overhead fraction F1 can also contain one or several components or a portion of one or of several components of the distilling composite solvent at the same time as the water without necessarily forming azeotropes with the water.

[0080] Note: the expression "$w/w_{used\ composite\ solvent}$" means that the percentage is calculated in relation to the total weight of the used solvent to be treated by fractionated distillation.

[0081] The intermediate fraction F2 shows more than 75% $w/w_{used\ composite\ solvent}$ and contains more preferably the dry cleaning composite solvent less at least one portion, by weight, of one or of several of its components, said portion was removed, for example, with the overhead fraction F1 and/or was lost in the bottom fraction of distillation as explained hereinbelow.

[0082] From a safety standpoint, the bottom fraction of the fractionated distillation is generally not recovered. It is withdrawn from the distillation unit and transferred to a tank for

later treatment. This bottom fraction can contain insoluble dirt and/or soluble dirt. It can also contain another portion, by weight, of one or several components of the composite solvent, even one or several components of the composite solvent of which the boiling point is too high even under reduced pressure, such as antioxidants, disinfectants and surfactants which are possibly included in the composition of the dry cleaning composite solvent.

[0083] The step of treating c), more preferably, by filtration followed by fractionated distillation, can be carried out during or in parallel to the dry cleaning cycle mentioned in the step a).

[0084] By way of example, in the case of the preferred composite solvent S developed by the Applicant (see hereinabove), and contaminated by 5% $w/w_{used\ composite\ solvent}$ S of water:

[0085] the overhead fraction F1 removed by fractionated distillation in the step c), distils at a temperature less than 82° C. and under a pressure of 65 mBars (or at a temperature between 20° C. and 121° C. under 267 mBars) and comprises at least water, dipropylene glycol monomethyl ether, and where applicable an amphiphilic solvent A' having the following formula: R'—O—C_3H_6—OH (I') wherein R' represents an alkyl group in C3 or in C4. This overhead fraction F1 can further comprise a fraction <20% $w/w_{overhead\ fraction\ F1}$ in dibasic ester according to the conditions chosen for the fractionated distillation. It represents less than 15% $w/w_{used\ composite\ solvent\ S}$.

[0086] and,

[0087] the intermediate fraction F2 collected by fractionated distillation in the step b) distils at a temperature greater than 83° C., more preferably between 83° C. and 140° C., under a pressure of 65 mBars. This intermediate fraction F2 represents more than 75% $w/w_{used\ composite\ solvent\ S}$, more preferably more than 95% $w/w_{used\ composite\ solvent\ S}$.

[0088] By way of example of amphiphilic solvent A', mono-n-butyl ether of propylene glycol, mono-iso-butyl ether of propylene glycol, mono-tert-butyl ether of propylene glycol, mono-n-propyl ether of propylene glycol, mono-iso-propyl ether of propylene glycol and mixtures thereof can be mentioned.

[0089] The intermediate fraction F2 collected in the step c) therefore has a composition which is different from that of the composite solvent used for dry cleaning. In order to be able to use this fraction F2 in another dry cleaning cycle of textile articles, its composition has to be re-adjusted.

[0090] In practice, the intermediate fraction F2 (or recycled composite solvent) is transferred from the treatment unit to a reserve tank wherein it composition will be supplemented by incorporating therein at least the portion, by weight, of the component or components that was lost during the step c).

[0091] By way of example, in the case of the preferred composite solvent S, the portion to be incorporated into the composition of the recycled composite solvent (here the intermediate fraction F2) in the step d) comprises at least dipropylene glycol monomethyl ether, and where applicable one or several amphiphiles A having the following formula R—$(O—C_3H_6)_n$—OH (I) wherein n is an integer equal to 1 or 2, R represents an alkyl group in C_3 or in C_4. The portion, by weight, to be incorporated into the composition of the recycled composite solvent can further comprise one or several dibasic esters B and/one or several additional components.

[0092] The treatment and re-adjusting cycle represented by the steps c) to e) described hereinabove is entirely automatic and can be implemented during or in parallel to the dry cleaning phase of textile articles.

[0093] In the case of a treatment of the composite solvent by fractionated distillation, it may be useful to retreat the overhead fraction F1 removed during the fractionated distillation in order to, on the one hand, minimize the volume of the solvent discharge, and, on the other hand, offset a possible lack in selectivity of the fractionated distillation. To this effect, this invention propose to recover the overhead fraction F1 after N dry cleaning cycles and to subject it to a fractionated distillation. Typically, this second fractionated distillation is conducted in such a way as to remove an overhead fraction F'1, and to recover a fraction F'2, said fraction F'2 is intended to be added, before the step e) of re-adjusting, to the intermediate fraction F2 collected after the cycle N of dry cleaning. Generally, the overhead fraction F'1 removed during this second fractionated distillation contains a preponderant quantity of water. The number N of the dry cleaning cycles after said removed overhead fraction F1 must be recovered, can be determined by those skilled in the art according to the composition of the composite solvent implemented and the selectivity of the fractionated distillation. By way of a non-restricted example, in the case of the preferred composite solvent S of the invention, the overhead fraction F1 recovered is retreated by fractionated distillation every N cycles of dry cleaning, for example every 10 to 50 cycles of dry cleaning, preferentially every 20 to 30 cycles of dry cleaning. In this case, the fraction F'1 containing a preponderant quantity (>50% $w/w_{fraction\ F'1}$) of water, distils at a temperature less than 100° c. under 200 mBars and the fraction F'2 to be added to the fraction F2, distils under pressures less than 70 mBars.

Unit for the Dry Cleaning of Textile Articles and for the Regenerating of the Used Composite Solvent

[0094] The annexed FIGS. **1** and **2** schematize, according to two preferred embodiments, the organization of a unit in accordance with the invention. This unit comprises at least one dry cleaning chamber (**1**) configured to mix, during a cleaning cycle, the textile articles to be cleaned with the composite solvent; a tank (**5**) for storing the clean composite solvent; a device (**8**) for treating the used composite solvent in order to recycle the latter at least partially; and a device (**9**) for re-adjusting the composition of the recycled composite solvent. By way of example, the tank (**5**) can have a capacity of 120 liters in the case of a cleaning unit provided for 12 to 14 KG of textile articles to be cleaned.

[0095] A perforated drum (**2**), made of stainless steel, intended to receive the textile articles to be cleaned is mounted rotatingly in the cleaning chamber (**1**). Typically, this drum (**2**) is made of stainless steel, has a capacity of 200 L to 1500 L and can receive 9 Kg to 70 kg of textile articles to be dry cleaned. The rotating speed of the drum during a cleaning operation can vary for example from 1 revolution/minute to several hundred revolutions/minute, preferably from 300 rpm to 600 rpm, preferentially from 400 rpm to 500 rpm.

[0096] The cleaning chamber (**1**), which is furthermore leaktight, has at least one opening (**20**) for the placing of textile articles to be cleaned in the perforated drum (**2**), with

this opening (**20**) able to be closed (hermetically) by a door or a porthole; an orifice (**3**) connected to a duct for introducing (**4**) clean composite solvent which is placed in the storage tank (**5**); and an orifice (**6**) connected to a duct for recovering (**7**) used composite solvent after a cleaning cycle.

[0097] The duct for the introduction (**4**) is, generally, provided with at least the following means (not shown in FIG. **1**):

[0098] a supply pump for conveying the composite solvent stored in the tank (S) to the cleaning chamber (**1**),

[0099] means of heating, such as a heat exchanger, in order to increase the temperature of the composite solvent for the purpose of carrying out the cleaning of textile articles at a temperature higher than the ambient temperature, for example at a temperature between 25° C. and 50° C.,

[0100] means, such as a fan, for introducing a flow of hot air (heated to a temperature greater than 40° C., more preferably between 65° C. to 75° C.) in the cleaning chamber (**1**) with the purpose of drying the cleaned textile articles.

[0101] After a dry cleaning cycle, the used composite solvent is removed by the recovery duct (**7**). The latter is, generally, provided with at least:

[0102] one drain valve (not shown) controlled by a control device,

[0103] one removal pump (not shown) able, on the one hand, to suck the used composite solvent, and where applicable the residual, evaporated and condensed composite solvent, from the chamber (**1**), and, on the other hand, to transfer it to the treatment device (**8**) for the purpose of being recycled at least partially.

[0104] According to a preferred embodiment, the treatment device (**8**) is provided with a filtration device (**12**), such as a button (or pin) filter, an active carbon filter or combinations thereof, in order to clarify the used composite solvent, in particular in order to remove the insoluble dirt; and with a fractionated distillation unit (**13**) operating in such a way as to allow for, on the one hand, the removal of an overhead fraction F1 representing less than 15% $w/w_{used\ composite\ solvent}$ and containing at least the water, one or several azeotropes formed between the water and one or several components of the composite solvent; and, on the other hand, the recycling of an intermediate fraction F2 representing more than 75% $w/w_{used\ composite\ solvent}$ and containing the dry cleaning composite solvent less at least one portion, by weight, of one or of several of its components, said portion which was lost in the step of treatment c).

[0105] The fractionated distillation unit (**13**) comprises at least the following means (not shown in FIG. **1**): a distillation column provided at its base with a distiller and at its head with a condenser associated with a vacuum pump. Said distiller is supplied with used composite solvent, by the duct (**12***a*) and has for function to vaporize at least partially the used composite solvent. The operating conditions of said distiller are conventional and are according to the used composite solvent to be treated by fractionated distillation, with the latter able to be implemented by temperature gradient under a constant pressure, or by pressure and temperature gradient.

[0106] By way of example, in the case of the preferred composite solvent S (see hereinabove), the temperature in the distiller can be maintained at a value less than 250° C., for example at a value ranging from 25° C. to 180° C., preferably from 120° C. to 160° C. under a reduced pressure of 65 mBars.

[0107] The fractionated distillation unit (**13**) has at least a first outlet for the removal according to the arrow F1 of the overhead fraction F1 to a removal tank (or fluid container) (**30**) for later treatment for the purpose of re-use, and a second outlet for the recovery according to the arrow F2 of the intermediate fraction F2 which is sent via the duct (**7***a*) to the buffer tank (**10**) wherein it has to be re-adjusted for the purpose of being re-used in another dry cleaning cycle. By way of example, the capacity of the buffer tank (**10**) can be 60 liters in the case of a cleaning unit provided for 12 to 14 KG of textile articles.

[0108] According to a preferred alternative of the invention, the removal tank (**30**) containing the overhead fraction F1, comprises a duct (**300**) connected to an injection device (**301**) which makes it possible to inject, after N dry cleaning cycles, the fraction F1 into the fractionated distillation unit (**13**) for the purpose of separating it into at least two fractions: an overhead fraction F'1 intended to be removed, and a fraction F'2 intended to be added, before the step of re-adjusting e) of the recycled composite solvent, to the intermediate fraction F2 collected after the cycle N of dry cleaning.

[0109] More precisely, the re-adjustment device (**9**) of the composition of the recycled composite solvent is comprised of at least:

[0110] the buffer tank (**10**) provided with at least one supply inlet (**10***a*) for the recycled composite solvent (intermediate fraction F2), with at least one inlet (**10***b*) for the supply with at least the portion, by weight, of the component or components of the composite solvent to be introduced into the buffer tank (**10**) in order to re-adjust the composition of the recycled composite solvent (or intermediate fraction F2), and with at least one outlet (**10***c*) of the recycled and re-adjusted composite solvent, with this outlet (**10***c*) being connected to the storage tank (**5**) for the dry cleaning composite solvent,

[0111] a metering pump (**14**) of the quantity (predetermined) of the component or components of the composite solvent to be introduced into the buffer tank (**10**) through said inlet (**10***b*), this pump is connected upstream to at least one storage tank (**11**) of one or several components of the composite solvent. By way of example, the tank (**11**) can be of a capacity of 20 liters in the case of a cleaning unit provided for 12 to 14 KG of textile articles to be cleaned.

[0112] The re-adjustment device (**9**) can be provided with an analyzer (**15**) provided on the buffer tank (**10**) and which makes it possible to analyze the physical and/or chemical characteristics of the recycled composite solvent, in such a way as to determine the quantity of the component or components of the composite solvent to be introduced into this buffer tank (**10**). The analyzer (**15**) consists, for example, of a weight detector; a liquid level detector; a UV, visible or Infra-Red (IR) spectrometer; a refractometer; or other, said analyzer (**15**) being connected to a computer server of the type that integrates a processor and a memory wherein one or several computer programs are recorded. The latter integrate instructions that, when they are executed by the processor, make it possible to implement the functionalities defined hereinafter. The analyzer (**15**) analyzes the physical and/or chemical characteristics of the recycled composite solvent and transfers this data to the server. The latter compares the characteristics determined for the recycled composite solvent contained in the buffer tank (**10**) with those of the clean dry cleaning composite solvent. It is then possible to determine

the quantity of the component or components to be taken in the storage tank or tanks (**11**) and to be introduced into the buffer tank (**10**). The analyzer (**15**) as such transmits an adapted control instruction to the metering pump (**14**).

[0113] According to another alternative of the invention (FIG. **2**), the fractionated distillation unit (**13**) is provided with a collection container (**31**) configured to receive in a first step the overhead fraction F1 before it is removed according to the arrow F1 to the removal tank (**30**), then in a second step, the intermediate fraction F2 before it is sent according to the arrow F2 to the buffer tank (**10**). The collection container (**31**) has a drawing-off point (**31***a*) in its lower portion, through which the overhead fraction F1 and the intermediate fraction F2 are removed to their respective tanks. According to this alternative, the collection container (**31**) is provided with an analyzer (**15***a*) which makes it possible to analyze the physical and/or chemical characteristics of the overhead fraction F1 of the overhead fraction F1 or of the fraction F2 before they are removed from said collection container (**31**), in such a way as to determine as described hereinabove the quantity of the component or components of the composite solvent to be introduced into this buffer tank (**10**). The analyzer (**15***a*) can be of the same type as the analyzer (**15**) described hereinabove. According to this alternative, the buffer tank (**10**) can also be provided with the analyzer (**15***a*) (option not shown). According to another alternative (not shown) only the buffer tank (**10**) is provided with the analyzer (**15***a*).

[0114] Particularly advantageously, the dry cleaning composite solvent comprises at least:

[0115] 40% to 80% w/$w_{composite\ solvent}$ of dipropylene glycol monomethyl ether,

[0116] 5% to 40% w/$w_{composite\ solvent}$ of an amphiphilic solvent A having the following formula: R—(O—C_3H_6)$_n$—OH (I) wherein n is an integer equal to 1 or 2, and R an alkyl group in C_3 or in C_4,

[0117] 10% to 40% w/$w_{composite\ solvent}$ Of a dibasic ester B selected from the group comprising dimethyl succinate, dimethyl glutarate, dimethyl adipate and mixtures thereof, and

[0118] 0% to 10% w/$w_{composite\ solvent}$ of additional components.

[0119] The various pumps that are provided in the unit of this invention are for example pumps of the centrifuge, peristaltic or vortex type. And, the various ducts of the unit are provided with valves of which the arrangement makes it possible to circulate the fluids correctly. These various pumps as well as the various valves can be controlled independently of each other in order to provide optimum operation of the unit according to the invention.

[0120] The unit of this invention is advantageously a semi-industrial unit (hospitals, hotels . . .) or for launderette or a unit for household use.

[0121] Note:

[0122] the composite solvents of which example is mentioned in this description (dipropylene glycol monomethyl ether, amphiphilic solvent A and amphiphilic solvent A') can exist in the form of positional isomers, optical isomers or combinations thereof.

[0123] The term "and/or" used in certain passages of this description, includes the meanings and, or, as well as all other possible combinations of the elements connected with this term.

[0124] It is of course obvious that various alternatives and improvements can be made to the cleaning unit without however leaving the scope of the invention. As such:

[0125] the treatment device, in particular the distillation unit, can be arranged to the exterior of the cleaning unit, and where applicable connected to one or several other cleaning units.

[0126] the distiller of the distillation unit can be provided with a drawing-off point in its lower portion in order to recover the heavy fractions that have not distilled, for the purpose of later treatment.

EXAMPLES

Example 1

Preferred Dry Cleaning Composite Solvents

[0127] The preferred composite solvents 1 to 6 of the invention are prepared using the ingredients indicated in the table hereinbelow via any method known to those skilled in the art.

	Weight proportion (w/$w_{composite\ solvent}$) as % Examples:					
Ingredients	1	2	3	4	5	6
dipropylene glycol monomethyl ether (DPM),	64	70	70	58	58	64
mono-n-butyl ether of propylene glycol (PnB)						9
mono-n-butyl ether of dipropylene glycol (DPnB)	14	10	20	12	30	5
dibasic ester (DBE)	22	20	10	30	12	22

[0128] The dibasic ester DBE used in examples 1 to 6 is Rhodiasolv® RPOE marketed by Rhodia®.

[0129] Composite solvents 1 to 6 that are anhydrous (not containing any added water), limpid and colorless, which are chemically stable, are obtained. These composite solvents can be stored for more than 1 year, and even more than 2 years, at a temperature less than 40° C., in closed containers and away from air and light. They add, in particular, the following properties:

[0130] compatibility with respect for the environment, human and animal health, and safety at work in dry cleaning establishments,

[0131] flash points: greater than 75° C.,

[0132] Kauri-Butanol index: greater than 70

[0133] anhydrous (non-aqueous) and can be diluted in water with a miscibility greater than 40% v/v in water.

Example 2

Effects of Composite Solvents 1 to 6

[0134] The effect of composite solvents 1 to 6 as dry cleaning solvents, was studied on a panel of fabrics (10 cm×10 cm) constituted of various fibers as well as on accessories that are frequently encountered on the textile articles. A first study covered the observation of deformation of the fabrics and the discoloration and the second on the effectiveness of the cleaning of stains.

[0135] To carry out these tests, the fabrics were impregnated (via immersion) and mechanically stirred in composite solvents 1 to 6 pendant 10 min then dried in a ventilated oven at 70° C.

[0136] Results:

1) Deformations, Discoloration and Deteriorations of the Linings:

[0137] The tests carried out on various fabrics of the polyester, cotton, viscose, flax, acrylic, wool, acetate, elastane, silk types have shown that the fabrics are correctly washed, dried easily, do not contain any odor after drying and retain their measurements even in the case of wool (deformation less than 0.2 mm). The experiment on pieces of textiles has shown that with these composite solvents the fabric is substantially less dry than with perchloroethylene, and procures a good sliding which seriously facilitates ironing, and reduces the risk of felting in machines. Elastic textiles have retained their extensible property. The best dry cleaning results were obtained with composite solvents 2 and 4.

[0138] With regards to the discoloration, we have observed a slight washing out in the case of the composite solvent without re-depositing of the latter on the other fabrics. In the case of the other composite solvents the resistance to discoloration is good and even better than that of perchloroethylene when the dry cleaned fabrics are compared with the reference samples.

2) Behavior on the Linings:

[0139] The effect of composite solvents 1 to 6 as a dry cleaning solvent was studied on linings frequently encountered on textile articles such as buttons, plastic or metal zippers and glued sequins.

[0140] The tests on the linings (buttons and accessories) have shown that composite solvents 1 to 6 yield identical and even better results than perchloroethylene with a preference for composite solvents 1, 2, 5 and 6 which respect these elements more.

3) Behavior on Stains:

[0141] The fabrics studied contained dirt caused by the following contaminants: olive oil, chocolate (Nutella®), mayonnaise, lipstick, red wine, ink and were compared with perchloroethylene and hydrocarbons. These tests were carried out without the use of a intensifier (surfactant).

[0142] The results of these tests have shown that:

[0143] the composite solvents of examples 1 to 6 made it possible to very easily clean the fatty stains without using additives.

[0144] the composite solvents of examples 1, 2, 4 and 6 are in particular highly effective for the dry cleaning of stains due to butter or olive oil, said stains are no longer visible after the cleaning process.

[0145] the composite solvents of examples 1 and 2 have shown to be in particular very effective for dry cleaning, in particular on stains caused by chocolate, lipstick and wine, said stains became less visible after the cleaning process contrary to perchloroethylene which leaves larger stains.

[0146] The arrangement of the various elements and/or means and/or steps of the invention, in the embodiments described hereinabove, must not be understood as requiring such an arrangement in all of the implementations. In any case, it will be understood that various modifications can be made to these elements and/or means and/or steps, without leaving the frame of mind and scope of the invention.

1. A Unit for dry cleaning of textile articles using a composite solvent comprising several components comprising:

a dry cleaning chamber (**1**) configured to mix, during a cleaning cycle, textile articles to be cleaned with a composite solvent;

a device (**7**) for recovering the composite solvent after the cleaning cycle;

a treatment device (**8**) for removing water and dirt and recycling at least a portion of the composite solvent for the purpose of using the recycled composite solvent for another dry cleaning cycle,

a re-adjustment device (**9**) for re-adjusting the recycled composite solvent by incorporating therein at least a portion of the component or components that was lost in the treatment device (**8**), wherein the device comprises at least:

a buffer tank (**10**) provided with at least one supply inlet (**10***a*) for the recycled composite solvent, with at least one inlet (**10***b*) for the supply of at least the portion of the component or components of the composite solvent to be introduced into said buffer tank (**10**) in order to re-adjust the composition of the recycled composite solvent, and with at least one outlet (**10***c*) for the recycled and re-adjusted composite solvent, with this outlet (**10***c*) being connected to the storage tank (**5**) for the dry cleaning composite solvent,

a storage tank (**11**) for one or several components of the dry cleaning composite solvent, and

a metering pump (**14**) of the quantity of the component or components of the composite solvent to be introduced into the buffer tank (**10**) through said inlet (**10***b*) for the re-adjustment of the composition of the recycled composite solvent, this pump is connected upstream to at least one storage tank (**11**) containing one or several components of the dry cleaning composite solvent.

2. The Unit according to claim **1**, wherein the re-adjustment device (**9**) is provided with an analyzer (**15**) which makes it possible to analyze the physical and/or chemical characteristics of the recycled composite solvent, to determine the quantity of the component or components of the composite solvent to be taken from the storage tank (**11**) and to be introduced into the buffer tank (**10**).

3. The Unit according to claim **1**, wherein the cleaning chamber (**1**) is provided with a perforated drum (**2**) intended to receive the textile articles to be cleaned, said perforated drum (**2**) being mounted rotatingly in said chamber, with the latter having:

an opening (**20**) for the placing of textile articles to be dry cleaned in the perforated drum (**2**), with this opening able to be closed by a door or a porthole;

an orifice (**3**) connected to a duct for introducing (**4**) the composite solvent which is placed in a storage tank (**5**); and

an orifice (**6**) connected to the recovery device (**7**).

4. The Unit according to claim **1** wherein the device (**8**) for treating the used composite solvent comprises at least one filtration device (**12**) for filtering insoluble dirt contained in said used composite solvent and a fractionated distillation unit (**13**) comprises:

an outlet for the removal of a top fraction F1 representing less than 15% $w/w_{used\ composite\ solvent}$ and containing at least water, one or several azeotropes formed between the water and one or several components of the composite solvent; and

an outlet for the recycling of an intermediate fraction F2 representing more than 75% w/$w_{used\ composite\ solvent}$ and containing the dry cleaning composite solvent less at least one portion, by weight, of one or of several of its components, said intermediate fraction F2 being directed after recycling to the buffer tank (**10**).

5. The Unit according to claim **4**, wherein the fractionated distillation unit (**13**) is provided with a collection container (**31**) configured to receive in a first step the top fraction F1 before it is discharged to the removal tank (**30**), then in a second step, the intermediate fraction F2 before it is sent to the buffer tank (**10**), said collection container (**31**) having a drawing-off point (**31***a*) in its lower portion, through which the top fraction F1 and the intermediate fraction F2 are removed to their respective tanks (**30**) and (**10**); and being provided with an analyzer (**15***a*) making it possible to analyze the physical and/or chemical characteristics of the top fraction F1 or of the fraction F2 in such a way as to determine the quantity of the component or components of the composite solvent to be introduced into said buffer tank (**10**).

6. The Unit according to claim **5**, wherein the removal tank (**30**) intended to contain the top fraction F1, comprises a duct (**300**) connected to an injection device (**301**) making it possible to inject, after N dry cleaning cycles, said fraction F1 into the fractionated distillation unit (**13**) for the purpose of separating it into at least two fractions: one top fraction F' 1 intended to be removed, and a fraction F2 intended to be added, before the re-adjusting of the recycled composite solvent, to the intermediate fraction F2 collected after the cycle N of dry cleaning.

7. The unit according to claim **1**, wherein the composite solvent comprises at least:

40% to 80% w/w dipropylene glycol monomethyl ether,

5% to 40% w/w an amphiphilic solvent A having the following formula: R—(O—C_3H_6)$_n$—OH (1) wherein n is an integer equal to 1 or 2, and R a C_3- or C_4-alkyl group,

10% to 40% w/w a dibasic ester B selected from the group comprising dimethyl succinate, dimethyl glutarate, dimethyl adipate and mixtures thereof, and

0% to 10% w/w additional components.

8. A method of dry cleaning of textile articles with a composite solvent having a plurality of components and of recycling the used composite solvent for reuse, said method comprising:

a) a dry cleaning cycle comprising contacting fabric articles to be cleaned with the composite solvent,

b) recovering the used composite solvent contaminated with dirt and water at the end of the dry cleaning cycle,

c) treating the used composite solvent in order to remove at least water and dirt, and

d) recycling at least a portion of the composite solvent treated in step c) for the purpose of using it for another dry cleaning cycle,

wherein the composition of the recycled composite solvent is readjusted by incorporating at least the portion, by weight, of the component or the components of the composite solvent, which portion was lost during the treatment step aimed at removing the water and dirt.

9. The method according to claim **8**, wherein the portion, by weight, to be incorporated in the composition of the recycled composite solvent is determined from the physical and/or chemical analysis of the recycled composite solvent.

10. The method according to claim **8**, wherein the treatment step aimed at removing the water and dirt comprises a fractional distillation.

11. The method according to claim **10**, wherein the fractional distillation is conducted so as:

to remove a top fraction F1 comprising less than 15% w/w used composite solvent and containing at least water and one or several azeotropes formed between water and one or more components of the composite solvent, and

to collect an intermediate fraction F2 representing more than 75% w/w used composite solvent containing the dry cleaning composite solvent less at least a portion, by weight, of one or more of its components, which portion was lost in the treatment comprising the fractional distillation.

12. The method according to claim **11**, wherein the top fraction F1 removed by fractional distillation in step c) is distilled at a temperature less than 82° C. and a pressure of 65 bars and comprises at least water, dipropylene glycol monomethyl ether, and optionally an amphiphilic solvent A' having the following formula: R'-0-C_3H_6—OH (I') wherein R' represents a C_3- or C_4-alkyl group.

13. The method according to claim **11**, wherein the intermediate fraction F2 recovered by fractional distillation in step c) distills at a temperature above 83° C. and under a pressure of 65 bars.

14. The method according to claim **7**, wherein the portion to be incorporated into the composition of the recycled composite solvent comprises at least dipropylene glycol monomethyl ether, and optionally an amphiphilic solvent A' of formula R'—0-C_3H_6—OH (I') wherein R' represents an C_3- or C_4-alkyl group.

15. The method according to claim **13**, wherein the top fraction F1 removed in step c) is recovered in a drain tank, then, after N dry cleaning cycles, is subjected to a fractional distillation, which fractional distillation is conducted so as to remove a top fraction F1, said top fraction F1 containing a major amount of water, and to recover a fraction F2, said fraction F'2 being intended to be added, before step e) of readjustment, to the intermediate fraction F2 recovered after the N dry cleaning cycle.

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